THREE ESSAYS ON FINANCIAL INTERMEDIATION AND ASSET PRICING

by

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ABSTRACT

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This dissertation consists of three essays on financial intermediation and asset pricing. In the first essay (Chapter 1), I investigate individuals' consumption-portfolio choices in the presence of financial intermediation. Unlike the existing literature where individuals seamlessly transform their savings to productive assets, I show that individuals employ intermediaries and that individuals' consumption growth is a *scaled* version of intermediaries' liabilities growth. As a consequence, the growth of intermediaries' balance sheet variables, such as liabilities and assets, determines the stochastic discount factor. That is, it is shown that the stochastic discount factor for asset returns is affine in intermediaries' balance sheet shocks. The empirical tests of the Euler equation help resolve equity premium and risk-free rates puzzles.

In the second essay (Chapter 2), I derive an investment-based asset pricing kernel under the funding constraints of financial intermediaries. The intermediation-augmented investment-

based model shows that the stochastic discount factor for asset returns is affine in intermediary funding shocks. It is shown that the existing investment-based asset pricing models are a special case of a general asset pricing kernel. Intermediation factors, measured by intermediary balance sheet shocks, explain size and value premiums and behave as state variables predicting market returns. In the cross-section of size, value, and industry portfolios, intermediation factors are priced and outperform the existing investment-based and productivity-based factors. Importantly, the *single*-intermediation-factor model performs as well as portfolio-based asset pricing models.

The third essay (Chapter 3), investigates the relationship between systematic intermediation risk and asset market liquidity. The findings contrast with the existing literature that derive firm productivity, and hence stock returns in the absence of financial intermediation. I incorporate the theoretical results of the second essay and argue that asset liquidity is a function of intermediary balance sheet shocks. Using intermediaries' balance sheet data from 1955 to 2009, the empirical results support the model predictions. The results further show that the observed commonality in stock liquidity can be explained by systematic intermediation risk.

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Chapter 1

Risk aversion in an intermediary-augmented exchange economy

1.1 Introduction

There are many consumption-based asset pricing models, such as Lucas's (1978), where identical households invest in risky assets without financial intermediation. For this strand of the literature, financial intermediation is exogenous. Alternatively, there are no frictions transferring individuals' savings to productive assets. Additionally, the transfer process from individuals to productive assets is assumed to be seamless, that is, there is no asset transformation delay. However, intuition tells us that individuals save through financial intermediaries, such as banks, in risky assets, such as stocks and that the asset transformation (savings to assets) process is not instantaneous. It is also intuitive that firms borrow from intermediaries rather than from individuals because financial intermediaries help reduce asymmetric information between borrowers and savers. It is thus natural to reason that the existing consumption-based asset pricing models have shortcomings that need to be addressed. The primary contribution of the paper is to show that financial intermediation has equilibrium asset pricing implications.

In the model, I relax the assumption that intermediaries are exogenous to individuals' consumption-portfolio choice problem. In its simplest form, the standard one period initial consumption-savings decision into investors' portfolio choice problem assumes that individuals save a portion of their wealth at date 0, and consume a random payoff they receive at date 1. To enjoy the fruit of the dividends in such a pure exchange economy, individuals must employ some form of intermediation: at date 0, to invest; at date 1, to receive payoffs. That is, intermediaries are central to the exchange process. At date 0, what individuals invest is a liability of intermediaries. At date 1, what individuals receive as payoffs is also a liability of intermediaries. Hence, in aggregate individuals' consumption growth is nothing but a *scaled* version of intermediaries' liabilities growth. However, liability is not a standalone variable in intermediaries' balance sheet. Other balance sheet variables, such as assets, are a function of liabilities. As a direct consequence, I show that the growth of intermediaries' balance sheet variables is mirror-reflections of individuals' consumption growth, and hence the growth of each balance sheet variable determines the pricing kernel. That is, it is shown that the stochastic discount factor for asset returns is defined by intermediary balance sheet shocks. Importantly, I derive the stochastic discount factor under the standard assumption about individuals' preferences where individuals maximize the CRRA (Constant Relative Risk Aversion) utility. The economy used to derive the stochastic discount factor is illustrated in Figure 1.1.

For the empirical validation of the intermediary-based Euler equation, I use the growth of aggregated balance sheet variables of 17 U.S. intermediaries (with total assets of about 74 $US trillions) as the stochastic discount factor. I measure β, individuals' subjective discount rate, and γ, the coefficient of relative risk aversion (RRA), at each spot of the transaction process from individuals through intermediaries to the marketplace.[1] While individuals' consumption is persistent, individuals' savings, measured at the intermediaries' balance sheet level, is far more volatile. This feature of the intermediary balance sheet data helps evade equity premium and risk-free rates puzzles. This is the primary empirical finding.

To match equity (stock) market returns, the RRA measured by intermediaries' assets- or liabilities-growth is about 4, which with the time aggregation correction of Breeden, Gibbons, and Litzenberger (1989) is about 2, and hence the estimates match the observed risk aversion. The results further show that the *scaled* subjective discount rate measured at the liabilities- or assets-side is about 1.03 and the economic interpretations of which are explained in the subsequent paragraphs. The estimates are not significantly different with different sets of test assets.

While the derivation of the intermediation-based Euler equation does not require alternative preferences, the model shows that β', the subjective discount rate measured at the intermediaries' liabilities-side of the balance sheet is a *scaled version* of individuals' subjective discount rate, β, which by definition must satisfy the condition $\beta < 1$. Specifically, I show that $\beta' = \beta * (x)^{-\gamma}$, where β' is the *scaled subjective discount rate* measured at intermediaries' liabilities side, x is the *scaling factor* that measures the fraction of individuals' consumption that are saved through intermediaries, and γ, the coefficient of relative risk aversion (RRA). Since

[1] It is argued that γ may reflect investors' concerns about not knowing the precise riskiness that they confront in the marketplace (see Anderson, Hansen, and Sargent (2003)).

intermediaries' liabilities and assets are highly correlated, measured subjective discount rate by the growth of assets inherits the same property.

The first interpretation of the results that the scaled subjective discount rate measured at the liabilities- or assets-side of intermediaries is greater than one revolves around the very notion of financial intermediation. Intermediaries are asset transformers and they transform individuals' savings to productive assets. Since the transformation process is not instantaneous, individuals' time preference gets modified during the asset transformation process. Hence, $\beta' > 1$ captures the asset transformation delay. The stated explanation of $\beta' > 1$ is thus distinct from the explanations of the existing literature (e.g., Kocherlakota (1990), among others).

Second, the *scaling factor* simply measures the fraction of individuals' aggregated consumption that intermediaries hold. The estimates show that intermediaries hold about 98% of individuals' total consumption in the economy, that is, about 50% of the total wealth in the economy is held by intermediaries.[2] Thus, the intermediary-based Euler equation has the ability to predict the total wealth of the economy.

Next, I investigate whether conditional consumption growth can match the observed risk aversion. The conditioning variables are described as follows. In essence, all assets intermediaries hold belongs to individuals. Hence, the growth of intermediaries' assets or liabilities can be interpreted as the growth of individuals' wealth. If individuals' date *t*

[2] As per the model prediction, the total wealth of the U.S. economy in 2008 should have been 148 US$ trillions (2X74), which is closer to the estimated total wealth of 188 US$ trillions from the Federal Flow of Funds. To be fair, neither the total wealth of the economy nor intermediaries' total assets are measured with the absolute accuracy. What is important is that about 50% of individuals' total wealth is held by intermediaries.

consumption is dependent upon their wealth growth between dates *t-1* and *t*, that is, if we condition consumption by the growth of intermediaries' assets or liabilities, then the estimates of γ by conditional consumption growth are about 2.[3] Thus, the estimates match the observed risk aversion. The estimates of β by conditional consumption are about 0.98; that is, the conditioning variable, individuals' wealth, cancel out the asset transformation delay, and hence $\beta<1$. Thus, the estimates by conditional consumption growth do not require $\beta>1$ and still match the observed risk aversion. The result thus suggests that the conditional consumption growth capture the observed preferences of individuals. While still high, the corresponding implied risk-free rates are about 2.5% per quarter, which is far lower than the implied risk-free rates from consumption growth. Thus, the results jointly evade equity premium and risk-free rates puzzles.

Finally, I measure β and γ by the growth of intermediaries' equity, defined as the difference between assets and liabilities, and leverage, defined as the asset to equity ratio. The results show that using equity growth as the stochastic discount factor, the estimates of β are about 0.95. If test assets are a combination of risky and risk-free assets, then the estimated γ is slightly negative (-0.56) with equity growth as the stochastic discount factor. With intermediaries' leverage growth as the stochastic discount factor and a set of risky and risk-free assets as test assets, estimated β and γ are about 0.95 and -100 respectively.

To gain a better understanding of the estimates of β and γ using leverage and equity growth, I investigate the relationship between intermediaries' balance sheet variables. I show

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[3] The wealth effect on consumption is discussed in Aït-Sahalia, Parker and Yogo (2004).

that intermediaries' leverage is procyclical, that is, intermediaries borrow (take leverage) and invest more when asset prices are high and *vice versa*. Since intermediaries' borrowings must be funded by savings from individuals, individuals who supply intermediaries' leverage invest when asset prices are booming. Alternatively, individuals who prefer the *leverage channel* of intermediation are highly risk-seekers. As a consequence, measuring γ by intermediaries' leverage growth unravels behaviors of individuals who are risk-seekers. Hence, high negative γ (-100) is consistent with this group of individuals. Since leverages are transformed to assets instantly, there are no asset transformation delays. As a consequence, estimated subjective discount rate by intermediaries' leverage growth is less than one.

Similarly, measuring γ and β by intermediaries' equity growth measures the behavior of individuals who invest through the *equity channel.* Since individuals who invest through the equity channel are not likely to wait for their savings to be transformed to productive assets, there are no asset transformation delays, and the estimated β by the growth of intermediaries' equity is less than one. While the estimated γ by intermediaries' equity growth is not zero, the estimates are close enough to support the perceived notion that intermediaries are risk-neutral. At the least, we can safely argue that the equity channel investors are mildly risk-seekers.

Thus, in contrast to the existing literature where the measurement of individuals' *aggregate* risk aversion using consumption growth is of prime interest, the intermediary-based Euler equation allows for measuring γ of *disparate* groups of individuals. The reason is that if we measure γ by the growth of intermediaries' liability, then we are measuring γ of representative individuals. However, if we measure γ by the growth of intermediaries' leverage, then we are measuring risk aversion of individuals that are not representative since these individuals prefer the *leverage channel* of intermediation. Similarly, measuring γ by intermediaries' equity growth can be interpreted as the measure of risk aversion of investors who initiate the intermediation process.

The economic interpretation or rather application of the model and empirical results are regulatory. He and Krishnamurthy (2012) study the dynamics of risk premia during crises where the marginal investor is a financial intermediary. They find among the three government policy choices, such as injecting equity capital, lowering borrowing costs, and buying distressed assets, the first policy choice is particularly effective.

By contrast, the model presented here assumes intermediaries invest on behalf of individuals, and the model is not restricted to crises. Nevertheless, the model allows for investigating the efficacy of government policy choices. It is shown that the equity channel investors are possibly risk-neutral, and hence equity capital injection may not have any impact in the long-run. On the other hand, the leverage channel investors are highly risk-seekers and they invest when asset prices are high. As a result, unless asset prices move higher, lowering borrowing costs (that is, allowing intermediaries to take on leverage) may not have any impact on the economy. The recent evidences show that intermediaries simply *store* borrowed funds in safer securities rather than lend, that is, lowering borrowing costs may not have any effect on kick starting the economy.

Since the intermediation channel, as evidences in this paper show, is most active when asset prices are high, buying distress assets may help ameliorate systemic risk in crises.

However, looking beyond crises, buying distress assets is a debatable issue. First, buying distressed asset may not translate to higher asset prices across the board, and second, it has social costs. Thus, we argue that none of the three government policy choices mentioned above have long-term effect on the economy unless asset prices move higher. The recovery from a downturn probably has only one solution, and the solution is time. Eventually, with time on their side, economic agents sort things out and asset prices move higher in a definitive manner to kick start the next economic cycle.

This paper is related to the vast literature that endeavors to resolve the equity premium puzzle. The existing resolution relies on introducing alternative measure of consumption (e.g., Savov (2011)), new measure of preferences (e.g., Epstein and Jin (1991) and Constantinides (1990)), incomplete markets (e.g., Constantinides and Duffie (1996)), rare disasters (e.g., Reitz (1988)), and long-run risks (e.g, Bansal and Yaron (2002)). With the introduction of intermediation in individuals' consumption-savings decisions, I show that a new and different measure of *scaled* consumption sheds light on the puzzle.

The paper is also related to recent studies that derive asset prices in the presence of intermediaries, such as the models of He and Krishnamurthy (2011, 2012) and Brunnermeir and Sannikov (2011). However, these studies do not investigate whether fluctuations of intermediaries' wealth can explain the observed risk aversion.

Drawing on the Brunnermeier and Pedersen (2009) model, Adrian et al. (2012) consider a stochastic discount factor for excess returns that is affine in brokers and dealers' leverage shocks and show that brokers and dealers' leverage is priced in the cross-section of stock returns.

However, Johnson (2008) argues that controlling for the aggregate financial position of the economy, there should not be any role for the financial position of securities dealers and brokerage firms in explaining aggregate fluctuations of overall market liquidity. We show why the stochastic discount factor for asset returns must be derived from the aggregate financial position of intermediaries rather than from the funding liquidity of brokers and dealers as in Brunnermeier and Pedersen (2009).

In this paper, I show that financial intermediation has equilibrium asset pricing implications. If intermediaries' balance sheet growth is able to explain the observed preferences of individuals, then it must price assets in the cross-section. It is thus important to investigate whether the cross-section of asset returns can be explained by intermediaries' balance sheet variables growth. I leave this task for future research.

The essay proceeds as follows. Section 1.2 derives an intermediary-based asset pricing kernel, where individuals save in risky assets through intermediaries. Section 1.3 tests the intermediary-based Euler equation, and Section 1.4 concludes.

1.2 The model

When individuals save, they have several options. Among other choices, individuals can contribute to retirement plans, buy mutual funds from mutual fund companies, buy stocks through brokers, purchase annuities through insurance companies, and buy certificate of deposits from banks. Whatever method individuals choose, they use intermediaries' services. As a consequence, a dollar saved by individuals becomes a dollar of liability to intermediaries. Intermediaries as asset transformers convert individuals' savings to assets, that is, the saved dollar is converted to an asset of equal value. In a future date, when individuals decide to claim the assets to meet their consumption needs, they claim intermediary-created-assets from intermediaries. That is, the intermediation process is central to individuals' consumption-savings choices, and hence financial intermediation has equilibrium asset pricing implications.

The setting of the derivation that follows is a frictionless pure exchange economy for two dates depicted in Figure 1.1. The economy has two types of agents: individuals and intermediaries who take individuals' savings and convert these savings to risky assets. At date 0, individuals receive endowments and make optimized consumption-savings decisions. At date 0, intermediaries take individuals' optimal savings as given and maximize their profits at date 1 by converting individuals' savings to assets. At date 1, intermediaries liquidate assets and keep their profits; individuals claim their savings (plus returns on savings) and consume. It is assumed that intermediaries' compensation is performance-based so that individuals' and intermediaries' interests are aligned. Given the setup, first, I derive individuals' optimal consumption-savings decisions. Next, I derive intermediaries' profit maximization. Finally, I impose market clearing conditions to derive the intermediary-augmented asset pricing kernel.

1.2.1 Individuals' consumption-savings decisions

Individuals make their consumption-savings decisions where they derive utility from consuming at the beginning, as well as at the end period. Followings are the model assumptions that solve the optimal consumption-savings problem:

Model assumptions and setup:

1) Let W_0 and C_0 be the wealth and consumption at date 0. At date 1, individuals are assumed to consume all their wealth, which is denoted by C_1. That is, her utility function can be written as $\mathrm{U}(C_0) + \beta E[\mathrm{U}(C_1)]$, where $\beta < 1$ is the subjective discount factor that reflects the individuals' time preference, and E(.) is the expectation operator conditional on information at date 0.
2) There is no labor income.
3) Individuals choose to invest in *n* risky assets through intermediaries. Let P_i, Γ_i, and $R_i = \Gamma_i / P_i$ be the price at date 0, payoff and return at date 1 of asset *i* respectively.
4) Let w_i be the portion of date 0 savings invested in asset *i*.
5) Individuals are power utility maximizer, i.e., $U(C) = C^{1-\gamma}/1-\gamma$, where γ is the coefficient of relative risk aversion.

Given the setup,

Date 0 savings are $(W_0 - C_0) = xC_0$ (1)

where *x* is the portion of date 0 consumption that is saved for date 1 consumption.

The intertemporal budget constraint is $C_1 = (W_0 - C_0)\sum_{i=1}^{n} w_i R_i$ (2)

The maximization problem is $\max_{C_0,\{w_i\}} \mathrm{U}(C_0) + \beta E[\mathrm{U}(C_1)]$ (3)

Since the above maximization problem is standard,[4] I write the Euler equation as

$1 = \mathrm{E}[\mathrm{m}_{01} R_i]$ (4)

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[4] See Pennacchi, 2008, pages 80-91 for details.

where m_{01} is the stochastic discount factor between date 0 and date 1, and is given by

$$\mathrm{m}_{01} = \beta \left(\frac{C_1}{C_0}\right)^{-\gamma} \tag{5}$$

The caveat of the above derivation is that individuals invest in *n* risky assets through intermediaries. Moreover, individuals' end-of-period consumption also depends on intermediaries. As a consequence, I next investigate the role of intermediaries in the exchange process.

1.2.2 Intermediaries' profit maximization

Following Pyle (1971) and Hart and Jaffee (1974), I derive the optimal portfolio allocation of intermediaries. However, unlike the above models, I allow intermediaries to interact with individuals.

Model assumptions and setup:

1) Intermediaries operate as portfolio managers who hold a mean-variance efficient portfolio.
2) Intermediaries generate profits by borrowing from individuals, keeping a portion of borrowed funds as reserves, and the rest are invested in risky assets.
3) At date 0, x_b^0 is the net borrowing and it costs $\tilde{r}_b$, which is random. Alternatively, $\tilde{r}_b$ is the return that individuals expect to receive for postponing their consumption.
4) x_l is the portion of the borrowed fund that is invested in risky assets, such as loans, and it earns random returns $\tilde{r}_l$.

5) $x_R = (x_b^0 - x_l)$ is the portion of the borrowed fund that is invested in risk-free asset that earns returns R^f.

6) At date 1, intermediaries liquidate the assets they hold. Intermediaries keep a portion as profits, and the rest are returned to individuals. That is, at date 1, intermediaries' liabilities are $x_b^1 = \tilde{r}_b x_b^0$ and this determines individuals' end-of-period consumption.

Given the setup, intermediaries' random profits are

$$\tilde{\pi} = \tilde{r}_l x_l - \tilde{r}_b x_b^0 + R^f x_R \quad (6)$$

under the budget constraints

$$x_R + x_l - x_b^0 = 0 \quad (7)$$

Note that intermediaries take x_b^0 as given, and they optimally select x_R and x_l. Since intermediaries act as mean-variance efficient portfolio managers, they maximize the objective function

$$\Phi(x) = U\{E(\tilde{\pi}), Var(\tilde{\pi})\} \quad (8)$$

Equation (8) is the standard mean-variance efficient portfolio optimization representation.

If μ and σ are the expected returns and variance of the portfolio constructed from liabilities, reserves, and asset portfolios, and $x^* = [x_l{}^* \;\; x_R{}^*]'$ denotes the optimal allocations that maximizes Φ, then the first order condition implies

$$x^* = \gamma V^{-1} \rho \quad (9)$$

where

$$\gamma = \frac{\frac{\delta U}{\delta \mu}}{2(\frac{\delta U}{\delta \sigma^2})} \tag{10}$$

$$V = \begin{bmatrix} var(\widetilde{r_l}) & cov(\widetilde{r_l}, \widetilde{r_b}) \\ cov(\widetilde{r_l}, \widetilde{r_b}) & var(\widetilde{r_b}) \end{bmatrix} \tag{11}$$

$$\rho = [\tilde{r}_b - R^f \quad \tilde{r}_l - R^f]' \tag{12}$$

Since the results are standard mean-variance asset allocation solutions,[5] I do not report the derivations.

The above maximization problem is central to individuals' consumption-savings decisions. At date 0, individuals decide savings x_b^0; at date 1, intermediaries determine individuals' consumption $x_b^1 = \tilde{r}_b x_b^0$.

1.2.3 Market clearing conditions

Since there are only two types of agents, the market clearing condition implies that individuals' savings at date 0 must show up as liabilities in the intermediaries' balance sheet. Using intermediaries' profit maximization model assumption (3) and equation (1), I write the date 0 market clearing condition as

$$(W_0 - C_0) = xC_0 = x_b^0 \tag{13}$$

Similarly, the market clearing condition at date 1 implies individuals' consumption equals liabilities of intermediaries. As a result, using intermediaries' profit maximization model assumption (6), the market clearing condition at date 1 implies

$$C_1 = x_b^1 \tag{14}$$

[5] See Freixas and Rochet, 1997, pages 286-289, for details.

Plugging C_0 and C_1 and from equations (13) and (14) respectively in equation (5) yields,

$$\mathrm{m}_{01} = \beta\left(\frac{\mathrm{C}_1}{\mathrm{C}_0}\right)^{-\gamma} = \beta\left(\frac{x\mathrm{C}_1}{x\mathrm{C}_0}\right)^{-\gamma} = \beta'\left(\frac{x_b^1}{x_b^0}\right)^{-\gamma} \quad (15)$$

where $\beta' = \beta * (x)^{-\gamma}$ and it represents the scaled version of the subjective discount factor at the liabilities side of intermediaries.

Since intermediaries' assets and liabilities are highly correlated (the correlation coefficient is about 0.97) and are of the same magnitude, consumption of individuals at date 1 is nearly equal to the assets in the intermediaries' balance sheet. Under the assumption that the exchange process from liabilities to assets is instantaneous, equations (13) and (14) can be rewritten as

$$x\mathrm{C}_0 = x_b^0 = L_0 \approx \mathrm{A}_0 \quad (16)$$

$$\mathrm{C}_1 = x_b^1 = L_1 \approx \mathrm{A}_1 \quad (17)$$

where L and A represent liabilities and assets, the corresponding subscripts denotes dates, and $\approx$ denotes that assets and liabilities are nearly equal. The assumption that assets and liabilities are nearly equal is not a necessity, but the assumption is made for notational simplicity.

Using equations (16) and (17), I restate equation (15) in terms of intermediaries' liabilities as

$$\mathrm{m}_{01} = \beta'\left(\frac{\mathrm{L}_1}{\mathrm{L}_0}\right)^{-\gamma} \quad (18)$$

The above could be written in terms of intermediaries' assets as

$$\mathrm{m}_{01} = \beta'\left(\frac{\mathrm{L}_1}{\mathrm{L}_0}\right)^{-\gamma} = \beta''\left(\frac{\mathrm{A}_1}{\mathrm{A}_0}\right)^{-\gamma} \quad (19)$$

where $\beta'' = \beta' * (\frac{\mathrm{L}_1}{\mathrm{L}_0}/\frac{\mathrm{A}_1}{\mathrm{A}_0})^{-\gamma}$ captures the scaling of liabilities to represent the asset growth, and it represents the scaled version of the subjective discount factor at the terminal transaction process at the marketplace. *Ex ante*, it could be argued that $\beta'' \approx \beta'$, since $L_1 \approx A_1$ and $L_0 \approx A_0$.

What I show above is that the stochastic discount factor is defined by intermediaries' balance sheet variables shocks. The stochastic discount factor can also be expressed in terms of other balance sheet variables, such as leverage, but I skip those derivations to save space.

The primary testable implication of the above derivations is the Euler equations (4). In this paper, I focus on estimating β and γ. However, as opposed to using the standard stochastic factor defined by consumption growth as in equation (5), I use alternative specification for the stochastic discount factor defined by intermediaries' liabilities and assets growth as in equations (18) and (19) respectively. Since intermediaries' liability or assets are functions of other balance sheet variables, I also have specification where the stochastic discount factor is defined by intermediaries' equity and leverage growth. The last two specifications allows for investigating the relationship between asset prices and intermediaries' equity and leverage.

