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Global Liquidity Provision and Risk Sharing

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Abstract

We examine liquidity-related characteristics of U.S. firms with cross-listed shares in 20 foreign markets in the 1950-2013 period. We find that firms after foreign market listing exhibit lower liquidity sensitivity, lower liquidity beta, and suffer less from transitory price shocks. These results are stronger when firms are listed on multiple exchanges, in larger and more liquid markets. The liquidity enhancement is associated with firms' increased foreign ownership post-listing and is effective for firms with high levels of volatility, foreign income, foreign trading, and PIN. Our findings provide support for global markets providing liquidity and reducing liquidity risk to U.S. firms.

JEL classifications: G11; G14; G15

Keywords: Foreign holdings; Funding liquidity; Difference-in-difference; Market segmentation

I. Introduction

During the financial crisis of 2007-2009, many segments of financial markets experienced a sharp decline in liquidity. Market illiquidity could result from funding illiquidity during market downturns (Khandani and Lo (2007), Brunnermeier and Pedersen (2008), Aragon and Strahan (2012), and Ben-David, Franzoni, and Moussawi (2012)).[1] For instance, due to a sharp market decline, speculators may risk hitting their margin constraints and thus be forced to liquidate their assets. Furthermore, tighter risk management by financial intermediaries in response to higher volatility reduces their borrowing capability and restricts dealers from providing market liquidity (Hameed, Kang, and Viswanathan (2010) and Nagel (2012)). Therefore, funding liquidity, market liquidity, and their interaction are important concerns for many investors. However, while the causal impact of funding liquidity on market liquidity in U.S. markets has received much scholarly attention, little is known about how funding liquidity influences market liquidity in an international context.

In the international context, the impact of funding liquidity on market liquidity is not straightforward (Gromb and Vayanos (2002)). For example, consider a domestic market and a foreign market, both of which face funding constraints. On the one hand, after a significant negative shock in the foreign market, foreign intermediaries may reach their margin limits in their own markets and need to liquidate their holdings in the domestic market as well. In this case, international investors act as *net liquidity demanders* by intensifying the selling pressure in the domestic market during the foreign market downturn. On the other hand, international investors could also behave as *net liquidity suppliers* by providing liquidity to the domestic market during its downturns.[2]

[1] An asset's market liquidity is defined as "the ease with which it is traded" and the trader's funding liquidity means "the ease with which traders can obtain funding" (Brunnermeier and Pedersen, 2008, p. 2201).

[2] Garleanu and Pedersen (2011) derive a consumption CAPM augmented by a security's margin times the general funding cost. Their model suggests a considerable funding risk premium for a stock if its margin requirements deteriorate during market declines. Furthermore, Brunnermeier and Pedersen's (2008) theoretical model links the market liquidity to funding liquidity by highlighting that the two can mutually reinforce each other and lead to liquidity spirals. Overall, the theoretical results of the aforementioned studies call for a better understanding of the issue of how market liquidity and funding liquidity risk interact in international settings.

The latter scenario is possible through two plausible, yet not mutually exclusive channels: ownership dispersion and liquidity provision. During the U.S. market turmoil in the example, capital constraints become binding, and U.S. investors may be obliged to liquidate their holdings. Meanwhile, as the funding constraints of foreign shareholders remain relatively intact, there is a lower liquidation demand from these investors. The *dispersed ownership* structure helps to decrease a firm's liquidity sensitivity to domestic market downturns. This channel can be attributed to the diversified demand for liquidity. In the *liquidity provision* channel, a lack of funding liquidity in the U.S. market can drive asset prices away from their fundamental values. Foreign arbitrageurs, unaffected by the aforementioned tightening of U.S. funding constraints, may take advantage of arbitrage opportunities by buying U.S. equities. This channel facilitates an increase in the supply of liquidity. While there is substantial evidence of commonality in liquidity around the world, the aggregate liquidity at a given exchange is only partially driven by a global commonality component (Brockman, Chung, and Perignon (2009) and Karolyi, Lee, and Van Dijk (2012)).[3] Therefore, the equilibrium effect of international markets on liquidity remains unclear.

In order to provide insight on the impact of international funding liquidity on the U.S. markets, we examine whether the cross-listing of U.S. companies on foreign exchanges leads to improved or degraded liquidity characteristics (e.g., liquidity sensitivity to lagged market returns, liquidity betas) for those firms during U.S. market declines. We use a sample of U.S. firms cross-listed in 20 foreign markets since 1901, with the return and liquidity data covering the 1950 to 2013 period. This setting provides several advantages. First, a cross-listing event by a U.S. company delivers a unique shock to its ownership structure, in which the holdings ratio by foreign investors in the firm significantly increases after it is listed on an overseas exchange. Second, using cross-listings provides a better understanding of how pools of different investors with dissimilar margin constraints across international markets (e.g., Beber and Pagano (2013))

[3] Kamara, Lou, and Sadka (2008) show that, for the cross-section of U.S. stocks, the commonality in liquidity has even decreased over time.

affect the liquidity of two almost identical (in the time series or cross-section) U.S. firms. The only difference between the two firms is that one is traded globally, and the other is not. This helps to better isolate the liquidity effects from other possible factors. Third, in our sample period, the U.S. firms we examined placed their shares in 20 markets around the world, without a clear dominance of any one market.[4] This finding enables us to test our main relations in a variety of foreign market environments.[5] Fourth and last, our focus on the U.S. as a domestic market allows us to work with a much longer time period than if we were dealing with other markets. Our gain is determined by both the availability of stock return-based data and, more importantly, the possibility of using longer and more precise time-series measure of liquidity – the Amihud (2002) liquidity measure (see Goyenko, Holden, and Trzcinka (2009)).[6] Our rich U.S. dataset also allows us to look deeper into the impact of firm characteristics on the propensity of international markets to shield liquidity drains.

Our results are as follows. First, we find that global markets can significantly lower the liquidity sensitivity of U.S. firms in response to past U.S. market returns. In line with the findings of Hameed et al. (2010), the liquidity of U.S. firms listed only at home significantly dries up in bear markets, while the negative U.S. market return leads to a considerably smaller reduction in liquidity among U.S. firms following the first placement of their stocks abroad. This pattern also holds after the inclusion of various firm-level controls, and we obtain similar results for two equal sub-periods: 1950-1981 and 1982-2013. Moreover, in poor U.S. market conditions as determined by the above-median values of U.S. market volatility, the TED spread, and the VIX index, the positive liquidity effect of cross-listings mitigates the reduction in liquidity resulting from the domestic market downturn. However, in good market conditions, the cross-listing has an opposite, but much smaller effect on firm liquidity. This decrease in liquidity

[4] Note that certain foreign markets become more attractive for cross-listings during specific time periods (Sarkissian and Schill, 2016).
[5] As shown by Fernandes and Ferreira (2008), cross-listings improve price informativeness and, therefore, potentially provide stock liquidity only for firms from developed markets.
[6] We also perform our main tests with Corwin and Schultz's (2012) illiquidity measure, but achieve similar results (see the Internet Appendix).

sensitivity is not observed in a comparable sample of matched firms without foreign-traded shares. We show that cross-listing benefits for firm liquidity are particularly strong when firms are listed on multiple stock exchanges, as well as when they list in larger and more liquid markets. At the firm level, the additional liquidity provision induced by cross-listings is also higher for firms with high return volatility, high foreign income, high probability of informed trading (PIN), and high foreign trading volume.

The decrease in liquidity sensitivity of cross-listed firms to the lagged U.S. market returns coincides with the cross-listing event and persists afterwards. These findings are robust to a variety of alternative estimations, including using a bid-ask spread as a measure of liquidity instead of the Amihud liquidity measure and an extended set of control variables with non-linear return terms. Our results are also free from the Heckman's (1979) sample selection bias. In addition, we refute an alternative explanation that the decrease in liquidity sensitivity results from an increase in firm size associated with cross-listing, rather than the listing event itself. In contrast, we find that negative tendencies in international markets induce very little change in the liquidity sensitivity of U.S. firms, both cross-listed and traded only on U.S. exchanges.

Second, using the liquidity CAPM of Acharya and Pedersen (2005), we estimate the impact of cross-listings on three liquidity betas of U.S. firms: liquidity sensitivity to the market return, market liquidity, and return sensitivity to market liquidity. The results show that the liquidity beta based on the sensitivity of firm liquidity to its domestic market return is significantly lower after cross-listing on foreign stock exchanges. The average decrease in this beta after cross-listing is 0.29.

Third, we test the two channels through which a cross-listing can reduce a firm's liquidity sensitivity to U.S. market returns. First, to reflect the existence of the ownership dispersion channel, we show that, following the listing of U.S. firms on overseas exchanges, the liquidity gains among these firms are associated with a 50% increase in ownership by foreign investors. Second, in line with the liquidity provision channel, if foreign arbitrageurs buy U.S. equities when their valuation deviates from their fundamental values, cross-listed firms would suffer less from transitory price shocks, and experience weaker return reversals than comparable firms without foreign presence. In this respect, we expect a greater decrease in temporary price deviations for cross-listed firms relative to their respective pre-listing periods, as compared to their domestically listed counterparts. Using Nagel's (2012) liquidity provision framework, we find that cross-listed firms indeed suffer less from negative domestic market shocks. The reduction in the magnitude of weekly return reversals for these firms is 3.5 times larger than that for similar firms without cross-listings. This reduction is particularly strong during recessions, which is the most critical time for investors. The reduction in return reversals is also larger for firms listed on multiple foreign exchanges, and in markets with high liquidity and market capitalization, as well as for firms with high PIN, volatility, and foreign income.

Our results underscore the essential role of international markets in supplying liquidity to U.S. firms and the U.S. equity market. Liquidity has been widely understood as an important determinant of asset returns. For instance, Pastor and Stambaugh (2003), Liu (2006), Bekaert, Harvey, and Lundblad (2007), and Korajczyk and Sadka (2008) find that liquidity is a priced factor. Accordingly, many previous studies focus on the impact of U.S. equity and debt markets on the stock market liquidity in foreign countries (Levine and Schmukler (2006), Lee (2011), and Goyenko and Sarkissian (2014)). However, there is little research on the other side of the relation. Moreover, considering that, even in 2012, foreign-owned U.S. long-term securities reached over $13.2 trillion, the effect of international market funding liquidity on U.S. market liquidity cannot be neglected.[7] Furthermore, although several studies examine cross-listings affect firm liquidity (e.g., Domowitz, Glen, and Madhavan (1998), Bailey, Karolyi, and Salva (2006), Chung (2006), and Baruch, Karolyi, and Lemmon (2007)), they only analyze changes in the liquidity of foreign firms listed in the U.S., without any risk-return implications. By contrast, we use the cross-listing universe as a natural setting that delivers unique shocks to firms' foreign ownership structure. In addition, we assume that cross-listing can provide a better understanding of liquidity provision and risk sharing in global markets in relative isolation from the influences

[7] http://www.treasury.gov/resource-center/data-chart-center/tic/Documents/shla2012r.pdf.

of other possible cross-country linkages and frictions. Our results show that cross-listing not only improves firm liquidity, but also has a positive impact on the firm's risk structure and return dynamics.

The rest of the paper is organized as follows. In Section II, we describe cross-listing, stock return data, and our liquidity measure. In Section III, we report our main results on the effect of cross-listings on liquidity sensitivity and liquidity betas of U.S. firms. In Section IV, we analyze the impact of various foreign market and firm characteristics on our results. In Section V, we highlight the importance of global stock ownership on the liquidity sensitivity of U.S. firms. In Section VI, we estimate the effect of liquidity provision on short-term stock return reversals. We draw conclusions in Section VII. The results of an array of robustness tests are in the Internet Appendix.

II. Data

Our study period is from 1950 to 2013. However, the cross-listing sample is from 1901 to 2012.[8] This sample comes from several sources. Most of the data are from the Sarkissian and Schill public database, which provides the geography of foreign listings from the 1900s until 2006.[9] These data are supplemented by the listing information from more recent years obtained directly from the main stock exchanges around the world, as well as from CRSP. Our sample contains only cross-listed U.S. firms with an identifiable permanent number (permno) in CRSP. The first identified cross-listing by a U.S. firm was in 1901 by the USX Marathon Group, and it was placed on the Amsterdam Stock Exchange in the Netherlands. Our sample includes a total of 293 firms with 570 cross-listings spanning 20 foreign markets; the stocks of 105 firms are traded in more than one foreign exchange.

Table 1 shows the distribution of the cross-listings of U.S. firms across individual

[8] We intentionally made our cross-listing sample shorter by one year than our overall sample. Since we aim to examine the liquidity risk sharing effects that arise from the cross-listing, for each listing event, we need at least some observations occurring after the listing. Given that our goal is to test what happens after U.S. firms list abroad, the stock return and liquidity information in 2013 can be essential for the firms listed in 2012.

[9] See http://sergei-sarkissian.com/data.html.

countries and decades. The largest number of foreign listing placements by U.S. firms was in the 1980s (180), with almost a third being in Japan (65). This is almost twice the second largest number over the 1990s and 2000s. Note that the country representation is more concentrated in the earlier part of our sample period. Before 1950 and in the 1960s, U.S. firms were listed only in six countries, with 75 listings occurring in Europe and only one in Canada. Yet, in the 2000s, U.S. firms were present in 16 foreign markets, with Canada becoming the preferred choice for listing. The recent presence of U.S. firms in foreign exchanges is more dispersed across countries than even during the 1980s, when they were only in 10 foreign exchanges.

We obtain U.S. stock return and turnover data from the CRSP daily stock dataset for the 1950 to 2013 period. We then construct the liquidity measure based on Amihud (2002). The Amihud liquidity is based on the price impact and is computed as follows: $-\log((10^6 \times |R_t|)/(PRC_t \times Vol_t))$, where PRC_t is the closing price of the stock, $|R_t|$ is the absolute value of stock return, and Vol_t is the trading volume at time t. The liquidity is then aggregated at monthly frequency.[10]

Table 2 reports the means, standard deviations, and number of observations of stock returns, turnover, and liquidity of U.S. firms cross-listed in each foreign market. We consider only the market of the first firm cross-listing. The return is the annualized daily holding period return including dividends. The turnover is the percentage of the daily trading volume out of the total shares outstanding. All variables are winsorized at 1% and 99%. The grand mean return across all cross-listed firms is 16% annually. The top five foreign markets with the best U.S. firm performance are Brazil, Hong Kong, Austria, Israel, and Canada (median annual return of 28%), while the bottom five markets are Sweden, Belgium, the Netherlands, Switzerland, and Germany (median annual return of 14%). The average share turnover rate of cross-listed U.S. firms is 40%, with those traded in Hong Kong and Australia exceeding 100%. Conversely, the firms listed in the historically more established overseas exchanges like Austria, Belgium, and the Netherlands, along with one firm placed in Brazil, have a turnover of only about 30% or below.

[10] The aggregated monthly liquidity series is the average of the (logged) daily measures in each month.

Finally, the firms with higher liquidity are cross-listed first in countries such as Belgium, Hong Kong, the Netherlands, Switzerland, and, surprisingly, Chile, while less liquid U.S. firms are listed in Austria, Brazil, Canada, Israel, and Sweden.[11] In line with our expectation, with over two million daily observations for all three of our variables (returns, turnover, and liquidity), their average number of observations vary greatly across markets. For instance, U.S. firms in the Netherlands have the highest number of data entries, while all observations in Brazil come from only one firm.

III. Liquidity and Past Returns

In this section, we develop our empirical methodology and conduct the main tests on the impact of cross-listing on two liquidity characteristics of U.S. firms – their liquidity sensitivity to past returns and liquidity betas. We also discuss an alternative explanation for our results.

A. Empirical Methodology

In this section, we investigate the relation between asset liquidity and past returns before and after listing abroad. We start by aggregating the daily Amihud liquidity measure for each stock to the average monthly Amihud liquidity, $LIQ_{i,t}$. We remove the firm from the sample if there are fewer than 15 observations in a month. We then compute the percentage change in liquidity, $\Delta LIQ_{i,t}$, as follows: $(LIQ_{i,t} - LIQ_{i,t\text{-}1})/|LIQ_{i,t\text{-}1}|$. Since our task is to evaluate the effects of lagged market returns on U.S. firm liquidity before and after cross-listing, we introduce a cross-listing dummy, $CL_{i,t}$, which equals one if the stock of firm i is listed in a foreign market at time t, and zero otherwise.

