The liquidity of international real estate securities

Content table

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Abstract

This paper examines the liquidity of international real estate securities, across three continents over the period 1995-2015.

We apply and compare results for four different measures of liquidity, and find that liquidity has increased consistently, wide variations across markets exist. All four measures – volume, turnover, Amihud's illiquidity ratio, and the number of zero return days – all identify the U.S., Japanese and Australian markets as the most liquid ones in the world. The introduction of a local REIT regime does not to have any pervasive effects on stock liquidity, as European REIT markets like Germany and France still lag behind.

When we link these liquidity statistics to the corresponding returns, we document new and consistent evidence for international trend chasing behavior in listed real estate market. Liquidity is commonly a function of past returns. At the same time, we also find interesting international variations in our output that suggests that the interaction with the equity market is dependent on the dominance of the local financial market.

In case financial markets are strong, we find strong interaction between equity returns and listed real estate liquidity and returns. We also report evidence that the auto-regressive patterns in both liquidity and returns of real estate securities weaken when markets mature and become more efficient.

Finally, we find that in these most mature markets, listed real estate effectively serves as an inflation hedging store for value when the economy weakens.

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1. Introduction

Publicly listed property shares have become an increasingly popular channel to acquire property exposure. The convenience of selling and buying property investments swiftly at low costs through the stock market has been stressed as a unique selling point for these indirect real estate investments. Compared to direct investments in the private real estate markets property shares are considered to be rather liquid.

The question is whether they are as liquid as common stocks. The public stock listing of property shares by itself does not guarantee the liquidity institutional investors are looking for. Lieblich and Pagliari (1997) showed that the limited market capitalisation of the average U.S. REIT hampered their appeal, since it was impossible to sell of large quantities of shares without suffering from a significant price impact. But while the U.S. equity REIT-market composed of only 58 firms with a total market capitalisation of just over 5 billion dollars in 1990, by the end of 2005 the equity REIT market has grown in both numbers and value comprising of 160 firms representing a total market cap of over 300 billion U.S. dollars. This development may imply greater liquidity in the property share market.

Liquidity is a rather vague and relative concept. According to Boulding (1955) “Liquidity is a quality of assets which is not a very clear or easily measurable concept”. Fifty years later, his words still seem to remain true as there has been no unique definition and measure of financial asset liquidity. Kyle (1985) claims that liquidity of a financial asset includes three transactional characteristics: the cost of liquidating a position over a short period of time – tightness, the ability to buy or sell large quantities of shares with minimal price impact – depth, and the propensity of prices to recover quickly from a random shock to the market – resiliency.

In the real estate literature numerous studies have been performed in which liquidity of the U.S. REIT market was the focal point. Below, Kiely and McIntosh (1996) analyse d the tightness of the market by measuring liquidity using the bid-ask spread. They reported declining bid-ask spreads between 1992-1994 for NYSE-listed REITs and concluded that liquidity was indeed rising. Recently Clayton and MacKinnon (2000) were the first to examine the depth of the REIT market. By employing trade-by-trade data they looked at the price impact of REIT trades at the NYSE, AMEX, and NASDAQ between 1993 and 1996. Calculating

Kyle's (1985) lambda, a measure of the price impact of trades, they find that the median price impact declined for equity REITs during the period examined.

This paper extends the available literature in two ways. First, we look at the period 1990 – 2015. Especially the last ten years of that sample period we have seen strong growth in the property share markets and institutional interest therein. This is likely to have an impact on liquidity, and these years have not been covered in the existing literature. Second, we analyse liquidity internationally in order to find out whether findings for the REIT-market also hold in the property share markets of France, Germany, the Netherlands, the U.K., Australia, Hong Kong, Japan, Singapore, Canada and the U.S. During all of this we compare our results with a control sample of non-real estate related stock, which are matched on market capitalisation.

Controlling for share price, market capitalisation, analyst coverage, return volatility, free float and ownership level, we document significant and periodic differences in liquidity between property shares and common stocks across all markets, as measured by trading volume and price impact of trading. Specifically, the paper finds relatively low liquidity in property share markets in the 1990s, but similar or greater levels of liquidity in the post-2000 period. Furthermore, across markets and time, a stock's share price is found to be significantly inversely related to liquidity, whereas its market capitalisation and analyst coverage exhibit positive relationships with liquidity.
The remainder of the paper proceeds as follows. First we offer an overview of the most relevant literature on liquidity. In the third section we present our data and summary statistics and discuss the methodology we have selected for our analysis. We proceed by explaining the cross sectional variation in velocity for our four international samples using multivariate regression analysis. Next we examine the relationships between trading velocity and stock performance, to see whether velocity really matters. We summarize our most important findings in the concluding section.

2. Liquidity literature

Bernstein (1987) argues "that no single measure tells the whole story about liquidity". In fact, his statement seems to be reflected in the multitude of proxies which can be found in the literature on the liquidity of financial assets trading on exchanges or in over-the-counter markets.

Asset trading activity measures relate to the liquidity dimensions of time and quantity. The reasoning to relate these measures to liquidity is that assets which are traded more actively are easier to buy or to sell for investors than assets which are traded less actively, especially when dealing with larger positions within a shorter period of time. Trading volume (number of shares traded), dollar trading volume (value traded), turnover (trading volume adjusted by number of shares outstanding), and number of trades have been investigated in studies like Wang, Erickson and Chan (1995), Below, Kiely and McIntosh (1995), Clayton and MacKinnon (1999), Chordia, Roll and Subrahmanyan (2001), and Hasbrouck and Seppi (2001).

2.1 Factors driving liquidity

Several factors have been found to be linked to the liquidity of financial assets trading on exchanges or over-the-counter. Bolton and Von Thadden (1998) and Loughran and Schultz (2004), for instance, argue that the liquidity of a stock is a positive function of its market capitalisation. Furthermore, Bolton and Von Thadden (1998) posit that this effect might be related to potential information asymmetries. Pritsker (2002, p.129) states that, in the presence of asymmetric information, “prices change in response to trades because of the information that the trades might convey about asset fundamentals”. Asymmetric information problems might, however, be mitigated by an asset’s market capitalisation. Specifically, Bolton and Von Thadden (1998, pp. 2-3) posit that “the number of investors willing to invest in information acquisition in a particular stock will be increasing with the anticipated gains from trade and, hence, in the stock’s market capitalisation”. This has the consequence that stocks with larger market capitalisations should have tighter bid-ask spreads, higher trading volume, and greater liquidity ratios.

An asset’s liquidity is also likely to be affected by its price and the number of shares outstanding. All else equal, it might be expected that the trading volumes of stocks with relatively higher prices are lower than for stocks with relatively lower prices, as investors are able to shift the same amount of value with relatively lower volumes. With regards to the number of shares outstanding, it might be expected that, all else equal, the trading volumes of stocks with relatively less shares outstanding are lower than for stocks with relatively more shares outstanding, as investors need to trade less shares to shift the same amount of value.

Ownership concentration also might have a significant effect on asset liquidity. Bolton and Von Thadden (1998) claim that block holdings effectively decrease the number of shareholders and, thus, the liquidity of a stock. Benston and Hagerman (1974), Holmstrom and Tirole (1993), and Amihud, Mendelson and Uno (1999) come to a similar conclusion in that ownership dispersion promotes liquidity.

Insider holdings might have an impact on asset liquidity via asymmetric information problems. According to Heflin and Shaw (2000), high insider ownership may lead to greater asymmetric information problems. Sarin, Shastri and Shastri (2000) document that information asymmetry faced by traders is positively related to insider ownership, with the effect of widening quoted bid-ask spreads. Moreover, institutional ownership levels have also been documented to potentially impact an asset’s liquidity. Nelling, Mahoney, Hildebrand and Goldstein (1995) find that bid-ask spreads are inversely related to institutional ownership levels. They attribute this relationship to the role of institutional investors in reducing information asymmetries. Following the reasoning of Ling and Ryngaert (1997), Cole (1998) argues that greater institutional ownership should increase

adverse selection risks and thus spreads. His tests, however, merely find an insignificant positive relationship between institutional ownership levels and spreads. In contrast, besides observing a positive effect of insider holdings on spreads, Chiang and Venkatesh (1988) document no effect for institutional holdings on spreads. In addition, Sarin et al. (2000) discover that higher institutional ownership levels are associated with larger average transaction sizes. Analyst coverage has also been found to promote an asset's liquidity by mitigating information asymmetries. Both Brennan and Subrahmanyan (1995) and Roulstone (2002) find a positive relationship between the number of analysts covering a stock and an asset's liquidity.

2.2 Liquidity of property shares

Systematic investigation of the liquidity of property shares seems to have been quite limited to date and is almost exclusively focused on US REITs. Looking at the US market in the period 1973-1992, Wang, Erickson and Chang (1995) find that the liquidity of REIT stocks is substantially lower than that of the general stock market. Specifically, they show that, controlling for market value, REIT stocks have significantly lower turnover ratios, lower institutional ownership levels, and thinner financial analyst coverage, on average, than do other stocks regardless of the year examined. Nelling, Mahoney, Hildebrand and Goldstein (1995) look at US REITs from 1986 to 1990 and find that REIT liquidity, as measured by month-end absolute bid-ask spreads, increases over the period examined, is inversely related to market capitalisation, and is – in contrast to findings by others – similar in magnitude to that of other common US stocks of comparable size. Moreover, they find that bid-ask spreads are primarily determined by market capitalisation.

