Securities' Liquidity under Uncertainty in Financial Intermediaries' Liquidity

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This paper investigates whether asset liquidity (i.e. the ease with which assets are traded) is determined by financial intermediaries' liquidity (i.e. the funding that intermediaries provide). Unlike standard production-based asset pricing models where firms have access to external financing at some costs, we derive stock returns and stock liquidity under financial constraints of financial intermediaries. We show that the marginal funding provided by intermediaries is a factor not only for asset returns but also for asset liquidity. Using intermediaries' balance sheet data from 1955 to 2009, we find support for the model predictions.

INTRODUCTION

We derive a production-based asset pricing kernel under financial intermediaries' liquidity constraints. Subsequently, we show that the transaction liquidity of assets is determined by the liquidity that intermediaries provide. The model predicts that the marginal funding provided by intermediaries is an important factor in explaining asset returns and asset liquidity. The empirical results attest to the theoretical predictions.

Since the recent financial crisis, there have been considerable discussions on the role of intermediaries in the crisis. By conducting a survey of CFOs around the world, Campello et al., (2010), present a realistic view on the firm behavior during the recent crisis. The survey finds that about 86% of U.S. CFOs believed that their firms are financially constrained, and about half of the CFOs cancelled or postponed investments. Is the role of intermediaries in supplying credit and its relation to firm investments are unique to the recent liquidity driven crisis? To answer this question, we develop a model that is time-invariant, and that links intermediaries' funding constraints to firm investments. We show that the fundamental relationship between the money-flow from intermediaries and real activities in the economy is not new. The primary contribution of the paper is to derive an intermediary-augmented asset pricing kernel.

We develop a production-based asset pricing model, where value-maximizing managers work under the uncertainty of external funds. The asset pricing model suggests that the marginal funding from intermediaries induce variations in investment returns, and hence affect firm productivity. As a consequence, stock returns and stock liquidity follow the innovations in the external funding that firms receive from intermediaries.

Next, based on the theoretical predictions, we test whether funding from intermediaries predicts stock returns and stock liquidity. We further test whether intermediaries funding explains the value and size premium. The growth intermediaries' financial assets is used as a proxy for the marginal funding that intermediaries provide. The empirical results conform to the model predictions. The findings are robust to different controls.

The results contribute to several strands of the literature. On the microeconomic front, Q-theory based investments research has been prolific in investigating the shadow-costs of external funds (Hennessy and Whited, 2006, Hennessy, 2004). Campello and Chen (2010) investigate whether financial constraints affect stock returns. Gomes et al. (2006) explore the cyclical nature of financial constraints and its effect on stock returns. On the macroeconomic front, there exists an extensive body of work that addresses financial frictions in supplying credit. The existing literature study (such as, Bernanke and Gertler, 1989) 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 credit.

Intriguingly, investigating the role of financial intermediaries in supplying credit in a financially imperfect world is relatively rare. Within microeconomic research, intermediaries funding is exogenous and firms' financial constraints are evaluated using firm-level financial variables. However, irrespective of whether firms are financially constrained or not, firms rely on intermediaries for the external sources of funds. Given a set of investment opportunities, a value maximizing manager would always optimally choose external financing. However, there are several important questions that remain unanswered. First, is optimally chosen external financing available? Second, how do fluctuations in the availability of external financing affect firm investments decisions? We contribute to the literature by incorporating intermediaries' liquidity constraints into the firm value optimization problem.

The Brunnermeir and Pedersen (2009) model provides the link between asset market liquidity and funding liquidity, and they show that traders provide market liquidity as long as traders have sufficient funding. 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. The reason is that the aggregated money-flow from intermediaries dictates real economic activities. We show that intermediaries' funding is important for firm productivity, and hence intermediaries' liquidity (or funding they provide) predicts stock returns and stock liquidity.

We contribute to the market microstructure literature on liquidity in that we show that intermediaries' liquidity 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 is embedded in asset growths of intermediaries, 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).

The paper is organized as follows. Section 2 presents the model that derives the intermediary augmented asset returns and asset liquidity. Section 3 describes data. Section 4 presents the empirical results. Section 5 concludes.

