On the Scale of Financial Intermediaries

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Abstract

This paper studies the economic scale of financial institutions. We show that banks and security broker dealers actively smooth book equity by adjusting payouts. The smoothing of book equity is associated with procyclical book leverage and procyclical net payouts. In contrast, market leverage largely reflects movements in valuation levels as measured by book-to-market ratios. The 2008 crisis caused a structural break, after which the growth rates of the banking and dealer sectors are subdued relative to pre-crisis levels. We draw conclusions for theories of financial intermediation and capital regulation.

JEL classification: E02, E32, G00, G28

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1 Introduction

The global financial crisis of 2008-9 has had a far-reaching impact on the economics profession by pressing home the importance of financial intermediation in propagating macroeconomic shocks. Within dynamic equilibrium models, financial intermediation has been shown to matter for asset pricing, systemic risk, monetary policy, and macroprudential policy.[1] This recent literature builds on earlier papers by Bernanke and Gertler (1989) and Kiyotaki and Moore (1997) but, instead of studying frictions faced by the ultimate borrowers in the economy (such as non-financial firms), it has focused on the balance sheet management of banks and other intermediaries that finance the ultimate borrowers.

In these general equilibrium models, the frictions faced by the financial sector determine both how intermediaries propagate shocks to the real economy and how intermediaries shape their own balance sheets. In a frictionless Modigliani and Miller (1958) world, balance sheet management decisions such as payouts to equity holders and leverage choices are irrelevant to the value of the firm. When frictions are present, the amount of leverage and the timing of payouts matters, and intermediary equity and leverage become key state variables in describing equilibrium outcomes. The equity of intermediaries not only represents the value of the firm from the point of view of the owners of the firm, but also determines the amount of the own funds that are available to be lent out. Since equity also determines the funding cost at which the intermediary can borrow, the size of the equity base is an important determinant of the lending activities of the intermediary. In turn, the size of equity is managed by the intermediaries via payout and share buyback decisions. Earnings can be paid out or retained, and leverage can be scaled up and down over time.

In this paper, we document empirically how intermediaries manage their equity actively through dividend payout decisions, and how the management of the size of its book equity is linked to the

[1] He and Krishnamurthy (2013) and Adrian and Boyarchenko (2012) examine asset pricing implications, He and Krishnamurthy (2012b,a), Brunnermeier and Sannikov (2014), and Gertler and Kiyotaki (2012) analyze systemic risk, Brunnermeier and Sannikov (2011) investigate monetary policy, and Goodhart, Kashyap, Tsomocos, and Vardoulakis (2012), Angelini, Neri, and Panetta (2011), Angeloni and Faia (2013), Korinek (2011), and Bianchi and Mendoza (2011) examine macro prudential policy.

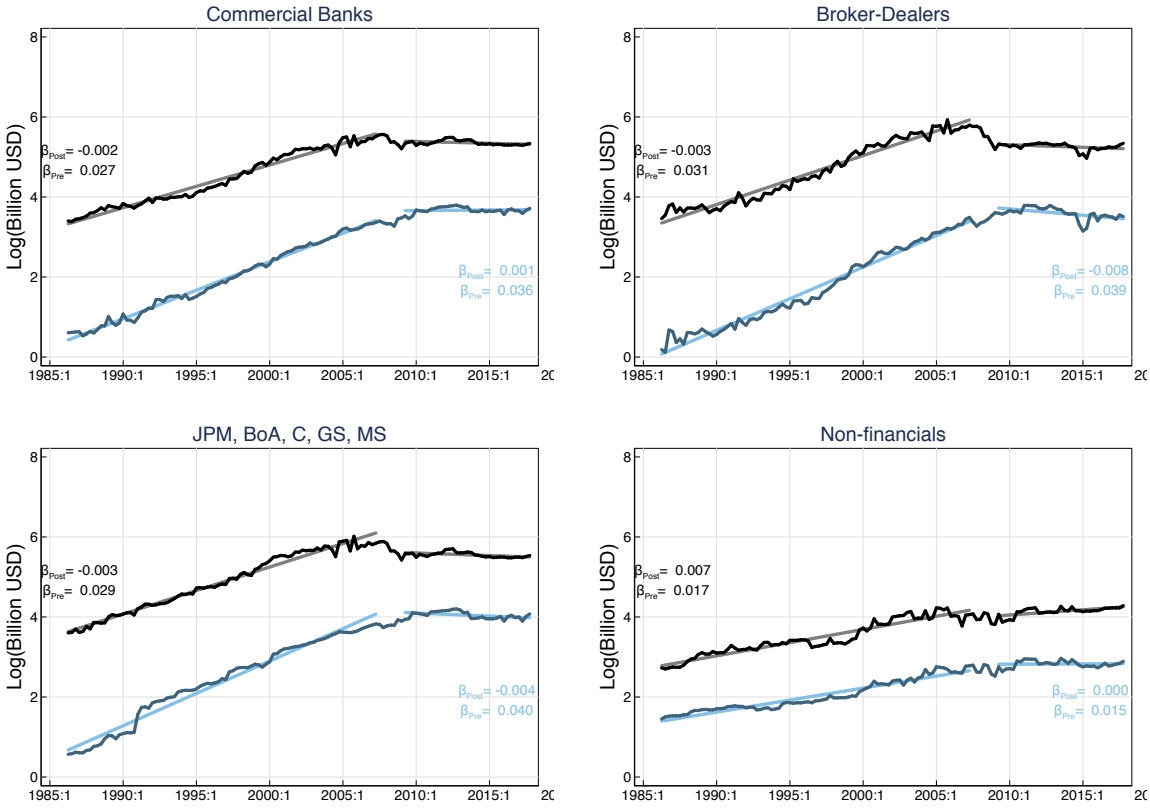
intermediary's lending decisions. Our aim is to help discriminate between different theories of financial intermediation by providing evidence on both long-run and business-cycle-frequency behavior of intermediaries.

The theoretical literature has identified two hypotheses for how the leverage of intermediaries fluctuate over the business cycle: namely, procyclical versus countercyclical leverage. The importance of the leverage cycle for aggregate fluctuations was first pointed out by Geanakoplos (2003) and Fostel and Geanakoplos (2008). In their theory, heterogenous agents are subject to collateral constraints, giving rise to an inherently procyclical leverage cycle: booms are fueled by a loosening in collateral requirements, while busts feature contractions in leverage. Such procyclicality of leverage has also been a key amplification mechanism in models with value-at-risk constraints, as shown by Brunnermeier and Pedersen (2009), Danielsson, Shin, and Zigrand (2011), Adrian and Shin (2014), and Adrian and Boyarchenko (2012). Value-at-risk constraints loosen in booms when volatility is low, enabling higher leverage, and tighten in downturns when volatility increases. In addition, Gertler and Kiyotaki (2012) introduce accounting frictions that fuel procyclical leverage. In contrast, He and Krishnamurthy (2012b, 2013), and Brunnermeier and Sannikov (2014, 2011) feature countercyclical leverage, driven by the intuition that equity is run down in bad times, leading to an involuntary increase in leverage.

Figure 1 presents the long sweep of the evolution of total assets and book equity of the U. S. commercial bank sector, the U. S. broker-dealer sector, the largest five universal banks (JP Morgan, Bank of America, Citigroup, Goldman Sachs, and Morgan Stanley), and all U. S. nonfinancial firms from 1985, where we have superimposed the linear time trend estimated through Q4 2008 of each series.[2] We note four features. First, the broker-dealer sector has grown at a slightly faster pace than the commercial bank sector over this period, and has operated at a higher book leverage than the commercial bank sector, as indicated by the wider tram-lines between the total assets and book equity trend series. This difference is not driven by the largest institutions but is instead a robust

[2]We have also estimated corresponding trend lines generated using a Hodrick-Prescott filter, and have found the results to be both quantitatively and qualitatively similar. We focus on the linear trend in the exposition in order to be able to formally test for a structural break in the trend after the financial crisis.

Figure 1. Equity and Assets of Banks and Dealers over Time



This figure plots average total assets (in black) and book equity (in blue) together with the corresponding time trend for the commercial bank sector, the broker-dealer sector, the largest five universal banks (JP Morgan, Bank of America, Citigroup, Goldman Sachs, and Morgan Stanley), and all nonfinancial firms, over time. The linear time trend is estimated through 2008:4. Total assets and book equity are from Compustat.

feature of the data.

Second, the book equity series for the each subgroup of financial institutions displays a smoother path over time than total assets, suggesting that banks and dealers actively smooth book equity. We will see shortly that this is indeed the case, and banks adjust payouts to achieve a desired trajectory of book equity. We document the evidence both through the determinants of book equity, but also through dynamic impulse responses from a panel vector autoregression (VAR) of a large cross-section of banks and how they manage their balance sheets.

Third, there is an apparent structural break after the 2008 financial crisis in asset and equity growth of both the broker-dealer and the commercial bank sectors. While this structural break is

apparent in both financial sectors, growth in the broker-dealer sector has been particularly subdued, with the current total assets and book equity of the broker-dealer sector remaining substantially below the pre-crisis trend line. The contrast between the flat-lining of banking sector growth versus the catch-up in GDP levels after the crisis is striking.

Figure 2 shows that the structural break at around the time of the Great Financial Crisis holds more generally for a global sample of banks. Moreover, when we look at banks separately across regions, we see that European banks show perhaps the clearest slowdown in both assets and equity. In effect, globally, banking sector asset growth has stalled, and this is also reflected in the stalling of the global book equity base of banks. The flat-lining of global banking after the crisis is one of the most remarkable facts in economics today and is in need of explanation.

Fourth, the balance sheet behavior of nonfinancial firms is significantly different from that of the financial sectors. Assets and equity move in parallel, suggesting that leverage dynamics are less important for nonfinancials. The deviation of book equity from the linear trend is larger than the deviation for book assets, suggesting that, unlike the financials, nonfinancial firms manage the size of their balance sheet. Furthermore, there does not appear to be a pronounced structural break after the financial crisis, and the post-crisis deviations from trend have been to the positive side: both the total assets and the book equity have grown faster after the crisis than predicted by the pre-crisis linear trend.