Using intraday transaction data, Below, Kiely and McIntosh (1995) analyse the liquidity of US REIT stocks trading on the NYSE for 1991. They find that REIT stocks were less liquid than non-REIT stocks. Specifically, they observe that non-REIT stocks exhibited larger average trading volumes and number of trades than did similar REIT stocks. Furthermore, their results suggest that equity REIT stocks traded at average absolute bid-ask spreads that were wider than those of similar non-REIT stocks. In general, the results of their analysis suggest that REITs with high institutional ownership levels appear to have relatively small smaller spreads.

In a subsequent study, again employing intraday transaction data, Below, Kiely and McIntosh (1996) examine the liquidity of US REIT stocks which traded on the NYSE both during the pre-boom period of 1992 and the post-boom period of 1994. They show that REIT share liquidity significantly increases. Moreover, their study shows that, in general, the REIT stocks trade in larger volumes, more often, and at narrower absolute spreads in 1994 than in 1992. In addition, the results indicate that institutional ownership has minimal impact on the frequency of REIT stock trading, but significantly increases the trading volume of REITs. Bhasin, Cole and Kiely (1997) find comparable evidence of increased REIT liquidity from 1990 to 1994. Moreover, they document that percentage bid-ask spreads were an increasing function of return variances, and a decreasing function of trading volume, turnover, share price, and market capitalisation. In a later study by Cole (1998), Bhasin et al.'s (1997) finding of narrowing bid-ask spreads is qualified. Cole shows that when only REIT stocks which traded both in 1990 and 1994 are looked at, percentage spreads widened rather than narrowed. He credits the contradictory previous observation of industry-wide narrowing of spreads to new and structurally different REITs which went public between 1990 and 1994.

Clayton and MacKinnon (2000) employ trade-by-trade data to investigate the liquidity of REITs in 1993 and 1996. Calculating Kyle's (1985) lambda, a measure of the price impact of trades, they find that the median price impact declined for equity REITs during the period examined. Furthermore, they show that adverse-selection costs due to the presence of more informed traders were more than compensated for by an increase in the number of uninformed traders, resulting in decreased information asymmetries faced by market makers.

Studying a REIT market decline on the NYSE in 1998, Clayton and MacKinnon (1999) find a decrease in trading volume and an increase in price volatility and relative effective bid-ask spreads of equity REIT stocks. Furthermore, their results indicate that the decrease in liquidity was more profound for small capitalisation REIT stocks than for large capitalisation REIT stocks, which demonstrated fairly stable liquidity throughout the downturn. As a consequence, they advocate REIT industry consolidation as a mean of fostering the liquidity of REIT stocks. Examining a general market decline on the NYSE on October 27, 1997, Glascock, Michayluk and Neuhauser (2004) document that the market value decline of REITs was one and a halve times larger than the decline of non-REIT stocks. Furthermore, they witness that on the event day the closing percentage bid-ask spreads of all stocks significantly increased and that only the spreads of non-REIT stocks continued to widen on the following day of partial market reversion while those on REIT stocks declined.

In particular, the research to date has predominantly examines US REITs. Apparently, only Wang, Erickson and Chang (1995) provide a rudimental evaluation of the liquidity of non-REIT real estate stocks. Studies for property share markets outside of the United States are not available. Furthermore, with the exception of Below, Kiely and McIntosh (1995 and 1996), all authors appear to restrict their analyses of liquidity differences to comparisons of average values of liquidity measures and factors impacting liquidity, instead of controlling for potentially confounding effects on liquidity and explicitly examining comparable stocks. Moreover, the last year studied so far has been 1998, while no evaluations of potential liquidity differences for the last six years have been carried out. In addition, the most dominant liquidity proxy appears to have been the bid-ask spread. Our subsequent analysis intends to add to the existing research on the differences in liquidity between non-real estate stocks and real estate stocks by addressing some of these deficits. Specifically, it extends the examination internationally, looks at both stocks of real estate firms and of non-real estate companies, examines the period 1990-2005, adjusts for potentially confounding factors and compares similar companies, and employs other liquidity proxies than bid-ask spreads.

3. Data and liquidity measures

We focus our empirical analysis on the ten largest listed property share markets – France, Germany, the Netherlands, the U.K., Australia, Hong Kong, Japan, Singapore, Canada and the U.S. Ten market that jointly reporesent over 75% of the total market capitalisation of the Global listed real estate markets, today.

We obtain the required data from two main sources which provide access to individual REIT / property company data on a daily basis. To obtain reliable results and to compute monthly liquidity measures, we use a long time series of 615 companies for more than 4000 days over the period December 1995 to March 2015. We initially download the following daily data from SNL Financials for all companies: share price [P], number of shares traded [NOSH] and total return [TR]. Market values are instead obtained from Datastream (Thomson Reuters group) after checking that other measures were consistent between these sources. The decision to use these sources jointly was to guarantee the maximum coverage possible. In fact, SNL Financials does not have great coverage of market values (especially at the beginning of our sample period) but showed better coverage for other data points. Finallly, macroeconomic data were also obtained from Datastream.

In table 1, we list the summary statistics for the firms in our sample at the start of 2015. In total our sample consists of 615 property shares, of which 136 European, 204 Asian-Pacific, and 275 Northern American.

The statistics in Table 1 show that although by now REIT regimes have been introduced in each of these ten markets, less than two third of the sampled firms have in fact adopted the REIT regime as of today. This may be partly due to the maturity of the local REIT regimes, which has been around since 1960 in the U.S., and has only been introduced in Germany in 2007. Another remarkable variation in our international sample relates to the stakes of institutional investors. These vary between 11.61% for the Hong Kong firms in our sample to no less than 76.12% for the U.S. When analyzing the liquidity of these shares, we obviously take these variation into account, as institutional investors tend to have different trading patterns than smaller retail investors. Also the property focus tends to differ across markets. In Canada and the U.S. firms tend to focus their asset portfolio on one single real estate industry, whereas in Europe and Asia it is more common to diversify on firm level. Since focused firms may enable investors to adjust their property type allocations by trading, we might find that property focus is related to stock liquidity across property shares.

Table 1: summary statistics

	No of firms	% REITs	% Self-manag	% Inst. Own.	%age Divers.	%age Retail	%age Resid.	%age Offices
Europe	*136*	*46.44%*	*58.79%*	*37.79%*	*48.15%*	*16.41%*	*16.92%*	*11.73%*
France	22	81.82%	63.64%	30.76%	68.18%	4.55%	9.09%	13.64%
Germany	23	8.70%	73.91%	25.51%	43.48%	8.70%	34.78%	13.04%
The Netherlands	7	57.14%	42.86%	45.08%	28.57%	42.86%	14.29%	14.29%
U.K.	84	38.10%	54.76%	49.79%	52.38%	9.52%	9.52%	5.95%
Asia-Pacific	*204*	*57.71%*	*43.22%*	*26.87%*	*52.89%*	*8.83%*	*6.24%*	*10.24%*
Australia	32	81.25%	59.38%	38.98%	43.75%	25.00%	0.00%	9.38%
Hong Kong	61	11.48%	62.30%	11.61%	81.97%	3.28%	0.00%	4.92%
Japan	58	75.86%	17.24%	39.23%	50.00%	5.17%	15.52%	17.24%
Singapore	53	62.26%	33.96%	17.66%	35.85%	1.89%	9.43%	9.43%
North America	*275*	*83.14%*	*62.90%*	*49.26%*	*20.02%*	*14.84%*	*13.40%*	*10.47%*
Canada	58	81.03%	53.45%	22.39%	20.69%	17.24%	18.97%	10.34%
U.S.	217	85.25%	72.35%	76.12%	19.35%	12.44%	7.83%	10.60%

Total	615	64.72%	57.40%	46.74%	38.54%	10.57%	9.92%	10.08%

Given the multidimensional nature of liquidity, Bernstein (1987) argues "that no single measure tells the whole story about liquidity." And, in fact, a multitude of liquidity proxies can be found in the literature. In this international analysis we combine four different measures with a monthly frequency using daily data:

1. Trading volumes [VOLUME] are simply computed for each month as the sum of the daily numbers of traded shares multiplied by the stock price (computed as the average of the closing prices of current and previous day of trading. The implicit assumption in this calculation is that on average, transaction have been executed at a price between the closing prices of the two days). We present these volumes in U.S. dollars to allow fair comparisons across markets, but analyse trading volumes in local currencies to avoid the interactions with currency rates in the subsequent analysis when we use macroeconomic factors to explain the variation in liquidity.

2. Stock turnover [TURNOVER] are the trading volumes in local currencies divided by the corresponding market capitalisations. In other words, stock turnover measures the monthly share trades as a percentage of the total shares outstanding (i.e. the percentage of available shares traded every month).