THE MODEL

The model builds on the existing literature on neoclassical investment and production-based asset pricing models, such as Cochrane (1991 and 1996), Livdan et al. (2009), Whited (1992), Gomes et al. (2003 and 2006), Hennessy (2004), Hennessy and Whited (2006). In contrast to the existing literature, however, we do not assume that firm mangers have intermediated lines of credits. The rationale is that with the business cycle intermediaries face borrowing and lending constraints, and hence they cannot provide loans to all firms that have a demand for loans. The recent crisis in the U.S. and the ongoing banking crisis in Europe succinctly support the stated observation.

We depart from the standard assumption in the production-based investment/asset pricing models (e.g., Hennessy, Levy, and Whited, 2006, etc.) that firms have access to intermediated lines of credit. That is, we introduce frictions in supplying credit from representative investors via intermediaries to firms. We define the portfolio allocation function $\Omega(K_t, \zeta_t) \in [0\ 1]$ that captures the variations in lending with the business cycle. The argument K is the capital-stock of firms to which intermediaries lend, and ζ is exogenous, which captures the states of the economy. While value maximizing managers may optimally demand external funds (for instance, equity E_t and debt D_t), external funds are not always available. That is, if the external funs demand is $(E_t + B_t)$, then intermediaries provide a Ω fraction of it, and hence the fund supply is $\Omega_t(K_t, \zeta_t)(E_t + B_t)$. If intermediaries cannot provided demanded funding then $0 \leq \Omega < 1$; if they do provide demanded funds then $\Omega = 1$. Having state the stage, we write down the model assumptions.

Model assumptions and setup:

1) A value maximizing manager who optimizes firm value $\mathrm{V}(.)$ in a period between the time t and t+1, and she has complete access to financial markets.
2) Firm invests I_t and investment decisions are made by choosing the optimal capital at time t+1. Investments are financed by internal cash flows from gross profit and funds that intermediaries provide. The gross profit function $\Pi(K_t, \zeta_t)$ is linear in capital and may exhibit constant/increasing/decreasing returns-to-scale depending upon the firm characteristics. The endogenous variable K_t is the capital stock, which depreciates at the rate of δ. The variable ε is exogenous, and it captures firms' production innovations such as input costs, output prices, and productivity that affect the capital accumulation.
3) Firm demands external funding $(E_t + B_t)$. However, the funds supply is $\Omega_t(K_t, \zeta_t)(E_t + B_t)$.
4) The adjustment costs to capital $\Psi(K_t, I_t)$ are convex with $\boldsymbol{\alpha}$ >0 as the curvature.

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

$$\mathrm{V}(K_t, \Omega_t, \zeta_t) \equiv \max_{\{K_{t+1}\}}[C_t(K_t, \Omega_t, \zeta_t) + \frac{1}{R_{t+1}^I} C_{t+1}(K_{t+1}, \Omega_{t+1}, \zeta_{t+1})] \tag{1}$$

where C_t is the cash flow, which is the net of gross profit, new equities and debt, investments, and the adjustment costs to capital $\Psi(K_t, I_t)$; the gross discount rate or the return on investments is R_{t+1}^I, which is known at the beginning of time t+1. At time ‘t’, the cash flow C_t is written as

$$C_t = \Pi(K_t, \zeta_t) + \Omega(K_t, \zeta_t)(E_t + B_t) - I_t - \Psi(K_t, I_t)K_t \tag{2}$$

where the adjustment cost to capital is

$$\Psi(K_t, I_t) = \frac{\alpha}{2}[\frac{I_t}{K_t}]^2 K_t \tag{3}$$

and the capital accumulation follows

$$\mathrm{K}_t = I_t + (1 - \delta)K_t \tag{4}$$

After substituting the cash flow for time ‘t’ and ‘t+1’ in (1), the first order condition implies that

$$\mathrm{R}_{t+1}^I = \frac{\{\Pi_{k+1} + \Omega_{k+1}(E_{t+1} + B_{t+1}) + \frac{\alpha}{2} i_{t+1}^2 + (1-\delta)(1 + \alpha i_{t+1})\}}{(1 + \alpha i_t)} \tag{5}$$