Hence I consider the following variables: the growth of a) assets, b) liabilities, c) equity, and d) leverage, where $\text{equity} = (\text{asset} - \text{liability})$ and $\text{leverage} = (\text{asset}/\text{equity})$. The intermediation variables are described in the Appendix A. The Appendix A also describes the data needed to test the Euler equation along with their sources.

Depending on the test specification, following are the test assets: a) the equity premium (R^e), which is value-weighted CRSP stock returns less T-bill returns, b) value-weighted CRSP stock returns (MKT), c) T-bill returns (R^f), d) excess returns on the 25 Fama-French (1993) size and book-to-market portfolios, 10-year Treasury, Moody's Aaa and Baa bonds, and e) returns on the 25 Fama-French (1993) size and book-to-market portfolios (FF25).

1.3 Main Empirical Results

The important feature of the aggregated intermediation data is that the growth of aggregated balance sheet variables is more volatile and is highly correlated with stocks. This feature of the data allows intermediaries balance sheet variables to fit the equity premium with the robust coefficient of relative risk aversion (RRA) estimates that ranges from 4.25 when intermediaries' assets are used for the estimation. The estimate of RRA by the growth of liabilities is of the same order.

With the realistic assumption that individuals' consumption is contingent upon their wealth, that is, conditioning consumption with the intermediaries' assets or liabilities growth, the estimates are closer to the observed risk aversion.

1.3.1 Summary Statistics

Table 1.1 Panel A compares the distribution of the quarterly consumption growth versus the quarterly aggregated balance sheet variables growth. All balance sheet variables are about 30 times more volatile than consumption. Except for the growth of equity, the correlation between the growth of other balance sheet variables and market excess returns (return on value-weighted CRSP stocks minus risk-free returns) is above 60%, which is about four times as high as that for consumption. While the correlation between the leverage growth and consumption growth is about 7%, the correlation between consumption and other balance sheet variables are about 20%. Thus, the correlation analysis conforms to the theoretical prediction that consumption growth and the intermediaries' balance sheet growth move in unison.

Consumption and intermediaries' balance sheet variables also differ in persistence. Table 1.1 Panel B reports the autocorrelation structure for all variables of interests. The table shows that consumption, leverage, and equity growth have first and higher orders statistically significant autocorrelation, whereas the asset and liability growth are neither persistent nor random. While a first order autocorrelation is absent for the asset and liability growth, they have statistically significant second-order autocorrelation. The asset and liability growth seem to follow a pulsating wave pattern where pulses come in every second and fourth quarter. To account for potential time aggregation, I report corrected risk aversion estimates following Breeden, Gibbons, and Litzenberger (1989).

Figure 2 provides a graphical comparison of the intermediation and consumption data. The plot shows that intermediaries' asset growth is far more volatile than consumption and the pattern is consistent throughout the whole 1955-2009 sample. Consumption growth declines at the onset of a recession and picks up sharply towards the end. By contrast, except for the recent recession, the asset growth fluctuates within the recession period.

1.3.2 Estimates of risk aversion and the equity premium

The strong positive correlation between intermediaries' balance sheet variables growth and the stock market returns, and the positive correlation between the balance sheet variables growth and consumption imply that returns on stocks present consumption risk.

I now formally test the Euler equation (4) and estimate γ to ascertain the observation. Following Hansen and Singleton's (1982), among others, using equations (4), (5), (18), and (19)

I write the general multi-period[6] version of the Euler equation as

$$E\left[\beta\left(\frac{X_{t+1}}{X_t}\right)^{-\gamma} R^e_{t+1}\right] = 0 \qquad (20)$$

where R^e_{t+1} is the excess returns on risky assets over the T-bill return, X represents either consumption or any one of the intermediation variables. I have also assumed that $\beta = \beta' = \beta''$ in equation (20) for notational simplicity. Every variable in equation (20) is observable excluding β and γ.

Hansen and Singleton (1982) and Mehra and Prescott (1985) show that the estimates of the coefficient of risk aversion γ obtained with the consumption data are too high from an economic perspective. Weil (1989) further shows that high risk aversion estimates translates to very high implied unconditional risk-free rates. The high estimates of γ are a direct consequence of low volatility of the consumption data. To satisfy the Euler equation, low volatility consumption data and high estimated γ is needed to match stock returns. That is, the equity premium puzzle is the direct consequence of smooth consumption data. A new measure of consumption from what individuals save through intermediaries directly addresses the puzzle.

To match the quarterly equity premium (R^e), which is value-weighted CRSP stock returns (R^M) returns less T-bill returns of 1.55 % in the sample, calibrated γ and β are presented in Table 1.2.

Following Mehra (2003), the simulation results in Table 1.2 assume $\beta = 0.99$ for the estimation of γ using consumption growth. I assumed $\beta = 1.04$ for the estimation of γ using

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6 The formal derivation in a multi-period setup does not bring additional insight to the understanding of the exchange process, and hence I skip the derivation for simplicity.

intermediaries' asset and liabilities growth. The rationale for which is discussed in the subsequent sections.

The results with consumption growth highlight the equity-premium and risk-free-rates puzzles, and estimates of γ and β are similar to Mehra's (2003) results. The results with asset and liabilities growth as stochastic discount factors solve the equity-premium puzzle. Looking at the implied risk-free returns, the estimates[7] are about 1.5% per quarter, which is far higher than historical data, that is, the risk-free rate puzzle holds. Next, I investigate economic interpretations of $\beta > 1$.

While the calibrated β with the asset or liabilities growth is greater than one, it is consistent with equation (15), where it is shown that the β measured at the asset or liabilities side of intermediaries' balance sheet is a scaled version of the actual β. While literature (for example, Kocherlakota, 1990) provides a unique perspective on point estimates of $\beta > 1$, I provide an alternative perspective.

The primary role of intermediaries is to transform assets: individuals' savings to productive assets. Neither is the transfer of individuals' savings to productive assets costless nor is the conversion process instantaneous. There exists a time delay. Hence, $\beta' > 1$ captures the time delay at the liabilities side. This allows for individuals to have a time preference $\beta < 1$, but they do anticipate the delay transferring their savings to productive assets. When individuals claim their assets, intermediaries need to liquidate the assets they hold, and the asset liquidation process may not be instantaneous. The delay in liquidating assets is also

[7] The implied unconditional risk-free rate is $R^f = [\beta(C_{t+1}/C_t)^{-\gamma}]^{-1}$. A log-normal approximation yields $\ln(R^f) = -\ln(\beta) + \gamma E[\ln(C_{t+1}/C_t)] - 0.5\gamma^2 \text{var}[\ln(C_{t+1}/C_t)]$.

captured in $\beta'' > 1$.

Additionally, recall that the scaled discount rate at the liabilities side of the intermediaries' balance sheet is $\beta' = \beta * (x)^{-\gamma}$. With $\beta = 0.99$, $\beta' = 1.04$ and $\gamma = 2.57$, parameter estimates by liabilities growth respectively, implies that $x \approx 0.98$. Using equation (9), the interpretation is that about 50% of agents' aggregated wealth shows up as liabilities or assets in the intermediaries' balance sheet. In the sample, total assets of intermediaries is 74 US$ trillions, and this translates to total assets of the U.S. economy to be 148 US$ trillions. Given that neither the sample selection of this paper nor the estimate of total assets is exhaustive, the estimate of total assets in the economy[8] by intermediaries' balance sheet using the Euler equation is strikingly close.

In Figure 1.3, I show the sensitivity of γ with β. For the plots I have restricted β to be less than one for the γ estimates with consumption data following the bound imposed by the theory. As for the RRA estimates, I do not pose any restriction on β since economic interpretations of which is explained earlier. Figure 3A shows that RRA estimates with consumption growth are more sensitive to the variations in β. Figure 1.3B shows that the RRA estimates with assets and liabilities growth are similar in magnitude.

The plots clearly show that the measured RRA with assets or liabilities growth are relatively stable when β>1 and estimated RRA is well within the range of observed risk aversion.

[8] As of December 2008, Rutledge Capital estimates (from the Federal flow of funds data) total assets to be 188 US$ trillions (See details at: http://rutledgecapital.com/2009/05/24/total-assets-of-the-us-economy-188-trillion-134xgdp/).

1.3.2.1 Dynamic estimates of risk aversion

I next estimate RRA (γ) with Equation (21), where the subjective discount rate is pinned down at 0.95 following Hansen, Heaton, and Li (2008) and Savov (2011), among others. This allows for comparing the results in this paper with the latest literature.

$$E\left[\beta\left(\frac{X_{t+1}}{X_t}\right)^{-\gamma} R^e_{t+1} \otimes Z_t\right] = 0 \qquad (21)$$

where $R^e_{t+1}$is the excess returns on risky assets over the T-bill return, X represents either consumption or any one of the intermediation variables, and Z_t is the information set at time t.

Savov (2011) shows that *garbage* production as a measure of consumption matches the U.S. equity premium with the RRA estimate of 17. Additionally, garbage as a measure of consumption outperforms NIPA expenditure consumption, the Q4-Q4 measure that uses the fourth-quarter year-over-year growth in expenditure (Jagannathan and Wang (2007)) and the long run P-J measure that uses three-year consumption growth (Parker and Julliard (2005)) in estimating the RRA.

Table 1.3 Panel A presents the results of an Iterated GMM test of the Euler equation, where I use the equity premium as the test asset. As for the stochastic discount factor, I use the growth of intermediaries' balance sheet variables that are described earlier and consumption growth. Additionally, I have included the growth of followings two variables:

a) $cag_t = Consumption_t * (Asset_t / Asset_{t-1})$, consumption scaled by intermediaries' asset growth

b) $clg_t = Consumption_t * (Liabiltiy_t / Liabilty_{t-1})$, consumption scaled by intermediaries' liabilities growth.

These two variables represent the intuition that consumption is contingent upon individuals' wealth,[9] which I proxy for by intermediaries' assets or liabilities growth. I use the following instruments: the lagged asset, liability, equity, and leverage growth, lagged consumption growth, lagged *cay*, consumption to wealth ratio from Lettau and Ludvigson (2001), and lagged price to dividend ratio. The usage of the last four instruments is common in the literature (Savov (2011)).

Looking at the first column, the estimated RRA with consumption growth is 169, which is far too high to reconcile with the observed risk aversion. By contrast, the estimates of RRA using the intermediation factors are far lower. While still large, the estimates of RRA with leverage, *cag*, and *clg* are about 15, which is about the same as the reported RRAs using garbage as a proxy for consumption (Savov (2011)). Following Aït-Sahalia, Parker and Yogo (2004) and Breeden, Gibbons and Litzenberger (1985), the time aggregation correction yields the estimates of RRA that is half the size of the unadjusted estimates.

Looking at the implied risk-free rates, the estimates cannot be economically reconciled. For consumption growth, the implied risk-free rate is about 72% per quarter. By contrast, with intermediaries' balance sheet growth, while still huge, the estimates of the implied risk-free rate are about 8% per quarter are far lower than that measured by consumption.

Following literature (Lewellen, Nagel and Shanken (2010)), I use excess returns on the 25 Fama-French (1993) size and book-to-market portfolios (FF25) as a first set of test assets. To enhance the power to the tests, I use several bond returns with FF25 as test assets. The bond

[9] Correlations between *clg* and *cag* with *cay*, the consumption to wealth ratio of Lettau and Ludvigson (2001) are 0.00314 and 0.00228 respectively. Hence, they are unrelated since the wealth measured in this paper is different. I thank an anonymous seminar participant at Universitat Pompeu Fabra for raising the question.

returns are T-bill returns as risk-free asset returns, excess returns on 10-year Treasuries, and excess returns on Moody's Aaa and Baa corporate bonds. None of these specifications have any instrument to address Ferson and Foerster's (1994) criticism that GMM estimates with too many instruments and moment conditions may be biased.

In Table 1.3 Panel B, I show that by having diversified test assets, the estimated of RRA using *clg* and *cag* remains practically unchanged. For parsimony, the estimates by other intermediation variables are not reported since the estimated RRAs are not as robust. The stability of the RRA estimates with diversified test asset shows the importance of both *clg* and *cag*. Note these two variables measure conditional consumption, where the conditioning variables are individuals' wealth growth. Thus, the results suggest that the specified conditional consumption best captures individuals' risk preference.

The implied-risk free rate with excess returns of FF25 is about 8% per quarter and is still too high. Estimating the implied risk-free rates with risk-free assets as test assets is counterintuitive; hence, throughout the paper implied risk-free rates are not reported for any combination of test assets that has risk-free assets as one of the test assets.

In summary, the estimates of γ by the growth of intermediaries' balance sheet variables are far better than the estimates by consumption growth. To match the equity premium, conditional consumption, where the conditioning variables are measured by intermediaries' asset or liabilities' growth, match the estimates of γ by garbage growth.

The caveat with the above estimation methodology is that it is assumed that the subjective discount rate (β) is constant. I next relax the assumption and estimate β directly.

1.3.3. The risk aversion and subjective discount rate estimates

Equations (15) and (19) show that the subjective discount rate measured at the liability or asset side of the balance sheet is a scaled version of individuals' subjective discount rate (β). Hence, pinning down β to 0.95, as was done in the previous sub-section, may not be proper for the present study. Hence, I estimate β and show that the scaled β measured at the liability or asset side of intermediaries' balance sheet has important economic significances. I use the following specification of the Euler equation, which is similar to the specification of Ferson and Harvey (1992), among others.

$$E\left[\beta\left(\frac{X_{t+1}}{X_t}\right)^{-\gamma} R_{t+1} \otimes Z_t\right] = 1 \quad (21)$$

where $R_{t+1}$is the return on any asset, and the rest of the variables are same as equation (20).

The primary reason for using equation (21) is as follows. One needs to make strong assumptions regarding the joint properties of two stochastic equations of the form (21) (one for a risky asset and the other for the risk-free asset) to derive equation (20). The existing literature (and the results of this paper) show that such strong assumptions leads to economically implausible estimates of γ. As a direct consequence, the implied unconditional risk-free rates are orders of magnitude too high. In essence, any study that uses equation (21) may not be able to estimate β and γ that has any economic interpretation. For example, Cochrane (1996) estimates β and γ to be 1.29 and 116 respectively for consumption growth scaled by the constant, term spread, and dividend-to-price ratio using an iterated GMM procedure.

Table 1.4 presents the results where intermediaries' asset and liabilities are used to test the

Euler equation. Looking from the left, first two columns present the estimates of γ and β with MKT as test assets with the instruments mentioned earlier. The estimates of γ and β using the asset or liability growth are of the same order, and are about 4 and 1.03 respectively, and the estimates are similar to the calibrated results provided in Section 3.2. With the time aggregation correction of Breeden, Gibbons, and Litzenberger (1989), the estimates of γ is about 2, and hence match the observed risk aversion.

The results further demonstrate that β' and β'' of equations (15) and (19) respectively are almost identical since liabilities and assets are highly correlated.

Looking next at the implied risk-free rates, with MKT as the test asset, while still large, the estimates are 1.28%, 1.38%, and 1.26 % per quarter, for the asset, liability and consumption growth respectively. Thus, the liability or asset growth simultaneously evades the equity premium and risk-free rates puzzles.

With FF 25 as test assets, the risk-free rates estimates are about 3% per quarter, thus the risk-free-rates puzzle holds when test assets are diversifies risky assets.

Next, turning to Table 1.5, where *cag* and *clg*, the conditional consumption growth, are used to estimate γ and β. The test assets and instruments are the same as before. Looking at the first two columns, strikingly, the estimates of γ are about 2 and are similar to the observed risk aversion. The estimates of β are about 0.98. Hence, the estimates do not require $\beta>1$ and still match the observed risk aversion. Thus, the results show why both *cag* and *clg* were able to explain the equity premium with the lowest estimate of γ under restrictive tests of the Euler equation (see Table 1.3). Thus, the conditional consumption growth basically captures individuals' preferences.

In each subsequent estimates, I have used $\beta = 0.977$, and the results show that while the estimates of γ using *cag* and *clg* are nearly insensitive to test assets, the estimates of γ by consumption vary by a large margin with diversified test assets. Finally, none of the estimates of implied risk-free rates are economically plausible.

1.3.3.1 Intermediaries' Equity and Leverage

In this section, I estimate γ using intermediaries' equity and leverage growth and investigate the economic implications of the estimated γ. To appreciate the dynamics of equity and leverage, I first show the evolution of intermediaries' balance sheet variables with the business cycle. Next, I estimate γ using the growth of intermediaries' equity and leverage.

Adrian and Shin (2010) discuss the relationship between intermediaries' equity and leverage and its implication on intermediaries' balance sheet. They show commercial banks maintain a preset leverage and investment banks' leverage is pro-cyclical. As asset prices rise, intermediaries' equity rises, thereby lowering their leverage. Commercial banks respond to falling leverage by expanding the balance sheet by borrowing and lending more to attain the desired leverage. The effect of asset prices on investment banks is far more pronounced since their leverage is pro-cyclical. Investment banks borrow and lend more than commercial banks and their leverage keep rising with the rising asset prices until an asset bubble sets in.

In Figure 1.4, I show that intermediaries' leverage *in aggregate* is pro-cyclical. In the scatter plot shows the relationship between intermediaries' asset and leverage growths. Since the slope of the regression line is positive, intermediaries' leverage is pro-cyclical.

As a direct consequence, in economic expansions when asset prices are high intermediaries expand the balance sheet. In recessions, however, intermediaries contract the balance sheet by borrowing and lending less.

Since intermediaries' borrowings must be funded by savings from individuals, individuals who supply the leverage pursue booming asset prices. Alternatively, individuals who prefer the *leverage channel* do not postpone their consumption at all times; these individuals save when asset prices are high and they consume when asset prices are low. Hence, individuals who prefer the leverage channel are not representative investors. Thus, measured γ by intermediaries' leverage growth is different from measured γ by the growth of asset or liabilities. As a consequence, measuring γ by intermediaries' leverage and equity unravels behaviors of disparate groups of individuals.

Having discussed the balance sheet dynamics, I estimate γ using the equity and leverage growth. Table 1.6 presents the results, where the test assets and instruments are the same as before.

Looking from the left, where stock returns and instruments are used, the results show that the estimate of RRA by the equity growth is negative. Since intermediaries' equity must come from individuals, the RRA estimates indicate that individuals who invest through the equity channel are risk-seekers. Alternatively, these individuals would invest when the risky asset returns are high. While the estimates remain negative irrespective of the test assets, the estimated γ of -0.56 with stock market and T-bill returns as test assets suggests that equity investors are possibly risk-neutral.

Note that whether it is equity or leverage, funds must come from individuals, and hence the measured preference by equity is the preference of individuals who are entrepreneurs. As opposed to the estimated β by asset or liabilities growth, the estimated β of 0.95 by equity growth confirms that there is no time delay channeling equity to productive assets.

By contrast, we observe that when test assets are stock market returns or FF25 returns, the estimated γ by leverage is about 4 and 1.34 respectively. However, when T-bill returns are an additional asset to stock market returns, we observe that γ is about -104. That is, individuals that invest through the leverage channel when confronted with the choices between risky assets and a risk-free asset, they prefer risky assets. Unreported results show when T-bill returns are added to FF25 returns as test assets, the estimated γ is -113.861. Such a strong preference for risk has important economic implications. In economic expansions with the boom in the asset prices, individuals that invest through the leverage channel lever up, which leads to asset bubbles. In economic contractions when asset prices are low, these individuals simply sit idle.

He and Krishnamurthy (2012) investigate three government policy choices during crises, such as injecting equity capital, lowering borrowing costs, and buying distressed assets and they find injecting equity capital is effective. By contrast, the results presented here allow for investigating the efficacy of government policy choices in economic recoveries. For the discussion below, I consider the marginal investor is a financial intermediary as in He and Krishnamurthy (2012).

Since the intermediation channel, specifically the leverage channel, is most active when asset prices are high, intermediaries as marginal investors have no incentive to invest in risky assets if asset prices are low. As a result, lowering borrowing costs (that is, allowing intermediaries to take on leverage) may not have any impact on the economy if asset prices are low: intermediaries would simply borrow at a lower cost and hold borrowed funds in safer securities rather than lend. Buying distress assets may help ameliorate systemic risk in crises. However, looking beyond crises, buying distress assets is a debatable issue. First, buying some distressed asset may not translate to higher asset prices across the board, and second, it has social costs. Importantly, buying distressed asset may actually hurt asset prices, because it may act as a negative signal. Injecting capital may be required in crisis, but capital injection has no effect on economic recoveries since intermediaries' capital constraints are not an issue as long as asset prices, albeit at a lower level after recessions, are stable. Simply put, none of the policy measures discussed above may translate to an economic recovery. With time, economic agents sort things out and asset prices rebound in a definitive manner to kick start the next economic cycle.

1.4 Conclusions

In this paper, I show that the stochastic discount factor is defined by intermediaries' balance sheet variables shocks. Importantly, the stochastic discount factors are derived under the standard assumption about individuals' preferences.

Since the publication of the Mehra and Prescott (1985) paper, academicians attempted to reconcile observations with theory to resolve the puzzle using a plethora of measurements of preferences, alternative measure of consumption, incomplete markets, rare disasters, and long-run risks. In contrast, I show that individuals save through intermediaries. As a direct consequence, individuals' consumption growth is a scaled version of the growth of intermediaries' balance sheet variables. By measuring the coefficient of relative risk aversion by the growth of balance sheet variables of intermediaries evades the equity premium puzzle. The results further show the differences in individuals' preferences as they employ financial intermediaries.

Appendix 1.A. Data

The quarterly-sample under investigation dates from the first quarter of 1951 through the fourth quarter of 2009. Unless noted otherwise, all data are obtained from the Federal Reserve Bank of New York. I collect intermediaries' balance-sheet data from the Federal Flow of Funds for 16 intermediaries that are grouped into six different categories based on their mode of operations. It is worth mentioning that balance-sheet data at the Federal Flow of Funds are reported at the subsidiary level, and hence any possibility of double counting the balance-sheet information is minimized. This information is important for our subsequent analysis. I obtain Fama-French factors, size and book-to-market and industry portfolios, and risk free (T-bills) rates data from Ken French's website. The data for *cay,* the consumption to wealth ratio of Lettau and Ludvigson (2001) and consumption is obtained from Martin Lettau's website. I obtain the dividend to price ratio data from Robert J. Shiller's website. For all intermediaries' data, several data points are missing, and I get consistent data from the first quarter of 1951. I also discard data from 1951 to 1954 to account for the initial data reporting errors. As a result, the sample is from 1955 through 2009. All data is adjusted from inflation.

Following Adrian and Shin (2009), I include 17 intermediaries to proxy for the U.S. financial intermediation, and intermediaries are grouped into six categories: banks, mutual funds, pension funds, insurance companies, securities brokers & dealers, and shadow-banks[10]. Table A.1 presents the descriptive statistics for these intermediaries. For the subsequent analysis, I aggregate assets and liabilities of these intermediaries. I measure the equity as assets-liabilities and leverage as assets divided by equity. The growth of balance-sheet variables are the intermediation factors.

10 See Pozsar, Adrian, Ashcraft, Boesky, "Shadow Banking", Federal Reserve Bank of New York, Report #458, 2010.

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Table 1.1
Summary Statistics

This table presents summary statistics. Panel A presents sample moments for the growth of consumption, assets, liabilities, $\text{Equity} = (\text{Assets} - \text{Liabilities})$, and leverage defined as $\text{Leverage} = (\text{Assets})/(\text{Assets} - \text{Liabilities})$. The correlation of each variable with the equity premium (R^e), which is value-weighted CRSP stock returns (R^M) returns less T-bill returns is shown just below the sample moments. Pearson correlations are presented right after that. Panel B presents the auto-correlation structure of the variables described. P-values are in the parenthesis. Sample 1955:Q1-2009:Q4.