Since global financial markets are susceptible to various spillover effects that can impact asset liquidity, we also include domestic and foreign market returns — $R_{US,t}$ and $R_{IN,t}$, respectively — as additional explanatory variables. For the U.S. market return, we use the CRSP

[11] The negative sign on the liquidity measure in Brazil is due to a very low trading volume of only one U.S. cross-listed company in that country.

total return index. However, computing the corresponding return in foreign markets is not straightforward. Considering that, along with cross-listing in different foreign markets, each firm can also place its shares simultaneously in various markets; thus, there is no readily available proxy for returns in foreign markets. Furthermore, the set of host markets for U.S. firms can change. For example, Apple Inc. listed in Japan in the 1990s, while American Express Inc. listed in the United Kingdom in the 1970s; both companies later listed in Germany in 1992 and 1993, respectively. Ideally, each U.S. firm i at a particular date t should have its distinct $R_{IN,t}$ based on the geography of its cross-listings at that time. Following this logic, and considering the complex nature of cross-listing, we construct the foreign market return variable, $R_{IN,t}$, as follows. Once a U.S. firm is cross-listed, the foreign market return is defined as the equally-weighted average of the MSCI country index return for all host markets at time t.[12] For instance, $R_{IN,t}$ for Apple Inc. is the MSCI Japan index return from September 1990 to October 1992. After October 1992, Apple Inc.'s $R_{IN,t}$ is the average of the MSCI Japan index return and the MSCI Germany index return. In this way, the foreign market return has different values for each firm.

Our regression framework is a modified version of the framework proposed by Hameed et al. (2010). Instead of using individual regressions for each firm, we use panel regressions with clustered standard errors.[13] The regression model relates the change in assets liquidity, $\Delta LIQ_{i,t}$, to the aforementioned variables:

$$\begin{aligned}\Delta LIQ_{i,t} = \alpha + \beta_1 R_{i.t-1} + \beta_2 R_{US,t-1} + \beta_3 R_{IN,t-1} + \varphi CL_{i,t} + \gamma CL_{i,t} \times R_{US,t-1} + \\ + \lambda CL_{i,t} \times R_{IN,t-1} + FirmControls_{i,t-1} + MarketControls_{i,t-1} \\ + FirmFE_i + \varepsilon_{i,t}\end{aligned} \quad . \qquad (1)$$

Coefficients β_1 and β_2 measure how firm liquidity is affected by its own lagged return and the lagged U.S. market return, respectively. In Model (1), we employ cross-market interactions, which differs from models used in previous studies. Such effects are captured by the slope

[12] Before a U.S. firm is cross-listed, to avoid any drastic change to the foreign market return variable, we define the foreign market return as the MSCI country index return of the firm's first foreign market.
[13] We also run time-series regressions for each firm (see the Internet Appendix).

coefficient, β_3. A positive β_3 implies that a contagious spillover effect on U.S. firms arises from equity market returns in foreign countries.

Another important modification from earlier work is that we focus on the changes that occur between the pre- and post-cross-listing periods, which are captured by parameters γ and λ, respectively. A negative γ implies that, after cross-listing, the U.S. market decline (rise) causes a firm's liquidity to deteriorate (improve) less than in the period before its listing on an overseas exchange. Therefore, in the case of U.S. market downturns, international market participants act as net liquidity suppliers by providing liquidity to the U.S. market during its own downturns. Conversely, a positive λ suggests that, after cross-listing, a U.S. firm's liquidity becomes more vulnerable to foreign market shocks, and that international investors could act as net liquidity demanders by intensifying the selling pressure in the U.S. when foreign markets decline.

Model (1) includes two sets of control variables. The first set contains two firm-specific characteristics: (1) the lagged changes in firm volatility, $\Delta\sigma_{i,t\text{-}1}$, and (2) the turnover of its shares, $\Delta STOV_{i,t\text{-}1}$. Hameed et al. (2010) also use these control variables and they are supported by other market microstructure studies (e.g., Amihud and Mendelson (1986), and Chordia, Roll, and Subrahmanyam (2000)). The second set of control variables includes the same two variables estimated at the market level for the U.S. and other countries. These include the lagged changes in the aggregate market volatility in the U.S., $\Delta\sigma_{US,t\text{-}1}$, and the turnover of its shares, $\Delta STOV_{US,t\text{-}1}$, as well as in international market volatility, $\Delta\sigma_{IN,t\text{-}1}$, and the turnover of its shares, $\Delta STOV_{IN,t\text{-}1}$. The U.S. market volatility is the monthly standard deviation of the CRSP total market index returns. The international market volatility is the standard deviation of monthly foreign market returns. The aggregate U.S. market turnover is the equally-weighted share turnover of all firms listed on the NYSE and NASDAQ. For each U.S. firm *i*, the aggregate international market turnover is the equally-weighted share turnover of all firms with the same host market as that of firm *i*.

B. Impact of Cross-Listing on Firm Liquidity

Table 3 reports the panel estimation results for various specifications of Model (1),[14] Panel A reports the results for the overall market conditions. Regressions (1)-(6) report the results of the full sample. Regression (1) contains only the first three independent variables in Model (1), that is, the lagged firm, the U.S. market, and international market returns, $R_{i,t\text{-}1}$, $R_{US,t\text{-}1}$ and $R_{IN,t\text{-}1}$, respectively. In line with Hameed et al. (2010), we find positive and highly significant relations between a firm's liquidity and both its own return and the domestic market return, which implies a liquidity squeeze (enhancement) in poor (favorable) firm or U.S. market conditions. However, we find no significant relation between U.S. firm liquidity and foreign market returns, which suggests that international markets exert little influence on U.S. firms.

In Regression (2), we add the cross-listing dummy, $CL_{i,t}$, and two interaction terms, $CL_{i,t} \times R_{US,t\text{-}1}$ and $CL_{i,t} \times R_{IN,t\text{-}1}$. The coefficient on $CL_{i,t}$ is insignificant.[15] More importantly, we find that one of our main coefficients of interest that shows the impact of the $CL_{i,t} \times R_{US,t\text{-}1}$ term on firm liquidity, is negative and significant at the 1% level. This suggests that, during negative (positive) U.S. market performance, the liquidity of U.S. firms cross-listed in foreign markets decreases (increases) less than when those firms are listed only on U.S. exchanges. However, another coefficient of interest on the $CL_{i,t} \times R_{IN,t\text{-}1}$ term is not significant, implying that negative overseas market returns do not diminish a cross-listed U.S. firm's liquidity.[16]

In Regressions (3)-(4), we include the two firm-level controls: changes in stock volatility and turnover, as well as add four market-level control variables: changes in the U.S. and international market volatilities and turnover. Consistent with previous findings (Benston and

[14] Note that the firm fixed effects for 27 U.S. firms listed overseas before 1950 coincide with their cross-listing dummies, and, therefore, for these firms the non-interactive $CL_{i,t}$ terms are dropped in estimations. However, the interactive terms, $CL_{i,t} \times R_{US,t-1}$ and $CL_{i,t} \times R_{IN,t-1}$, are still properly estimated. The exclusion of these pre-1950 cross-listings does not materially affect our findings. These results are available on request.

[15] An insignificant coefficient on $CL_{i,t}$ is not unexpected. There is mixed evidence of liquidity benefits of cross-listing, even for listings placed in the United States, which is the most liquid financial market. Some studies find an increase in the trading volume and a reduction in bid-ask spreads of cross-listed stocks (e.g., Mittoo, 1997; Foerster and Karolyi, 1999, while others find either a decrease in domestic liquidity or no significant effect, which is often explained by the partial trading flow migration (e.g., Domowitz, Glen, and Madhavan, 1998; Levine and Schmukler, 2006). Therefore, finding no effect of cross-listing on the *level* of domestic liquidity of U.S. firms placed abroad is consistent with the literature.

[16] In unreported tests (available upon request), we find some limited evidence that, during major foreign crises, the spillover of global funding shocks increases to the U.S. firms cross-listed only in the troubled regions.

Hagerman (1974), Amihud and Mendelson (1986), and Chordia, Roll, and Subrahmanyam (2000)), we find that the lagged changes in both firm volatility and individual share turnover are significant drivers of a firm's liquidity. Specifically, both increases in volatility and decreases in share turnover appear to reduce firm liquidity. The inclusion of market-level controls further demonstrates that only changes in aggregate volatility of the U.S. market have a statistically important linkage to firm liquidity. Importantly, the inclusion of all these controls does not qualitatively change our conclusions with respect to coefficients on $CL_{i,t} \times R_{US,t-1}$ and $CL_{i,t} \times R_{IN,t-1}$. We again see that, after cross-listing, U.S. firms experience a much lower decrease (increase) in liquidity during domestic market declines (rises), while it is unaffected when return shocks hit international markets. Interestingly, firm-level controls significantly increase the overall explanatory power of the regression: the adjusted R-squared increases from 1.5% in Regressions (1)-(2) to 22% in Regression (3). The inclusion of market-level controls has hardly any effect on the R-squared.

Hameed et al. (2010) document that liquidity reacts asymmetrically to positive and negative lagged returns: the decline in liquidity in response to negative returns is stronger than the improvement in liquidity when returns are positive. Therefore, in Regressions (5)-(6), we modify Model (1) to do piecewise linear estimations. In Regression (5), we allow firm liquidity to react asymmetrically to prior losses and gains. In this specification, $Down_{t-1}$ is a dummy variable that equals one for negative lagged returns, and zero otherwise. We find that the coefficient on the interactive term $Down_{t-1} \times CL \times R_{US,t-1}$ is -0.157, statistically significant at the 5% level. However, the coefficient on $CL \times R_{US,t-1}$ is only -0.084. This implies that cross-listings provide more liquidity benefits to U.S. firms when their returns are negative. In Regression (6), we conduct a separate estimation of liquidity sensitivity for the small and large declines. In this specification, $DownL_{t-1}$ ($DownS_{t-1}$) equals one if and only if the lagged return is below (above) the median of its negative returns.[17] Importantly, the coefficient on $DownL_{t-1} \times CL \times R_{US,t-1}$ (-0.175)

[17] Regressions (5)-(6) also include the corresponding *Down*, *DownS*, and *DownL* dummies, as well as their respective interactive terms with $R_{IN,t-1}$, but their estimates (all insignificant) are not shown.

is 90% greater in magnitude than that on $DownS_{t\text{-}1}{\times}CL{\times}R_{US,t\text{-}1}$ (-0.091). Therefore, we can infer that the liquidity provision benefit of cross-listings for U.S. firms is particularly effective when stocks incur large losses.

Finally, Regressions (7) and (8) estimate Model (1) for two sub-periods, 1950 to 1981 and 1982 to 2013, respectively. The results show that the patterns observed in the overall data sample also hold in the two subsamples. Importantly, we find no reduction in the economic or statistical significance of the coefficient on $CL_{i,t} \times R_{US,t\text{-}1}$ between the two sub-periods.

It is also important to compare coefficients β_2 and γ, that is, the slopes on $R_{US,t\text{-}1}$ and $CL_{i,t} \times R_{US,t\text{-}1}$ terms. The F-test results in Table 3 show that the sum of these two coefficients is zero. For the full sample, $\beta_2 + \gamma$ is statistically indistinguishable from zero in Regressions (2)-(4), implying that the liquidity provision by international markets effectively offsets the reduction in firm liquidity due to the declines in U.S. markets. Furthermore, for the 1982 to 2013 sub-period, the sum of β_2 and γ is also statistically zero, indicating that, in more globalized financial markets, cross-listed U.S. firms achieve a higher reduction in liquidity risk.

Next, we re-estimate Model (1) for different levels of U.S. market uncertainty and propensity for liquidity dry-outs, which are proxied by three measures: (1) stock market volatility, (2) TED spread, and (3) VIX (e.g., Chordia, Sarkar, and Subrahmanyam (2005)). Due to the unavailability of data, the samples for the TED spread and VIX estimations start in 1986. We split each characteristic by the median into "low" (below the median) and "high" (above the median) subsamples. Columns (1)-(2) in Panel B of Table 3 show the results for the U.S. stock market volatility subsamples. We observe that, while the coefficient on $CL_{i,t} \times R_{US,t\text{-}1}$ is negative and significant in both columns, it is by more than 50% larger, in absolute terms, for more volatile times. The difference in coefficients on $CL_{i,t} \times R_{US,t\text{-}1}$ between the high and low periods becomes even more dramatic for the TED spread and the VIX in columns (3)-(4) and (5)-(6), respectively. In these tests, the point estimates of $CL_{i,t} \times R_{US,t\text{-}1}$ are large in magnitude, negative, and strongly significant only for the high subsamples. The corresponding point estimates for the low subsamples are economically small and insignificant. Therefore, we can conclude that cross-listings provide the largest liquidity benefits to U.S. firms when U.S. market conditions are poor, precisely when investors need liquidity the most.

C. Cross-Listings and the Matched Sample

The results in Table 1 show that more firms became cross-listed over the course of our sample period, which coincides with an increased cross-market market openness and globalization trends. Therefore, all or most of the liquidity gains that we associate with cross-listing placements may not be driven by cross-listings per se, but by the general upward trend in global market integration that mitigates liquidity constraints among U.S. firms towards the end of our sample period. To rule out this possibility, we examine how changes in firm liquidity are related to past firm, U.S., and foreign market returns not only for cross-listed firms, but also for other comparable U.S. firms that are traded solely in the U.S. To this end, we consider a sample of U.S. firms without cross-listings, including only firms with comparable liquidity characteristics and similar propensity to list abroad as our cross-listing firm sample. Using the methodology proposed by Heckman, Ichimura, and Todd (1997), we construct a matched sample based on four firm characteristics: market capitalization, past returns, and two liquidity sensitivity measures. The inclusion of market capitalization and past returns is motivated by evidence showing that large firms and firms with superior past performance are more likely to cross-list abroad (e.g., Pagano, Röell, and Zechner (2002) and Sarkissian and Schill (2009, 2016)). The two measures of liquidity sensitivity, *Liquidity Sensitivity* R_i and *Liquidity Sensitivity* R_{US}, are the estimated coefficients of regressing monthly Amihud liquidity on $R_{i,t-1}$ and $R_{US,t-1}$, respectively. The inclusion of two liquidity measures is to ensure similar liquidity dynamics for the cross-listed and matched sample firms before listing (pseudo listing) events.[18]

The matched sample is constructed as follows. First, we collect the four firm

[18] Despite the attractiveness of the foreign sales of firms, we were unable to use it as another characteristic in constructing our matched sample, since these data are sparse: in Compustat, only 11% of entries have non-missing foreign sales values. In addition, out of our 8,548 matched firms, a non-missing foreign sale number was available for only 2,737 (32%) of the firms.

characteristics for cross-listed firms and a pool of non-cross-listed U.S. firms. The non-cross-listed candidates must be in the same sector (the first digit of the SIC code) as the cross-listed firms. For each cross-listed firm *i*, all four firm characteristics are obtained in the year preceding the cross-listing events.[19] For each non-cross-listed firm *j*, the four characteristics are obtained at the end of each year *t* in the sample period. Then, we compute the normalized Euclidean distance between each pair of cross-listed firm *i* and non-cross-listed firm *j* in year *t* based on four (demeaned and standardized) firm characteristics: market capitalization, past returns, and two liquidity sensitivity measures, R_i and R_{US}. Finally, for each U.S. firm with a cross-listing, we select two control firms with the closest Euclidean distance to that of the cross-listed firm. In doing so, we follow Dehejia and Wahba (2002) and conduct matching with replacement—that is, we allow one firm to be matched with multiple cross-listed firms during the matching process. For each firm in the matched sample, we set its pseudo initial cross-listing date to be the date on which the Euclidean distance is the closest to the corresponding cross-listed firm in the year preceding its cross-listing event.

The summary statistics of firm characteristics for U.S. firms with cross-listings, all U.S. firms without cross-listings, and the matched sample of non-cross-listed U.S. firms are in Table 4. There are 281 cross-listed firms,[20] 9,725 firms without cross-listings, and 453 matched firms without cross-listings. The two-sample *t*-test results for the inequality of means are economically and statistically insignificant all four firm matching characteristics. Therefore, the sample of U.S. firms with no cross-listings is successfully matched to the firm sample with cross-listings.

Table 5 presents the results based on Model (1) using the samples of cross-listed firms (columns (1)-(3)), copied for convenience from Table 3, columns (1)-(2) and (4), respectively, the matched sample of non-cross-listed firms (columns (4)-(6)), as well as the difference-in-difference (DiD) estimations (columns (7)-(8)). The results in columns (1) and (4) show that,

[19] Market capitalization is the logarithm of a firm's total dollar market value of all outstanding common shares at the end of the year preceding its cross-listing event. Past return is the annual gross stock return in the year preceding the cross-listing event. The liquidity sensitivity measures are based on all observations before the cross-listing event.