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

Equation (5) could be decomposed into firm specific and financial intermediary specific components as

$$\mathrm{R}_{t+1}^I = \mathrm{R}_{t+1}^a|_{\mathrm{FirmSpecific}} + \mathrm{R}_{t+1}^b|_{\mathrm{IntermediaryFundingSpecific}} \tag{6}$$

where,

$$\mathrm{R}_{t+1}^{a}|_{\mathrm{FirmSpecific}} = \{\Pi_{k+1} + \frac{\alpha}{2} i_{t+1}^{2} + (1-\delta)(1+\alpha i_{t+1})\}/(1+\alpha i_t) \tag{7}$$

$$\mathrm{R}_{t+1}^{b}|_{\mathrm{IntermediaryFundingSpecific}} = \{\Omega_{k+1}(E_{t+1} + B_{t+1})\}/(1+\alpha i_t) \tag{8}$$

Equation (7) provides a tractable version of the intuition that investment returns, in addition to firm specific characteristics, depend on the innovations in Ω, the availability of external funds. Thus, equation (7) is a richer representation of the asset pricing dynamics in a production-based framework and is interpreted as follows.

Equation (8) is the essence of our model. It shows that Ω_{k+1}, the marginal funding that intermediaries provide is one of the determinants of investment returns. If $\Omega(K_t, \zeta_t) = 1$ then firms have access to demanded external funds, such as lines of credit, that is, firms' external funding remains unchanged relative to capital, and hence, $\Omega_{k+1} = 0$. The stated relation is the standard assumption in the existing literature. In addition, if $\Omega(K_t, \zeta_t) = 0$ then firms have no access to external funds, that is, all investments needs are met internally. In either case intermediation has no effect on firm investment returns. However, these are extreme cases. Generally, external funds change relative to capital, that is, $\Omega_{k+1} \neq 0$, and hence investment returns follow the innovations in external funds.

To derive asset returns from investment returns, we extend the result given in equation (5). Following Cochrane (1996), we assume that investment returns are a factor of asset returns. Given the simplifying assumption, and using equation (6), we write assets returns as

$$\mathrm{R}_t = \alpha + \beta R_t^I = \alpha_0 + \beta_1 R_t^a + \beta_2 R_t^b \tag{9}$$

Note that the existing investment-based models have only R_t^a factor. We argue that R_t^b is more important and encompasses R_t^a.

Testable Implications

The primary testable implication is to test whether R_t^b is an economically important factor for asset returns. We show that R_t^b explains the value and size premium, that it predicts stock returns and stock liquidity. The other testable implication is to explore whether intermediaries' liquidity explains asset returns in the cross-section. For parsimony, we leave the task for future research.

We capture R_t^b by the fluctuations of intermediaries' balance sheet variables, such as assets. The growth of intermediaries' assets is the primary factor. Since intermediaries' assets evolve endogenously with other balance sheet variables, we also investigate other balance sheet variables, such as leverages, to investigate the dynamics.

Though simplistic, our argument that the asset growth proxy for R_t^b parallels Cochrane's (1991 and 1996) argument in three ways. First, since economy-wide aggregated capital does not change considerably, the intermediary specific investment returns component, given by equation (10), is proportional to the aggregate innovations in the balance sheet variables. Second, the term $(1 + \alpha i_t)$ is fairly steady in aggregate; for the 1947-1987 data 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 noise is eliminated.

Cochrane (1996) observes that for the lack of explicit productivity shock data, investment returns proxies R_t^a. While Cochrane (1996) uses residential- and non-residential investment returns as factors for asset returns, we use aggregated private-investments returns as a sole factor to capture the firm specific component of the asset returns process. Since we use aggregated growth of the balance sheet variables to proxy for intermediary specific component of asset returns, aggregated investment measures are more appropriate for the comparison purpose.

Given the discussions above, the testable factor analogues for equation (9) are written as follows.

