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Leverage and Liquidity: Evidence from the Closed-End Fund Industry

Yuehua Tang

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LEVERAGE AND LIQUIDITY: EVIDENCE FROM THE CLOSED-END FUND INDUSTRY

BY

YUEHUA TANG

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ACCEPTANCE

This dissertation was prepared under the direction of the *YUEHUA TANG's* Dissertation Committee. It has been approved and accepted by all members of that committee, and it has been accepted in partial fulfillment of the requirements for the degree of Doctoral of Philosophy in Business Administration in the J. Mack Robinson College of Business of Georgia State University on April 19, 2013.

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ABSTRACT

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BY

YUEHUA TANG

APRIL 19, 2013

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This paper uses the February 2008 auction rate security (ARS) market freeze to examine the spillover effects of an exogenous funding liquidity shock on the underlying asset markets. Consistent with theory, I find that the stocks held by closed-end funds (CEFs) that borrow from the ARS market experience larger declines in market liquidity and lower returns than other stocks after the ARS market freeze. These effects are more pronounced when (i) these ARS-levered CEFs hold a larger fraction of shares outstanding, (ii) the borrowing level from the ARS market is higher, and (iii) the stocks are less liquid before the ARS market freeze. The spillover effects of the ARS market freeze are temporary and diminish during the next 12 months. Further investigation shows that the spillover effects are indeed associated with the heavy selling behavior of the ARS-levered CEFs after experiencing the ARS market shock. Overall, this study provides evidence that a funding liquidity shock to financial institutions can cause a decline in both market liquidity and the prices of the underlying assets.

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Leverage and Liquidity:
Evidence from the Closed-End Fund Industry

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April 2013

ABSTRACT

This paper uses the February 2008 auction rate security (ARS) market freeze to examine the spillover effects of an exogenous funding liquidity shock on the underlying asset markets. Consistent with theory, I find that the stocks held by closed-end funds (CEFs) that borrow from the ARS market experience larger declines in market liquidity and lower returns than other stocks after the ARS market freeze. These effects are more pronounced when (i) these ARS-levered CEFs hold a larger fraction of shares outstanding, (ii) the borrowing level from the ARS market is higher, and (iii) the stocks are less liquid before the ARS market freeze. The spillover effects of the ARS market freeze are temporary and diminish during the next 12 months. Further investigation shows that the spillover effects are indeed associated with the heavy selling behavior of the ARS-levered CEFs after experiencing the ARS market shock. Overall, this study provides evidence that a funding liquidity shock to financial institutions can cause a decline in both market liquidity and the prices of the underlying assets.

JEL Classification: G01, G12, G20

Keywords: Leverage; Funding liquidity; Market liquidity; Closed-end funds

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Leverage and Liquidity:
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The interaction between financial institutions' funding liquidity and the financial markets in which they operate has received much attention in economics and finance studies. Theory shows that funding liquidity shocks to financial institutions can be transmitted to the underlying asset markets through three microeconomic mechanisms: (i) rollover borrowing (Acharya and Viswanathan (2011)); (ii) margin funding (Brunnermeier and Pedersen (2009)); and (iii) redemption (Diamond and Dybvig (1983), Shleifer and Vishny (1997)). As Brunnermeier (2009) summarizes, funding liquidity risk can take three forms: (i) rollover risk, or the risk that it will be more costly to roll over short-term borrowing, (ii) margin funding risk, or the risk that margins will change, and (iii) redemption risk, or the risk that bank depositors or investors of mutual funds and hedge funds withdraw capital. Consistent with theory, previous studies show empirical evidence of the spillover effects of margin funding and investors' redemption on underlying asset markets (Coval and Stafford (2007), Aragon and Strahan (2012)).

One important type of financing that has been less studied is short-term rollover borrowing. Many types of financial institutions, such as banks, broker–dealers, hedge funds, and closed-end funds (CEFs), have substantial short-term rollover borrowing on their balance sheets. The rollover borrowing can be in the form of commercial papers, repurchase agreements (repos), and auction rate securities (ARS) that have to be rolled over during periods ranging from overnight to a few months. Though rollover borrowing is prevalent in financial firms, there is little empirical evidence of its spillover effects on the underlying asset markets. To fill this gap, I use the CEF industry as a laboratory to examine the spillover effects on the assets held by institutions that experience an exogenous shock to their rollover financing.

Due to their unique organizational structure, CEFs are exposed mainly to rollover risk, rather than redemption and margin funding risks. Many CEFs experienced a negative shock to their rollover borrowing when a primary borrowing source, the ARS market, froze in early February 2008. Since forces such as liquidity withdrawals of large broker–dealers were responsible for the ARS market freeze (Han and Li (2009)), it can be used as an exogenous funding liquidity shock to the CEF industry. I refer to CEFs that borrow from the ARS market as ARS-levered CEFs. Using this experiment, I find systematic evidence of the spillover effects of the ARS market freeze on stocks held by ARS-levered CEFs. My evidence suggests that the ARS market freeze caused a decline in both market liquidity and the prices of the stocks held by ARS-levered CEFs.

The CEF industry provides an ideal setting to examine the issues related to rollover borrowing for the following reasons. First, CEFs are frequent users of leverage. The average borrowing level of U.S. CEFs is about 25% of their total assets (Cherkes, Sagi, and Stanton (2009)). Unlike hedge funds, which are largely unregulated and therefore do not have to report leverage, CEF leverage data are available on their balance sheets. Second, CEFs typically need to roll over their short-term borrowing because many of them obtain financing from the ARS market. The interest rates of auction rate securities are reset through auctions every one or four weeks. Third, unlike open-end mutual funds and hedge funds, CEFs are not subject to redemption or margin funding risks because they are closed to fund flows and generally do not trade on margin. This feature allows me to focus on rollover risk without the confounding effects of other types of funding liquidity risk.

Lastly, CEFs experienced a negative shock to their funding liquidity when the ARS market froze in February 2008. The ARS market freeze caused CEF borrowing costs to increase substantially. The reason is that when an auction fails, a CEF's borrowing rate is automatically reset to the predetermined maximum rate according to the security prospectus, which can be as high as 20% (Han and Li (2009)). The ARS market freeze forced ARS-levered CEFs to liquidate assets to redeem

the auction rate securities they had issued. According to the Investment Company Institute, more than half of the 668 CEFs in their report had auction rate securities outstanding at the end of the first quarter of 2008, with a total liquidation preference of about $64 billion.[1] In 2008 U.S. domestic equity CEFs redeemed about 60% of their ARS borrowing. While the deleveraging of the CEF industry may not have affected the overall stock market, it can have had substantial effects on commonly held stocks when many CEFs that experienced the funding liquidity shock attempted to sell these positions simultaneously.

Using data on all U.S. domestic equity CEFs, I examine the spillover effects of the ARS market freeze on stocks held by ARS-levered CEFs. I use a difference-in-differences approach to compare changes in market liquidity and returns of stocks held by ARS-levered CEFs (the treatment group) to stocks not held by these CEFs (the control group) during the four quarters of 2008. My main results show that stocks held by ARS-levered CEFs experience larger declines in market liquidity and lower stock returns after the ARS market freeze than stocks not held by ARS-levered CEFs. The magnitude of the spillover effect is increasing in (i) the fraction of shares outstanding held by ARS-levered CEFs, (ii) the borrowing ratio from the ARS market of ARS-levered CEFs, and (iii) the illiquidity of stocks before the ARS market freeze. These spillover effects are also economically significant. For instance, for a given stock, a one standard deviation increase in the percentage of shares outstanding held by ARS-levered CEFs induces a 4.5 percentage point drop in annualized stock returns. In counterfactual tests, I do not find similar results before the funding liquidity shock (*i.e.*, during 2006 and 2007).

An alternative explanation of the results mentioned above is that there is some unobserved new information about the fundamentals of stocks held by ARS-levered CEFs. To test this alternative hypothesis, I investigate whether the spillover effects of the ARS market freeze on stock returns are

[1] See http://www.ici.org/policy/markets/domestic/08_sec_amps_com.

transient or permanent. I find that the spillover effects of the ARS market freeze on stock returns are only concentrated in the three-month period after the quarter-end holding date of ARS-levered CEFs and disappear over the next three quarters. Thus, the spillover effects of the ARS market freeze are temporary and unlikely to be driven by the arrival of new information.

To confirm that the above results are indeed due to the ARS market freeze, I also consider the concurrent forces during the sample period, particularly investor redemptions of open-end mutual funds. Evidence shows that large investor redemptions from open-end mutual funds can induce price pressure on the stocks they hold (Coval and Stafford (2007)). To see whether such forces can explain the previous results, I include a mutual fund outflow measure following Edmans, Goldstein, and Jiang (2012) in my empirical tests. The main results are robust to the consideration of concurrent outflows of open-end mutual funds.

To shed light on the channel for these spillover effects, I analyze the selling behavior of ARS-levered CEFs after the ARS market freeze. I find that ARS-levered CEFs sell about 8.1% of their portfolio value each quarter after experiencing the ARS market shock, while other CEFs do not exhibit similar selling patterns during this period. Moreover, I find that the spillover effects of the ARS market freeze documented above are concentrated in the stocks sold by the ARS-levered CEFs. These results corroborate that the spillover effects of the ARS market freeze are driven by the selling behavior of ARS-levered CEFs.

In addition, I examine how ARS-levered CEFs adjust their portfolios after experiencing the ARS market shock. I find that after the ARS market freeze, ARS-levered CEFs tend to sell positions that are liquid and have large market capitalization and lower liquidity beta. This evidence suggests that ARS-levered CEFs attempt to minimize the price impact by trying to avoid selling illiquid and small stocks in their portfolios. Taken together with my earlier findings, this strategic behavior does

not fully remove the negative impact of the ARS market freeze on ARS-levered CEFs, which borrow heavily from the ARS market and have concentrated portfolio holdings.

To alleviate the concern that stocks held by ARS-levered CEFs and non-ARS-levered CEFs may have different characteristics, I use propensity score matching to construct an alternative control group. I find similar results of the spillover effects using this alternative control group. Moreover, my results are robust to the use of alternative ways of calculating liquidity changes (*e.g.*, as percentage changes rather than absolute value changes) and the inclusion of international equity CEFs in my sample.

This paper provides new empirical evidence that supports models that link the funding liquidity of financial institutions and the underlying assets they trade (e.g., Brunnermeier and Pedersen (2009), Acharya and Viswanathan (2011)). Using an exogenous shock for identification, this study provides direct evidence that a decline in funding liquidity causes a drop in market liquidity and asset prices. This paper is closely related to Aragon and Strahan (2012), who show that the bankruptcy of a large broker (*i.e.*, Lehman Brothers) can be transmitted to the underlying asset markets. This study adds the literature on the spillover effects of different types of funding liquidity shocks. Unlike open-end mutual funds and hedge funds, which mostly face redemption and/or margin fund risks, CEFs are exposed mainly to rollover risk. This paper is the first to study the spillover effects of a rollover borrowing shock on the underlying asset market. Moreover, while the explicit level of leverage used by hedge funds is not easily available due to the off-balance sheet activities and holdings of hedge funds are only available at the fund family level in 13F forms; this study uses the explicit level of leverage and the holdings of individual CEFs. This setting allows me to examine how the spillover effects vary with the level of leverage used by CEFs.

This study also adds to the literature on the fire-sale externalities associated with leverage in the financial sector on financial markets (*e.g.*, Stein (2009)). It is also related to empirical studies on

funding liquidity shocks and asset fire sales (Ben-David, Franzoni, and Moussawi (2010), Boyson, Helwege, and Jindra (2010), He, Khang, and Krishnamurthy (2010)), market liquidity during crisis periods (Anand, Irvine, Puckett, and Venkataraman (2010)), funding liquidity risk and stock returns (Adrian, Etula, and Muir (2011)), and funding liquidity and contagion (Boyson, Stahel, and Stulz (2010), Hau and Lai (2012), Manconi, Massa, and Yasuda(2012)). Using the ARS market freeze as an exogenous shock, this study allows one to establish a causal relation between funding liquidity and market liquidity.

The remainder of the paper is organized as follows. Section I discusses the motivation for my empirical analyses. Section II describes the data and variables. Section III describes the empirical methodology. Section IV examines the spillover effects of the ARS market freeze on stocks held by ARS-levered CEFs. Section V concludes the paper.

I. Motivation and Empirical Hypotheses

A. Closed-End Funds and the Auction Rate Security Market Freeze

Unlike open-end mutual funds, closed-end funds are frequent users of leverage. The average leverage ratio (defined as (Total assets - Total NAV)/Total assets)) of U.S. closed-end funds is about 25% during the period 1994-2006 (Cherkes, Sagi, and Stanton (2009)). One primary form of their financing is the issuance of auction rate preferred stocks (ARPS) in the ARS market.[2] Auction rate securities are long-term debt instruments whose interest rates are regularly reset through modified Dutch auctions every one or four weeks. The ARS-levered CEFs are exposed to rollover risk since they need to rollover their financing from the ARS market.

[2] Different from the usual auction rate securities with long-term debt maturity, auction rate preferred stocks (ARPS) have perpetual maturity and are typically redeemable. For more details on the ARS market, see Alderson, Brown, and Lummer (1987), and Alderson and Fraser (1993), Han and Li (2009), McConnell and Saretto (2010).