[20] In this table, the sample of cross-listed firms includes only cross-listed U.S. firms with valid links between the CRSP and Compustat fundamental and supplemental data.

over the full sample period, the average impact of $R_{US,t\text{-}1}$ on liquidity innovations is much larger in absolute terms among the matched firms than among the cross-listed ones. These differences originate from the firms' responses to the (pseudo) cross-listing events. Comparing columns (2) and (3) to (5) and (6), the coefficients of $R_{US,t\text{-}1}$ are of similar magnitude, suggesting that the two samples respond in a similar manner to shocks in lagged market returns before (pseudo) cross-listing events. More importantly, the coefficient of $CL_{i,t} \times R_{US,t\text{-}1}$ for the matched sample of firms is economically small and statistically insignificant in columns (4)-(6), unlike that for cross-listed firms in columns (1)-(3). The point estimates of the $CL_{i,t} \times R_{US,t\text{-}1}$ coefficients for cross-listed firms are more than three times larger in magnitude than those for the matched sample of firms (e.g., -0.239 vs. -0.076 for column (3) vs. column (6)). The DiD estimations in columns (7)-(8) show that there is a significant decrease in the liquidity sensitivity to lagged market returns after cross-listing events for the cross-listed firms, although this effect is not observed for the matched firms. We also observe that, irrespective of whether or not a firm has a foreign listing, international market returns do not materially influence the liquidity of U.S. firms.

Finally, Figure 1 shows the changes in liquidity sensitivity to lagged U.S. market returns (coefficient β_2 on $R_{US,t\text{-}1}$) around the cross-listing event for cross-listed firms and pseudo cross-listings for the matched sample of firms based on specification (1) in Table 5. Due to the high volatility of these estimates, each coefficient in year t is the average of estimates over a three-year window [t-1, t, t+1]. The plot shows that a decline in the liquidity sensitivity of cross-listed firms occurs around the listing event and then persists. In contrast, β_2 is almost flat for the matched firm sample around the pseudo cross-listing event. This result suggests that the parallel trend assumption in DiD tests is not violated. Therefore, the results in Table 5 and Figure 1 provide evidence that cross-listing reduces the liquidity sensitivity of U.S. firms to past U.S. market returns.

D. Alternative Explanation for Lower Liquidity Sensitivity after Cross-Listing

In this section, we discuss one alternative explanation for the observed lower liquidity sensitivity in cross-listed U.S. firms – an increase in their firm size. Indeed, it is possible that the drop in firm liquidity sensitivity is not due to the cross-listing event per se, but rather emerges from the change in firm size over time associated with cross-listing. For instance, firms with an increasing market value are more likely to be listed overseas and to experience a decline in liquidity risk.

Our reasons for why this potential explanation can be dismissed are as follows. First, while firms have been shown to be the largest and most liquid in their home markets by the time of the cross-listing, their size does not increase as a result of listing (Sarkissian and Schill (2009, Figure 4; 2012, Figure 1)). Second, Figure 2 provides similar evidence for our sample of cross-listed firms: their size does not increase after cross-listing. This figure also shows the same series for our matched sample of non-cross-listed firms. Note the strong upward trajectory in the size of matched firms after pseudo cross-listing throughout the full sample period. However, the results in Table 5 (columns (4)-(6)) show no significant effect of pseudo cross-listing on the liquidity of matched firms (insignificant coefficient on $CL_{i,t} \times R_{US,t\text{-}1}$). Third, another concern is that the upward trajectory of matched firms does not perfectly mimic that of cross-listed firms. To rule this out, we construct a placebo sample of non-cross-listed firms that are more closely aligned in size to cross-listed firms.[21] We plot these series in Figure 2 too. We then repeat regression specifications (1), (2), and (4) of Table 3 for the placebo sample and again find an economically and statistically insignificant slope on $CL_{i,t} \times R_{US,t\text{-}1}$ (data not shown). Therefore, we conclude that our results are not driven by the changes in the size of firms after cross-listing.

[21] The placebo sample is constructed as follows. From our matched control sample of firms (a sample of U.S. firms without cross-listings), we compute the time series of the market capitalization of each firm. Then we select firms with a time series pattern similar to that of the cross-listing sample at months -60, 0, and +60 relative to the listing month. The selection procedure is as follows. (1) At t = -60, we rank the matched firms by their market cap. Then, one firm at a time, we drop the firms with the smallest size until the average market cap gets the closest to the average market cap of cross-listed firms at t = -60. (2) At t = +60, we rank the matched firms by market cap. Then, one firm at a time, we drop the firms with the largest size until the average market cap gets the closest to the average market cap of cross-listed firms at t = +60. (3) At t = 0, we rank the matched firms by market cap. Then, one firm at a time, we drop the firms with the smallest size (or the largest firm) until the average market cap gets the closest to the average market cap of the cross-listed firms at t = 0. This procedure uses 90% of the matched sample.

E. Liquidity Risk

In this subsection, we examine the sensitivity of liquidity to current market returns and other dimensions of liquidity risks, i.e., the commonality in firm liquidity with the market liquidity and the return sensitivity to market liquidity. Following the methodology initially proposed by Acharya and Pedersen (2005), we consider three liquidity betas: $\beta(\Delta Liq_i, \Delta Liq_m)$, $\beta(\Delta Liq_i, r_m)$, and $\beta(r_i, \Delta Liq_m)$. For each firm *i*, we fit the following bivariate model to obtain each of the three liquidity betas:

$$y_{i,t} = \alpha_i + \beta_i x_{i,t} + \varepsilon_{i,t}, \quad \varepsilon_{i,t} \sim N(0, \sigma_i^2), \tag{2}$$

where (y_i, x_i) can take the form of $(\Delta Liq_i, \Delta Liq_m)$, $(\Delta Liq_i, r_m)$, or $(r_i, \Delta Liq_m)$. ΔLiq_i is the innovation of firm *i*'s monthly Amihud liquidity measure obtained from the estimated residuals in the univariate AR(2) model, which is adjusted to account for the time trend in liquidity (Pastor and Stambaugh (2003), Acharya and Pedersen (2005), Watanabe and Watanabe (2008)). The adjusted AR(2) model is shown in equation (3):

$$\frac{MC_{i,t-1}}{MC_{i,1}} Liq_{i,t} = \alpha + \beta_1 \left(\frac{MC_{i,t-1}}{MC_{i,1}} Liq_{i,t-1} \right) + \beta_2 \left(\frac{MC_{i,t-1}}{MC_{i,1}} Liq_{i,t-2} \right) + \varepsilon_{i,t}, \tag{3}$$

where $MC_{i,t-1}$ is the total market capitalization of firm *i* at month *t*-1, and $MC_{i,1}$ is the corresponding value for the initial month. ΔLiq_m is the innovation of the monthly market aggregated Amihud liquidity measure obtained from the estimated residuals in the univariate AR(2) model. The market aggregated Amihud liquidity measure is the equally-weighted Amihud liquidity measure of all firms listed on the NYSE and NASDAQ. R_i is the monthly excess returns of firm *i* and r_m is the CRSP U.S. Total Market Index less the one-month Treasury bill rate.

Table 6 reports the means and standard deviations of the estimated liquidity betas for cross-listed U.S. firms and matched firms before and after the listing date (pseudo) over the full sample period. The results of the DiD test in the last column show the difference in the changes in each beta before and after the listing between the cross-listed and matched samples of firms.

We find that, among the three betas, only $\beta(\Delta Liq_i, r_m)$ is significantly lower after cross-listing, which implies that the liquidity of U.S. firms with foreign listings is much less sensitive to U.S. stock market returns than the liquidity of firms with no cross-listings. This result is consistent with the results in Table 5. Moreover, while the average $\beta(\Delta Liq_i, r_m)$ of firms before the cross-listing is slightly higher than that of the matched sample of firms (0.975 vs. 0.881), after the listing, the situation with betas reverses (0.607 vs. 0.806). Therefore, the findings suggest that cross-listing reduces the sensitivity of firm liquidity to lagged market returns, and decreases its liquidity risk as well.

IV. Foreign Market and Firm-level Subsample Tests

In this section, examine how the characteristics of foreign markets influence cross-listing placement and the liquidity of U.S. firms. According to the ownership dispersion hypothesis, trading in more overseas exchanges would provide an additional diversification, leading to more liquidity supply to U.S. firms during market downturns, as long as global markets do not strongly move in unison. Similarly, according to the liquidity provision hypothesis, more liquid markets and markets with larger market caps—and, therefore, larger potential investor pools—would be more effective sources of liquidity provision to U.S. firms through their shares listed on overseas exchanges. Therefore, we consider three characteristics of overseas markets: (1) the number of host overseas markets with cross-listings of a given U.S. firm; (2) foreign market liquidity; and (3) and market capitalization.[22] The market liquidity is the zero-return measure proposed by Lesmond, Ogden, and Trzcinka (1999); see also Goyenko and Sarkissian (2014). It is the equally-weighted average proportion of zero daily returns per month across all firms in a given country from 1977 to 2010. The market capitalizations of foreign countries are from the World Development Indicators (WDI) database of the World Bank. We split our full set of observations into two subsamples for each foreign market characteristic at the corresponding median value

[22] Strictly speaking, the number of foreign exchanges that a given firm's stock is trading in is more suitable for a firm-specific characteristic. However, since the properties of foreign exchanges can influence the cross-listing-liquidity relation that we examine, their number can also be important.

(single vs multiple host markets, and low vs high values of market liquidity and capitalization).

Table 7 shows the estimation results, which are based on regression Model (1). We use the full set of control variables, the intercept, and firm fixed effects in all regressions. Columns (1)-(2) show the impact of cross-listing on U.S. firm liquidity when the firm is placed in only one overseas exchange and in multiple exchanges, respectively. In line with the economic intuition, we find a much stronger liquidity supply for firms listed on multiple overseas exchanges: the coefficient on $CL_{i,t} \times R_{US,t\text{-}1}$ is over 60% larger in absolute value for the firms cross-listed in the exchanges in two or more countries than for those present on only one. Columns (3)-(4) show the cross-listing impact for firms traded in markets with low and high liquidity, while columns (5)-(6) show the impact for high and low market capitalization markets. The results in Table 7 are aligned with our expectations: specifically, the countries with a high aggregate liquidity or larger financial market provide at least 50% more liquidity to U.S. firms listed on their exchanges than the countries with below-median values of liquidity and size.

Next, we examine how cross-listings impact firm liquidity sensitivity depending on firm-specific characteristics. To this end, we focus on four characteristics: PIN, total volatility, foreign income, and foreign trading. We collect all firm-specific information at the end of each year and average over our entire sample period. We calculate the PINs using Venter and Jongh's (2006) methodology. Total volatility is the standard deviation of a firm's gross returns over the sample period. Foreign income is the ratio of the firm's foreign pretax income to its total pretax income. Foreign trading is the ratio of the trading volume in the host markets over that in the U.S. The data on daily trading volume is from Compustat Global Security Daily and is very limited in time and across firms. For each firm, we compute the annual average trading volume (in U.S. dollars) in both the U.S. and host markets, and then compute their ratio. As the trading volume information in Compustat Global for international markets only starts in the early 1990s, our sample of firms with foreign trading data is much smaller than our main sample.

We have already discussed the link between firm liquidity and volatility. Furthermore, Easley et al. (1996) introduce the PIN measure and link it to stock liquidity. Stocks with a high

PIN receive less liquidity provision and, therefore, would suffer more during a liquidity crisis. By listing on an overseas exchange, a firm attracts additional noise traders, which makes its stock more amenable for liquidity providers. Therefore, we expect more liquidity benefits for stocks with a high PIN. Then, Grullon, Kanatas, and Weston (2004) find that a higher firm visibility improves its liquidity. Since a firm's foreign operations improve its overall visibility, we expect greater liquidity benefits resulting from an influx of foreign income, when U.S. firms cross-list on overseas exchanges. Finally, Halling et al. (2008) report sizable shifts in a firm's trading volume towards foreign markets following cross-listing. We expect that U.S. firms with a larger proportion of overseas equity trading will have more pronounced gains in liquidity. Note that standard firm attributes, such as the book-to-market ratio, earnings per share, and leverage, are not clearly related to firm liquidity.

Table 8 reports the results for Model (1) across the four firm characteristics subsamples described above. The first three subsamples are split at the median, while the foreign trading volume is at the 25th and 75th percentiles.[23] As before, in every regression, we use the full set of control variables, but do not show the intercepts and firm fixed effects, as well as cluster standard errors by firm and month. In support of our expectation, we find a much stronger cross-listing effect on firm liquidity among the firms with a high PIN, high volatility, and high foreign income; their coefficients on the interactive term, $CL_{i,t} \times R_{US,t\text{-}1}$, are larger by about 150%, 50%, and 60% than the corresponding estimates for the firms with low PIN, low volatility, and low foreign market income, respectively. The same coefficient for foreign trading tests diverges even more remarkably between the low- and the high-volume firms: it is positive for U.S. firms with weak overseas trading, but negative and significant for those with high transaction volumes abroad. Therefore, the findings suggest that there is a direct relation between the liquidity gains of U.S. firms in the domestic market and the extent of their trading on foreign exchanges.

[23] The median foreign trading volume is already 14.4%; however, at the 75th percentile of the distribution, about half of the trading of U.S. equities occurs on U.S. exchanges, while the rest is on overseas exchanges. This facilitates the interpretation of the results on foreign trading volume due to the scarcity of the data.

V. Foreign Ownership and Firm Liquidity

A decline in the liquidity sensitivity to lagged U.S. market returns could result from ownership dispersion. In view of unsynchronized funding constraints, the ownership dispersion channel suggests that a diffused global stock ownership of cross-listings can mitigate liquidity shocks that a company faces in its domestic market. In Section V.A, we examine whether or not the ownership structure of U.S. firms becomes more dispersed after cross-listing events. In Section V.B, we analyze whether a large foreign ownership of firm equity, even without cross-listings, is still conducive to liquidity. [24]

A. Foreign Ownership Changes around Cross-Listing

First, we investigate the changes in the ownership diffusion resulting from the cross-listing of U.S. firms on overseas exchanges. To this end, we match our sample of cross-listed firms with firm holdings data from FactSet Ownership database (Unadjusted Fund Holdings). The sample period for the ownership data is from 2000 to 2013, since the pre-2000 data are very sparse. For each institution (mutual fund, ETF, pension fund, etc.), we categorize it as "foreign" when its headquarters is located outside the U.S. Then, we compute the proportion of holdings by foreign institutions at the end of each year. We repeat this procedure also for our matched sample of firms without cross-listings.

Figure 3 shows the dynamics of foreign holdings in U.S. firms cross-listed on overseas exchanges and the matched U.S. firms four years before and four years after the cross-listing event year (year 0). The results show a large expansion in the foreign holdings of U.S. firms after their cross-listing. Before the listing event, the average proportion of the foreign holdings in these firms is around 17%. In the year of cross-listing, the ratio increases to 28% and, in the next three to four years, decreases only slightly and remains in the 25%-27% range. Said differently,

[24] In the Internet Appendix, we also show that the foreign ownership of cross-listed firms substantially increases with an increase in the TED spread, a popular proxy of funding liquidity during the financial crisis of 2007-2009. The foreign ownership of matched U.S. firms does not show similar patterns. This is consistent with the net buying of cross-listed stocks by foreign investors when their valuation deviates from their fundamentals.

we find that at least a 50% increase in the foreign ownership of U.S. firms is directly associated with their cross-listing in foreign markets. However, we observe no sizable changes in foreign ownership for our firms in the matched sample. Therefore, the results in Figure 3 reveal that the liquidity gains for firms listed on overseas exchanges are associated with increased ownership by foreign investors.

B. Foreign Ownership and Liquidity of Non-Cross-Listed Firms

It is important to acknowledge that a listing on an overseas exchange is not a mandatory condition for a firm to be globally owned. Therefore, if foreign holdings are conducive to firm liquidity, we should also observe that, without cross-listings, firms differ in their ability to handle liquidity dry-outs depending on the degree of the diffusion of their global equity ownership. To this end, we collect the average foreign holding information for 5,668 U.S. firms between 2000 and 2013 from FactSet (excluding the firms with foreign listings) and divide them into five quintiles, from high to low, according to the level of their foreign holdings ratios. We find that the median foreign holdings ratio is 3.5%, while that for the first (highest) and fifth (lowest) quintiles are 14.4% and 0.0%, respectively. Then, following Hameed et al. (2010), we rerun the main benchmark regressions for each of these groups. To this end, we use the estimation specification as in Model (1), but without the foreign market return term.