3. Amihud (2002) suggests an alternative proxy for liquidity [ILLIQ] that captures market depth. More specifically, Amihud measures the illiquidity of stock *i* in a period *t* (for our study being a month) as follows:

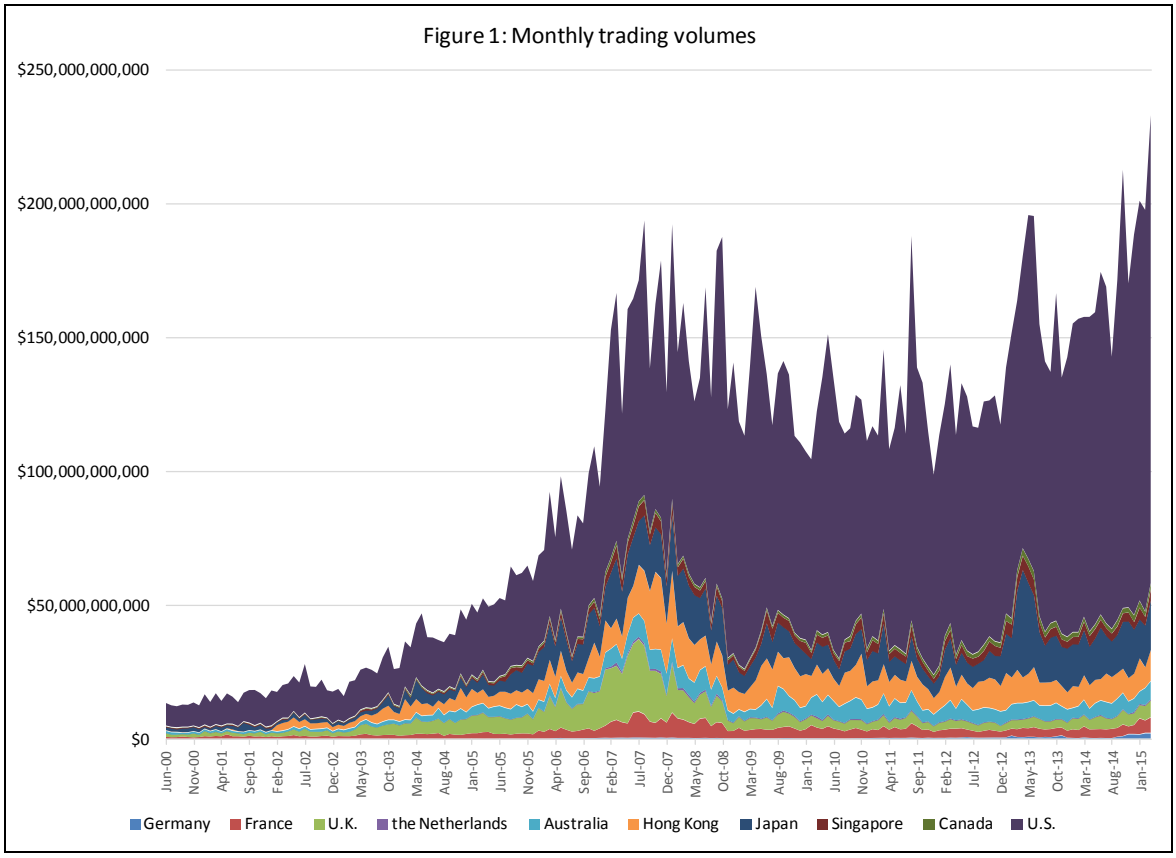
$$ILLIQ_t^i = \frac{1}{Days_t^i} \sum_{d=1}^{Days_t^i} \frac{\left| R_{t,d}^i \right|}{V_{t,d}^i} \tag{1}$$

   where $R_{t,d}^i$ and $V_{t,d}^i$ are, respectively, the stock's total return and dollar trading volume on day *d* in year *t*, and is the number of trading days in year *t* for stock *i*. ILLIQ is based on the notion that returns for illiquid stocks are more sensitive to trading volumes.

4. Our fourth and final measure of stock liquidity is the simple count of zero return days [ZERO] that occur during a month. This is a simple but common alternative measure for illiquidity, assuming that zero returns occur as a result of lack of stock trades. It is often used in studies involving emerging markets.#

4. Liquidity trends and global ranking

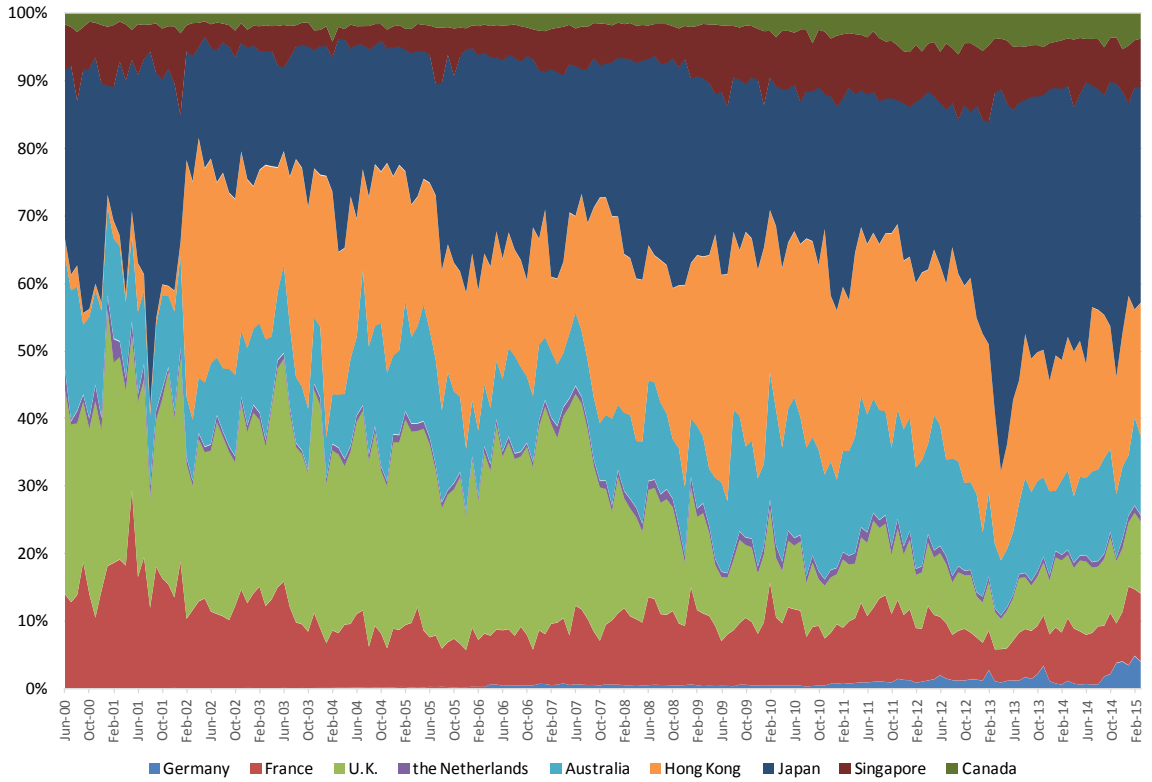
We start our empirical analysis with an international overview of the evolution of trading volumes over time. In figure 1, we plot the daily trading volumes in U.S. dollars for the ten markets in our sample for the past fifteen years. These numbers immediately reveal two compelling facts. First, trading volumes have grown massively in the past fifteen years. In the year 2000, daily trading volumes in our sample ranged between $13bn to $16bn., while today (2015) over $200bn. worth of property stock is trade every day in the ten sampled markets. Second, the vast majority of these trading volumes occurred in the U.S. market, a market that accounts for 35% of the firms in our total sample but also for no less than 76% of the 2015 trading volumes. Clearly, if trading volume were the measure of stock liquidity, we could now firmly conclude that liquidity is strongest in the U.S. market. A fact that is true today and at the start of our sample, as the stake of total trading volumes of the U.S. market started at 63% in the year 2000, and gradually increased to the current stakes of 76%.