Taken together, the smooth evolution of financial firm equity over the long-run and the relatively more volatile evolution of financial firm assets imply that the long-run scale of these types of financial firms is determined by book equity. In the short-run, financials adjust leverage conditional on a book equity realization, making total assets fluctuate around their long-run trend. When book equity deviates from its time trend, financials tend to adjust their net payouts, bringing them back to the equity trend line. These findings suggest that financial firms have decreasing returns to scale. In Table 3 we further document that financial firms pay down book equity during upswings, a fact that is especially noteworthy since book equity growth reflects strong profitability of banks. Financials thus actively manage the size of their book equity. They tend to pay out, and leverage,

to the maximum, so as to achieve high return on equity.

Overall, Figure 1 illustrates the fundamental finding of our paper: size plays a different role for financial and nonfinancial firms. While financial firms target equity growth and actively manage their leverage, nonfinancial firms appear to target asset growth and adjust their leverage more passively.

This payout behavior raises the question why banks choose to finance the growth in credit through debt, even while they erode the size of their book equity through increased payouts. This suggests that banks' operations do not exhibit constant returns to scale. If the banking business had constant returns to scale, the bank could refrain from dividend payouts by retaining the profit as book equity and replicate their existing operations based on a larger book equity foundation. Cash dividends dissipate book equity and shareholders are reluctant to be diluted by issuing new shares. This points towards the existence of an optimal scale of the bank as given by an optimal size of its book equity. The optimal size of the book equity determines the shadow value of book equity. The existence of such an optimal scale for the bank reconciles the long-run unit elasticity of book equity with respect to total assets with the payout behavior of banks targeting a level of book equity.

The above results are obtained by considering equity at book values. Empirically, equity and leverage can be measured using book values or using market values. The definition of book leverage is the ratio of total assets to book equity, while the definition of market equity is the ratio of enterprise value to market equity (enterprise value is the sum of total liabilities and market equity). Adrian and Shin (2014) document that book leverage is procyclical while market leverage is countercyclical. These facts raise the question whether the relevant empirical measure of leverage is at book or at market values. Book values figure prominently in both financial firms' discussions of what they do, as well as in the regulations that govern banks. For example, the annual reports of major U. S. banking organizations commonly present their targets for return on equity – a measure of performance at book value – and they report the evolution of leverage at book values. Regulations are typically built around ratios related to book leverage, not market leverage. In particular,

the Basel bank capital regulations all refer to measures of capital at book value. In addition, U. S. and European stress tests measure capital adequacy in terms of the book value of equity.

We document empirically that banks base their balance sheet management around book equity and book leverage. Market leverage also plays a role in the banks' balance sheet management, but that role is secondary, and turns out to matter at shorter horizons. Furthermore, we present evidence that balance sheet management of intermediaries is linked to market risk.

As for market leverage, we show that virtually all the cyclical variation of market leverage is driven by fluctuations in the book-to-market ratio, reflecting the valuation changes of free cash flows generated by the bank. Nevertheless, there are important links between market leverage and shifts in the book leverage of the bank. At short horizons, an increase in market leverage (reflecting the higher valuations of intangible income) has a similar effect as a decline in the implicit haircut paid by the bank to borrow.

Crucially, just as we observe a structural break in the total assets and book equity series around the financial crisis, we also observe a structural break in the relationship between market leverage and the book-to-market ratio; in particular, the slope of the relationship between the two undergoes a structural shift, so that the book-to-market ratio for any given market leverage is significantly lower after the crisis. In other words, both book leverage and market leverage undergo a structural shift post-crisis.

The remainder of the paper is organized as follows. Section 2 shows the procycliality of book leverage and countercyclicality of market leverage for commercial banks and broker-dealers. Section 3 shows that book leverage is actively managed via changes to payout that impact the equity cushion of firms, while market leverage is largely a function of fluctuations in market to book values. Section 4 links leverage management to the scale of banking by showing that net payout is a function of the equity gap – the difference between book equity and its long term trend. Section 6 discusses the points of contact with the asset pricing literature. Section 7 concludes.

2 Cyclicality of Leverage

As a starting point, we study the behavior of leverage over the business cycle, and the determinants of the evolution of leverage. Previous work (see Adrian and Shin, 2014) has established the importance of distinguishing between book and market values of equity and leverage. We follow this work in defining book equity as the difference between total assets and total debt, and market equity as market capitalization. Similarly, book leverage is defined as the ratio of total assets to book equity, while market leverage is defined as the ratio of enterprise value (total assets - book equity + market equity) to market equity. Maintaining the distinction between these different concepts of equity and leverage is important, as they have distinct interpretations and display disparate behavior both across sectors and over the business cycle.

The enterprise value of a firm addresses how much the firm is worth to its stakeholders. A firm's enterprise value is the theoretical sum of money that would be needed to buy out the shareholders and debt holders. In contrast, the total assets of financial firms measure how much the firm lends, either directly as loans or through other claims. For nonfinancial firms, total assets measure how much productive capital the firm has. Both of these valuation concepts are economically meaningful and capture different facets of how financial institutions manage their balance sheets.

Figure 3 shows the procyclicality of book leverage for broker-dealers, commercial banks, five of the largest U. S. banks and broker-dealers (JP Morgan, Citibank, Bank of America, Goldman Sachs, and Morgan Stanley). For each cut of the financial sector data, book leverage is procyclical, while market leverage is countercyclical, as noted by Adrian and Shin (2014). That is, book leverage is high when total assets are large, but market leverage is low when enterprise value is high. This result illustrates the fundamental difference between book and market leverage: while financial institutions can actively manage the behavior of book leverage, market leverage is determined primarily by market forces. The procyclicality of book leverage derives from financials reducing lending by reducing their debt – that is, by deleveraging. Hence, book leverage is low during downturns and high during booms. The countercyclicality of market leverage comes from

the fact that more of the value of the financial firm is in the hands of the debt holders during downturns, as the share price of the bank falls. Thus, market leverage is high during downturns.

Figure 3 also shows that the balance sheet management of nonfinancial firms is markedly different. For book leverage, nonfinancials exhibit very weak, negative correlation between asset growth and leverage growth. This points to a balance sheet management that is passive relative to the book value of equity. The picture for the market value is very different. There is a strong, negative relationship between enterprise value and market leverage, indicating that market leverage is determined by enterprise value.

Figure 4 provides another look at the procyclicality of book leverage by plotting the dollar changes of book equity and debt against the dollar changes of total assets for commercial banks, broker-dealers, the five largest banks and broker-dealers, as well as the nonfinancial sector. For the financial sector, changes in book equity are very small compared to changes in debt. The margin of balance sheet adjustment is thus leverage, not equity. In contrast, for nonfinancial firms, both asset size and equity are adjusting in comparable magnitude.

To delve further into the difference between book leverage and market leverage, it is helpful to consider the relationship of leverage with book-to-market values, reported in Figure 5. The top four panels show that market leverage moves almost one-for-one with the book-to-market ratio. In contrast, book leverage exhibits very low correlation with the book-to-market ratio (lower four panels). It is worth emphasizing that the countercylicality of market leverage is not simply about the marking-to-market of balance sheets and the potentially stale nature of accounting values. Broker-dealers mark their whole balance sheet to market, while commercial banks use historical cost accounting for their loan book. However, Figures 3 and 5 show that the behavior of leverage and of the book-to-market ratio is qualitatively very similar when comparing broker-dealers and commercial banks. This suggests that accounting is an unlikely driver of the different cyclicality using book and market values, as dealers are fully marking to market their balance sheets, while banks use historical cost accounting.

This observation brings us to the importance of intangible assets in accounting for the differ-

ence between book equity and market capitalization. Market capitalization is the discounted value of free cash flows, and those cash flows can be generated by intangible assets. For example, the relationships that firms have with their clients are important determinants of future profitability, but those assets are not visible on the balance sheet, and hence do not count towards book equity. An important reason for fluctuations in book-to-market values for financial firms therefore consist in fluctuations of the value of future cash flows from intangible assets.

Fluctuations in the book-to-market ratio due to variations in the discounted future value of intangible assets are distinct from leverage management. Active leverage management of financial intermediaries reflects asset sales and purchases, lending decisions, market making, and other financial transactions. The intangible assets of intermediaries, on the other hand, are related to fee income from investment banking and similar activities. Such activities need little, if any, balance sheet. These considerations thus establish that the countercyclicality of market leverage is primarily related to fluctuations in value not directly related to financial assets and liabilities on the balance sheets of intermediaries.

The cyclicality of book and market leverage can also be seen from Table 1 for financial firms in Panel A and for nonfinancial firms in Panel B. Columns (1) and (2) report the regression of quarterly (book) asset growth on quarterly book leverage growth using firm fixed effects and time fixed effects, respectively, while columns (4) and (5) show the regressions of quarterly enterprise value growth on quarterly market leverage growth, again using fixed effects and time effects, respectively. Columns (1) and (2) show that the procyclicality of leverage holds both in the time series (using firm fixed effects) and in the cross section (using time fixed effects). In contrast, for market leverage, the time series relationship is negative, but the cross-sectional relationship is actually positive. It is particularly revealing that the R^2s for the book value regressions are large, while the R^2s for the enterprise value regressions are small.

Panel B of Table 1 shows these same regressions for nonfinancial firms. Unlike financials, nonfinancials appear to manage enterprise value of the firm, rather than book equity. In particular, while the regression of asset growth on book leverage growth still has a positive coefficient, it is

no longer significant in the time series, is of much smaller magnitude than for the financials and, crucially, has almost no explanatory power (as demonstrated by the low R^2s). In contrast, the relationship between enterprise value growth and market leverage growth has large R^2s, is robust to including either time or firm fixed effects (or both), and the coefficients are economically large. These results again suggest that the balance sheet management of financial firms is very distinct from the balance sheet management of nonfinancial firms.

3 Balance Sheet Management over Short and Long Run

We now examine the role of book equity in banks' lending decisions and how banks adjust their balance sheets over the short and long run. Figure 6 from Adrian and Shin (2014) shows three ways that a firm (financial or otherwise) can increase its leverage. In each case, the grey shaded area represents the balance sheet component that does not change.

Mode 1 on the left is the case typically dealt with in corporate finance textbooks. The set of positive net present value (NPV) projects is taken as given, with the implication that the size of the balance sheet is not part of the firm's decision. Instead, attention falls on how the firm's assets are financed. The left hand panel of Figure 6 depicts a financial operation where the firm issues debt and buys back equity financed with the proceeds of the debt issue. The assets of the firm are unchanged. This is the way, for instance, that a private equity fund would finance the acquisition of a target firm.