Another important feature of CEFs is that they are not subject to redemption risk and margin funding risk because they are closed to fund flows and usually do not trade on margin. This feature distinguishes CEFs from open-end mutual funds and hedge funds, which mainly face redemption risk and/or margin funding risks.[3] It allows one to isolate the effects of rollover borrowing from the effects of redemptions and/or margin funding. In addition, CEFs have the simple business structure, which allows one to measure the explicit level of leverage using balance sheet data. In contrast, other leveraged institutions either have more complex organizational structures (*e.g.*, multiple business divisions) as in commercial/investment banks or engage in many off-balance sheet activities as in hedge funds. These features make CEFs an ideal laboratory to test issues related to rollover borrowing.

The main borrowing source of CEFs, the ARS market, froze in early February 2008.[4] The freeze of the ARS market was mainly caused by liquidity withdrawals of large broker-dealers such as Citigroup, UBS, and Morgan Stanley (Han and Li (2009)), which is exogenous to the CEF industry. As a result of the ARS market freeze, ARS-levered CEFs' borrowing costs increased substantially. The reason is that the ARS market borrowing rate automatically resets to the predetermined maximum rate according to the security prospectus (*i.e.*, as high as 20%) when the auctions fail. The ARS market freeze thus forced CEFs to liquidate assets and redeem the ARPS that they had issued. According to a report by FitchRatings, over 70% of the 437 U.S. closed-end funds that they reviewed undertook redemptions of their ARPS in 2008, totaling $35.6 billion.[5] As shown in Figure 1, U.S.

[3] Open-end mutual funds are are exposed mainly to redemption risk of fund outflow (*e.g.*, Coval and Stafford (2007), Chen, Goldstein, and Jiang (2010)) and generally less aggressive in using leverage to enhance returns (*e.g.*, Koski and Pontiff (1999), Almazan, Brown, Carlson, and Chapman (2004)). Moreover, hedge funds have some unique features, such as lock-up periods, notice periods, and redemption periods, to protect their investments (*e.g.*, Aragon (2007), Agarwal, Daniel, and Naik (2009)), which can alleviate potential redemption risk.

[4] On February 13, 2008, as much as 80% of auctions in the ARS market failed. See "Florida Schools, California Convert Auction rate Debt (Update5)" by Jeremy R. Cooke, Bloomberg.com, February 22, 2008, http://www.bloomberg.com/apps/news?pid=newsarchive&sid=awCJRyi5ngcQ&refer=us.

[5] See "Closed-End Funds: Redemptions Provide Some Liquidity to Illiquid ARPS Market" by FitchRatings, August 31, 2010, http://www.fitchratings.com/creditdesk/reports/report_frame.cfm?rpt_id=552106.

domestic equity CEFs redeemed about 60% of their ARPS in 2008.[6] For instance, the Claymore Dividend & Income Fund redeemed more than $300 million auction rate preferred shares in the second half of 2008, about half the size of their total assets under management.[7]

[Insert Figure 1 here]

B. Motivation for Empirical Analyses

Theoretical models predict that an adverse funding liquidity shock to financial firms (*i.e.*, an event that makes it more costly or impossible to obtain funding) can be transmitted to the market of assets that these firms hold (*e.g.*, Shleifer and Vishny (1997), Brunnermeier and Pedersen (2009), Stein (2009), Acharya and Viswanathan (2011)). There are also many amplification models that propose that funding disruptions force financial institutions to engage in asset sales (*e.g.*, Diamond and Rajan (2010), Garleanu and Pedersen (2011), Geanakoplos (2010), Krishnamurthy (2009)). As summarized by Brunnermeier (2009), different types of financial institutions expose themselves to three types of funding liquidity risk: (i) rollover risk (the risk that it will be more costly or impossible to roll over short-term borrowing); (ii) margin funding risk (the risk that margins and haircuts will change); (iii) redemption risk (the risk that depositors of banks or investors of mutual funds or hedge funds withdraw funds).

Motivated by these theoretical studies, I empirically examine the spillover effects of a funding liquidity shock to financial institutions on underlying assets that they hold. The effects of reduced funding liquidity of financial institutions on the assets they trade/hold are not easily identifiable. To help identify any potential effects, I use the ARS market freeze in February 2008 as

[6] The level of borrowing from other sources of these CEFs also dropped, but to a much less extent, which suggests that many CEFs redeemed their ARPS by liquidating assets, not by raising capital from other sources such as bank loans.

[7] "Leverage Shakes Up Mutual Funds, Which Discover a Strategy's Downside" by Shefali Anand, *The Wall Street Journal*, January 24, 2009.

an exogenous funding shock. While the $300 billion CEF industry may not have a large impact on the overall stock market, it could have substantial effects when a number of ARS-levered CEFs attempt to liquidate commonly-held positions simultaneously. For instance, domestic equity CEFs cumulatively owned between 1% and 15% of 245 stocks at the end of the last quarter of 2007. Specifically, I empirically test *whether there is spillover effect of the ARS market freeze on the stocks held by ARS-levered CEFs.*

Moreover, I examine whether the spillover effects are larger when (i) leveraged CEFs hold a larger fraction of the stocks, (ii) CEFs have higher borrowing from ARS market, and (iii) the stock is already less liquid. Next, I investigate whether the spillover effects of the ARS market freeze on stock returns are temporary or not. To further confirm that the spillover effects are caused by the ARS market freeze, I also test whether any concurrent forces, in particular investor redemptions of open-end mutual funds as in Coval and Stafford (2007), can explain the spillover effects. If the spillover effects are induced by the ARS market shock, one would expect the results to be robust to the consideration of concurrent forces such as investor outflows of open-end mutual funds. Lastly, I analyze the selling behavior of ARS-levered CEFs after experiencing the shock and test whether the spillover effects are indeed associated with the selling activities by ARS-levered CEFs.

Under the Investment Company Act of 1940, investment companies can only borrow up to 33.3% of total assets or issue preferred stock up to 50% of total assets.[8] Investment companies with leverage higher than the legal limits have three days to deleverage to stay in line with the federal requirements. These unconditionally constant legal limits can have potential perverse effects on asset markets when they force the investment companies to liquidate their assets to stay within the legal

[8] Closed-end funds can have both debt and auction rate preferred stocks on their balance sheets. They are required to maintain $3 of assets for every $1 borrowed as debt, and $2 for every $1 issued as preferred stocks.

bounds. To this extent, my study can also shed light on the unintended consequences of imposing a constant leverage ratio on financial institutions such as investment companies. [9]

II. Data and Variables

I first obtain information on all the U.S. closed-end funds that existed during the period from 2006 to 2009 from CRSP. This information includes PERMNO, fund name, market capitalization, and stock returns.[10] I then classify the closed-end funds based on the investment objectives published in their prospectus using the business descriptions of the funds.[11] Closed-end funds are classified into the following main categories: domestic equity, municipal bond, taxable fixed income, international equity, and others. To have a clean setting of testing the spillover effects, I focus on domestic equity CEFs in my study as these funds primarily invest in the U.S. domestic equity market. I exclude from my sample CEFs that primarily invest in municipal bonds, taxable bonds, international equity, REITs, and preferred stocks.[12] The final sample includes 103 domestic equity closed-end funds during the period from 2006 to 2009. My sample size is comparable to the ones used in previous literature (e.g., Bradley, Brav, Goldstein, and Jiang (2010)).

A key data component to this study is the degree of leverage used by closed-end funds, which is calculated using the data from the balance sheets of these funds. The balance sheet data are available in Form N-SAR that CEFs must file with the SEC semi-annually. I retrieve the information

[9] In the second half of 2008, SEC implemented temporary relief measures available to certain CEFs, designed to afford greater flexibility in avoiding forced deleveraging. The temporary relief measures were only for CEFs with above 33% preferred stock leverage, which makes them impossible to refinancing with debt to redeem all their preferred stocks. Moreover, it is subject to SEC approval and applies only to debt issued during the next two years for the purposes of redeeming outstanding auction rate preferred stock.

[10] Closed-end funds in CRSP are with the second digit of share code 4, mostly with share code 14 or 44.

[11] I use the information on the CEF's websites and SEC filings as well as business descriptions available on websites such as BusinessWeek (www.businessweek.com). I also verified my classifications with the information from Morningstar database.

[12] There are 32 international equity CEFs that hold positions in U.S. equity market during the four quarters of 2008. My results are robust if I include these international equity CEFs in my sample.

from the N-SAR forms after downloading these forms from the SEC EDGAR database. Next, I manually match the balance sheet data to the closed-end fund data from CRSP by Ticker and fund names. I obtain the CEFs' quarterly portfolio holdings from Thomson Reuters' S12 Ownership Database. Lastly, I match the data from CRSP and the N-SAR forms to Thomson Reuters' holdings data by fund name.

As in Cherkes, Sagi, and Stanton (2009), the total leverage of a closed-end fund (*Leverage_total*) is calculated as the difference between total assets and total net asset value divided by total assets. The leverage from the ARS market (*Leverage_ARS*) is measured as the total value of auction rate preferred stocks divided by total assets. Since the balance sheet data are available only at semi-annual frequency, I create a quarterly series by assuming the leverage ratios in the non-reporting quarters are the same as the previous quarters.

$$Leverage\_total_{i,t} = \left(Total\ Assets_{i,t} - Total\ NAV_{i,t}\right)/Total\ Assets_{i,t} \quad (1)$$

$$Leverage\_ARS_{i,t} = Auction\ Rate\ Preferred\ Stocks_{i,t}/Total\ Assets_{i,t} \quad (2)$$

where *i* indexes closed-end funds; *t* indexes quarters.

Table I Panel A presents the summary statistics of fund characteristics. The average total assets and market capitalization (share price times the shares outstanding) of the closed-end funds are $557.3 and $411.9 million, respectively. The mean (median) total leverage ratio of the closed-end funds in my sample is 19.7% (20.7%). Moreover, closed-end funds tend to borrow mainly through a single channel, either the ARS market or other sources such as bank loans.[13]

[Insert Table I here]

I refer to CEFs with non-zero borrowing from the ARS market as ARS-levered CEFs. Funds with no ARS borrowing are labeled as non-ARS-levered CEFs. In Panel B of Table I, I present the

[13] The correlation of the two types of leverage are negative (-0.25) and significant at 1% level.

fund characteristics for each group of funds in the year of 2008. The results suggest that ARS-levered funds have more total assets under management and more highly-concentrated portfolios than non-ARS-levered CEFs. The average total leverage of ARS-levered CEFs is 34.9% of total assets; the total leverage of non-ARS-levered CEFs is 9.6% of total assets. Interestingly, the average leverage ratio from other sources is similar across the two groups of CEFs. This feature is important for my empirical test when I use non-ARS-levered CEFs to serve as the control group to ARS-levered CEFs.

In my empirical tests, stocks held by ARS-levered CEFs are the treatment group. To construct a control group, I consider the stocks held by non-ARS-levered CEFs, but not held by ARS-levered CEFs. This control group tends to have similar characteristics to the treatment group. The stocks not held by any CEFs are not included in my sample. [14]

I use two variables to measure market illiquidity. The first measure is relative bid-ask spread, which is defined as the difference between ask and bid prices divided by the midpoint of the bid and ask prices. The second variable is Amihud's (2002) measure, which is defined as the ratio of absolute value of daily return over daily dollar volume.

$$Rspread_{i,t} = \left(Ask_{i,t} - Bid_{i,t}\right) / \left(\frac{Ask_{i,t} + Bid_{i,t}}{2}\right) \tag{3}$$

$$Amihud_{i,t} = \left|r_{i,t}\right| / \left(P_{i,t} * Vol_{i,t}\right) \tag{4}$$

where *i* indexes stocks; and *t* indexes dates. Both the relative bid-ask spread and the Amihud measure capture illiquidity; that is, a higher level of *Amihud* or *Rspread* means that the stock is less liquid. Each daily measure is averaged across all the trading days within a quarter to obtain a quarterly measure. I use natural logarithmic transformations of these variables in my empirical tests to mitigate any concerns related to the skewness of these variables.

[14] Interestingly, the stocks that are not held by any CEFs are smaller and less liquid than the two groups considered in my tests (results untablulated).

For each stock, I aggregate the CEFs' holdings at each quarter end. The unit of the holdings variable is the percentage of shares outstanding. I also aggregate the ownership of ARS-levered CEFs separately (*Shrpct_CEF_ARS*). Moreover, to examine whether the spillover effects vary with CEFs' level of borrowing from ARS market, I also construct continuous variables of leverage of CEFs at the stock level. Specifically, for each stock, I calculate a weighted average level of total leverage and leverage from ARS market of CEFs that hold that stock in their portfolios as follows:

$$Leverage_{i,t} = \sum_{j=1}^{n} \omega_{i,j,t} * Leverage_{j,t} \quad (5)$$

$$where\ \omega_{i,j,t} = shares_{i,j,t} / \sum_{j=1}^{n} shares_{i,j,t}$$

where *i* indexes stocks; *j* indexes closed-end funds; and *t* indexes quarters. For instance, suppose two closed-end funds hold stock *i* at quarter *t*: the first one, with total leverage of 30%, owns 10,000 shares and the other one, with total leverage of 15%, owns 5,000 shares. Based on equation (1), the average total leverage for stock *i* at quarter *t* is 25% (=30%*10K/15K +15%*5K/15K).[15] Based on equation (1), I calculate two weighed average measures at stock level for total leverage and leverage from the ARS market, respectively.