Panel A: Sample Moments

	Consumption	Asset	Liability	Equity	Leverage	R^e
Mean	1.004	1.022	1.023	1.020	1.002	0.015
Std. dev. (X100)	0.478	1.353	1.599	1.309	1.173	8.400
Corr. (R^e)	0.153	0.614	0.705	0.052	0.636	
	(0.023)	(0.000)	(0.000)	(0.445)	(0.000)	
Consumption		0.255	0.231	0.192	0.074	
		(0.000)	(0.001)	(0.004)	(0.274)	
Asset			0.967	0.592	0.478	
			(0.000)	(0.000)	(0.000)	
Liability				0.377	0.675	
				(0.000)	(0.000)	
Equity					-0.425	
					(0.000)	

Panel B: Auto-correlation Structure

	Lag 1	Lag 2	Lag 3	Lag 4	Lag 5
Consumption	0.310	0.154	0.224	-0.008	-0.153
	(0.000)	(0.032)	(0.002)	(0.912)	(0.026)
Asset	0.072	0.215	0.049	0.257	-0.058
	(0.296)	(0.002)	(0.476)	(0.000)	(0.411)
Liability	0.104	0.189	0.058	0.177	-0.050
	(0.136)	(0.007)	(0.404)	(0.012)	(0.491)
Equity	0.241	0.171	-0.153	0.423	-0.088
	(0.001)	(0.009)	(0.024)	(0.000)	(0.234)
Leverage	0.232	0.120	0.002	0.067	-0.082
	(0.001)	(0.095)	(0.976)	(0.375)	(0.305)

Table 1.2

Static estimates of relative risk aversion with the equity premium

This table presents calibrated results for RRA and DF using the Euler Equation to match the quarterly equity premium (R^e) of 1.55% following Mehra (2003). RRA (γ) is the relative risk aversion coefficient and DF (β) is the subjective discount factor.

Calibrated RRA (γ) and DF (β) to match the Equity Premium			
	Consumption	Asset	Liability
RRA (γ)	15.50	2.56	2.57
DF (β)	0.99	1.04	1.04
Implied R^f/Quarter	1.51	1.54	1.54

Table 1.3
The equity premium and estimates of relative risk aversion

This table presents relative risk aversion estimates. The moment conditions are

$$\mathrm{E}\left[\beta\left(\frac{\mathrm{X_{t+1}}}{\mathrm{X_t}}\right)^{-\gamma} R^{e}_{t+1}\otimes z_t\right] = 0$$

Xs are: Consumption, intermediaries' Asset and Liability. RRA (γ) is the estimated relative risk aversion coefficient. GMM p-values are in the parenthesis. The first estimate of RRA is from the above moment condition, and the adjusted estimate corrects for the time aggregation by a factor of ½ following Breeden, Gibbons, and Litzenberger (1989). Implied R^f is based on the estimated risk aversion. The pricing errors are the root mean squared errors. First three columns present the results with the equity premium as the test asset with z_t instruments; the instruments are the lagged asset, liability, equity, and leverage growth, lagged consumption growth, lagged *cay*, consumption to wealth ratio from Lettau and Ludvigson (2001), and lagged price to dividend ratio. Next, the estimates of RRA with the risk-premium and risk-free returns are presented without instruments. Following Hansen, Heaton, and Li (2008) the subjective discount factor is pinned down at 0.95.

Iterated GMM estimates of RRA (γ) with β =0.95							
Test Assets	Equity Premium & Instruments						
	Consumption	Asset	Liability	Equity	Leverage	*cag*	*clg*
RRA (γ)	168.841	42.827	32.229	45.770	13.893	15.625	14.732
S.E.	44.909	9.133	6.796	14.357	8.082	6.795	5.784
Adjusted RRA (γ)	84.421	21.413	16.114	22.885	6.946	7.812	7.366
Implied R^f/Quarter	72.396	44.026	38.875	29.938	-6.448	8.073	6.965
Pricing Error	4.816	5.215	5.425	5.588	7.588	6.309	6.361
P-Value	0.797	0.665	0.638	0.720	0.544	0.415	0.425

Panel B: Iterated GMM estimates of RRA (γ) with β =0.95						
Test Assets	Excess Returns on FF25		Excess Returns on FF25 & R^f		Excess returns on FF 25, 10-yr Treasury, AAA, BAA bonds, & R^f	
	cag	*clg*	*cag*	*clg*	*cag*	*clg*
RRA (γ)	15.864	13.349	16.088	13.436	15.795	13.414
S.E.	7.203	3.916	6.975	5.694	5.918	3.334
Adjusted RRA (γ)	7.932	6.674	8.044	6.718	7.898	6.707
Implied R^f/Quarter	8.051	7.261				
Pricing Error	0.934	0.938	0.941	0.946	1.115	1.121
P-Value	0.009	0.009	0.010	0.009	0.019	0.019

Table 1.4
Intermediaries' assets and liabilities and risk aversion

This table presents relative risk aversion estimates. The moment conditions are

$$E\left[\beta\left(\frac{X_{t+1}}{X_t}\right)^{-\gamma} R_{t+1}\otimes z_t\right] = 1$$

Xs are: Consumption, intermediaries' Asset and Liability. RRA (γ) is the estimated relative risk aversion coefficient. GMM p-values are in the parenthesis. The first estimate of RRA is from the above moment condition, and the adjusted estimate corrects for time aggregation by a factor of ½ following Breeden, Gibbons, and Litzenberger (1989). Implied R^f is based on the estimated risk aversion. The pricing errors are the root mean squared errors. First three columns present the results with market returns and instruments described in Table 1.2. Next three columns present the estimates of RRA with market and risk-free returns and without instruments. Last three columns present the estimates with returns on the 25 Fama-French (1993) size and book-to-market portfolios (FF25) without instruments. For Asset and Liability, DF (β) the subjective discount factor is estimated for the first two models. Each subsequent models use the estimated β from liabilities.

Iterated GMM Estimates of RRA (γ) and DF (β)									
Test Assets	R^M & Instruments			R^M & R^f			FF 25		
	Asset	Liability	Consumption	Asset	Liability	Consumption	Asset	Liability	Consumption
			β = 1.034						
RRA (γ)	3.845	3.767	10.037	4.153	4.192	14.193	5.843	5.188	15.617
S.E.	0.266	0.211	1.019	0.417	0.337	1.637	0.404	0.303	1.346
DF (β)	1.032	1.034							
S.E.	0.006	0.004							
Adjusted RRA (γ)	1.922	1.883	5.018	2.077	2.096	7.097	2.921	2.594	7.808
Implied R^f/Quarter	1.264	1.385	1.263				3.811	3.314	3.111
Pricing Error	0.056	0.045	0.094	1.519	1.492	1.504	0.078	0.070	0.091
P-Value	0.005	0.004	0.005	0.048	0.049	0.048	0.004	0.004	0.005

Table 1.5
The estimates of relative risk aversion with conditional consumption

This table presents relative risk aversion estimates. The moment conditions are

$$\mathrm{E}\left[\beta\left(\frac{\mathrm{X_{t+1}}}{\mathrm{X_t}}\right)^{-\gamma} R_{t+1}\otimes z_t\right] = 1$$

Xs are: consumption and consumption conditioned with the growth of assets (*cag*) and liabilities (*clg*) respectively. RRA (γ) is the estimated relative risk aversion coefficient. GMM p-values are in the parenthesis. The first estimate of RRA is from the above moment condition, and the adjusted estimate corrects for time aggregation by a factor of ½ following Breeden, Gibbons, and Litzenberger (1989). Implied R^f is based on the estimated risk aversion. The pricing errors are the root mean squared errors. First three columns present the results with market returns and instruments described in Table 2. Next three columns present the estimates of RRA with market and risk-free returns without instruments. Last three columns present the estimates with returns on the 25 Fama-French (1993) size and book-to-market portfolios (FF25) without instruments. For *cag* and *clg*, the subjective discount factor, DF (β), is estimated (first two models). Each subsequent models use the estimated β from *cag*.

Iterated GMM Estimates of RRA (γ) and DF (β)									
Test Assets	R^M & Instruments			R^M & R^f			FF 25		
	cag	*clg*	Consumption	*cag*	*clg*	Consumption	*cag*	*clg*	Consumption
			β = 0.977						
RRA (γ)	0.336	0.351	19.416	2.680	2.351	32.243	1.824	1.479	24.981
S.E.	0.223	0.189	6.713	1.216	1.175	11.617	0.865	0.844	8.279
DF (β)	0.977	0.976							
S.E.	0.005	0.005							
Adjusted RRA (γ)	0.168	0.176	9.708	1.340	1.176	16.122	0.912	0.740	12.491
Implied R^f/Quarter	2.501	2.512	11.740				3.158	2.996	14.415
Pricing Error	0.054	0.051	0.083	0.734	0.730	0.723	0.073	0.072	0.079
P-Value	0.004	0.004	0.005	0.045	0.045	0.056	0.004	0.004	0.005

Table 1.6
Intermediaries' Equity and Leverage

This table presents relative risk aversion estimates. The moment conditions are

$$E\left[\beta\left(\frac{X_{t+1}}{X_t}\right)^{-\gamma} R_{t+1} \otimes z_t\right] = 1$$

Xs are: $\text{Equity} = (\text{Asset} - \text{Liability})$ and $\text{Leverage} = (\text{Asset}/\text{Equity})$. RRA ($\gamma$) is the estimated relative risk aversion coefficient. GMM p-values are in the parenthesis. The first estimate of RRA is from the above moment condition, and the adjusted estimate corrects for time aggregation by a factor of ½ following Breeden, Gibbons, and Litzenberger (1989). Implied R^f is based on the estimated risk aversion. The pricing errors are the root mean squared errors. First two columns present the results with market returns and instruments described in Table 2. Next two columns present the estimates of RRA with market and risk-free returns without instruments. Last two columns present the estimates with returns on the 25 Fama-French (1993) size and book-to-market portfolios (FF25) without instruments. For Equity and Leverage, the subjective discount factor, DF (β), is estimated for the first two models. Each subsequent models use the respective β estimates.

Iterated GMM Estimates of RRA (γ) and DF (β)						
Test Assets	R^M & Instruments		R^M & R^f		FF 25	
	Equity	Leverage	Equity	Leverage	Equity	Leverage
			β = 0.95			
RRA (γ)	-1.857	3.433	-0.560	-104.252	-3.428	1.335
S.E.	1.128	0.580	0.584	14.878	0.319	0.500
DF (β)	0.952	0.956				
S.E.	0.014	0.005				
Adjusted RRA (γ)	-0.928	1.717	-0.280	-52.126	-1.714	0.502
Implied R^f/Quarter	3.143	1.912			1.481	3.564
Pricing Error	0.069	0.051	0.614	1.397	0.094	0.074
P-Value	0.005	0.004	0.044	0.230	0.005	0.005

Table 1.A.1
Financial Intermediaries and their assets

This table describes the intermediaries. Quarterly data is obtained from the Federal Flow of Funds for the 1955-2009 sample period.

Financial Intermediaries						
Intermediary Group	Members	Assets (US$ trillion) by Group				
		Mean	Median	Std. Dev.	Min.	Max.
Insurance Companies	Life Insurance Property and Casualty Insurance	1.64	0.65	1.90	0.08	6.36
Pension Funds	Private Pension Funds Federal Govt. Retirement Funds State Govt. Retirement Funds	2.59	0.79	3.21	0.02	10.99
Banks	Commercial Banks Credit Unions Savings Institutions	3.95	2.34	4.23	0.20	16.86
Shadow-banks	Asset Backed Securities Agency/GSE Mortgage Pools Funding Corporations Finance Companies	2.42	0.34	3.70	0.01	13.79
Mutual Funds	Money Market Funds Mutual Funds Closed End Funds Exchange Traded Funds	1.97	0.15	3.10	0.01	11.18
Securities Brokers & Dealers	Securities Brokers & Dealers	0.46	0.05	0.77	0.00	3.24
Total Assets		16.98	6.65	20.91	0.53	73.66

Figure 1.1

Claim on assets through intermediaries

This figure shows the intertemporal individuals' consumption-savings decisions and the role of intermediaries in the exchange process. At date 0, individuals are endowed with $W_0 = C_0 + xC_0$, where C_0 is consumption and xC_0 is saved through intermediaries. At date 1, individuals consume C_1, which they receive from intermediaries.

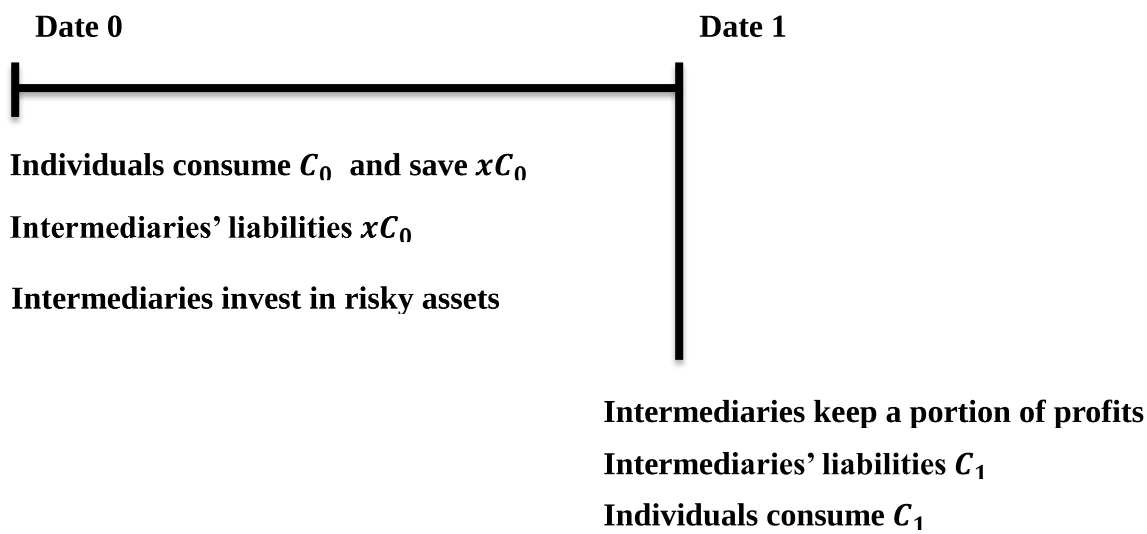


Figure 1.2
The time series of intermediaries' assets and consumption growth

This figure shows the time series of quarterly consumption growth and assets growth for six intermediary groups (commercial banks, mutual funds, securities brokers and dealers, retirement/pension funds, insurance companies, and shadow-banks) over the sample 1955 through 2009. Gray bands indicate NBER recessions. Both series are standardized for ease of comparison.

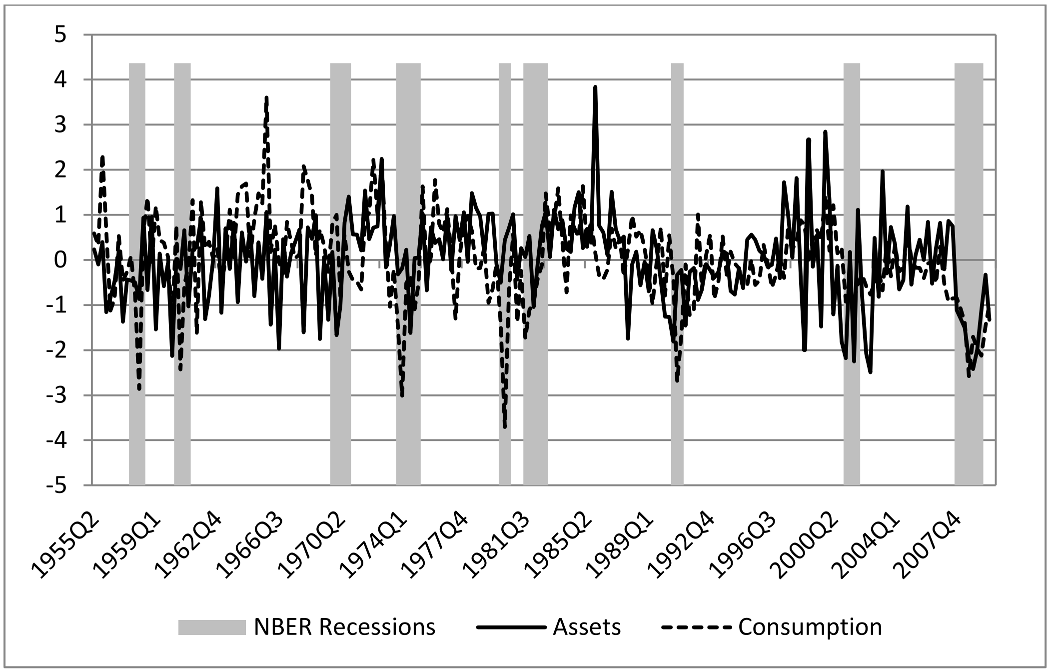


Figure 1.3
RRA Sensitivities to subjective discount rates

This figure shows the sensitivity of RRA with the subjective discount rate.
Figure A compares RRA sensitivity for Asset and Consumption Growth; the left axis is for RRA sensitivities to Consumption Growth, the right axis is for RRA sensitivities to Asset Growth.
Figure B compares RRA sensitivities to Asset and Liabilities Growth.

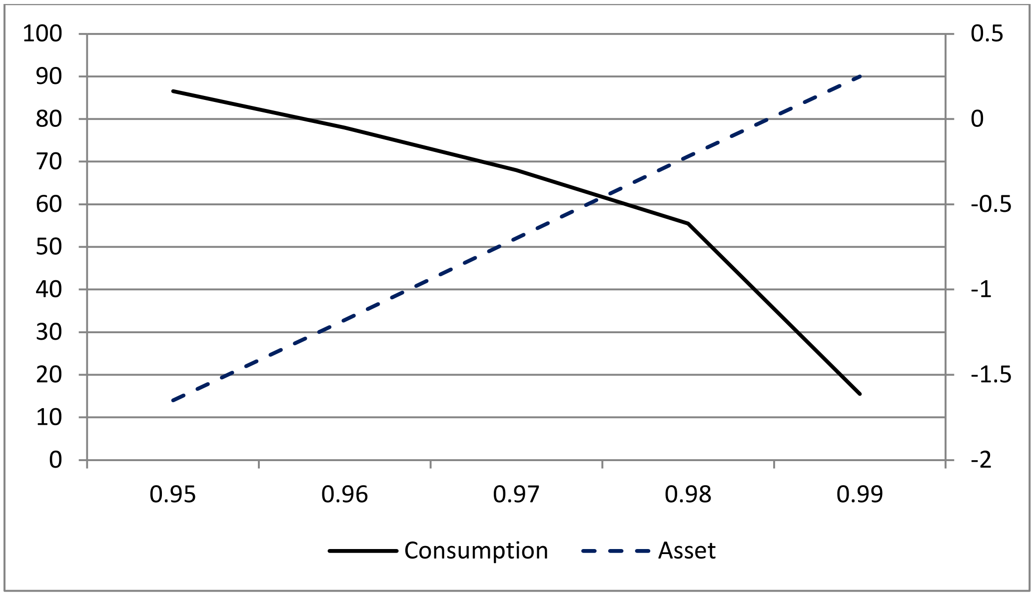


Figure A: Comparison of RRA sensitivity for Asset and Consumption Growth

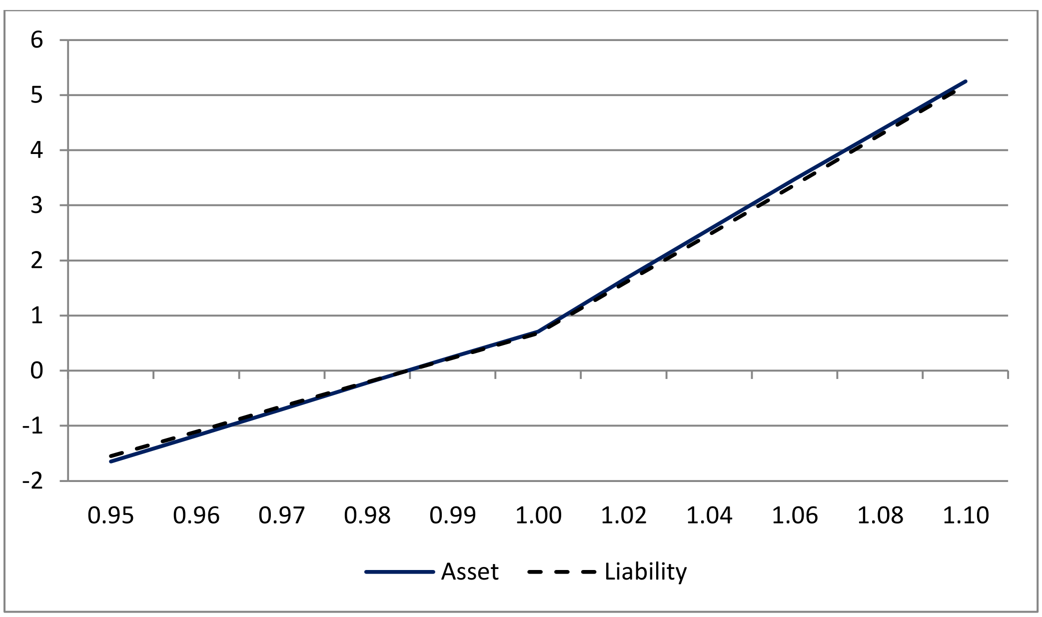
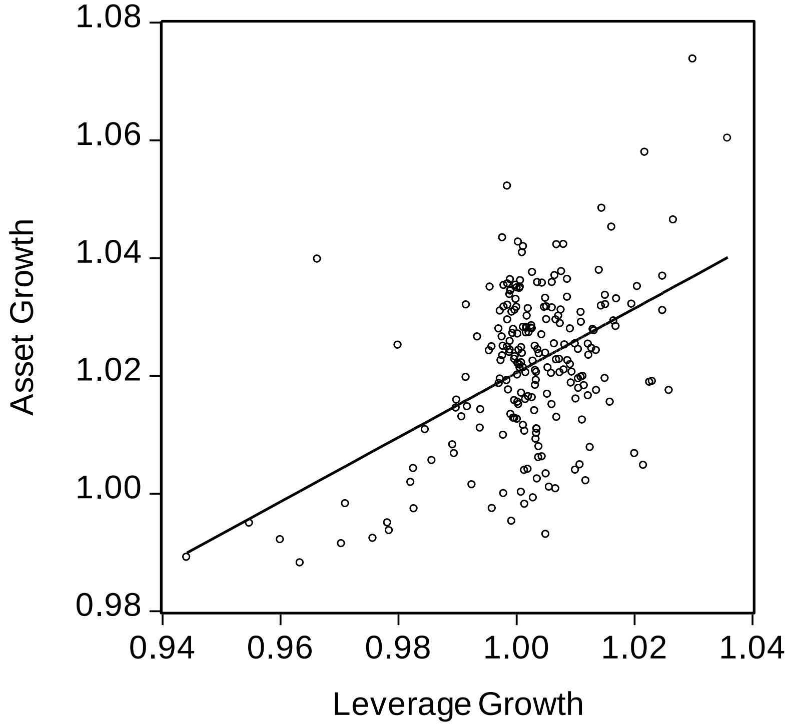


Figure B: Comparison of RRA sensitivity for Asset and Liabilities Growth

Figure 1.4
Intermediaries' procyclical leverage

The figure shows the scatter plot of the leverage growth versus the asset growth for six intermediary groups (commercial banks, mutual funds, securities brokers and dealers, retirement/pension funds, insurance companies, and shadow-banks). The data is from the Federal Flow of Funds for 1955-2009. The figure also plots the regression line.



Chapter 2

Intermediary-augmented investment-based asset pricing: Theory and Evidence

2.1 Introduction

Common sense tells us that individuals save through financial intermediaries, such as banks, in risky assets, such as stocks. It is also intuitive that firms borrow from intermediaries rather than from individuals because financial intermediaries help reduce asymmetric information between borrowers and savers. However, there are many neoclassical investment- and productivity-based asset pricing models where firms are assumed to have intermediated external funds at some cost, that is, the external funds supply is elastic. For this strand of the literature, financial intermediation is exogenous and firms pay a shadow price for external funds; financially constrained firms relative to unconstrained firms pay more for external funds. The underlying assumption is that frictions transferring funds from financial intermediaries to firms are captured by the shadow cost of external funds. We, however, argue that the shadow price of external funds is a necessary but not the sufficient condition for acquiring external financing. The rationale is that intermediaries may not be able to provide any funding even though there is a price for it. We show that financial intermediation risk is an important and distinct issue that the existing literature does not address.

Our model builds on the model of Gomes et al. (2006) who examine the asset pricing implications of firm financial constraints. However, we relax their model assumption that firms have access to intermediated credits, and allow firm managers to work under the uncertainty of external funds that intermediaries provide. We show that the stochastic discount factor for stock returns is affine in intermediary funding shocks. This is the primary contribution of the paper.

We measure intermediary funding shocks by the growth of intermediaries' balance sheet variables, such as assets. Next, we conduct stylized empirical tests to ascertain that intermediary funding shocks or intermediation factors are important in explaining stock returns. Finally, we show that intermediation factors are priced in the cross-section of stock returns.

