Federal Reserve Bank of New York
Staff Reports

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Staff Report No. 625
August 2013
Revised December 2014

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Federal Reserve Bank of New York Staff Reports, no. 625
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JEL classification: G10, G12

Abstract

We empirically investigate predictions from alternative intermediary asset pricing theories. The theories distinguish themselves in their use of intermediary equity or leverage as pricing factors or forecasting variables. We 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, and extends the cross-sectional results by Adrian, Etula, and Muir (2013) to a dynamic setting.

Key words: dynamic asset pricing, intermediary asset pricing, leverage cycle

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1 Introduction

Financial frictions have been the subject of intensive study as economists have refined their theoretical models to capture key aspects of the recent crisis and its aftermath. Although the building blocks used by economists share many common elements, a systematic study of the comparative *empirical* impact of financial frictions is still in its early stages. Our paper is an attempt to redress the balance by exploring the empirical implications of financial frictions in an asset pricing context.

There are several dimensions to the debate on how best to model financial frictions and how they impact asset prices and the financial system. The first is whether the key state variable is *net worth* or *leverage*, where leverage is defined as the ratio of assets to net worth. The literature emphasizing the importance of net worth (encompassing the work of Bernanke and Gertler (1989), Holmström and Tirole (1997) and Kiyotaki and Moore (1997)) is not necessarily limited to financial intermediaries. It could equally be aimed at households and non-financial corporates, as well as banks. This strand of the literature addresses the external finance premium more generally, whether it be for households, non-financial firms or banks. The insights have been developed in the asset pricing context by Gromb and Vayanos (2002), Brunnermeier and Sannikov (2014) and He and Krishnamurthy (2012) by interpreting the borrower as an intermediary. The focus is not necessarily on the lending activity of intermediaries but rather their borrowing cost. Indeed, in many of these models, the "bank" holds the real assets directly or holds equity claims on the real assets, rather than providing loans.

In contrast, Geanakoplos (2010) and Fostel and Geanakoplos (2008) address the role of intermediaries as *lenders*, and emphasize the role of leverage as the gauge of the ease of credit supply. When the bank's own funds are fixed, lending is then determined by leverage, and for Geanakoplos (2010) and Fostel and Geanakoplos (2008), leverage is the key state variable. They emphasize how leverage falls during downturns, mirroring the increased collateral requirements (increased "haircuts") imposed by lenders, and how the risk bearing capacity of the financial system fluctuates with changes in collateral requirements. Similarly, Gorton (2010) and Gorton and Metrick (2012) have explored the analogy between classical bank runs and the modern run in capital markets driven by increased collateral requirements and the reduced capacity to borrow that comes from a reduction in permitted leverage.

The contrasting perspectives on the importance of net worth and leverage in modeling financial frictions is potentially very important, as the empirical predictions of the two approaches are quite different. Our task in this paper is to investigate empirically which matters more for asset pricing - net worth or leverage. Among other things, finding an answer to our question will reveal to what extent financial frictions affect asset prices through external finance premium of borrowers generally or the credit supply decisions of banks.

A second, related debate is whether equity should be measured as the market capitalization of the intermediary or as its book equity (see He and Krishnamurthy (2013) and Adrian and Shin (2014)). The second debate remains relevant irrespective of the answer to the first question on whether it is equity or leverage that matters for asset pricing. Leverage presupposes a definition of equity, and so the exact definition of equity matters. The intermediary asset pricing literature uses two distinct measures of intermediary equity: book equity and market capitalization. Book equity is the owner's own stake in the portfolio, and is exemplified by the haircut applied to a repurchase agreement (repo). A repo haircut of 5 percent means that 5 cents of each dollar's worth of securities must be funded by the owner's stake, so that maximum achievable leverage is 20. For securities that are traded in liquid markets, the repo haircut gives an accurate marked-to-market snapshot of book equity and hence of book leverage. A rise in collateral requirements (increased haircuts) is the mirror image of decreased leverage, and Geanakoplos (2010), and Gorton and Metrick (2012) have examined how the risk bearing capacity of the financial system can be severely diminished when leverage falls through an increase in collateral requirements. Thus, leverage is procyclical—high during booms and low during busts (see Adrian and Shin (2010, 2014) for empirical evidence).

An alternative notion of equity is market capitalization, which is the discounted value of all future free cash flows. Enterprise value is the analogue of total assets, defined as the sum of market capitalization and debt. Enterprise value addresses the question "how much is the bank worth?" In contrast, total assets address the question "how much does the bank lend?" The two can diverge even in a perfect market—for instance when one bank has a higher fee income than another even when they hold identical portfolios of loans and securities. To the extent that credit availability is key to asset prices, total assets would be more imporant.

To summarize, our paper is motivated by two key questions. First, is it net worth or leverage that is the key determinant of asset prices? Second, irrespective of the answer to the first question, should net worth be measured as market capitalization or as book equity?

We look to empirical evidence in answering these two key questions. We do this by testing the reduced forms of four alternative intermediary pricing models, using either book or market values from either broker-dealers or commercial banks as state variables. The four intermediary asset pricing models distinguish themselves by their risk factors (the cross-sectional pricing factors) and their price of risk factors (the forecasting factors that capture the time variation in the pricing of risk). We employ the dynamic asset pricing model (DAPM) approach of Adrian, Crump, and Moench (2014) to empirically discriminate among the alternative models using a broad class of test assets that includes size, book-to-market, and momentum sorted equity portfolios, credit returns sorted by ratings and industries, and Treasury returns sorted by maturity.

The dynamic asset pricing tests answer our two questions. First, leverage is the driver of asset prices, not net worth. Second, it is book equity that should be used in defining leverage, not market capitalization. In particular, we show that models with book leverage as cross-sectional pricing factor and as price of risk variable generate more significant prices of risk and smaller pricing errors than models with equity variables. These tests are suggestive evidence in favor of asset pricing theories that feature intermediaries with risk based capital constraints such as value at risk constraints, which give rise to leverage as a state variable in equilibrium (e.g. the theories of Brunnermeier and Pedersen (2009), Danielsson, Shin, and Zigrand (2012), and Adrian and Boyarchenko (2013)). Consistent with those theories, we find that the price of risk associated with exposure to leverage shocks is positive, and that higher leverage growth forecasts lower future returns. Both of these findings reflect the procyclicality of leverage. The price of risk is positive as unexpectedly large leverage shocks correspond to states of the world when the marginal value of wealth is high. Leverage forecasts returns negatively as high leverage is associated with asset price booms, when expected returns are compressed. In contrast to the large literature that emphasizes the role of *equity* as the state variable, our empirical findings thus favor *leverage* as the key quantity. In addition, we note that it is leverage measured by book values, not market values, which is most significant for both the time series and cross-section. Measures of equity do not perform as well in the cross-sectional tests, have little predictive power for excess returns, and have the wrong sign in some specifications. The best performing model has broker-dealer book leverage as forecasting variable, and shocks to broker-dealer book leverage, together with the market return, as cross-sectional pricing factors.

Our findings thus extend the cross-sectional results by Adrian, Etula, and Muir (2013) to a dynamic setting. Adrian, Etula, and Muir (2013) document that innovations to broker-dealer book leverage are a useful cross-sectional pricing factor: exposures to these innovations are well aligned with average excess returns for a broad cross-section of equity and Treasury portfolios. We show that broker-dealer book leverage is also a strong forecasting variable for a broad range of risky asset returns. Combining these two results in a dynamic asset pricing model with time-varying prices of risk that depend on broker-dealer leverage, we find that one can explain both the time series and the cross-section of a broad set of test assets better than with benchmark asset pricing models.

Our approach is complementary to the intermediary asset pricing results of Muir (2014), who has investigated asset returns over long horizons of up to five years, where the market capitalization of the financial sector taken as a whole is used as a conditioning variable. Muir (2014) finds long-horizon predictability of equity returns. Our results complement those of Muir (2014) in that we focus on forecastability over one quarter, and we restrict ourselves to the financial intermediary sector defined narrowly as the broker-dealer and the banking sectors.

Our short-horizon focus has the advantage of being a better fit for the narrative of financial "frictions,"as the stickiness of equity and leverage should be more acute over short horizons than over long horizons of up to five years.

The remainder of the paper is organized as follows. In Section 2, we provide a brief summary of alternative intermediary asset pricing theories, and present our empirical approach. In Section 3, we describe the data. In Section 4, we present empirical evidence that helps to discriminate between alternative intermediary asset pricing theories, and analyze the predictive power of broker-dealer leverage in more detail. Section 5 concludes.

2 Alternative Intermediary Asset Pricing Models

As a background to our empirical investigation, we outline a framework where alternative intermediary asset pricing theories can be nested and compared. We first present reduced form asset pricing predictions form alternative theories, and then explain the empirical dynamic asset pricing approach that we use to discriminate between the theories.

2.1 Intermediary Asset Pricing Theories

The asset pricing approach that rests on equity can be described in the following terms. The emphasis is placed on the intermediary's equity, w_{t+1}, as the key variable in the pricing kernel. Formally, denote the return to intermediary equity R^w_{t+1} and $\lambda^w(w_t)$ the price of risk of intermediary equity, which is allowed to vary as a function of equity. The price of risk of the market return $\lambda^{R^M}(w_t)$ also depends on the level of intermediary equity. Expected excess returns are

$$E_t\left[R^i_{t+1}\right] = \beta^i_{R^M}\lambda^{R^M}(w_t) + \beta^i_w\lambda^w(w_t), \qquad \text{(Model 1)}$$

where β^i_w is the risk factor exposure of asset i relative to the return to intermediary equity R^w_{t+1}, $\beta^i_{R^M}$ is the risk factor exposure relative to the market excess return R^M_{t+1}. Model 1 implies a two factor asset pricing model where intermediary equity and the market return are the price of risk variables, and the prices of risk depend on the level of intermediary equity w_t.

This asset pricing model is in the spirit of He and Krishnamurthy (2012). In their model, the growth rate of intermediary equity represents the asset pricing factor when financial constraints bind while the standard capital asset pricing model holds when constraints are not binding.[1] The theory predicts:

- $\lambda^{R^M}(w) > 0$, i.e. the price of market risk should be positive,
- $\lambda^{w}(w) > 0$, i.e. the price of risk of intermediary equity should be positive,
- $\frac{\partial \lambda^{w}(w)}{\partial w} < 0$ and $\frac{\partial \lambda^{R^M}(w)}{\partial w} < 0$, i.e. high intermediary equity is associated with compressed prices of risk for the market and intermediary equity.

The assumption of equity as the key state variable has a long tradition starting with the seminal work by Bernanke and Gertler (1989), Holmström and Tirole (1997) and Kiyotaki and Moore (1997). While these early papers focused on the equity of borrowers (typically non-financial firms or households), the more recent literature has emphasized the equity of financial intermediaries. Intermediary asset pricing models that follow the equity approach include Gromb and Vayanos (2002), and Brunnermeier and Sannikov (2014), in addition to the work by He and Krishnamurthy (2012) mentioned above. The common thread among these theories is that the pricing of risk depends directly on intermediary equity, with the prediction that intermediary equity is a procyclical variable.

A second approach to intermediary asset pricing emphasizes the role of leverage. Brunnermeier and Pedersen (2009) propose a model where shocks to the pricing kernel are proportional to the financial intermediary's Lagrange multiplier on its leverage constraint ϕ_{t+1}, in addition to the market factor. A specification that is consistent with Brunnermeier and Pedersen (2009)

[1]Note that the model of He and Krishnamurthy (2012) features only one shock for analytical tractability. In the model, the market factor and intermediary return are (conditionally) perfectly correlated. To ensure that we capture both aspects of their model in our empirical tests, we add the return on the market portfolio as a second pricing factor. This further allows us to assess the incremental explanatory power of intermediary market equity growth over and above the return on the market portfolio which it is strongly correlated with. We use the market return as a pricing factor in all of the following empirical specifications as well.

is to proxy $\phi_{t+1} \approx a - b \ln (Lev_{t+1})$, such that lower leverage corresponds to tighter funding constraints. When funding constraints tighten, intermediaries are forced to deleverage by selling off assets they can no longer finance. We complement shocks to leverage with the market return in our empirical specification, giving the following reduced form model:

$$E_t \left[R^i_{t+1} \right] = \beta^i_{R^M} \lambda^{R^M} + \beta^i_{Lev} \lambda^{Lev}. \tag{Model 2}$$

The theory predicts that

- $\lambda^{R^M} > 0$, i.e. the price of market risk should be positive,
- $\lambda^{Lev} > 0$, i.e. the price of risk of intermediary leverage should be positive.