Table II Panel A presents the summary statistics of stocks held by any CEFs for the four quarters in 2008. It is worth noting that when calculating the average market liquidity measures and average daily returns for the first quarter of 2008, the trading days before the February 7, 2008 auction-ration security market shock are excluded. The average changes in *Log(Rspread)* and *Log(Amihud)* over the previous quarter are positive, while the average daily stock return is negative. These findings suggest that, for an average stock in my sample, both its liquidity and its price dropped in 2008. In my empirical tests, I do not try to explain the overall drop in market liquidity and stock prices in 2008. Instead, I take a difference-in-differences approach to identify the spillover

[15] These average leverage variables do not take into account of the aggregate holding level of CEFs.

effects of the ARS market freeze on stocks held by ARS-levered CEFs.[16] The average (median) total leverage of a stock is 11.4% (12.8%), while the average (median) leverage from the ARS market is 4.7% (0.0%). The market beta and liquidity beta for a stock at a given month are obtained from a regression of monthly stock returns on the value-weighted CRSP stock returns and the liquidity innovation factor of Pastor and Stambaugh (2003) in the previous five years. [17]

[Insert Table II here]

As shown in Table II Panel A, the mean (median) ownership of all closed-end funds in term of percentage of shares outstanding is 0.29% (0.05%). The maximum ARS-levered CEF ownership for a stock in my sample is 14.6%. In Panel B of Table II, I also show the ownership distribution of CEFs at the end of the fourth quarter of 2007. The closed-end funds in my sample own positive quantities of more than 60% of all common stocks (share code 10 or 11) in the CRSP database. These funds own 1%-15% of 245 stocks (about 5% of all common stocks on CRSP), meaning they hold significant positions in a number of stocks.

Figure 2 reports median quarterly percentage (%) changes in liquidity for the stocks held by ARS-levered CEFs after the ARS market freeze. I divide the sample of stocks held by ARS-levered CEFs into three groups based on the aggregated ownership: (0%, 1%], (1%, 3%], (3%, 15%). For both *Rspread* and *Amihud*, the percentage changes is calculated as *(Illiquidity(t) - Illiquidity(t-1))/ Illiquidity(t-1)*. The figure provides preliminary evidence that the decrease in liquidity was more severe for stocks with higher ARS-levered CEF ownership.

[Insert Figure 2 here]

[16] See Section III for more details of the difference- in-differences approach in the empirical tests.
[17] The liquidity innovation factor of Pastor and Stambaugh (2003) is obtained from WRDS. To get the market beta and liquidity beta, I require a stock to have at least 24 monthly observations to be included in the regressions.

III. Empirical Methodology

The goal of my empirical design is to identify the spillover effects of the ARS market freeze on stocks held by ARS-levered CEFs. I first estimate the following panel regression model over the four quarters in 2008:

$$\Delta Y_{i,j,t} = \alpha_t + \alpha_j + \beta_1 * Shrpct\_CEF\_ARS_{i,j,t-1} + \gamma_1 * Liquidity_{i,j,t-1} + \gamma_2 * Controls_{i,j,t-1} + \varepsilon_{i,j,t} \quad (6)$$

where *i* indexes stocks; *j* indexes industries (2-digit SIC code level) ; and *t* indexes quarters. $Shrpct\_CEF\_ARS_{i,j,t-1}$ is percentage of shares outstanding of stock *i* held by ARS-levered CEFs at the end of quarter *t-1*. The dependent variables are changes in quarterly stock liquidity (the log of relative spread or the log of Amihud ratio) or the quarterly average of daily stock returns. The main purpose of the regressions is to determine whether the spillover effects on market liquidity and stock returns are significantly different from zero; that is, the null hypothesis is β_1 =0. I expect β_1 to be positively significant for market liquidity and negatively significant for daily returns.

In Equation (7), I further consider the level of borrowing by ARS-levered CEFs from the ARS market. Specifically, I interact ARS-levered CEF stock holdings with a stock-level leverage variable and include this interaction term in the regressions. The leverage variable (*Leverage_ARS*) is the weighted average of leverage from the ARS market of all CEFs that hold that stocks. While equation (6) allows me to test whether the spillover effects increase in the level of ownership by ARS-levered CEFs, this model allows me to test whether these spillover effects are intensified for stocks held by CEFs with higher ARS borrowing.

$$\Delta Y_{i,j,t} = \alpha_t + \alpha_j + \beta_1(Hold > Median) + \beta_2(Hold > Median) \times Leverage\_ARS_{i,j,t-1} + \beta_3 Leverage\_ARS_{i,j,t-1} + \gamma_1 * Liquidity_{i,j,t-1} + \gamma_2 * Controls_{i,j,t-1} + \mu_{i,j,t} \quad (7)$$

where i indexes stocks; j indexes industries (2-digit SIC code level) ; and t indexes quarters. $(Hold > Median)$ is a dummy that indicates that the ownership of ARS-levered CEFs is above the median level among all stocks held by ARS-levered CEFs. $Leverage\_ARS_{i,j,t-1}$ is the weighted average of leverage from the ARS market of CEFs that held stock i at the end of quarter *t-1*. The dependent variables used in the model are changes in quarterly market liquidity or quarterly average daily returns. I test whether there is an intensifying effect between the holdings and the level of borrowing from the ARS market by ARS-levered CEFs. If the spillover effects increase with the level of CEFs' ARS market borrowing, I expect β_2 to be positively significant for market liquidity and negatively significant for daily returns.

The identification of models (6) and (7) rely on cross-sectional comparison of stocks held by ARS-levered CEFs (the treatment group) and those that were not held ARS-levered CEFs. In the control group, I only include stocks that are not held by ARS-levered CEFs but are held by non-ARS-levered CEFs, since these stocks are likely similar to those stocks in the treatment group.[18] It is important to note that my empirical tests do not aim to explain the overall drop in market liquidity and stock prices after February 2008.

Rather, both equations (6) and (7) use a difference-in-differences approach to estimate the effects of the ARS market freeze on the treatment group. The first step is to compute the changes in stock liquidity before and after the ARS market shock for the stocks in treatment and control groups separately.[19] The second step is to take the difference in the liquidity changes of these two groups. This will give us an estimate of the spillover effects of the ARS market freeze on the treatment group.

In both models, I included quarter fixed effects as well as industry fixed effects (2-digit SIC level). The overall market liquidity changes over time will be absorbed by the time fixed effects,

[18] My results are robust if I use the propensity score matching method to construct the control group. See Section IV.H for more details.

[19] For the second, third, and fourth quarters in 2008, the differences are between the average market liquidity of current quarter and previous quarter.

while any industry level changes will be captured by the industry fixed effects. Moreover, I control for the lagged market liquidity (*Lagged Liquidity Level*), the aggregate ownership level of institutional investors at previous quarter-end (*Shrpct_Other*), market capitalization (*Log(Size)*), a dummy variable for stocks listed on NASDAQ (*NASDAQ Dummy*), market beta (*Market Beta*), and lagged idiosyncratic volatility (*Idio. Volatility*) in the regressions.[20] I also include *Liquidity Beta* of the stock to control for liquidity risk (Amihud and Mendelson (1986), Pastor and Stambaugh (2003), Acharya and Pedersen (2005)). Lastly, I adjust standard errors for heteroskedasticity and cluster them at the stock level with time fixed effects.[21]

IV. Spillover Effects of the ARS Market Freeze

A. Spillover Effects and Ownership of ARS-levered CEFs

I first run pooled OLS regressions using model (6) with quarter and industry fixed effects. In this specification, the empirical question to be answered is whether there are spillover effects of the ARS market freeze on the stocks held by ARS-levered CEFs. The dependent variables are changes in the log of relative spread, changes in the log of Amihud ratio, and average daily stock returns. Results are reported Table III.

[Insert Table III here]

The results in Table III suggest that the spillover affects increase with the ownership of ARS-levered CEFs. In columns (1) and (2), the coefficients on the ownership of ARS-levered CEFs (*Shrpct_CEF_ARS*), namely β_1, are significantly positive: 3.39 with t-stat. of 4.78 for Δ*Log(Rspread)* and 5.07 with t-stat. of 4.34 for Δ*Log(Amihud)*. In column (3), the coefficient on the ownership of

[20] For the aggregate ownership level of institutional investors, I exclude the ownership level of all the U.S. closed-end funds.

[21] This procedure accounts for potential cross-sectional correlations of the error terms across different firms and serial correlation of the error terms within the same firm over time (Petersen (2009)). Moreover, my results are similar if I cluster the standard errors at the industry level such as 3-digit SIC code level.

ARS-levered CEFs is negative (-2.73) and significant (t-stat.= -4.07). These results suggest that higher ARS-levered CEFs' ownership leads to larger declines in daily stock returns after the ARS market shock.

As one would expect, stocks with smaller *Log(Size)*, higher *Market Beta*, higher *Liquidity Beta*, and higher *Idio. Volatility* have larger drop in market liquidity and lower daily returns.[22] Moreover, non-NASDAQ listed stocks experienced large market liquidity drop than NASDAQ listed stocks. The coefficients on the holdings of other institutional investors (*Shrpct_Other*) are insignificant across all the three columns, suggesting that the ownership of other institutional investors cannot predict future changes in market liquidity and stock returns.

The spillover effects are also economically significant. A one standard deviation increase in the ownership by ARS-levered CEFs induces a increase of 0.022 (=3.39* 0.64%) in the log of relative spread measure (the mean change is 0.16), a increase of 0.032(=5.07*0.64%) in the log of Amihud measure (the mean change is 0.36), and a decrease in daily stock return of 1.75 basis points (= -2.73*0.64%) (average daily return is -11 basis points). Overall, the results show stocks held by ARS-levered CEFs experienced larger drop in market liquidity and lower daily returns than stocks that were not held by these funds after the ARS market freeze.

I also consider counterfactual tests for the main findings in Table III by looking at the period before the ARS market freeze (*i.e.*, in the period of 2006 and 2007). Specifically, I estimate the same regressions of model (6) as in Table III, but for the period of 2006-2007. The results are reported in Table IV. When the changes in market liquidity variables are used as the dependent variable, the coefficients on the ownership of ARS-levered CEFs are positive, but insignificant at conventional levels. In column (3), with average daily returns as the dependent variable, the coefficient on

[22] The coefficients on *Lagged Liquidity Level* have the opposite sign due to the high correlation with *Log(Size)* (over 0.85). With *Lagged Liquidity Level* included alone, its coefficients are significantly positive in the first two columns and negative in column (3).

Shrpct_CEF_ARS is positive and insignificant (0.29 with t-stat. of 0.91). Thus, I do not find similar spillover effects in the period before the ARS market freeze, that is, during 2006 and 2007). These falsification tests further confirm that the results in Table III are due to the freeze the ARS market.

[Insert Table IV here]

B. Short-term vs. Long-term Effects of the ARS Market Freeze

An alternative explanation of the results documented above is that there is some concurrent unobserved new information about the fundamentals of stocks held by ARS-levered CEFs. In this section, I test this alternative hypothesis by investigating whether or not the spillover effects of the ARS market freeze on stocks held by ARS-levered CEFs are temporary. If the above spillover effects are only short-term, they are likely not driven by unobserved new information. The reason is that the arrival of any new information will have a long-term effect on stock returns.

To see how long the spillover effects persist, I examine the relation between the ownership of ARS-levered CEFs (*Shrpct_CEF_ARS*) at the previous quarter-end and future cumulative stock returns. Specifically, I estimate equation (6) with the cumulative stock returns over various horizons as the dependent variables. The regressors are the same as in Table III with time and industry fixed effects are included in the regressions. If the effects of the ARS market freeze are temporary, one would expect that the coefficients on ownership of ARS-levered CEFs to be negative and significant for cumulative stock returns over short horizons (*i.e.,* 3-month horizon), but not significant for cumulative stock returns over longer horizons (*i.e.,* 12-month horizon)

The OLS estimation results are reported in Table V. The dependent variables in columns (1)-(4) are cumulative stock returns over 3-month, 6-month, 9-month, and 12-month horizons respectively. Table V contains two interesting findings. First, in column (1), the coefficient on *Shrpct_CEF_ARS* is -1.48 (t-stat.=-5.19), significant at the 1% level. This result is similar to my

finding in column (3) of Table III, where average daily returns over a quarter are used as the dependant variable. In terms of economic significance, a one-standard deviation increase in *Shrpct_CEF_ARS* is associated with a 0.95 percentage point drop in the 3-month cumulative returns.

[Insert Table V here]

Second, the coefficient on *Shrpct_CEF_ARS* converges to zero and becomes statistically insignificant when longer horizon cumulative stock returns are used as the dependent variable. Specifically, the coefficients on *Shrpct_CEF_ARS* are -1.01 (t-stat.=-2.21) for 6-month cumulative stock returns in column (2), -0,78 (t-stat.=-1.14) for 9-month cumulative stock returns in column (3), and 0.02 (t-stat.=0.03) for 12-month cumulative stock returns in column (4). In sum, these results suggest the ARS market freeze in February 2008 only has a short-term effect (*i.e.*, 3-month), rather than a permanent effect, on stocks held by ARS-levered CEFs. Thus, the ARS market freeze is a temporary funding liquidity shock to the ARS-levered CEFs. It does not change the fundamentals of the stocks held by the ARS-levered CEFs.

To further check the time series change of spillover effects of the ARS market freeze, I estimate equation (6) with cumulative stock returns over 12 horizons starting from 1-month up to 12-month as the dependent variables. Then, I plot coefficients on the ownership by ARS-levered CEs (*Shrpct_CEF_ARS)* from the estimations in Figure 3. As shown in Figure 3, the effect of the ownership by ARS-levered CEs on stock returns are only concentrated in the 3-month after the quarter-end holding date of ARS-levered CEFs. After that, the spillover effects disappear over the next three quarters. All the above results show that the effects of the ARS market freeze on stock returns are temporary in nature and are unlikely to be driven by the arrive of new information.