Table 9 shows the estimation results. Again, the control variables, intercept, and firm fixed effects are present in each regression, but their estimates are not shown. In Panel A, we again use the Amihud liquidity measure. Column (1) presents the full sample results. As previously, there is a positive and significant relation between the lagged market return and firm liquidity. More importantly, we also find that the firms with a high level of foreign holdings react less to domestic market declines: the magnitude of the coefficient on $R_{US,t}$ for the firms with a high foreign holdings ratio (column (2)) is almost three times smaller than that for the firms with a low foreign holdings ratio (column (6)). In statistical terms, irrespective of the foreign holdings ratio quintile, all coefficients on $R_{US,t-1}$ are strongly significant. In Panel B, we use the ASPR (adjusted spread) illiquidity measure from Chordia, Sarkar, and Subrahmanyam (2005). As expected, the firms with high foreign holdings react less to domestic market declines. Expectedly, for the overall results in column (1), we find a negative and significant coefficient on $R_{US,t\text{-}1}$, implying an increase in firm illiquidity during market downturns. However, the reaction of firm liquidity to poor market conditions largely depends on the foreign ownership of the firm. Accordingly, the results in columns (2)-(6) show that, in adverse market conditions, U.S. firms with high foreign holdings ratios do not experience significant illiquidity increases, while those in the two lowest foreign holdings ratio quintiles do (columns (5)-(6)).

The results in Table 9 are not surprising, since the firms with high levels of foreign ownership are also generally more liquid (see Kacperczyk, Sundaresan, and Wang (2018)). However, the most important implication of the results in Table 9 is that foreign ownership is critical for boosting the liquidity of U.S. firms, both cross-listed and non-cross-listed. Therefore, any corporate action that increases the firm's foreign holdings ratio, such as a cross-listing, has a positive impact on the firm's liquidity.

VI. Liquidity Provision and Return Reversals

In previous sections, we have shown that cross-listed U.S. firms maintain their liquidity in adverse home market conditions. However, it remains unclear how the enhanced firm liquidity affects its return dynamics. Yet, a decline in the liquidity sensitivity to lagged U.S. market returns could also result from direct liquidity provision. The liquidity provision channel suggests that foreign investors may take advantage of arbitrage opportunities by buying U.S. equities when their valuation deviates from fundamentals. In this relation, due to the liquidity provision from foreign buyers, cross-listed firms should suffer less from transitory price shocks. That is, the *change* in temporary price deviations for cross-listed firms should be greater than that for their counterparts listed only domestically relative to their respective pre-listing periods (prepseudo-listing period for U.S.-only listed firms).[25]

Following Lehmann (1990), Lo and MacKinlay (1990), and Nagel (2012), we address this issue by applying the liquidity provision strategy framework. It specifies the portfolio weight for stock *i* at time *t* as follows:

$$w_{i,t} = -\left(1/2\sum_{i}^{N}|R_{i,t-s} - R_{m,t-s}|\right)^{-1}\left(R_{i,t-s} - R_{m,t-s}\right), \tag{4}$$

where $R_{m,t-s}$ is the *s*-period lagged daily equally-weighted market index return, $R_{i,t-s}$ is the *s*-period lagged daily gross return of firm *i*, and *N* is the total number of stocks in the portfolio. In effect, $R_{i,t-s} - R_{m,t-s}$ is the difference between the firm's return and the market index return at some lag *s*. The portfolio return at time *t* for the liquidity provision trading strategy is calculated as:

$$\Pi_{s,t} = -\left(1/2\sum_{i}^{N}|R_{i,t-s} - R_{m,t-s}|\right)^{-1}\sum_{i=1}^{N}\left(R_{i,t-s} - R_{m,t-s}\right)R_{i,t}\ . \tag{5}$$

Then we compute the weekly portfolio returns for $s = 1, 2\ldots, 5$ over the sample period as:

$$\Pi_{t} = \sum_{s=1}^{5}\Pi_{s,t}\ . \tag{6}$$

Table 10 shows the estimation results for return reversals, including the mean, μ, standard deviation, σ, and autocorrelation, ρ, of aggregated portfolio returns, Π_t, before and after the cross-listing. The last two columns of Table 10 provide the results of computing the difference in mean returns, $\mu_{Before} - \mu_{After}$. Panel A reports the weekly portfolio returns for the cross-listed and matched firm samples before and after the (pseudo) listing. The estimates are return reversals for the cross-listed and matched firms over the full sample period as well as the NBER-defined recessions and expansions. The means of the weekly return reversals before the

[25] Indeed, cross-listed firms may have weaker return reversals for many reasons other than their presence in overseas markets (e.g., relatively larger size). In this context, it is crucial to estimate the return reaction from liquidity provision before and after the cross-listing event.

listing for the cross-listed and the matched samples of firms are very close, 0.751% and 0.714%, respectively. This demonstrates that both firm samples behave similarly even with respect to a characteristic that is not used in the construction of the matched sample. After the (pseudo) listing, the means of the cross-listed and the matched samples of firms are 0.406% and 0.615%, respectively. While the return averages are statistically smaller after the listing for both firm samples, the reduction in the weekly return reversal magnitude is markedly higher for cross-listed firms. In economic terms, cross-listed firms achieve a 3.5-fold larger reduction in temporary return deviations than similar firms without listings on overseas exchanges. Note that the cross-sample decrease in the severity of return reversals after cross-listing may be driven by the increase in market integration over recent decades.

Furthermore, our results for the NBER-defined business cycles reveal two important patterns. First, the return reversal is larger during U.S. recessions. This pattern is intuitive, as stock prices more frequently deviate from their fundamental values in bad times. Second, the DiD results show a much larger reduction in return reversals for cross-listed firms than those listed only on U.S. exchanges during recessions. This implies that return reversals are related to funding liquidity, which improves for the cross-listed stocks, particularly when such improvement is most needed. Therefore, when liquidity provision is low in the U.S., the liquidity provided through international investors functions well.

Panel B of Table 10 consists of six sub-panels and reports the weekly portfolio returns for the sample of cross-listed firms, categorized by three foreign market-level (number of foreign listing markets, foreign market liquidity, and foreign market capitalization) and three firm-level characteristics (PIN, volatility, and foreign income). The two rows in each sub-panel report the portfolio returns of the two firm subsamples based on the median split of the corresponding firm characteristic. The first three sub-panels (B.1 to B.3) show portfolio returns grouped by the number of markets for firm listings, market liquidity, and market capitalization. We see that, after the listing for all subsamples of foreign markets, the average return reversal is often reduced, both economically and statistically, by over 50%. The last three sub-panels of Panel B

(B.4 to B.6) show portfolio returns grouped by PIN, total volatility, and foreign income. The results show that the mean return reversal difference, $\mu_{Before} - \mu_{After}$, is statistically zero for firms with low volatility and low foreign income, while it is only marginally significant for low-PIN firms. Conversely, firms with a high PIN, volatility, and foreign income exhibit much bigger drops in the weekly return reversals after the cross-listing than before it. In economic terms, these reductions amount to 16% (0.145/0.930), 13% (0.120/0.918), and 40% (0.278/0.701), respectively, of the original return reversal magnitudes.

Taken together, the results in Table 10 illustrate that, due to a higher liquidity provision, cross-listings yield sizable benefits to the stock returns of U.S. firms with their shares trading on overseas exchanges. The impact of transitory price shocks to firms with cross-listings is not as severe as for the firms with no listings on overseas exchanges. The cross-sectional patterns demonstrate that the cross-listing benefits across market and firm characteristics are similar to those for the impact of cross-listing on liquidity shown in Tables 3, 7, and 8.

VII. Conclusions

In this paper, we examine the impact of international markets on firms' liquidity risk using a sample of U.S. firms cross-listed on 20 overseas exchanges between 1901 and 2012 and with stock return and liquidity data from 1950 to 2013. This framework offers at least two advantages. First, a cross-listing event provides a unique positive shock to the foreign ownership ratio after a firm lists its shares on an overseas exchange. The more dispersed ownership structure could provide diversification to mitigate liquidity risks. Second, working with the U.S. firms enables us to examine the liquidity dynamics with comprehensive data on stock returns and liquidity.

We find that the presence of firm shares on overseas exchanges decreases the sensitivity of firm liquidity to lagged U.S. market returns. This result suggests that cross-listings improve firm liquidity during U.S. market downturns (i.e., when liquidity enhancement is needed the most). Indeed, the improvement in liquidity is larger during market downturns in the U.S.

determined by high levels of equity market volatility, TED spread, and the VIX index. Furthermore, we also find that the positive influence of cross-listings on firm liquidity is more pronounced when U.S. firms are listed on multiple overseas exchanges~~,~~ in markets with high capitalization and high aggregate liquidity. Furthermore, firms with high levels of volatility, foreign income, foreign trading volume, and probability of informed trading also receive liquidity benefits from foreign listings. The results of our analysis of liquidity betas show that the sensitivity of firm liquidity to aggregate U.S. market returns is significantly lower among cross-listed firms than among comparable firms with no presence on overseas exchanges. We also find that, due to the lower liquidity sensitivity of cross-listed U.S. firms, transitory shocks have a smaller effect on their returns than on those of non-cross-listed firms.

The observed reduction in firm liquidity sensitivity to past U.S. returns coincides with a significant increase in the foreign ownership of U.S. firms at the time of cross-listing. The findings suggest that international investors act as net liquidity suppliers through two possible channels: (1) ownership dispersion, which leads to a non-synchronous demand for liquidating the same stocks across countries due to different funding constraints, and (2) liquidity provision, which implies the involvement of foreign investors who trade U.S. stocks when, due to the lack of funding liquidity in the U.S. market, prices significantly deviate from their fundamental values. We rule out an alternative explanation that the drop in firm liquidity sensitivity upon cross-listing is due to an increase in firm size. Therefore, taken together, our findings provide strong evidence that international markets can offer liquidity provision and risk sharing under certain conditions.

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Table 1
Distribution of U.S. firms cross-listed abroad

Country	<1950	1950-59	1960-69	1970-79	1980-89	1990-99	2000-12	Total
Australia	0	0	0	0	1	6	4	11
Austria	0	0	0	1	0	1	1	3
Belgium	0	17	7	5	3	3	0	35
Brazil	0	0	0	0	0	1	0	1
Canada	0	1	1	4	5	11	41	63
Chile	0	0	0	0	0	0	16	16
France	0	4	13	7	14	5	6	49
Germany	0	0	0	1	4	36	1	42
Hong Kong	0	0	0	0	0	0	1	1
Israel	0	0	0	0	0	0	6	6
Japan	0	0	0	11	65	3	1	80
Luxembourg	0	0	0	0	0	1	0	1
Mexico	0	0	0	0	0	0	1	1
Netherlands	21	18	8	1	21	4	4	77
Norway	0	0	0	0	0	1	1	2
Peru	0	0	0	0	0	1	0	1
Romania	0	0	0	0	0	0	1	1
Sweden	0	0	0	0	1	5	1	7
Switzerland	4	9	10	20	20	5	2	70
United Kingdom	2	0	11	30	46	9	5	103
Total	27	49	50	80	180	92	92	570

This table provides the distribution of U.S. firms cross-listed aboard from 1901 to 2012 inclusive across countries and time. The cross-listing data come from several sources: the Sarkissian and Schill public foreign listing database, listing information from the major stock exchanges of each country, and CRSP.

Table 2
Descriptive statistics of U.S. firms cross-listed abroad

	Mean			Standard Deviation			Observations		
	Return	Turnover	Liq	Return	Turnover	Liq	Return	Turnover	Liq
Australia	0.193	1.089	5.446	0.523	3.287	2.695	34,024	33,211	29,966
Austria	0.275	0.318	1.146	0.662	0.718	2.195	5,071	5,071	4,227
Belgium	0.135	0.318	6.782	0.314	0.516	2.800	85,207	85,207	79,262
Brazil	0.375	0.226	-1.348	1.039	0.538	2.073	1,469	1,469	949
Canada	0.200	0.547	4.394	0.537	1.154	3.369	239,542	234,410	197,372
Chile	0.238	0.964	8.882	0.358	2.231	3.434	15,898	15,898	15,055
France	0.179	0.425	6.236	0.366	1.376	3.190	169,916	163,125	143,921
Germany	0.153	0.468	4.960	0.470	1.250	2.604	51,573	51,573	47,723
Hong Kong	0.341	1.244	8.879	0.438	0.909	1.643	3,328	3,328	3,299
Israel	0.255	0.675	3.612	0.622	1.264	3.532	22,101	22,101	20,099
Japan	0.155	0.332	6.196	0.305	0.979	2.671	305,915	299,294	269,731
Netherlands	0.143	0.330	6.716	0.304	0.665	2.719	642,784	642,133	583,657
Norway	0.188	0.953	5.905	0.550	1.376	2.449	9,853	9,853	9,173
Sweden	0.119	0.817	4.341	0.552	4.590	2.929	20,625	20,625	18,366
Switzerland	0.147	0.429	6.622	0.336	0.764	2.638	276,189	273,708	251,915
United Kingdom	0.165	0.376	5.828	0.350	0.644	2.727	493,059	481,225	434,034
Total	0.161	0.409	6.101	0.370	1.059	2.942	2,376,554	2,342,231	2,108,749

This table reports the summary statistics of return and liquidity characteristics for U.S. firms cross-listed abroad. The sample period is 1950-2013. Only the markets of the first U.S. firm cross-listings are considered. All the stock returns and liquidity measures are computed from CRSP daily stock dataset. Return is the annualized daily holding period return including dividends. Turnover is the percentage of the daily trading volume out of the total shares outstanding. Liq is the Amihud (2002) liquidity measure computed as $-\log((10^6 \times |r_t|)/(PRC_t \times Vol_t))$, where PRC_t is the closing price of the stock, $|r_t|$ is the absolute value of stock return, and Vol_t is the trading volume at time t. All variables are winsorized at 1% and 99%.

Table 3
Liquidity sensitivity of U.S. firms before and after cross-listing

Panel A: General U.S. market conditions

	Full sample						Sub-periods	
	(1)	(2)	(3)	(4)	(5)	(6)	1950-1981	1982-2013
$R_{i,t\text{-}1}$	0.167***	0.167***	0.146***	0.147***	0.110***	0.111***	0.093***	0.174***
	(11.60)	(11.59)	(11.71)	(11.71)	(19.95)	(19.95)	(12.02)	(9.47)
$R_{US,t\text{-}1}$	0.142***	0.348***	0.245***	0.248***	0.110**	0.109**	0.203**	0.221***
	(3.11)	(4.02)	(3.91)	(3.78)	(2.33)	(2.30)	(2.14)	(3.18)
$R_{IN,t\text{-}1}$	0.013	0.012	0.0789	0.124	0.017	0.018	0.047	0.049
	(0.44)	(0.26)	(0.23)	(0.36)	(0.71)	(0.71)	(0.91)	(0.14)
$CL_{i,t} \times R_{US,t\text{-}1}$		-0.264***	-0.240***	-0.239***	-0.084**	-0.088**	-0.162*	-0.202**
		(3.50)	(3.84)	(3.79)	(2.00)	(2.17)	(1.83)	(2.55)
$CL_{i,t} \times R_{IN,t\text{-}1}$		0.068	0.023	0.025	0.003	0.004	-0.011	0.022
		(0.16)	(0.62)	(0.67)	(0.13)	(0.17)	(0.20)	(0.41)
$CL_{i,t}$		0.163	-0.013	-0.091	-0.001	-0.001	-0.131	0.094
		(0.06)	(0.07)	(0.05)	(0.96)	(0.91)	(0.46)	(0.05)
$\Delta\sigma_{i,t\text{-}1}$			-0.099***	-0.129***	-0.131***	-0.131***	-0.098***	-0.152***
			(4.18)	(5.31)	(42.92)	(42.73)	(6.41)	(3.56)
$\Delta STOV_{i,t\text{-}1}$			0.019***	0.019***	0.015***	0.015***	0.008***	0.025***
			(5.34)	(5.08)	(12.23)	(12.22)	(3.01)	(4.17)
$\Delta\sigma_{US,t\text{-}1}$				0.083**	0.057**	0.056**	0.048*	0.012**
				(2.33)	(2.16)	(2.09)	(1.89)	(2.11)
$\Delta STOV_{US,t\text{-}1}$				0.005	0.014**	0.014**	0.020***	-0.001
				(0.77)	(2.46)	(2.46)	(3.47)	(0.17)
$\Delta\sigma_{IN,t\text{-}1}$				0.015**	0.006*	0.006*	0.005	0.018**
				(2.42)	(1.76)	(1.73)	(1.47)	(1.98)
$\Delta STOV_{IN,t\text{-}1}$				-0.052	-0.070*	-0.069*	-0.038	-0.048
				(0.73)	(1.77)	(1.76)	(0.70)	(0.48)
$Down_{t\text{-}1} \times R_{US,t\text{-}1}$					0.134*			
					(1.92)			
$Down_{t\text{-}1} \times CL_{i,t} \times R_{US,t\text{-}1}$					-0.157**			
					(2.12)			
$DownS_{t\text{-}1} \times R_{US,t\text{-}1}$						0.108*		
						(1.84)		
$DownS_{t\text{-}1} \times CL_{i,t} \times R_{US,t\text{-}1}$						-0.091*		
						(1.84)		
$DownL_{t\text{-}1} \times R_{US,t\text{-}1}$						0.132*		
						(1.71)		
$DownL_{t\text{-}1} \times CL_{i,t} \times R_{US,t\text{-}1}$						-0.175**		
						(2.11)		
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	91,927	91,920	91,920	91,920	91,920	91,920	49,731	42,189
Adj. R^2	0.015	0.016	0.223	0.223	0.473	0.473	0.348	0.210