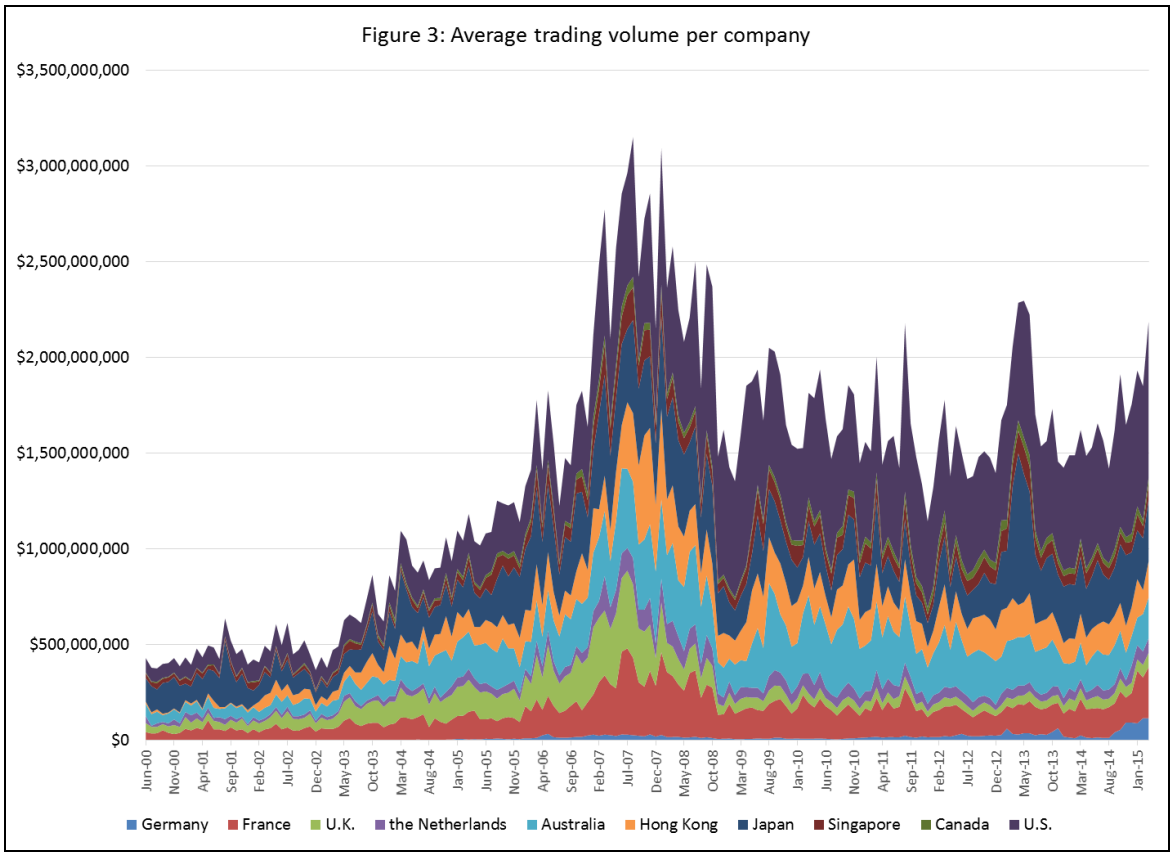
To abstract from the U.S. dominance in these numbers, we also present the breakdown of the residual stakes in trading volumes after excluding the U.S. market in Figure 2. Here, we find in fact that the trading volumes of the four European market are also dominated by the Asian-Pacific samples. Especially in the U.K. and French markets, it seems that trading volumes have not been

able to keep pace with the markets at the other side of the globe. Japan, Hong Kong and Australia have steadily matured when it comes to total trading volumes.

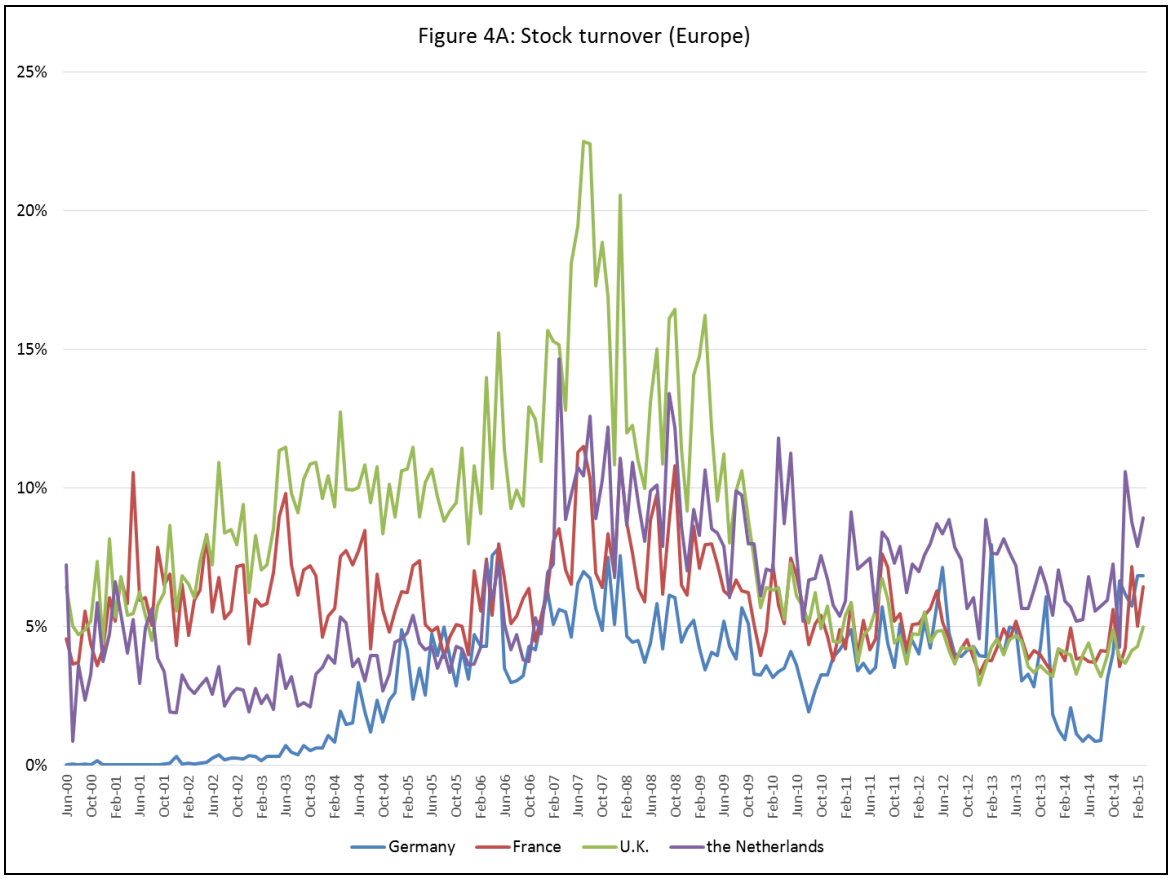
Figure 2: Monthly trading volumes, excl. U.S.



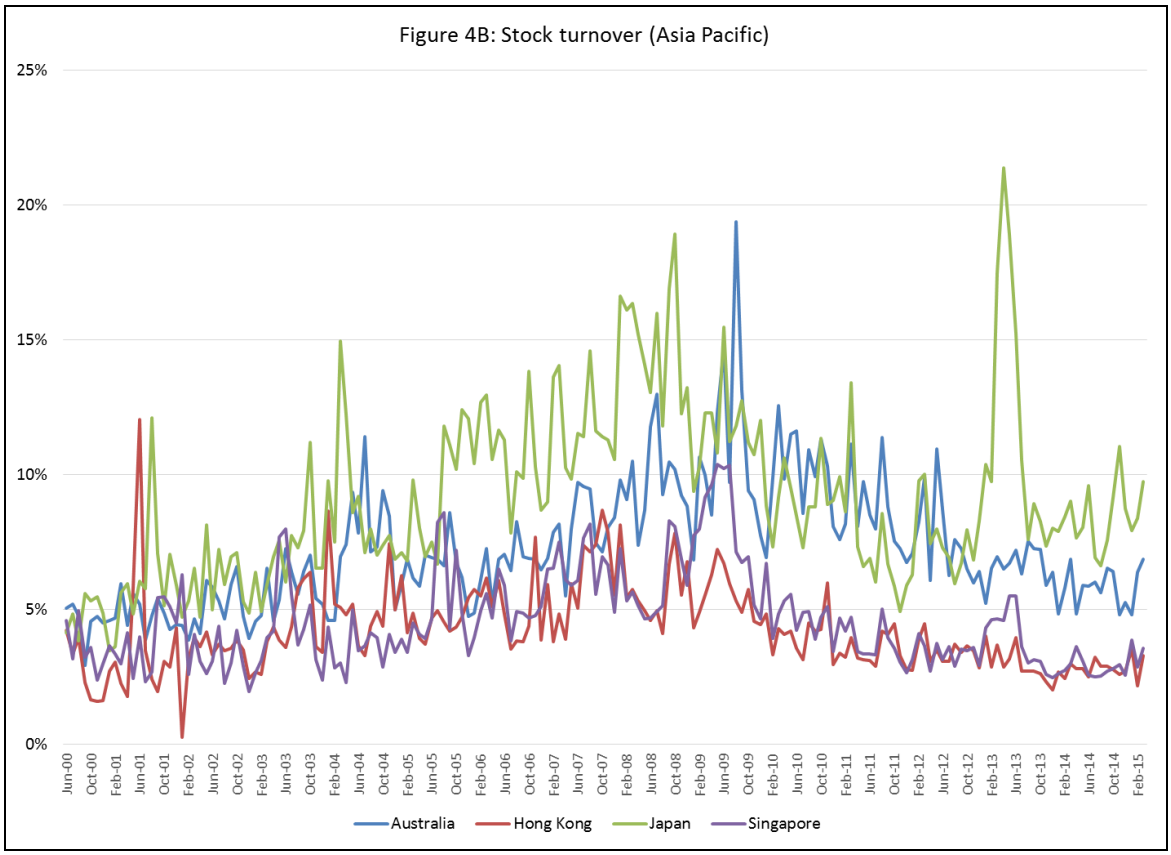
To ensure that these trends are not merely a reflection of an increase in the number of listed firms, we also repeat this trading volume comparison, by plotting the averaged volumes on a firm level for each market in Figure 3, where the time trend changed. At the start of this sample period, the average firm offered investors a daily trading volume of $43 mln., a number that peaked in August 2007 at $314 mln., and equals $218 mln. at the end of our sample period. In other words, trading volumes five folded on a firm level. But also when comparing this number across markets, we find strong differences. In 2015 the average U.S. property share showed trading volumes in excess of $800 mln., while the average Canadian firm barely made $40 mln. worth of trades a day. For both markets, these numbers equaled $70 mln. (U.S.) and $4 mln. (Canada) in the year 2000, reflecting a comparable growth over time, but a pervasive difference in magnitude across markets. To further enhance the comparability of liquidity across markets and firms, we need to control for the variations in firm size. Hence, we continue our analysis with a discussion of stock turnover.