Literature (Merton (1971, 1973), among others) suggests that factors driven by economic fundamentals must explain why some asset returns are higher than others. Cochrane (1999) further observes that macroeconomic factors are easier to motivate theoretically but none explains the value and size premium as well as portfolio-based factors do. The results in this paper show that intermediation factors explain value and size premiums. To our knowledge, no other macro factor can explain value and size premiums as well as intermediation factors do.

Cochrane (1999) notes that fundamentally determined macro factors may help explain why the portfolio-based factors, such as the SMB and HML factors (Fama and French, 1993), explain the cross-section of stock returns so well. We show that the SMB and HML factors are explained by systematic intermediation risk and that the external funds supply for small and value relative to large and growth firms are more volatile. As a consequence, the SMB spread expands and the HML spread contracts with the positive intermediation shock.

While explaining the value and size premium is important, predicting market excess returns is another important criterion that an asset pricing factor must fulfill (see Merton (1973), Santos and Veronesi (2006), among others). The reason is that factors cannot possibly both explain the cross-section of stock returns and predict stock returns spuriously. We show that intermediation factors predict stock returns.

A true factor must also explain the cross-section of stock returns, but this should be the final asset pricing test. We show that that intermediations factors outperform investment-based (Cochrane, 1996), and productivity-based (Balvers and Huang, 2007) factors in the cross-sectional tests.

The implications of our empirical results are two folds. First, we show that the shadow price of external funds may not capture systematic intermediation risk.[11] Stock portfolios formed on firm size are known to capture the level of firm financial constraints, and hence size-based stock portfolios indirectly capture the shadow price of external funds (see Gertler and Gilchrist (1994), Perez-Quiros and Timmermann (2000), Campello and Chen (2010), among others). Our empirical results show that intermediation factors explain size-based stock portfolio returns, and that intermediation factor loadings for small stock returns are larger than

[11] We thank an anonymous seminar participant at Universitat Pompeu Fabra to point out the issue that the shadow price of external funds may capture the intermediation risk.

that of large stock returns. Hence, we argue that if intermediation risk were entirely captured in the shadow price of external funds, then intermediation factors would not have any explanatory power for size-based stock portfolio returns. We further argue that in a bad state of the world, outrageous shadow prices of external funds would exclude firms from receiving any financing.[12] Hence, intermediation risk and the shadow price of external funds are related but distinct issues.

Second, the results in this paper pose considerable challenges to the notion that financial frictions can be captured by the default premium, defined as the yield spread between Aaa and Baa rated corporate bonds. Bernanke (1989), and Stock and Watson (1989, 1999) show that the default premium is one of the most powerful predictors for economic activities. Gomes et al. (2006) further argue that the default premium captures aggregate financial frictions and that the shadow price of external funds is a linear function of the default premium. We show that intermediation risk is more important than the default premium in predicting stock returns and in explaining value and size premiums. Thus, the results suggest intermediation risk is another source of risk that may not be captured by the default premium.

This paper is related to studies that investigate frictions in supplying credits. On the microeconomic front, Q-theory based investments research has a long tradition in investigating the shadow price of external funds.[13] On the macroeconomic front, there exists an extensive body of work that investigates financial frictions in supplying credit. The existing literature (e.g., Bernanke and Gertler, 1989) study the effect of macroeconomic shocks and business cycles

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[12] We thank Pete Kyle for pointing it out. For example, a highly constrained firm that is willing to pay 100% interests on borrowings will be immediately cutoff from external funding. The reason is that it raises questions about the credibility of the firm.

[13] A partial list includes Hennessy and Whited (2006) and Hennessy (2004).

on firms' demand for funding, and on firms' ability to secure external financing. The central thread that connects both the macroeconomic and microeconomic research is that financial imperfections lead firms to react heterogeneously, and that frictions such as asymmetric information often play a significant role in determining the supply of credits.

Intriguingly, investigating the role of financial intermediaries in supplying credits in a financially imperfect world is relatively rare. Within microeconomic research, intermediaries' funding is exogenous and firms' financial constraints are evaluated by considering firm-level financial variables. However, irrespective of whether firms are financially constrained or not, firms rely on intermediaries for external funds. Given a set of investment opportunities, a value maximizing manager would optimally choose internal and external funds. However, the existing investment-based asset pricing literature does not answer two important questions. Are optimally chosen external funds available at any given instant? How do fluctuations in external financing affect firm investments decisions, and hence affect investment returns? We answer these questions by incorporating intermediaries' funding constraints into the firm value optimization problem.

The paper is related to the literature (e.g., Holmstrom and Tirole (1997), among others) that investigate the effect of capital constraints of firms and intermediaries on investments. The paper is also related to recent studies that derive asset prices in the presence of intermediaries, such as the models of He and Krishnamurthy (2011 and 2012) and Brunnermeir and Sannikov (2011). However, these studies do not investigate whether fluctuations of intermediaries' wealth can explain stock returns.

Guided by the Brunnermeier and Pedersen (2009) model, Adrian et al. (2012) consider a stochastic discount factor for excess returns that is affine in brokers and dealers' leverage shocks and show that brokers and dealers' leverage is priced in the cross-section of stock returns. However, Johnson (2008) argues that controlling for the aggregate financial position of the economy, there should not be any role for the financial position of securities dealers and brokerage firms in explaining aggregate fluctuations of overall market liquidity. Hence, we argue and show that the stochastic discount factor for asset returns must be derived from the aggregate financial position of intermediaries rather than from the funding liquidity of brokers and dealers. The empirical results show that brokers and dealers' leverage shocks as an asset pricing factor fails to conform to stylized asset pricing tests we conduct.

The essay is organized as follows. Section 2.2 presents the model that derives the intermediary-augmented investment-based asset pricing kernel. Section 2.3 describes data. Section 2.4 presents the empirical results. Section 2.5 concludes.

2.2 The model

The model builds upon the existing literature on neoclassical investment-based asset pricing models.[14] In contrast to the existing literature, however, we do not assume that firm mangers have access to intermediated credits; that is, we do not assume that the external funds supply is elastic. Instead, we argue that firms are able to raise only a portion of the demanded external funds at any given instant. The reason is that when intermediaries are themselves financially

[14] An incomplete list includes Cochrane (1991, 1996); Livdan et al. (2009); Liu, Whited, and Zhang (2009); and Gomes et al. (2006).

constrained, they do not provide funding to all firms in the economy.[15] We illustrate the issue at hand with a simple example.

Suppose firms demand x *dollars*. As per the existing literature, each firm can raise x dollars but firms pay varying external financing costs depending on the level of firm financial constraints; financially constrained firms relative to financially unconstrained firms pay more for external funds. However, we argue that intermediaries provide a Ω fraction of the demanded funds. That is, firms are able to raise $\Omega * x$ *dollars* externally. Irrespective of the level of firm financial constraints and the shadow price of external funds, the same firm can have Ω that varies from 0 to 1. Alternatively, depending on intermediaries' financial constraints, firms are able to raise *zero* to x *dollars*. Specifically, we argue that while the shadow price of external funds are important, intermediation risk is a distinct issue: the shadow price of external funds sets the financing term, but it does not guarantee that firms are able to raise external funds.

To address the discussed issue, we define the fund allocation function $\Omega(K_t, \zeta_t) \in [0\ 1]$ that captures the funds supply elasticity. Since firm-size has long been used as a proxy for firm financial constraints in the literature (see Gertler and Gilchrist (1994), Perez-Quiros and Timmermann (2000), Campello and Chen (2010), among others), we believe firm size is one of the determinants for intermediaries' funding decisions. Firm size is also known to affect firm external financing (see Holmstrom and Tirole (1997), among others). Hence, K_t, the firm capital stock, is one of the arguments of $\Omega(K_t, \zeta_t)$. The variable ζ_t is exogenous, and it captures firms' production innovations such as input costs, output prices, and productivity that affect the

[15] The issue is quite evident from the ongoing intermediary triggered financial crisis in the U.S and Europe.

firm capital accumulation. Alternatively, ζ_t summarizes all forms of uncertainty. While the nature of the evolution of Ω with the business cycle is investigated in sub-section 4.3, we do not specifically model Ω because the exact mathematical form of Ω has no bindings on what follows. Instead, we investigate how firms respond to the innovation in Ω in an investment-based asset pricing framework.

2.2.1 The derivation of investment returns

This section derives firm investment returns. The derivation follows the existing literature (e.g., Cochrane 1991 and 1996, and Gomes et al., 2006), but the condition that the external funds supply is elastic is relaxed.

Model assumptions and setup:

1) A value maximizing manager optimizes firm value $V(.)$, and she needs external financing. The manager has complete access to financial markets.
2) Firms investment, I_t, and investment decisions are made by choosing the optimal amount of capital at the beginning of the next period, K_{t+1}. Investment spending and dividends are financed by internal cash flows from gross profit and external funds that intermediaries provide.
3) The external *funds demand* is new equity, X_t, and new one-period debt, B_{t+1}. One-period debt simplifies the notations without changing the asset pricing implications (see Gomes et al., 2006). Since intermediaries provide a Ω fraction of the demanded external funds, the new external *funds supply* is $\Omega_t(K_t, \zeta_t)(X_t + B_{t+1})$.

4) The gross profit function $\Pi(K_t, \zeta_t)$ is linear in capital, and K_t, the capital stock, depreciates at the rate of δ. The exact mathematical form of Π is not important in the current context.

5) The adjustment costs per unit of capital $\Psi(K_t, I_t)$ are convex with $\alpha > 0$ as the curvature.

Under the above assumptions, the firm value maximization problem can be written as

$$V(K_t, \Omega_t, B_t, \zeta_t) \equiv \max_{\{K_{t+1}\}}\{D_t - X_t\Omega(K_t, \zeta_t) + E_t[M_{t+1}V(K_{t+1}, \Omega_{t+1}, B_{t+1}, \zeta_{t+1})]\} \quad (1)$$

where D_t is the dividend and M_{t+1} is the stochastic discount factor for firm owners between time t to $t+1$. $X_t\Omega(K_t, \zeta_t)$ captures the firm value dilution effect following the new equity issuance X_t, where for simplicity we have assumed that there is one to one correspondence between the value dilution and new equity issuance, and this assumption has no bindings on the model (see Gomes et al., 2006).

Dividends are net of gross profits, new external funds, investments, debt repayments, and the adjustment cost to capital.

$$D_t = \Pi(K_t, \zeta_t) + \Omega(K_t, \zeta_t)(X_t + B_{t+1}) - I_t - R_t\Omega(K_{t-1}, \zeta_{t-1})B_t - \Psi(K_t, I_t)K_t \quad (2)$$

Where adjustment costs to capital is $\Psi(K_t, I_t)K_t = \frac{\alpha}{2}[\frac{I_t}{K_t}]^2 K_t$ (3)

the capital accumulation follows $K_t = I_t + (1-\delta)K_t$ (4)

and the dividend constraint is $D_t \geq \overline{D}$ (5)

where $\overline{D}$ is the dividend bound based on firms' dividend policies, and R_t is the gross (interest plus principle) repayment per dollar of debt raised.

Let λ_t be the Lagrange multiplier, the shadow cost of external funding, associated with the constraint (5). If $\mathrm{M}_{\mathrm{t+1}}$ follows $\mathrm{E}[\mathrm{M}_{\mathrm{t+1}}\mathrm{R}^{\mathrm{I}}_{\mathrm{t+1}}] = 1$ then investment returns are given by (derived in the appendix A)

$$\mathrm{R}^{\mathrm{I}}_{\mathrm{t+1}} = \frac{1+\lambda_{t+1}}{1+\lambda_t}\frac{\{\Pi_{k+1}+\Omega_{k+1}(B_{t+2})+\frac{\alpha}{2}i^2_{t+1}+(1-\delta)(1+\alpha i_{t+1})\}}{(1+\alpha i_t)} \qquad (6)$$

where, $i_t = I_t/K_t$, $\Pi_{k+1} = \delta\Pi(K_{t+1}, \zeta_{t+1})/\delta K_{t+1}$, and $\Omega_{k+1} = \delta\Omega(K_{t+1}, \zeta_{t+1})/\delta K_{t+1}$.

To gain a better understanding of the role of financial intermediation equation (6) could be decomposed into firm specific and financial intermediary specific components as:

$$\mathrm{R}^{\mathrm{I}}_{\mathrm{t+1}} = \mathrm{R}^{a}_{t+1}|_{\mathrm{FirmSpecific}} + \mathrm{R}^{b}_{t+1}|_{\mathrm{IntermediaryFundingSpecific}} \qquad (7)$$

where,

$$\mathrm{R}^{a}_{t+1}|_{\mathrm{FirmSpecific}} = \frac{1+\lambda_{t+1}}{1+\lambda_t}\{\Pi_{k+1} + \frac{\alpha}{2}i^2_{t+1} + (1-\delta)(1+\alpha i_{t+1})\}/(1+\alpha i_t) \qquad (8)$$

$$\mathrm{R}^{b}_{t+1}|_{\mathrm{IntermediaryFundingSpecific}} = \frac{1+\lambda_{t+1}}{1+\lambda_t}\{\Omega_{k+1}(B_{t+2})\}/(1+\alpha i_t) \qquad (9)$$

Equation (6) shows that investment returns, in addition to firm specific characteristics, depend on intermediaries' funding shocks captured by Ω_{k+1}. Equation (6) further shows that a) if $\lambda_t = \lambda_{t+1}$ then financial constraints have fixed effect on firm investment returns and b) if $\lambda_t \neq \lambda_{t+1}$ then financial constraints have variable effects on firm investment returns.

Gomes et al. (2006) argue that if $\lambda_t = \lambda_{t+1} = 0$ then investment returns are driven by firm fundamentals, such as i_t and Π_{k+1}. However, we show that even if $\lambda_t = \lambda_{t+1} = 0$, investment returns depend on external funding risk. Alternatively, even if financial markets are perfect, firms face the uncertainty of securing external funds.

Equation (9) is the essence of our model. It shows that Ω_{k+1}, the marginal funding that intermediaries provide relative to firm capital is one of the determinants of investment returns.

If intermediaries' funds supply relative to firm capital remains unchanged, $\Omega_{k+1} = 0$, then financial intermediation has no effect on investment returns and equation (6) transforms to equation (8), which is the expression Gomes et al. (2006) derive. Generally, intermediaries' funds supply relative to firm capital fluctuates, that is, $\Omega_{k+1} \neq 0$, and hence innovations in external funds produce time series variations in investment returns. The economic interpretation of equation (9) is that it captures the cyclical component of leverage in investment returns. The relationship further shows that the shadow price for external funds is a necessary but not the sufficient condition for external funds. That is, we show that the shadow price and the risk of securing external funds coexist.

2.2.2 Testable implications

We want to empirically investigate whether the intermediary specific component given by equation (9) has asset pricing implications. In particular, we test

$$E_t[\mathrm{M}_{t+1}\mathrm{R}_{t+1}] = 1 \qquad (10)$$

where M_{t+1} is the stochastic discount factor and R_{t+1} is a vector of asset returns including stocks, bonds, and R^I_{t+1} from equation (6). Following the investment-based asset pricing literature (Cochrane (1996), Gomes et al. (2006), among others), we parameterize the stochastic discount factor as a linear function of investment returns.[16]

$$\mathrm{M}_{t+1} = l_0 + l_1 R^I_{t+1} \qquad (11)$$

[16] Equation (11) provides a reasonable approximation. However, in complete general equilibrium setup one can derive the stochastic discount factor in terms of investment returns from economic theories. In Appendix C, we provide one such model where it is shown that the stochastic discount factor is inversely related to investment returns.

Equation (11) thus shows that the stochastic discount factor for asset returns is affine not only in productivity shocks R^a_{t+1} but also in intermediation shocks R^b_{t+1}. Note that the existing investment-based models have R^a_{t+1}. We argue that R^b_{t+1} is more important and may encompass R^a_{t+1} in explaining the stock returns dynamics.

One important implication of equation (11) is as follows. Brunnermeir and Pedersen (2009) argue that the funding liquidity of traders determines the pricing kernel for the cross-section of securities. Based on the Brunnermeir and Pedersen (2009) model, Adrian et al. (2012) show that securities brokers and dealers' leverage is priced in the cross-section of stock returns. However, the Johnson (2008) model suggests that controlling for the aggregate financial position of the economy, there should not be any role for the financial position of securities dealers and brokerage firms (i.e., traders) in explaining aggregate fluctuations of overall market liquidity. While investigating traders' liquidity is important in the crisis management, studying the liquidity dynamics with a larger set of intermediaries has far more economic ramifications. Since traders are involved dealing with marketable securities, their reach for assets in the economy is limited. By contrast, intermediaries in *aggregate* enter into transactions that involve every conceivable asset in the economy. The model presented here shows that any intermediary, including traders, or intermediaries in *aggregate*, determines the pricing kernel. In the empirical section of the paper, we show securities brokers and dealers' leverage fails important asset pricing tests that we discuss next.

Asset pricing theories at least since Merton (1971, 1973) recognized that factors driven by economic fundamentals must explain asset returns anomalies. In this paper, we conduct stylized asset pricing tests to show that intermediation factors derived from the intermediaries' balance sheet growth directly addresses the issue. While the existing factors motivated by economic fundamentals may be sound from a theoretical perspective, we show that these factors fail to conform to stylized asset pricing tests. One of the plausible reasons for failures for such factors is perhaps driven by measurement errors. We show that factors driven by economic fundamentals and measured from a readily available intermediation dataset with minimal data transformations can explain such stylized facts such as the value and size premium. This is the essence of our empirical tests.

The primary testable implication is to investigate whether R_{t+1}^{b} is an economically important factor for stock returns. Since we want to investigate the systematic effect of intermediation shocks on stock returns, we use the growth of assets of a large number of the U.S. intermediaries to proxy for R_{t+1}^{b}, and this is the primary intermediation factor. Since intermediaries' assets evolve endogenously with other balance sheet variables, we also consider the growth of other balance sheet variables, such as leverage, to proxy for intermediation shocks. The usage of the growth of balance sheet variables to proxy for intermediary funding shocks is common in the literature (e.g., Adrian and Shin (2009), Adrian et al. (2012), among others).

Though simplistic, the argument that the balance sheet growth proxy for R_{t+1}^{b} parallels that of Cochrane's (1991) in three ways. First, since aggregated capital does not change considerably within a short time interval, the intermediary funding specific investment returns component (see equation 9) is proportional to the innovations in intermediaries' balance sheet variables. Second, the term $(1 + \alpha i_t)$ is fairly steady in aggregate; Cochrane (1991) estimates that i_t has a mean of 0.137 and α is about 13.04. Third, we presume that in the first difference all noises are eliminated. We have also assumed that $\lambda_t = \lambda_{t+1}$, that is, the shadow price for external funds is constant over a short time interval. This allows for focusing on the role of intermediary funding shocks on stock returns. We, however, control for firm financial constraints to account for the shadow price for external funds in the empirical tests.

Cochrane (1996) observes that for the lack of explicit productivity shocks data, investment returns proxy for R^a_{t+1}. While Cochrane (1996) uses residential- and non-residential investment returns as factors for asset returns, we use aggregated private-investments returns as the investment factor. The specification we adopted is also consistent with the literature (Balvers and Huang, 2007).

Balvers and Huang (2007) (BH hereafter) show that without adjustment costs to capital R^a_{t+1} is same as $F_k(\theta_{t+1}, n_{t+1}, k_{t+1})$, where F_K is the partial derivative of the production function with respect to capital k_{t+1}, θ_{t+1} is the productivity, and per-capita inputs into the production process are labor n_{t+1} and capital k_{t+1}.[17] The productivity level follows the Markov process $\theta_{t+1} = H(\theta_t, \epsilon_t)$, where ϵ_t are productivity shocks. They argue that asset returns in the cross-section can be explained by the innovations in ϵ_t, and that conditioning ϵ_t with θ_t and k_t is important since productivity and capital are time-varying. Their unconditional and conditional productivity-shocks-based factors perform well relative to investment returns (and other alternative factors) in explaining the cross-section of stock returns. As a result, we employ BH productivity factors to proxy for R^a_{t+1}. We denote productivity

[17] BH further show that investment growth and productivity shocks are positively related with unit elasticity.

factors as PF1 and PF2, where the first factor is unconditional productivity shocks and the latter is productivity shocks conditioned with the *productivity state*, which is derived from the cointergrating residuals of θ_t and k_t. The construction of the productivity factors is described in the Appendix B. We use productivity factors of BH throughout the paper for robustness checks.

Given the discussions above, the testable factor analogues of equation (11) are written as follows. The investment-based stochastic discount factor is

$$\mathrm{M}_{t+1} = \alpha_1 + \beta_1 f_{t+1}^1 \tag{12}$$

where f_{t+1}^1 is measured either by investment returns following Cochrane (1996) or by the productivity factors of BH.

The intermediation-augmented investment-based stochastic discount factor is written as

$$\mathrm{M}_{t+1} = \alpha_2 + \beta_1 f_{t+1}^1 + +\beta_2 f_{t+1}^2 \tag{13}$$

where f_{t+1}^2 is measured by the growth of intermediaries' balance sheet variables.

2.3 Data

The quarterly-sample under investigation dates from the first quarter of 1955 to the fourth quarter of 2009. Unless noted otherwise, all data are obtained from the Federal Reserve Bank of New York. Intermediaries' balance sheet data is obtained from the Federal Flow of Funds. The balance sheet data at the Federal Flow of Funds are reported at the subsidiary level, and hence any possibility of double counting is eliminated. Following Adrian and Shin (2009), we include 17 intermediaries to proxy for the U.S. financial intermediation, and these intermediaries are grouped into six categories: banks, mutual funds, pension funds, insurance companies, securities brokers & dealers, and shadow-banks.[18] Table 2.1 presents the descriptive statistics for these intermediaries. For the subsequent analysis, we aggregate intermediaries' balance sheet data, and following balance sheet variables are used: assets, liabilities, $\text{equity} = (\text{assets} - \text{liabilities})$,and leverage, where leverage is defined as $\text{leverage} = (\text{assets}/\text{equity})$. Intermediation factors are the growth of the above four variables.

We obtain Fama-French factors, size and book-to-market portfolios, and risk free (T-bills) rates from Ken French's website. Investments data are obtained from the Bureau of Economic Analysis. *cay*, the consumption to wealth ratio of Lettau and Ludvigson (2001) is obtained from Martin Lettau's website. Productivity shocks data is obtained from Ronald Balvers's website. Adrian et al. (2012) show that securities brokers and dealers' leverage is priced in the cross-section of stock returns; hence, we obtain 'the leverage factor' from Tyler Muir's website.

We get consistent intermediation data from the first quarter of 1951. However, to account for the initial data reporting errors we discard data from 1951 to 1954. As a result, the final sample is from 1955 through 2009. Since we have access to productivity shocks data from 1964 through 2004, whenever productivity shocks data are used for the analysis, we use the above sub-sample. The sub-sample analysis allows for additional robustness checks.

2.4 Main empirical results

The empirical results show that intermediation factors are significantly correlated with excess

18 See Pozsar, Adrian, Ashcraft, and Boesky (2010) for more details about shadow banking.

market returns. These factors explain not only the return variations of small and value stocks but also the Fama-French SMB and HMB factors. When intermediation factors are paired with investment returns or BH productivity factors, intermediation factors maintain their explanatory powers for stock returns. Importantly, none of the competing factors can explain value and size premiums by themselves or in the presence of intermediation factors. Intermediation factors further predict excess market returns, and hence behave as state variables. By contrast, investment returns and BH productivity factors have limited predictive poser for excess market returns.

2.4.1 Summary statistics

Table 2.2 Panel A compares the distribution of the intermediation and competing factors. The factors are: the growth of intermediaries' financial assets (ASSET), liabilities (LIAB), equity (EQUITY), leverage (LEV), returns on investments (INV) in excess of T-bill returns, and BH productivity factors: PF1 and PF2.

Except for EQUITY, Table 2 Panel A shows that the correlation between all balance sheet variables and excess returns on value-weighted NYSE stocks (MKT) is above 60%. INV is inversely correlated to MKT and the inverse relationship is well established in the literature (see the Appendix C for the formal derivation), and productivity factors are positively correlated to MKT.

Table 2.2 Panel B reports the auto-correlation structure of intermediation factors. While EQUITY and LEV shows some level of persistence, ASSET and LIAB are neither persistent nor random; ASSET and LIAB follow a pulsating wave pattern where positive pulses come in every second and fourth quarter.

Figure 2.1 provides a graphical comparison of ASSET and INV in the first plot. The second plot in figure 1 compares ASSET and PF1.