The investment-based asset pricing model is

$$\mathrm{R}_t = \alpha_1 + \beta_1 f_t^1 \tag{10}$$

where f_t^1 is measured by investment returns following Cochrane (1996).

The intermediation-augmented investment-based model is written as

$$\mathrm{R}_t = \alpha_2 + \beta_1 f_t^1 + +\beta_2 f_t^2 \tag{11}$$

where f_t^2 is measured by the growth of the intermediaries' balance sheet variables.

DATA

The quarterly-sample under investigation dates from the first quarter of 1947 to the fourth quarter of 2009. Unless noted otherwise, all data are obtained from the Federal Reserve Bank of New York. 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 is eliminated. 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. Stock data and firm level data to calculate stock liquidity is obtained from CRSP/COMPUSTAT. For all intermediaries' data, several data points are missing, and we get consistent data from the first quarter of 1951. We also discard data from 1951 to 1954 to account for the initial data reporting errors.

TABLE 1
THE COMPONENTS OF INTERMEDIATION

This table describes the intermediaries. Panel A presents intermediaries by groups. Panel B presents intermediaries' assets.

Panel A: Financial Intermediaries					
Insurance Companies	Pension Funds	Shadow-banks	Banks	Mutual Funds	Brokers & Dealers
Life Insurance, Property and Casualty Insurance.	Private Pension Funds, Federal Govt. Retirement Funds, State Govt. Retirement Funds.	Asset Backed Securities, Agency/GSE Mortgage Pools, Funding Corporations, Finance Companies.	Commercial Banks, Credit Unions, Savings Institutions.	Money Market Funds, Mutual Funds, Closed End Funds, Exchange Traded Funds.	Brokers & Dealers.

Panel B: Intermediaries' Assets (US$ trillions)							
	Banks	Shadow-banks	Insurance Companies	Pension Funds	Mutual Funds	Brokers & Dealers	Total
Mean	3.95	2.42	1.64	2.59	1.97	0.46	16.98
Median	2.34	0.34	0.65	0.79	0.15	0.05	6.65
Std. Dev.	4.23	3.70	1.90	3.21	3.10	0.77	20.91
Min	0.20	0.01	0.08	0.02	0.01	0.00	0.53
Max	16.86	13.79	6.36	10.99	11.18	3.24	73.66

Following Adrian and Shin (2008 and 2009), we include 16 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. Table 1 presents the descriptive statistics for these intermediaries. For the subsequent analysis, we aggregate assets, liabilities, leverage, where leverage is defined $\text{Leverage} = \frac{Assets}{(Assets - Liabilities)}$, of these intermediaries. The growth of the balance sheet variables are used as proxies for the marginal funding that intermediaries provide.

MAIN RESULTS

The empirical results show that the intermediation factors are significantly correlated with excess market returns. These factors explain the return variations of small and value stock portfolios. The intermediation factors further predict excess market returns, and hence behave as state variables. Most importantly, the intermediation factors explain not only the liquidity of the overall market, but also explain liquidity of stocks of different sizes.

Summary Statistics

Table 2 Panel A compares the distribution of the intermediation and the competing factors. The factors are: excess returns on the market portfolio (MKT), the growth of intermediaries' financial assets (ROFA), the growth of intermediaries' liabilities (ROL), the growth of intermediaries' leverage (LEV), and returns on investments (INVEST) in excess of T-bill returns.

Looking at Table 2 Panel A, it is evident that the correlation between all balance sheet variables and MKT is above 60%.

This table presents summary statistics for the factors considered for the study: market excess returns (MKT), the growth of financial assets (ROFA), the growth of liability (ROL), the growth of leverage (LEV), and excess returns on investments (INVEST). 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 the intermediation factors. P-values are in the parenthesis.