Table 3 (continued)

Panel B: Specific U.S. market conditions

	U.S. market volatility		TED spread		VIX	
	Low	High	Low	High	Low	High
$R_{i,t\text{-}1}$	0.155***	0.139***	0.164***	0.129***	0.143***	0.146***
	(9.11)	(9.42)	(7.91)	(9.18)	(7.31)	(8.46)
$R_{US,t\text{-}1}$	0.147	0.290***	0.140	0.392**	-0.0210	0.329**
	(1.56)	(3.06)	(1.14)	(1.99)	(0.10)	(2.23)
$R_{IN,t\text{-}1}$	0.038	-0.019	0.046	-0.123	-0.035	-0.019
	(0.75)	(0.40)	(0.71)	(0.93)	(0.46)	(0.21)
$CL_{i,t} \times R_{US,t\text{-}1}$	-0.184**	-0.282***	-0.127	-0.377*	-0.0364	-0.315**
	(2.01)	(3.35)	(1.08)	(1.95)	(0.18)	(2.21)
$CL_{i,t} \times R_{IN,t\text{-}1}$	0.343	0.430	-0.517	0.116	0.032	0.081
	(0.06)	(0.87)	(0.08)	(0.84)	(0.00)	(0.87)
$CL_{i,t}$	-0.313	0.270	0.346	-0.644	0.186	-0.107
	(0.95)	(0.83)	(0.82)	(1.09)	(0.47)	(0.16)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	45,862	46,056	30,745	31,448	35,659	26,542
Adj. R^2	0.236	0.214	0.191	0.178	0.177	0.194

This table shows the results from panel regression of the U.S. cross-listed firms' liquidity innovation on the lagged firm stock return and the U.S. and international market return variables. Panel A shows the estimations for general U.S. market conditions. It reports aggregate tests (columns (1)-(6)) and estimations over two equal 32-year sub-periods (columns (7)-(8)). The U.S. stock market information is from CRSP, and international stock markets data is from DataStream. The dependent variable, $\Delta Liq_{i,t}$, is the percentage change in monthly Amihud liquidity measure for each individual firm *i* at time *t*. The variables $R_{i,t\text{-}1}$, $R_{US,t\text{-}1}$, and $R_{IN,t\text{-}1}$ are the lagged monthly returns for firm *i*, CRSP total market index, and international markets, respectively. For each firm *i*, $R_{IN,t\text{-}1}$ is constructed as the equally-weighted average of MSCI country index return for all hosting markets for its cross-listings at time *t*. $CL_{i,t}$ is a dummy equal to one after the initial cross-listing date by firm *i* and to zero before the listing. The control variables include the lagged changes in in firm volatility, $\sigma_{i,t\text{-}1}$, its individual shares turnover, $\Delta STOV_{i,t\text{-}1}$, the U.S. market volatility, $\Delta\sigma_{US,t\text{-}1}$, the aggregate U.S. market turnover, $\Delta STOV_{US,t\text{-}1}$, as well as international market volatility, $\Delta\sigma_{IN,t\text{-}1}$, and international market turnover, $\Delta STOV_{IN,t\text{-}1}$. The U.S. market volatility is the monthly standard deviation of CRSP total market index return. The international market volatility is the standard deviation of monthly foreign market returns. The aggregate U.S. market turnover is the equally-weighted share turnover of all firms listed in NYSE and NASDAQ. For each firm *i*, the aggregate international market turnover is the equally-weighted share turnover of all firms with the same hosting market as firm *i*. Panel B shows the results for different U.S. market volatility, TED spread and VIX. The TED spread is from the Federal Reserve Bank of St. Louis. The TED spread is the difference between the 3-month LIBOR and the 3-month T-bill rate scaled by the LIBOR rate. The VIX is from CBOE and is based on the prices of S&P 100 from January 1986 to September 2003, and on the S&P 500 options afterwards. The sample period is 1950-2013 (1986-2013 for TED spread and VIX). The intercept and firm fixed effects are present in each regression, but their estimates are not shown. Regressions (5)-(6) also include the individual *Down*, *DownS*, and *DownL* dummies and their respective interactive terms with $R_{IN,t\text{-}1}$, but their estimates are not shown. The standard errors are clustered by firm and month. The table also reports the number of observations and the adjusted R-squared. The absolute *t*-statistics are in parentheses. ***, **, and * indicate significance at 1%, 5%, and 10% levels, respectively.

Table 4
Summary statistics of characteristic of U.S. firms with and without cross-listings

	Variable	Obs.	Mean	S.D.	Min	Max
Cross-listed Firms	*Market Capitalization*	281	14.371	1.996	9.134	18.643
	Past Return	281	0.180	0.220	-0.764	1.957
	Liquidity Sensitivity R_i	281	0.395	0.383	-1.191	1.896
	Liquidity Sensitivity R_{US}	281	0.948	2.155	-11.098	12.466
All Firms ex Cross-listed	*Market Capitalization*	9,725	11.439	2.153	6.096	18.535
	Past Return	9,725	0.153	0.663	-0.962	7.641
	Liquidity Sensitivity R_i	9,725	0.311	0.618	-3.972	4.661
	Liquidity Sensitivity R_{US}	9,725	1.307	4.079	-35.801	47.909
Matched Firms	*Market Capitalization*	453	14.172	1.254	12.476	18.235
	Past Return	453	0.206	0.595	-0.623	3.166
	Liquidity Sensitivity R_i	453	0.394	0.381	-1.020	1.729
	Liquidity Sensitivity R_{US}	453	0.911	1.992	-11.598	10.496
Two-sample *t*-test for means (Cross-listed – Matched)	*Market Capitalization*		0.199			
			(1.49)			
	Past Return		-0.026			
			(0.08)			
	Liquidity Sensitivity R_i		0.001			
			(0.03)			
	Liquidity Sensitivity R_{US}		0.037			
			(0.23)			

This table reports the summary statistics of firm characteristics for U.S. firms with cross-listings, U.S. firms without cross-listings, and the matched sample of non-cross-listed firms. The sample period is 1950-2013. Accounting information is from Compustat and the stock market information is from CRSP. The reported four firm characteristics of cross-listed firms are collected at the end of the year preceding the cross-listing events. The same firm characteristics of matched firms are collected at the end of the year preceding the pseudo cross-listing events. *Market Capitalization* is the logarithm of firms' total dollar market value of all outstanding common shares. *Past Return* is the annual gross stock return in the year preceding the (pseudo) cross-listing events. *Liquidity Sensitivity R_i* and R_{US} are the estimated coefficients (sensitivities) of regressing monthly Amihud liquidity on $R_{i,t\text{-}1}$ and $R_{US,t\text{-}1}$, respectively. For the cross-listed and matched firms, the liquidity sensitivity estimates are based on all observations before the (pseudo) cross-listing events. For all other firms, the liquidity sensitivity estimates are based on all observations over the sample period. The sample of cross-listed firms includes only those cross-listed U.S. firms that have valid links between CRSP and Compustat fundamental and supplemental data. The matched sample is constructed by minimizing the normalized four-dimensional Euclidean distance between the sample of cross-listed and non-cross-listed firms based on four firm characteristics (demeaned and standardized) that are related to cross-listing decisions. For each U.S. firm with a cross-listing, we select two control firms with the closest Euclidean distance to the cross-listed firm. The matched firms must be in the same sector (first digit of SIC code) as the cross-listed firms. We allow the control firms to appear multiple times during the matching process. The lower part of the table shows the two-sample *t*-test for the equality of means for each firm characteristic between the cross-listed and matched samples of firms. The absolute *t*-statistics are in parentheses.

Table 5
Liquidity sensitivity of U.S. firms for cross-listed and matched non-cross-listed samples

	Cross-listed			Matched			DiD	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$R_{i,t\text{-}1}$	0.167***	0.167***	0.147***	0.132***	0.132***	0.104***	0.157***	0.131***
	(11.60)	(11.59)	(11.71)	(9.67)	(9.67)	(7.85)	(14.26)	(12.64)
$R_{US,t\text{-}1}$	0.142***	0.348***	0.248***	0.249***	0.298***	0.199***	0.238***	0.145***
	(3.11)	(4.02)	(3.78)	(4.77)	(4.44)	(3.74)	(7.46)	(5.02)
$R_{IN,t\text{-}1}$	0.013	0.012	0.124	0.011	0.024	0.027	0.024	0.027
	(0.44)	(0.26)	(0.36)	(0.91)	(1.25)	(1.09)	(1.25)	(1.40)
$CL_{i,t} \times R_{US,t\text{-}1}$		-0.264***	-0.239***		-0.111	-0.075	-0.033	-0.004
		(3.50)	(3.79)		(1.62)	(1.35)	(0.79)	(0.11)
$CL_{i,t} \times R_{IN,t\text{-}1}$		0.068	0.025		-0.044	-0.051*	-0.023	-0.030
		(0.16)	(0.67)		(1.51)	(1.94)	(0.67)	(0.91)
$CL_{i,t}$		0.163	-0.091		-0.174	-0.036*	-0.191	-0.115
		(0.06)	(-0.05)		(0.68)	(1.81)	(0.25)	(1.61)
$D \times CL_{i,t} \times R_{US,t\text{-}1}$							-0.179**	-0.197***
							(2.20)	(2.62)
$D \times CL_{i,t} \times R_{IN,t\text{-}1}$							-0.026	0.029
							(0.66)	(0.08)
Controls	No	No	Yes	No	No	Yes	No	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	91,927	91,920	91,920	133,320	133,320	133,320	225,240	225,240
Adj. R^2	0.015	0.016	0.223	0.003	0.003	0.091	0.012	0.205

This table shows the results from panel regression of the U.S. cross-listed firms' liquidity innovation on the lagged firm stock return and the U.S. and international market return variables for the cross-listed and matched samples of firms. The sample period is 1950-2013. The U.S. stock market information is from CRSP; and international stock markets data are from DataStream. Each firm in a matched sample is selected based on the procedure described in Table 4. The dependent variable, $\Delta Liq_{i,t}$, is the change in monthly Amihud liquidity measure for each individual firm i at time t. The variables $R_{i,t\text{-}1}$, $R_{US,t\text{-}1}$, and $R_{IN,t\text{-}1}$ are the lagged monthly returns for firm i, CRSP total market index, and international markets, respectively. For each firm i, $R_{IN,t\text{-}1}$ is constructed as the equally-weighted average of MSCI country index return for all hosting markets for its cross-listings at time t. For each firm in the matched sample, $R_{IN,t\text{-}1}$ is set to be identical to the corresponding cross-listed firm. The control variables are the same as in Table 3. CL_i is a dummy variable, which equals one after firm i cross-lists and is zero otherwise. D is a dummy variable which equals one for cross-listed firms and zero for matched firms. DiD are the estimates of the Difference-in-Difference (DiD) tests. Each DiD regression also includes $D \times R_{US,t\text{-}1}$, $D \times R_{IN,t\text{-}1}$, $D \times R_{i,t\text{-}1}$, and $D \times CL_{i,t}$, which are not shown. The control variables, intercept, and firm fixed effects are present in some regressions, but their estimates are not shown. The standard errors are clustered by firm and month. The table also reports the number of observations and the adjusted R-squared. The absolute t-statistics are in parentheses. ***, **, and * indicate significance at 1%, 5%, and 10% levels, respectively.

Table 6
Liquidity betas

		Cross-listed firms		Matched firms		
		Before	After	Before	After	DiD (ΔCross-listed – ΔMatched)
$\beta(\Delta Liq_i, \Delta Liq_m)$	Mean	0.984	0.958	1.027	1.035	-0.034
	SD	0.609	0.424	0.608	0.454	(0.50)
$\beta(\Delta Liq_i, r_m)$	Mean	0.975	0.607	0.881	0.806	-0.293***
	SD	0.666	0.373	0.537	0.518	(4.53)
$\beta(r_i, \Delta Liq_m)$	Mean	0.543	0.618	0.672	0.772	-0.025
	SD	0.632	0.457	0.549	0.641	(0.35)

This table reports the means and standard deviations of the estimated liquidity betas for cross-listed U.S. firms and matched firms without foreign listings before and after listing (pseudo listing) date. The sample period is 1950-2013. The sample of cross-listed U.S. firms includes the U.S. firms with foreign listings after their initial foreign listing date. The matched sample of firms is as in Table 4. To be included in our sample, we also require the firms to have at least twelve months of return and liquidity history available. The stock market return, risk free rate, and liquidity information is computed from CRSP. For each firm *i*, we fit the following bivariate model to obtain the three liquidity betas:

$$y_t = \alpha_i + \beta_i x_t + \varepsilon_t\ ,\ \ \varepsilon_t \sim N(0, \sigma_i^2)\ ,$$

where (y_i, x_i) can take the forms of (ΔLiq_i, ΔLiq_m), (ΔLiq_i, r_m), and (r_i, ΔLiq_m). $Liq_{i,t}$ is the Amihud liquidity measure of firm *i* at month *t*, while ΔLiq_i is the innovation of firm *i*'s monthly Amihud liquidity measure, obtained from the estimated residuals in the univariate AR(2) model. ΔLiq_m is the innovation of monthly market aggregated Amihud liquidity measure obtained from the estimated residuals in the univariate AR(2) model, adjusted to account for the time trend in liquidity as is Pastor and Stambaugh (2003), Acharya and Pedersen (2005), and Watanabe and Watanabe (2008):

$$\frac{MC_{i,t-1}}{MC_{i,1}} Liq_{i,t} = \alpha + \beta_1 \left(\frac{MC_{i,t-1}}{MC_{i,1}} Liq_{i,t-1} \right) + \beta_2 \left(\frac{MC_{i,t-1}}{MC_{i,1}} Liq_{i,t-2} \right) + \varepsilon_{i,t}\ ,$$

where $MC_{i,t-1}$ is the total market capitalization of firm *i* at month *t*-1, and $MC_{i,1}$ is the corresponding value for the initial month. The market aggregated Amihud liquidity measure is the equally-weighted Amihud liquidity measure of all firms listed on the NYSE and NASDAQ. r_i and r_m are the monthly excess returns of firm *i* and CRSP U.S. total market index over the one-month Treasury bill rate, respectively. The Difference-in-Difference (DiD) test in the last column shows the difference in changes in each beta after the listing and before the listing between cross-listed and matched samples of firms. The corresponding absolute *t*-statistics are in parentheses. *** indicate significance at 1% level.

Table 7
Liquidity sensitivity of U.S. firms for different foreign market characteristics

	Number of foreign markets		Market liquidity		Market capitalization	
	Single	Multiple	Low	High	Low	High
$R_{i,t\text{-}1}$	0.174***	0.086***	0.190***	0.111***	0.164***	0.082***
	(9.79)	(11.63)	(8.22)	(11.86)	(10.51)	(13.25)
$R_{US,t\text{-}1}$	0.225**	0.261***	0.195*	0.296***	0.226***	0.311***
	(2.55)	(4.07)	(1.71)	(3.61)	(2.78)	(3.97)
$R_{IN,t\text{-}1}$	0.010	0.015	-0.002	0.021	0.013	0.003
	(0.25)	(0.35)	(-0.03)	(0.56)	(0.35)	(0.06)
$CL_{i,t} \times R_{US,t\text{-}1}$	-0.160	-0.262***	-0.165	-0.288***	-0.192**	-0.314***
	(1.64)	(4.29)	(1.21)	(3.81)	(2.27)	(4.09)
$CL_{i,t} \times R_{IN,t\text{-}1}$	0.037	0.003	0.067	-0.004	0.031	0.014
	(0.79)	(0.08)	(0.92)	(-0.11)	(0.71)	(0.29)
$CL_{i,t}$	-0.292	-0.481	-0.151	0.085	-0.180	-0.271
	(0.13)	(0.28)	(0.63)	(0.37)	(0.09)	(0.14)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	46,446	45,474	30,381	61,539	60,192	31,728
Adj. R^2	0.214	0.536	0.235	0.228	0.218	0.535

This table shows the results from panel regression of the U.S. cross-listed firms' liquidity innovation on the lagged firm stock return and the U.S. and international market return variables for different market characteristics. The U.S. stock market information is from CRSP, and international stock markets data is from DataStream. The dependent variable, $\Delta Liq_{i,t}$, is the change in monthly Amihud liquidity measure for each individual firm i at time t. The variables $R_{i,t\text{-}1}$, $R_{US,t\text{-}1}$ and $R_{IN,t\text{-}1}$ are the lagged monthly returns for firm i, the S&P 500 index, and the international market returns, respectively. For each firm i, $R_{IN,t\text{-}1}$ is constructed as the equally-weighted average of MSCI country index return for all hosting markets for its cross-listings at time t. $CL_{i,t}$ is a dummy equal to one after the initial cross-listing date of firm i and to zero for the time before the listing. The control variables are the same as in Table 3. The market liquidity is the zero-return measure of Lesmond, Ogden, and Trzcinka (1999). It is the equally-weighted average proportion of zero daily returns across all firms in a given country from 1977 to 2010 and is taken from Goyenko and Sarkissian (2014). The host market capitalization information is from the World Development Indicators (WDI) database at the World Bank. The control variables, intercept and firm fixed effects are present in each regression, but their estimates are not shown. The standard errors are clustered by firm and month. The table also reports the number of observations and the adjusted R-squared. The absolute t-statistics are in parentheses. ***, **, and * indicate significance at 1%, 5%, and 10% levels, respectively.