The first plot shows that intermediaries' asset growth is far more volatile than investments returns and the pattern is consistent throughout the whole sample. The plot also suggests that INV lags behind ASSET, and the lag is more pronounced during recessions.

The lower volatility of INV relative to ASSET is interpreted as follows. Production processes require investments, which is sourced internally from firm profits, and externally by borrowings from intermediaries. Since intermediaries have the ability to monitor firm productivity, they are more likely to allocate their lending efficiently. In a bad state of the world, lower firm productivity leads to lower funding and *vice versa*. Alternatively, intermediation shocks are more volatile. On the contrary, *aggregated* investments are persistent. The reason for which is that the resource allocation from unproductive to productive assets at the firm level requires time. Among other reasons, adjustment costs to capital reduce firms' ability to mobilize their resources proactively. Hence, investments are far less volatile than asset growths, that is, *aggregated investments* are less volatile than intermediation shocks.

We interpret the investments lag, specifically during recessions, as follows. During recessions not only firm profitability falls but also external financing becomes difficult. Hence, investments suffer from two fronts. The plot seems to capture the effect by the sharp decline in investments towards the end of recessions. Unreported Granger Causality tests show that intermediaries' asset growth indeed predicts investments but the reverse is not true.

Looking at the second plot, we observe that ASSET is more volatile than PF1. While the volatility of productivity shocks is more prominent before the 1980s, the volatility of asset growth is dominant in the rest of the sample. We do not observe any discernible lead-lag pattern between those two factors. Unreported Granger Causality tests confirm the absence of any relationship between the two. To save space, we do not plot PF2 or the productivity state since the relationship is similar to that for PF1.

2.4.2 Explaining value & size premiums

Cochrane (1999) notes that macroeconomic factors are easier to motivate theoretically but none explains the value and size portfolios as well as Fama-French factors do. Cochrane (1999) further observes, "*….the next step is to link these more fundamentally determined factors with the empirically more successful value and small-firm factor portfolios. Because of measurement difficulties and selection biases, fundamentally determined macroeconomic factors will never approach the empirical performance of portfolio-based factors. However, they may help to explain which portfolio-based factors really work and why.*"

In retrospect, we examine the statistical and economic significance of intermediation factors *vis*-à-*vis* the value and size premium. We follow the Fama and French (1993) procedure where size and book-to-market portfolios are used to evaluate the factor performance. We estimate factor loadings from the following regression following Fama and French (1993).

$$\mathrm{R}_{i,j}^{e} = constant + b_{i,j}R_X + \varepsilon \qquad (14)$$

where $R^e_{i,j}$ represents excess returns on 25 Fama-French size and book-to-market portfolios, and R_X is a factor. If factors are portfolio returns then excess returns are used to evaluate the loadings. If factors are not returns, then the factor growth is used to estimate the loadings. In addition to the factors described earlier, we have included the CAPM (MKT) as an additional factor to compare the results with that of Fama and French (1993).

Table 2.3 Panel A replicates Table 4 of the Fama and French (1993) paper, where the explanatory variable is MKT. Table 3 Panel A also reports the loadings of ASSET for the ease of comparison. The loadings of MKT on the size and book-to-market portfolios are similar to the Fama and French's (1993) results. Looking at the results for RFOA, it loads more on the value and small stocks than the high book-to-market and large stocks, and hence explains value and size premiums. In terms of the factor loading pattern, ASSET loads size and book-to-market portfolios as well as MKT does. In terms of the loading sensitivity, however, stocks are more sensitive to ASSET than MKT. Alternatively, stocks are more sensitive to systematic intermediation risk than systematic stock market risk.

Table 2.3 Panel B presents the loadings of INV, and it shows that the loadings are erratic and often statistically insignificant. Hence, INV cannot explain value and size premiums.

For parsimony, we do not report the factor loadings of PF1 and PF2. While the statistical significance is below 10% for big and high book-to-market stock portfolios, factor loadings are reasonably good. Since the loadings for big and high book-to-market stocks are not as robust, we investigate whether PF1 and PF2 can explain the Fama-French SMB and HML factors in the next sub-section.

Looking at the loadings of LIAB and LEV on size and book-to-market portfolios reported in Table 2.3 Panel C, we observe that LIAB and LEV loads the portfolios as well as ASSET does. Since balance sheet variables commove, the loadings of the growth of liabilities and leverage are similar to that of assets. Since EQUITY loads size and book-to-market portfolios like other intermediation factors the results are not reported. We also omit ROL, the growth of liabilities, from subsequent analyses because liabilities and assets are highly correlated, and hence all tests including the loadings on size and book-to-market portfolios for LIAB and ASSET are similar.

The results above show, even if we control for firm financial constraints by firm size, and hence shadow costs of external funds, intermediation risk remains a robust and dominant factor to explain stock returns. That is, the results imply that intermediation risk and firm financial constraints may coexist.

To check the robustness of the results, we control for financial frictions. Following Gomes et al. (2006), we use the default premium (CREDIT), defined as the yield spread between Moody's Baa and Aaa rated corporate bonds, as a measure of aggregate financial frictions. The default premium is one of the most powerful predictors of aggregate economic conditions (see Bernanke, 1989). The default premium is also used as the premium of external funds (see Kashyap et al. (1994), Bernanke and Gertler (1995), and Bernanke et al. (1996, 1999), among others). In addition, we further control for the term-spread (TERM), the difference between the yields on 10-year Treasuries and 3-month T-bills. Unreported results show that controlling for CREDIT and TERM does not change the results qualitatively.

Table 2.3 Panel D presents zero-cost hedge portfolio returns or factor loading differentials for intermediation factors. Not to create confusion with the Fama-French SMB and HML, which are also zero-cost hedge portfolio returns, we represent the corresponding factor loading differentials as S-B and H-L. For brevity, we present the results for extreme portfolios, that is, we consider portfolios 1, 5, 20, and 25.

Looking first at the H-L spread, ASSET has the best performance. Looking at the S-B spread, EQUITY has the best performance. ASSET performs the best when we consider both the H-L and S-B spreads.

Importantly, in terms of factor loading differentials, intermediation factors are far better than MKT. For example, by buying portfolio 5 and selling portfolio 1 the H-L spread is 1.93% per quarter for ASSET (reported in Table 2.3 Panel D) and the corresponding spread is 0.35% per quarter for MKT (not reported but evident from Table 2.3 Panel A). The results thus suggests if one were to hedge against systematic intermediation risk rather than hedge against systematic stock market risk, the hedge portfolio based on systematic risk would be more profitable. Since there are limits to arbitrage, the long-short portfolio construction, as describes, may not be possible in reality. However, the analysis shows the importance of systematic intermediation risk.

Backed by the Brunnermeier and Pedersen (2009) theory, Adrian et al. (2012) consider a stochastic discount factor for excess returns that is affine in brokers and dealers' leverage shocks and show that brokers and dealers' leverage is priced in the cross-section of stock returns. We next test whether securities brokers and dealers' leverage shocks can explain why some stock returns are higher than others. Table 2.3 Panel E shows that securities brokers and dealers' leverage (BDLEV) cannot explain 25 Fama-French size and book-to-market portfolios.

Having observed that intermediaries' balance-sheet growth as factors can explain the value and size premium, we now explore whether these factors can explain the Fama-French SMB and HML factors.

2.4.3 Explaining SMB and HML factors

In this section, we explain the SMB and HML factors by intermediation factors. The investigation addresses Cochrane's (1999) observation that fundamentally determined macro factors may explain why portfolio-based factors perform well.

We run regressions with either the SMB or the HML factor as the dependent variable and one of the intermediation factors as the explanatory variable. We further augment intermediation factors with investment- and production-based factors to investigate the importance of intermediations factors over other factors. Table 2.4 Panel A and Table 2.4 Panel B present the regression results for the SMB and HML factors respectively.

Looking at Table 2.4 Panel A from the left, models 1 through 3 show that intermediation factors ASSET, LEV, and EQUITY explain SMB with robust coefficients. The results suggest that a positive intermediation shock expands the SMB spread. As for the competing factors only PF1 (model 5) explain the SMB spread. The intermediation-augmented productivity-based or investment-based models (models 6 through 11) show that intermediation factors maintain their explanatory power.

Looking at Table 2.4 Panel B, intermediation factors (models 1 through 3) explain the HML spread with the correct sign of the coefficients: a positive intermediation shock contracts the HML spread. As for the competing factors, INV (model 4) is the only factor that explains the HML spread. Taken all factors together (models 6 through 11), none except intermediation factors can explain the HML spread.[19]

Looking at the adjusted R-squares, we observe that augmenting intermediation factors with investment or productivity factors do not enhance the explanatory power for the SMB and HML factors considerably. Importantly, all intermediation factors by themselves have far better explanatory power than pure-play investment and productivity factors for the SMB and HML factors.

The results thus suggest that while intermediation factors can explain both the SMB and HML factors, the competing investment- or productivity-based factors cannot explain both the SMB and HML factors.

Why do intermediation factors explain the SMB and HML factors so well? The answer to the question rests both on the relationship among intermediaries' balance sheet variables and on the relationship between intermediaries and firms. We first investigate how intermediaries' balance sheet variables interact with each other with the business cycle. Next, we relate the evolution of intermediaries' balance sheets to firm characteristics.

Adrian and Shin (2010) discuss the relationship between intermediaries' equity and leverage and its implication on intermediaries' balance sheets. They show commercial banks

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[19] However, BH show that '*productivity state*' predicts the HML spread at longer time horizons (12- and 16-quarters-ahead-forecasts).

target a preset leverage and investment banks' leverage is procyclical. As asset prices rise, intermediaries' equity rises, thereby lowering the leverage. Commercial banks respond to the falling leverage by expanding the balance sheet by borrowing and lending more to revert back to the desired leverage. The effect of asset prices on investment banks' balance sheets is more pronounced since their leverage is procyclical. Investment banks borrow and lend more than commercial banks and their leverage keep rising with the rising asset prices until an asset price bubble sets in.

By contrast, we show intermediaries' leverage *in aggregate* is procyclical. In Figure 2.2, we show the relationship between intermediaries' asset and leverage growths. The positive slope of the regression line implies that intermediaries' leverage is procyclical.

As a direct consequence, in economic expansions when asset prices are high intermediaries expand the balance sheet. In the process, intermediaries have no choice but to provide liquidity to every financially eligible firm in the economy. In recessions, however, intermediaries contract the balance sheet by borrowing and lending less. It is the smaller firms that are more affected in recessions since their liquidation value, which is what intermediaries care for, is smaller. Since the liquidation value is smaller and the default probability is higher for smaller firms, intermediaries shun these firms in recessions. That is, funding from intermediaries to smaller firms is more volatile with the business cycle. On the other hand, large firms' external funding is less volatile. Hence, the size premium arises from systematic intermediation risk.

Value firms are typically established firms that ran out of steam. These firms receive funding from intermediaries in economic expansions because intermediaries have no choice, and because the borrowing cost is possibly lower than the return on investment for these firms. However, in recessions, when borrowing costs are higher, intermediaries have no monetary incentive to provide funding to value firms since the return on investment for value firms is lower than the borrowing cost. That is, external funding for value firms is more volatile. Hence, the value premium arises from systematic intermediation risk.

While firms' distress may be an explanation for the SMB and HML factors (see Fama and French, 1993), none of our explanations require firms be distressed; the SMB and HML factors simply capture systematic intermediation risk.

Literature (Gomes et al., 2006) investigates the procyclical nature of the shadow price of external funds. We show that intermediaries' funding exhibits procyclical variations. That is, the results show that firms are exposed not only to varying shadow prices for external funds but also to varying availability of external funds. In a bad state of the world, when firms are more likely to be financially constrained they also are less likely to receive external funds since intermediaries' contract the balance sheet by lending less in such a state.

In summary, intermediation factors conforms to what Merton's (1971, 1973) theory implies: factors must explain why average returns of some assets are higher than that of others. The results further suggest that intermediation factors dominate investment and productivity factors in explaining stock returns.

2.4.4 Predicting market excess returns

Literature (Merton (1973), Campbell (1996), Lettau and Ludvigson (2001a), and Santos and Veronesi (2006), among others) suggests that a state variable must forecast excess market returns. As a result, we investigate whether intermediation factors can predict excess market returns to ascertain that these factors are indeed state variables.

Fama and French (1988), among others, argue that the forecast for a *moving sum* of the market return is better than forecasting a *single market return realization* since forecasting for a moving sum improves the signal-to-noise ratio. Following Balvers and Huang (2007), we forecast the moving average rather than the moving sum of excess market returns by intermediation factors, and we run the following regression:

$$\text{MVA}^{e}_{t,MKT} = constant + \beta f_{t-j} + \varepsilon \qquad (15)$$

where $\text{MVA}^{e}_{t,MKT}$ is the moving average of excess market returns over four quarters t through $t\text{-}3$, an intermediation factor is f , and j varies from one to five for one- through five-quarter-ahead forecasts. The estimated β are reported in Table 2.5.

Looking at Table 2.5 Panel A, the results show that both ASSET and LEV produce robust results in predicting excess market returns, and thus show that these two factors are indeed state variables. However, EQUITY has no predictive power for excess market returns. The result is consistent with intermediaries' procyclical leverage. Among the three factors, LEV and ASSET fluctuate more than EQUITY with the business cycle, and hence the growth of leverage and assets better predicts excess market returns.

To check the robustness of the results, we control for variables that are known to have strong predictive power for market returns. In addition to TERM and CREDIT, we use *cay*, the consumption to wealth ratio of Lettau and Ludvigson (2001) as additional controls. The robustness results with additional controls are not presented to save space. The unreported results show that after including additional controls, the predictive power of ASSET and LEV for excess market returns is not qualitatively different. Importantly, *cay* loses its predictive power for excess market returns in the presence of LEV.

By contrast, unreported results show that INV has no short-run predictability for excess market returns. That is, INV cannot predict excess market returns as well as intermediation factors do. BH report that *productivity state* has 12- and 16-quarters-ahead predictive power for excess market returns. While the BH result is important, forecasters may care about short-run rather than long-run predictability. However, BH report that *productivity state-squared*, has one-quarter-ahead forecasting power for excess market returns.

Unreported results show that BDLEV, the leverage factor of Adrian et al. (2012) cannot predict market returns.

To check the robustness, we also conduct one-quarter-ahead predictability of the *single market return realization* by intermediation factors. The procedure is described below.

Since ASSET and other intermediation factors are highly correlated with excess market returns, a large part of the excess market return can be explained by the expected value of intermediation factors. In other words, we may know the expected part of excess market returns, but we don’t know the unexpected part. As a result, we consider a moving average of intermediation factors as proxies for the expected part of excess market returns, and then run a predictive regression of the following form to estimate the unexpected part:

$$R^{e}_{t,MKT} = constant + \alpha MVA^{f}_{t-1\ to\ t-4} + \beta f_{t-1} + \varepsilon \tag{16}$$

where $MVA^{f}_{t-1\ to\ t-4}$ is the moving average of an intermediation factor f over four quarters *t-1* through *t-4*, and the excess market returns realization is $R^{e}_{t,MKT}$. That is, the expected value of intermediation factors measured over four quarters captures the expected excess market returns for the next quarter. The unexpected part of excess market returns next quarter can be predicted by the current quarter intermediation factor. In the regressions, we also control for TERM, CREDIT, and *cay.*

The estimates of α and β are reported for the one-quarter-ahead-forecasts in Table 2.5 Panel B. The results show ASSET and LEV maintains their predictive power for excess market returns. While *cay* remains an important predictor variable for excess market returns along with ASSET, LEV consumes the predictive power of all control variables including *cay*.

We replicate the results of Table 2.5 Panel B with INV, PF1 and PF2, and the unreported results show that these factors do not have the same property as ASSET or LEV. The plausible reason is that either the moving average of these factors cannot capture the expected part of excess market returns or one-lag of these factors cannot predict the unexpected part of excess market returns. In the short-run, the results thus suggest that the existing investment or productivity factors can predict neither the moving average of excess market returns nor the excess market realization.

To summarize, overall evidences from the above analyses suggest that intermediation factors behave as state variables in predicting market excess returns. The factors explain the value and size premiums. Additionally, stocks are found to be more sensitive to systematic intermediation risk than systematic stock market risk. Importantly, competing investment and productivity factors have very limited power for the stylized asset pricing tests. Additionally, the leverage of securities brokers and dealers as a factor fails stylized asset pricing tests, and hence we do not consider this factor for the rest of the analysis.

2.4.5 The cross section of stock returns

In this section, we investigate whether the intermediation factors help explain the observed cross-sectional variation in average stock returns. Equation (10) can be written in the familiar beta form[20] as

$$\mathrm{R}_{i,t}^{e} = a_i + \beta_{i,\mathrm{f}} f + \varepsilon_{i,t} \tag{17}$$

where $\mathrm{R}_{i,t}^{e}$ excess stock returns and f represents factors that explain stock returns. Following Fama and MacBeth (1973), we estimate betas for each explanatory variable in a time series regression using the sample of each asset's returns using equation (17). Next, we run cross-sectional regression at every date t of the following equation

$$\mathrm{R}_{i,t}^{e} = \alpha_i + \lambda_{f,t} \beta_{i,f} \tag{18}$$

Following Savov (2011), we do not include a free constant term to run cross-sectional regressions of the above equation. Savov (2011) observes that the inclusion of a free constant gives the model more freedom but it leads to poor factor premia estimates. The estimates of factor premia become more problematic when there are little variations in betas across time.

[20] Literature (e.g., Jagannathan and Wang (2002), among others) shows that a linear beta representation of expected returns is equivalent to a linear factor model for the stochastic discount factor.

Additionally, employing Fama-French 25 size and book-to-market portfolios as test assets often gives the market premia to be negative (e.g., Balvars and Huang (2007) and Jagannathan and Wang (2007)). The regression results with a free constant also imply counterintuitive nonzero excess returns for risk-free rate. The specification also conforms to one of the specifications of Jagannathan and Wang (2007).

Finally, we calculate the average of the estimated premia and pricing error across time as

$$\lambda_f = \frac{1}{T}\sum_0^T \lambda_{f,t}, \;\; \alpha_i = \frac{1}{T}\sum_0^T \alpha_{i,t} \qquad (19)$$

The model (18) predicts that $\lambda > 0$ and $\alpha = 0$ for every asset. Following literature, we use the 25 Fama-French size and book-to-market portfolios as test assets and Table 2.6 presents the Fama MacBeth regressions results. While Panel A presents unconditional estimates of factor premia along with the CAPM and Fama-French 3-factor models, Panel B presents regressions results for conditional models.

Looking at Table 2.6 Panel A, it is evident that all models are rejected. Except for INV, all factors gets a positive premium. The quarterly pricing errors are about 0.9% for MKT, ASSET and LEV. The lowest pricing error is observed for the Fama-French 3-factor model (model 7). All other unconditional models have higher pricing errors than that of MKT, ASSET and LEV.

The quarterly-factor-premia estimates and pricing errors for the models 6 and 7 are of the same order as the yearly-factor-premia estimates reported in Savov (2011) for MKT and Fama-French 3-factor models. Since we do not use a free constant in cross-sectional tests, the results ascertain that our results are similar to that of Savov's (2011).

Looking at the investment-based model, the negative sign for INV is consistent with the theory that postulates the expected sign for ‘investment beta’ to be negative. However, judging by the pricing errors, PF1 and PF2 are better than INV, and the results are consistent with the BH results.

Looking at the first column of Table 2.6 Panel B, where INV and ASSET are included in the model (model 9), both INV and ASSET gets positive premium. While the quarterly premium for INV changes from -8.23% (Model 1) to 6.78% (model 9), the quarterly premium for ASSET doubles from 0.56% to 1.07%. Unreported results show that the root cause of such a variation in risk premia estimates is the high correlation (81%) between INV and ASSET ‘betas’ that are obtained in the first-stage of the Fama-Macbeth regression. That is, multi-colinearity in the second-stage invalidates the factor premia estimates. Alternately, the result shows that both INV and ASSET has similar information about the riskiness of the economy.

Now turning to pricing errors, the unconditional INV (model 1) model has 1.04% quarterly pricing error, and the pricing error reduces in the conditional version of the model (model 9) to 0.95%. By contrast, the unconditional ASSET model has far lower pricing error of 0.90%. Thus, the results suggest a parsimonious one factor ASSET model is superior to both the unconditional INV and encompassing conditional models. We do not report the factor premia for the interaction term between INV and ASSET since it is insignificant.

Looking at the model 10 of Table 2.6 Panel B, which is the conditional model of BH, the results show that the factor premia of productivity based models with the expected sign. BH report factor premiums for PF1 and PF2 to be 0.869 and -0.510 respectively. The estimates presented in this paper are 0.935 and -0.445 respectively, and thus the estimates are similar to that of BH.[21]

In the model 11, we include ASSET as an additional factor along with productivity factors. While PF1 maintains its importance, PF2 and ASSET lose their significance. Unreported results show that PF2 and ASSET betas, which are obtained in the first-stage of the Fama-Macbeth regression, are highly correlated (the correlation is about 72%). Hence, the factor premia estimates are not robust in this model. Now turning attention to the pricing errors, it is evident that the addition of ASSET to the conditional productivity model does not increase the explanatory power of the model. The pricing error of the conditional productivity model is 0.95, which is higher than that of the unconditional ASSET model, and hence one factor ASSET model is superior to both the productivity-based and the encompassing intermediary-augmented-productivity models.

The results presented above show that the intermediary funding specific component dominates the firm specific component in determining asset returns given by equation (7). For a given technology, production processes requires capital, and labor is chosen optimally based on capital. The capital can either be raised from internally generated profits or be raised by combining the external funds and internally generated profits. Since the external funds, represented by intermediary balance sheet growth, are more volatile relative to INV, the net effect of internal and external funds, INV produces more pricing errors. Additionally, external funds are procyclical, and hence are more aligned with the asset prices. Thus intermediation

[21] BH do not estimate factor premia directly, instead they report *implied* factor premia.

factors produce less pricing errors in explaining stock returns.

When BH factors are compared head-to-head, however, the intermediation factors perform better. The reason is that productivity does not vary considerably from one quarter to another, that is, the volatility of productivity is not as large as funds from intermediaries. Additionally, productivity factors have far lower correlation with excess market returns than that for the intermediation factors. From the economic perspective, while firm productivity determines asset prices, forward-looking stock market measures expected asset prices. The realization of the productivity state thus lags behind the market expectation.

On the contrary, intermediaries are forced to adjust their balance-sheets in tandem with the market expectation of asset prices. Hence, the funds they provide closely follow the forward-looking market, and productivity lags behind intermediaries' funding in capturing the dynamics of asset returns. The manifestation of the economic dynamics is reflected in the data. While productivity factors are less volatile and have lower correlation with excess market returns, the intermediation factors are more volatile and have higher correlation with excess market returns. Thus, the intermediation factors price assets better than productivity factors.

2.4.5.1 The CAPM and Fama-French 3-factor models

Having investigated the interaction between intermediation-based factors and existing investment-based and productivity-based models, we now investigate how intermediation-based factors compares with the CAPM and Fama-French 3-factor models.

In the model 11 of Table 2.6 Panel B, we estimate the factors premia where MKT and

ASSET are the two factors. The result shows high significant negative premium for ASSET. The results are similar when ASSET is an additional factor in the Fama-French 3-factor model (model 13). The reason is the high correlation between ASSET and MKT (60% correlation with the raw data and more than 90% correlation of factor 'betas' after the first-stage Fama-Macbeth regression). However, one could ask the question why ASSET estimates lose their explanatory power in the presence of MKT? The answer is the volatility of the factors. ASSET is far less volatile than MKT. As a result, OLS pays more attention to the higher frequency MKT data than to the lower frequency ASSET data to fit stock returns. Nevertheless, a high correlation of explanatory variables, and hence the presence multi-collinearity nullifies any conclusion that could be drawn from the model 11 specification.

To investigate the conjecture that the data frequency is the root cause of the failure of ASSET, in the model 14, we replace MKT with ASSET in the 3-factor Fama-French model. The rationale for a model that consists of ASSET, SMB, and HML is discussed in sub-section 4.2, where it was shown that ASSET loads the value and size portfolios exactly the same way MKT does. In the model 14, ASSET gets a robust premium, and the difference in pricing errors between the model 14 and model 8 is 0.001%. This implies that along with the SMB and HML factors, ASSET explains the cross-section of returns as well as the Fama-French 3-factor model does. The results further imply that MKT and ASSET have similar information about the systematic risks that investors encounter in the marketplace.