Adrian, Etula, and Muir (2013) test this model in the cross-section of asset returns. A drawback of Model 2 is its static nature: the price of risk is constant. To capture asset price dynamics, the price of risk must be explicitly modeled as time-varying as is done in the following approaches.

One way to generate time varying prices of risk is by emphasizing the role of margin constraints. In such models, the pricing factor is the market return, and the price of risk depends on the Lagrange multiplier of margin constraints. Garleanu and Pedersen (2011) is a recent exposition of such an approach. Empirically, the tightness of the margin constraint is difficult to observable directly, but Adrian and Etula (2011) discuss how theories with margin constraints compare to models that use intermediary leverage as state variable. A more directly testable approach is presented by Danielsson, Shin, and Zigrand (2012) who consider risk-neutral financial intermediaries that are subject to a value at risk (VaR) constraint. In their model, the intermediaries' demand for risky assets depends on the Lagrange multiplier of the VaR constraint that reflects effective risk aversion. In equilibrium, asset prices depend on the leverage of the intermediaries, which determines the level of effective risk aversion—times of low intermediary leverage are times when effective risk aversion is high. As a result, financial intermediary leverage directly enters the equilibrium pricing kernel. The reduced form asset pricing restriction takes the following form:

$$E_t\left[R^i_{t+1}\right] = \beta^i_{R^M}\lambda^{R^M}\left(Lev_t\right). \tag{Model 3}$$

The pricing factor is therefore the market return R^M_{t+1}, while the price of risk depends on intermediary leverage, reflecting the time varying effective risk aversion of intermediaries. Importantly, leverage—not equity—is the key measure of time varying effective risk aversion in these models. The theory's predictions regarding the prices of risk are:

- $\lambda^{R^M}\left(Lev\right) > 0$, i.e. the price of risk of the market should be positive,
- $\frac{\partial\lambda^{R^M}(Lev)}{\partial Lev} < 0$, i.e. high intermediary leverage is associated with a low price of risk.

A pricing kernel in which the pricing of risk varies as a function of leverage over time, and in which shocks to leverage are cross-sectional pricing factors, can be motivated from the equilibrium asset pricing model of Adrian and Boyarchenko (2013). Adrian and Boyarchenko study an economy in which financial intermediaries have risk based leverage requirements, forcing them to deleverage when volatility increases. Volatility endogenously increases when intermediaries deleverage, thus generating a feedback mechanism. In equilibrium, the price of risk can be expressed as varying as a function of leverage, while the model implies that the relevant risk factors are shocks to intermediary leverage and the market return:[2]

$$E_t\left[R^i_{t+1}\right] = \beta^i_{R^M}\lambda^{R^M}\left(Lev_t\right) + \beta^i_{Lev}\lambda^{Lev}\left(Lev_t\right). \tag{Model 4}$$

This theory makes the following predictions:

- $\lambda^{Lev}\left(Lev_t\right) > 0$, i.e. the price of leverage risk is positive,

[2]While Adrian and Boyarchenko (2013) present their pricing kernel as a function of shocks to leverage and shocks to output, we are using an empirical specification with the market return instead of output shocks.

- $\frac{\partial \lambda^{R^M}(Lev)}{\partial Lev} < 0$ and $\frac{\partial \lambda^{Lev}(Lev)}{\partial Lev} < 0$, i.e. high intermediary leverage is associated with low pricing of risk.

Hence, in this theory leverage is again procyclical with a positive price of leverage risk, and leverage growth forecasting lower future returns.

2.2 Dynamic Asset Pricing Framework

The reduced-form representations of all four alternative intermediary asset pricing models can be cast in the *Dynamic Asset Pricing Model* (DAPM) framework of Adrian, Crump, and Moench (2014). In the DAPM framework, systematic risk in the economy is captured by a $K \times 1$ vector of state variables X_t that follow a stationary vector autoregression (VAR),

$$X_{t+1} = \mu + \Phi X_t + v_{t+1}, \qquad t = 1, \ldots, T, \tag{1}$$

with initial condition X_0. The dynamics of these state variables can be assumed to be generated by an equilibrium model of the economy.

State variables can be "risk" factors, "price of risk" factors, or both. Risk factors refer to variables that are significant factors for the cross-section of asset returns, but do not predict excess returns in the time series, while price of risk factors refer to variables that significantly predict excess returns in the time series, but do not comove with returns contemporaneously.[3] Finally, some state variables can be contemporaneously correlated with returns and also predict returns, implying that they act as both a price of risk and a risk factor. In the DAPM, the state variables are therefore partitioned into three categories:

$$\begin{aligned} X_{1,t} &\in \mathbb{R}^{K_1} : \text{risk factor only} \\ X_{2,t} &\in \mathbb{R}^{K_2} : \text{risk and price of risk factor} \\ X_{3,t} &\in \mathbb{R}^{K_3} : \text{price of risk factor only} \end{aligned}$$

[3] In the fixed income literature, such price of risk factors are sometimes referred to as "unspanned" factors, see Joslin, Priebsch, and Singleton (2012), and Adrian, Crump, and Moench (2013).

Define

$$C_t = \begin{bmatrix} X_{1,t} \\ X_{2,t} \end{bmatrix}, \quad F_t = \begin{bmatrix} X_{2,t} \\ X_{3,t} \end{bmatrix}, \quad u_t = \begin{bmatrix} v_{1,t} \\ v_{2,t} \end{bmatrix},$$

where "C_t" is for "cross-section" and "F_t " is for "forecasting".

Assuming a linear pricing kernel and prices of risk that are affine in the forecasting factors F_t, the beta representation of the DAPM is given by

$$R_{i,t+1} = \beta_i' (\lambda_0 + \Lambda_1 F_t) + \beta_i' u_{t+1} + e_{i,t+1}, \tag{2}$$

$$X_{t+1} = \mu + \Phi X_t + v_{t+1}, \qquad t = 1, \ldots, T. \tag{3}$$

The realized excess return, $R_{i,t+1}$, can thus be decomposed into the expected excess return, $\beta_i' (\lambda_0 + \Lambda_1 F_t)$, a component that is conditionally correlated with the innovations to the risk factors, $\beta_i' u_{t+1}$, and a return pricing error, $e_{i,t+1}$, that is conditionally orthogonal to the risk factor innovations. The expected excess return depends on the asset's exposures with respect to the pricing factors of the model, β_i, as well as the associated prices of risk $\lambda_t = \lambda_0 + \Lambda_1 F_t$ which are affine functions of the forecasting factors.

Adrian, Crump, and Moench (2014) propose a regression-based estimator for the parameters of the model and show that it is consistent and asymptotically normal. They further derive asymptotic standard errors that are robust to heteroskedasticity in the return pricing errors. Importantly, this estimator nests the popular Fama-MacBeth two-pass regression estimator when both $\Lambda_1 = 0$ and $\Phi = 0$. That is, the DAPM estimator can be thought of as a generalized Fama-MacBeth estimator that explicitly allows for state variables and prices of risk to be time-varying.

In this model, to gauge whether differential exposures to a given pricing factor result in significant spreads of expected excess returns, one has to test whether a specific element of $\bar{\lambda}$ is equal to zero, where

$$\bar{\lambda} = \lambda_0 + \Lambda_1 \mathbb{E}[F_t].$$

Adrian, Crump, and Moench (2014) derive the asymptotic distribution of $\bar{\lambda}$ and show how it can be computed as a function of quantities that are known in closed form.

The alternative intermediary asset pricing theories discussed above attribute different roles to the excess return on the market portfolio, intermediary leverage, and equity. These different roles can be represented in terms of the three types of state variables, as summarized in the following table:

Model	X_1	X_2	X_3
1	R^M	w	–
2	R^M, Lev	–	–
3	R^M	–	Lev
4	R^M	Lev	–

In Appendix A, we provide the DAPM beta representations of each of the four intermediary asset pricing models discussed in the previous section. While all four models are nonlinear, we empirically test affine reduced form versions of these models. These reduced forms can be viewed as first-order linear approximations to the nonlinear models. The predictions concerning the signs of the prices of risk in the four models are as follows:

Model	$\bar{\lambda}$	Λ_1
1	$\bar{\lambda}^{R^M} > 0$, $\bar{\lambda}^{w} > 0$	$\Lambda_1^{w,w} < 0$
2	$\bar{\lambda}^{R^M} > 0$, $\bar{\lambda}^{Lev} > 0$	
3	$\bar{\lambda}^{R^M} > 0$	$\Lambda_1^{R^M,Lev} < 0$
4	$\bar{\lambda}^{R^M} > 0$, $\bar{\lambda}^{Lev} > 0$	$\Lambda_1^{R^M,Lev} < 0$, $\Lambda_1^{Lev,Lev} < 0$

In this notation, $\frac{\partial \lambda^{x_i}(x_j)}{\partial x_j} = \Lambda_1^{x_i,x_j}$ as prices of risk are affine. $\Lambda_1^{x_i,x_j}$ thus represents the extent to which the price of risk associated with pricing factor x_i depends on x_j. $\bar{\lambda}^{x_i}$ is the unconditional price of risk of pricing factor x_i.

In Section 4, we present estimates of the four models using the DAPM estimator and show tests of the alternative models. Before moving to the empirical results, we discuss the data used in our analysis.

3 Data

We draw on three types of data for our empirical exercise in this paper. The first are excess returns for equities, Treasury and corporate bond portfolios. The equity returns are decile portfolios sorted on book-to-market, market capitalization, and momentum, respectively, from Kenneth French's website. The Treasury returns are the constant maturity returns for maturities $n = 1, 2, 5, 7, 10, 20, 30$ years, obtained from CRSP. The corporate bond returns are the Barclays total return series for benchmark indices for investment grade industrials, utilities and financials, as well as for AAA, AA, A, and BAA rated bonds.

We collect intermediary balance sheet data from various sources. We obtain book equity and book leverage for Securities Brokers and Dealers ("broker-dealers") from the Federal Reserve Flow of Funds series (Table L.127). We obtain broker-dealer market equity and leverage from Compustat-CRSP by aggregating individual firm data with SIC codes 6712 or 6211. We also use Compustat-CRSP to construct market equity and leverage for commercial banks using individual firm data with SIC codes from 6000 through 6099. Finally, we obtain book equity and leverage series for commercial banks by aggregating the individual Call Report data obtained from the Federal Deposit Insurance Corporation (FDIC). A detailed discussion of how these aggregates have been constructed is provided in Appendix B.

We detrend all balance sheet indicators by computing annual growth rates and check the robustness of our main results with respect to alternative detrending methods in Appendix C. We use the following naming convention: the annual growth rates of broker-dealer book equity and leverage are labeled $yBDbeg$ and $yBDblevg$; similarly, broker-dealer market equity and leverage growth are named $yBDmeg$ and $yBDmlevg$. The corresponding quantities for commercial banks are $yCBbeg$, $yCBblevg$, $yCBmeg$, and $yCBmlevg$.