[Insert Figure 3 here]

C. Spillover Effects and Leverage from ARS Market by CEFs

To test whether the spillover effects intensify as the level of borrowing from the ARS market increases, I include an interaction term of ARS-levered-CEFs holdings and the level of ARS market borrowing by ARS-levered CEFs in my next set of tests. These models are described in Equation (7).

Table VI reports the results. First, I find that the coefficients of the dummy variable *(Hold>Median)* are positive for the liquidity-related variables and negative for stock returns, consistent with my results in Table III. Second, the coefficients on the interaction term, *Leverage_ARS×(Hold>Median)*, have the predicted sign in all three columns: 0.337 (t-stat. = 1.96) with Δ*Log(Rspread)*, 0.371 (t-stat. =3.76) with Δ*Log(Amihud)*, and -0.283 (t-stat. = -1.67) for daily returns. In terms of economic significance, for stocks held by ARS-levered CEFs at above median levels, a 10% increase in ARS-market leverage is associated with an increase of 0.03 (=0.337*10%) in *Log(Rspread)* (the mean change is 0.21), an increase of 0.04 (=0.371*10%) in *Log(Amihud)* (the mean change is 0.41), and a decrease in daily stock returns of 2.8 basis points (= -0.283*10%) (average daily return is -14 basis points). These results suggest that the spillover effects of the ARS market freeze intensify when the CEFs were more affected by the ARS market freeze.

[Insert Table VI here]

D. Spillover Effects and the Pre-Shock Liquidity Level

Brunnermeier and Pedersen (2009) predict that the "liquidity spiral" effects are more pronounced if the stock is *ex ante* less liquid. To empirically test this prediction, I interact the *Shrpct_CEF_ARS* variable in model (6) with two dummy variables capturing stock liquidity before the ARS market freeze. Specifically, the sample of stocks is split into two subsamples based on the median liquidity level in 2007 of stocks in the CRSP database. The modified specifications allow me to estimate spillover effects separately for the two subsamples. Based on the theoretical model by Brunnermeier and Pedersen (2009), I expect that the spillover effects will be stronger for the

subsample of stocks that were relatively illiquid before the ARS market freeze. Thus, I expect the difference of the two interactions to be positive.

Table VII presents the results for the modified model (6). The results are consistent with the prediction of Brunnermeier and Pedersen (2009). For both market liquidity measures, coefficients on *Shrpct_CEF_ARS* × *Illiquid Dummy* and *Shrpct_CEF_ARS* × *Liquid Dummy* are both positive and significant. More importantly, the former is significantly larger than the latter (with a difference of 2.59 for Δ*Log(Rspread)*, p-value of 2.34%, and 3.56 for Δ*Log(Amihud)*, p-value of 5.47%). My finding is similar to what Aragon and Strahan (2012) find using a different exogenous event, the Lehman Brothers' bankruptcy to examine margin funding risk in hedge funds. Moreover, the results are robust when I run the regressions separately on the two subsamples, rather than using the interaction term (untablulated). In sum, the spillover effects of the ARS market freeze are stronger if the stocks held by ARS-levered CEFs are less liquid before the ARS market freeze. This evidence supports the theory of Brunnermeier and Pedersen (2009).

[Insert Table VII here]

E. Spillover Effects of the ARS Market Freeze and Concurrent Forces

To confirm that the above spillover effects are caused by the ARS market freeze, one needs to consider the concurrent forces during that time period, such as inflows and outflows of open-end mutual funds (*e.g.*, Coval and Stafford (2007)). Many open-end mutual funds experienced large outflows in the year of 2008, which can induce price pressure on the stocks if they need to sell the stocks to meet the redemption. To test whether my results are driven by concurrent outflows of open-end mutual funds, I construct a mutual fund outflow measure (*MF_Outflow*) at the stock level. Following Edmans, Goldstein, and Jiang (2012), I construct this measure using funds' previously disclosed portfolio holdings, rather than mutual funds' actual purchases and sales (as in Coval and

Stafford (2007)). I first calculate the percentage flow of each open-end mutual fund in Thomson Reuters S12 Ownership database.

$$Flow\_pct_{j,t} = Flow_{j,t}/TA_{j,t-1} \quad (8)$$

where *j* indexes mutual funds and *t* indexes quarters. $Flow_{j,t}$ is the total flow experienced by fund *j* in quarter *t*, and $TA_{j,t-1}$ is fund *j*'s total assets at the end of previous quarter. Then, I construct the following mutual fund outflow measure for each stock-quarter observation:

$$MF\_Outflow_{i,t} = -\sum_{j=1}^{m} \frac{Flow_{j,t} \times s_{i,j,t-1}}{VOL_{i,t}} = -\sum_{j=1}^{m} \frac{Flow_{j,t} \times Shares_{i,j,t-1} \times PRC_{i,t-1}}{TA_{j,t-1} \times VOL_{i,t}} \quad (9)$$

where *i* indexes stocks; *t* indexes quarters; $s_{i,j,t-1} = (Shares_{i,j,t-1} * PRC_{i,t-1})/TA_{j,t-1}$ is the dollar value of fund *j*'s position in stock *i*, as a percentage of its portfolio at the end of the previous quarter; $VOL_{i,t}$ is the total dollar trading volume of stock *i* in quarter *t*. Following Edmans, Goldstein, and Jiang (2012), the summation is only computed for over funds with more than 5% outflow, namely $Flow\_pct_{j,t} \leq -5\%$.[23] I add a negative sign to this measure to ease with interpretation. That is, higher values of $MF\_Outflow_{i,t}$ mean the stock is owned more by open-end mutual funds that experienced large capital outflows.

The measure $MF\_Outflow$ captures the price pressure on stocks that is induced by investor outflow of mutual funds. I include both *MF_Outflow* and *Shrpct_CEF_ARS* in a modified version of model (6). Table VIII presents the results. First, the coefficients on *MF_Outflow* are positive for columns (1) and (2) (0.07 with t-stat. of 1.26 for Δ*Log(Rspread)* and 0.34 with t-stat. of 3.46 for Δ*Log(Amihud)*) and negative in column (3) (-0.30 with t-stat. of -2.84). Thus, large investor outflow induces lower stock returns and drop in market liquidity. More importantly, *Shrpct_CEF_ARS* still have similar coefficients, both in terms of magnitude and significance, to the ones reported in Table

[23] My results are not sensitive to this restriction imposed. Similar results are obtained if I sum it over the mutual fund with top 10 percentile of outflows.

III. This set of results suggests that the spillover effects of the ARS market freeze can not be explained by concurrent forces like investor outflows of open-end mutual funds.

[Insert Table VIII here]

F. Spillover Effects and Selling by ARS-Levered CEFs

In this section, I analyze the selling behavior of CEFs and further test whether the spillover effects documented above are indeed associated with the selling by ARS-levered CEFs.

First, I examine the selling behavior of CEFs before and after the ARS market freeze. I compare the net sales as a percentage of the portfolio dollar value for ARS-levered and other CEFs. Panel A of Table IX presents the results. I find that, on average, ARS-levered CEFs sell about 8.1% of their portfolio value each quarter in 2008, while other CEFs do not exhibit similar selling behaviors during this time period. The difference between the two groups is 11.7% with a p-value of 0.028. In addition, in the years before or after 2008, neither ARS-levered CEFs nor non-ARS-levered CEFs exhibit these selling behaviors. These results confirm that there is indeed intense selling behavior by ARS-levered CEFs after the ARS market freeze in 2008.

[Insert Table IX here]

Next, I examine whether the spillover effects are associated with the selling behavior of ARS-levered CEFs. To do this, I include a dummy variable, Δ*Shrpt_CEF_ARS<0*, which is equal to 1 if ARS-levered CEFs reduce their position in a quarter, in Equation (6) regressions.[24] To help reduce concerns about reverse causality, I use the ownership of ARS-levered CEFs at the end of previous quarter, rather than the current actual holding position change, as the main independent variable. Panel B of Table IX presents the results. The coefficients on Δ*Shrpt_CEF_ARS<0* are positive in the first two columns (0.08 with t-stat. of 14.65 Δ*Log(Rspread)* and 0.10 with t-stat. 9.34 for

[24] If I include a continuous variable of the actual position changes of ARS-levered CEFs, the results are qualitatively similar.

Δ*Log(Amuhid)*) and negative for daily returns (-0.06 with t-stat. of -6.44). This set of results confirms that the spillover effects of the ARS market freeze are driven by the selling behavior of ARS-levered CEFs.

G. Portfolio Decisions of ARS-Levered CEFs after the ARS Market Freeze

We have documented that there is intense selling by ARS-levered CEFs in the previous sections. In this section, I examine how ARS-levered CEFs adjust their portfolios after experiencing a sharp increase in their borrowing costs due to the ARS market freeze. Specifically, I investigate whether ARS-levered CEFs "strategically" avoid selling illiquid stock positions in their portfolios to minimize the associated price pressure.

To do this, I first compare the characteristics of stock positions that are sold by ARS-levered CEFs after the ARS market freeze to other positions in their portfolios. Panel A of Table X reports the univariate comparison results. The analyses are carried out at fund-quarter-stock level. The results in Panel A show that there are significant differences between the two groups in market liquidity, market capitalization, *Shrpct_CEF_ARS*, liquidity beta, and idiosyncratic volatility. It suggests that, after the ARS market freeze, ARS-levered CEFs tend to sell positions that are liquid, with larger market cap, with lower liquidity beta, and with higher idiosyncratic volatility, which can help minimize the price impact associated with trading. Also, they tend to sell larger positions in their portfolio to raise capital after the ARS market freeze.

[Insert Table X here]

Next, I employ a Logit model approach to carry out the multivariate analyses. The dependant variable is a dummy variable that equals 1 if a stock position is sold after the ARS market freeze and 0 otherwise. I regress the dummy variable on various lagged characteristics of the stock positions, including liquidity, size, *Shrpct_CEF_ARS*, idiosyncratic volatility, B/M ratio, momentum, Market

Beta, and Liquidity Beta. I also include time and industry dummies in the regressions. Panel B of Table X reports the estimation results. Similar to the univariate results, the multivariate results confirm that large positions in the portfolio that are liquid, with large capitalization, with higher idiosyncratic volatility, and with lower liquidity beta are more likely to be sold by ARS-levered CEFs after the ARS market freeze.

The above empirical evidence suggests that ARS-levered CEFs tend to avoid selling illiquid and small stocks in their portfolios to minimize the associated price pressure. Nevertheless, this strategic behavior is not likely to fully remove the negative impact of the ARS market freeze on ARS-levered CEFs, which borrow on average 23% of their total assets from the ARS market and also have concentrated portfolio holdings. It will only work against one to find any spillover effects on the stocks sold by ARS-levered CEFs.

H. Additional Tests

I conduct several additional tests for robustness purposes. First, I use propensity score matching to construct a control sample. Specifically, for the stocks held by any CEF, I first model the likelihood the stock is held by an ARS-levered CEF. The independent variables used in the Logit model include lagged liquidity, market cap, momentum, B/M ratio, quarter dummies, and industry dummies. I generate a one-to-one matched sample based on the predicted likelihood that a stock is held by an ARS-levered CEF. I re-estimate the main specification as in Equation (6) on this matched sample. As shown in Table XI, the results are similar to the results reported in Table III. Thus, my results are robust to alternative ways of constructing the control group.

[Insert Table XI here]

Second, my results are robust to the use of percentage changes in market liquidity instead of the absolute value of the changes as the dependent variable. As shown in columns (1) and (2) of

Table XII, the results are similar to those in Table III; in columns (3) and (4), I find similar results as in Table VI. Thus, my results are robust to the way I measure the stocks' liquidity changes.

[Insert Table XII here]

Third, there are some international equity closed-end funds that also have a certain portion of their assets invested in the U.S. domestic equity market. There are 52 international equity closed-end funds with some U.S. common stocks in their portfolios during the year of 2008. Though I do not have the complete portfolio holdings of these international equity CEFs, my results are robust if I include international equity closed-end funds in my sample. Results are tabulated in Table A.I in the Appendix.

Last, I also examine the determinants of leverage of the U.S. closed-end funds industry over the period from 1994 to 2009. Specifically, I estimate a pooled OLS regression of the total leverage of 677 closed-end funds in U.S. with all objectives (*i.e.,* domestic equity, municipal bond, taxable bond, international equity, and others CEFs) on lagged macro-economic variables and fund characteristics. Results are reported in Table A.II in the Appendix. Consistent with theory (*e.g.,* Acharya and Viswanathan (2011), Fostel and Geanakoplos (2008), Geanakoplos (2010)), the results show that the closed-end fund industry tends to borrow more during good times, proxied by higher term spread, low VIX index, and higher dividend yields of the overall stock market.[25] These findings are consistent with the evidence of Adrian and Shin (2010), who find that the leverage ratio of the main investment banks in U.S. is high during boom times and low during bust times.

[25] The term spread is calculated as the difference in the returns of long term treasury bonds and three-month treasury bills; VIX index is the option-implied measure of volatility from Chicago Board Options Exchanges; CRSP dividend yields of the overall stock market are calculated as the difference between CRSP value-weighted stock returns with and without dividends.

V. Concluding Remarks

Using the ARS market freeze in February 2008 as an exogenous funding shock, I find systematic empirical evidence of the spillover effects of the shock on stocks held by ARS-levered CEFs. I find that the stocks held by ARS-levered CEFs experience larger declines in market liquidity and lower daily returns after the ARS market freeze than other stocks. The spillover effects on stock returns are temporary and disappear within the next twelve months. Further investigation shows that ARS-levered CEFs liquidated a large portion of their portfolios after experiencing the ARS market shock, which causes the temporary spillover effects.