We repeat the experiment with EQUITY in models 15 and 16. In the model 15, the inclusion of EQUITY in Fama-French 3-factor model, EQUITY gets a negative premium.

However, in the model 16, where EQUITY replaces MKT, EQUITY gets a positive premium. As a result, the model 16 supports the conjecture that intermediaries' balance-sheet variables have information that captures the information content of the market portfolio.

2.4.5.2 Robustness with larger sets of test assets

We include 10 industry portfolios as test assets to address the Lewellen, Nigel, and Shanken (2010) critique that 25 Fama-French size and book-to-market portfolios are too structured. Since asset pricing tests often find it demanding to explain 30 industry portfolios, we also include 30 industry portfolios to 25 Fama-French size and book-to-market portfolios for robustness checks.

The results by including 10 industry portfolios to the size and book-to-market portfolios are presented in Table 2.7. All models are rejected and the pricing errors are wider than that for 25 size and book-to-market portfolios. Other than the pricing error difference and except for the model 10, the results are qualitatively similar to the results presented earlier. Importantly, the 3-factor ASSET, SMB, and HML (model 14) model performs as well as the Fama French 3-factor model does.

The BH model predicts that the factor premium for PF2 to be negative, the model 10 shows it is positive. Moreover, productivity factors premia are very different from the estimated premia from 25 size and book-to-market portfolios as test assets. In contrast, factor premia estimates for intermediation factors, INV, and MKT remains relatively unaffected.

To ascertain that the factors get premium with more diversified test assets, we include 30 industry portfolios to 25 size and book-to-market portfolios. However, as opposed to the factors considered earlier, we only include ASSET, MKT, SMB and HML. The specification allows for concentrating on the relationship between portfolio-based factors and intermediation factors. We omit other intermediation factors since the results are not qualitatively different from the results for ASSET. Unreported results further show that the conclusion about INV or PF1 and PF2 does not change with the larger set of test assets. The exclusion of PF1 and PF2 also allows for investigating the relationship with the larger data set that spans from 1955-2009.

Looking from the left, in model 1 of Table 2.8, ASSET as a sole factor gets a robust high and significant premium. The premium is not affected adversely with the inclusion of the HML and the SMB factors as seen in the model 4. The same conclusion emerges when MKT is the sole factor (model 2) or in model 3, where the HML and the SMB are additional factors.

A factor has economic significance. The factor beta may be time-varying but the significance and corresponding premium, to a large extent, should be independent of the choice of test assets. When compared head-to-head with different sets of test assets with different samples, only two factors that emerges to be significant are MKT and ASSET.

In essence, the investigation above tells us that asset growths of intermediaries have similar information as the market in explaining a wide variety of assets returns. That is, intermediation risk, that we proxy for by the fluctuations of intermediaries' balance sheet, and stock market risk, which is a proxy for by the market portfolio, seems to capture the same information.

We conduct further robustness checks. First, we investigate whether value-weighted asset growths of intermediaries collect a positive risk premium. Second, we investigate whether asset-growths of intermediaries by themselves explain asset returns in the cross-section. The results by considering the value-weighted asset growths of intermediaries or asset growths of each intermediary as factors do not change the conclusion of the empirical results.

The intermediation risk can be best measured when the riskiness of each constituent intermediaries are given equal weights. Since one intermediary acts as counterparty for others, intermediaries are interconnected. As a result, a possibility of the failure of one intermediary triggers the possibility of the failure of others. Examples of interconnectivity or the contagion effect among intermediaries are abundant. The recent sub-prime mortgage crisis show how delinquencies and foreclosure of a fraction of the total sub-prime mortgages translated into a full-blown global financial crisis. Thus, the fluctuations of the total money flow, represented by the aggregated growth of assets, from intermediaries are most important to gauge the systematic intermediation risk.

2.5 Conclusions

In this paper, we derive an intermediation-augment investment-based asset pricing model. The existing investment-based asset pricing models assume that firms have excess to external financing at some cost, and that financially constrained firms relative to less constrained firms pay more for external funds. That is, the underlying assumption of the existing literature is that the external funds supply is elastic. We relax the assumption by arguing that firms may not be able to raise any external fund if financial intermediaries are themselves constrained. As a direct consequence, firm managers work under the uncertainty of external funds. Hence, systematic financial intermediation risk has asset pricing implications.

We contribute to the literature by showing that the exiting investment-based asset pricing models, such as Cochrane's (1991 and 1996), are a special case of a general asset pricing kernel. The intermediation-augmented investment-based model predicts that the marginal funding that intermediaries provide explains stock returns. The results suggest that intermediation factors outweigh existing investment- and productivity-based factors in explaining stock returns. We further show that stocks are more sensitive to systematic intermediation risk than systematic stock market risk. We also find that intermediation factors are priced in the cross-section.

Literature (Gomes et al. (2006), Whited and Wu (2007), Campello and Chen (2010), among others) find evidence that financial constraints are priced factors. However, we find evidences that intermediation risk systematically affects firms whether firms are financially constrained or not. We further show that the shadow price and the risk of securing external funds coexist. It is thus reasonable to investigate whether and to what extent the shadow price of external funds is related to systematic intermediation risk. We leave the task for future research.

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Appendix 2.A: The derivation of investment returns

This appendix derives equation (6) of the essay. The firm managers maximize

$$V(K_0, \Omega_0, B_0, \zeta_0) \equiv \max_{\{K_{t+1}\}} E_0[\sum_{t=0}^{\infty} M_{0t}(D_t - X_t\Omega(K_t, \zeta_t))] \quad \text{(A.1)}$$

$$D_t = \Pi(K_t, \zeta_t) + \Omega(K_t, \zeta_t)(X_t + B_{t+1}) - I_t - R_t\Omega(K_{t-1}, \zeta_{t-1})B_t - \frac{\alpha}{2}[\frac{I_t}{K_t}]^2 K_t \quad \text{(A.2)}$$

capital accumulates as $K_{t+1} = I_t + (1-\delta)K_t$ (A.3)

the dividend constraint is $D_t \geq \overline{D}$ (A.4)

where, K is the capital stock, Π[.] is the profit function, Ω[.] is the fund allocation function that determines the external fund supplied by intermediaries, X and B is new equity and debt issued, $X_t\Omega(K_t, \zeta_t)$ captures the value dilution effect after equity issuance, M_{0t} is stochastic discount factor between time 0 to time 1, I is investments, δ is depreciation, α is curvature of adjustment cost function, ζ captures all sorts of uncertainties.

Given (A.1) through (A.4), the Lagrangian conditional on the information set at time *t* is given below, where λ is the Lagrange multiplier associated with the dividend constraint.

$$L_t = \cdots + M_{0t}(1+\lambda_t)\{ \Pi(K_t, \zeta_t) + \Omega(K_t, \zeta_t)(B_{t+1}) - R_t\Omega(K_{t-1}, \zeta_{t-1})B_t - \left[\frac{K_{t+1}}{K_t} - (1-\delta)K_t - \frac{\alpha}{2}\left[\frac{K_{t+1}}{K_t} - (1-\delta)\right]^2 K_t\right\} + E_t[M_{0t+1}(1+\lambda_{t+1})\left\{\Pi(K_{t+1}, \zeta_{t+1}) + \Omega(K_{t+1}, \zeta_{t+1})(B_{t+2}) - R_{t+1}\Omega(K_t, \zeta_t)B_{t+1} - \left[\frac{K_{t+2}}{K_{t+1}} - (1-\delta)K_{t+1} - \frac{\alpha}{2}\left[\frac{K_{t+2}}{K_{t+1}} - (1-\delta)\right]^2 K_{t+1}\right\}\right] + \cdots \quad \text{(A.5)}$$

The first order condition with respect to K_{t+1}, that is, $\frac{\delta L_t}{\delta K_{t+1}} = 0$, implies

$$M_{0t}(1+\lambda_t)(1+\alpha i_t) = E_t[M_{0t+1}(1+\lambda_{t+1})\left(\Pi_{K+1} + \Omega_{K+1}(B_{t+2}) + \frac{\alpha}{2}[i_{t+1}^2 + (1-\delta)\right](1+\alpha i_{t+1}) \quad \text{(A.6)}$$

where, $i_t = I_t/K_t$, $\Pi_{k+1} = \delta\Pi(K_{t+1}, \zeta_{t+1})/\delta K_{t+1}$, and $\Omega_{k+1} = \delta\Omega(K_{t+1}, \zeta_{t+1})/\delta K_{t+1}$.

Simplifying equation (A.6), and using $E\left[\frac{M_{0t+1}}{M_{0t}} R_{t+1}^I\right] = E[M_{t+1}R_{t+1}^I] = 1$, we get equation (6).

Appendix 2.B: Construction of productivity factors of Balvers and Huang (2007)

The conditional ($\epsilon_t|_{\theta_t \text{ and } k_t}$) and unconditional ($\epsilon_t$) productivity shocks described in sub-section 2.2. are constructed as follows. Following King and Rebelo (2000), the level of productivity θ_t is constructed by 2/3 weight of labor and 1/3 weight of capital. Since the state variables productivity and capital θ_t and k_t are cointegrated, ϵ_t is calculated by first differencing $\log(\theta_t)$ and then subtracting the mean. Then, ϵ_t is whitened by regressing ϵ_t on lags of θ_t and k_t since both capital and productivity lags are correlated with ϵ_t. Following Sims et al. (1990), the cointegrating residuals (of θ_t and k_t) are used as the state, s_t. The productivity state measures relative scarcity of capital in the economy – the level of the existing capital relative to productivity. The conditional shocks $\epsilon_t|_{\theta_t \text{ and } k_t}$ are derived by multiplying ϵ_t and s_t. PF1 and PF2 represent the unconditional (ϵ_t) and conditional ($\epsilon_t|_{\theta_t \text{ and } k_t}$) productivity shocks respectively.

Appendix 2.C: The proof that the SDF is inversely proportional to investment returns

This appendix shows investment and the stochastic discount factor are inversely related. Since the derivation is standard, we keep the derivation as parsimonious as possible.

Under the Cobb-Douglas production function, the consumption-investment model is as follows:

$Max\, E_j[\sum_{j=0}^{\infty} \beta^j \ln(c_j)]$, subject to $y_t = i_t + c_t = \lambda_t i_{t-1}^{\alpha}$ and $ln\lambda_t = \rho ln\lambda_{t-1}$.

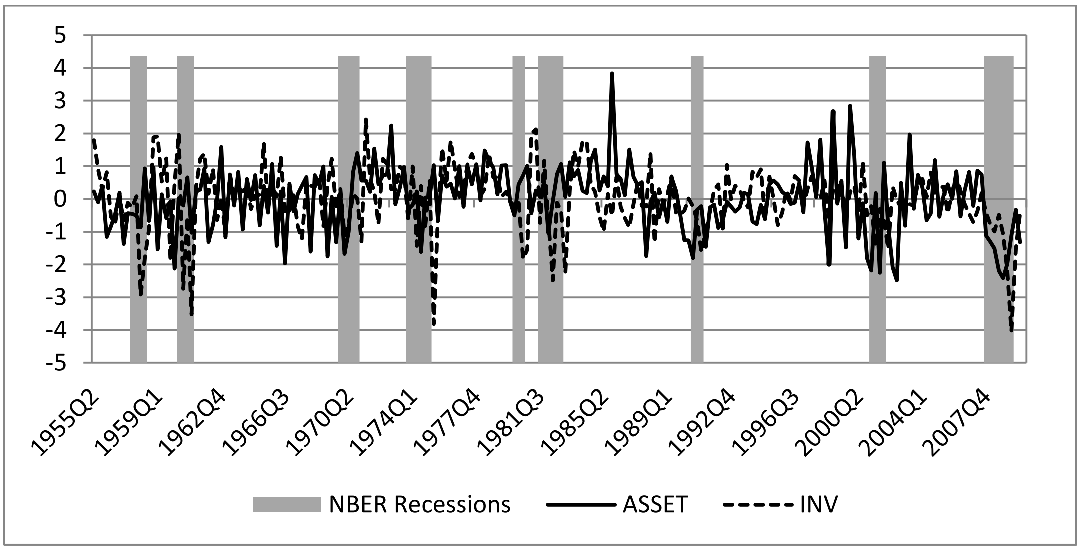
The investment return is $r_{t-1}^i = \alpha\lambda_{t+1} i_t^{\alpha-1} = \alpha y_{t+1}/i_t$.

Hence, the solutions are $c_t = (1-\alpha\beta)y_t$, and $i_t = \alpha\beta y_t$.

Substituting c_t and i_t in investment returns yields, $r_t^i = \frac{1}{\beta}\frac{c_{t+1}}{c_t} = \frac{1}{m_{t+1}}$.

Figure 2.1
Time series of intermediaries' asset-growth, investment-returns, and productivity shocks

This figure shows the time series of quarterly investments returns, productivity shocks, and the growth of intermediaries' assets for six intermediary groups (commercial banks, mutual funds, securities brokers and dealers, retirement/pension funds, insurance companies, and shadow-banks). The first plot compares investment returns (INV) and the growth of intermediaries' financial assets (ASSET) for the sample 1955 through 2009. The second plot compares productivity shocks (PF1) and ASSET for the sample 1964 through 2004. Gray bands indicate NBER recessions. All series are standardized for the ease of comparison.



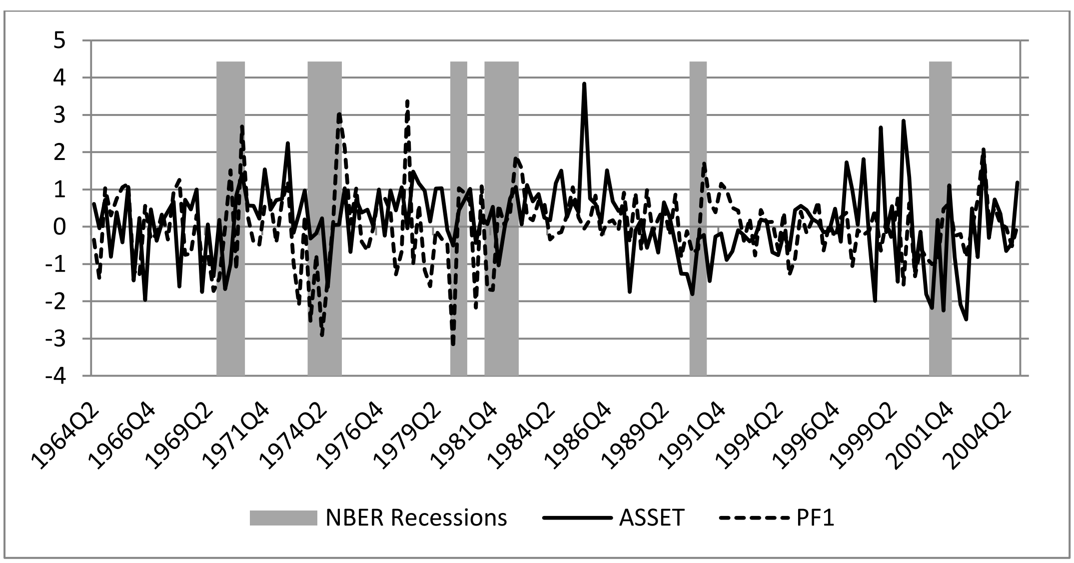


Figure 2.2
Procyclical leverage of Intermediaries

The figure shows the scatter plot of the leverage growth versus the asset growth for intermediaries. The intermediaries are described in Table 2.1. The data is from the Federal Flow of Funds for 1955-2009. The figure also plots the regression line.

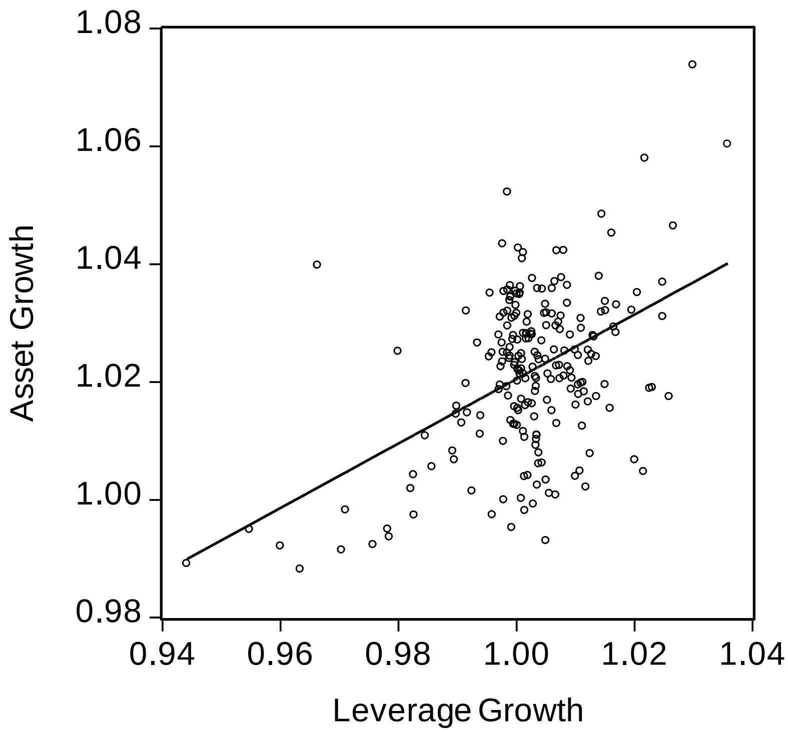


Table 2.1
Financial Intermediaries and their assets

This table describes the intermediaries. Quarterly asset data is obtained from the Federal Flow of Funds for the 1955-2009 sample period.

Financial Intermediaries						
Intermediary Group	Members	Assets (US$ trillions) by Group				
		Mean	Median	Std. Dev.	Min.	Max.
Insurance Companies	Life Insurance	1.64	0.65	1.90	0.08	6.36
	Property and Casualty Insurance					
Pension Funds	Private Pension Funds	2.59	0.79	3.21	0.02	10.99
	Federal Govt. Retirement Funds					
	State Govt. Retirement Funds					
Banks	Commercial Banks	3.95	2.34	4.23	0.20	16.86
	Credit Unions					
	Savings Institutions					
Shadow-banks	Asset Backed Securities	2.42	0.34	3.70	0.01	13.79
	Agency/GSE Mortgage Pools					
	Funding Corporations					
	Finance Companies					
Mutual Funds	Money Market Funds	1.97	0.15	3.10	0.01	11.18
	Mutual Funds					
	Closed End Funds					
	Exchange Traded Funds					
Securities Brokers & Dealers	Securities Brokers & Dealers	0.46	0.05	0.77	0.00	3.24
Total Assets		16.98	6.65	20.91	0.53	73.66

Table 2.2
Summary statistics

This table presents summary statistics for the factors considered for the study: market excess returns (MKT), the growth of financial assets (ASSET), the growth of liability (LIAB), the growth of leverage (LEV), the growth of equity (EQUITY), excess returns on investments (INV), and Balvers and Huang's (2007) unconditional and conditional productivity shocks (PF1 and PF2, respectively), where the conditioning variable is the *productivity state* derived from the cointegrating residuals of productivity and labor. Panel A presents sample moments, correlation of the factors with MKT, and pairwise correlation between the factors. Panel B presents the auto-correlation structure of intermediation factors. P-values are in the parenthesis.

Panel A: Sample moments

	INV	PF1	PF2	ASSET	LIAB	EQUITY	LEV
Mean	0.017	0.000	0.000	1.023	1.003	1.020	1.002
Std. dev. (X100)	4.233	0.766	0.411	1.357	1.088	1.267	1.173
Corr. MKT	-0.068	0.312	0.242	0.614	0.705	0.052	0.636
	(0.388)	(0.000)	(0.000)	(0.000)	(0.000)	(0.445)	(0.000)
INV		-0.140	0.007	0.119	0.065	-0.205	-0.089
		(0.075)	(0.925)	(0.132)	(0.408)	(0.009)	(0.259)
PF1			0.331	0.138	0.142	-0.090	0.067
			(0.000)	(0.079)	(0.071)	(0.255)	(0.392)
PF2				0.137	0.131	-0.128	0.022
				(0.081)	(0.095)	(0.103)	(0.782)
ASSET					0.967	0.592	0.478
					(0.000)	(0.000)	(0.000)
LIAB						0.377	0.675
						(0.000)	(0.000)
EQUITY							-0.425
							(0.000)

Panel B: Auto-correlation Structure of Intermediary's Balance-Sheet Variables					
	Lag 1	Lag 2	Lag 3	Lag 4	Lag 5
ASSET	0.072	0.215	0.049	0.257	-0.058
	(0.296)	(0.002)	(0.476)	(0.000)	(0.411)
LIAB	0.104	0.189	0.058	0.177	-0.050
	(0.136)	(0.007)	(0.404)	(0.012)	(0.491)
EQUITY	0.241	0.171	-0.153	0.423	-0.088
	(0.001)	(0.009)	(0.024)	(0.000)	(0.234)
LEV	0.232	0.120	0.002	0.067	-0.082
	(0.001)	(0.095)	(0.976)	(0.375)	(0.305)

Table 2.3
Factor loadings on Fama-French 25 Size and Book-to-Market portfolios

This table presents factor loadings on 25 Size and Book-to-Market portfolios where $R^e_{i,j}$ is excess returns of Size and Book-to-Market portfolios, R_X is excess return if factors are returns, else R_X is growth or the factor itself. Panel A presents factor loadings of MKT and ASSET. Panel B presents factor loading of INV. Panel C presents factor loading of LIAB and LEV. Panel D presents factor loading differentials between extreme portfolios. Panel E presents factor loadings of BDLEV, the leverage factor of Adrian et al. (2012) measured from securities brokers and dealers' leverage. Estimates of b, factor loadings, and t(b), the corresponding t-statistics, are reported. Since BDLEV data is available from 1968-2009, Panel E present results for this sub-sample.