TABLE 2
SUMMARY STATISTICS

Panel A: Sample moments				
	INVEST	ROFA	ROL	LEV
Mean	0.017	0.023	0.003	1.002
Std. dev. (X100)	4.233	1.357	1.088	1.173
Corr. MKT	-0.068	0.614	0.705	0.636
	(0.388)	(0.000)	(0.000)	(0.000)
INVEST		0.119	0.065	-0.089
		(0.132)	(0.408)	(0.259)
ROFA			0.967	0.478
			(0.0000	(0.000)
ROL				0.675
				(0.000)

Panel B: Auto-correlation Structure of Intermediary's Balance sheet Variables					
	Lag 1	Lag 2	Lag 3	Lag 4	Lag 5
ROFA	0.072	0.215	0.049	0.257	-0.058
	(0.296)	(0.002)	(0.476)	(0.000)	(0.411)
ROL	0.104	0.189	0.058	0.177	-0.050
	(0.136)	(0.007)	(0.404)	(0.012)	(0.491)
LEV	0.232	0.120	0.002	0.067	-0.082
	(0.001)	(0.095)	(0.976)	(0.375)	(0.305)

The negative correlation between investment returns and MKT is shown in Cochrane (1996). The reason for the negativity is theoretically reconciled by the fact that the investment returns and the stochastic discount factor are inversely related (see Cochrane, 1996). By contrast, the balance sheet variables of intermediaries are positively correlated with the stochastic discount factor. The reason for which can be intuitively resolved with two related but different facts. First, with high asset returns, individuals' wealth increases and hence agents' consumption increases. Second, since intermediaries have pro-cyclical leverage (discussed in sub-section 2.1), high asset returns forces intermediaries to expand their balance sheets by borrowing and lending more.

However, note the positive correlation between intermediaries' asset growth and investments, and the high positive correlation between intermediaries' asset growth and MKT. Taken together, the above suggests that intermediaries' funding may encompass investments and have far greater effect on asset returns than that of investments.

Table 2 Panel B reports the auto-correlation structure of each variable. While LEV is persistent, ROFA and ROL are neither persistent nor random; ROFA and ROL follow a pulsating wave pattern where pulses come in every second and fourth quarter.

Explaining Value & Size Premiums by Intermediation Factors

Cochrane (1999) notes that macroeconomic factors are easier to motivate theoretically but none explains the value and size portfolios 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 show that the growth of intermediaries' balance sheet variables as factors explain the value and size premium. We estimate factor loadings from the following regression as in Fama and French (1993).

$$\mathrm{R}_{i,j}^{e} = constant + b_{i,j} R_X + \varepsilon \tag{12}$$

where the subscript i X j represents 5X5 Fama-French size and book-to-market portfolios excess returns, and R_X is the either returns in excess of the risk-free rate or growths. If factors are portfolio returns then excess returns are used to evaluate the loading. If factors are not returns, then the factor growth is used to estimate the loadings. The factors considered for the analysis are described earlier. In addition, we have included the CAPM (MKT) and the Fama-French 3-factor model (MKT SMB HML).

Table 3 Panel A replicates Table 4 of the Fama and French (1993) paper, and reports the loadings of ROFA. In terms of the loading pattern, ROFA loads size and book-to-market portfolios as MKT does. However, in terms of the factor sensitivity, ROFA is much more sensitive than MKT. The first implication is that if we were to create the SMB and HML factors using ROFA, ROFA would pick the same portfolios as MKT would. The second and important implication is that irrespective of stocks' value or size, stocks are more sensitive to the systematic intermediation risk than the systematic stock market risk.

Table 3 Panel B presents the loadings of INVEST. The loadings of INVEST are erratic, and they are often statistically insignificant. Hence, INVEST cannot explain the value and size premium. That is, INVEST fails the very first test to ascertain that it is a factor for asset returns.

Table 3 Panel C presents the loadings of ROL and LEV, and it shows that these variables load the size and book-to-market portfolios almost the same way as ROFA does. Since the asset-side of the balance sheet is determined by the liabilities and leverage, similarities in loadings of all the balance sheet variables are not surprising. Since liabilities and assets are highly correlated (0.97) and the factor loadings are similar, we omit ROL from the analysis in the rest of the paper.

Table 3 Panel D presents the loading differentials of ROFA and LEV. Not to create confusion with the Fama-French SMB and HML factors, we represent H-L as returns on value minus growth stocks and S-B as returns on small minus big stocks. For brevity, we present the 2X2 extreme portfolio differentials for the intermediation factors.