This paper contributes to the literature by providing new empirical evidence on the transmission of funding liquidity shocks to the underlying asset markets (Brunnermeier and Pedersen (2009), Acharya and Viswanathan (2011)). It also helps our understanding of the fire-sale externality associated with leverage in the financial sector on financial markets (*e.g.,* Stein (2009)). Moreover, this study has policy implications on the leverage regulation of financial intermediaries, such as investment companies. During the crisis period, unconditionally constant legal limits on assets coverage ratio or capital requirement ratio are more likely to bind financial firms, which can force them to deleverage and liquidate assets to stay in line with the legal requirements. My evidence supports the idea that the regulators should manage system wide leverage along with market cycles, that is to curtail leverage in good times and to prop up leverage in bad times (Geanakoplos (2010), Wang (2010)).

Lastly, many ARS-levered CEFs specialize in asset markets such as municipal bond markets, corporate bond markets, and international equity markets. To the extent that these asset markets are less liquid than the U.S. equity market, my study provides a lower bound of the spillover effects of the ARS market freeze to the underlying asset markets. One would expect spillover effects of the ARS market freeze in 2008 to be larger for CEFs specialized in these less liquid assets. Moreover,

future research may also examine the relation between closed-end fund discounts and the level of ARS borrowing before and after the ARS market freeze. The deterioration of debt market liquidity may lead to the firm to default even when the firm's fundamentals are still high (He and Xiong (2011)). Thus, it would be interesting to examine the exit of CEFs after the ARS market shock such as liquidations, open-ending, and mergers of CEFs.

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Figure 1

Time Series of Borrowing of Auction Rate Securities by Closed-End Funds

This figure reports the aggregated borrowing from the auction rate security market and other sources such as bank loans of the closed-end funds during the period from 2007Q1 to 2009Q2. I aggregate the borrowing in term of auction rate securities and other debt across all the U.S. domestic equity closed-end funds in my sample.

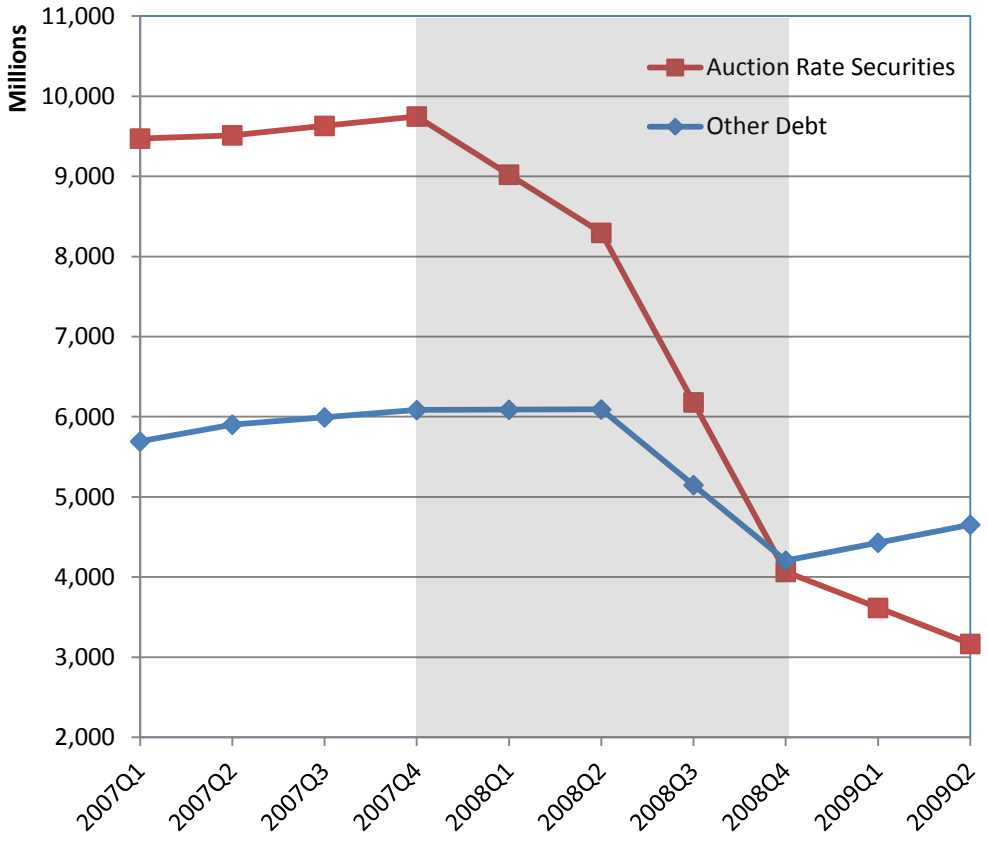

Figure 2

Ownership of ARS-levered Closed-End Funds and Percentage Change in Liquidity

This figure reports % change in liquidity of the stocks held by ARS-levered CEFs after the ARS market freeze in February 2008. I divide the sample of stocks held by ARS-levered CEFs into three groups based on the aggregated ownership: (0%, 1%], (1%, 3%], (3%, 15%). The median % change in liquidity of each group over the previous quarter is reported for two liquidity measures, *Amihud Ratio* and *Rspread*. *Amihud ratio* is the Amihud (2002) illiquidity measure, defined as quarterly average of the ratio of absolute value of daily return over daily dollar volume. *Rspread* is the relative bid-ask spread in percentage points, defined as the difference between ask and bid prices over the midpoint. The percentage change is calculated as *(Illiquidity(t) - Illiquidity(t-1))/ Illiquidity(t-1)*.

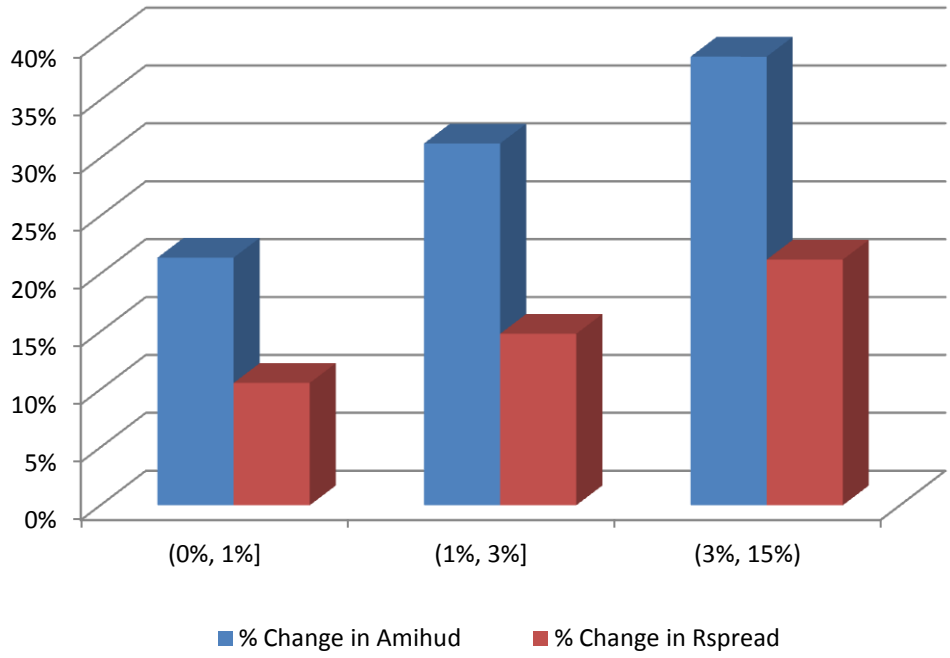

Figure 3

Effects of Auction Rate Security Market Freeze on Stock Returns

This figure plots the monthly coefficients of ownership by ARS-levered CEFs (*Shrpct_CEF_ARS*) with the cumulative stock returns as the dependent variable as in Table V. All the controls in Equation (6) are included in the regressions, including time and industry dummies. *t0* is the quarter-end month that ARS-levered CEFs hold stock positions prior the ARS market freeze. The coefficients plotted are backward-looking two-month moving average of the coefficients over months *t* and *t-1*.

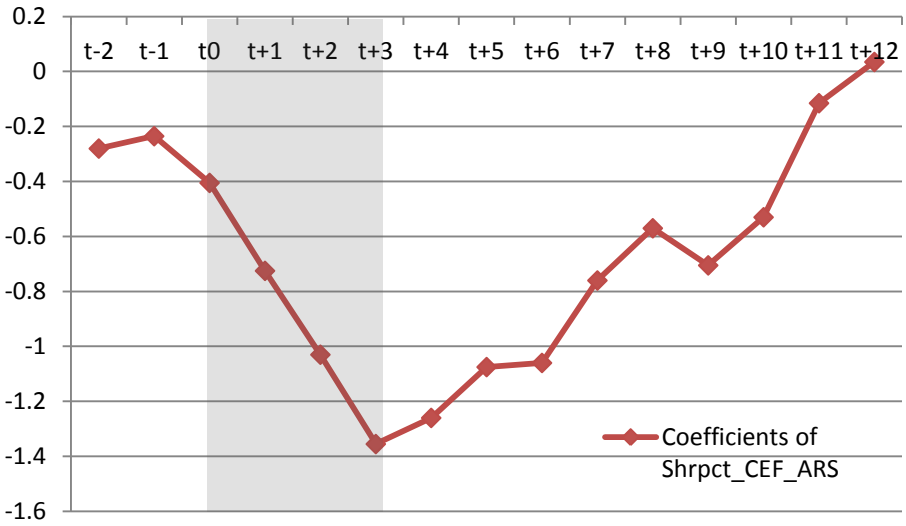

Table I

Summary Statistics of Closed-End Fund Characteristics

Panel A of this table reports the summary statistics of the variables of closed-end funds (CEFs) in my sample from 2006-2009. *Leverage_total* is the total leverage of a closed-end fund, calculated as (Total assets – Total NAV)/ Total Assets; *Leverage_ARS* is the level of borrowing from the auction rate security (ARS) market, measured as (Total auction rate preferred stocks / Total assets); *Leverage_other* is the borrowing from other sources such as bank loans, calculated as the difference between total leverage (*Leverage_total*) and leverage from the ASR market (*Leverage_ARS*). Total assets, Total auction rate preferred stocks, and Total NAV are obtained from balance sheet and income statement data on the N-SAR reports that CEFs file to SEC. *Market Capitalization* is the product of stock price of the CEF and shares outstanding. Panel B of this table compares the fund characteristics and holding characteristics in the four quarters of 2008 of ARS-levered CEFs *versus* other CEFs. The holding information is from s12 data of Thomson Reuters Ownership Database. *N* is the number of fund-quarter observations. *PortHHI* is the Herfindahl index of the portfolio, calculated from the market value of each component of the stock.

Panel A. Closed-End Fund Characteristics

Variables	Mean	Median	Std.	1% Percentile	99% Percentile	N
Total Assets	557.3	298.7	664.0	11.6	3478.4	1,524
Market Capitalization	411.9	241.5	466.3	8.5	2375.7	1,507
Leverage_total	19.7%	20.7%	16.3%	0.1%	51.5%	1,524
Leverage_ARS	9.8%	0.0%	13.9%	0.0%	43.5%	1,524
Leverage_other	9.9%	3.6%	12.6%	0.1%	48.8%	1,524

Panel B. Comparison of ARS-Levered CEFs and Non-ARS-Levered CEFs

	ARS-Levered CEFs				Non-ARS-Levered CEFs				Diff. in	
	N	**Mean**	**Median**	**Std.**	**N**	**Mean**	**Median**	**Std.**	**Mean**	**t-stat.**
Fund Characteristics										
Total Assets	104	673.1	462.3	635.6	177	368.1	266.7	377.6	305.0***	5.05
Market Cap.	104	995.9	750.6	904.1	177	419.0	265.8	425.2	576.9***	7.24
Leverage_total	104	34.9%	36.7%	12.2%	177	9.6%	3.7%	12.2%	25.3%***	16.79
Leverage_ARS	104	23.1%	25.2%	12.1%	177	0.0%	0.0%	0.0%	23.1%***	19.38
Leverage_other	104	11.8%	8.8%	12.3%	177	9.6%	3.7%	12.2%	2.2%	1.46
Portfolio Holdings										
# of Stocks	104	62	27	109	177	137	49	275	-75***	-3.23
Size ($ Billions)	104	35.0	18.6	39.1	177	59.4	57.5	39.8	-24.3***	-5.00
HHI	104	0.30	0.06	0.35	177	0.08	0.027	0.19	0.22***	6.01
Rspread (%)	104	0.154	0.130	0.088	177	0.140	0.099	0.187	0.014	0.86
Amihud Ratio	104	0.022	0.001	0.081	177	0.065	0.0001	0.475	-0.043	-1.18
Market Beta	101	0.77	0.75	0.31	177	0.97	0.93	0.26	-0.20***	-5.42
Liquidity Beta	101	-0.008	-0.010	0.061	177	-0.004	-0.007	0.063	0.00	-0.50

Table II

Stock Characteristics and Holdings of Closed-End Funds

This table reports the summary statistics of stock characteristics in the four quarters of 2008. *Log(Amihud)* is the log of Amihud (2002) illiquidity measure, defined as quarterly average of the ratio of absolute value of daily return over daily dollar volume. *Log(Rspread)* is the log of relative bid-ask spread in percentage points, defined as the difference between ask and bid prices over the midpoint. Δ*Log(Amihud)* and Δ*Log(Rspread)* are the changes in the log of Amihud ratio and Rspread measure over previous quarter. *Daily Return* is the quarterly average of daily return of a stock. *Log(Size)* is the log of quarter-end market capitalization of a stock in millions of dollars. *Market Beta* and *Liquidity Beta* for a stock at a given month are obtained from a regression of monthly stock returns on value-weighted CRSP stock returns and liquidity innovation factor of Pastor and Stambaugh (2003) in the previous five years. *Shrpct_CEF* is the aggregated ownership from S12 data of Thomson Reuters by all CEFs in my sample, as a percentage of shares outstanding of a stock; *Shrpct_CEF_ARS* is the ownership of a stock by CEFs that borrow from the ARS market, referred as ARS-levered CEFs. *Leverage_total* and *Leverage_ARS* are the weighted-average total leverage and leverage from the ARS market of closed-end funds that held a specific stock using the number of shares as the weight: $Leverage_{i,t} = \sum_{j=1}^{n} \omega_{i,j,t} * Leverage_{j,t}$; $where\ \omega_{i,j,t} = shares_{i,j,t} / \sum_{j=1}^{n} shares_{i,j,t}$where *i* indexes stocks; *j* indexes closed-end funds; and *t* indexes quarters. Panel B of this table presents the distribution of aggregate ownership as percentage of shares outstanding by CEFs at the fourth quarter of 2007, before the ARS market freeze.