Panel A: Loadings on excess returns of Size and Book-to-Market Portfolios

$$R^e_{i,j} = constant + b_{i,j}R_X + \varepsilon$$

$R_X = MKT$

Size Quintile	Low	2	3	4	High	Low	2	3	4	High
			b					t(b)		
Small	1.56	1.35	1.17	1.11	1.21	20.9	23.39	19.46	18.79	16.65
2	1.48	1.24	1.09	1.05	1.14	24.12	24.59	21.71	20.13	16.42
3	1.36	1.13	1.01	1.00	1.02	25.18	28.03	19.77	17.51	14.67
4	1.26	1.07	1.01	0.99	1.08	25.82	23.91	20.32	18.76	13.93
Big	1.02	0.92	0.80	0.82	0.88	41.31	29.66	20.47	16.16	15.39

$R_X = ASSET$

Size Quintile	Low	2	3	4	High	Low	2	3	4	High
			b					t(b)		
Small	5.70	4.73	3.69	3.49	3.76	7.25	7.87	7.51	7.45	6.75
2	5.28	4.24	3.76	3.46	3.59	8.48	9.05	9.05	7.24	6.79
3	5.14	4.08	3.49	3.20	3.21	9.40	9.20	8.26	6.67	5.99
4	4.94	3.94	3.64	3.55	3.57	8.60	9.15	8.22	8.30	6.83
Big	4.00	3.65	3.25	3.00	3.28	9.97	10.49	9.19	7.46	7.65

Panel B: Loadings on excess returns of Size and Book-to-Market Portfolios

$$R^e_{i,j} = constant + b_{i,j}R_X + \varepsilon$$

$R_X = INV$

Size Quintile	Low	2	3	4	High	Low	2	3	4	High
			b					t(b)		
Small	-0.46	-0.32	-0.25	-0.16	-0.20	-2.05	-1.67	-1.48	-1.01	-1.11
2	-0.40	-0.25	-0.16	-0.15	-0.10	-2.06	-1.51	-1.10	-1.02	-0.60
3	-0.26	-0.15	-0.14	-0.18	-0.16	-1.47	-1.03	-1.02	-1.32	-1.07
4	-0.27	-0.15	-0.09	-0.16	-0.20	-1.70	-1.12	-0.70	-1.17	-1.29
Big	-0.14	-0.13	-0.08	0.01	-0.10	-1.11	-1.11	-0.78	0.08	-0.77

Table 2.3 continued

Panel C: Loadings on excess returns of Size and Book-to-Market Portfolios

$$R^{e}_{i,j} = constant + b_{i,j} R_X + \varepsilon$$

$R_X = LIAB$

Size Quintile	Low	2	3	4	High	Low	2	3	4	High
	b					t(b)				
Small	5.87	4.93	4.00	3.75	4.12	9.78	10.4	9.64	8.81	7.88
2	5.50	4.47	3.98	3.73	3.90	11.74	11.13	10.59	8.68	7.54
3	5.34	4.31	3.66	3.48	3.48	13.20	11.98	9.06	7.68	7.02
4	5.07	4.10	3.84	3.73	3.89	12.42	10.51	9.12	9.13	7.78
Big	4.09	3.76	3.36	3.19	3.41	14.37	12.87	11.27	8.11	8.58

$R_X = LEV$

Size Quintile	Low	2	3	4	High	Low	2	3	4	High
	b					t(b)				
Small	6.66	5.67	4.90	4.52	5.50	8.25	8.53	7.92	6.84	7.70
2	6.23	5.09	4.65	4.36	4.95	8.66	8.47	8.75	6.97	6.87
3	6.09	4.95	4.20	4.43	4.35	9.47	8.62	7.44	7.6	6.25
4	5.60	4.71	4.50	4.41	4.87	9.13	7.98	7.35	7.11	7.32
Big	4.48	4.14	3.88	3.75	3.83	9.48	9.55	9.13	7.51	7.24

Table 2.3 continued

Panel D: Factor Loading Differentials						
	$R_X = ASSET$					
Size Quintile	Low	High	H-L	Low	High	H-L
	b			t(b)		
Small	5.70	3.76	1.93	7.25	6.75	3.29
Big	4.00	3.28	0.72	9.97	7.65	2.17
S-B	1.70	0.48		3.20	1.95	
	$R_X = LEV$					
Size Quintile	Low	High	H-L	Low	High	H-L
	b			t(b)		
Small	6.66	5.50	1.16	6.79	7.25	2.61
Big	4.48	3.83	0.65	8.05	6.51	1.44
S-B	2.18	1.67		3.27	2.88	
	$R_X = EQUITY$					
Size Quintile	Low	High	H-L	Low	High	H-L
	b			t(b)		
Small	9.13	7.78	1.35	6.79	7.25	1.78
Big	5.95	4.98	0.97	8.05	6.51	1.52
S-B	3.18	2.80		3.01	4.01	

Panel E: Loadings on excess returns of Size and Book-to-Market Portfolios										
$R^e_{i,j} = constant + b_{i,j} R_X + \varepsilon$										
$R_X = BDLEV$										
Size Quintile	Low	2	3	4	High	Low	2	3	4	High
	b (X100)					t(b)				
Small	0.02	0.03	0.04	0.05	0.06	0.65	1.06	1.69	1.90	2.03
2	0.02	0.04	0.05	0.05	0.07	0.54	1.59	2.09	2.17	2.62
3	0.02	0.04	0.04	0.04	0.05	0.64	1.54	1.94	2.02	2.20
4	0.02	0.04	0.04	0.05	0.05	0.69	1.61	1.80	2.25	2.03
Big	0.01	0.02	0.03	0.04	0.04	0.75	1.24	1.40	2.28	2.46

Table 2.4
Explaining Fama-French SMB and HML factors

The table presents the explanatory power of intermediation factors for the SMB and HML factors. Panel A shows the explanation for the SMB factor. Panel B presents the explanation for the HML factor. Explanatory variables are described earlier. T-statistics are in the parenthesis. The sample is from 1964:Q2-2004:Q4, since PF1 and PF2 data are available for this period only. T-statistics are in the parenthesis.

Panel A

	Dependent: SMB										
	1	2	3	4	5	6	7	8	9	10	11
ASSET	0.92					0.97	0.78				
	(3.10)					(3.10)	(2.33)				
LEV		1.39						1.36	1.31		
		(3.49)						(3.52)	(3.36)		
EQUITY			3.86							3.80	3.58
			(3.45)							(3.48)	(3.13)
INV				-0.10		-0.13		-0.06		-0.05	
				(-0.78)		(-1.01)		(-0.56)		(-0.40)	
PF1					1.64		1.50		1.51		1.47
					(2.30)		(2.10)		(2.32)		(2.33)
PF2					0.87		0.60		0.87		0.77
					(0.63)		(0.41)		(0.66)		(0.61)
$\bar{R}^2$	0.04	0.05	0.07	0.00	0.04	0.04	0.06	0.05	0.09	0.06	0.10

Panel B

	Dependent: HML										
	1	2	3	4	5	6	7	8	9	10	11
ASSET	-1.50					-1.59	-1.53				
	(-2.42)					(-2.51)	(-2.52)				
LEV		-1.52						-1.46	-1.54		
		(-2.47)						(-2.37)	(-2.47)		
EQUITY			-3.70							-3.50	-3.75
			(-2.74)							(-2.55)	(-2.75)
INV				0.20		0.26		0.17		0.16	
				(1.81)		(2.64)		(1.47)		(1.31)	
PF1					0.37		0.65		0.52		0.55
					(0.55)		(1.01)		(0.83)		(0.87)
PF2					-0.97		-0.45		-0.97		-0.86
					(-0.69)		(-0.37)		(-0.72)		(-0.64)
$\bar{R}^2$	0.10	0.06	0.06	0.01	-0.01	0.13	0.09	0.07	0.06	0.06	0.05

Table 2.5
Predicting excess market returns

This table shows the predictability of excess market returns by intermediation factors. Panel A presents prediction of 4-quarter moving average of excess market returns for different forecast horizons by intermediation factors. Panel B presents one-quarter-ahead prediction of excess market realization by intermediation factors, where lags of additional predictive variables the term-spread, the difference between the yields on 10-year Treasuries and 3-month T-bills (TERM), the default premium, the difference between the yields on Moody's Aaa and Moody's Baa bonds (CREDIT), and *cay*, the consumption to wealth ratio of Lettau and Ludvigson (2001) are used as controls. P-values are in the parenthesis.

Panel A: Predicting the moving average of excess market returns

$$\text{MVA}^{e}_{t,MKT} = constant + \beta f_{t-j} + \varepsilon$$

	ASSET			LEV			EQUITY		
	Est.β	p-value	$\bar{R}^2$	Est.β	p-value	$\bar{R}^2$	Est.β	p-value	$\bar{R}^2$
Forecast Quarters									
1	0.49	0.00	0.06	0.88	0.00	0.10	0.05	0.75	-0.03
2	0.40	0.00	0.02	0.81	0.00	0.08	0.20	0.07	-0.04
3	0.54	0.00	0.03	0.96	0.00	0.07	0.10	0.45	0.88
4	-0.29	0.00	0.01	-0.46	0.00	0.01	0.25	0.15	-0.04
5	-0.39	0.14	0.01	0.01	0.96	0.01	0.24	0.16	-0.03

Panel B: One-quarter-ahead predictability of the excess market returns realization

$$\text{R}^{e}_{t,MKT} = constant + \alpha MVA^{f}_{t-4\ to\ t-1} + \beta f_{t-1} + \varepsilon$$

	ASSET		LEV		EQUITY	
Est.α	2.59	3.18	5.27	5.11	0.71	-0.24
	(0.01)	(0.00)	(0.00)	(0.00)	(0.32)	(0.78)
Est.β	-0.85	-0.81	-2.05	-1.89	-0.12	0.00
	(0.10)	(0.10)	(0.00)	(0.00)	(0.84)	(1.00)
TERM		0.01		0.01		0.01
		(0.38)		(0.30)		(0.32)
CREDIT		0.02		0.01		0.01
		(0.36)		(0.37)		(0.45)
cay		1.31		0.30		1.08
		(0.00)		(0.47)		(0.03)
$\bar{R}^2$	0.05	0.10	0.06	0.09	-0.01	0.04

Table 2.6
Fama MacBeth Regressions on 25 Size & Value Portfolios

The factor premia are estimated following Fama MacBeth cross-sectional procedure. There is no cross-sectional intercept. Pricing errors are the root mean squared errors with associated p-value are in the parenthesis for the hypothesis that all pricing errors are zero. Three-lag Newey-West t-statistics are in the parenthesis for factor premia estimates. Panel A presents unconditional estimates along with the Fama-French 3-factor model. Panel B presents conditional models. Sample 1964:Q1-2004:Q4.

Panel A: Factor Premium of unconditional and Fama-French 3-factor model

	1	2	3	4	5	6	7	8
INV	-8.299							
	(-2.160)							
PF1		0.518						
		(3.060)						
PF2			0.403					
			(2.960)					
LEV				0.439				
				(3.190)				
ASSET					0.535			
					(3.150)			
EQUITY						3.573		
						(2.720)		
MKT							1.925	1.534
							(3.190)	(2.690)
SMB								0.658
								(1.560)
HML								1.625
								(3.160)
Pricing Error	1.038	0.957	0.962	0.901	0.904	0.956	0.900	0.878
(p-value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 2.6 continued

Panel B: Factor Premium of conditional models

	9	10	11	12	13	14	15	16
INV	6.777							
	(3.310)							
ASSET	1.074		0.046	-0.924	-1.060	0.374		
	(4.050)		(0.260)	(-2.750)	(-3.650)	(2.370)		
PF1		0.935	1.008					
		(4.140)	(3.670)					
PF2		-0.445	-0.309					
		(-2.100)	(-1.590)					
EQUITY							-1.660	1.701
							(-4.880)	(1.930)
MKT				1.192	1.462		1.479	
				(2.080)	(2.540)		(2.580)	
SMB					0.592	0.718	0.759	1.126
					(1.390)	(1.720)	(1.810)	(2.760)
HML					1.377	1.680	1.812	1.403
					(2.740)	(3.250)	(3.510)	(2.730)
Pricing Error	0.953	0.947	0.943	0.890	0.877	0.878	0.877	0.885
(p-value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 2.7
Fama MacBeth Regressions on 25 Size & Value and 10 Industry Portfolios

The test assets are 25 Size and Book-to-Market Portfolios and 10 industry portfolios. The factor premia are estimated following Fama MacBeth cross-sectional procedure. There is no cross-sectional intercept. Pricing errors are the root mean squared errors with associated p-value are in the parenthesis for the hypothesis that all pricing errors are zero. Three-lag Newey-West t-statistics are in the parenthesis for factor premia estimates. Panel A presents unconditional estimates along with the Fama-French 3-factor model. Panel B presents conditional models. Sample 1964:Q1-2004:Q4.

Panel A: Factor Premium of Unconditional and Fama-French 3-factor Models

	1	2	3	4	5	6	7	8
INV	-8.767							
	(-2.430)							
PF1		0.505						
		(3.050)						
PF2			0.381					
			(2.950)					
LEV				0.426				
				(3.200)				
ASSET					0.520			
					(3.170)			
EQUITY						3.403		
						(2.920)		
MKT							1.896	1.694
							(3.210)	(2.980)
SMB								0.524
								(1.250)
HML								1.213
								(2.330)
Pricing Error	1.189	1.108	1.114	1.048	1.051	1.052	1.047	1.022
(p-value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 2.7 continued

Panel B: Factor Premium of Conditional Models

	9	10	11	12	13	14	15	16
INV	4.009							
	(2.600)							
ASSET	0.824		0.112	-0.561	-0.555	0.420		
	(3.690)		(0.680)	(-1.940)	(-1.950)	(2.640)		
PF1		0.527	0.718					
		(3.160)	(3.130)					
PF2		0.648	-0.024					
		(1.220)	(-0.190)					
EQUITY							-0.004	1.842
							(-0.010)	(2.540)
MKT				1.463	1.589		1.696	
				(2.530)	(2.760)		(2.970)	
SMB					0.536	0.626	0.520	1.109
					(1.280)	(1.510)	(1.250)	(2.640)
HML					1.172	1.200	1.207	0.783
					(2.260)	(2.310)	(2.350)	(1.500)
Pricing Error	1.107	1.102	1.095	1.037	1.018	1.023	1.019	1.035
(p-value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 2.8

Fama MacBeth Regressions on 25 Size & Value and 30 Industry Portfolios

The test assets are 25 Size and Book-to-Market Portfolios and 30 industry portfolios. Factors are described earlier. The factor premia are estimated following Fama MacBeth cross-sectional procedure. There is no cross-sectional intercept. Pricing errors are the root mean squared errors with associated p-value are in the parenthesis for the hypothesis that all pricing errors are zero. Three-lag Newey-West t-statistics are in the parenthesis for factor premia estimates. Sample 1955:Q1-2009:Q4.

	1	2	3	4
ASSET	0.505			0.453
	(3.060)			(2.860)
MKT		1.818	1.795	
		(3.090)	(3.190)	
SMB			0.296	0.479
			(0.690)	(1.110)
HML			0.643	0.579
			(1.200)	(1.090)
Pricing Error	1.420	1.416	1.394	1.395
(p-value)	0.000	0.000	0.000	0.000

Chapter 3

Intermediation risk, firm productivity, and asset market liquidity

3.1 Introduction

In a recent paper, Brunnermeir and Pedersen (2009) argue that the funding liquidity and asset market liquidity are closely related. Their model shows that traders provide market liquidity as long as traders have sufficient funding. However, the Johnson (2009) model suggests that controlling for the aggregate financial position of the economy, there should not be any role for the financial position of securities dealers and brokerage firms (i.e., traders) in explaining aggregate fluctuations of overall market liquidity. While investigating traders' liquidity is important in the crisis management, studying the liquidity dynamics with a larger set of intermediaries has far more economic ramifications. Since traders are involved dealing with marketable securities, their reach for assets in the economy is limited. By contrast, intermediaries in *aggregate* enter into transactions that involve every conceivable asset in the economy. To our knowledge, however, the existing literature does not investigate the market liquidity dynamics by considering the aggregate financial position of the economy.

In this paper, we derive an intermediation-augmented investment-based asset pricing kernel to investigate the liquidity dynamics in the economy. We build on Gomes et al. (2006)

who examines the asset pricing implications of firms' financial constraints. However, for the existing investment-based literature (e.g., Cochrane (1991, 1996), Gomes et al. (2006), among others), financial intermediation is exogenous. The underlying assumption is that firms have access to external financing at some cost determined by the shadow costs of external funds, and that financially constrained firms relative to less constrained firms pay more for external funds. That is, the external funds supply is elastic. We relax the standard assumption of the existing investment-based asset pricing models that firms have access to intermediated external funds by arguing that firms may not be able to raise any external fund if financial intermediaries are themselves constrained. As a direct consequence, firm managers work under the uncertainty of external funds. We show that the innovations in intermediaries' funding produce time-series variations in investment returns, and hence the stochastic discount factor for stock returns is affine in intermediary funding shocks. Next, we extend the results of Kyle (1985), who argues that information asymmetry between insiders and noise traders defines stock transaction liquidity, and show that stock liquidity is also a function of intermediary funding shocks. This is the primary contribution of the paper.

We measure intermediary funding shocks by the growth of intermediaries' balance sheet variables, such as assets. Next, we conduct stylized empirical tests to ascertain that intermediary funding shocks or intermediation factors behaves as state variables and explain stock liquidity.

Following Merton (1973), Campbell (1996), Lettau and Ludvigson (2001a), and Santos and Veronesi (2006), among others, suggest that a state variable must forecast excess market returns. We show that intermediation factors forecast stock market returns, and thus behave as state variables.

Merton (1980) further argues that the full story of the asset returns dynamics is revealed when innovations in higher moments of asset prices are investigated. Since stock liquidity and stock volatility co-moves, investigating stock liquidity, in essence, allows for investigating higher moments of asset prices. Furthermore, the existing literature (Acharya and Pedersen (2005), among others) finds that stock liquidity is a priced factor. We show that intermediation factors not only explain stock liquidity but also raise questions about the evidence found in the existing literature that stock liquidity is a priced factor.

Cochrane (1999) observes that macroeconomic factors are easier to motivate theoretically but none explains the value and size premium as well as Fama-French factors do. The results in this paper show that intermediation factors explain the value and size premium. To our knowledge, no other macro factor can explain the value and size premiums as well as intermediation factors do.

A true factor must also explain the cross-section of stock returns, but this should be the final asset pricing test. We find that investment-based (Cochrane, 1996), productivity-based (Balvers and Huang, 2007) and liquidity-based (Acharya and Pedersen (2005), among others) asset pricing factors that are known to explain the cross-section of stock returns perform poorly in predicting stock returns and/or explaining value and size premiums. We conduct the cross-sectional tests in a separate paper where we show that intermediations factors are indeed priced.

The implications of our empirical results are as follows. First, we contribute to the market microstructure literature on liquidity in that we show that intermediaries' funding is one of the determinants of stock liquidity. Our study provides new evidence that time-varying market liquidity has the monetary liquidity component. By showing that the commonality (see Chordia et al. (2001), among others) is embedded in intermediaries' balance sheet shocks, our paper argues against the notion that the pricing of liquidity risk can be explained by the premium uninformed investors require for accommodating informed investors' trades (O'Hara, 2003).

Second, we show that the shadow price of external funds may not capture systematic intermediation risk.[22] Stock portfolios formed on firm size are known to capture the level of firm financial constraints, and hence size-based stock portfolios indirectly capture the shadow price of external funds (see Gertler and Gilchrist (1994), Perez-Quiros and Timmermann (2000), Campello and Chen (2010), among others). Our empirical results show that intermediation factors explain size-based stock portfolio returns, and that intermediation factor loadings for small stock returns are larger than that of large stock returns. Hence, we argue that if intermediation risk were entirely captured in the shadow price of external funds, then intermediation factors would not have any explanatory power for size-based stock portfolio returns. We further argue that in a bad state of the world, outrageous shadow prices of external funds would exclude firms from receiving any financing.[23] Hence, intermediation risk and the shadow price of external funds are related but distinct issues.

Third, the results in this paper pose considerable challenges to the notion that financial

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[22] We thank an anonymous seminar participant at Universitat Pompeu Fabra to point out the issue that the shadow price of external funds may capture the intermediation risk.

[23] We thank Pete Kyle for pointing it out. For example, a highly constrained firm that is willing to pay 100% interests on borrowings will be immediately cutoff from external funding. The reason is that it raises questions about the credibility of the firm.

frictions can be captured by the default premium, defined as the yield spread between Aaa and Baa rated corporate bonds. Bernanke (1989), and Stock and Watson (1989, 1999) show that the default premium is one of the most powerful predictors for economic activities. Gomes et al. (2006) further argue that the default premium captures aggregate financial frictions and that the shadow price of external funds is a linear function of the default premium. We show that intermediation risk is more important than the default premium in predicting stock returns and in explaining value and size premiums. Thus, the results suggest intermediation risk is another source of risk that may not be captured by the default premium.

This paper is related to studies that investigate frictions in supplying credits. On the microeconomic front, Q-theory based investments research has a long tradition in investigating the shadow price of external funds.[24] On the macroeconomic front, there exists an extensive body of work that investigates financial frictions in supplying credit. The existing literature (e.g., Bernanke and Gertler, 1989) study the effect of macroeconomic shocks and business cycles on firms' demand for funding, and on firms' ability to secure external financing. The central thread that connects both the macroeconomic and microeconomic research is that financial imperfections lead firms to react heterogeneously, and that frictions such as asymmetric information often play a significant role in determining the supply of credits.

Intriguingly, investigating the role of financial intermediaries in supplying credits in a financially imperfect world is relatively rare. Within microeconomic research, intermediaries' funding is exogenous and firms' financial constraints are evaluated by considering firm-level

[24] A partial list includes Hennessy and Whited (2006) and Hennessy (2004).

financial variables. However, irrespective of whether firms are financially constrained or not, firms rely on intermediaries for external funds. Given a set of investment opportunities, a value maximizing manager would optimally choose internal and external funds.[25] However, the existing investment-based asset pricing literature does not answer two important questions. Are optimally chosen external funds available at any given instant? How do fluctuations in external financing affect firm investments decisions, and hence affect investment returns? We answer these questions by incorporating intermediaries' funding constraints into the firm value optimization problem.

The paper is related to studies (e.g., Holmstrom and Tirole (1997), among others) that investigate the effect of capital constraints of firms and intermediaries on investments. The paper is also related to recent studies that derive asset prices in the presence of intermediaries, such as the models of He and Krishnamurthy (2011 and 2012) and Brunnermeir and Sannikov (2011). However, these studies do not investigate whether fluctuations of intermediaries' wealth can explain stock liquidity or predict stock returns.

Adrian et al. (2012) consider an ad hoc stochastic discount factor for excess returns that is affine in brokers and dealers' leverage shocks. However, they observe that they cannot provide any theoretical justification for their empirical findings. We provide a plausible theoretical foundation for the empirical results of Adrian et al. (2012). Importantly, the model presented here shows that the empirical model of Adrian et al. (2012) is a special case of a general asset pricing model.

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[25] While internal funds are important (see, Rajan and Zingales (1995)) in financing projects, firm capital structure depends also on external funds.

The essay is organized as follows. Section 3.2 presents the model that shows the relationship between asset liquidity and the investment-based stochastic discount factor. Section 3.3 describes data. Section 3.4 presents the empirical results. Section 3.5 concludes.

3.2 The model

The model builds on the essay 2 of this dissertation and the existing investment-based asset pricing models.[26] I use results of essay 2 as given and argue that the stochastic discount factor that defines asset prices also defines asset liquidity. What follows from essay 2 is that the intermediation-augmented investment-based stochastic discount factor can be written as

$$\mathrm{M}_{t+1} = \alpha_2 + \beta_1 f_{t+1}^1 + +\beta_2 f_{t+1}^2 \quad (1)$$

where f_{t+1}^1 is measured by either invest returns or productivity factors of BH and f_{t+1}^2 is measured by the growth of intermediaries' balance sheet variables.

3.2.1 Stock liquidity

One of the other testable implications of equation (1) is to test whether financial intermediaries' funding determines stock liquidity. The motivation is that higher moments of stock returns may provide alternative explanations for the stock returns dynamics. A full story of the asset returns dynamics is revealed when innovations in higher moments of asset prices are investigated (Merton, 1980). Johnson (2008) further notes the contemporaneous nature of volatility and liquidity by arguing, *"Intuitively, even in more general economics, anything that causes asset*

[26] An incomplete list includes Cochrane (1991, 1996); Livdan et al. (2009); Liu, Whited, and Zhang (2009); and Gomes et al. (2006).

risk to rise will steepen the demand curves." Hence, the co-movements of stock liquidity and stock volatility make stock liquidity a prime candidate for investigating the stock returns dynamics.

The true value of firms, and hence the fundamental value of stocks, which is a claim on firms' assets, is unobservable. The degree of fluctuations from the true value is the liquidity of stocks, and it represents the ease with which stocks are traded with less impact on prices; the lower (higher) is the deviation, the higher (lower) is the liquidity. Since securities' liquidity has different explanations, such as search cost, inventory costs, information asymmetry etc., no model can accurately capture every dimension of stock liquidity. Following the information asymmetry-based explanation for stock liquidity *à la* Kyle (1985), we illustrate how stock price dispersion is related to stock liquidity.

Assume firm stocks are traded in a market in the Kyle (1985) world, where there are three types of economic agents: an insider (informed traders), a noise trader (uninformed or liquidity traders), and a market maker. The informed trader knows the true value of the firm given by equation (1), and its distribution $\tilde{V} \sim N(\mu_V, \sigma_V)$, where μ_V *and* σ_V are the mean and variance of the firm value process. That is, among other things, informed traders know firms' sources of internal and external funds, and hence know firm productivity innovations represented by equation (6). As a direct consequence, informed traders know both the impact of firm external funds on the stochastic discount factor given by equation (10) and the distribution of the firm value process.[27] The informed trader trades to maximize profits by camouflaging his trades

[27] Equation (10) implies that the firm value follows $E_t[M_{t+1}V_{t+1}] = V_t$.

with the trades of the noise trader. The noise trader trades an exogenous amount distributed according to $\widetilde{U} \sim N(0, \sigma_U)$, where $\widetilde{U}$ is uncorrelated with $\widetilde{V}$. The market maker observes the order flow (from both informed and noise traders) but cannot distinguish between the two trades, and hence the market maker sets the stock price equal to the expected firm value conditional on the observed order flow. In equilibrium, the market maker uses a linear price function that has a slope of Kyle's (1995) Lambda (Λ), which measures the price impact per dollar of order flow, and hence Λ captures the liquidity of traded stocks. Using Kyle's (1985) results we write

$$\Lambda = \frac{1}{2}(\sigma_V / \sigma_U) \qquad (2)$$

However, in Kyle's (1985) model, σ_V is exogenous, that is, the sources in the fluctuations of firm value are not explicitly defined. We argue that σ_V is driven by economic fundamentals as shown in equation (6). Two stocks may have the same σ_U, but σ_V could be different, and hence they have different liquidity. To be specific, firms that are exposed to volatile external funding have volatile productivity, and hence traded securities of these firms are less liquid relative to that for firms that have stable sources of external funds. On the contrary, if two stocks have the same σ_V, but have different σ_U, then two stocks will have different liquidity and information asymmetry solely drives stock liquidity. It is intuitive that by observing Λ, one cannot disentangle whether it is determined by σ_V or σ_U. However, one can definitely investigate whether Λ can be explained by intermediaries' funding shocks. One can also investigate the impact of σ_V on stock liquidity. For larger firms, σ_V is likely to be lower because the firm value process is less sensitive to intermediation risk.