This table presents factor loadings on 25 Size and Book-to-Market portfolios using $R^e_{i,j} = constant + b_{i,j}R_X + \varepsilon$, 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 loadings of MKT and ROFA. Panel B presents loading of INVEST. Panel C presents loading of ROL and LEV. The variables are described in Table 2. Panel D presents return differential between extreme portfolios, such as difference in returns on the smallest to largest portfolio. Estimates of b and t(b), the t-statistics, are reported. Sample 1955:Q1-2009:Q4.

TABLE 3
FACTOR LOADING ON 25 SIZE AND BOOK-TO-MARKET PORTFOLIOS

Panel A

$R_X = MKT$

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

$R_X = ROFA$

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

$R_X = INVEST$										
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

Panel C

$R_X = ROL$										
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

Panel D

$R_X = ROFA$						
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	

Looking first at the S-B or H-L, ROFA has the best explanatory power for the spreads. Looking at the S-B, all intermediation factors explain the premium.

Finally, in terms of returns differentials, loadings of ROFA are far better than that of MKT. For example, H-L is 1.93% per quarter for ROFA and the corresponding spread is 0.35% per quarter for MKT (not reported). The results thus imply that if intermediaries' asset portfolio were 'the market' then investors would gain significantly from a zero-cost hedge portfolio.

Why value and size portfolios are more sensitive to the intermediation factors than MKT? The market implied cost of capital that firms face is decided by the stock market. However, external funds that firms require are contingent upon whether intermediaries can provide funding or not. As a result, in addition to the stock market risk, there exist another layer of uncertainties that firms face. Thus, the additional uncertainty is reflected in higher factor loadings for the intermediation factors.

In essence, the balance sheet variables of intermediaries as factors for asset returns pass what Merton's (1971 and 1973) theory implies: factors must explain why average returns of some assets are higher than that of others.

Predicting Market Excess Returns

Do the intermediation factors act as state variables as the above discussion suggests? Merton (1973), Campbell (1996), Lettau and Ludvigson (2001a), and, Santos and Veronesi (2006), among others, show that the state variables in their respective asset-pricing models forecast excess market returns. Campbell (1996) observes, "…*variables that spuriously explain the cross-section are unlikely to be the same as variables that spuriously forecast the time series*." Hence, to show that the intermediation factors have the property of state variables, we run a predictive regression on excess market returns with the intermediation factors. 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. Hence, we run the following regression.

$$\mathrm{MVA}^{e}_{t,MKT} = constant + \beta f_{t-j} + \varepsilon \tag{13}$$

where $\mathrm{MVA}^{e}_{t,MKT}$ is the moving average of excess market return over four quarters *t* through *t-3*, intermediation factor is *f* and *j* is one for the one-quarter-ahead forecast and so on. The estimates of β are reported for up to five-quarter forecast horizons in Table 4.

This table shows the predictability of excess market returns by the intermediation factors. Panel A presents prediction of 4-quarter moving average of excess market returns for different forecast horizons by the intermediation factors. Panel B presents one-quarter-ahead prediction of excess market realization by the intermediation factors, where additional predictive variables the term-spread, the difference between the yields on 10-year Treasuries and 3-month T-bills (TERM), the credit-spread, difference between the yields on 30-year government and Moody's Baa bonds (CREDIT), and *cay*, the consumption to wealth ratio of Lettau and Ludvigson (2001) are used for robustness. Estimation regressions for panel A and Panel B are as follows:

TABLE 4
PREDICTING EXCESS MARKET RETURNS

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

Panel A: Predicting the moving average of market excess returns

	ROFA		$\bar{R}^2$	LEV		$\bar{R}^2$
Forecast Quarters	Est.β	p-value		Est.β	p-value	
1	0.49	0.00	0.06	0.88	0.00	0.10
2	0.40	0.00	0.02	0.81	0.00	0.08
3	0.54	0.00	0.03	0.96	0.00	0.07
4	-0.29	0.00	0.00	-0.46	0.00	0.00
5	-0.39	0.14	0.01	0.01	0.96	0.00