Table 8
Liquidity sensitivity of U.S. firms for different firm characteristics

	Stock PIN		Stock volatility		Foreign income		Foreign Trading	
	Low	High	Low	High	Low	High	Low	High
$R_{i,t\text{-}1}$	0.077***	0.178***	0.078***	0.159***	0.128***	0.173***	0.091**	0.262***
	(13.36)	(10.24)	(13.04)	(10.18)	(8.79)	(8.52)	(3.05)	(3.23)
$R_{US,t\text{-}1}$	0.124***	0.331***	0.215***	0.305***	0.218***	0.328**	-0.021	0.535***
	(2.91)	(3.15)	(3.27)	(2.97)	(3.20)	(2.45)	(0.22)	(3.13)
$R_{IN,t\text{-}1}$	-0.006	0.028	0.032	-0.015	-0.007	0.056	0.126	-0.250*
	(0.27)	(0.52)	(1.20)	(0.29)	(-0.18)	(0.91)	(0.94)	(1.78)
$CL_{i,t} \times R_{US,t\text{-}1}$	-0.121***	-0.276**	-0.195***	-0.284***	-0.196***	-0.348***	0.111	-0.511***
	(3.13)	(2.51)	(3.15)	(2.65)	(2.69)	(2.62)	(0.45)	(3.00)
$CL_{i,t} \times R_{IN,t\text{-}1}$	0.013	0.034	-0.013	0.068	0.034	-0.006	-0.068	0.229
	(0.59)	(0.58)	(0.44)	(1.14)	(0.85)	(0.09)	(0.48)	(1.69)
$CL_{i,t}$	-0.145	0.054	-0.072	0.015	-0.288	0.404	-0.844	-0.123
	(0.97)	(0.22)	(0.42)	(0.06)	(1.36)	(1.50)	(1.34)	(1.67)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	45,895	46,025	46,215	45,705	50,312	41,607	2,039	1,430
Adj. R^2	0.506	0.220	0.407	0.217	0.244	0.206	0.273	0.237

This table shows the results from panel regression of the U.S. cross-listed firms' liquidity innovation on the lagged firm stock return and the U.S. and international market return variables for different firm-level characteristics. The sample period is 1950-2013. The U.S. stock market information is from CRSP, and international stock markets data is from DataStream. The dependent variable, $\Delta Liq_{i,t}$, is the change in monthly Amihud liquidity measure for each individual firm i at time t. The variables $R_{i,t\text{-}1}$, $R_{US,t\text{-}1}$ and $R_{IN,t\text{-}1}$ are the lagged monthly returns for firm i, the S&P 500 index, and the international market returns, respectively. For each firm i, $R_{IN,t\text{-}1}$ is constructed as the equally-weighted average of MSCI country index return for all hosting markets for its cross-listings at time t. $CL_{i,t}$ is a dummy equal to one after the initial cross-listing date of firm i and to zero for the time before the listing. The control variables are the same as in Table 3. The firm characteristics are: the probability of informed trading (PIN), total volatility, the proportion of foreign income, and the proportion of foreign trading, i.e., the ratio of the trading volume in host markets over that in the United States. All firm specific information is collected at the end of each year and averaged over the sample period. The PINs are calculated using the methodology of Venter and Jongh (2006). Firm volatility is the standard deviation of firm gross returns over the sample period. Foreign income is the proportion of the firm's foreign pretax income out of the total pretax income. The information of daily trading volume is from Compustat Global Security Daily. For each firm, we compute the annual average trading volume (in U.S. dollars) in both the U.S. and host markets and then take their ratio. The first three firm characteristic samples are split at the median, while the foreign trading at the 25% and 75% percentiles. The control variables, intercept, and firm fixed effects are present in each regression, but their estimates are not shown. The standard errors are clustered by the firm and month. The table also reports the number of observations and the adjusted R-squared. The absolute t-statistics are in parentheses. ***, **, and * indicate significance at 1%, 5%, and 10% levels, respectively.

Table 9
Foreign ownership and U.S. firms with no cross-listings

Panel A: Changes in the Amihud liquidity measure

	All	Foreign Holdings Ratio				
		Q1 (High)	Q2	Q3	Q4	Q5 (Low)
$R_{i,t\text{-}1}$	0.350***	0.316***	0.284***	0.313***	0.393***	0.569***
	(26.21)	(23.19)	(22.12)	(21.62)	(19.33)	(19.44)
$R_{US,t\text{-}1}$	0.465***	0.344***	0.318***	0.468***	0.706***	0.916***
	(4.97)	(4.13)	(4.55)	(5.55)	(5.58)	(3.79)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	754,785	146,013	212,106	200,817	135,184	60,665
Adj. R^2	0.151	0.144	0.136	0.162	0.159	0.153

Panel B: Changes in the bid-ask spread (illiquidity measure)

	All	Foreign Holdings Ratio				
		Q1 (High)	Q2	Q3	Q4	Q5 (Low)
$R_{i,t\text{-}1}$	-0.162***	-0.144***	-0.160***	-0.143***	-0.156***	-0.207***
	(50.55)	(15.04)	(11.92)	(11.61)	(12.42)	(12.90)
$R_{US,t\text{-}1}$	-0.117***	-0.096	-0.062	-0.057	-0.188***	-0.363***
	(13.29)	(1.49)	(1.07)	(0.85)	(3.28)	(4.00)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	717,258	128,805	182,299	191,858	140,341	73,955
Adj. R^2	0.109	0.100	0.107	0.104	0.118	0.128

This table shows the results from panel regression of the liquidity innovation of U.S. firms without foreign listings on the lagged firm stock return and the U.S. market returns for different quintiles of foreign holdings ratios. The sample period is 2000-2013. There are in total 5,668 firms in the sample. Panel A shows the results for changes in the Amihud liquidity measure. Panel B reports the results for changes in the bid-ask spread. The U.S. stock market information is from CRSP. The foreign holding information for U.S. firms with no foreign listings is from FactSet Ownership database that contains institutional holdings data. All firms are groups into quintiles based on the level of their average foreign holdings ratio over the sample period. In Panel A the dependent variable, $\Delta Liq_{i,t}$, is the change in monthly Amihud liquidity measure for each individual firm *i* at time *t*. In Panel B the dependent variable is the ASPR (adjusted bid-ask spread) illiquidity measure from Hameed, Kang, and Viswanathan (2010). The variables $R_{i,t\text{-}1}$, and $R_{US,t\text{-}1}$ are the lagged monthly returns for firm *i* and the S&P 500 index, respectively. The control variables include changes in firm volatility, share turnover, and U.S. market volatility. The control variables, intercept, and firm fixed effects are present in each regression, but their estimates are not shown. The standard errors are clustered by the firm and month. The table also reports the number of observations and the adjusted R-squared. The absolute *t*-statistics are in parentheses. ***, **, and * indicate significance at 1%, 5%, and 10% levels, respectively.

Table 10
Liquidity provision strategy and return reversals

Panel A: Cross-listed and matched firm samples

	Before cross-listing			After cross-listing				
Portfolio return (%)	μ	σ	ρ	μ	σ	ρ	$\mu_{Before} - \mu_{After}$	*t*-stat
A.1. All Periods								
Matched firms	0.714	2.928	0.039	0.615	4.454	0.038	0.099**	2.26
Cross-listed firms	0.751	4.580	-0.024	0.406	2.649	0.004	0.345***	8.48
A.2. NBER Recession								
Matched firms	0.805	3.422	0.039	0.851	5.598	0.079	-0.045	0.31
Cross-listed firms	1.076	5.393	-0.080	0.486	3.158	0.064	0.590***	11.25
A.3. NBER Expansion								
Matched firms	0.701	2.848	0.033	0.583	4.268	-0.012	0.118***	2.63
Cross-listed firms	0.700	4.437	0.039	0.395	2.569	-0.008	0.305***	7.24

Panel B: Cross-listed firm sample

	Before cross-listing			After cross-listing				
Portfolio return (%)	μ	σ	ρ	μ	σ	ρ	$\mu_{Before} - \mu_{After}$	*t*-stat
B.1. Number of foreign listing markets								
Low (single)	0.789	5.886	-0.046	0.680	4.213	0.006	0.108*	1.89
High (multiple)	0.534	3.933	-0.009	0.257	2.712	0.002	0.277***	7.31
B.2. Foreign market liquidity								
Low	0.799	6.714	-0.069	0.664	4.492	0.019	0.135**	2.11
High	0.577	6.047	-0.007	0.366	2.938	-0.026	0.211***	3.96
B.3. Foreign market capitalization								
Low	0.881	6.627	-0.047	0.681	4.279	-0.027	0.200***	3.19
High	0.538	4.823	-0.036	0.256	3.469	0.113	0.282***	5.99
B.4. Firm PIN								
Low	0.312	4.365	-0.062	0.243	2.627	-0.001	0.070*	1.72
High	0.930	6.820	-0.005	0.785	4.692	-0.026	0.145**	2.21
B.5. Firm volatility								
Low	0.231	2.954	-0.049	0.235	1.765	-0.032	-0.004	0.13
High	0.918	6.826	-0.039	0.797	4.843	-0.006	0.120*	1.81
B.6. Firm foreign income								
Low	0.612	7.457	-0.031	0.562	4.026	-0.018	0.050	0.74
High	0.701	5.754	-0.071	0.423	3.193	-0.017	0.278***	5.33

Table 10 (continued)

This table reports the weekly portfolio return from the liquidity provision strategy as in Lehman (1990), Lo and MacKinlay (1990), and Nagel (2012). The sample period is from 1950 to 2013. The accounting information is from Compustat and stock market information is from CRSP. The liquidity provision trading strategy specifies the portfolio weight for stock *i* at time *t* as

$$w_{i,t} = -\left(1/2\sum_{i}^{N} | R_{i,t-s} - R_{m,t-s} |\right)^{-1} (R_{i,t-s} - R_{m,t-s}) \, ,$$

where $R_{m,t-s}$ is the *s*-period lagged daily equally-weighted market index return, $R_{i,t-s}$ is the *s*-period lagged daily gross return of firm *i*, and *N* is the total number of stocks in the portfolio. The portfolio return at time *t* for the liquidity provision trading strategy is calculated as

$$\Pi_{s,t} = -\left(1/2\sum_{i}^{N} | R_{i,t-s} - R_{m,t-s} |\right)^{-1} \sum_{i=1}^{N} (R_{i,t-s} - R_{m,t-s}) R_{i,t} \, .$$

The weekly portfolio return is computed for *s* = 1, 2…, 5 over the sample period as

$$\Pi_{t} = \sum_{s=1}^{5} \Pi_{s,t} \, .$$

The mean, μ, standard deviation, σ, and autocorrelation, ρ, of aggregated portfolio returns, Π_t, are reported in each column. The Panel A shows the portfolio returns for cross-listed firms and matched firm sample. The details of the cross-listed and the matched sample firms are in Table 4. Panel B shows portfolio returns categorized by three foreign market characteristics (the number of markets for firm listings, market liquidity, and market capitalization) and three firm-specific characteristics (probability of informed trading, PIN, total volatility, and foreign income). All these variables are described in Tables 4 and 5. The first two rows of each panel reports the portfolio return of subsamples based on the median-split. The third row of each panel computes the difference between the means. The last row of each panel reports the absolute *t*-statistic of the two-sample *t*-test. ***, **, and * indicate significance at 1%, 5%, and 10% levels, respectively.

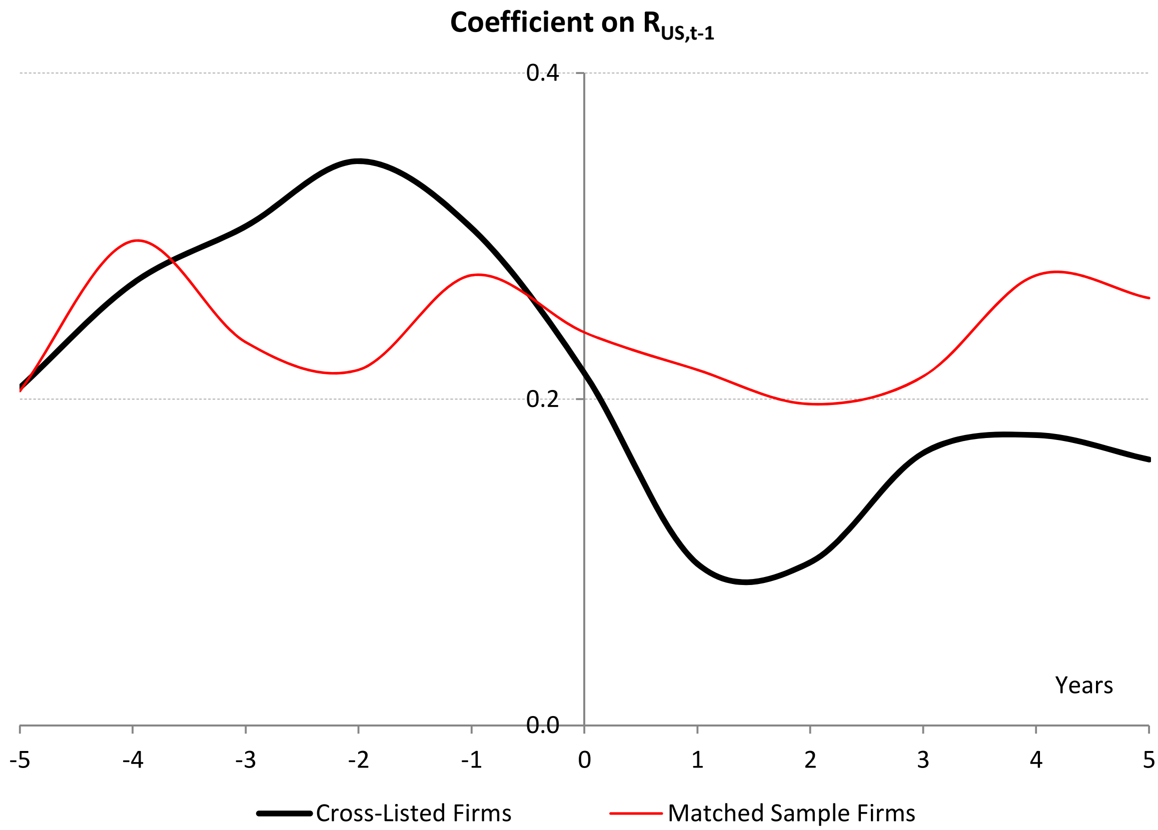

Figure 1. Liquidity sensitivity to U.S. market returns around cross-listing

The plot shows the regression coefficient from regressing firms' liquidity innovation on the lagged U.S. market return variable in the presence of lagged firm stock return and international market return (coefficient β_2 on $R_{US,t-1}$ in specification (1) in Table 5). The coefficient is estimated five years before and five years after the cross-listing (pseudo-cross-listing) event for the cross-listed (matched) sample of firms. Due to a high volatility of estimates, each depicted coefficient in year *t* is the average of respective estimates over a three-year window [*t*-1, *t*, *t*+1]. Each year mark corresponds to the year beginning.

Figure 2. Dynamics of market size of cross-listed and matched firms around cross-listing.
The plot shows the time-series of market capitalization (natural log) of cross-listed firms, as well as matched sample and placebo sample non-cross-listed firms from five years before to five years after the cross-listing month. The sample period is 1950-2013. The matched sample construction is discussed in Table 4. A placebo sample of firms is constructed as follows. First, from the matched sample of firms (a sample of U.S. firms without cross-listings) the time series of market capitalization of each firm is computed. Then firms with a time series pattern similar to that of the cross-listing sample at months -60, 0, and +60 relative to the listing month are selected. The market capitalization data is from CRSP.