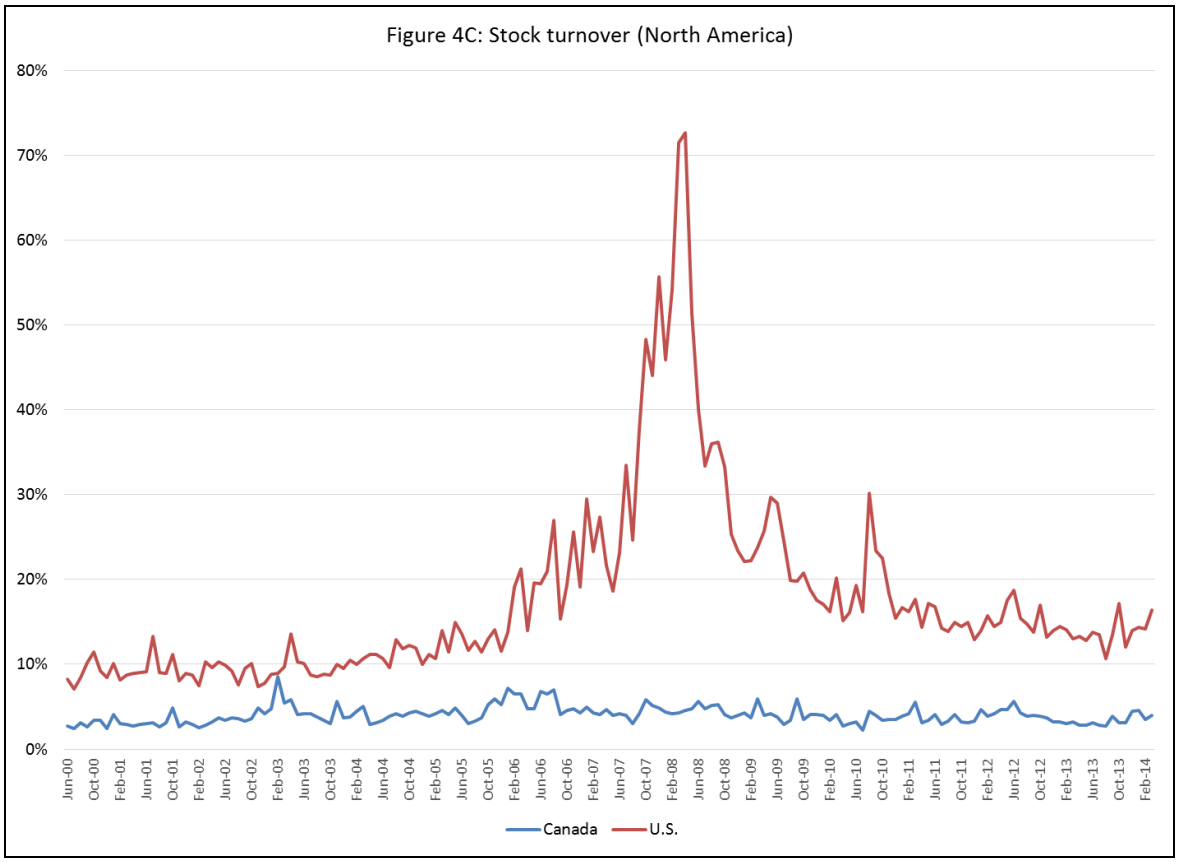
We plot and analyse these stock turnover rates for each continent, to allow for the needed detail. In Figure 4A, we compare these rates for the four European markets, and find turnover rates of around 4.5% at the start of our sample, a peak at 2007, and an average of 6.8% in 2015. In other words, these rates have not shown these same increases as trading volumes, indicating that a large fraction of volume growth has been the result of stock price appreciation. The *true* increase in stock trading has only increased marginally over time, at least for the European countries. Interesting here, is also the fact that the introduction of the local REIT regimes (in 2003 in France, and in 2007 in the U.K. and Germany) does not seem to have had any lasting fact of illiquidity when considering these turnover rates. Although various elements of REIT regime design are targeted at increasing trading, we cannot conclude that this effects has occurred in the three European markets that have introduced the regime during our sample period.



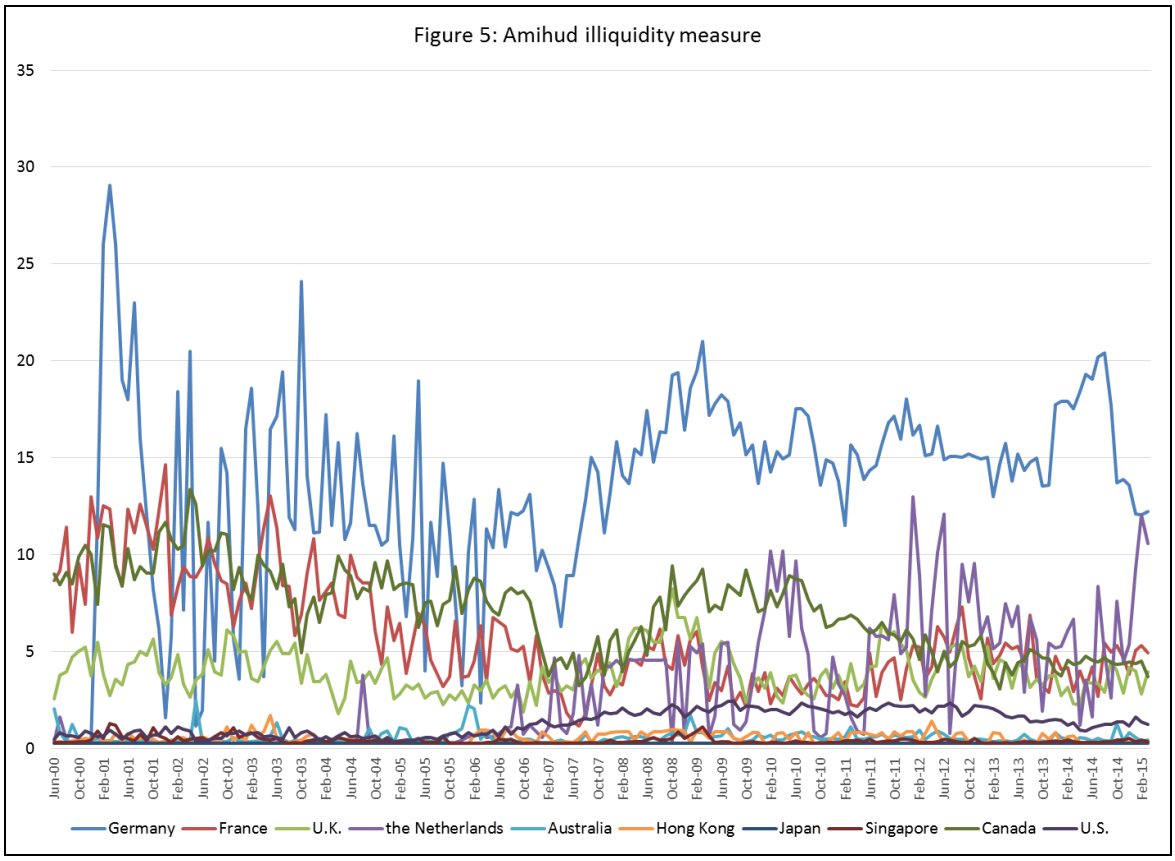
To assess whether this 'REIT effect' has also been absent in other markets, we now switch to the Asian-Pacific quartet in our international sample. In figure 4B, we compare turnover rates for Australia, Hong Kong, Japan, and Singapore. Overall, we find turnover rates that are very comparable to the European numbers. Again, we find no compelling effects of the local REIT inceptions (1999 in Singapore, 2000 in Japan, and 2003 in Hong Kong). If we would relate the early in turnover rates of the first years in our sample, we need another explanation for why the rates reduce and return to initial levels in the later years.