We compare the predictive power of the balance sheet indicators with benchmark return forecasting factors that have been used in the literature. These are the dividend yield (dy) for the S&P500, from Haver Analytics, the term spread ($TERM$), calculated as the difference between the ten-year constant maturity Treasury yield and the three-month Treasury bill rate, both from the Federal Reserve's H.15 release, the default spread (DEF), calculated as the difference between Moody's Aaa and Baa yields, also from the H.15 release, the equity share in new issues (ES) from Baker and Wurgler (2000), which we update with recent data, the book-to-market ratio (BM) for the aggregate value-weighted market portfolio from CRSP, the log consumption-wealth ratio from Martin Lettau's website (CAY), as well as the Cochrane and Piazzesi (2005) Treasury return forecasting factor (CP), which we update with recent data from CRSP.

4 Empirical Results

In this section, we empirically evaluate the various intermediary asset pricing theories and examine whether their predictions are borne out by the data. We use both intermediary equity and leverage as pricing factors and return forecasting factors. We first present univariate forecasting and cross-sectional regressions for intermediary balance sheet variables and then evaluate *Models 1–4* using the regression-based DAPM estimator. We also present robustness results for the predictive power of broker-dealer book leverage.

As equity and leverage can be measured using book values or market values, we consider four different measures: book and market values of leverage and equity. We furthermore measure each of those four variables for two types of institutions: security broker-dealers and commercial banks. We therefore compare asset pricing implications for eight alternative intermediary balance sheet indicators. Figures 1 and 2 show the time series of these eight indicators.

4.1 Preliminary Results

We set the stage by showing the results of simple predictive return regressions and cross-sectional regressions for the eight different intermediary balance sheet factors. As the different theories make predictions about the signs of the parameters characterizing the pricing of risk of the relevant state variables, we first examine these estimates. We turn to explicitly estimating *Models 1–4* in the next subsection. To test the time series implications of the various models we estimate one quarter ahead predictive return regressions of the form

$$R^i_{t+1} = a_i + b_i X_t + \varepsilon^i_{t+1} \tag{4}$$

where the X_t variables are measures of intermediary equity or leverage. These regressions allow us to assess whether the pricing of risk varies over time as a function of the intermediary variables.

As dependent variables we use the value-weighted equity market return from CRSP, the return on the BAA rated corporate bond portfolio from Barclays, and the ten-year zero coupon constant maturity Treasury return. The sample period is 1975Q1-2012Q4. The upper panel of Table 1 shows that broker-dealer book leverage growth from the Flow of Funds strongly predicts the excess returns on the CRSP equity market portfolio as well as the portfolio of BAA rated corporate bonds. In both cases, the estimated predictive slope coefficients for broker-dealer leverage are negative, in line with the prediction of *Model 3* and *Model 4* that tighter (looser) balance sheet constraints result in higher (lower) risk premiums. The coefficient for the ten-year Treasury return is insignificant. Interpreted in terms of the availability of credit to market participants, these results fit the narrative well, since leveraged market players would typically figure as the primary holders of risky assets, such as equities and credit, but not of less risky assets such as Treasury bonds.

Comparing the predictive power of broker-dealer book leverage from the Flow of Funds with that of alternative balance sheet indicators, we see that none predicts excess returns as significantly. While broker-dealer book equity growth from the Flow of Funds shows some predictive power for the quarterly excess return on the S&P 500 index, the slope coefficient has a positive sign. This empirical finding is in contrast to the theories underlying *Model 1* which predict a negative relation between intermediary equity and risk premiums. That said, broker-dealer market equity growth predicts the BAA credit return with a negative sign, but the coefficient is only statistically significant at the 10 percent level.

Interestingly, none of the commercial bank variables appear significant in the predictive return regressions for the equity market return. However, commercial bank book equity predicts the BAA credit return significantly and with a negative sign, as implied by the theories underlying *Model 1.* That said, broker-dealer book leverage as obtained from the Flow of Funds shows the strongest predictive performance for risky asset returns, and the sign of the predictive relationship is consistent with the theories underlying *Model 1* and *Model 2.*

In the second exercise, reported in Panel B of Table 1, we estimate the unconditional prices of risk associated with exposure to various intermediary asset pricing factors following Adrian, Etula, and Muir (2013). We test how well these intermediary balance sheet indicators fare in explaining the cross-section of asset returns, beyond the return on the market portfolio. According to *Models 1, 2, 4*, exposure to intermediary balance sheet risk should be a priced factor in the cross-section of risky assets. Specifically, we estimate the following reduced-form asset pricing model:

$$
\begin{aligned}
R^i_{t+1} &= \beta_i'\lambda_0 + \beta_i' v_{t+1} + e^i_{t+1} \\
X_{t+1} &= \mu + \Phi X_t + v_{t+1}
\end{aligned}
$$

where $X_t = \left(R^M_t, Lev_t\right)'$ or $X_t = \left(R^M_t, w_t\right)'$, and v^X_{t+1} denotes the VAR(1) innovations to the two pricing factors. We apply the DAPM estimator of Adrian, Crump, and Moench (2014) with constant prices of risk (only X_1-type variables) and assess the significance of the estimates using standard errors that are robust to heteroskedasticity in the pricing errors. As shown in

Adrian, Crump, and Moench (2014), in the constant price of risk case these standard errors are equivalent to the Fama-MacBeth standard errors provided by Jagannathan and Wang (1998).

The lower panel of Table 1 provides estimates of the prices of risk associated with exposure to the various intermediary balance sheet indicators. The results show that among the balance sheet indicators considered, broker-dealer book leverage growth, broker-dealer market equity growth, commercial bank book equity growth and commercial bank market equity growth feature prices of risk that are positive and significant at least at the 5 percent level. Hence, on the basis of these results none of the theories can be ruled out. That said, the price of broker-dealer book equity growth risk is estimated to be negative (albeit only at the 10 percent significance level) which is inconsistent with *Model 1*.

Note that among the intermediary variables considered in the cross-sectional regressions, broker-dealer book leverage growth is the most strongly significantly different from zero. This is consistent with the findings in Adrian, Etula, and Muir (2013) who use innovations to seasonally-adjusted broker-dealer book leverage as a pricing factor in similar cross-sectional tests. Moreover, the positive sign of the estimated price of broker-dealer book leverage is consistent with the theories of Brunnermeier and Pedersen (2009) and Adrian and Boyarchenko (2013).

The results in Table 1 show that broker-dealer book leverage growth is a strong predictor of future returns on risky assets and also carries a highly significant risk premium in the cross-section of stock and bond returns. This is consistent with *Models 2 - 4*. For all other intermediary balance sheet factors the evidence is weaker, but some results appear inconsistent with *Model 1*. We now turn to explicitly estimating the reduced form representations of all four intermediary pricing models.

4.2 Estimation of the Alternative Intermediary Pricing Models

While the time series and cross-sectional results of Table 1 provides suggestive evidence in favor of intermediary asset pricing theories, these regressions do not exploit the joint evolution of asset prices in the time series and cross-section. *Models 1, 3, 4* make predictions about both the time series and cross-section of asset returns and therefore the predictive and cross-sectional relationships need to be estimated jointly. In fact, Adrian, Crump, and Moench (2014) show that in a DAPM the parameters governing the predictive and the cross-sectional relationships between state variables and asset returns are intimately linked and their estimation approach improves inference for both sets of coefficients.

Appendix A provides the reduced-form DAPM representations of all the intermediary pricing models of Section 2. Table 2 reports estimates of the market price of risk parameters for each of the four models with the corresponding t-statistics in brackets below. As before, we implement each model for four different measures of the respective leverage or equity indicator: measured at book values or market values for either broker-dealers or commercial banks.

Estimated using broker-dealer book equity growth, the market price of risk parameters for the balance sheet factor in *Model 1*, displayed in the first panel of Table 2, have signs opposite to those implied by theory. In particular, broker-dealer book equity growth predicts the excess return on the market portfolio with a positive sign and carries a negative risk premium in the cross-section. In contrast, market equity growth for both broker-dealers and commercial banks earn a significant positive risk premium, consistent with the theory underlying *Model 1*. However, these two intermediary balance sheet factors do not drive time variation in expected returns as implied by the insignificant coefficient $\Lambda_1^{w,w}$.

A comparison of the results from Tables 1 and 2 shows the power of the dynamic asset pricing approach relative to static asset pricing. While commercial bank book equity is a significant pricing factor in Table 1, it ceases to be significant in Table 2. This implies that in the correctly specified dynamic model (as *Model 1* implies that prices of risk vary as a function of intermediary equity), the average price of commercial bank book equity risk is not statistically different from zero. In sum, *Model 1* does not seem to be favored by the data.

Model 2 features two pricing factors, the market portfolio and intermediary leverage, which are both predicted to command a positive risk premium. Panel B of Table 2 provides the estimated average prices of risk and associated t-statistics of the two pricing factors. Broker-dealer book leverage (the first row of panel B), features a strongly significant price of risk. This is consistent with the results in the bottom panel of Table 1 and confirms the results of Adrian, Etula, and Muir (2013). That said, all other measures of intermediary leverage that we consider do not feature significant prices of risk. Thus, *Model 2* appears to be consistent with the data only when broker-dealer book leverage from the flow of funds is used as a measure of intermediary leverage.

While *Model 2* has intermediary leverage as a cross-sectional pricing factor with no predictive role, *Model 3* exclusively associates leverage with time variation in risk premiums. In this model, the market portfolio is the only risk factor, but its price of risk is assumed to depend negatively on intermediary leverage: when intermediaries increase their balance sheet leverage, asset prices rise and risk premiums are compressed. Vice versa, when they delever by selling assets, prices fall and expected excess returns rise. Consistent with the time series regressions in Table 1, this prediction is borne out by the data when we use broker-dealer book leverage as price of risk factor (the first row of Panel 3). The estimated loading of the price of market risk on lagged broker-dealer leverage growth is strongly significantly negative. The corresponding estimates using alternative measures of intermediary leverage growth are either negative but insignificant or, in the case of commercial bank market leverage, positive and weakly significant. In sum, *Model 3* is consistent with the data when we use broker-dealer book values to measure intermediary leverage.

Figure 3 provides an intuitive visualization of the strong empirical relationship between the price of market risk and lagged broker-dealer leverage growth. It shows a four-quarter moving average of the CAPM price of market risk obtained using period-by-period cross-sectional regressions representing the first stage of the well-known two-pass Fama and MacBeth (1973) estimator. As can be seen, there is a strong correlation between the estimated price of CAPM market risk and one-quarter lagged broker-dealer book leverage growth especially in the second part of the sample.

Model 4 associates both cross-sectional and predictive power with intermediary leverage. In the DAPM nomenclature, intermediary leverage is an X_2-type variable whose innovations act as cross-sectional pricing factors and whose lagged levels drive time variation in expected excess returns. Estimating this model using broker-dealer book leverage growth (the first row in panel 4), we see that while exposure to innovations in this factor continues to command a strongly significant risk premium, the expected excess return on the market portfolio negatively comoves with broker-dealer leverage growth in a strongly significant way. Thus, when evaluated using broker-dealer leverage growth as a state variable, *Model 4* is consistent with the data. However, the results in Panels 2 and 3 show that this is not the case for any of the other intermediary leverage indicators. Figure 4 provides a plot of the estimated time series of the price of market risk in *Model 4*, along with its 95% confidence band. As can be seen, the estimated price of market risk, while positive on average, is strongly time-varying.

4.2.1 Pricing Errors

In addition to assessing whether the individual coefficients have the signs predicted by the corresponding intermediary asset pricing theories, it is instructive to evaluate the overall pricing performance of the different models. Given that broker-dealer book values generally perform the best among the considered set of intermediary pricing factors, we restrict ourselves to evaluating the pricing performance of the four models using broker-dealer book equity and leverage as state variables, respectively. Precisely, we report the cross-sectional pricing errors for a selection of test assets, as well as the mean absolute pricing error across all 44 test assets in the upper panel of Table 3. As a benchmark we also report the corresponding statistics for the CAPM in which the return on the equity market portfolio, R^M, is the only pricing factor, and the Fama-French three factor model which augments the CAPM with the HML

and SMB factors. Both models feature constant prices of risk. In the lower panel, we show the mean squared one-step ahead prediction error of the various models relative to those implied by the CAPM. This allows us to evaluate the ability of the models to capture the dynamics of asset returns.