Mode 2 depicts the consequences of a drop in the value of assets of the firm – say, through a dividend paid to shareholders financed by an asset sale. The leverage goes up because the notional debt remains unchanged, but the firm's assets shrink in value. The shrinking of the asset value could alternatively just reflect market value changes, with notional amounts held fixed. The middle panel is closest to the way that leverage fluctuates in the Merton (1974) model of long-term debt, where leverage fluctuates due to changes in the value of assets, with notional debt held fixed.

For banks, Adrian and Shin (2014) show that neither Mode 1 nor Mode 2 turns out to be the

right picture over short horizons – say over one quarter. Banks adjust their leverage as in Mode 3, where new assets are financed by issuing new debt, with the relationship between assets and book equity being flat. This can be seen in Figure 7 where quarterly book equity growth is plotted against quarterly asset growth for broker-dealers and commercial banks.

On the other hand, we know from the long-term trends in assets and equity given in Figure 1 that over long horizons of several years, there is a proportional relationship between book equity and total assets. Thus, whereas short-run changes in assets are driven by shifts in leverage taking book equity as given, long-run growth in assets mirror the growth of book equity. Equivalently, the long-run elasticity of book equity with respect to total assets is 1, but the short-run elasticity of book equity with respect to total assets is much smaller.

Figure 7 plots the growth rate of book equity against the growth rate of total assets and the growth rate of market equity against the growth rate of enterprise value. We see that, at the quarterly horizon, total asset growth has only a weak relationship with book equity growth for financial firms and especially so for commercial banks and the five global banks. Thus, the short-run elasticity of total assets with respect to book equity is small. This translates into a weak negative relationship between growth rate of book leverage and book equity growth, as shown in the left column of Figure 8.

In contrast, market equity growth has a strong positive relationship with enterprise value growth, shown in the right column of Figure 7. This short-run relationship between the firms' worth to their stakeholders and market equity translates into a strong relationship between market equity growth and market leverage growth. The panels on the relationship between market equity growth and market leverage growth in the right column of Figure 8 is particularly striking, as they demonstrate that market equity growth is strongly negatively related to market leverage growth. To a first approximation, market leverage is entirely determined by the valuation of equity: the R^2 is 90 percent for broker-dealers, and 97 percent for commercial banks. For book equity and book leverage the R^2 is only slightly lower for the case of commercial banks, at 71 percent, but considerably lower for the broker-dealers (18 percent).

4 Book Equity and the Scale of the Bank

The scale of a firm is given by its total assets. In corporate finance textbooks, the assets of a firm are determined exogenously by the set of positive net present value projects available to the firm. When the firm happens to be a financial firm, we have seen that the firm's book equity plays an important role in defining the scale of the firm. The long-run scale of the financial firm is determined by the book equity of the firm, and any short-run fluctuations in total assets take place around a fixed book equity base. In other words, it is the book equity of the financial firm that takes the role of the scaling variable for the firm.

Additional evidence that book equity is the right scale variable for the bank comes from the active management of the size of the bank's book equity through dividend payouts by the bank. The evidence is that banks tend to adjust net payouts so as to target a fixed trend level of book equity. Figure 1 shows that book equity evolves very smoothly over the long-run, and much more so than total assets.

More specifically, consider the balance sheet identity

$$A_t = D_t + E_t, \tag{1}$$

where A_t denotes total assets, D_t the level of debt, and E_t book equity. This identity implies the following evolution of book equity:

$$E_t - E_{t-1} = Earnings_{t,t-1} - NetPayouts_{t,t-1} + A_t - A_{t-1} - (D_t - D_{t-1}), \tag{2}$$

where earnings and payouts are between t and $t-1$. Net payout are defined as dividend distributions plus share repurchases minus equity issuances. Changes in book equity are thus determined by the flow variables (earnings, payout, issuance) and changes in the stock variables (total assets and debt). The amount of equity and the level of leverage thus depend not only on adjustments to balance sheet size and debt levels, but also on payout and issuance decisions.

Figure 9 shows the relationship between net payouts, equity growth and leverage growth across different lags. The top panels shows that increases in net payouts precede positive book leverage growth for financial institutions and coincides with negative market leverage growth. In other words, book leverage increases after net payouts have been high. When the firm increases net payouts, market leverage decreases as the market valuation of the firm increases, as shown in the middle right panel. The middle left panel shows that decreases in book equity follow increases in net payouts. Thus, when book equity has been strong in the recent past (over the preceding 4 to 5 quarters), net payouts increase significantly, and book equity dissipates. Taken together, the evidence is that financials actively manage the size of their book equity, paying down book equity through higher payouts when it has been growing strongly. Finally, the bottom two panels show that book leverage growth precedes decreases in both the market-to-book ratio and market equity growth. In other words, when financial firms raise debt, the value of the firms to its shareholders decreases, dissipating the market equity of the institution.

The evidence in the cross-correlograms on the active management of book equity by the banks is confirmed in the impulse response charts in Figure 10 obtained from a panel VAR where the variables in the VAR are ordered from left to right in the order depicted in Figure 10. The estimates of the panel VAR are reported in Table 2. We focus in particular on the panels showing the response of book leverage to a payout shock (third row, fourth column) and the response of payouts to a book equity shock (fourth row, second column). Regarding the former, we see that book leverage tends to increase after a payout shock, showing that payouts are one way for the bank to keep book leverage high. For the response of payouts to a book equity shocks, we see first that there is an instantaneous negative relationship between payouts and book equity – a mechanical relationship – but there is a more interesting effect at a longer horizon of around 5 quarters in which payout increases significantly when book equity increases. This response of payouts to an equity shock indicates that the bank is actively managing book equity and trying to keep book equity along a smooth path. Indeed, the opening chart in Figure 1 showed how smooth book equity was, and the VAR evidence supports the hypothesis of active management of book equity.

Table 3 reports the results of a panel regression for net payouts of the bank as a function of the de-trended book equity of the bank, defined as the deviation of book equity from its linear trend line plotted in Figure 1 pre-Q4 2008, and a separate linear trend estimated post Q4 2008. We see that the coefficient on detrended book equity 4 quarters-lagged is strongly positive, implying that the bank pays down book equity if it has recently (over the year) seen strong growth in book equity. Conversely, if the bank has suffered losses and has seen an erosion of book equity, the bank takes action to rebuild book equity.

The fact that banks pay down book equity during the upswing is especially noteworthy. Since book equity growth reflects strong profitability of banks, the period of rapid book equity growth coincides with periods of buoyant economic conditions and strong credit growth. The question is why banks choose to finance the growth in credit through debt, even while they erode the size of their book equity through increased payouts.

Another way to pose the question is to ask whether the banks' operations have constant returns to scale. If the banking business had constant returns to scale, the bank could refrain from dividend payouts by retaining the profit as book equity and replicate their existing operations based on a larger book equity foundation. To the extent that the bank's shareholders are reluctant to issue new equity due to the dilution of incumbent shareholders' claims, the shadow value of book equity is bigger than one. That is, one dollar in book equity is worth more to the shareholders than one dollar in cash. However, to the extent that banks' shareholders are also willing to pay out cash dividends suggests that the shadow value of book equity cannot be strictly larger than 1.

We need to reconcile (1) cash dividends that dissipate book equity and (2) reluctance of shareholders to be diluted by issuing new shares. One way to reconcile these two features would be the existence of an optimal scale of the bank as given by an optimal size of its book equity E^*. The optimal size of the book equity determines the shadow value of book equity, so that the shadow value of book equity is larger than one when book equity E is below this optimal scale ($E < E^*$), but the shadow value is less than 1 when $E > E^*$. Moreover, we may hypothesize that the optimal scale E^* is a slow-moving variable. The existence of such an optimal scale E^* for the bank rec-

onciles the long-run unit elasticity of book equity with respect to total assets (Figure 1) with the payout behavior of banks targeting a level of book equity.

In terms of equation (2), the active usage of leverage via changes in total assets and debt levels suggests that firms have a preference for positive net payouts, preferring dividends and repurchases in favor of equity issuance. Such a preference for net payouts would then lead firms to adjust leverage in order to achieve the optimal scale E^*. Around the long-term trend for book equity, the bank's lending behavior in the short-run is determined by its leverage decision, which in turn is closely related to the market conditions that tie down the bank's market capitalization and the book-to-market ratio of the bank.

Our finding that financials institutions appear to have an optimal scale given its book equity E^* raises a more fundamental question: do financial institutions operate according to constant returns to scale? In other words, if the institution could simply replicate its existing business by expanding its balance sheet in exact proportion, what would happen to the overall value of the institution? If the institution had constant returns to scale, the firm's value would be proportional to the size of its balance sheet, and the shadow value of its book equity would be constant. If the shadow value of book equity is strictly larger than one, the firm's shareholders value one dollar of book equity more than one dollar of cash. Under constant returns to scale, the institution would never pay a cash dividend and instead would retain all profits, expanding the firm's business by replicating the existing balance sheet. The fact that the financial firm appears to have an optimal scale of book equity and actively manages it suggests that the firm's business is not perfectly scaleable. Its intangible assets, such as its workforce and relationships with clients would be very difficult to replicate.

Table 4 reports the panel regressions of leverage on payout and equity. Higher payout increases book leverage, as it leads to a compressed equity cushion for a given level of assets. Consequently, net payout is highly significantly related to book leverage. However, it has low explanatory power. Book equity, on the other hand, is strongly negatively correlated with book leverage, yielding a 32 percent R^2. Market equity growth, and book-to-market growth have very low explanatory power

for book leverage. When all indicators are used jointly (column (5)), only book equity growth appears significant. Hence we conclude that net payout and equity valuations matter for book leverage only to the extent to which they have an impact on book equity growth.

For market leverage the panel regressions give R^2s of 87 percent, respectively, when market leverage growth is regressed on market equity or the book-to-market ratio (columns (3) and (5) in Panel B of Table 4). Net payout and book leverage, on the other hand, have barely any explanatory power for market leverage, with R^2s below 1 percent. These findings are consistent with the notion that market leverage growth rates are largely outside of the control of firms, and are instead moved by exogenous variations in valuations. This contrasts with book leverage, which is pinned down by book equity, which is directly in control of the firms, via retained earnings and net payout.