For parsimony, we do not formally derive the relationship between Λ and intermediaries' funding shocks because such a derivation does not add anything beyond the firm value process captured by the relationship (6). Instead, starting from the liquidity measurement from stock returns, described in the next sub-section, we provide intermediation-based explanation of stock liquidity.

3.2.2 Stock Liquidity Proxies

Having discussed how stock returns can be measured in terms intermediaries' balance sheet shocks; we next discuss stock liquidity measures. We use three liquidity proxies to capture stock liquidity. Amihud's illiquidity ratio (ILR) measure, which is based on the price impact to the order flow and is the empirical analog for Kyle's Λ, is calculated as the ratio of the price movement to the trading volume:

$$\mathrm{ILR}_{i,t} = \frac{1}{D_{i,t}} \sum_{d=1}^{D_{i,t}} \frac{|R_{i,d,t}|}{(VOL_{i,d,t})} \tag{3}$$

where, $|R_{i,d,t}|$ and $VOL_{i,d,t}$ are the absolute return and the dollar volume of security *i* on date *d*. It is customary to multiply ILR by 10^6. $ILR_{i,t}$ measures the effect on returns for a given trading volume, and the ILR measure could be viewed as a scaled version of return volatility. For a given trading volume of securities, the higher is the deviation of returns from the mean, the lower is the liquidity. Since Equation (11) shows that a portion of stock return variations are tied to the variations in external funding relative to capital, we argue that ILR, in essence, is partially determined by intermediary's funding.

The second measure is the liquidity measure of Roll (1984) which is a canonical model of the dealer market with fixed cost and it is an estimate of the implicit spread. The variations of this model are present, in disguise, throughout the market-microstructure literature. Under the assumption that there exists a constant effective spread, the liquidity of a stock 'i' is captured by

$$\text{Roll}_{i,t} = \frac{1}{D_{i,t}} \sum_{d=1}^{D_{i,t}} \sqrt{-cov(R_{i,d,t}, R_{i,d,t-1})} \quad (4)$$

where, $R_{i,d,t}$ is stock returns, $D_{i,t}$ is the number of days. ROLL, in essence, measures stock return dispersions. As a direct consequence, we argue that ROLL is determined by the innovations in intermediaries funding.

We use the third measure to conduct robustness checks. The relative spread measure of stock liquidity is based on the trading cost, and is calculated as the ratio of the bid-ask spread to the midpoint price of a security and is calculated as:

$$\text{RS}_{i,t} = \frac{1}{D_{i,t}} \sum_{d=1}^{D_{i,t}} \frac{(price^{ask} - Price^{bid})_{i,d,t}}{(0.5price^{bid}{}_{highest} + 0.5price^{bid}{}_{lowest})_{i,d,t}} \quad (5)$$

Where D is number of trading days, d is the day when bid and ask of security 'i' is calculated.

The liquidity of a portfolio is calculated by averaging liquidity proxies over the number of NYSE stocks in a portfolio. Consistent with the literature (e.g., Amihud, 2002) we consider stocks with share price more than $5 and less than $1000.

We first calculate liquidity of each stock based on ILR, RS, and ROLL. Next, we calculate equally weighted average of liquidity of all stocks to get a measure of stock market liquidity, which we denote as ILR, RS, and ROLL for parsimony. Note that each liquidity measure proxy for stock illiquidity.

We also investigate the dynamics with liquidity of stocks of different sizes for robustness checks. We form three stock portfolios with stocks ranked on market capitalization (size) into treciles, and then calculate liquidity of each portfolios. If ILR is the liquidity proxy, liquidity of stock based on size are denoted as ILR_Small, ILR_Mid, and ILR_Large.

3.3. Data

The quarterly-sample under investigation dates from the first quarter of 1955 to the fourth quarter of 2009. Unless noted otherwise, all data are obtained from the Federal Reserve Bank of New York. Intermediaries' balance sheet data is obtained from the Federal Flow of Funds. The balance sheet data at the Federal Flow of Funds are reported at the subsidiary level, and hence any possibility of double counting is eliminated. Following Adrian and Shin (2009), we include 17 intermediaries to proxy for the U.S. financial intermediation, and these intermediaries are grouped into six categories: banks, mutual funds, pension funds, insurance companies, securities brokers & dealers, and shadow-banks.[28] Table 2.1 presents the descriptive statistics for these intermediaries. For the subsequent analysis, we aggregate intermediaries' balance sheet data, and following balance sheet variables are used: assets, liabilities, $\text{equity} = (\text{assets} - \text{liabilities})$,and leverage, where leverage is defined as $\text{leverage} = (\text{assets}/\text{equity})$. Intermediation factors are the growth of the above four variables.

We obtain stock returns, risk free (T-bills) rates, and 25 Fama-French size and book-to-market portfolio returns data from Ken French's website. To calculate stock market liquidity, we obtain NYSE stocks data from CRSP. Investments data are obtained from the Bureau of Economic Analysis. *cay*, the consumption to wealth ratio of Lettau and Ludvigson (2001) is

28 See Pozsar, Adrian, Ashcraft, and Boesky (2010) for more details about shadow banking.

obtained from Martin Lettau's website. Productivity shocks data is obtained from Ronald Balvers's website.

We get consistent intermediation data from the first quarter of 1951. However, to account for the initial data reporting errors, we discard data from 1951 to 1954. As a result, the final sample is from 1955 through 2009. Since we have access to productivity shocks data from 1964 through 2004, when productivity shocks are used for the analysis we use the above sub-sample. The sub-sample analysis allows for additional robustness checks.

We use three control variables. The term-spread (referred to as TERM), calculated as the difference between the yield on the 3-month Treasury-bill and the yield on a 10-year Treasury bond index, is included to capture the uncertainties in the Treasury bond market. The literature (e.g., Bernanke and Gertler, 1995) further suggests that financial frictions can be captured by the default premium (referred to as CREDIT), the difference between the yields on 10 year Aaa and Baa rated corporate bonds, and hence we use CREDIT as an additional control.

Since stock liquidity and stock volatility commove, volatility of NYSE stocks (referred to as VOL) is used as a control whenever we use stock liquidity in the analysis.

3.3.1 Characteristics of data

We conduct ADF (Augmented Dickey-Fuller, 1979) unit-root tests in conjunction with KPPS (Kwiatkowski et al., 1992) stationarity tests to ascertain stationarity of data. We find that ILR is trend-stationary, with a statistically significant downward sloping trend. Since the stock trading volume, which is in the denominator of the ILR measure, has been steadily rising across stocks, ILR has been contracting for years. As a direct consequence, ILR has a downward sloping trend. To maintain the data integrity, we remove both the drift and linear trend to get detrended ILR data, and find that the detrended ILR is stationary. As for the rest of the data, CREDIT is the only variable that is not stationary for the whole sample, and we take the first difference to attain stationarity.

3.4. Main results

The results show that intermediation factors predict stock liquidity, and hence conform to the model prediction that the stochastic discount factor explains asset liquidity. While productivity is important, productivity factors lose their predictive power for asset liquidity in the presence of intermediation factors.

3.4.1 Summary statistics

Table 3.1 Panel A presents the summary statistics for stock liquidity measures. We have four sets of data for each stock liquidity proxy: liquidity of small, mid, and large size stocks and the aggregated liquidity of all stocks. Table 1 Panel B presents the sample correlation. The results show intermediation-based factors are negatively correlated with stock liquidity proxies and is consistent with the liquidity measures all of which measure ‘illiquidity’. That is, positive intermediation stocks improve stock liquidity. Since the univariate relationship may not hold in the presence of controls that are known to affect stock liquidity, we next investigate the relationship in a comprehensive manner.

3.4.2 Predicting Stock Liquidity

We run a predictive regression to investigate the relation between stock liquidity and intermediation factors.

$$Y_t = \alpha_t + \sum_{i=1}^{n} \beta_i Y_{t-i} + \gamma_t Z_{t-1} + \delta_t K_{t-1} + \varepsilon_t \qquad (6)$$

where Y is stock liquidity, we use lags of Y on the right-hand of the regression equation to whiten Y, one lag of Z is the explanatory variable, and K is the vector of control variables. In addition to the controls variables used earlier, we use volatility of NYSE stocks (VOL) since stock volatility and liquidity co-move. Additionally, we control for recessions and the recent crisis.

Looking from the left in Table 3.2 Panel A, first we present the result for the full sample with ASSET as the primary explanatory variable. The results show ASSET predicts ILR and adding INVEST as an additional variable does not change the result qualitatively. Most importantly, INVEST has no predictive power for ILR. Since ILR measures illiquidity, the sign of the coefficient of ASSET is negative. The results thus indicate that in explaining stock liquidity ASSET is the primary variable. The sub-sample analysis, where we control for recessions or the recent crisis, shows ASSET remains important. The last six columns show that alternate measures for stock liquidity do not change the results.

Looking next at Table 3.2 Panel B, we observe that by considering ILR of different sizes the results hold. However, we see the impact of ASSET is different across liquidity of stock portfolios, and the impact of ASSET on liquidity of small stocks is the largest. Thus, the results capture the volatility of firm value process (σ_V of equation (12)) across different stock sizes.

Since large stocks are likely to be least affected by intermediation risk, and hence the firm value process is least sensitive to intermediation risk. As a result, large stock liquidity is least sensitive to ASSET. While information asymmetry may be one of the reasons for why some stocks are more liquid than others, the explanation above does not depend on information asymmetry.

Note that Kyle's $\Lambda = \frac{1}{2}(\sigma_V/\sigma_U)$ measured across stocks are necessarily measuring the level of information asymmetry. Small stocks are less liquid (see Table 3.1 Panel C), that is, Λ is large, because σ_U is small relative to σ_V. If σ_U alone drives stock liquidity, then ASSET should not have any explanatory power for ILR, which is inverse of Λ. However, we observe that ASSET is inversely proportional to ILR, that is, ASSET measures σ_V. If the contribution of ASSET on Λ is larger than that of σ_U, then uninformed traders may not ask for the liquidity risk they are bearing.

The results hold for the subsequent sub-sample analysis. For parsimony, we do not report the results where the primary explanatory variables are EQUITY or LEV since the results are similar. We also do not report the results for other measures of stock liquidity since the results are not qualitatively different from the results for ILR.

Table 3.2 Panel C shows the regression results where we control for BH productivity factors. Since BH productivity factors data is available for 1964 through 2004, the results allow for additional robustness checks. Looking from the left, first we present the results with ASSET as the primary explanatory variable. The results show ASSET predicts ILR_Small, and augmenting the model with PF1 and PF2 as additional variables does not change the result qualitatively. As for productivity factors, unconditional productivity factor PF1 predicts ILR_Small. Controlling for recessions has minimal effect on both ASSET and PF1.

Looking next for the results in the next six columns show that both ASSET and PF1 predicts ILR_Mid. As for ILR_Large, the predictive power of both ASSET and PF1 is not as robust as that for ILR_Small and ILR_Mid. That is, the results suggest that larger firms are less affected by systematic intermediation or productivity shocks.

Looking at the last column, the results, however, show that ASSET better predicts overall stock market liquidity even after controlling for recessions. By contrast, productivity factors have no predictive power for overall stock market liquidity.

In summary, the results suggest that intermediation factors are more important than investment-based or productivity-based factors in explaining stock market liquidity.

3.4.3 Economic Interpretations

Why do intermediation factors predict stock returns and liquidity well? The answer to the question rests both on the relationship among intermediaries' balance sheet variables and on the relationship between intermediaries and firms. We first investigate how intermediaries' balance sheet variables interact with each other with the business cycle. Next, we relate the evolution of intermediaries' balance sheets to firm characteristics.

Adrian and Shin (2010) discuss the relationship between intermediaries' equity and leverage and its implication on intermediaries' balance sheets. They show commercial banks target a preset leverage and investment banks' leverage is procyclical. As asset prices rise, intermediaries' equity rises, thereby lowering the leverage. Commercial banks respond to the falling leverage by expanding the balance sheet by borrowing and lending more to revert back to the desired leverage. The effect of asset prices on investment banks' balance sheets is more pronounced since their leverage is procyclical. Investment banks borrow and lend more than commercial banks and their leverage keep rising with the rising asset prices until an asset price bubble sets in.

By contrast, we show intermediaries' leverage *in aggregate* is procyclical. In Figure 2.2, we show the relationship between intermediaries' asset and leverage growths. The positive slope of the regression line implies that intermediaries' leverage is procyclical. As a direct consequence, in economic expansions (recessions) when asset prices are high (low) intermediaries expand (contract) the balance sheet

3.5 Conclusions

The Brunnermeir and Pedersen (2009) model shows that the funding liquidity and asset market liquidity are intimately related: traders provide market liquidity as long as traders have sufficient funding in crisis periods. By contrast, the Johnson (2009) model suggests that controlling for the *aggregate* financial position of the economy, there should not be any role for the financial position of securities dealers and brokerage firms in explaining aggregate fluctuations of overall market liquidity. The implication of the above studies is that while investigating traders' liquidity is important in the crisis management, studying the market liquidity dynamics with a larger set of intermediaries has far more economic ramifications. The reason is that while traders are involved dealing with marketable securities, the aggregated financial position of intermediaries encompasses every conceivable asset in the economy. Hence, investigating the role of aggregated financial position of intermediaries in determining the market liquidity is important. In this paper, we develop a model to show how the growth of intermediaries' financial position explains the aggregated market liquidity. This is the primary contribution of the paper.

We further address the shortcomings of the existing investment-based asset pricing models, such as Cochrane's (1991 and 1996), that assume financial intermediation is exogenous to the firm value maximization problem. We relax the assumption that firms have intermediated lines of credit at some cost, and show that fluctuations in intermediaries' funding a) is a factor for stock returns, and b) can explain stock liquidity.

We contribute to the market microstructure literature on liquidity in that we show that intermediaries' funding shocks are one of the determinants of stock liquidity. That is, we show that the commonality in stock liquidity is determined by intermediaries' balance sheet shocks.

We contribute to the asset pricing literature by showing that the exiting investment-based asset pricing models, such as Cochrane's (1991 and 1996), are a special case of a general asset pricing kernel. The intermediation-augmented investment-based model predicts that the marginal funding that intermediaries provide explains stock returns. The empirical results suggest that intermediation factors outweigh existing investment- and productivity-based factors in predicting stock returns and stock liquidity.

We find that investment-based (Cochrane, 1996), productivity-based (Balvers and Huang, 2007) and liquidity-based (Acharya and Pedersen (2005), among others) asset pricing factors that are known to explain the cross-section of stock returns perform poorly in predicting stock returns. By contrast, intermediation factors predict stock returns and stock liquidity. Thus, intermediation factors behave as a true state variable in the economy. As a natural extension, future research may investigate the cross-sectional asset pricing implications of intermediation factors. We leave this task for future research.

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Table 3.1
Summary statistics

This table presents summary statistics for stock liquidity Panel A presents the statistics for stock liquidity for NYSE stocks, where ILR (Amihud, 2002), RS, and ROLL (Roll, 1984) are stock liquidity measures. Stock portfolios are constructed by allocating stocks into treciles (Small, Mid, and Large) formed on market capitalization (size) and corresponding liquidity of stock portfolios are measured. Panel B shows the correlation between ASSET, INVEST, PF1 and PF2 with ILR, ROLL and RS.

Panel A: Stock Liquidity measures

	ROLL_Small	ROLL_Mid	ROLL_Large	ROLL	ILR_Small	ILR_Mid	ILR_Large	ILR	RS_Small	RS_Mid	RS_Large	RS
Mean	0.02	0.02	0.02	0.02	1.15	0.20	0.03	0.42	0.02	0.02	0.02	0.02
Median	0.02	0.02	0.01	0.02	0.66	0.11	0.02	0.21	0.02	0.02	0.02	0.02
Std. dev.	0.00	0.01	0.01	0.01	1.24	0.40	0.03	0.43	0.01	0.01	0.01	0.01
Min	0.01	0.01	0.01	0.01	0.16	0.02	0.00	0.02	0.01	0.01	0.01	0.01
Max	0.05	0.06	0.06	0.06	7.12	4.41	0.13	1.90	0.08	0.09	0.08	0.08
N (Obs)	220	220	220	220	220	220	220	220	220	220	220	220

Panel B: Correlation of ASSET, competing factors and stock liquidity

	INVEST	PF1	PF2	ASSET	ILR	ROLL
PF1	-0.200					
PF2	-0.145	0.331				
ASSET	0.119	0.138	0.137			
ILR	-0.374	-0.060	-0.068	-0.230		
ROLL	-0.287	-0.061	0.014	-0.286	0.342	
RS	-0.248	-0.044	0.029	-0.259	0.251	0.976

Table 3.2
Predicting Stock Liquidity

The table shows the results of the regression equation $Y_t = \alpha_t + \sum_{i=1}^{n} \beta_i Y_{t-i} + \gamma_t Z_{t-1} + \delta_t K_{t-1} + \varepsilon_t$, where Y is the dependent variable, which represents one of the portfolios stock liquidity, Z is ASSET, the asset growth of intermediaries; K is the vector of control variables: VOL, TERM, and CREDIT, where VOL is the volatility of NYSE stocks. Panel B presents the results for the whole sample (1955-2009), and the results after controlling for INVEST, recessions, and the recent crisis. Panel C presents the results for liquidity of stocks of different sizes. Panel C presents the results for liquidity of stocks of different sizes after controlling for productivity factors: PF1 and PF2, and recessions. Errors are corrected for Newey-West heteroscedasticy adjustments. T-statistics are in the parenthesis. The *indicator* is one if recessions or the recent crisis.

Panel A: Predicting Stock Liquidity by Intermediaries' Asset Growth and Investment Returns

Dependent Variable: Stock Liquidity	ILR				ROLL			RS		
Sample Period	1955-2009		Recession versus Non-recession	Crisis versus Non-crisis	1955-2009	Recession versus Non-recession	Crisis versus Non-crisis	1955-2009	Recession versus Non-recession	Crisis versus Non-crisis
ASSET	-0.68	-0.61	-0.64	-0.68	-0.04	-0.02	-0.04	-0.06	-0.04	-0.06
	(-3.46)	(-2.91)	(-3.13)	(-3.48)	(-1.98)	(-0.93)	(-2.02)	(-2.09)	(-3.34)	(-2.12)
INVEST		0.03	0.12	0.00		-0.05	0.08		-0.13	-0.01
		(0.29)	(0.26)	(-0.29)		(-1.16)	(0.66)		(-0.98)	(-0.08)
Indicator* ASSET			0.12	0.00		-0.05	0.08		-0.13	-0.01
			(0.26)	(-0.29)		(-1.16)	(0.66)		(-0.98)	(-0.08)
Indicator			0.01	-0.20		0.00	0.00		0.00	0.01
			(0.96)	(-0.58)		(3.30)	(2.41)		(3.39)	(2.63)
TERM	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.58)	(-0.66)	(0.99)	(0.61)	(-0.01)	(1.00)	(0.90)	(0.09)	(0.78)	(1.00)
CREDIT	-0.01	-0.05	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00	0.00
	(-1.57)	(-1.86)	(-1.88)	(-1.29)	(0.07)	(-0.82)	(-1.09)	(-0.12)	(-0.50)	(-1.11)
VOL	1.14	1.88	1.08	1.28	0.00	0.00	-0.04	0.02	0.01	-0.07
	(1.83)	(2.19)	(1.54)	(2.01)	(0.04)	(-0.01)	(-0.50)	(0.16)	(0.04)	(-0.54)
N (Obs)	220	220	220	220	220	220	220	220	220	220
Adj. R-Squared	0.51	0.51	0.52	0.51	0.29	0.33	0.31	0.22	0.26	0.24

Table 3.2 continued

Panel B: Predicting Liquidity of Stocks of Different Sizes by Intermediaries' Asset Growth									
Dependent Variable: Stock Liquidity									
	ILR_Small			ILR_Mid			ILR_Large		
Sample Period	1955-2009	Recession versus Non-recession	Crisis versus Non-crisis	1955-2009	Recession versus Non-recession	Crisis versus Non-crisis	1955-2009	Recession versus Non-recession	Crisis versus Non-crisis
ASSET	-1.68	-1.64	-1.80	-0.19	-0.14	-0.14	-0.04	-0.04	-0.04
	(-3.21)	(-2.97)	(-3.32)	(-2.30)	(-1.63)	(-1.69)	(-3.06)	(-2.22)	(-2.90)
Indicator* ASSET		0.73	1.44		-0.24	-0.39		-0.02	0.00
		(0.64)	(1.11)		(-1.42)	(-2.27)		(-0.75)	(0.07)
Indicator		0.02	-0.02		0.01	0.01		0.00	0.00
		(0.76)	(-0.79)		(1.78)	(2.34)		(0.87)	(0.05)
TERM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.32)	(0.71)	(0.49)	(1.11)	(1.68)	(1.24)	(0.85)	(1.16)	(0.66)
CREDIT	-0.03	-0.03	-0.03	-0.01	-0.01	-0.01	0.00	0.00	0.00
	(-1.63)	(-1.96)	(-1.30)	(-1.33)	(-1.67)	(-1.88)	(-1.05)	(-1.30)	(-0.89)
VOL	3.03	3.03	3.53	0.54	0.40	0.39	0.02	0.02	0.02
	(1.81)	(1.71)	(2.16)	(1.88)	(1.27)	(1.28)	(0.52)	(0.35)	(0.43)
N (Obs)	220	220	220	220	220	220	220	220	220
Adj. R-Squared	0.52	0.52	0.51	0.44	0.44	0.44	0.24	0.24	0.23

Table 3.2 continued

Panel C: Predicting Liquidity of Stocks of Different Sizes by Intermediaries' Asset Growth and Productivity Factors

Dependent Variable: Stock Liquidity										
	ILR_Small			ILR_Mid			ILR_Large			ILR
Sample Period	1964-2004		Recession versus Non-recession	1964-2004		Recession versus Non-recession	1964-2004		Recession versus Non-recession	Recession versus Non-recession
ASSET	-4.29	-3.96	-2.55	-0.54	-0.48	-0.30	-0.07	-0.06	-0.02	-0.96
	(-3.46)	(-3.05)	(-2.34)	(-3.38)	(-2.90)	(-2.11)	(-1.89)	(-1.55)	(-0.69)	(-2.34)
PF1		-5.66	-3.34		-0.81	-0.55		-0.08	-0.05	-1.31
		(-2.13)	(-1.23)		(-2.74)	(-2.00)		(-1.43)	(-0.72)	(-1.31)
PF2		-4.24	-1.10		-0.99	-0.62		-0.26	-0.20	-0.64
		(-0.60)	(-0.18)		(-1.02)	(-0.74)		(-1.71)	(-1.44)	(-0.27)
Indicator* ASSET			2.82			0.20			-0.02	1.00
			(0.58)			(0.33)			(-0.19)	(0.54)
Indicator			0.23			0.03			0.01	0.09
			(1.67)			(1.79)			(1.57)	(1.69)
TERM	-0.04	-0.02	0.01	-0.01	0.00	0.00	0.00	0.00	0.00	0.00
	(-1.57)	(-1.26)	(0.54)	(-2.28)	(-1.98)	(-0.38)	(-1.98)	(-1.78)	(-0.78)	(0.41)
CREDIT	0.02	0.04	-0.06	-0.01	0.00	-0.01	0.00	0.00	0.00	-0.03
	(0.41)	(0.94)	(-1.58)	(-0.94)	(-0.510	(-2.92)	(-0.55)	(-0.08)	(-1.22)	(-1.79)
VOL	17.18	15.92	14.59	1.83	1.64	1.46	0.28	0.25	0.22	5.42
	(2.36)	(2.32)	(2.74)	(2.69)	(2.67)	(3.31)	(1.94)	(1.87)	(2.00)	(2.84)
N (Obs)	164	164	164	164	164	164	164	164	164	164
Adj. R-Squared	0.20	0.23	0.34	0.21	0.26	0.36	0.12	0.16	0.20	0.35

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