The cross-sectional pricing error comparison indicates that *Model 2* and *Model 4*, which augment the market return with broker-dealer book leverage growth as pricing factor, have the best overall ability at pricing the cross-section of equity and bond returns. In fact, the mean absolute average pricing errors of these two models across test assets are smaller than those implied by the Fama-French three factor model. This finding again corroborates the results of Adrian, Etula, and Muir (2013). In contrast, *Model 1*, which relies on broker-dealer equity growth as the state variable, does not do as well as either benchmark model in explaining the cross-section of asset returns. Moreover, *Model 3*, which has the market return as the only pricing factor but features prices of risk that vary as a function of broker-dealer leverage growth, performs very similarly to the CAPM in explaining the cross-section of returns.

Looking at the mean squared one-step ahead return forecasting errors, shown in the lower panel of the table, the picture changes considerably. Along this dimension, *Model 3* and *Model 4* which both have prices of risk that move with broker-dealer book leverage, imply smaller prediction errors than the remaining models. In fact, both models on average reduce the mean squared forecast errors relative to the CAPM by five percent per quarter. By comparison, *Model 1*—which features time variation in risk premiums as a function of broker-dealer book equity growth—reduces mean squared forecast errors by only two percent. Not surprisingly, the return predictions of the models featuring constant prices of risk (*Models 2* and *3* as well as the CAPM and the Fama-French model) are all very similar.

4.3 Discussion of the Empirical Results

The results reported in this section give rise to several conclusions. First, when broker-dealer book values are used in empirical tests, leverage commands a positive and highly statistically significant price of risk, consistent with theories such as Brunnermeier and Pedersen (2009) and Adrian and Boyarchenko (2013). Moreover, market prices of risk are significantly negatively related to lagged broker-dealer book leverage, in line with theories that feature time variation in risk premiums arising from value at risk constraints (Danielsson, Shin, and Zigrand (2012) and Adrian and Boyarchenko (2013)). In contrast, equity is only weakly significantly priced in the cross-section and furthermore has a negative price of risk when broker-dealer book equity is used as a factor. Furthermore, none of the alternative intermediary equity indicators has significant predictive power in the dynamic asset pricing tests.

In addition to matching the signs implied by the theory, models based on broker-dealer book leverage also explain the cross-section and time series of stock and bond returns better than models using broker-dealer equity as a state variable. Overall, these results thus provide support for models that attribute a primary role to intermediary leverage as both a risk factor, which affects the differences between average excess returns, but also as a price of risk factor which helps predict future excess returns.

Our result that neither market equity nor market leverage significantly forecast asset returns in the DAPM model suggests that book values are the more appropriate measures for financial conditions for asset pricing. This finding can be related to the debate concerning the measurement of balance sheet quantities. In intermediary asset pricing theories, all assets and liabilities are assumed to be marked to market, and there is thus no distinction between book and market equity. Put differently, the book to market ratio always equals one in those theories.

Empirically, there are two main reasons for time variation of the book to market ratio. One is that not all financial institutions mark their balance sheets to market. Another is that market equity measures not just the residual value of financial assets, but also that of intangible assets, which are not modeled in asset pricing theories. The problem that not all assets are marked to market is particularly important for commercial banks, whose loan books are held at historical accounting values. In contrast, for broker-dealers, all assets and liabilities are typically accounted at fair value. As a result, for those institutions, the difference between market and book equity can be viewed as a pure measure of intangible assets.

The finding that the balance sheets of broker-dealers are more informative about asset price dynamics than the balance sheets of commercial banks is likely due to two factors. First, the inertia in accounting values of commercial bank assets might mask true financial conditions. Bischof, Brüggemann, and Daske (2011) discuss how illiquid assets gave rise to "stale" book values when fair value reporting requirements were changed temporarily at the height of the crisis. In contrast, broker-dealers mark their assets and liabilities to market.

A second reason for the relatively better performance of the broker-dealer sector might be that broker-dealers provide a better proxy for the marginal investor in traded assets. Our asset pricing tests are conducted on equity and bond portfolios, for which broker-dealers are the market makers. In contrast, commercial bank balance sheets primarily contain non-traded loans, for which we cannot conduct asset pricing tests. We thus interpret our results not as evidence against the importance of commercial banks for pricing and economic activity more generally, but rather as evidence of the degree to which their balance sheet fluctuations mask conditions in equity and credit markets.

In summary, the results in this section show that broker-dealer book leverage growth is a strong predictor of excess equity and bond returns and also represents a priced risk factor in the cross-section of risky assets. While Adrian, Etula, and Muir (2013) have studied the cross-sectional pricing ability of broker-dealer book leverage, with the exception of Adrian, Moench, and Shin (2010), the predictive power of broker-dealer book leverage has not previously been documented.

4.4 Predictive Power of Broker-Dealer Leverage: Robustness

Thus far, we have shown that among the various intermediary balance sheet indicators, broker-dealer book leverage growth is the only variable that both predicts excess returns on stocks and bonds *and* acts as a significant cross-sectional pricing factor.

In this subsection, we examine the robustness of broker-dealer book leverage as a significant predictor of excess returns. Specifically, we run simple predictive regressions where we use the book leverage factor as a predictor for subsequent returns over different sample periods, and controlling for the most commonly used return predictor variables, building on results by Adrian, Moench, and Shin (2010). As a reminder, among the theories considered in Section 2 which feature time varying prices of risk, *Model 3* and *Model 4* predict that high intermediary leverage is associated with lower risk premiums, and hence on average lower subsequent returns for all risky assets.

We expand our set of dependent variables and use the quarterly return in excess of the three-month Treasury bill for five benchmark assets: the excess return on the CRSP market portfolio (MKT), the excess return on the S&P500 index (SPX), the excess return on an investment grade corporate bond portfolio (IG), the excess return on a portfolio of BAA rated corporate bonds (BAA), and the excess return on a constant maturity ten-year Treasury portfolio ($CMT10$).

Table 4 reports the results for one quarter ahead predictive return regressions using the five alternative risky assets as dependent variables. The first panel shows results for the sample period $1975Q1 - 2012Q4$, the second panel for the sample period $1986Q1 - 2012Q4$, and the last for the sample period $1986Q1 - 2008Q2$. The rows labeled "cst" provide the regression intercept term, and the rows labeled "coeff" show the OLS regression coefficient on lagged broker-dealer leverage growth. For robustness, we also report "coeff-Stambaugh" which provide the Stambaugh (1999) bias adjusted regression coefficients. In all panels, t-statistics are provided in square brackets below, and all standard errors are Newey-West adjusted with a maximum lag length of four quarters.

The results confirm our main finding that broker-dealer book leverage growth is a strong predictor of subsequent excess returns on risky assets. The predictive coefficients are negative and strongly significant for stock returns (MKT, SPX) as well as the BAA-rated bond portfolio (BAA) for all sub-periods, with or without adjusting for the Stambaugh bias. The interpretation is that high broker-dealer book leverage indicates lower risk premiums due to the greater availability of credit to leveraged investors. The predictive relationship between broker-dealer leverage and one-quarter ahead excess returns on equity market and credit portfolios is also economically significant: a one standard deviation increase in annual broker-dealer leverage growth translates into a two percent decline in next quarter's excess stock market returns and a reduction of a little less than one percent in quarterly excess returns on the BAA-rated bond portfolio for the 1975-2012 sample period. While broker-dealer book leverage is a significant predictor of returns on investment grade bonds (IG) in the subsamples starting in 1986, the Treasury portfolio ($CMT10$) is the conspicuous exception. The broker-dealer book leverage term has no role in predicting excess returns on Treasuries in any of the subsamples considered.

As a further check on the predictive power of our broker-dealer book leverage variable, we compare it with other return forecasting factors that have been considered in the literature. Table 5 reports results for one quarter-ahead predictive return regressions using the excess return on the CRSP market portfolio (MKT) as the dependent variable. As predictor variables, we consider our broker-dealer leverage growth variable together with the log dividend yield ("dy"), the log consumption-wealth-ratio, ("CAY") from Lettau and Ludvigson (2001), the equity share in new issuance ("ES") from Baker and Wurgler (2000), the market portfolio's book-to-market ratio ("B2M"), the term spread between the ten-year Treasury yield and the three-month Treasury bill yield ("TERM"), and the default spread between the yields on Moody's benchmark BAA-rated and AAA-rated corporate bonds. The three panels show results for the sample periods $1975Q1 - 2012Q4$, $1986Q1 - 2012Q4$, and $1986Q1 - 2008Q2$, respectively.

We see from Table 5 that our broker-dealer leverage variable has incremental predictive value even in the presence of all of the typical return predictor variables. In fact, it is the only variable that appears consistently as a strong predictor, with statistical significance at least at the 5 percent level in all subsamples. Moreover, in the period between 1986 and 2008, all other pricing factors become insignificant when we include broker-dealer leverage growth as a predictor.

Table 6 reports the results of a similar exercise, except that we use as dependent variable the excess return on the BAA-rated bonds (BAA) instead of the CRSP market portfolio. The predictor variables are annual broker-dealer leverage growth as well as a few commonly used bond return forecasting factors. These are the term spread between the ten-year Treasury yield and the three-month Treasury bill yield ("TERM"), the default spread between the yields on Moody's benchmark BAA-rated and AAA-rated corporate bonds, and the Cochrane and Piazzesi (2005) Treasury return forecasting factor ("CP"), which has been updated to include more recent data. Again, we see the predictive power of the broker-dealer leverage variable in all sub-periods. While the significance level in the earlier period from 1975 is somewhat lower than for equities, broker-dealer leverage is significant at the one percent level from 1986 onwards.

We take the results in Tables 5 and 6 as confirmation that broker-dealer leverage contains important information on the risk premiums for risky assets, even after controlling for the most commonly used return forecasting factors.

5 Conclusion

Asset pricing theories in which financial intermediaries, not representative consumers, are the marginal investor, have attracted increasing attention since the financial crisis of 2007-2009. The theories differ along key dimensions. While some emphasize the role of intermediary equity as the key, procyclical variable, other theories emphasize intermediary leverage.

In this paper, we test the predictions from four alternative intermediary asset pricing theories empirically. The four theories differ in the primacy of intermediary equity versus leverage in explaining the cross-section or time series of returns. Extending the cross-sectional results of Adrian, Etula, and Muir (2013) to the time series dimension, we find that a parsimonious dynamic asset pricing model with detrended intermediary book leverage as forecasting variable and innovations to intermediary leverage as well as the market return as price of risk factor exhibits pricing performance consistent with intermediary pricing theories. Intermediary leverage is procyclical with a positive price of risk and high leverage growth predicting low future returns. In contrast, intermediary equity does not have strong forecasting ability, and its price of risk is negative in some specifications.

For macroeconomic modeling, our results imply that intermediary leverage should emerge endogenously as a procyclical variable, as is the case in theories with risk-based leverage constraints, such as Fostel and Geanakoplos (2008), Brunnermeier and Pedersen (2009), Adrian and Boyarchenko (2013), and Danielsson, Shin, and Zigrand (2012). The comparison of the dynamic asset pricing model with intermediary state variables suggests that intermediaries are central to the pricing of risk.