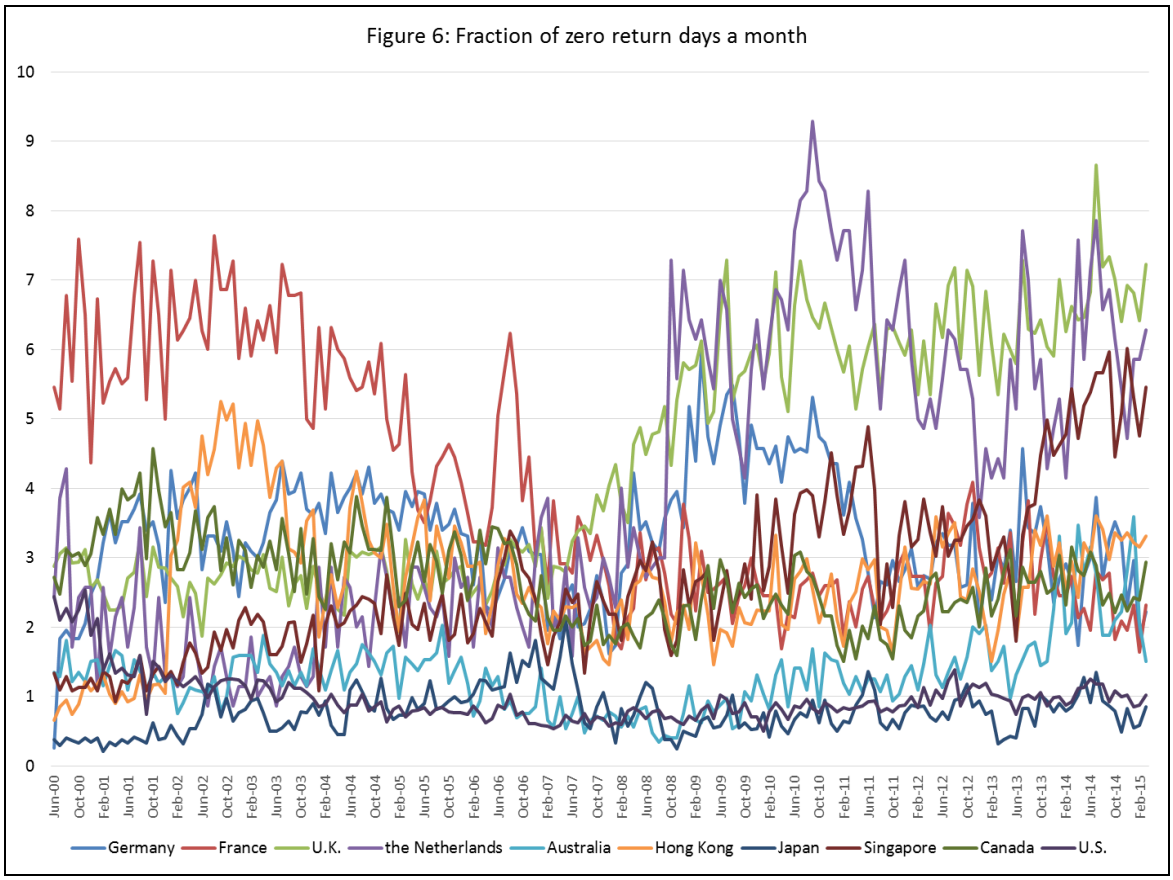
Finally, when we turn to turnover rates of the two Northern American markets, we find two very different patterns. The Canadian listed property shares look like the colleagues in the other eight markets, when it comes to stock turnover levels. The average rates of Canadian property shares started and ended at levels around 4% a day. For the U.S. firms this is very different. The average U.S. property share started at levels of around 10%, peaked at 70% just before the credit crisis, and leveled of around 15% at the end of the sample period. In both markets REIT regimes have been present throughout the sample period, so no traces of any REIT effect are to be found here.



To also look at the depth of liquidity, we now turn our attention to the measures of illiquidity. We start with Amihud's illiquidity ratio, which measures the price impact of trading volumes. In case of liquid stocks, we expect very low numbers, as trades are easily absorbed into the clearing price. In figure 5, we compare the results of this measure across our sample. Given that illiquidity is measured here, we expect and find a reverse reflection of what we have seen thus far. In figure 5, we find high values for Canada and the European markets, which is in line with the fact that their turnover rates were lowest. The Asian-Pacific and U.S. numbers are hard to read, as their illiquidity ratios are low and sometimes even close to zero. This echoes the diagnosis from our volume and turnover analysis. High trading levels clearly reduce the price impact of trades, and thus reduce the illiquidity measure. Regarding the time trends, we find little evidence of coherent patterns. The most surprising trend, is visible in the U.S. sample, where illiquidity scores start low, increased around 2007, and fall back towards the initial low levels. A trend that is somewhat counterintuitive, when considering the turnover trends that look identical. One might expect that the increase in turnover rates would have further reduced illiquidity, but apparently these large and frequent trades that occurred in 2007 have had a more pronounced price impact that the trading before and after. This may well be an indication, that although trading volumes and turnover rates have been high, single trades have been too big to be absorbed in the prevailing prices levels.



The fourth and final liquidity measure in our analysis, is the fraction of zero return days every month. When comparing the figures 5 and 6, which both present indicators for illiquidity, we find both similarities and differences. First of all, we find the high volume and turnover markets U.S., Japan, and Australia and the bottom end of figure 6. The high trading levels evidently also result in the lowest fractions of zero return days. Assuming that zero return occur as a result of thin trading, this makes perfect sense. When considering the late half of figure 6, we find the European markets at the high end, just like in the case of the Amihud's measure in figure 5. The main differences are found in the early half of the sample period, where France starts high and gradually lowers down and ends up near the most liquid markets. This is somewhat surprising, since the French turnover rates have not shown this type of evolution. Also the results of Singapore and Hong Kong appear rather high considering everything we have seen regarding volume, turnover and illiquidity levels.



To sum up this comparative analysis of different measures, we present the results of the liquidity rankings of sampled markets for the full and sub periods in Table 2. Overall, we find consistency across measures. Japan, U.S., and Australia tend to rank high across measures and periods. At the other end, we steadily find Germany and Canada.

Obviously, some remarkable deviations also exist. For instance, the Dutch market ranks low in liquidity when measures as trading volume (signaling for market breadth, i.e. available size of the trading market) and zero return days, while according to the turnover rates and illiquidity ratios (signaling for market depth), the Netherlands rank rather high. The same diffused result is found for the U.K., which ranks low on liquidity when considering the zero return days and illiquidity ratios (depth), while scoring high on turnover and volumes (breadth).

Table 2: Rankings of liquidity across measures and periods

Rank 95-15	VOL $	TURN	ILLIQ	ZERO
	US	US	JAP	JAP
	JAP	JAP	SING	US
	HK	UK	AUS	AUS
	UK	NL	HK	HK
	AUS	AUS	US	SING
	FR	FR	NL	CAN
	SING	SING	UK	GER
	CAN	HK	FR	NL
	NL	CAN	CAN	FR
	GER	GER	GER	UK
Rank 95-05	**VOL $**	**TURN**	**ILLIQ**	**ZERO**
	US	US	JAP	JAP
	UK	FR	NL	SING
	JAP	UK	SING	AUS
	HK	NL	AUS	US
	AUS	JAP	US	HK
	FR	AUS	HK	NL
	SING	HK	UK	CAN
	CAN	SING	CAN	GER
	NL	CAN	FR	UK
	GER	GER	GER	FR
Rank 06-15	**VOL $**	**TURN**	**ILLIQ**	**ZERO**
	US	US	JAP	JAP
	UK	FR	NL	SING
	JAP	UK	SING	AUS
	HK	NL	AUS	US
	AUS	JAP	US	HK
	FR	AUS	HK	NL
	SING	HK	UK	CAN
	CAN	SING	CAN	GER
	NL	CAN	FR	UK
	GER	GER	GER	FR

As a final step of our initial analysis, we compute the lower and upper confidence intervals of the average liquidity measures for the entire sample as follows:

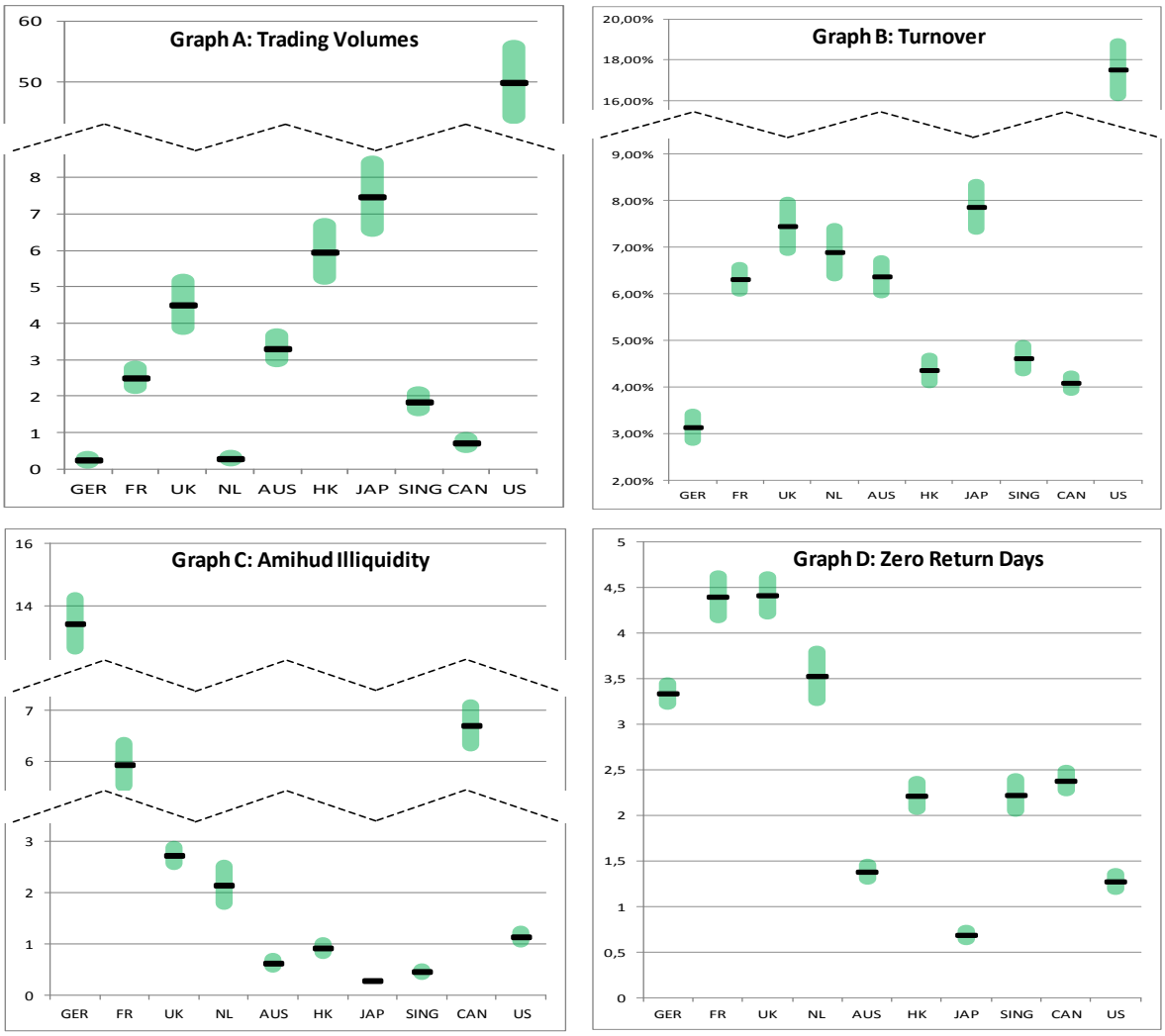
$$Lower\ Interval = Average - \frac{Standard\ Deviation}{No.\ Observations}$$