5 Post-crisis Trends

The preceding discussion focused on the long sweep of book equity and total assets evolution. Figure 1, however, shows that, after Q4 2008, the financial sector has grown at much slower rates. We now study the difference between pre-crisis and post-crisis trends more formally.

Panel A of Table 5 documents the difference in trends prior to Q3 2007 and after Q3 2009. For broker-dealers and the five global banks, the trend growth rate of total assets decreased from 3% pre-crisis to 0.3% post-crisis, a ten-fold decline. For book equity, the decrease is even more dramatic, from 3.8% pre-crisis to -0.1% post-crisis. The last two columns of Table **??** show that these changes are statistically significant at the 1% level. For commercial banks, we observe a similar decline in trend growth, albeit at much less dramatic rates: total asset growth rate declines from 2.5% to 0.5% and book equity growth rate declines from 3.5% to 0.4% percent. Finally, while nonfinancials also experienced a decline in growth rates (from 1.7% to 0.8% for total assets and from 1.3% to 0.2% for book equity), the decline is much more mild and less statistically significant.

Overall, Panel A shows that the 2008 crisis caused a structural break that is particular pronounced for broker-dealers. The trend growth rate of total assets declines ten-fold for the dealers,

five-fold for commercial banks, and two-fold for the nonfinancial sector. Thus, firms most affected by post-crisis regulation have decreased in size the most. The decrease in total assets for financial firms implies a decrease in the total lending capacity of broker-dealers and commercial banks, which translates into a decrease in the size of non-financial firms.

Panel B of Table 5 shows the differences in mean absolute deviation from the pre-crisis trend for the different sectors. The table shows large increases in the absolute deviations for the dealers and banks since the financial crisis, and increases for the nonfinancial sector, albeit on a smaller scale. This additional evidence confirms the structural break that occurred around the financial crisis which seems to have the financial sector off its desired growth path.

6 Points of Contact with Asset Pricing Literature

We have seen that, although book equity and total assets are accounting constructs, rather than market variables, they nevertheless hold important information on market conditions, as book equity and book leverage determine the supply of credit to the economy, including to the financial system. To the extent that asset prices are sensitive to credit conditions through, for instance, the ease with which financial market participants can obtain leverage, the combination of book equity and book leverage will hold important information that is relevant for asset returns.

Recent asset-pricing literature has explored the impact of book leverage on asset returns. Adrian, Etula, and Muir (2014) use shocks to the leverage of broker-dealers to construct an intermediary SDF. Intuitively, deteriorating funding conditions are associated with deleveraging and high marginal value of wealth. The single-factor model of Adrian, Etula, and Muir (2014) prices size, book-to-market, momentum, and bond portfolios with an R^2 of 77 percent and an average annual pricing error of 1 percent. The model performs as well as standard multi-factor benchmarks designed to price these assets. The findings support the hypothesis that financial intermediaries trade frequently in many markets using sophisticated models. Building on Adrian, Etula, and Muir (2014), Adrian, Moench, and Shin (2014) investigate predictions from alternative intermediary as-

set pricing theories which distinguish themselves in their use of intermediary equity or leverage as pricing factors or forecasting variables. Adrian, Moench, and Shin (2014) find strong support for a parsimonious dynamic pricing model based on broker-dealer leverage as the return forecasting variable and shocks to broker-dealer leverage as a cross-sectional pricing factor. The model performs well in comparison to other intermediary asset pricing models as well as benchmark pricing models. Adrian, Moench, and Shin (2014) in turn extends results by Adrian, Moench, and Shin (2010) who document that broker-dealer leverage growth contains strong predictive power for excess returns on a broad set of equity and corporate bond portfolios. Adrian, Friedman, and Muir (2015) build a model for the cost of equity capital of financial intermediaries that absorbs the common variation of financial sector equity returns in both the cross section and time series. Adrian, Friedman, and Muir (2015) construct risk factors from the cross-section of intermediary returns, including a leverage and a return on equity factor, and a financial sector excess return. Despite apparent overlap, the return factors have surprisingly low correlation with standard benchmark pricing factors that are not specifically constructed for the financial sector, and these benchmark pricing models fail to price financial sector portfolio returns. Adrian, Friedman, and Muir (2015) relate the leverage factor to the balance sheet expansion of intermediaries which predicts low future returns, in sharp contrast to nonfinancials. The model is used to estimate the time-series for the cost of capital of the financial sector.

7 Lessons and Conclusions

Banking organizations manage payout and leverage in order to achieve a scale of operation that is best captured by its book equity. The long-run leverage of the bank is then built on the trend book equity.

In the short-run, however, the bank's total assets can fluctuate considerably depending on market conditions, especially on those same forces that determine the book-to-market ratio of the bank. Qualitatively, the book-to-market ratio behaves similarly to the implied volatility of the

bank's share price, which is known to be closely linked with the Value-at-Risk (VaR) and the haircut variables that banks are subject to (Adrian and Shin, 2014). Net payout is high in booms, and issuance only occurs in severe financial crisis. Furthermore, book leverage is managed in a strongly procyclical manner. Market leverage, on the other hand, appears to be primarily linked to the market to book ratio, which is largely determined by fluctuations in valuations.

Intriguingly, we have documented a structural break with the onset of the 2008 financial crisis that has subdued both the market leverage of the bank but also its book equity growth. Post-crisis, the trend growth of the book equity of the banking sector (but especially the broker dealer sector) has been on a flatter trajectory. At the same time, the book-to-market ratio of the banks have also undergone a step decline, to the extent that the book value of equity has exceeded the market value in aggregate since the crisis. The relationship between market leverage and the book-to-market ratio lies on a different line altogether after the crisis.

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A Data

Firm-level data are from CRSP and the merged CRSP-Compustat databases. Daily and monthly returns, and monthly prices and shares outstanding from CRSP are merged with quarterly accounting data from Compustat. Following much of the asset pricing literature, we only retain common stocks. Firm characteristics are winsorized at the 5% and 95% levels. Additionally, an analysis of the merger-adjusted sample is presented in the appendix as a robustness check. The sample period is 1985:1-2018:3. We windsorize at the 95 and 5 percent levels in both levels and growth rates.

A.1 The universe of firms

Our full sample includes any firm with a SIC code between 6000 and 6799, which we take to be the CRSP universe of all financial firms. This universe includes banks, dealers, real estate, and insurance, as well as a variety of smaller lenders, investment advisors, and holding offices. However, only banks and dealers are retained for analysis. We define commercial banks broadly, as firms with SIC codes less than 6200. This includes all commercial banks, from small community banks to large financial conglomerates [3], as well as credit unions, and a few government-sponsored entities (e.g., Fannie and Freddie). We define broker-dealers as firms with SIC codes between 6200 and 6300, and 6712. Our sample of dealers is much smaller than our sample of commercial banks, and is dominated by a few big firms (Bear Sterns, Goldman Sachs, Lehman Brothers, Merrill Lynch, and Morgan Stanley). Finally, we drop any firms whose total assets fall below $2 billion and any firm that has zero observations for assets, book equity, or market equity over the whole sample.

A.2 Merger adjustment

Mergers and acquisitions create discontinuities in the time series of firm characteristics. Therefore, we use the delisting file from CRSP to merger-adjust the raw data. Given firms A, B, and C, where B *acquires* A and is *acquired by* C, merger adjustment is simply the process of consolidating the balance sheets of A, B, and C over the whole sample period. Additive variables, such as assets and equity, are simply summed up, while for non-additive variables, such as returns and return volatility, we take a (lagged) market equity weighted average across the firms. Ratios (e.g. ROE) and growth rates are then re-calculated for the merger-adjusted entity. Merger adjusting has the advantage of removing irrelevant (for our purposes) discontinuities in the data, but has several drawbacks. Most importantly, two out of the five large U.S. broker-dealers are folded into the balance sheets of commercial banks (Bear into JPMorgan, and Merrill into Bank of America). Therefore, we opt to focus on our analysis of the unadjusted firms.

[3] While we categorize Bank of America, Citibank, and JPMorgan Chase as commercial banks, we often distinguish between these three firms and the rest of the commercial banks, due to the fact that they each have large broker-dealer subsidiaries.

B Tables and Figures

Table 1: Asset Growth and Leverage Growth

This table displays estimates from panel regressions of total asset (enterprise value) growth on book (market) leverage growth, for financial (A) and nonfinancial (B) firms. Enterprise value is the sum of total debt and market equity; book (market) leverage is the ratio of total assets (enterprise value) to book (market) equity. Balance sheet data are quarterly from Compustat (SEC), and returns are daily from CRSP. Growth rates are quarterly, and expressed as percentages. The sample period is 1985:1 - 2018:3. *** ** and * denote significance at the 1%, 5%, and 10% levels, respectively. Robust standard errors, clustered by PERMNO, in parentheses.