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

	ROFA		LEV	
Est.α	2.59	3.18	5.27	5.11
	(0.01)	(0.00)	(0.00)	(0.00)
Est.β	-0.85	-0.81	-2.05	-1.89
	(0.00)	(0.00)	(0.08)	(0.08)
TERM		0.01		0.01
		(0.38)		(0.30)
CREDIT		0.02		0.01
		(0.36)		(0.37)
cay		1.31		0.30
		(0.47)		(0.00)
$\bar{R}^2$	0.05	0.10	0.06	0.09

The results shows that ROFA and LEV produce robust results in predicting excess market returns, and thus show that the intermediation factors are indeed state variables. The robustness of LEV as a state variable lends support to the observation that leverage and asset growths is pro-cyclical and captures the business cycle. As Cochrane (1996) show, we find that INVEST predicts excess market returns, and the results are not reported for parsimony.

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

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

$$R^e_{t,MKT} = constant + \alpha MVA^f_{t-1\ to\ t-4} + \beta f_{t-1} + \varepsilon \quad (14)$$

where $MVA^f_{t-1\ to\ t-3}$ is the moving average of intermediation factor *f* over four quarters *t-1* through *t-4*, and excess market returns is $R^e_{t,MKT}$. That is, we consider that the expected value of the intermediation factors calculated 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 intermediation factors. In the regressions, we also control for variables that are known to have strong predictive power for market returns. The controls are the term-spread (TERM), the difference between the yields on 10-year Treasuries and 3-month T-bills (Term), the credit-spread, the difference between the yields on 30-year government and Moody's Baa bonds (CREDIT), and *cay*, the consumption to wealth ratio of Lettau and Ludvigson (2001). The estimates of α and *βs* are reported for the one-quarter-ahead-forecasts in Table 4 Panel B. Given such an upheaval task, ROFA and LEV still predicts excess market returns. While *cay* remains an important predictor variable for excess market returns along with LEV, ROFA consumes the predictive power of all control variables.

We conduct additional predictive regressions, where $MVA^f_{t-1\ to\ t-3}$ is omitted from Equation (14). Unreported results show that in the presence of the intermediation factors, *cay*, which is found to have a very high predictive power for market returns, loses its predictive power.

Overall, the evidence from the above investigation suggests that the fluctuations of intermediaries' balance sheets behave as state variables predicting market returns. Since the results are similar for ROFA and LEV, we use ROFA for the rest of the analysis. Since *cay* is less effective in predicting stock returns when ROFA is an explanatory variable, *cay* is also not considered for further analysis.

Predicting Stock Liquidity

One of the other testable implications of Equation (10) is to test whether financial intermediaries' liquidity 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). The co-movements of stock liquidity and stock volatility make stock liquidity a prime candidate for the investigation. Additionally, stock liquidity is far more volatile than stock returns, and hence the signal to noise ratio for stock liquidity is lower than that of stock returns. As a direct consequence, as is shown below, ROFA predicts the realization of stock liquidity far more accurately.

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 all explanations. Irrespective of the way stock liquidity is explained, liquidity measures are proxies that are often derived from stocks returns, and measuring liquidity of stocks boil down to measuring some form of dispersion of stock returns. Starting from the liquidity measurement from stock returns, we provide an alternative explanation for stock liquidity.

We use three liquidity proxies to capture stock liquidity. The first measure is the Amihud's illiquidity ratio (ILR) measure, which is based on the price impact to the order flow, and is calculated as the ratio of the price movement to the trading volume:

$$ILR_{i,t} = \frac{1}{D_{i,t}} \sum_{d=1}^{D_{i,t}} \frac{|R_{i,d,t}|}{(VOL_{i,d,t})} \quad (15)$$

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. Johnson (2008) notes the contemporaneous nature of volatility and liquidity by arguing, *"Intuitively, even in more general economics, anything that causes asset risk to rise will steepen the demand curves."* For a given trading volume of securities, the higher is the deviation of returns from the mean, the lower is the liquidity. Since Equation (10) shows that a fraction 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 the liquidity intermediaries provide. We show below that intermediation factors is more important than investment in determining stock liquidity.