Panel A. Summary Statistics of Stock Characteristics

Variables	Mean	Median	Std.	Min	Max	N
Stock Characteristics						
Log (Amihud)	-19.52	-19.62	2.55	-26.72	-9.93	11,220
Log (Rspread)	-6.19	-6.38	0.98	-8.84	-1.37	11,221
Δ Log (Amihud)	0.36	0.27	0.70	-3.88	3.94	11,213
Δ Log (Rspread)	0.16	0.10	0.38	-3.85	2.52	11,218
Daily Return	-0.11%	-0.06%	0.58%	-13.52%	6.56%	11,220
Log(Size)	6.78	6.53	1.64	1.60	10.89	11,134
Market Beta	1.29	1.18	0.74	-1.52	6.95	10,157
Liquid Beta	0.01	0.002	0.27	-2.68	1.39	10,157
Holdings Related Variables						
Shrpct_CEF	0.29%	0.05%	0.77%	0.000002%	14.55%	11,225
Shrpct_CEF_ARS	0.17%	0.00%	0.64%	0.00%	14.55%	11,225
Leverage_total	11.4%	12.8%	9.2%	0.0%	48.8%	11,225
Leverage_ARS	4.7%	0.0%	7.7%	0.0%	39.7%	11,225

Panel B. Distribution of Ownership by Domestic Equity CEFs at the end of 2007Q4

Ownership Range	**No. of stocks**	**Percentage**
No. of stocks held by CEFs	**2,880**	**61.4%**
No. of stocks with less than **0.5%** held by CEFs	2,407	51.3%
No. of stocks with **0.5%** to **1%** held by CEFs	228	4.9%
No. of stocks with **1%** to **3%** held by CEFs	194	4.1%
No. of stocks with **3%** to **15%** held by CEFs	51	1.1%
No. of stocks not held by CEFs	**1,810**	**38.6%**
Total	**4,690**	**100.0%**

Table III Spillover Effects of the Auction Rate Security (ARS) Market Freeze

This table reports pooled OLS estimation results of equation (6) with the time and industry fixed effects over the four quarters of 2008. The dependent variables used are changes in the log of relative spread in column (1), changes in the log of Amihud ratio in column (2), and quarterly average daily returns in column (3). *Shrpct_CEF_ARS* are the ownership of a stock by ARS-levered CEFs in the previous quarter-end. *Shrpct_Other* is the aggregate ownership of a stock by institutional investors from S34 data of Thomson Reuters, excluding CEFs. *Idio. Volatility* is idiosyncratic volatility calculated as the standard deviation of the residuals from Carhart (1997) four-factor model of each quarter using daily stock return. Other variables are defined in Table II. Standard errors are adjusted for heteroskedasticity and clustering at the stock level; t-statistics are reported in parentheses. Coefficients marked with ***, **, and * are significant at the 1%, 5%, and 10% level respectively.

	(1)	(2)	(3)
VARIABLES	ΔLog(Rspread)	ΔLog(Amihud)	Daily Return (%)
Shrpct_CEF_ARS	3.39***	5.07***	-2.73***
	(4.78)	(4.34)	(-4.07)
Lagged Liquidity Level	-0.10***	-0.22***	0.13***
	(-13.64)	(-26.29)	(18.97)
Log (Size)	-0.04***	-0.33***	0.19***
	(-12.30)	(-27.29)	(18.97)
Market Beta	0.03***	0.06***	-0.01
	(6.55)	(6.77)	(-1.03)
Liquid Beta	0.05***	0.05***	0.14***
	(4.81)	(2.65)	(6.28)
NASDAQ Dummy	-0.06***	-0.05***	0.07***
	(-10.44)	(-4.62)	(6.26)
Shrpct_Other	-0.00	0.01	0.01
	(-0.07)	(0.90)	(0.65)
Idio. Volatility	5.26***	5.37***	-2.43***
	(21.37)	(12.68)	(-4.21)
Constant	-0.37***	0.18***	0.26***
	(-9.69)	(2.87)	(3.78)
Time Fixed Effects	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes
Observations	10,134	10,133	10,133
R-squared	0.508	0.570	0.157

Table IV Contrafactual Tests over the Period of 2006-2007

This table reports pooled OLS estimation results of equation (6) over the period of 2006-2007. The dependent variables used are changes in the log of relative spread in column (1), changes in the log of Amihud ratio in column (2), and quarterly average daily returns in column (3). *Shrpct_CEF_ARS* are the ownership of a stock by ARS-levered CEFs in the previous quarter-end. Other variables are defined in Table II. Standard errors are adjusted for heteroskedasticity and clustering at the stock level; t-statistics are reported in parentheses. Coefficients marked with ***, **, and * are significant at the 1%, 5%, and 10% level respectively.

	(1)	(2)	(3)
VARIABLES	ΔLog(Rspread)	ΔLog(Amihud)	Daily Return (%)
Shrpct_CEF_ARS	0.50	1.50	0.29
	(1.62)	(1.31)	(0.91)
Lagged Liquidity Level	-0.13***	-0.17***	0.07***
	(-26.01)	(-28.16)	(21.32)
Log (Size)	-0.05***	-0.25***	0.11***
	(-23.53)	(-28.50)	(22.86)
Market Beta	0.01**	-0.01***	-0.01
	(2.07)	(-2.70)	(-1.33)
Liquid Beta	0.00	-0.02	-0.01
	(0.09)	(-1.50)	(-0.98)
NASDAQ Dummy	-0.02***	-0.03***	0.03***
	(-5.96)	(-3.43)	(4.59)
Shrpct_Other	-0.02***	-0.03***	0.01
	(-3.06)	(-2.61)	(0.94)
Idio. Volatility	0.92***	0.51	-0.24
	(2.87)	(0.81)	(-0.40)
Constant	-0.18**	0.03	-0.06
	(-1.97)	(0.16)	(-1.06)
Time Fixed Effects	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes
Observations	15,424	15,407	15,407
R-squared	0.284	0.296	0.157

Table V Short-term vs. Long-term Effects of the ARS Market Freeze

This table reports pooled OLS estimation results of equation (6) with cumulative stock returns as the dependent variables. The dependent variables in columns (1)-(4) are 3-month, 6-month, 9-month, and 12-month cumulative stock returns respectively. *Shrpct_CEF_ARS* are the ownership of a stock by ARS-levered CEFs in the previous quarter-end. Other variables are defined in Table II. Standard errors are adjusted for heteroskedasticity and clustering at the stock level; t-statistics are reported in parentheses. Coefficients marked with ***, **, and * are significant at the 1%, 5%, and 10% level respectively.

VARIABLES	(1) 3-month Cum. Return	(2) 6-month Cum. Return	(3) 9-month Cum. Return	(4) 12-month Cum. Return
Shrpct_CEF_ARS	-1.48***	-1.01**	-0.78	0.02
	(-5.19)	(-2.21)	(-1.14)	(0.03)
Lagged Liquidity Level	0.06***	0.04***	0.02***	0.01*
	(17.96)	(8.83)	(3.50)	(1.77)
Log (Size)	0.08***	0.05***	0.02***	0.02**
	(17.12)	(8.57)	(3.25)	(1.96)
Market Beta	-0.02***	-0.04***	-0.05***	-0.04***
	(-3.80)	(-5.90)	(-7.24)	(-4.55)
Liquid Beta	0.04***	0.02	0.01	0.02
	(4.31)	(1.02)	(0.39)	(0.80)
NASDAQ Dummy	0.03***	0.04***	0.05***	0.04***
	(4.92)	(4.92)	(4.67)	(3.64)
Shrpct_Other	-0.00	0.00	0.00	0.01
	(-0.25)	(0.16)	(0.25)	(0.56)
Idio. Volatility	-2.97***	-3.55***	-3.36***	-2.27***
	(-13.95)	(-14.86)	(-11.21)	(-6.18)
Constant	0.30***	0.23***	0.56***	0.39***
	(10.41)	(5.52)	(11.73)	(6.99)
Time Fixed Effects	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes
Observations	10,089	9,941	9,797	9,676
R-squared	0.279	0.247	0.192	0.222

Table VI Spillover Effects and Leverage from the ARS Market

This table reports pooled OLS estimation results of equation (7) over the four quarters of 2008. The dependent variables used are changes in the log of relative spread in column (1), changes in the log of Amihud ratio in column (2), and quarterly average daily returns in column (3). *Hold>Median* is a dummy variable indicating that the level of holding by ARS-levered CEFs in quarter *t*-1 is above median level among all stocks with positive ownership by ARS-levered CEFs, *Leverage_ARS* is the weighted-average leverage from the ARS market of CEFs that hold a given stock, and the interaction term of the two are included in the regressions. Other variables are defined in Table II. Standard errors are adjusted for heteroskedasticity and clustering at the stock level; t-statistics are reported in parentheses. Coefficients marked with ***, **, and * are significant at the 1%, 5%, and 10% level respectively.

	(1)	(2)	(3)
VARIABLES	ΔLog(Rspread)	ΔLog(Amihud)	Daily Return (%)
Hold>Median	0.078***	0.068***	-0.040*
	(3.13)	(4.91)	(-1.78)
Leverage_ARS × Hold>Median	0.337*	0.371***	-0.283*
	(1.96)	(3.76)	(-1.67)
Leverage_ARS	0.087	0.039	-0.092
	(0.58)	(0.45)	(-0.64)
Lagged Liquidity Level	-0.219***	-0.104***	0.133***
	(-27.39)	(-14.67)	(19.76)
Log (Size)	-0.331***	-0.044***	0.194***
	(-28.31)	(-13.00)	(19.61)
Market Beta	0.062***	0.032***	-0.009
	(6.78)	(6.73)	(-1.02)
Liquid Beta	0.051**	0.049***	0.140***
	(2.51)	(4.64)	(6.42)
NASDAQ Dummy	-0.047***	-0.056***	0.066***
	(-4.22)	(-9.55)	(5.94)
Shrpct_Other	0.008	-0.004	0.013
	(0.59)	(-0.57)	(0.88)
Idio. Volatility	5.368***	5.278***	-2.424***
	(12.57)	(21.29)	(-4.19)
Constant	0.193***	-0.366***	0.250***
	(2.99)	(-9.84)	(3.65)
Time Fixed Effects	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes
Observations	10,134	10,133	10,133
R-squared	0.510	0.570	0.158

Table VII Spillover Effects and Liquidity Level before the ARS Market Freeze

This table reports pooled OLS estimation results of equations (6) over two subsamples divided based the median liquidity level in 2007. The dependent variables used are changes in the log of relative spread in column (1) and changes in the log of Amihud ratio in column (2). *Illiquid (Liquid) Dummy* is a dummy variable indicating that the market liquidly of a stock is below (above) median level among all the common stocks in 2007. *Shrpct_CEF_ARS* are the ownership of a stock by ARS-levered CEFs in the previous quarter-end. Other variables are defined in Table II. Standard errors are adjusted for heteroskedasticity and clustering at the stock level; t-statistics are reported in parentheses. Coefficients marked with ***, **, and * are significant at the 1%, 5%, and 10% level respectively.

	(1)	(2)
VARIABLES	ΔLog(Rspread)	ΔLog(Amihud)
Shrpct_CEF_ARS × Illiquid Dummy (a)	4.080***	6.061***
	(3.89)	(3.66)
Shrpct_CEF_ARS × Liquid Dummy (b)	1.495***	2.498***
	(2.92)	(2.73)
Illiquid Dummy	0.029***	0.043***
	(3.92)	(3.01)
Lagged Liquidity Level	-0.104***	-0.224***
	(-13.87)	(-25.99)
Log (Size)	-0.037***	-0.326***
	(-9.97)	(-27.09)
Market Beta	0.033***	0.063***
	(6.72)	(6.75)
Liquid Beta	0.056***	0.060***
	(5.15)	(2.85)
NASDAQ Dummy	-0.062***	-0.054***
	(-10.67)	(-4.81)
Shrpct_Other	-0.006	0.005
	(-0.80)	(0.33)
Idio. Volatility	5.348***	5.449***
	(21.47)	(12.82)
Constant	-0.497***	0.055
	(-9.72)	(0.92)
Time Fixed Effects	Yes	Yes
Industry Fixed Effects	Yes	Yes
Observations	10,134	10,133
R-squared	0.509	0.570
Additional Tests:		
(a) – (b)	2.585**	3.563*
p-value	2.34%	5.47%

Table VIII Spillover Effects and Outflows of Open-end Mutual Funds

This table reports the estimation results of Equation (6) with a mutual fund outflow measure added in the regressions. The dependent variables used are changes in the log of relative spread in column (1), changes in the log of Amihud ratio in column (2), and quarterly average daily returns in column (3). *Shrpct_CEF_ARS* are the ownership of a stock by ARS-levered CEFs in the previous quarter-end. *MF_Outflow* is a mutual fund price pressure measure calculated as follows:

$$MF\_Outflow_{i,t} = -\sum_{j=1}^{m} \frac{Flow_{j,t} \times Shares_{i,j,t-1} \times PRC_{i,t-1}}{TA_{j,t-1} \times VOL_{i,t}}$$

It takes a higher value if the stock is held by more open-end mutual funds with more than 5% outflow of total assets. Other variables are defined in Table II. Standard errors are adjusted for heteroskedasticity and clustering at the stock level; t-statistics are reported in parentheses. Coefficients marked with ***, **, and * are significant at the 1%, 5%, and 10% level respectively.