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Tables and Figures

Table 1: **Comparing the Predictive and Cross-Sectional Pricing Power of Alternative Measures of Intermediary Leverage and Equity**

This table provides results comparing the predictive and cross-sectional pricing power of alternative measures of intermediary leverage and equity. The explanatory variables are the annual growth rates of broker-dealer book leverage growth from the Flow of Funds, $yBDblevg$; broker-dealer market leverage growth from Compustat-CRSP, $yBDmlevg$; broker-dealer book equity growth from the Flow of Funds, $yBDbeg$; broker-dealer market equity growth from Compustat-CRSP, $yBDmeg$; commercial bank book leverage growth from Call report-data, $yCBblevg$; commercial bank market leverage growth from Compustat-CRSP, $yCBmlevg$; commercial bank book equity growth from Call report data, $yBDbeg$; and commercial bank market equity growth from Compustat-CRSP, $yCBmeg$. The upper panel shows results for univariate one quarter ahead predictive return regressions using as dependent variables the excess return on the CRSP market portfolio (MKT), the excess return on a portfolio of BAA rated corporate bonds (BAA), as well as the excess return on a constant maturity ten-year Treasury portfolio ($CMT10$). The lower panel shows estimates of the cross-sectional prices of risk associated with each of the factors. These are obtained from applying the estimation approach of Adrian, Crump, and Moench (2014) to two-factor models with constant prices of risk where the pricing factors are given by the return on the market portfolio and the respective balance sheet variable. The test assets are ten size sorted stock decile portfolios, ten book-to-market sorted decile portfolios, and ten momentum sorted decile portfolios (all from Ken French's website), as well as constant maturity Treasury returns for maturities ranging from 1 through 30 years, obtained from CRSP, and Barclay's benchmark corporate credit portfolios for various ratings classes and industries. The sample period is $1975Q1 - 2012Q4$. t-statistics are shown in brackets. The standard errors for the predictive coefficients are Newey-West adjusted with a maximum lag length of 4 quarters. The standard errors for the cross-sectional prices of risk are computed as in Adrian, Crump, and Moench (2014). ***, **, and * denote statistical significance at the 1%, 5%, and 10% level.

	$yBDblevg$	$yBDmlevg$	$yBDbeg$	$yBDmeg$	$yCBblevg$	$yCBmlevg$	$yCBbeg$	$yCBmeg$
				Predictive Regressions				
MKT	-0.075***	-0.001	0.047*	-0.012	-0.147	0.033	-0.045	-0.031
	[-2.928]	[-0.055]	[1.866]	[-0.841]	[-0.818]	[1.119]	[-0.386]	[-1.066]
BAA	-0.027**	0.004	0.015	-0.013*	-0.048	0.024*	-0.154**	-0.013
	[-2.163]	[0.519]	[1.559]	[-1.849]	[-0.580]	[1.706]	[-2.518]	[-1.068]
CMT10	0.011	0.010	-0.007	-0.008	-0.098	-0.006	-0.010	0.007
	[0.574]	[1.414]	[-0.552]	[-1.182]	[-1.482]	[-0.599]	[-0.188]	[0.500]
				Cross-Sectional Regressions				
λ_0	15.122***	-0.869	-7.409*	58.023**	-0.261	-4.388	1.987**	21.260***
	[2.985]	[-0.082]	[-1.656]	[2.343]	[-0.340]	[-1.511]	[1.987]	[2.831]

Table 2: **Testing Alternative Intermediary Asset Pricing Models**

This table provides estimated price of risk parameters for the four intermediary asset pricing models presented in Section 2.2. *Model 1* is in the spirit of He and Krishnamurthy (2012) and has the market return and intermediary equity growth as pricing factors whose price of risk varies as a function of intermediary equity, w. *Model 2* is based on the theory of Brunnermeier and Pedersen (2009) which implies that R^M_{t+1} and the innovation to intermediary leverage act as pricing factors which both have constant prices of risk. *Model 3* is a reduced-form specification of the model in Danielsson, Shin, and Zigrand (2012) which has the excess return on the market portfolio, R^M_{t+1}, as the sole pricing factor whose price of risk depends on intermediary leverage (Lev). *Model 4* is a reduced form version of the model in Adrian and Boyarchenko (2013) which features shocks to intermediary leverage and the market return as pricing factors and the prices of risk of both factors as varying with intermediary leverage, Lev. We test each model using four different measures of intermediary leverage or equity: broker-dealer book values, broker-dealer market values, commercial bank book values, and commercial bank market values. $\bar{\lambda}^{R^M}$, $\bar{\lambda}^{Lev}$, and $\bar{\lambda}^{w}$ denote the average prices of risk for R^M_{t+1}, Lev, and w, respectively. $\Lambda_1^{R^M,Lev}$ and $\Lambda_1^{R^M,w}$ denote the coefficients of the price of market risk on lagged intermediary leverage and equity, respectively. $\Lambda_1^{Lev,Lev}$ and $\Lambda_1^{Lev,w}$ are the coefficients of the price of leverage risk on lagged intermediary leverage and equity, and $\Lambda_1^{w,w}$ is the coefficient of the price of intermediary equity risk on lagged intermediary equity. The sample period is $1975Q1 - 2012Q4$. Standard errors are computed as in Adrian, Crump, and Moench (2014). ***, **, and * denote significance at the 1%, 5%, and 10% level.

	$\bar{\lambda}^{R^M}$	$\bar{\lambda}^{Lev}$	$\bar{\lambda}^{w}$	$\Lambda_1^{R^M,Lev}$	$\Lambda_1^{R^M,w}$	$\Lambda_1^{Lev,Lev}$	$\Lambda_1^{Lev,w}$	$\Lambda_1^{w,w}$
				Model 1				
BD book	1.624**		-9.033*		0.046*			0.130
	[2.103]		[-1.847]		[1.856]			[1.003]
BD mkt	2.333***		58.956**		-0.012			-0.035
	[2.764]		[2.256]		[-0.796]			[-0.108]
CB book	2.077		3.057		-0.003			-0.124
	[1.207]		[1.422]		[-0.016]			[-0.577]
CB mkt	2.385***		18.906**		-0.041			0.174
	[2.937]		[2.452]		[-1.575]			[0.998]
				Model 2				
BD book	2.030**	15.122***						
	[2.422]	[2.985]						
BD mkt	2.064***	-0.869						
	[2.890]	[-0.082]						
CB book	2.050***	-0.261						
	[2.866]	[-0.340]						
CB mkt	2.013***	-4.388						
	[2.833]	[-1.511]						
				Model 3				
BD book	2.736***			-0.077***				
	[3.735]			[-3.047]				
BD mkt	2.119***			-0.005				
	[2.831]			[-0.314]				
CB book	1.837**			-0.166				
	[2.446]			[-0.911]				
CB mkt	1.842**			0.046*				
	[2.563]			[1.871]				
				Model 4				
BD book	2.704***	14.366***		-0.078***		0.087		
	[3.653]	[2.654]		[-3.055]		[0.598]		
BD mkt	2.144***	0.749		-0.006		-0.127		
	[2.869]	[0.064]		[-0.364]		[-0.532]		
CB book	1.837**	-0.159		-0.166		0.080		
	[2.446]	[-0.183]		[-0.912]		[0.425]		
CB mkt	1.816**	-3.216		0.040*		-0.240**		
	[2.542]	[-1.122]		[1.695]		[-2.046]		

Table 3: **Pricing Error Comparison**

This table provides average pricing errors (upper panel) and mean-squared one-step ahead forecast errors (lower panel) for six different pricing models. *CAPM* is the standard Capital Asset Pricing Model with the excess return on the market portfolio as the only pricing factor; *FF* denotes the Fama-French (1993) three factor model. Both models feature constant prices of risk. *Model 1* through *Model 4* denote the intermediary asset pricing models described in the previous table, implemented using broker-dealer book leverage and equity measures, respectively. The upper panel reports the average pricing errors $\bar{e}^i = \frac{1}{T}\sum\left(R^i_t - \widehat{R^i}_t\right)$ for a selected set of test assets as well as the cross-sectional average of the absolute values $|\bar{e^i}|$, "MAPE". The lower panel reports mean squared one-quarter ahead prediction errors $\nu_i = \frac{1}{T}\sum\left(R^i_{t+1} - E_t\left[R^i{}_{t+1}\right]\right)^2$ relative to those implied by the *CAPM* for selected test assets as well as the cross-sectional average of those ratios.

	CAPM	FF	Model 1	Model 2	Model 3	Model 4
Average pricing errors						
BM1	-0.81	-0.52	-1.09	-0.40	-0.83	-0.40
BM5	0.28	0.06	0.18	0.12	0.27	0.12
BM10	0.96	0.44	1.18	0.26	0.99	0.26
ME1	0.23	0.64	0.36	0.26	0.22	0.26
ME5	0.28	0.50	0.15	0.13	0.25	0.13
ME10	-0.31	-0.39	-0.48	-0.25	-0.32	-0.25
MOM1	-3.25	-3.10	-1.85	-1.53	-3.17	-1.53
MOM5	-0.27	-0.48	-0.34	-0.53	-0.27	-0.53
MOM10	0.93	1.35	0.43	1.36	0.86	1.36
CMT1	0.25	0.23	0.26	0.19	0.25	0.19
CMT5	0.66	0.58	0.73	0.58	0.66	0.58
CMT10	0.82	0.72	0.93	0.74	0.81	0.74
AAA	0.56	0.43	0.65	0.55	0.55	0.55
A	0.62	0.48	0.90	1.02	0.63	1.02
BAA	0.73	0.59	0.98	0.83	0.76	0.83
MAPE	0.53	0.50	0.51	0.48	0.52	0.48
Mean squared one-step ahead forecast errors relative to CAPM						
BM1		1.00	1.00	1.00	0.96	0.95
BM5		1.00	0.98	1.00	0.95	0.95
BM10		0.99	0.97	0.99	0.93	0.93
ME1		1.00	0.99	1.00	0.95	0.95
ME5		1.00	0.99	1.00	0.97	0.97
ME10		1.00	0.98	1.00	0.94	0.94
MOM1		1.00	0.95	0.97	0.93	0.90
MOM5		1.00	0.98	1.00	0.95	0.95
MOM10		1.01	0.99	1.01	0.99	0.99
CMT1		0.99	1.00	0.98	1.00	0.98
CMT5		0.99	1.01	0.99	1.00	0.99
CMT10		0.99	1.01	0.99	1.00	0.99
AAA		0.99	1.01	1.00	1.00	1.00
A		0.99	1.02	1.04	1.00	1.03
BAA		0.99	1.01	1.01	0.98	0.99
Avg		1.00	0.98	1.00	0.95	0.95

Table 4: **Predicting Excess Returns with Broker-Dealer Book Leverage**

This table provides results for one quarter ahead predictive return regressions using annual broker-dealer leverage growth as the predictor variable. The dependent variables are the excess return on the CRSP market portfolio (MKT), the excess return on the S&P500 index (SPX), the excess return on an investment grade corporate bond portfolio (IG), the excess return on a portfolio of BAA rated corporate bonds (BAA) as well as the excess return on a constant maturity ten-year Treasury portfolio ($CMT10$). The first panel shows results for the sample period $1975Q1 - 2012Q4$, the second panel the sample period $1986Q1 - 2012Q4$, and the last the sample period $1986Q1 - 2008Q2$. The rows labeled "cst" provide the point estimates for the regression intercept, the rows labeled "coeff" show the OLS regression coefficient on lagged broker-dealer leverage growth, and "coeff-Stambaugh" show the Stambaugh (1992) bias adjusted regression coefficients. t-statistics are provided in brackets below. All standard errors are Newey-West with a maximum lag length of 4 quarters. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level.