	Asset Growth			Enterprise Value Growth		
	(1)	(2)	(3)	(4)	(5)	(6)
			Panel A: Financial Firms			
Book Leverage Growth	0.245^{***}	0.261^{***}	0.265^{***}			
	(0.037)	(0.036)	(0.036)			
Market Leverage Growth				-0.058^{***}	-0.017	-0.016
				(0.011)	(0.010)	(0.010)
Adjusted R^2	0.105	0.194	0.191	-0.002	0.097	0.080
Observations	17443	17453	17443	17423	17433	17423
			Panel B: Nonfinancial Firms			
Book Leverage Growth	0.076^{**}	0.102^{***}	0.105^{***}			
	(0.036)	(0.025)	(0.025)			
Market Leverage Growth				-0.339^{***}	-0.259^{***}	-0.260^{***}
				(0.016)	(0.018)	(0.018)
Adjusted R^2	-0.004	0.086	0.071	0.209	0.295	0.284
Observations	24818	24835	24818	24796	24813	24796
Firm FE	Yes	No	Yes	Yes	No	Yes
Time FE	No	Yes	Yes	No	Yes	Yes

Table 2: Vector Autoregression

This table reports the panel vector autoregression of annual growth rates of equity volatility, market-to-book, book equity, book leverage, and net payout. Data on book values are quarterly from Compustat, data on market equity are monthly from CRSP, and returns are daily from CRSP. Growth rates are quarterly, and expressed as percentages. The sample period is 1985:1 - 2018:3. ***, ** and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Market-to-Book	Book Equity	Book Leverage	Net Payouts
Market-to-Book (1M lag)	0.805***	0.025***	-0.023***	0.011
	(45.026)	(3.280)	(-3.063)	(1.336)
Book Equity (1M lag)	0.139***	0.953***	-0.081***	0.007
	(3.509)	(38.746)	(-4.303)	(0.736)
Book Leverage (1M lag)	-0.199***	0.035	0.730***	-0.013
	(-4.607)	(1.457)	(32.570)	(-1.235)
Net Payouts (1M lag)	0.360***	0.011	0.051**	0.477***
	(3.240)	(0.814)	(2.267)	(2.847)
Market-to-Book (2M lag)	-0.125***	-0.031***	0.031***	0.000
	(-7.551)	(-4.657)	(4.537)	(0.001)
Book Equity (2M lag)	-0.152***	-0.198***	0.090***	-0.003
	(-3.943)	(-9.020)	(5.342)	(-0.438)
Book Leverage (2M lag)	0.074*	-0.008	-0.038*	0.000
	(1.772)	(-0.358)	(-1.793)	(0.008)
Net Payouts (2M lag)	-0.182	-0.036***	0.005	0.158*
	(-1.397)	(-2.615)	(0.278)	(1.684)

Table 3: Payouts and the Equity Gap

This table displays the estimates of panel regressions of net payouts on detrended book equity. Book values are quarterly from Compustat (SEC). Growth rates are quarterly, and expressed as percentages. The sample period is 1985:1 - 2018:3. *** ** and * denote significance at the 1%, 5%, and 10% levels, respectively. Robust standard errors, clustered by PERMNO, in parentheses.

	Net Payouts, as a percent of:					
	Contemporaneous Assets			4Q Lagged Assets		
	(1)	(2)	(3)	(4)	(5)	(6)
Detrended Book Equity (4Q) Lag	1.204***	1.091***	0.973***	1.220**	1.216***	1.067***
	(0.337)	(0.275)	(0.253)	(0.512)	(0.379)	(0.366)
Market/Book (4Q) Lag		-0.080	-0.072		-0.003	0.008
		(0.096)	(0.094)		(0.180)	(0.177)
Book Leverage (4Q) Lag			-0.042**			-0.053**
			(0.017)			(0.024)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4069	4057	4057	4058	4057	4057
Adjusted R^2	0.060	0.059	0.064	0.031	0.030	0.035

Table 4: What is Driving Leverage?

This table displays estimates from panel regressions of leverage growth on net payouts, book equity growth, market equity growth, and book/market growth. Data on book values are quarterly from Compustat (SEC), and data on market values are monthly from CRSP. Net payouts are in billions of US dollars. Growth rates are quarterly, and expressed as percentages. The sample period is 1985:1 - 2018:3. *** ** and * denote significance at the 1%, 5%, and 10% levels, respectively. Robust standard errors, clustered by PERMNO, in parentheses.

	(1)	(2)	(3)	(4)	(5)
	Panel A: Book Leverage Growth				
Net Payouts	0.207***				0.070**
	(0.049)				(0.032)
Book Equity Growth		−0.689***			−0.779***
		(0.021)			(0.042)
Market Equity Growth			−0.038***		0.053
			(0.006)		(0.036)
Book/Market Growth				−0.033***	0.035
				(0.005)	(0.036)
Adjusted R^2	0.007	0.381	0.013	0.010	0.416
Observations	4837	9775	9755	9755	4837
	Panel B: Market Leverage Growth				
Net Payouts	−0.360				−0.005
	(0.233)				(0.071)
Book Equity Growth		−0.286***			−0.150**
		(0.047)			(0.074)
Market Equity Growth			−0.813***		−0.498***
			(0.007)		(0.070)
Book/Market Growth				0.779***	0.298***
				(0.009)	(0.070)
Adjusted R^2	0.004	0.010	0.866	0.810	0.858
Observations	4837	9755	9755	9755	4837
Firm FE	Yes	Yes	Yes	Yes	Yes

Table 5: Mean Absolute Deviation of Book Value Aggregates from Pre-Crisis Trend

This table displays estimates of the pre-Crisis trends and mean absolute deviation (MAD) of log assets and book equity around their pre-Crisis trend, before and after financial crisis. We compute both statistics for the four different universes of firms plotted in Figure 1: broker-dealers, commercial banks, the top five universal banks, and non-financial firms, and we test for differences pre- and post-crisis. The sample period is 1985:1 - 2018:3. *** ** and * denote significance at the 1%, 5%, and 10% levels, respectively.

	1985:1 - 2007:3		2009:3 - 2018:3		$t_{pre-crisis \neq post-crisis}$	
	Assets	Book Equity	Assets	Book Equity	Assets	Book Equity
			Panel A: Testing for differences in slope			
Broker-Dealers	0.031	0.039	-0.011	-0.018	12.536***	15.704***
Commercial Banks	0.027	0.036	-0.003	-0.001	15.901***	25.691***
JPM, BoA, C, GS, MS	0.029	0.040	-0.004	-0.006	18.146***	17.780***
Non-financials	0.017	0.015	0.003	-0.004	5.912***	9.621***
			Panel B: Testing for differences in MAD			
Broker-Dealers	0.130	0.116	1.526	0.900	11.375***	5.505***
Commercial Banks	0.098	0.061	0.915	0.656	8.425***	5.537***
JPM, BoA, C, GS, MS	0.081	0.139	1.311	1.072	11.941***	7.733***
Non-financials	0.104	0.090	0.469	0.252	4.542***	1.989**

Figure 2. Banking sector assets and book equity in advanced economies

Annual growth rates in log-differences is USD billion (for Global and US samples) and EUR billion (for Euro area and Other European economies sample); reported in percentage terms. US banks: BB&T Corporation, Bank of America Corporation, Bank of New York Mellon Corporation, Capital One Financial Corporation, Citigroup Inc., Citizens Financial Group, Inc., Fifth Third Bancorp, JPMorgan Chase & Co., Morgan Stanley, Goldman Sachs Group, Inc., Northern Trust Corporation, PNC Financial Services Group, Inc., Regions Financial Corporation, State Street Corporation, SunTrust Banks, Inc., U.S. Bancorp and Wells Fargo & Company. Euro area banks: Erste Group Bank AG, Raiffeisen Bank International AG, Dexia SA, KBC Group NV, Commerzbank AG, Deutsche Bank AG, Banco Bilbao Vizcaya Argentaria, SA, Banco Popular Español, SA, Banco Santander, SA, Banco de Sabadell, SA, Bankia, SA, CaixaBank, SA, BNP Paribas SA, Crédit Agricole SA, Crédit Industriel et Commercial SA, Natixis SA, Société Générale SA, AIB Group Plc, Governor and Company of the Bank of Ireland, Banca Monte dei Paschi di Siena SpA, Banco Popolare Società Cooperativa, Intesa Sanpaolo SpA, UniCredit SpA, Unione di Banche Italiane SpA and ING Groep NV. Other European economies(CH, DK, GB, NO and SE) banks: Credit Suisse Group AG, UBS Group AG, Danske Bank A/S, Barclays Plc, HSBC Holdings Plc, Lloyds Banking Group Plc, Royal Bank of Scotland Group Plc, Standard Chartered Plc, DNB ASA, Skandinaviska Enskilda Banken AB, Svenska Handelsbanken AB and Swedbank AB. The sample period is 1994–2018. Source: Datastream.

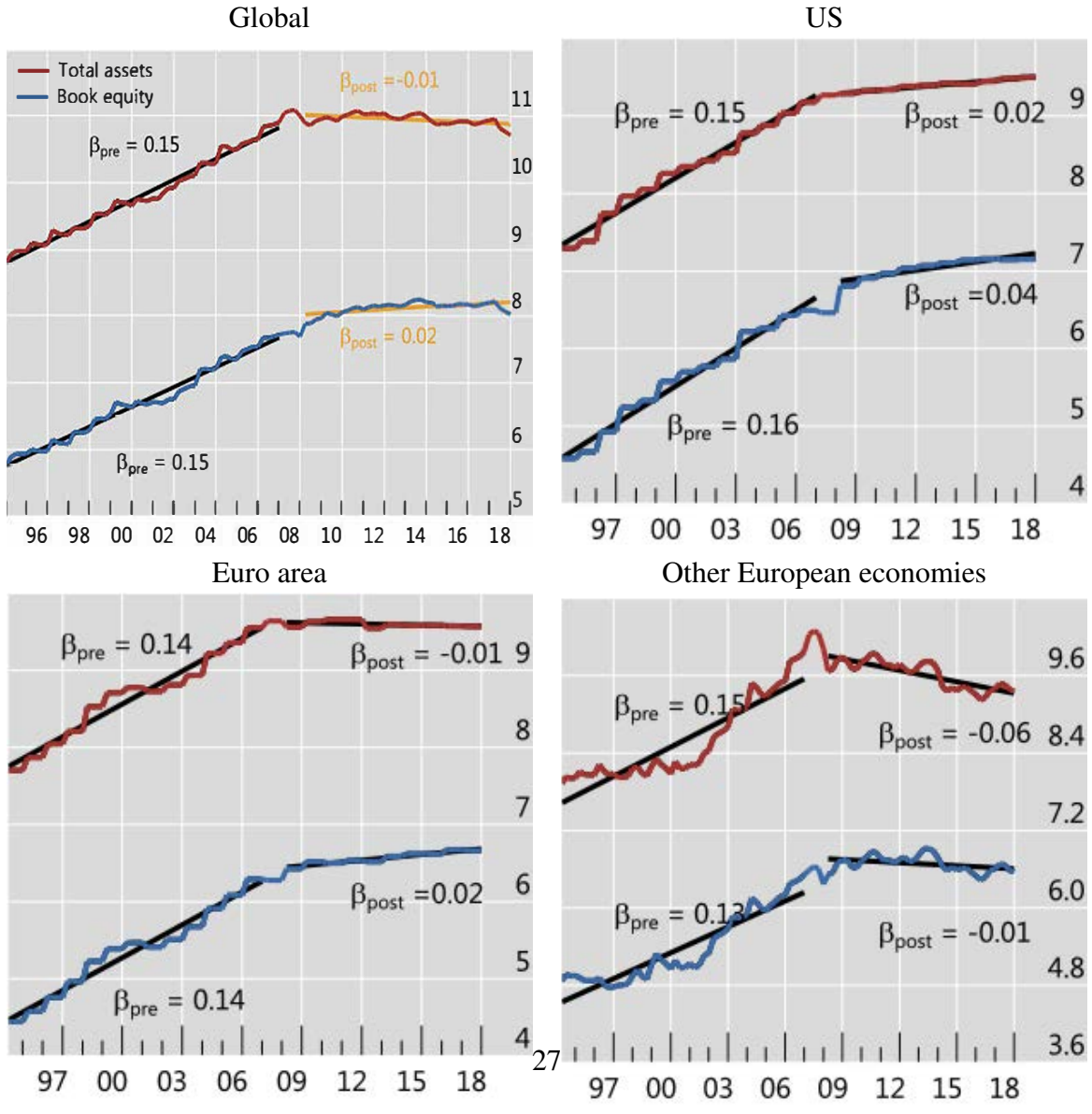

Figure 3. Balance Sheets Size and Leverage

Growth rates in log-differences; reported in percentage terms. The sample period is 1985:1 – 2018:3. Source: Compustat and CRSP.