	(1)	(2)	(3)
VARIABLES	ΔLog(Rspread)	ΔLog(Amihud)	Daily Return (%)
Shrpct_CEF_ARS	3.39***	5.09***	-2.74***
	(4.78)	(4.35)	(-4.13)
MF_Outflow	0.07	0.34***	-0.30***
	(1.26)	(3.46)	(-2.84)
Lagged Liquidity Level	-0.10***	-0.22***	0.13***
	(-13.59)	(-26.23)	(18.88)
Log (Size)	-0.04***	-0.33***	0.19***
	(-12.20)	(-27.17)	(18.78)
Market Beta	0.03***	0.06***	-0.01
	(6.56)	(6.80)	(-1.05)
Liquid Beta	0.05***	0.05***	0.14***
	(4.81)	(2.65)	(6.30)
NASDAQ Dummy	-0.06***	-0.05***	0.07***
	(-10.37)	(-4.50)	(6.16)
Shrpct_Other	-0.00	0.01	0.01
	(-0.05)	(0.95)	(0.61)
Idio. Volatility	5.26***	5.38***	-2.45***
	(21.38)	(12.73)	(-4.23)
Constant	-0.37***	0.16**	0.28***
	(-9.75)	(2.55)	(4.03)
Time Fixed Effects	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes
Observations	10,134	10,133	10,133
R-squared	0.508	0.570	0.158

Table IX Ownership Changes of ARS-levered CEFs

Panel A of this table analyze the selling behavior of CEFs during the period from 2006 to 2009. I compare the net sales as a percentage of portfolio dollar value for ARS-levered CEFs and other CEFs. Panel B reports the estimation results of Equation (6) with contemporaneous ownership changes of ARS-levered CEFs, rather than the ownership in the previous quarter. The dependent variables used are changes in the log of relative spread in column (1), changes in the log of Amihud ratio in column (2), and quarterly average daily returns in column (3). *Shrpct_CEF_ARS* are the ownership of a stock by ARS-levered CEFs. *ΔShrpct_CEF_ARS<0* is a dummy variable that equals to 1 if the change in *Shrpct_CEF_ARS* in the current quarter is negative. Other variables are defined in Table II. Standard errors are adjusted for heteroskedasticity and clustering at the stock level; t-statistics are reported in parentheses. Coefficients marked with ***, **, and * are significant at the 1%, 5%, and 10% level respectively.

Panel A. Net Sales as % of Portfolio Dollar Value by CEFs

	ARS-Levered CEFs				Non-ARS-Levered CEFs					
Year	N	Mean	Median	Std Dev	N	Mean	Median	Std Dev	Diff.	p-value
2006	143	-1.76	-1.52	15.15	145	-0.86	-1.95	37.75	-0.90	79.1%
2007	146	-0.91	-1.37	27.35	171	0.32	-1.24	21.98	-1.23	66.3%
2008	**106**	**-8.11**	**-4.01**	**27.59**	**162**	**3.63**	**-1.35**	**58.53**	**-11.74****	**2.8%**
2009	94	-0.31	-1.01	9.60	219	3.77	-2.20	50.49	-4.08	25.2%

Panel B. Multivariate Results

VARIABLES	(1) ΔLog(Rspread)	(2) ΔLog(Amihud)	(3) Daily Return (%)
ΔShrpct_CEF_ARS<0	0.08***	0.10***	-0.06***
	(14.65)	(9.34)	(-6.44)
Lagged Liquidity Level	-0.11***	-0.22***	0.13***
	(-15.08)	(-27.40)	(19.69)
Log (Size)	-0.05***	-0.34***	0.20***
	(-14.72)	(-28.62)	(19.75)
Market Beta	0.03***	0.06***	-0.01
	(6.74)	(6.77)	(-1.06)
Liquid Beta	0.05***	0.05**	0.14***
	(4.78)	(2.55)	(6.39)
NASDAQ Dummy	-0.06***	-0.05***	0.07***
	(-9.83)	(-4.35)	(6.04)
Shrpct_Other	-0.01	0.01	0.01
	(-0.87)	(0.41)	(0.95)
Idio. Volatility	5.21***	5.25***	-2.36***
	(21.23)	(12.36)	(-4.09)
Constant	-0.32***	0.26***	0.21***
	(-8.80)	(4.19)	(3.17)
Time Fixed Effects	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes
Observations	10,134	10,133	10,133
R-squared	0.514	0.572	0.159

Table X Portfolio Decisions of ARS-levered CEFs

This table presents the results of the analyses on the portfolio decisions of ARS-levered CEFs after the ARS market freeze in February 2008. Panel A compares the lagged characteristics of the stock positions that are sold by ARS-levered CEFs after the ARS-market freeze to other positions in their portfolio. Panel B reports the results from the multivariate Logit regressions. The dependent variable is a dummy variable that equals to 1 if a stock position is sold after the ARS market freeze and 0 otherwise. *Adj. B/M Ratio* is the Book-to-Market ratio of a stock, adjusted by the industry median level. *Momentum* is the three-month cumulative stock returns. The regressors are lagged by one quarter. Other variables are defined in Table II. Standard errors are adjusted for heteroskedasticity and clustering at the stock level; t-statistics are reported in parentheses. Coefficients marked with ***, **, and * are significant at the 1%, 5%, and 10% level respectively.

Panel A. Univariate Results

	Sell Positions of ARS-Levered CEFs				Other Positions of ARS-Levered CEFs					
Variable	N	Mean	Median	Std Dev	N	Mean	Median	Std Dev	Diff	t-stat.
Log(Rspread)	2,456	-6.76	-7.04	0.99	5,956	-6.68	-6.94	0.97	-0.08***	(-3.32)
Log(Amihud)	2,452	-21.58	-22.22	2.93	5,947	-21.24	-21.73	2.86	-0.34***	(-4.87)
Size ($M)	2,441	8.23	8.34	2.30	5,911	8.00	8.00	2.22	0.23***	(4.14)
Market Beta	2,326	1.12	0.97	0.67	5,644	1.11	1.00	0.63	0.004	(0.23)
Liquidity Beta	2,326	0.02	0.00	0.22	5,644	0.026	0.011	0.211	-0.010*	(-1.85)
Idio. Volatility	2,451	2.22%	1.85%	1.39%	5,946	2.09%	1.75%	1.20%	0.14%***	(4.30)
Shrpct_CEF_ARS	2,457	0.55%	0.12%	1.34%	5,963	0.47%	0.13%	0.95%	0.08%***	(2.81)

Panel B. Multivariate Results

VARIABLES	(1) Sell	(2) Sell	(3) Sell
Lagged Liquidity	-0.122**		-0.155**
	(-2.19)		(-1.97)
Log (Size)		0.143**	-0.042
		(2.37)	(-0.67)
Market Beta	-0.022	0.014	-0.056
	(-0.44)	(0.28)	(-1.17)
Liquid Beta	-0.296**	-0.268**	-0.231*
	(-2.17)	(-2.01)	(-1.90)
Idio. Volatility	19.119***	17.786***	19.147***
	(6.08)	(6.29)	(6.92)
Shrpct_CEF_ARS	15.553**	14.025**	16.737**
	(2.20)	(2.10)	(2.32)
Adj. B/M Ratio	0.023	0.017	0.021
	(0.78)	(0.58)	(0.60)
Momentum	-0.001	-0.048	0.028
	(-0.00)	(-0.32)	(0.20)
NASDAQ Dummy	0.159*	0.136	0.176
	(1.86)	(1.48)	(1.63)
Constant	-16.960***	-16.249	-5.161***
	(-11.18)	(-3.50)	(-2.73)
Time Fixed Effects	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes
Observations	7,898	7,898	7,898
R-squared	0.0269	0.0252	0.0196

Table XI Robustness: Propensity Score Matching Method

Panel A of this table reports the univariate comparison of the stocks held by ARS-levered CEFs and the matched sample that is constructed using a propensity score matching method. I generate a one-to-one matching sample to the stocks held by ARS-levered CEFs based on the predicted propensity. The variables that used in the propensity score matching process include lagged liquidity, lagged market cap, lagged momentum, lagged B/M ratio, quarter dummies, and industry dummies. Panel B reports pooled OLS estimation results of Equation (6) with the Propensity Score Matched control sample. Variables are defined in Table II. Standard errors are adjusted for heteroskedasticity and clustering at the stock level; t-statistics are reported in parentheses. Coefficients marked with ***, **, and * are significant at the 1%, 5%, and 10% level respectively.

Panel A. Univariate Comparison

	Stocks held by ARS-Levered CEFs				Matched Sample				Diff. in	
Variable	N	Mean	Median	Std Dev	N	Mean	Median	Std Dev	Mean	t-stat.
Shrpct_CEF_ARS	4,065	0.46%	0.15%	1.00%	4,065	0.00%	0.00%	0.00%	0.46%***	(16.35)
Log(Rspread)	4,065	-6.43	-6.69	1.01	4,065	-6.70	1.09	-7.95	-0.04	(-0.90)
Log(Amihud)	4,065	-20.31	-20.59	2.81	4,065	-20.76	2.83	-25.30	-0.10	(-0.74)
Log(Size)	4,065	14.03	13.97	2.02	4,065	13.99	1.91	9.61	0.06	(0.55)
Momentum	4,065	-11.8%	-11.8%	25.4%	4,065	-11.0%	27.5%	-73.7%	-0.4%	(-0.50)
Adj. B/M Ratio	4,065	0.14	-0.04	0.87	4,065	-0.10	0.98	-0.99	-0.009	(-0.26)

Panel B. Multivariate Results

VARIABLES	(1) ΔLog(Rspread)	(2) ΔLog(Amihud)	(3) Daily Return (%)
Shrpct_CEF_ARS	2.44***	4.57***	-2.24***
	(4.35)	(5.30)	(-3.02)
Lagged Liquidity Level	-0.07***	-0.16***	0.09***
	(-8.39)	(-17.08)	(10.42)
Log (Size)	-0.03***	-0.23***	0.11***
	(-6.60)	(-17.92)	(9.46)
Market Beta	0.01	0.03**	0.03***
	(1.12)	(2.14)	(2.67)
Liquid Beta	0.05***	0.07**	0.09***
	(3.20)	(2.42)	(2.95)
NASDAQ Dummy	-0.02***	-0.02	0.03*
	(-2.81)	(-1.53)	(1.91)
Shrpct_Other	-0.02	-0.01	0.01
	(-1.60)	(-0.44)	(0.39)
Idio. Volatility	5.02***	6.06***	-3.51***
	(13.99)	(10.60)	(-4.50)
Constant	-0.13*	-0.23***	0.44***
	(-1.85)	(-2.84)	(4.53)
Time Fixed Effects	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes
Observations	7,584	7,584	7,584
R-squared	0.515	0.477	0.118

Table XII Robustness: Percentage Changes in Market Liquidity

This table repeats the analyses in Table III and reports pooled OLS estimation results of Equation (6), except using different dependent variables. The dependent variables used are percentage changes in relative spread in column (1) and percentage changes in Amihud ratio in column (2). *Shrpct_CEF_ARS* are the ownership of a stock by ARS-levered CEFs in the previous quarter-end. Other variables are defined in Table II. Standard errors are adjusted for heteroskedasticity and clustering at the stock level; t-statistics are reported in parentheses. Coefficients marked with ***, **, and * are significant at the 1%, 5%, and 10% level respectively.

VARIABLES	(1) % change in Rspread	(2) % change in Amihud Ratio
Shrpct_CEF_ARS	2.83***	5.12**
	(3.34)	(2.21)
Log (Size)	0.00	-0.09***
	(0.56)	(-10.27)
Market Beta	0.05***	0.25***
	(6.80)	(12.79)
Liquid Beta	0.05***	0.13***
	(3.05)	(2.92)
NASDAQ Dummy	-0.09***	-0.10***
	(-11.75)	(-4.22)
Shrpct_Other	0.01	0.06**
	(0.82)	(2.24)
Idio. Volatility	7.04***	20.16***
	(19.64)	(17.01)
Constant	-0.35***	0.89**
	(-7.67)	(2.07)
Time Fixed Effects	Yes	Yes
Industry Fixed Effects	Yes	Yes
Observations	10,134	10,133
R-squared	0.309	0.544

Appendix

This Appendix tabulates two sets of additional results for some of the empirical tests that are mentioned in paper.

A. Including International Equity Closed-End Funds

There are 52 international equity closed-end funds with some U.S. common stocks in their portfolios. Table IA.I reports the analyses of the spillover effects of the ARS market freeze by considering both domestic and international equity CEFs. Panel A of this table repeats the analyses in Table III; Panel B repeats the analyses in Table V; and Panel C repeats the analyses in Table XII.