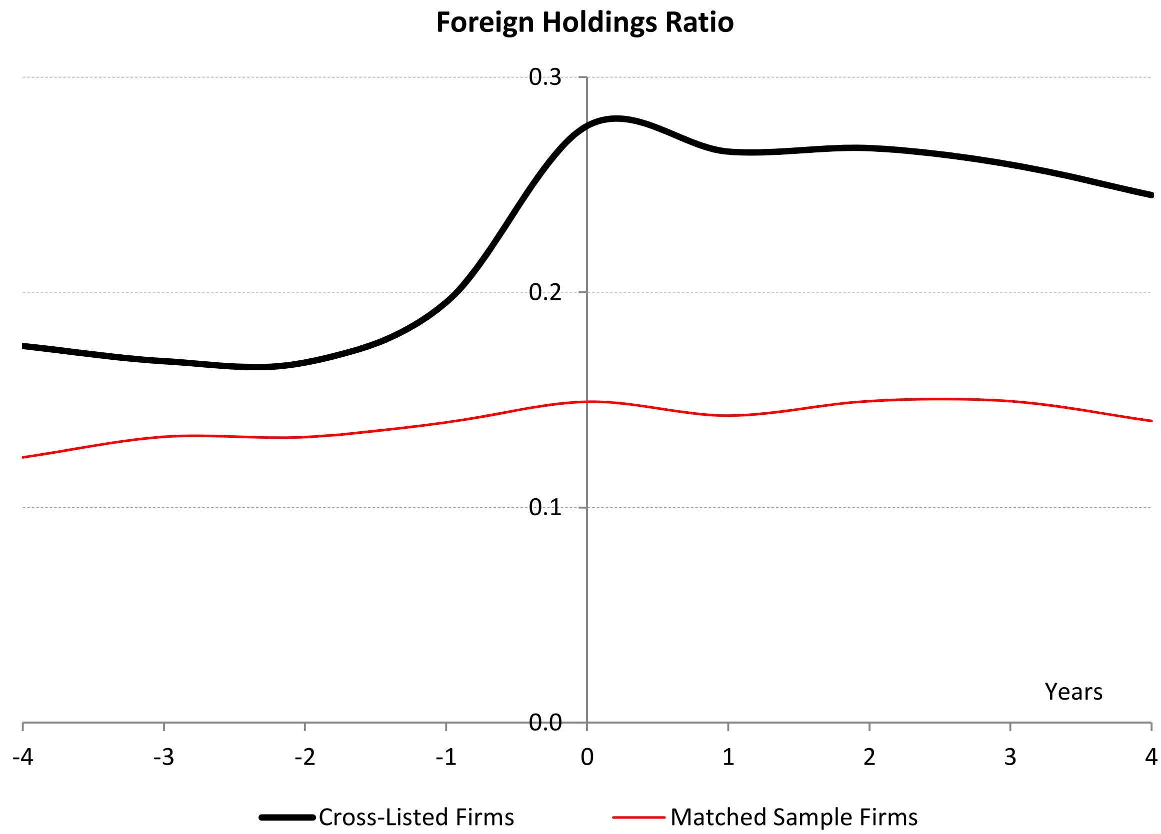

Figure 3. Foreign holdings ratios of cross-listed and matched firms around the listing event.
This figure shows the dynamics of foreign holding ratios of U.S. firms cross-listed in overseas markets and the matched U.S. firms without foreign listings four years before and four years after the cross-listing (pseudo-cross-listing) year (year 0). The sample period is 2000-2013. We first match our sample of cross-listed firms with the FactSet Ownership database that contains institutional holdings data. For each institution (mutual fund, pension fund, etc.), we categorize it as “foreign” if its headquarters are located outside the United States. Then, we compute the proportion of holdings of cross-listed by foreign institutions at the end of each year. We repeat the same procedure for the matched sample.

Global Liquidity Provision and Risk Sharing

INTERNET APPENDIX

(Not for publication)

Feng Jiao and Sergei Sarkissian

Contents:

A.1. Sample Selection Bias

In the present study, we have established that U.S. firms after cross-listing on foreign exchanges enhance firm liquidity during market downturns. Furthermore, our results also demonstrate that the positive impact of foreign listing is stronger in certain types of markets and for firms with certain characteristics. However, the decision to cross-list is endogenous, so that the sample of U.S. firms, which place their shares on foreign exchanges, is not random. Consequently, U.S. firms that decide to cross-list abroad may have unique, but unobservable features that simultaneously affect their decision to cross-list in foreign markets, causing increased global ownership and liquidity gains. Said differently, it is possible that the observed liquidity gains from foreign listing are biased upwards. A cross-listing is frequently associated with time-varying market and industry trends and changes in firms' investment and growth opportunities (see Sarkissian and Schill, 2016).

To address this possible sample selection bias, i.e. to understand whether or not our sample selection affects our findings, we use the Heckman two-stage model (Heckman, 1979). For the first stage estimation, we run a Probit model to predict the probability of U.S. cross-listing on foreign exchanges. The dependent variable is an indicator, $I_{i,j,t}$, which is equal to one after firm *i* cross-lists in a host market *j* at time *t*, and is zero otherwise. Based on the gravity model in Sarkissian and Schill (2016), we include a set of macroeconomics variables, proximity measures, aggregate market conditions, firm level controls, and industry fixed effects as our explanatory variables. The macroeconomic variables include host market GDP (log) and GDP growth rates, as well as the logs of exports from and imports to the United States. All these variables are at annual frequency from the Penn World Tables. We use two static familiarity variables: geographic proximity and cultural proximity. Geographic proximity is the inverse of the logarithm of the great-circle distance between a host country and the United States. Cultural proximity is a dummy that equals to one if the host country has the same colonial heritage or language as the United States (and zero otherwise). We also include U.S. market return, host market return firm return, B/M ratio, and firm size as control variables. All these variables are collected at the end of each year from CRSP and Compustat. International stock market data are from DataStream. All dynamic variables are lagged by one period.[26]

Table A.1 presents the results of both Stage 1 and Stage 2 tests. Along with the point estimates and their absolute t-statistics, the results in Table A.3 also report the number of observations and pseudo R-squared for Stage 1 estimation and adjusted R-squared for Stage 2 estimation. The results of Stage 1 estimation show that the probability of U.S. firms to be listed abroad increases with the proximity and size of the host market, its GDP growth, and imports to the United States. The cross-listing is also more likely with a higher host market return, as well with a larger firm size and foreign income. These results are generally consistent with the determinants on cross-listings found in previous studies (e.g., Pagano, Röell, and Zechner, 2002; Sarkissian and Schill, 2016). Probably the most surprising are the signs of the coefficients on firm return and B/M ratio. Their point estimates only imply that the decision of U.S. firms to be listed abroad is not closely tied to their pre-listing performance. Furthermore, the results of Stage 2 show that the coefficient on $CL_{i,t} \times R_{US,t\text{-}1}$ is still almost identical, both qualitatively and quantitatively, to that in column (4) of Table 3 – our main regression specification. In addition, the inverse Mills ratio coefficient is insignificant. Therefore, the results in Table A.3 provide evidence that our finding on the importance of cross-listing for U.S. firm liquidity enhancement to adverse market conditions is immune to potential sample-selection endogeneity issues.

A.2 Regressions by Firm and Spread-Based Liquidity Measure

Hameed, Kang and Viswanathan (2010) estimate time-series regressions of liquidity innovations on stock returns separately for each individual stock and use a bid-ask spread as their measure of illiquidity. Note that, unlike the bid-ask spread, which is available for a much shorter time period, the Amihud measure allows us to compute stock liquidity over our long sample

[26] Our sample includes all cross-listed firms. In Stage 1, it is constructed by conducting a Cartesian join of each cross-listing *i* and host country *j* in year *t*. We set $I_{i,j,t}$, to unity after firm *i* cross-lists in a host market *j* at time *t*, and zero otherwise. In Stage 2, the sample size is smaller, because the inverse Mills ratio is not available for firms without "Firm Foreign Income".

period. Therefore, in this section, we restate our main results in Table 3 using individual firm regressions with both Amihud and bid-ask spread liquidity measures.

Corwin and Schultz (2012) derive an implicit bid-ask spread, the high-low spread (HLS) estimator, using stock prices collected over two consecutive trading days. This allows us to estimate the bid-ask spread without settling for a short sample period. In what follows, we briefly present their methodology.

Denote H_t (L_t) the high (low) stock price on day t, $H_{t,t+1}$($L_{t,t+1}$) the high (low) stock price over the two consecutive days t and t + 1. Then, the daily HLS or stock illiquidity estimator is:

$$ILLiq_t = \frac{2\left(e^{\alpha} - 1\right)}{1 + e^{\alpha}}, \tag{A.1}$$

where

$$\alpha = \frac{\sqrt{2\beta} - \sqrt{\beta}}{3 - 2\sqrt{2}} - \sqrt{\frac{\gamma}{3 - 2\sqrt{2}}}\ , \ \gamma = \left[ln\left(\frac{H_{t,t+1}}{L_{t,t+1}} \right) \right]^2 , \ \beta = \sum_{j=0}^{1} \left[ln\left(\frac{H_{t+j}}{L_{t+j}} \right) \right]^2 . \tag{A.2}$$

We calculate the monthly averages of $ILLiq_{i,t}$ for each stock i from its daily values. The illiquidity innovation for each firm i at time t, $\Delta ILLiq_{i,t}$, is the percentage change in its monthly HLS estimator, i.e. $\Delta ILLiq_{i,t}$, = ($ILLiq_{i,t}$ – $ILLiq_{i,t-1}$) / $ILLiq_{i,t-1}$. Corwin and Schultz (2012) note that their HLS can be negative for some two-day periods. In these cases, they suggest changing negative daily values to zero. We follow their recommendation. In addition, to simplify comparisons with our estimations that use the Amihud liquidity measure, we multiply $\Delta ILLiq_{i,t}$ by (-1) to arrive to the liquidity-equivalent innovation measure from the bid-ask spread, $\Delta Liq_{i,t}$.

Thus, for each cross-listed stock, we estimate the equation separately for the pre-cross-listing and post-cross-listing periods,

$$\Delta Liq = \alpha + \beta_1 R_{i,t-1} + \beta_2 R_{US,t-1} + \beta_3 R_{IN,t-1} + Firm\_Controls + MKT\_Controls + \varepsilon, \tag{A.3}$$

where ΔLiq is the change in liquidity, while other variables are identical to those in Model (1). The results from these estimations are reported in Table A.2. For brevity, we report the estimates, including standard deviations, of the three main variables of equation (A.3), $R_{i,t-1}$, $R_{US,t-1}$, and $R_{IN,t-1}$. The first three columns of the table reflect the test results based on the Amihud liquidity measure; the last three – on the bid-ask spread.

Columns (1) and (4) of Table A.2 show the equally-weighted mean coefficients across all individual firm regressions using the pre-cross-listing subsample. Columns (2) and (5) correspond to these values from the post-cross-listing subsample. Columns (3) and (6) report the difference in the estimated coefficients between pre- and post-cross-listing subsamples and its statistical significance. The test results are largely consistent with our main findings in Table 3. The average sensitivity of stock liquidity in response to U.S. market returns (coefficient β_2) based on Amihud liquidity is 0.217 before cross-listing but drops to 0.067 after cross-listing. This decline is statistically significant at the 5% level. Meanwhile, there are no significant changes in the other two regression coefficients. The results using the bid-ask spread are also similar to Table 3. Cross-listing decreases the liquidity sensitivity of U.S. firms (the coefficient on $R_{US,t-1}$ drops from 0.891 to 0.416). Statistically, the effect is significant at the 10% level, which is not surprising, since this estimator is less precise than its Amihud counterpart.

A.3. Alternative Controls

We also examine the impact of "bad controls" (Angrist and Pischke, 2009) and non-linearity on the impact of cross-listing on firm liquidity. In our estimations, we control for the observable firm and country characteristics (e.g., volatility, turnover) and find that they do not drive away the beneficial impact of cross-listing on liquidity in weak market conditions. However, one may not exclude the possibility that these variables directly or indirectly depend on the cross-listing decision. For instance, Domowitz, Glen, and Madhavan (1998) and Halling, Pagano, Randl, and Zechner (2008) document big shifts in trading of shares after foreign listing placement. This can impact not only the firm volatility, but also the market-wide volatility and turnover. As a result, controlling for such variables may introduce biases in interpreting our main results. Therefore, in Table A.3, we replace our control variables with the fixed effects composed of the interaction of firm and time fixed effects, as well as the interaction of country and time fixed effects. This change in the estimation specification accounts for unobserved time-varying factors that may influence firm liquidity. The results in column (1) of Table A.3 show that the coefficient on $CL_{i,t} \times R_{US,t\text{-}1}$ and again significantly negative with the point estimate similar to that in Table 3. Then, in column (2), in order to control for any possible association between lagged stock returns and cross-listing, we add an additional term, $CL_{i,t} \times R_{i,t\text{-}1}$. This specification slightly reduces the magnitude of coefficient on $CL_{i,t} \times R_{US,t\text{-}1}$, but it is still negative, large, and statistically significant at the 5% level. Finally, in the last two columns of Table A.3, we add the non-linear terms, first only the lagged squared firm and U.S. market returns, and then alongside with the interaction of these variables with the cross-listing dummy. The assumption underlying this inclusion of squared return terms is that the funding liquidity is more likely to get hit during bad market times characterized by large negative returns. However, controlling for non-linearity does not alter the economic or statistical inference of our previous estimations.

A.3. Return Magnitude around Cross-Listing and Liquidity Sensitivity

It is well known that firms experience substantial changes in returns around their cross-listing dates (e.g., Foerster and Karolyi, 1999; Sarkissian and Schill, 2009). Therefore, we would like to see if the size of returns around the listing date is related to changes in liquidity sensitivity. We address this issue by ranking all U.S. firms based on their cumulative abnormal returns (CARs) around cross-listing events.

First, following Foerster and Karolyi (1999), we compute the CARs over three periods: the pre-listing period (from day -100 to day -2) and the full period around listing events (from day -100 to day +250). The CARs are based on a U.S. market model. For each firm, the U.S. market model is estimated during the 150-day pre-listing period from day -250 to day -101. We require a minimum of 40 observations for the U.S. market model estimation. Then we split this ranked sample by the median and re-run estimations based on Regression (4) from Table 3 on the resulting subsamples.

The test results are shown in Table A.4. Regressions (1) and (3) correspond to the firms with below-median pre-listing, post-listing, and full listing period CARs, respectively; while Regressions (2) and (4) are for those with above-median CARs. Our results reveal that the coefficient of $CL_{i,t} \times R_{US,t\text{-}1}$ is consistently larger in magnitude for the subsamples with above-median CARs. This is quite intuitive. In unreported results, we find that firms with above-median CARs experience larger changes in their market cap, liquidity, trading volume, and foreign ownership upon cross-listing than their below-median counterparts. This implies that a superior stock performance during the listing period is associated with strong demand for it among global investors. As a result, the larger foreign ownership of firms with high CARs facilitates their ownership dispersion channel resulting in larger coefficient on $CL_{i,t} \times R_{US,t\text{-}1}$.

A.4. Foreign Ownership Changes around the Crisis Period

The liquidity provision channel implies that foreign arbitrageurs, unaffected by tighter U.S. funding constraints, may take the advantage of arbitrage opportunities by buying the U.S. equities during U.S. market downturns. This pattern resembles the trading of a market maker, who buys when the public sells (which tends to coincide with falling prices). Consequently, we explore whether foreign investors buy the U.S. cross-listed firms when the U.S. funding constraint tightens, i.e., when the effect of foreign holdings on firm liquidity is maximal.

Figure A.1 summarizes foreign holdings ratio of cross-listed U.S. firms five years before and after the financial crisis year of 2008. Plot A in Figure A.1 shows holdings of both cross-listed firms and the matched U.S. firms without foreign listings. It also shows the average annualized TED spread. In line with the intuition, there is a monotone and profound increase in the TED spread between 2003 and 2008, which suggests a steadily tightening funding liquidity conditions prior to the 2008 financial crisis. However, after 2008, the TED spread drops significantly, remaining below 0.5% on average in annual terms. In support of our expectation, we observe that the proportion of foreign ownership of cross-listed firms also increases from about 12% prior to the crisis to almost 20% after it, to peak by 2009 and then decrease in subsequent years. By contrast, the foreign ownership of matched firms does not experience any increase around the crisis years: the overall change in its proportion within the eleven-year window is below 2%. Therefore, Plot A in Figure A.1 shows that, with an increase in market uncertainty and decrease in funding liquidity, holding of cross-listed firms only becomes more attractive to international investors.