	MKT	SPX	BAA	IG	$CMT10$
			1975Q1 - 2012Q4		
coeff	-0.075***	-0.081***	-0.027**	-0.015	0.011
	[-2.928]	[-3.103]	[-2.163]	[-1.318]	[0.574]
coeff-Stambaugh	-0.074***	-0.081***	-0.027**	-0.014	0.011
	[-2.916]	[-3.091]	[-2.166]	[-1.307]	[0.583]
R^2	0.057	0.126	0.029	0.009	0.004
N obs	151.000	151.000	151.000	151.000	151.000
			1986Q1 - 2012Q4		
coeff	-0.084***	-0.089***	-0.038***	-0.024**	0.005
	[-2.972]	[-2.996]	[-4.119]	[-2.488]	[0.238]
coeff-Stambaugh	-0.084***	-0.089***	-0.038***	-0.024**	0.005
	[-2.954]	[-2.979]	[-4.123]	[-2.466]	[0.251]
R^2	0.082	0.172	0.162	0.066	0.002
N obs	107.000	107.000	107.000	107.000	107.000
			1986Q1 - 2008Q2		
coeff	-0.052**	-0.050***	-0.028**	-0.025**	-0.023
	[-2.472]	[-2.777]	[-2.460]	[-2.134]	[-1.343]
coeff-Stambaugh	-0.052**	-0.049***	-0.028**	-0.025**	-0.023
	[-2.429]	[-2.715]	[-2.471]	[-2.149]	[-1.368]
R^2	0.026	0.050	0.084	0.067	0.024
N obs	89.000	89.000	89.000	89.000	89.000

Table 5: **Predictive Return Regressions for the Equity Market Return**

This table provides results for one quarter ahead predictive return regressions using the excess return on the CRSP market portfolio (MKT) as dependent variable. The predictor variables are annual broker-dealer leverage growth as well as the following a variety of commonly used equity return forecasting factors. These are the log dividend yield ("dy"), the log consumption-wealth-ration (CAY) from Lettau-Ludvigson, the equity share in new issuance (ES) from Baker-Wurgler, the market portfolio's book-to-market ration ($B2M$), the term spread between the ten-year Treasury yield and the three-month Treasury bill yield ($TERM$), the default spread between the yields on Moody's benchmark BAA-rated and AAA-rated corporate bonds, the Cochrane-Piazzesi (2005) forecasting factor (CP), and the realized volatility of the equity market portfolio return ($RVOL$). The first panel shows results for the sample period $1975Q1 - 2012Q4$, the second panel the sample period $1986Q1 - 2012Q4$, and the last the sample period $1986Q1 - 2008Q2$. The rows labeled "coeff" show the OLS regression coefficient and t-statistics are provided in brackets below. All standard errors are Newey-West with a maximum lag length of 4 quarters. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level.

					1975Q1 - 2012Q4					
	$yBDblevg$	dy	CAY	ES	$B2M$	$TERM$	DEF	CP	$RVOL$	$\bar{R}^2$
Coeff	-0.07***									0.05
t-stat	[-2.93]									
Coeff		-0.31	0.66*	-19.78***	8.99**	0.18	-0.05	0.02	-0.31	0.06
t-stat		[-0.38]	[1.65]	[-2.69]	[2.49]	[0.31]	[-0.02]	[0.03]	[-0.13]	
Coeff	-0.08***	-0.06	0.73**	-19.01***	8.69***	0.26	-0.79	-0.05	-0.71	0.11
t-stat	[-4.02]	[-0.09]	[2.08]	[-3.68]	[2.95]	[0.45]	[-0.29]	[-0.09]	[-0.34]	
					1986Q1 - 2012Q4					
	$yBDblevg$	dy	CAY	ES	$B2M$	$TERM$	DEF	CP	$RVOL$	$\bar{R}^2$
Coeff	-0.08***									0.07
t-stat	[-2.97]									
Coeff		-0.78	0.40	-28.08*	11.07**	-0.09	-4.92	0.19	1.08	0.06
t-stat		[-0.39]	[0.90]	[-1.93]	[2.18]	[-0.08]	[-1.22]	[0.12]	[0.49]	
Coeff	-0.08***	-0.47	0.55	-21.35**	10.55***	-0.30	-5.35	-0.20	0.89	0.13
t-stat	[-4.45]	[-0.29]	[1.49]	[-2.27]	[2.70]	[-0.29]	[-1.53]	[-0.16]	[0.44]	
					1986Q1 - 2008Q2					
	$yBDblevg$	dy	CAY	ES	$B2M$	$TERM$	DEF	CP	$RVOL$	$\bar{R}^2$
Coeff	-0.05**									0.01
t-stat	[-2.47]									
Coeff		2.68	0.98*	-40.40**	-4.20	0.43	0.04	-2.07	1.04	0.03
t-stat		[1.22]	[1.89]	[-2.30]	[-0.65]	[0.38]	[0.01]	[-1.21]	[0.55]	
Coeff	-0.05**	2.47	0.85*	-38.02**	-2.12	0.34	-2.07	-1.73	0.78	0.04
t-stat	[-2.33]	[1.22]	[1.70]	[-2.28]	[-0.36]	[0.32]	[-0.34]	[-1.11]	[0.42]	

Table 6: **Predictive Return Regressions for the BAA Credit Return**

This table provides results for one quarter ahead predictive return regressions using the excess return on the CRSP market portfolio (MKT) as dependent variable. The predictor variables are annual broker-dealer leverage growth as well as the following a variety of commonly used bond return forecasting factors. These are the term spread between the ten-year Treasury yield and the three-month Treasury bill yield ("TERM"), and the default spread between the yields on Moody's benchmark BAA-rated and AAA-rated corporate bonds, and the Cochrane-Piazzesi (2005) return forecasting factor which has been updated to include more recent data. The first panel shows results for the sample period $1975Q1 - 2012Q4$, the second panel the sample period $1986Q1 - 2012Q4$, and the last the sample period $1986Q1 - 2008Q2$. The rows labeled "coeff" show the OLS regression coefficient and t-statistics are provided in brackets below. All standard errors are Newey-West with a maximum lag length of 4 quarters. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level.

			1975Q1 - 2012Q4		
	$yBDblevg$	$TERM$	DEF	CP	$\bar{R}^2$
Coeff	-0.03**				0.02
t-stat	[-2.16]				
Coeff		0.71**	0.92	0.51	0.09
t-stat		[2.08]	[1.00]	[1.55]	
Coeff	-0.02**	0.71**	0.66	0.55	0.10
t-stat	[-2.24]	[2.06]	[0.73]	[1.64]	
			1986Q1 - 2012Q4		
	$yBDblevg$	$TERM$	DEF	CP	$\bar{R}^2$
Coeff	-0.04***				0.15
t-stat	[-4.12]				
Coeff		0.49**	1.32	0.22	0.09
t-stat		[2.17]	[1.36]	[0.59]	
Coeff	-0.03***	0.43*	0.90	0.21	0.20
t-stat	[-3.71]	[1.90]	[1.07]	[0.54]	
			1986Q1 - 2008Q2		
	$yBDblevg$	$TERM$	DEF	CP	$\bar{R}^2$
Coeff	-0.03**				0.07
t-stat	[-2.46]				
Coeff		0.31	-1.14	0.60**	0.05
t-stat		[1.33]	[-1.19]	[2.19]	
Coeff	-0.03***	0.25	-2.16***	0.81***	0.16
t-stat	[-2.97]	[1.15]	[-3.10]	[2.58]	

Figure 1: **Broker-Dealer Balance Sheet Indicators**

This figure shows the time series of the four different indicators of broker-dealer balance sheet conditions that we use in our empirical analysis. Broker-dealer book leverage and equity are obtained from the Federal Reserve's Flow of Funds data, broker-dealer market leverage and equity are obtained from Compustat-CRSP. See Appendix B for further details.

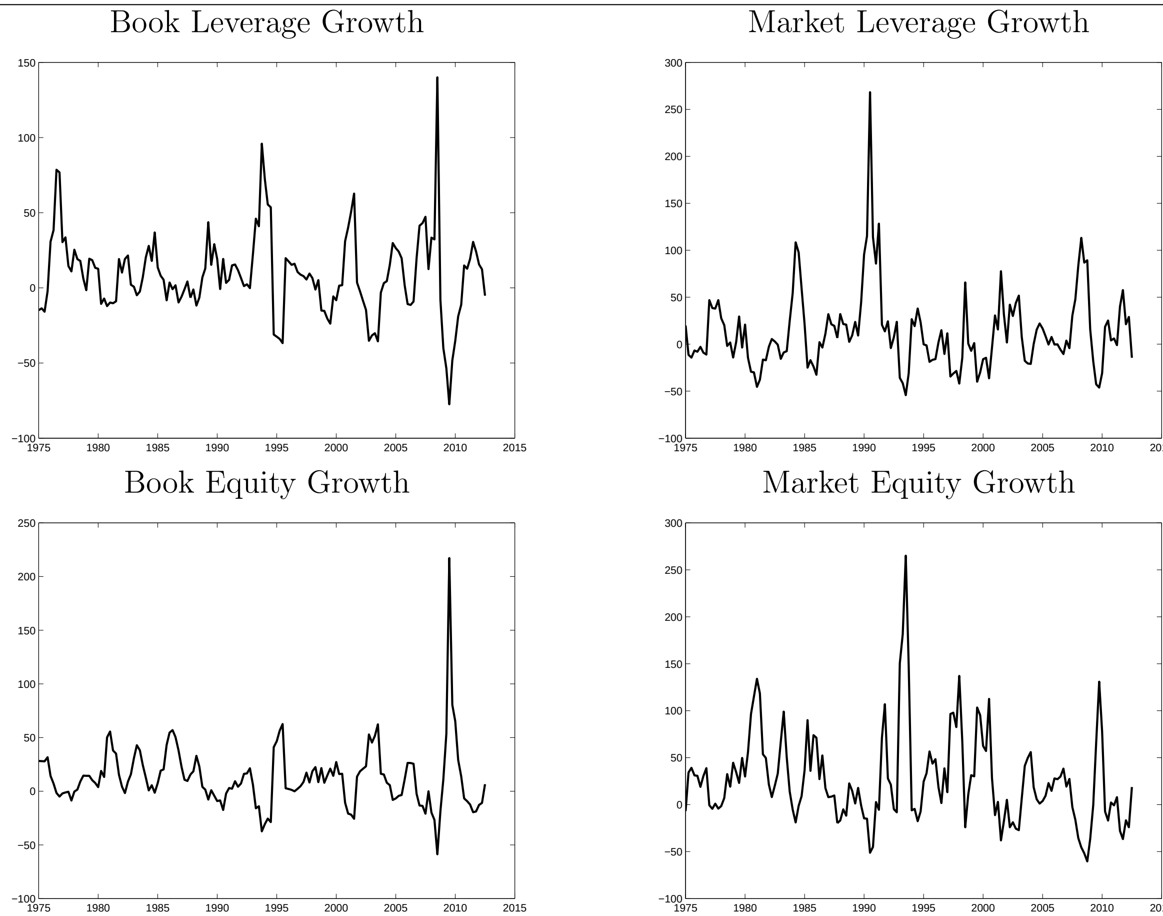


Figure 2: **Commercial Bank Balance Sheet Indicators**

This figure shows the time series of the four different indicators of commercial bank balance sheet conditions that we use in our empirical analysis. Commercial bank book leverage and equity are obtained from Call report data, commercial bank market leverage and equity are obtained from Compustat-CRSP. See Appendix B for further details.