$$Upper\ Interval = Average + \frac{Standard\ Deviation}{No.\ Observations}$$

We present the graphs of the average (black line) of the four main liquidity measures along with their confidence intervals (green histogram around the mean) in Figure 7. This representation helps us to visualize the statistical difference of the country averages. In fact if the green histograms of two countries reach overlapping values, their average cannot be considered statistically different.

In particular, trading volumes (Graph A) show that the ranking is also statistically significant if we exclude the second and third position where the upper limit of Hong Kong is slightly above the lower limit of Japan.

Figure 7: Liquidity measures and confidence intervals.



As far as turnover is concerned (Graph B), the overall averages of European countries are not always statistically different, with the Netherlands showing overlapping regions with both UK (upper) and France (lower). In Asia, Japan is the most liquid country followed by Australia and the pair Hong Kong and Singapore whose average measures do not appear to be statically different. Overall, the US and Germany have respectively the highest and lowest turnover.

In Graph C, the Amihud illiquidity measure reveals that the ranking in both Europe and Asia is statistically significant, with the Netherlands and Japan showing the highest market depth within each area. Overall, the US is behind all Asian countries for this metric while Germany is still the least liquid, followed by Canada.

Finally, in Graph D reports zero returns days (normally associated to lower levels of transactions and hence high illiquidity) which show overlapping confidence intervals for several countries. European markets seem to be the least liquid, with Japan competing with the US (this time preceding it) as the most liquid country.

5. Liquidity impact on returns, and vice versa

The final step in our analysis is to examine the link between liquidity and returns. Previous literature has proved the existence of an interaction between pricing and trading, finding mixed results on the causality. In fact, on one hand high returns attract investors into the market – revealing a return chasing attitude –, hence improving the market liquidity. On the other hand, investors want to be compensated for liquidity risk and, consequently, lower liquidity should be compensated by higher returns. Since key to the problem is the causality of the two variables (returns and liquidity), we estimate a VAR (vector autoregressive) model, also including exogenous macroeconomic and financial indicators - the term spread, interest rates, equity returns, GDP growth and inflation. The system of equations is represented as follows:

$$Liquidity_t = \alpha + \sum_{s=1}^{p} \beta_i * Liquidity_{t-s} + \sum_{s=1}^{p} \gamma_i * TR_{t-s} + \sum_{i=1}^{m} \lambda_i * X_{i,t}$$

$$TR_t = \alpha + \sum_{s=1}^{p} \beta_i * Liquidity_{t-s} + \sum_{s=1}^{p} \gamma_i * TR_{t-s} + \sum_{i=1}^{m} \lambda_i * X_{i,t}$$

where $Liquidity_{i,t}$ and *Total Return* ($TR_{i,t}$) represent the endogenous variables of the system and p is the lag structure necessary for the impact of liquidity on pricing (and vice versa) to occur. $X_{i,t}$ represents a vector of control variables which are specified in line with the literature. In case we expect return chasing in our data, we should find positive and significant coefficients the equally weighted returns in our liquidity equation, meaning that lagged returns lead to more liquidity. In case we expect low liquidity to result in higher returns, we would expect to find negative and significant coefficients for liquidity in our return equation. In our model estimation, we measure liquidity using both trading volumes (vol) and turnover (turn) as a robustness test. We also estimate similar models using the Amihud illiquidity measures and zero returns but we decided not to report results as they are very similar to the ones obtained with volumes and turnover.

Regarding our control variables, the literature predicts that inflation and interest rates reduce liquidity, while equity returns and GDP growth have a positive effect on liquidity. Regarding the return equation, the literature predicts that returns are positively affected by equity returns and GDP growth, and negatively by the term spread, interest rates, and inflation. Given the institutional

variations and differing market maturities in our sample, we also analyse our estimation results with respect to international variations.

We start our estimation report with Europe. Table 3 presents the results of both the liquidity (panel A) and return equations (panel B) for Germany, France, UK, and the Netherlands. The estimation was performed over the full sample period of 1995-2015, using quarterly data, since GDP growth numbers required this frequency.

For the liquidity equation we report compelling pan-European evidence for an autoregressive process, past liquidity tends to trigger future liquidity in each market. Moreover, we also find broad European evidence that indicates return chasing behavior, since we also find positive and significant coefficients for the lagged returns in the liquidity equation. Except for Germany, it appears that high returns lead up to higher liquidity of listed real estate securities because investors are attracted/influenced by highly positive/negative past returns and tend to buy/sell.

Regarding the control variables, our European results offer consistent evidence that the liquidity of real estate securities is reduced by increases in the term spread, inflation and interest rates, while the good news of strong equity returns and GDP growth (proxy for positive market cycles) enhances liquidity. Results that corroborate the literature, and that are independent of the use of trading volumes or turnover rates.

Table 3: VAR Estimations, European Sample

A: Liquidity equation	Germany		France		UK		Netherlands	
Liquidity	vol	turn	vol	turn	vol	turn	vol	turn
lag 1	0.618***	0.635***	0.486***	0.376***	0.623***	0.657***	0.386***	0.449***
lag 2	0.216***	-0.037	0.083	0.052	0.081	0.229*	-0.15	0.053
lag 3	0.038	0.201	-0.058	-0.147	0.179	-0.099	0.424***	0.251*
lag 4	-0.022	-0.055	0.441***	0.375***	0.068	0.124	0.174	0.132
Equally weighted return index								
lag 1	0.311	-0.009	0.769***	0.011	0.742***	0.006	0.567**	0.007
lag 2	0.601*	0.012	0.304	-0.005	0.488**	0.043**	0.472*	0.028***
lag 3	0.28	0.011	0.646***	0.012	-0.082	0.001	0.67***	0.022**
lag 4	-0.504	-0.007	0.625***	0.023**	0.354	0.023	0.11	-0.006
Control variables								
term spread	-22.242*	-0.439	-10.399***	-0.584***	-5.733*	-0.414***	-6.266	-0.502**
10 year interest rate			-5.834**	0.036		-0.053	-6.51**	-0.215
3 month interest rate	-13.495**	-0.106			-2.779			
equity index (beta)	0.383	0.003	0.201	-0.01	0.548**	-0.015	0.029	-0.013
GDP growth	7.283***	0.156**	1.592	-0.005	3.763***	0.278***	2.46**	0.112*
Inflation (total CPI)	-23.762**	-0.482	-3.665	0.021	2.716	0.52**	-17.792***	-0.549***
Constant	3.763***	0.021**	1.424	0.025***	1.006	-0.013	4.021***	0.03***

B: Return equation	Germany		France		UK		Netherlands	
Liquidity	vol	turn	vol	turn	vol	turn	vol	turn
lag 1	-0.046	1.919	-0.109**	-2.496***	0.002	-0.658	-0.043	-0.836
lag 2	-0.007	-1.797	0.057	1.212	-0.003	0.982	-0.051	-0.153
lag 3	-0.03	-0.126	0.003	0.08	0.028	-0.742	-0.005	-1.223
lag 4	0.054**	-1.347	0.001	-0.581	-0.057	0.01	0.019	0.236
Equally weighted return index								
lag 1	0.342***	0.239*	0.089	0.057	0.121	0.154*	-0.065	-0.087
lag 2	0.196	0.174	0.03	-0.013	-0.118	-0.14	-0.292**	-0.139
lag 3	0.333***	0.236*	-0.092	-0.119	-0.204**	-0.129	0.01	-0.064
lag 4	-0.127	-0.09	0.227***	0.234***	0.171*	0.136	0.194**	0.154*
Control variables								
term spread	-1.961	0.46	-0.663	0.049	-2.353**	-0.297	-2.468	-1.045
10 year interest rate			0.627	3.379***		-1.161	1.299	1.54
3 month interest rate	-3.469*	-2.195			-1.98***			
equity index (beta)	0.42***	0.57***	0.674***	0.755***	0.853***	0.838***	0.325***	0.292***
GDP growth	-0.363	-1.79**	-1.584**	-1.547**	-0.485	-0.46	-0.704	-1.282**
Inflation (total CPI)	6.778**	10.891***	3.887***	4.468***	-1.579	-2.138**	-3.244*	-0.788
Constant	0.572*	-0.044	1.064*	-0.026	0.834***	0.16***	1.707***	0.133