The next logical question to address is what types of institutions are responsible for the observed dynamics of foreign ownership of cross-listed stocks. Plot B of Figure A.1 shows foreign holdings ratios over the same 2002-2013 sample period by type of institution: closed-end funds, exchange traded funds, mutual funds, pension funds, annuity funds, and hedge funds. With regard to these results, the first observation is that, in the years before the financial crisis, the largest foreign institutional owners of cross-listed U.S. firms were closed-end funds and pension funds; however, post-crisis, such largest foreign institutional owners were pension funds and hedge funds. Over time, closed-end funds have very significantly lost their appetite for holding cross-listed securities: while, in 2003, their share of foreign ownership was about 60%, by 2011, it dropped below 20%. The other types of institutional owners maintained low, relatively more stable, or slightly increasing proportions of holdings of cross-listed U.S. stocks. The second and more important observation is that the foreign holdings of both pension funds and hedge funds experience strong run-up prior to the crisis, followed by a gradual decrease and levelling off over some higher level of holdings ratio. The time-series pattern of foreign holding ratios of these two types of institutions effectively explains the aggregate institutional ownership results presented in Plot A (Figure A.1).

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Table A.1
Sample selection bias

Stage 1: Probit Regression (annual frequency)		Stage 2: Main Regression	
Host GDP (Log)	2.814*** (43.96)	$R_{i,t\text{-}1}$	0.146*** (12.35)
Host GDP Growth	0.112*** (6.71)	$R_{US,t\text{-}1}$	0.246*** (4.16)
Export to the U.S. (Log)	-0.842*** (44.26)	$R_{IN,t\text{-}1}$	0.009 (0.26)
Import from the U.S. (Log)	0.330*** (20.99)	$CL_{i,t} \times R_{US,t\text{-}1}$	-0.230*** (4.52)
Geographic Proximity (Log)	0.104*** (6.68)	$CL_{i,t} \times R_{IN,t\text{-}1}$	0.024 (0.61)
Cultural Proximity	-1.375*** (58.74)	$CL_{i,t}$	-0.008 (0.28)
US Market Return	0.000 (0.01)	IMR	0.095 (0.79)
Host Market Return	0.299*** (6.61)		
Firm Return	-0.181*** (10.12)		
Firm Size	0.279*** (63.41)		
Firm Foreign Income	0.041*** (8.46)		
B/M	0.137*** (10.75)		
		Controls	Yes
Industry FE	Yes	Firm FE	Yes
Intercept	Yes	Intercept	Yes
Obs.	125,037	Obs.	71,970
Pseudo R^2	0.310	Adj. R^2	0.251

This table shows the results from Heckman's selection bias tests. The sample period is 1950-2013. Stage 1 gives Probit model results from regressing the cross-listing indicator on financial and economic characteristics. The dependent variable is an indicator, $I_{i,j,t}$, which is equal to one after firm *i* cross-lists in a host market *j* at time *t*, and is zero otherwise. All macroeconomic variables are at annual frequency from the Penn World Tables. U.S. market return, firm returns, B/M ratio, and firm size are collected at the end of each year from CRSP and Compustat. International stock market data is from DataStream. Geographic proximity is the inverse of the logarithm distance between a host country and the United States. Cultural proximity is a dummy equals to one if the host country has the same colonial heritage as the United States, and is zero otherwise. Firm size is the logarithm of market capitalization. Firm Foreign Income is the proportion of a firm's income generated from non-U.S. sources. Industry fixed effects are constructed using one-digit SIC codes. Stage 2 gives the main regression results from Table 3 after including the inverse Mills ratio (IMR) from Stage 1 as an additional control variable. All other variables are defined as in Table 3. The table also reports the number of observations and pseudo-R^2 in Stage 1 and adjusted R^2 in Stage 2 estimations. The absolute *t*-statistics are in parentheses. ***, **, and * indicate significance at 1%, 5%, and 10% levels, respectively.

Table A.2
Regression by firm and spread-based liquidity measure

		Amihud Liquidity			High-Low Spread × (-1)		
		Before	After	After - Before	Before	After	After - Before
$R_{i,t\text{-}1}$	Mean	0.105	0.139	-0.033	0.201	0.095	-0.106
	SD	0.162	0.270	(1.60)	1.051	0.621	(1.34)
$R_{US,t\text{-}1}$	Mean	0.217	0.067	-0.149**	0.891	0.416	-0.476*
	SD	0.992	0.554	(2.01)	3.562	2.177	(1.75)
$R_{IN,t\text{-}1}$	Mean	-0.038	0.008	0.047	-0.337	-0.089	0.248*
	SD	0.604	0.375	(1.00)	1.572	1.310	(1.79)

This table shows the average coefficients from the regression of U.S. cross-listed firms' liquidity innovation on the lagged firm stock return and the U.S. and international market return variables. The sample period is 1950-2013. It reports the results based on the Amihud liquidity measure and the Corwin and Schultz (2012) high-low spread (HLS) estimator. For each cross-listed stock, we estimate equation (A.3) separately for the pre-cross-listing and post-cross-listing sub-periods. Then, we report the equally-weighted mean coefficients across all individual firm regressions. The U.S. stock market information is from CRSP, and international stock markets data is from DataStream. In columns (1)-(3), the dependent variable is the innovation in Amihud liquidity measure. The dependent variable in columns (4)-(6), is the change in the monthly HLS estimator for each individual firm i at time t multiplied by (-1). The daily HLS estimator is:

$$ILLiq_{i,t} = \frac{2\left(e^{\alpha}-1\right)}{1+e^{\alpha}},\ \alpha = \frac{\sqrt{2\beta}-\sqrt{\beta}}{3-2\sqrt{2}} - \sqrt{\frac{\gamma}{3-2\sqrt{2}}},\ \gamma = \left[ln\left(\frac{H_{t,t+1}}{L_{t,t+1}}\right)\right]^2,\ \beta = \sum_{j=0}^{1}\left[ln\left(\frac{H_{t+j}}{L_{t+j}}\right)\right]^2.$$

H_t (L_t) is high (low) price on day t, $H_{t,t+1}$ ($L_{t,t+1}$) is the high (low) price on days t and t+1. The monthly average HLS estimator for each stock is computed from its daily measure. The illiquidity innovation is the percentage change in the monthly illiquidity measure, that is, $\Delta ILLiq_{i,t}$, = ($ILLiq_{i,t}$ - $ILLiq_{i,t\text{-}1}$) / $ILLiq_{i,t\text{-}1}$. We multiply $\Delta ILLiq_{i,t}$ by (-1) to arrive to the liquidity-equivalent innovation measure of the bid-ask spread. Other variables are as in Table 3 and are winsorized at 1% and 99%. The absolute t-statistics are in parentheses. ***, **, and * indicate significance at 1%, 5%, and 10% levels, respectively.

Table A.3
Alternative controls

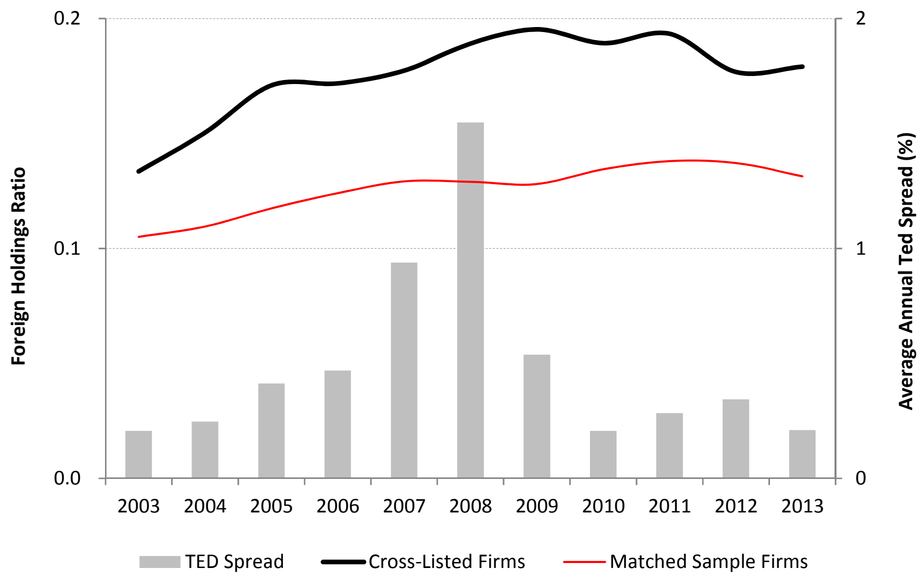
	(1)	(2)	(3)	(4)
$R_{i,t\text{-}1}$	0.140***	0.178***	0.174***	0.170***
	(9.89)	(5.21)	(5.12)	(4.98)
$R_{US,t\text{-}1}$	0.357***	0.315***	0.319***	0.321***
	(4.04)	(3.50)	(3.54)	(3.53)
$R_{IN,t\text{-}1}$	0.033	0.029	0.030	0.032
	(0.64)	(0.55)	(0.57)	(0.61)
$CL_{i,t} \times R_{US,t\text{-}1}$	-0.259***	-0.206***	-0.207***	-0.209***
	(3.43)	(2.63)	(2.63)	(2.68)
$CL_{i,t} \times R_{IN,t\text{-}1}$	-0.023	-0.017	-0.017	-0.021
	(0.49)	(0.37)	(0.37)	(0.43)
$CL_{i,t}$	-0.011	-0.011	-0.011	-0.009
	(1.57)	(1.45)	(1.50)	(1.21)
$CL_{i,t} \times R_{i,t\text{-}1}$		-0.050	-0.049	-0.044
		(1.41)	(1.39)	(1.23)
$R_{i,t\text{-}1}{}^{2}$			0.065	0.134
			(1.43)	(1.41)
$R_{US,t\text{-}1}{}^{2}$				0.161
				(0.20)
$CL_{i,t} \times R_{i,t\text{-}1}{}^{2}$				-0.087
				(0.80)
$CL_{i,t} \times R_{US,t\text{-}1}{}^{2}$				-0.178
				(0.25)
Country × Time FE	Yes	Yes	Yes	Yes
Firm × Time FE	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes
Obs.	91,921	91,921	91,921	91,921
Adj. R^2	0.012	0.012	0.012	0.012

This table shows the main regression results after controlling for additional fixed effects and non-linearity. The sample period is 1950-2013. The U.S. stock market information is from CRSP, and international stock markets data is from DataStream. The dependent variable and explanatory variables are defined as in Table 3. $R_{i,t\text{-}1}{}^{2}$ is the squared term of $R_{i,t\text{-}1}$. Country × Time FE is the interaction of home country and time fixed effects. Firm × Time FE is the interaction of firm and time fixed effects. The time fixed effects are at the annual frequency. The intercept and fixed effects are present in each regression, but their estimates are not shown. The standard errors are clustered by firm and month. The table also reports the number of observations and the adjusted R-squared. The absolute *t*-statistics are in parentheses. ***, **, and * indicate significance at 1%, 5%, and 10% levels, respectively.

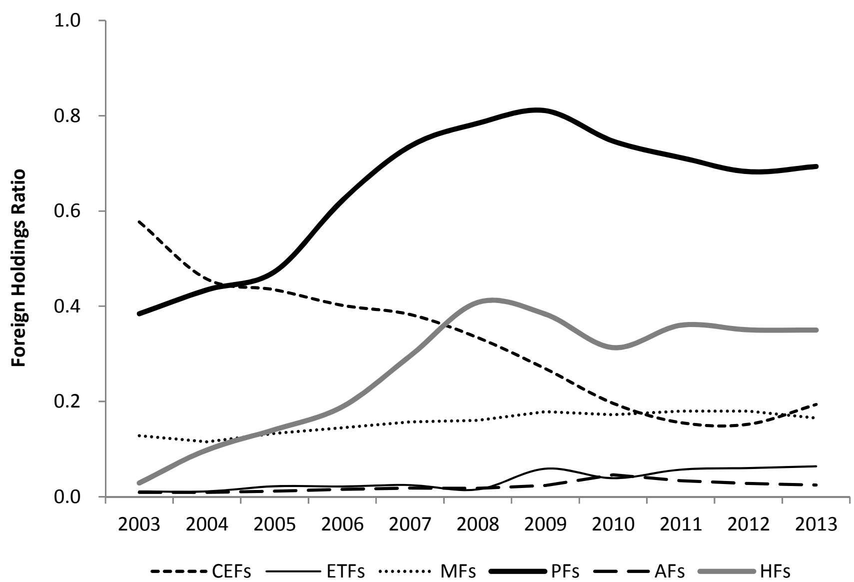
Table A.4
Return magnitude around cross-listing and liquidity sensitivity

	Pre-listing period		Full listing period	
	Low CARs	High CARs	Low CARs	High CARs
$R_{i,t\text{-}1}$	0.131***	0.145***	0.142***	0.132***
	(8.13)	(7.17)	(8.17)	(6.41)
$R_{US,t\text{-}1}$	0.147	0.352***	0.145*	0.357***
	(1.56)	(4.78)	(1.78)	(4.09)
$R_{IN,t\text{-}1}$	0.032	-0.040	-0.019	0.014
	(0.67)	(-0.95)	(-0.45)	(0.30)
$CL_{i,t} \times R_{US,t\text{-}1}$	-0.184**	-0.302***	-0.165**	-0.332***
	(2.10)	(3.14)	(2.18)	(3.20)
$CL_{i,t} \times R_{IN,t\text{-}1}$	0.044	0.034	0.075	0.006
	(0.73)	(0.77)	(1.44)	(0.12)
$CL_{i,t}$	-0.042	-0.015	-0.018	0.011
	(0.17)	(0.07)	(0.78)	(0.42)
Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes
Obs.	34,744	33,921	33,906	33,425
Adj. R^2	0.223	0.242	0.236	0.230

This table shows the results from panel regression of the U.S. cross-listed firms' liquidity innovation on the lagged firm stock return and the U.S. and international market return variables depending on the magnitude of pre-listing cumulative abnormal returns (CARs). Columns (1) and (3) show the estimation of liquidity sensitivity for firms with below median CARs (Low CARs); columns (2) and (4) – for firms with above median CARs (High CARs). The U.S. stock market information is from CRSP, and international stock markets data is from DataStream. The dependent variable, $\Delta Liq_{i,t}$, is the change in monthly Amihud liquidity measure for each individual firm i at time t. First, for each individual stock, we calculate the monthly average Amihud liquidity measure from its daily measure. Then we compute the liquidity innovation as percentage change in the monthly Amihud liquidity measure, i.e. $(Liq_{i,t} – Liq_{i,t\text{-}1})/|Liq_{i,t\text{-}1}|$. The variables $R_{i,t\text{-}1}$, $R_{US,t\text{-}1}$, and $R_{IN,t\text{-}1}$ are the lagged monthly returns for firm i, CRSP total market index, and international markets, respectively. For each firm i, $R_{IN,t\text{-}1}$ is constructed as the equally-weighted average of MSCI country index return for all hosting markets for its cross-listings at time t. $CL_{i,t}$ is a dummy equal to one after the initial cross-listing date by firm i and to zero for the time before the listing. The control variables are the same as in Table 3. The CARs are computed over three periods: the pre-listing period (from day -100 to day -2) and the full period around the listing event (from day -100 to day +250). The CARs are based on a U.S. market model. For each firm, the U.S. market model is estimated during the 150-day pre-listing period from day -250 to day -101. The standard errors are clustered by firm and month. The table also reports the number of observations and the adjusted R-squared. The absolute t-statistics are in parentheses. ***, **, and * indicate significance at 1%, 5%, and 10% levels, respectively.



Plot A: Foreign holding ratios of cross-listed and matched firms versus the TED spread



Plot B: Foreign holdings ratios by institution type

Figure A.1. Foreign holdings ratio of cross-listed U.S. firms around the crisis period

This figure shows the dynamics of foreign holdings ratios of cross-listed U.S. firms five years before and five years after 2008. Plot A shows holdings of both cross-listed firms and the matched U.S. firms without foreign listings (pseudo cross-listing). It also shows the average annualized TED spread. We first match our sample of cross-listed firms with the FactSet Ownership database that contains institutional holdings data. For each institution (mutual fund, ETF, pension fund, etc.), we categorize it as "foreign" if its headquarters are located outside the United States. Then, we compute the proportion of holdings of cross-listed by foreign institutions at the end of each year. We repeat the same procedure for the matched sample. Plot B shows foreign holdings ratios by the type of institution: CEF – closed-end funds, ETFs – exchange traded funds, MFs – mutual funds, PFs – pension funds, AFs – annuity funds, HFs – hedge funds.