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

$$\text{Roll}_{i,t} = \frac{1}{D_{i,t}} \sum_{d=1}^{D_{i,t}} \sqrt{-cov(R_{i,d,t}, R_{i,d,t-1})} \tag{16}$$

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

We use the third measure to conduct robustness checks for the empirical results. 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:

$$\text{RS}_{i,t} = \frac{1}{D_{i,t}} \sum_{d=1}^{D_{i,t}} \frac{(price^{ask} - Price^{bid})_{i,d,t}}{(0.5price^{bid_{highest}} + 0.5price^{bid_{lowest}})_{i,d,t}} \tag{17}$$

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

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 ROFA, 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 A presents the statistics for stock liquidity, where ILR (Amihud, 2002), RS, and ROLL (Roll, 1984) are stock liquidity measures. Stock liquidity is measured for all NYSE stocks, and for stock portfolios, which are constructed by allocating stocks into treciles (Small, Mid, and Large) formed on market capitalization (size). Panel B presents the results for the whole sample (1955-2009), and the results after controlling for recessions, and the recent crisis. Panel C presents the results for liquidity of stocks of different sizes. Errors are corrected for Newey-West heteroscedasticy adjustments. T-statistics are in the parenthesis. The *indicator* is one if recessions or the recent crisis.

TABLE 5
PREDICTING STOCK LIQUIDITY

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: Predicting Stock Liquidity by Intermediaries' Asset Growth

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
ROFA	-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* ROFA			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

Panel C: 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
ROFA	-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* ROFA		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

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 proxies. 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 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. The summary statistics for liquidity measures are presented in Table 5 Panel A.

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

$$Y_t = \alpha_t + \sum_{i=1}^{n} \beta_i Y_{t-i} + \gamma_t Z_{t-1} + \delta_t K_{t-1} + \varepsilon_t \tag{18}$$

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 VOL and liquidity co-move. Additionally, we control for recessions and the recent crisis.

Table 5 Panel B and C show the regression results. Looking from the left in Table Panel B, first we present the result for the full sample with ROFA as the primary explanatory variable. The results show ROFA predicts ILR and adding INVEST as an additional variable does not change the result. Most importantly, INVEST has no predictive power for ILR. Since ILR measures illiquidity, the sign of the coefficient of ROFA is negative. The results thus indicate that in explaining stock liquidity ROFA is the primary variable. The sub-sample analysis, where we control for recessions or the recent crisis, shows ROFA remains important. The last six columns show that alternate measures for stock liquidity do not change the results.

Looking next at Table 5 Panel C, we observe that by considering liquidity of stocks of different sizes does not change the main results. However, we see the impact of ROFA is different across liquidity of stock portfolios. The impact of ROFA on liquidity of small stocks is the largest. The results thus reconfirm what we observe when the dependent variable was stock returns (See table 3): the loading of ROFA on smaller stocks is higher than that on larger stocks. The results hold for subsequent sub-sample analyses. For parsimony, we do not report the results where the primary explanatory variables are other balance sheet variables growths.

In summary, the results suggest that financial intermediaries' liquidity predicts stock liquidity. The results further suggest that if financial intermediaries are constrained, they provide liquidity to larger firms more than they do to smaller firms. Most importantly, we show that intermediaries' liquidity or the monetary liquidity is more important than investments in determining securities' liquidity.

CONCLUSION

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 macroeconomic models, such as Lucas's (1978), where identical households invest in risky assets without financial intermediation. There are neoclassical investment- and productivity-based asset pricing and investment models, such as Hayashi's (1982) and Cochrane's (1991 and 1996), where firms are assumed to have intermediated external funds at some cost. For these strands of the literature, financial intermediation is exogenous. That is, there are no frictions transferring individuals' savings to production processes. It is thus natural to reason that the existing asset pricing and investment models have shortcomings that needs to be addressed. We relax the assumption that firms have intermediated lines of credit, and show that fluctuations in intermediaries' funding a) is a factor for stock returns, and b) can explain stock liquidity.

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