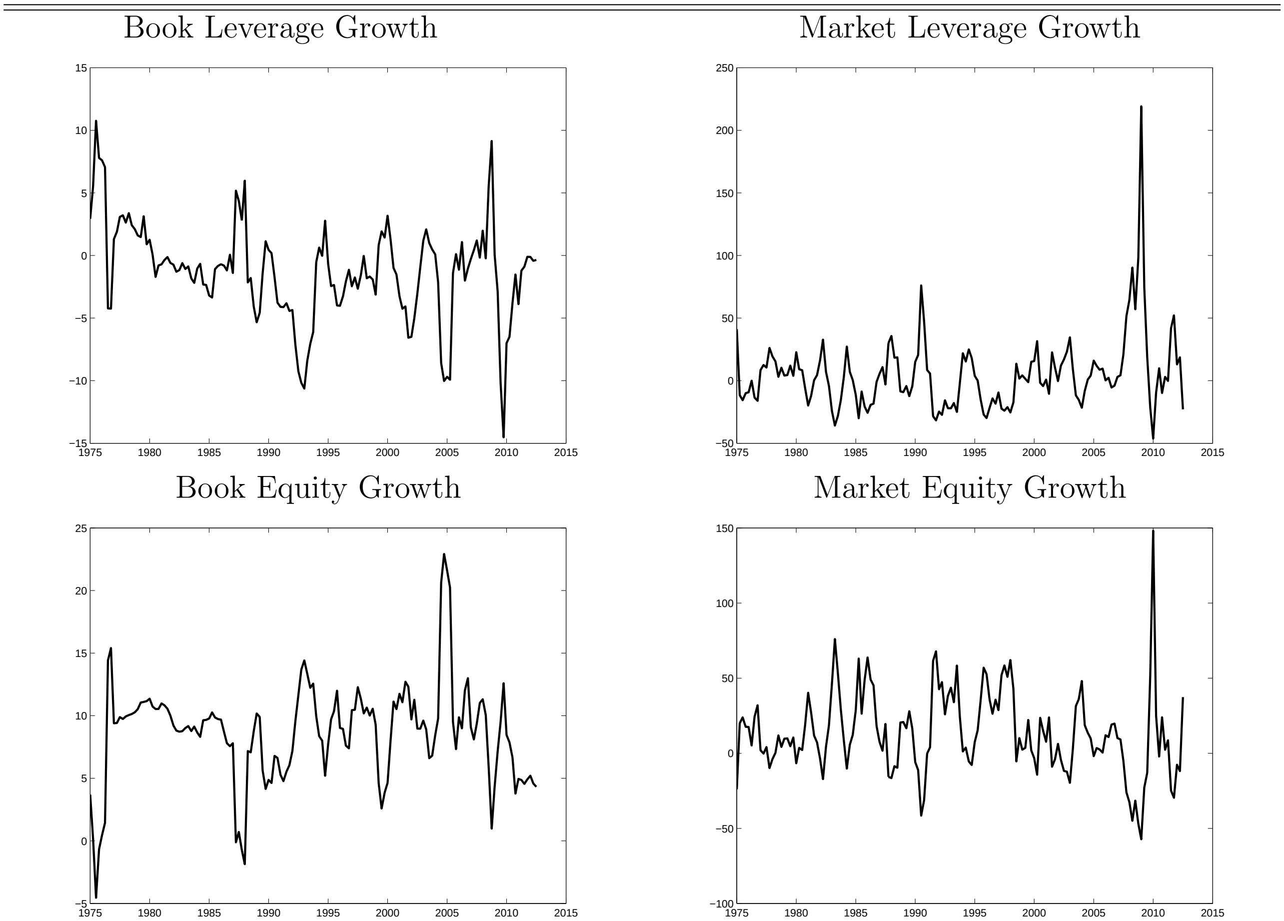


Figure 3: **CAPM Price of MKT Risk and lagged Broker-Dealer Leverage Growth**

This figure provides the time series of estimated price of MKT risk from Fama-MacBeth (1973) regressions of the static $CAPM$ along with one-quarter lagged broker-dealer leverage growth. The test assets are ten size sorted stock decile portfolios, ten book-to-market sorted decile portfolios, and ten momentum sorted decile portfolios (all from Ken French's website), as well as constant maturity Treasury returns for maturities ranging from 1 through 30 years, obtained from CRSP, and Barclay's benchmark corporate credit portfolios for various ratings classes and industries. The sample period is $1975Q1 - 2012Q4$.

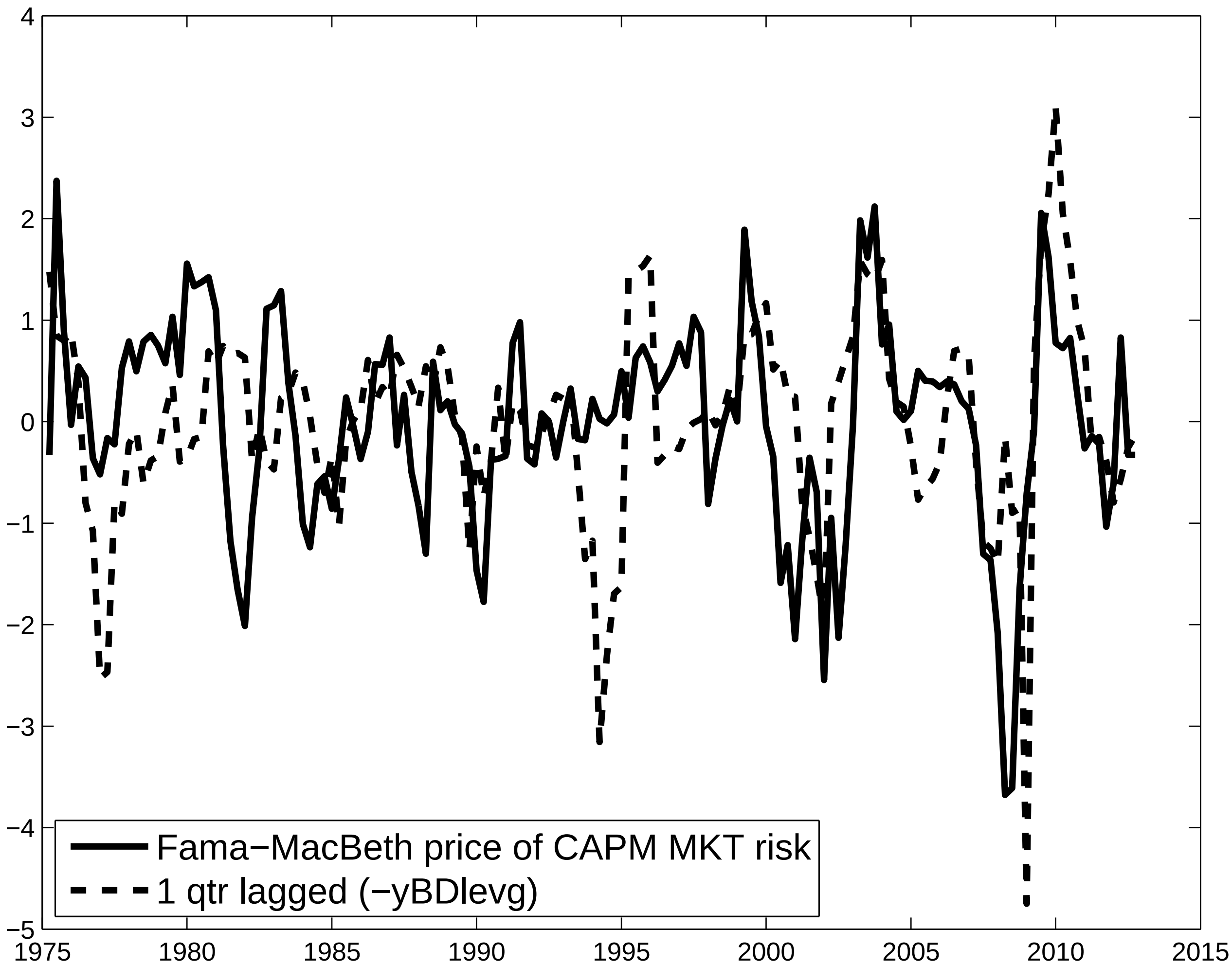
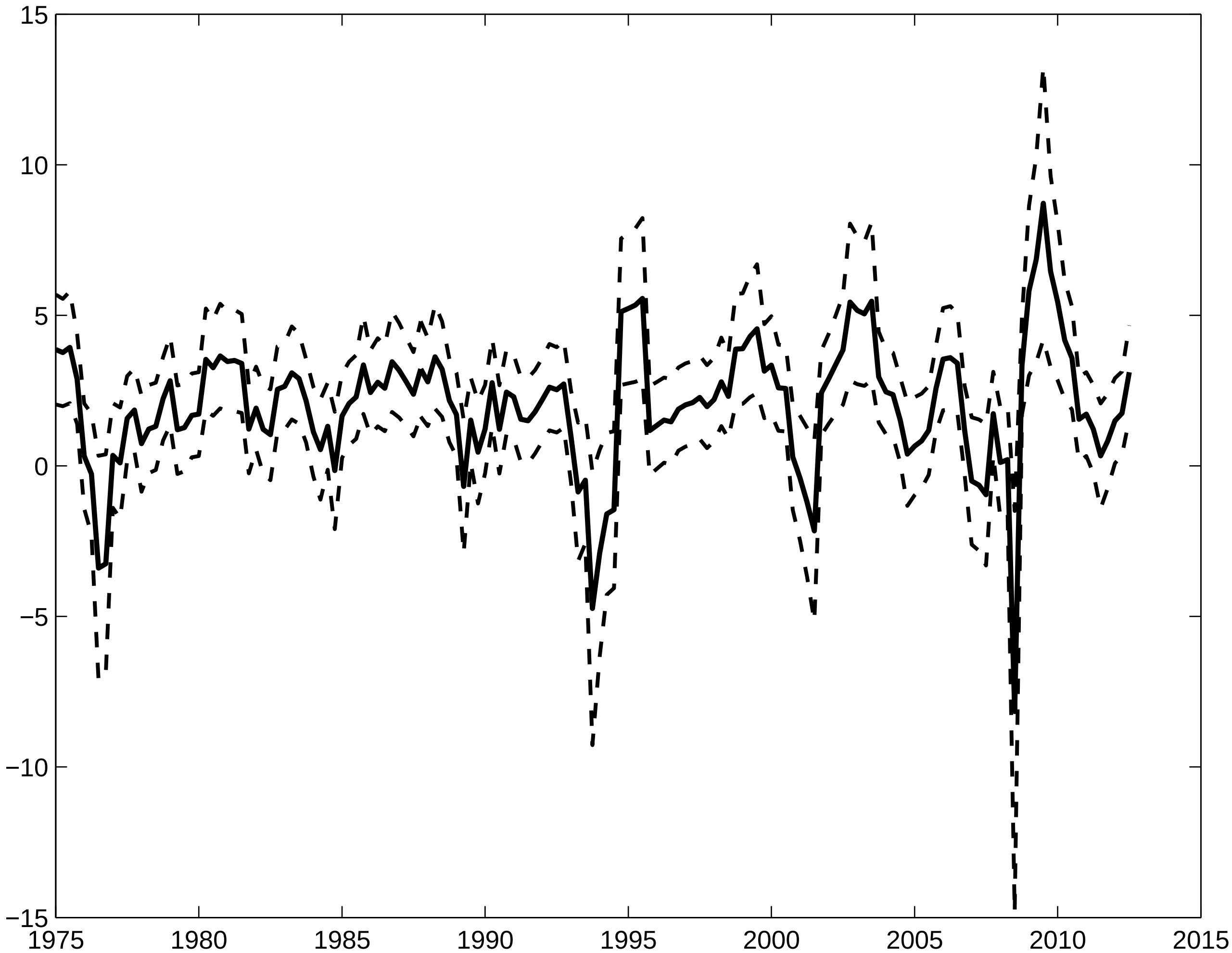


Figure 4: **DLAPM Price of MKT Risk**

This figure provides the estimated price of MKT risk along with 95% confidence bands implied by the dynamic asset pricing model with broker-dealer book leverage growth as cross-sectional pricing and forecasting factor, described in Section 4. The estimator is based on Adrian, Crump, and Moench (2014) for time-varying prices of risk and constant factor risk exposures. The test assets are ten size sorted stock decile portfolios, ten book-to-market sorted decile portfolios, and ten momentum sorted decile portfolios (all from Ken French's website), as well as constant maturity Treasury returns for maturities ranging from 1 through 30 years, obtained from CRSP, and Barclay's benchmark corporate credit portfolios for various ratings classes and industries. The sample period is $1975Q1 - 2012Q4$.



A Beta Representations of Intermediary Pricing Models

The four intermediary pricing models discussed in Section 2 can be cast in terms of their beta representations in the dynamic asset pricing model ("DAPM") framework of Adrian, Crump, and Moench (2014). In this appendix, we provide these beta representations for all four models in turn. While each of the models is nonlinear, we test affine pricing kernel representations, which can be viewed as first-order approximations to the intermediary asset pricing models.