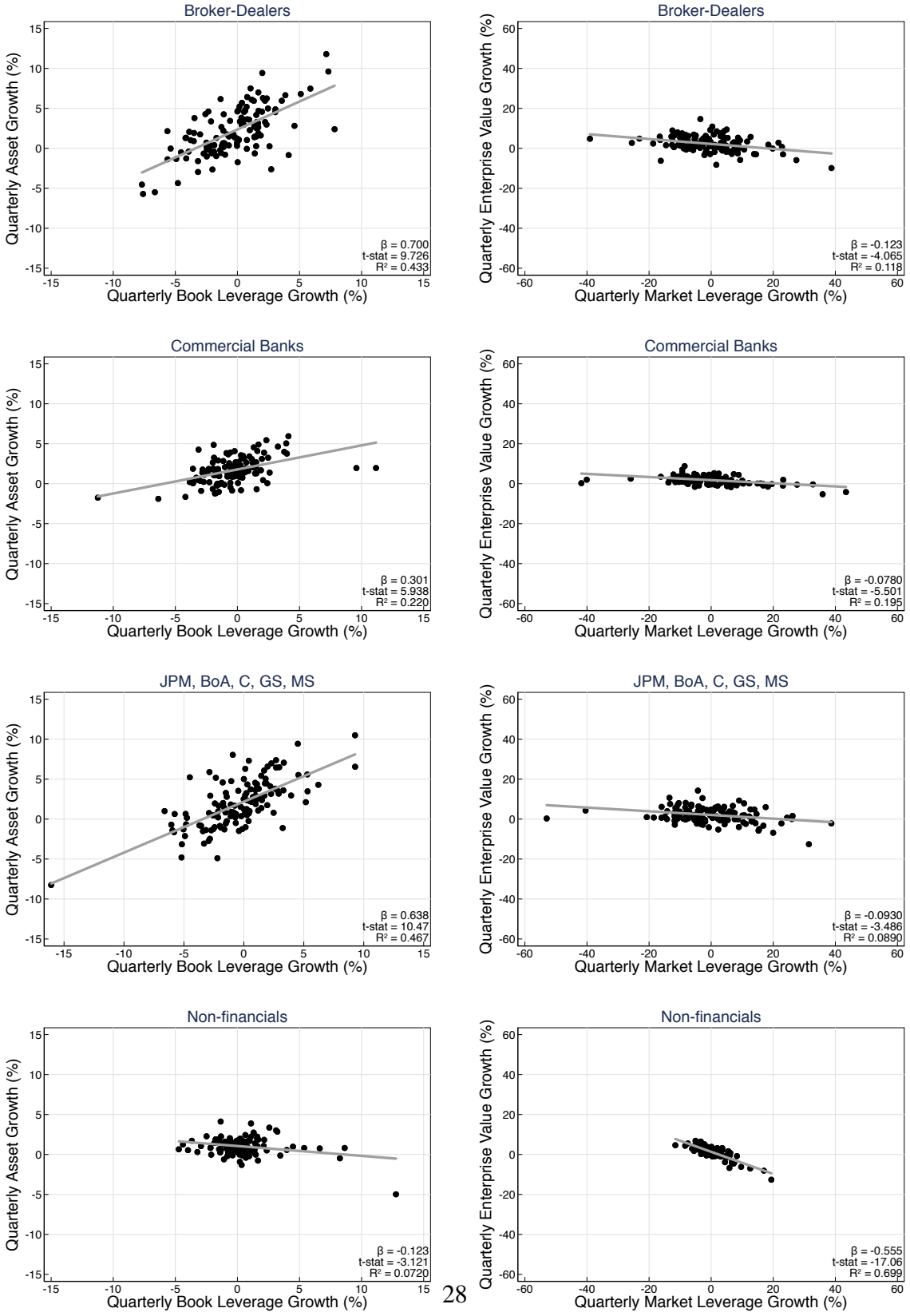

Figure 4. Balance Sheet Changes across Sectors

The sample period is 1985:1 – 2018:3. Source: Compustat and CRSP.

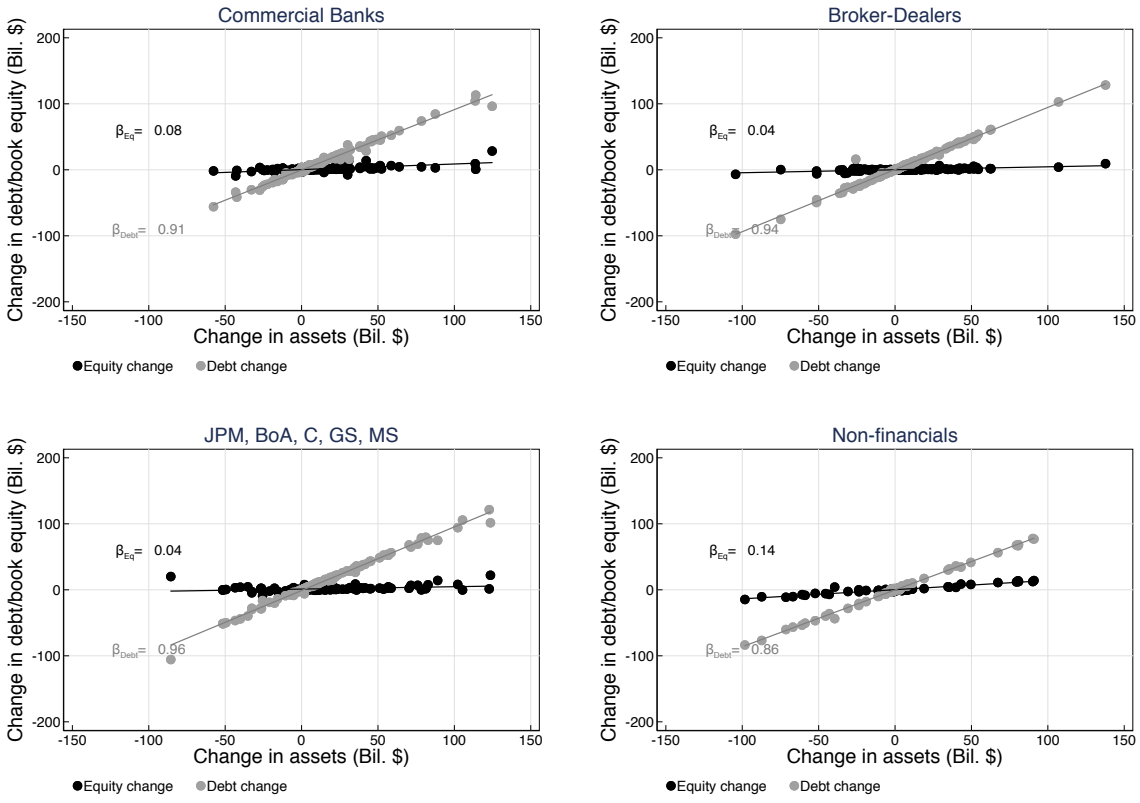

Figure 5. Leverage and the Book-to-Market Ratio

Growth rates in log-differences; reported in percentage terms. The sample period is 1985:1 – 2018:3. Source: Compustat and CRSP.