B. Determinants of Closed-End Fund Leverage

In Table A.II, I examine the determinants of leverage of the U.S. closed-end funds industry over the period from 1994 to 2009. Specifically, I estimate a pooled OLS regression of the total leverage of 677 closed-end funds in U.S. with different fund objectives (i.e., domestic equity, municipal bond, taxable bond, international equity, and others CEFs) on lagged macro-economic variables and fund characteristics. Panel A reports the summary statistics of the characteristics of U.S. closed-end funds over the period from 1994 to 2009; Panel B reports the summary statistics of macro variables; Panel C reports the correlation matrix; Panel D reports the estimation results of the determinants of the leverage usage of U.S. CEFs.

Table A.I Spillover Effects of ARS Market Freeze: All Equity CEFs

Panel A of this table repeats the analyses in Table III; Panel B repeats the analyses in Table V; and Panel C repeats the analyses in Table XII, by considering both domestic and international equity CEFs. *Shrpct_CEF_ARS* is the ownership of a stock by ARS-levered domestic and international equity CEFs in the previous quarter-end. Other variables are defined in Table II. Standard errors are adjusted for heteroskedasticity and clustering at the stock level; t-statistics are reported in parentheses. Coefficients marked with ***, **, and * are significant at the 1%, 5%, and 10% level respectively.

Panel A. Spillover Effects of ARS Market Freeze: All Equity CEFs

	(1)	(2)	(3)
VARIABLES	ΔLog(Rspread)	ΔLog(Amihud)	Daily Return (%)
Shrpct_CEF_ARS	3.09***	4.40***	-2.39***
	(4.42)	(4.17)	(-3.85)
Lagged Liquidity Level	-0.10***	-0.22***	0.13***
	(-13.62)	(-26.32)	(18.96)
Log (Size)	-0.04***	-0.33***	0.19***
	(-12.29)	(-27.32)	(18.96)
Market Beta	0.03***	0.06***	-0.01
	(6.54)	(6.74)	(-1.02)
Liquid Beta	0.05***	0.05***	0.14***
	(4.80)	(2.65)	(6.28)
NASDAQ Dummy	-0.06***	-0.05***	0.07***
	(-10.45)	(-4.63)	(6.27)
Shrpct_Other	-0.00	0.01	0.01
	(-0.08)	(0.89)	(0.66)
Idio. Volatility	5.26***	5.37***	-2.44***
	(21.32)	(12.65)	(-4.21)
Constant	-0.37***	0.19***	0.26***
	(-9.65)	(2.95)	(3.73)
Time Fixed Effects	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes
Observations	10,134	10,133	10,133
R-squared	0.508	0.569	0.157

Panel B. Short- vs. Long-term Effects of the ARS Market Freeze: All Equity CEFs

VARIABLES	(1) 3-month Cum. Return	(2) 6-month Cum. Return	(3) 9-month Cum. Return	(4) 12-month Cum. Return
Shrpct_CEF_ARS	-1.28***	-0.88**	-0.67	0.09
	(-4.74)	(-1.99)	(-1.03)	(0.10)
Lagged Liquidity Level	0.06***	0.04***	0.02***	0.01*
	(17.93)	(8.80)	(3.48)	(1.76)
Log (Size)	0.08***	0.05***	0.02***	0.02**
	(17.10)	(8.56)	(3.24)	(1.96)
Market Beta	-0.02***	-0.04***	-0.05***	-0.04***
	(-3.78)	(-5.90)	(-7.24)	(-4.54)
Liquid Beta	0.04***	0.02	0.01	0.02
	(4.32)	(1.02)	(0.39)	(0.80)
NASDAQ Dummy	0.03***	0.04***	0.05***	0.04***
	(4.93)	(4.92)	(4.67)	(3.65)
Shrpct_Other	-0.00	0.00	0.00	0.01
	(-0.25)	(0.16)	(0.25)	(0.56)
Idio. Volatility	-2.97***	-3.56***	-3.36***	-2.27***
	(-13.95)	(-14.86)	(-11.22)	(-6.18)
Constant	0.30***	0.22***	0.56***	0.39***
	(10.35)	(5.50)	(11.70)	(6.96)
Time Fixed Effects	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes
Observations	10,089	9,941	9,797	9,676
R-squared	0.278	0.247	0.192	0.222

Panel C. Percentage Changes in Market Liquidity: All Equity CEFs

VARIABLES	(1) % change in Rspread	(2) % change in Amihud Ratio
Shrpct_CEF_ARS	2.61***	4.36**
	(3.10)	(2.04)
Log (Size)	0.00	-0.09***
	(0.54)	(-10.31)
Market Beta	0.05***	0.25***
	(6.80)	(12.77)
Liquid Beta	0.05***	0.13***
	(3.05)	(2.91)
NASDAQ Dummy	-0.09***	-0.10***
	(-11.76)	(-4.23)
Shrpct_Other	0.01	0.06**
	(0.81)	(2.23)
Idio. Volatility	7.04***	20.16***
	(19.61)	(17.01)
Constant	-0.35***	0.90**
	(-7.66)	(2.08)
Time Fixed Effects	Yes	Yes
Industry Fixed Effects	Yes	Yes
Observations	10,134	10,133
R-squared	0.309	0.544

Table A.II Determinants of Closed-End Fund Leverage

Panel A of this table reports the summary statistics of the characteristics of U.S. closed-end funds over the period from 1994 to 2009. *Dividend Yield* is the difference of the quarterly cumulative fund stock returns with and without dividends. *Age* is the number of years since a CEF first appears in CRSP. *Fund Return* is the quarterly cumulative CEF stock returns. *Top Family* is the indicator of the CEFs which belong to the top five CEFs families, BlackRock, Nuveen, Invesco Van Kampen, Eaton Vance, and Western Asset. *Expense Ratio* is defined as Selling, General & Administrative Expense (SG&A) over Total Common Equity. Other variables are defined in Table II. Panel B reports the summary statistics of macro variables. *Term Spread* is the quarterly average of the difference between the rates of US treasures with 20 year and 3month horizons. *VIX* is the quarterly average of the VIX index from Chicago Board Option Exchange. *VWRETD* is the quarterly cumulated value-weighted CRSP stock index return. *CRSP Dividend Yield* is the difference of the quarterly cumulative value weighted CRSP index returns with and without dividends. Panel C reports the correlation matrix. Panel D reports the estimation results of the determinants of the leverage ratio of U.S. closed-end funds over the period from 1994 to 2009. Standard errors are adjusted for heteroskedasticity and clustering at the fund level; t-statistics are reported in parentheses. Coefficients marked with ***, **, and * are significant at the 1%, 5%, and 10% level respectively.

Panel A. Summary Statistics of CEF Characteristics

	Market Cap.	Total Assets	Age	Leverage-total	Leverage-ARS	Leverage-other	Expense Ratio	Top Family	Dividend Yield	Fund Return
Full Sample (N=677)										
Mean	266.2	399.9	9.8	23.4%	16.6%	6.8%	0.34%	0.50	1.70%	1.9%
Median	161.0	225.6	8.6	31.0%	15.4%	1.7%	0.31%	1	1.60%	2.1%
Std.	316.8	1,724.1	6.6	16.1%	16.7%	10.4%	0.15%	0.50	0.92%	9.4%
1% Percentile	15.3	21.9	0.7	0.1%	0.0%	0.0%	0.09%	0	0.00%	-27.8%
99% Percentile	1,756.0	2,442.1	33.3	50.4%	41.6%	44.0%	1.09%	1	5.45%	33.0%
Divided by Fund Objectives										
Domestic Equity *(N=109)*										
Mean	392.2	510.3	10.0	17.8%	10.0%	7.6%	0.40%	0.11	1.91%	1.8%
Median	178.2	238.1	7.9	14.5%	0.0%	2.0%	0.33%	0	2.00%	2.1%
International Equity *(N=87)*										
Mean	241.6	299.5	10.4	7.2%	2.4%	4.8%	0.47%	0.05	0.93%	2.6%
Median	141.1	174.4	10.3	1.7%	0.0%	1.4%	0.45%	0	0.00%	2.6%
Municipal Bond (N=295)										
Mean	213.3	367.8	8.6	29.9%	27.4%	2.6%	0.30%	0.82	1.50%	1.7%
Median	144.9	219.8	7.8	34.8%	32.9%	0.8%	0.30%	1	1.50%	1.9%
Taxable Bond (N=139)										
Mean	294.3	430.5	11.9	22.4%	6.6%	15.7%	0.30%	0.33	2.29%	1.7%
Median	197.8	253.9	9.6	26.2%	0.0%	13.5%	0.28%	0	2.17%	2.2%
Others (N=47)										
Mean	373.5	512.5	10.3	18.2%	4.7%	13.5%	0.36%	0.25	2.27%	2.2%
Median	178.6	236.3	9.3	19.8%	0.0%	8.4%	0.34%	0	2.17%	2.4%

Panel B. Summary Statistics of Macro variables

Variable	N	Mean	Median	Std Dev	Minimum	Maximum
Term Spread	64	2.02%	1.77%	1.38%	-0.31%	4.26%
VIX	64	20.8	20.3	8.4	11.0	58.6
VWRETD	64	2.26%	2.56%	9.19%	-23.82%	21.29%
CRSP Dividend Yield	64	0.47%	0.46%	0.12%	0.26%	0.74%

Panel C. Correlation Matrix

	Leverage-total	Leverage -ARS	Leverage- other	Expense Ratio	Dividend Yield	Market Cap.	Total Assets	Age	Fund Return	Term Spread	VIX Index	CRSP Div. Yield	CRSP VWRET
Leverage-total	1												
Leverage -ARS	0.79	1											
	0.0%												
Leverage- other	0.27	-0.37	1										
	0.0%	0.0%											
Expense Ratio	-0.32	-0.32	0.01	1									
	0.0%	0.0%	14.6%										
Dividend Yield	0.13	-0.06	0.28	-0.14	1								
	0.0%	0.0%	0.0%	0.0%									
Market Cap.	-0.02	-0.06	0.07	-0.14	0.10	1							
	0.1%	0.0%	0.0%	0.0%	0.0%								
Total Assets	0.02	0.004	0.03	-0.05	0.02	0.25	1						
	0.0%	47.8%	0.0%	0.0%	0.0%	0.0%							
Age	-0.24	-0.21	-0.03	0.07	-0.08	0.02	0.001	1					
	0.0%	0.0%	0.0%	0.0%	0.0%	0.7%	88.8%						
Fund Return	-0.04	-0.04	-0.01	-0.08	0.12	0.01	0.01	0.01	1				
	0.0%	0.0%	17.9%	0.0%	0.0%	2.4%	36.8%	31.1%					
Term Spread	0.07	0.06	0.02	0.01	0.07	-0.06	-0.02	0.07	0.09	1			
	0.0%	0.0%	0.1%	14.1%	0.0%	0.0%	0.0%	0.0%	0.0%				
VIX Index	0.01	-0.04	0.08	0.07	0.13	-0.08	-0.03	0.10	0.17	0.38	1		
	23.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			
CRSP Div. Yield	0.07	0.04	0.05	-0.06	0.04	0.01	0.01	0.002	0.15	0.27	0.01	1	
	0.0%	0.0%	0.0%	0.0%	0.0%	1.6%	27.4%	73.4%	0.0%	0.0%	1.7%		
CRSP VWRET	-0.05	-0.03	-0.04	-0.05	-0.10	0.03	0.004	-0.06	0.01	-0.03	-0.41	0.27	1
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	56.0%	0.0%	3.5%	0.0%	0.0%	0.0%	

Panel D. Determinants of CEF Leverage Usage

VARIABLES	(1) Leverage_total	(2) Leverage_total	(3) Leverage_total
Fund Characteristics			
Log (Market Cap.)	-0.017***	-0.002	-0.001
	(-3.524)	(-0.397)	(-0.287)
Log(Age)	-0.033***	-0.039***	-0.027***
	(-6.293)	(-8.356)	(-6.130)
Expense Ratio	-32.976***	-2.040	-7.346
	(-7.254)	(-0.452)	(-1.566)
Top Fund Family	0.060***	-0.004	0.006
	(5.413)	(-0.336)	(0.509)
Dividend (Lagged)	1.827***	1.875***	1.817***
	(4.653)	(4.807)	(5.158)
Cumulative Ret.	-0.088***	-0.032***	-0.097***
	(-7.951)	(-2.806)	(-9.550)
Fund Objectives			
Domestic Equity		0.068***	0.074***
		(3.534)	(3.876)
Taxable Bond		0.127***	0.114***
		(7.061)	(6.243)
Municipal Bond		0.210***	0.192***
		(12.453)	(11.279)
Others		0.080***	0.074***
		(3.840)	(3.473)
Macro Variables			
Term Spread (Lagged)			0.562***
			(5.351)
Log(VIX) (Lagged)			-0.014***
			(-3.655)
Dividend Yield (Lagged)			10.073***
			(6.992)
CRSP VW Ret. (Lagged)			-0.139***
			(-12.603)
Constant	0.153***	-0.205***	0.139***
	(5.051)	(-5.394)	(3.546)
Quarter Fixed Effects	Yes	Yes	No
Cluster at Fund Level	Yes	Yes	Yes
Observations	27,063	27,063	27,051
R-squared	0.251	0.347	0.276
Additional Tests			
Taxable Bond-Domestic Equity		0.059***	0.040**
Municipal Bond-Domestic Equity		0.142***	0.118***
Municipal Bond-Taxable Bond		0.083***	0.078***