Model 1 is in the spirit of He and Krishnamurthy (2012) and has the market return, R^M, and intermediary equity growth as pricing factors whose price of risk varies as a function of intermediary equity, w. Thus, in the DAPM framework, R^M is a pricing factor whereas w acts as both a pricing and a price of risk factor. The beta representation of the model is

$$R^i_{t+1} = \beta_i^{R^M}\left(\lambda_0^{R^M} + \Lambda_1^{R^M,w} w_t + u_{t+1}^{R^M}\right) + \beta_i^w\left(\lambda_0^w + \Lambda_1^{w,w} w_t + u_{t+1}^w\right) + e_{t+1}^i$$

$$\begin{pmatrix} R^M_{t+1} \\ w_{t+1} \end{pmatrix} = \begin{pmatrix} \mu_{R^M} \\ \mu_w \end{pmatrix} + \begin{pmatrix} \phi_{R^M,R^M} & \phi_{R^M,w} \\ \phi_{w,R^M} & \phi_{w,w} \end{pmatrix} \begin{pmatrix} R^M_t \\ w_t \end{pmatrix} + \begin{pmatrix} u^{R^M}_{t+1} \\ u^w_{t+1} \end{pmatrix}.$$

Model 2 implements the theory of Brunnermeier and Pedersen (2009), which implies that R^M_{t+1} and the innovation to intermediary leverage act as pricing factors which both have constant prices of risk. The DAPM beta representation is given by

$$R^i_{t+1} = \beta_i^{R^M}\left(\lambda_0^{R^M} + u_{t+1}^{R^M}\right) + \beta_i^w\left(\lambda_0^w + u_{t+1}^w\right) + e_{t+1}^i$$

$$\begin{pmatrix} R^M_{t+1} \\ w_{t+1} \end{pmatrix} = \begin{pmatrix} \mu_{R^M} \\ \mu_w \end{pmatrix} + \begin{pmatrix} \phi_{R^M,R^M} & \phi_{R^M,w} \\ \phi_{w,R^M} & \phi_{w,w} \end{pmatrix} \begin{pmatrix} R^M_t \\ w_t \end{pmatrix} + \begin{pmatrix} u^{R^M}_{t+1} \\ u^w_{t+1} \end{pmatrix}.$$

Model 3 is a reduced-form version of the model by Danielsson, Shin, and Zigrand (2012), which has the excess return on the market portfolio, R^M_{t+1}, as the sole pricing factor whose price of risk depends on intermediary leverage, Lev. Its beta representation is:

$$R^i_{t+1} = \beta_i^{R^M}\left(\lambda_0^{R^M} + \Lambda_1^{R^M,Lev} Lev_t + u^{R^M}_{t+1}\right) + e^i_{t+1}$$

$$\begin{pmatrix} R^M_{t+1} \\ Lev_{t+1} \end{pmatrix} = \begin{pmatrix} \mu_{R^M} \\ \mu_{Lev} \end{pmatrix} + \begin{pmatrix} \phi_{R^M,R^M} & \phi_{R^M,Lev} \\ \phi_{Lev,R^M} & \phi_{Lev,Lev} \end{pmatrix} \begin{pmatrix} R^M_t \\ Lev_t \end{pmatrix} + \begin{pmatrix} u^{R^M}_{t+1} \\ u^{Lev}_{t+1} \end{pmatrix}.$$

Model 4 is a reduced form specification of the model by Adrian and Boyarchenko (2013), which features shocks to intermediary leverage and the market return as pricing factors and the prices of risk of both factors as varying with intermediary leverage, Lev. The DAPM representation of the model is

$$R^i_{t+1} = \beta_i^{R^M}\left(\lambda_0^{R^M} + \Lambda_1^{R^M,Lev} Lev_t + u^{R^M}_{t+1}\right) + \beta_i^{Lev}\left(\lambda_0^{Lev} + \Lambda_1^{Lev,Lev} Lev_t + u^{Lev}_{t+1}\right) + e^i_{t+1}$$

$$\begin{pmatrix} R^M_{t+1} \\ Lev_{t+1} \end{pmatrix} = \begin{pmatrix} \mu_{R^M} \\ \mu_{Lev} \end{pmatrix} + \begin{pmatrix} \phi_{R^M,R^M} & \phi_{R^M,Lev} \\ \phi_{Lev,R^M} & \phi_{Lev,Lev} \end{pmatrix} \begin{pmatrix} R^M_t \\ Lev_t \end{pmatrix} + \begin{pmatrix} u^{R^M}_{t+1} \\ u^{Lev}_{t+1} \end{pmatrix}.$$

B Data Appendix

B.1 Compustat-CRSP

We construct aggregate market equity and leverage for the commercial bank and broker-dealer sectors using the monthly stock file from CRSP. In order to account for the changing ownership of institutions, a merger adjustment is performed. This entails using the new CRSP permno (nwperm), and assigning to each firm the ultimate acquirer, i.e. if firm A is acquired by B and B is acquired by C, a variable acquirer is created whose value is equal to the permno of C for the entire lives of A, B, and C. Before collapsing by acquirer, a quarterly dataset is generated by compounding end of month returns to the quarterly frequency. Then, the dataset is collapsed by acquirer-quarter, summing up total market equity and computing a value-weighted average return. This gives a historical time series of effective market equity and returns of merger-adjusted entities. We then merge the permno-acquirer link generated by the CRSP data to the Compustat Fundamentals Quarterly File and apply the same merger adjustment summing up total assets (atq) and liabilities (ltq) by acquirer-quarter. Finally, the merger adjusted CRSP and Compustat data are merged together by acquirer-quarter where acquirer is now taken to be permno. We assign to the entire history of each merger adjusted firm the most recently available SIC code from CRSP and the most recently available permco from Compustat. The universe of broker-dealers is defined to be firms with SIC codes 6712 or 6211. Using the FRBNYs permco-rssd link, the universe of Commercial Banks is defined to be those firms with institution type Commercial Bank or Bank Holding Company. Additionally, Merrill Lynch, Bear Stearns, Morgan Stanley, Lehman Brothers, and Goldman Sachs are hard-coded as broker-dealers, and JP Morgan, Bank of America, and Citigroup are hard-coded as commercial banks. For each firm, annual growth rates of assets, book and market equity, and book and market leverage, are calculated. Within each quarter, growth rates less than the 1% and greater than the 99% percentiles, are dropped. Aggregate growth rates are then calculated by taking lagged asset-weighted averages within the two universes already defined.

B.2 Call Reports and Flow of Funds

We construct book equity and leverage for commercial banks by compiling the raw data from historical call reports of all FDIC-insured Banks. Book assets and liabilities are simply aggregated across firms, and book equity, defined as assets liabilities, and book leverage, defined as [assets]/[book equity], are then calculated for the entire sector. This series is only available going back to the third quarter of 1975, meaning that the corresponding series of annual growth rates are only available going back to the third quarter of 1976. Therefore, we use the total assets and equity capital series from the Federal Reserve Board of Governors flow of funds underlying detail dataset, to calculate leverage, and equity and leverage growth rates before the third quarter of 1976. We obtain the total financial assets and total liabilities series for broker-dealers from the flow of funds (not the underlying detail), and construct broker-dealer book equity as [total financial assets] [total liabilities], and broker-dealer book leverage as [total financial assets]/[book equity].

C Alternative Detrending of Broker-dealer Leverage

We have shown that the annual growth rate of broker-dealer book leverage is a strong predictor of excess returns on risky assets and that innovations of broker-dealer leverage is a priced factor in the cross-section of assets. However, the theories discussed in Section 2 typically provide a role for the level of leverage rather than its growth rate. Leverage might be subject to secular trends due to changing financial system and regulatory frameworks. It is therefore advisable to use measures of detrended leverage in empirical tests. The annual growth rates is a convenient way of detrending leverage or other variables.

In this appendix, we provide evidence that corroborates these claims. In particular, we show that other methods of detrending broker-dealer book leverage yield very similar forecasting results as our preferred variable $yBDblevg$. We use this variable along with two alternative measures of detrended book leverage. The first is "MA4" which is the the difference between current quarter log leverage and its past four quarter moving average. The second is "HP" which is the cyclical component of a one-sided HP-filter applied to log broker-dealer leverage with a penalty parameter of 1600. The sample period is 1975Q1-2012Q4.

The performance of each detrended variable is presented in Table 7. The results are for the one quarter-ahead predictive return regressions using the excess return on the CRSP market portfolio (MKT) and the excess return on a portfolio of BAA rated corporate bonds (BAA) as dependent variables. The predictor variables are three different measures of detrended broker-dealer leverage: annual broker-dealer leverage growth ("yBDblevg "), the MA4 detrended series and the HP-filter detrended series. The first panel shows results for the sample period $1975Q1 - 2012Q4$, the second panel for the sample period $1986Q1 - 2012Q4$, and the last for the sample period $1986Q1 - 2008Q2$.

We see from Table 7 that both alternative detrending methods perform at least as well or even better than the annual broker-dealer leverage growth series used in the main text. In fact, both in terms of the t-statistics of the estimated predictive regression coefficients as well as in terms of R^2, the two other detrended series appear to perform better. Hence, the strong predictability results reported in the main text for annual broker-dealer book leverage growth are conservative, as alternative detrending methods imply even stronger predictability.

Table 7: **Predicting Returns with Alternative Measures of Detrended Broker-Dealer Book Leverage**

This table provides results for one quarter ahead predictive return regressions using the excess return on the CRSP market portfolio (MKT) and the excess return on a portfolio of BAA rated corporate bonds (BAA) as dependent variables. The predictor variables are three different measures of detrended broker-dealer leverage: annual broker-dealer leverage growth ("yBDblevg'), the difference between current quarter log leverage and its past four quarter moving average ("MA4"), and the cyclical component of log broker-dealer leverage extracted using a one-sided HP-filter ("HP"). The first panel shows results for the sample period $1975Q1 - 2012Q4$, the second panel for the sample period $1986Q1 - 2012Q4$, and the last for the sample period $1986Q1 - 2008Q2$. The column labeled "t" provides the t-statistics of the OLS regression coefficient with OLS standard errors, the column "t-NW" provides the t-statistics of the OLS regression coefficient with Newey-West adjusted standard errors, and the column labeled "t-Stambaugh" provides t-statistics for Stambaugh-bias adjusted regression coefficients with Newey-West standard errors. The column R^2 shows predictive R-squared. ***, *, and * denote statistical significance at the 1%, 5%, and 10% level.

	MKT				BAA			
	t	t-NW	t-Stambaugh	R^2	t	t-NW	t-Stambaugh	R^2
1975Q1 - 2012Q4								
yBDlevg	-3.00***	-2.93***	-2.92***	0.06	-2.10**	-2.16**	-2.17**	0.03
MA4	-3.39***	-6.29***	-6.26***	0.07	-3.31***	-5.34***	-5.32***	0.07
HP	-3.53***	-5.39***	-5.36***	0.08	-3.03***	-5.05***	-5.03***	0.06
1986Q1 - 2012Q4								
yBDlevg	-3.07***	-2.97***	-2.95***	0.08	-4.51***	-4.12***	-4.12***	0.16
MA4	-3.36***	-6.30***	-6.26***	0.10	-5.59***	-5.37***	-5.35***	0.23
HP	-3.55***	-5.59***	-5.55***	0.11	-5.09***	-5.26***	-5.24***	0.20
1986Q1 - 2008Q2								
yBDlevg	-1.51	-2.47**	-2.43**	0.03	-2.83***	-2.46**	-2.47**	0.08
MA4	-1.40	-1.94*	-1.90*	0.02	-3.07***	-2.46**	-2.45**	0.10
HP	-1.98**	-3.92***	-3.84***	0.04	-2.68***	-2.20**	-2.20**	0.08