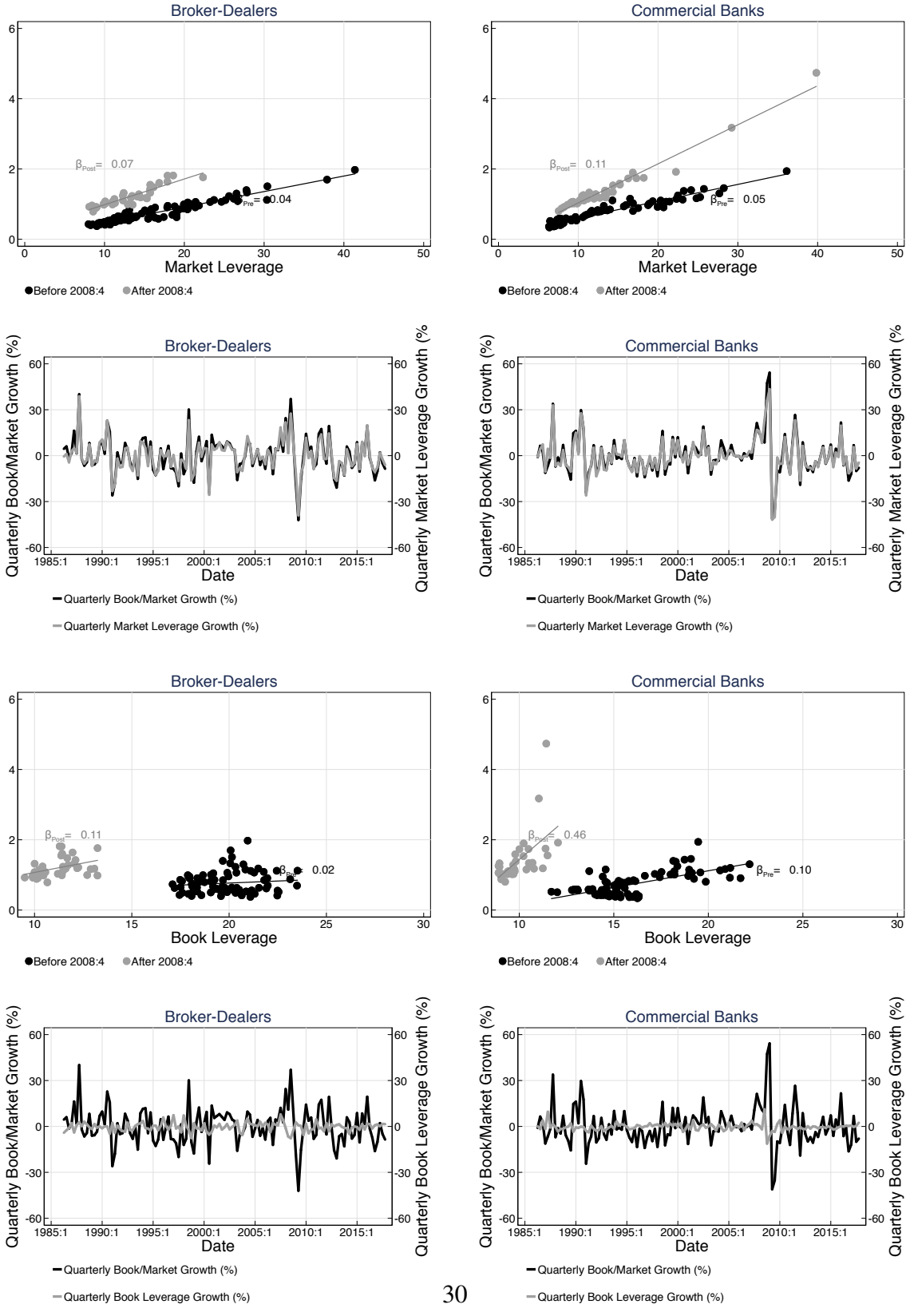

Figure 6. Three Modes of Leveraging Up

Mode 1 is through an equity buyback through a debt issue. Mode 2 is through a dividend financed by asset sale. Mode 3 is through increased borrowing to fund new assets. In each case the shaded area indicates the balance sheet component that is held fixed.

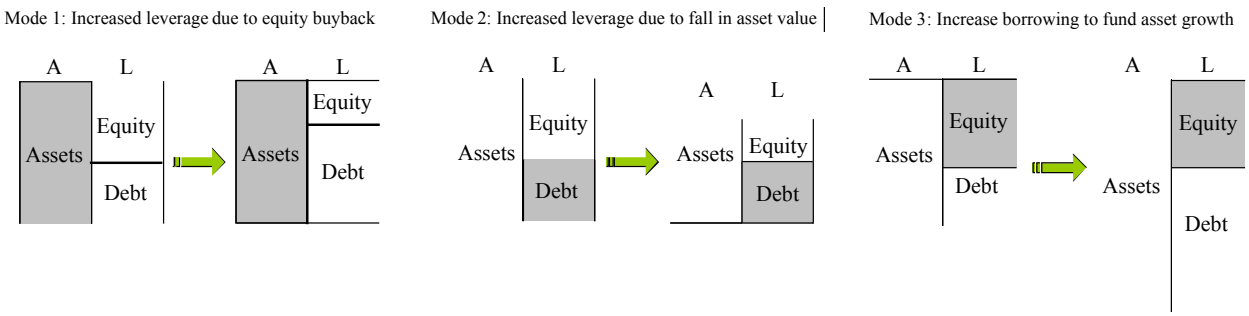

Figure 7. Equity and Balance Sheet Size

The left hand panel is the scatter chart of the growth of book equity and growth of total assets at quarterly frequency for broker-dealers. The right panel is the equivalent scatter for the commercial banks. Growth rates in log-differences; reported in percentage terms. The sample period is 1985:1 – 2018:3. Source: Compustat and CRSP.

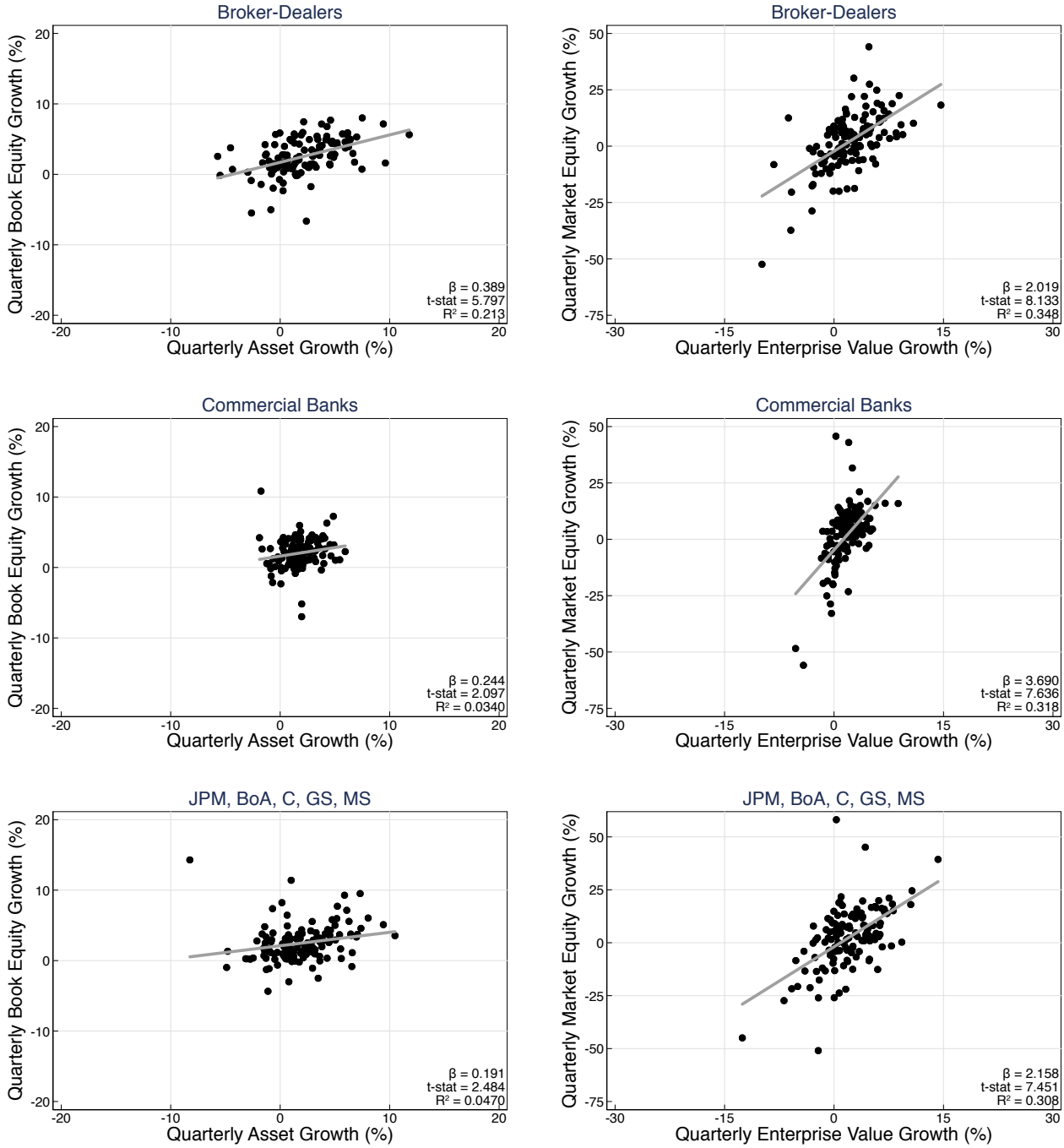

Figure 8. Equity and Leverage

Growth rates in log-differences; reported in percentage terms. The sample period is 1985:1 – 2014:1. Source: Compustat and CRSP.