Table 4: VAR Estimations, Asian Sample

A: Liquidity equation	Australia		Hong Kong		Japan		Singapore	
Liquidity	vol	turn	vol	turn	vol	turn	vol	turn
lag 1	0.687***	0.385***	0.913***	0.45***	0.874***	0.568***	0.552***	0.53***
lag 2	-0.033	0.112	-0.193	-0.179	-0.132	0.067	0.061	0.06
lag 3	0.197	0.26**	0.339*	0.28*	0.177	-0.002	0.28**	0.219**
lag 4	0.146	0.17	-0.158	0.157	0.081	0.148	-0.011	-0.048
Equally weighted return index								
lag 1	0.258*	-0.007	-0.223	-0.013	0.427*	0.035**	0.316	-0.014
lag 2	0.032	-0.024***	-0.495	0.01	-0.201	-0.003	0.064	-0.02**
lag 3	0.154	-0.019**	-0.505	-0.002	-0.022	-0.005	-0.173	-0.014*
lag 4	0.546***	0.021**	-0.307	-0.015*	-0.061	0.014	-0.245	-0.004
Control variables								
term spread	-3.565	0.051	-2.362	-0.187	4.813	-0.897	-13.075***	-0.564***
10 year interest rate	5.984**	0.327**	-11.303**	-0.128			-13.66***	-0.355**
3 month interest rate					1.039	1.968**		
equity index (beta)	0.724***	0.02	1.424***	0.036***	0.912***	0.025	0.654***	0.002
GDP growth	-2.202*	0.054	2.974	0.022	4.027***	0.171	0.465	0.003
Inflation (total CPI)	-1.153	0.013	-6.619**	-0.151**	-4.293	-0.253	-1.515	-0.128*
Constant	-0.063	-0.014*	3.039*	0.02***	0.027	0.022**	3.301***	0.033***

B: Return equation	Australia		Hong Kong		Japan		Singapore	
Liquidity	vol	turn	vol	turn	vol	turn	vol	turn
lag 1	0.056	-1.824*	-0.055*	-2.037	0.074	0.797	-0.007	-0.753
lag 2	-0.125	0.931	-0.035	-1.197	-0.031	-0.004	-0.031	0.67
lag 3	0.016	-1.919**	0.104**	3.437**	-0.115*	-0.929	-0.025	-1.14
lag 4	0.033	2.283***	0.007	-1.125	0.05	0.515	0.049	0.955
Equally weighted return index								
lag 1	-0.157*	-0.089	-0.237**	-0.17	-0.221**	-0.166	-0.196*	-0.226**
lag 2	-0.154*	-0.095	-0.027	-0.012	-0.427***	-0.423***	0.096	-0.017
lag 3	-0.033	-0.06	-0.116	-0.163	-0.075	-0.132	-0.175*	-0.251***
lag 4	0.06	0.091	-0.231***	-0.157*	0.042	-0.048	0.025	-0.019
Control variables								
term spread	4.373**	5.315***	0.764	-3.146**	-8.536***	-0.173	-3.135**	-3.188**
10 year interest rate	-1.802	-1.583	-3.004**	-3.138***			-5.573***	-5.976***
3 month interest rate					-5.188	-12.962**		
equity index (beta)	0.973***	0.993***	0.757***	0.911***	0.746***	0.725***	0.758***	0.667***
GDP growth	0.43	1.023*	1.137**	-0.677	1.616**	1.476**	0.123	0.696**
Inflation (total CPI)	-1.611*	0.297	-4.504***	-2***	-2.626**	-2.852**	-2.543***	-2.972***
Constant	0.564	0.052	-0.307	0.289***	0.78*	0.06	0.582	0.276***

Within the return equation, control variables appear to have a more heterogeneous effect. Overall, the term spread and interest rates carry the expected negative signs when results are significant. For inflation results are mixed, indicating that in Germany and France the returns of listed real estate securities have inflation hedging qualities, while in the UK and the Netherlands this is not the case. However, for a proper analysis of inflation hedge qualities, this total inflation rates ought to be decomposed into expected and unexpected inflation, which is beyond the scope of our analysis. The equity returns coefficients indicate that European real estate securities qualify as conservative stocks, since their betas are well below 1.0 in all markets.

Table 5: VAR Estimations, American Sample

A: Liquidity equation	Canada		USA	
Liquidity	vol	turn	vol	turn
lag 1	0.516***	0.477***	0.495***	0.793***
lag 2	0.253**	0.182	0.068	0.126
lag 3	0.122	0.042	0.27**	-0.158
lag 4	-0.023	-0.095	0.216*	0.065
Equally weighted return index				
lag 1	0.849***	0.029***	0.184	-0.096*
lag 2	0.76**	0.008	0.103	0.002
lag 3	-0.203	-0.003	0.352**	0.067
lag 4	0.301	0.022**	0.265*	-0.006
Control variables				
term spread	-4.056	-0.217**	0.658	-0.703*
10 year interest rate	-11.611***	-0.029	5.816**	-0.177
3 month interest rate				
equity index (beta)	0.641***	0.008	0.131	-0.209***
GDP growth	-1.001	-0.091*	2.437**	-0.37
Inflation (total CPI)	5.569*	0.041	3.43**	-0.253
Constant	3.219***	0.02***	-1.596**	0.073***

B: Return equation	Canada		USA	
Liquidity	vol	turn	vol	turn
lag 1	-0.004	-0.584	-0.037	-0.771**
lag 2	-0.005	-0.825	-0.054	0.007
lag 3	-0.001	-0.162	0.072	0.195
lag 4	-0.007	-0.355	0.016	0.022
Equally weighted return index				
lag 1	-0.014	0.043	0.097	-0.05
lag 2	0.158	0.165*	-0.069	-0.215*
lag 3	-0.111	-0.026	-0.014	-0.11
lag 4	0.004	0.078	0.001	-0.02
Control variables				
term spread	3.222***	2.035**	2.244**	1.22
10 year interest rate	-0.998	0.992*	0.636	1.172
3 month interest rate				
equity index (beta)	0.56***	0.591***	0.858***	0.897***
GDP growth	0.119	-0.831**	-0.379	-1.729**
Inflation (total CPI)	2.224**	0.587	2.377**	-1.852*
Constant	0.363	0.06	0.001	0.185***

In table 5, we present regression results for the Canadian and US REITs. Consistent with previous results, we find that liquidity shows a momentum effect, and that returns trigger liquidity. The size of these American coefficients is similar to the European, and the signs are again robust for the use of volumes and turnover. The control variables offer output that is different from what we reported for Europe and Asia. To exemplify, inflation, and (US) interest rates have a positive effect on listed real estate liquidity. This indicates that in North America investments in REITs increase when financial markets perform well. Perhaps, because in these mature markets listed real estate is seen as an industry unique from equity. This hypothesis is confirmed by the mixed and partially insignificant

equity return coefficients in the liquidity equation. Inflation has a positive and significant sign both in the liquidity and the return equation, which can be interpreted as that REITs are considered an inflation hedging store for value when the economy is softening.

Furthermore, and quite importantly, we find no convincing evidence in the return equation regarding liquidity and autoregressive patterns. Equity betas are below one and the positive inflation coefficients hints towards inflation hedge qualities.

Overall, our results offer new and consistent evidence for international trend chasing behavior in listed real estate market. Liquidity is commonly a function of past returns. At the same time, we also find interesting international variation in our output suggesting that the interaction with the equity market is dependent on the dominance of the local financial market. In case financial markets are strong, we find strong interaction between equity returns and listed real estate liquidity and returns. We also report evidence that the autoregressive patterns in both liquidity and returns of real estate securities, weaken when markets mature and become more efficient. Finally, we find that in these most mature markets, listed real estate effectively serves as an inflation hedging store for value when the economy weakens.

7. Conclusions

In this paper we examine the liquidity of listed property companies since 1995 in France, Germany, the Netherlands, the U.K., Australia, Hong Kong, Japan, Singapore, Canada and the U.S. Four all ten markets, we apply and compare four different liquidity measures – trading volume, stock turnover, Amihud's illiquidity ratio, and the number of zero return days. Our results show both consistent patterns across metrics, as wide variations across markets. All four measures identify the U.S., Japanese and Australian markets as the most liquid ones in the world, and in all three markets the liquidity measures have been high all through the sample period. The introduction of a local REIT regimes does not to have any pervasive effects on stock liquidity, as European REIT markets like Germany and France still lag behind.

When we link these liquidity statistics to the corresponding returns, we document new and consistent evidence for international trend chasing behavior in listed real estate market. Liquidity is commonly a function of past returns. At the same time, we also find interesting international variation in our output that suggests that the interaction with the equity market is dependent on the dominance of the local financial market. In case financial markets are strong, we find strong interaction between equity returns and listed real estate liquidity and returns. We also report evidence that the autoregressive patterns in both liquidity and returns of real estate securities, weaken when markets mature and become more efficient. Finally, we find that in these most mature markets, listed real estate effectively serves as an inflation hedging store for value when the economy weakens.

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