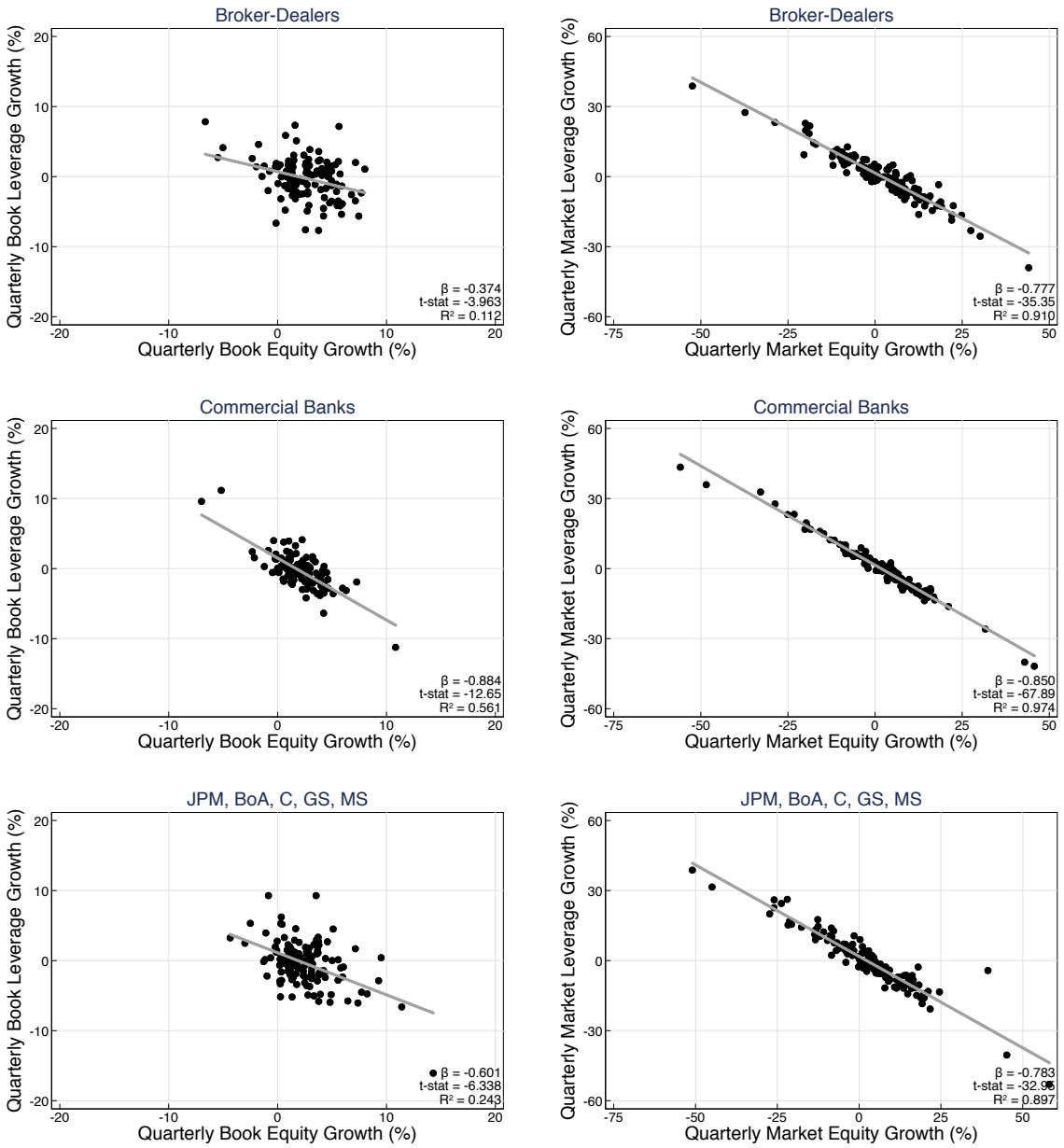

Figure 9. Net Payout, Leverage, and Market-to-Book: Cross-Correlation

Filled in points indicate statistical significance at the 5% level. Net payouts are measured as total dividends plus total share repurchases minus total share issuance. Growth rates in log-differences; reported in percentage terms. The sample period is 1985:1 – 2018:3. Source: Compustat and CRSP.

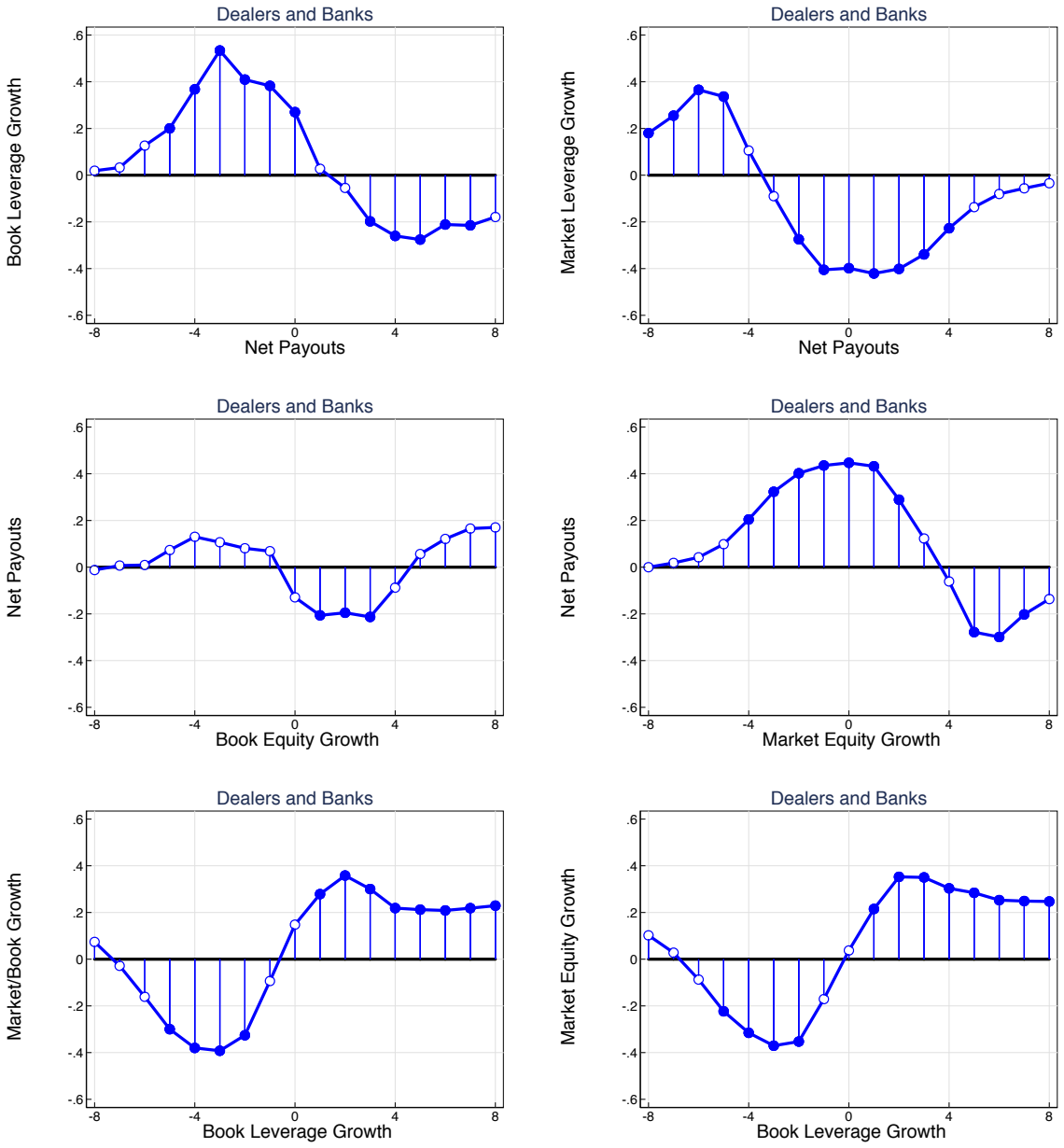

Figure 10. Impulse Response Functions from the Panel Vector Autoregression

Estimated impulse response functions (in blue) from a panel vector autoregression (VAR) and the 5% confidence bands for a one standard deviation shock. Impulses responses reported in percentage differences relative to the baseline. Return volatility, market-to-book, book equity and book leverage are all in quarterly log growth terms; payout is net payout normalized by assets. Shocks are ordered according to the order of columns in the figure. The sample period is 1985:1 – 2018:3. Source: Compustat and CRSP.

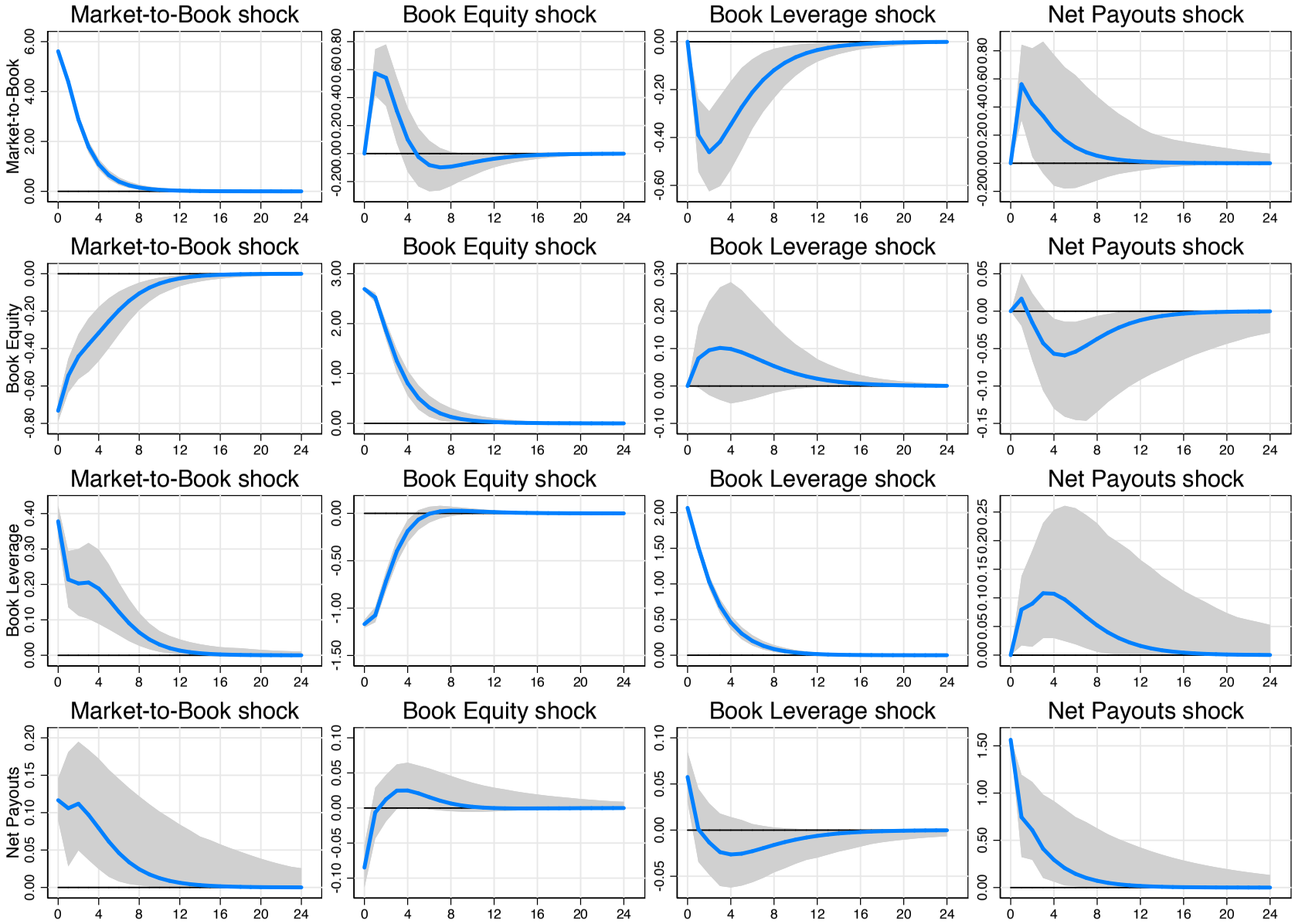

Figure 11. Net Payout over Time

Deviations from a Hodrick-Prescott filtered trend and returns reported in percentage terms. The sample period is 1985:1 – 2018:3. Source: Compustat and CRSP.