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Firm Value, Investment and Monetary Policy*

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Abstract

This paper presents empirical evidence on the effects of three nominal risk factors, local interest spreads, US interest spread, and US federal funds rate signal-to-noise ratio on the value of firms and on the cross-listing decision of firms destined to three major markets in North America, Asia and Europe. We use firm-level data in 29 countries of cross-listing origin over a six year period, from 2000 to 2005. We find consistent and robust evidence that the US federal funds rate signal-to-noise ratio risk factor in the Sharpe sense provides an important benchmark for firm value across the universe of publicly traded companies; and this effect is larger for smaller firms that cross-list abroad. Countries in Asia, Europe and South America tend to seek more funds abroad through cross-listing relative to other regions in this sample. In general, we find that the lagged local interest risk factor is positively related to current probability of cross listing. Small firms located in Asia, medium firms located in Europe, and large firms located in Asia, Europe and South America have a higher relative probability of cross listing abroad.

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1. Introduction

Open international capital markets have been instrumental in efficiently allocating risk and allowing firms to fulfill their capital investment demand. Also, nominal risk factors may affect business investment through multiple channels. First, changes in market interest rates imply changes in the cost of capital, which in turn affect investment; the so-called interest channel. Second, changes in market interest rates affect the net cash flow available to a firm. Given imperfect capital markets, the availability of net cash flow will have an effect on investment. This is generally referred to as the broad credit channel. However, many other linkages exist between monetary factors and real investment. Interest rate levels, risk factors such as banking spreads and monetary policy signal-to-noise ratios, contagion, leverage and liquidity effects are closely related to monetary policy activity and variability and those factors can affect real investment.

In terms of publicly traded companies, real investment funds are not bounded by local stock markets but also include the possibility of firms seeking funds abroad by cross-listing in foreign stock exchanges. In this paper, we use firm-level data in 29 countries of cross-listing origin over a six year period, from 2000 to 2005 to study the effects of nominal variables on firm value and the firm's decision to cross-list abroad.[1] The evidence in this paper is based on firms cross-listed in a major North-American, Asian and European market. Table 1 shows top exchanges by total share trading value where the U.S. markets in 2006 ranked first and second.[2]

This paper explores an empirical mechanism of monetary policy on the value of firms and thus real investment through interest rate channels. We consider nominal interest rate level effects, monetary growth effects and risk measures of monetary policy such as

[1] Several studies have examined the influence of U.S. monetary policy on U.S. stock prices. First, Modigliani and Cohn (1979) discuss the hypothesis that investors irrationally discount real cash flows using nominal interest rates implying that stock markets will be undervalued during periods of high expected inflation and overvalued during periods of low expected inflation. More recently, Ehrmann and Fratzscher (2004) show that cyclical, capital-intensive industrial sectors and financially-constrained firms react more strongly to U.S. monetary policy. Bernanke, Kuttner (2005) show that U.S. monetary policy shocks affect domestic stock markets mainly through their effects on risk premiums. Wongswan (2006) finds that global equity indexes mainly react to the Fed's target rate surprises rather than path surprises.

[2] However, from 2005 to 2006, the US was unable to raise as much investment capital as other markets, e.g. World Federation Exchange 2006 Annual Report

banking spreads and signal-to-noise ratio of interest rates. There is also literature that examines the premium in market value of firms that cross list abroad. In particular, Doidge et al (2004, 2009) provide evidence that cross-listing in the United States stock exchange provides a significant premium in firm's market value; see also Bianconi and Tan (2010). They attribute that premium to higher standards of corporate governance in the US. This evidence led us to seek measures of US monetary policy and risk factors as benchmarks for for the valuation of publicly traded firms around the world, and potential more important factors for firms that cross-list in the US. Hence, in addition to local measures of interest rates, monetary growth and spreads, we also include U.S. monetary policy measures of spread and signal-to-noise ratio in interest rates as a benchmark. We find consistent and robust empirical evidence that the US federal funds rate signal-to-noise ratio (in the Sharpe sense) risk factor provides an important benchmark for firm value across the universe of publicly traded companies.

Our main question is whether or not three risk factors, the local interest rate spread, the U.S. interest spread and the U.S. federal funds rate signal-to-noise ratio influence the valuation of firms worldwide firm value and whether or not they influence the decision of firms to cross-list abroad for our sample of 29 countries in the 2000-2005 period. First, we found that measures of contemporaneous and lagged local interest rate levels are irrelevant in the presence of measure of US interest rate levels; in particular the current and lagged US federal funds rate. However, when we add measures of local interest rate spreads and U.S. interest spread and U.S. federal funds rate signal-to-noise ratio; the level effects of US nominal interest rate on firm value become irrelevant. When the US lowers the current (and lagged) federal funds rate relative to its volatility (or when the signal-to-noise ratio in the U.S. federal funds rate is higher or the market price of interest rate risk is lower in the Sharpe sense) the market value of all firms increases in the cross-country balanced panel. A potential transmission mechanism could be through relative risks. A higher local interest rate spread relative to the lower U.S. spread and signal-to-noise ratio could capture more risk in the source country capital market relative to the U.S. A local firm cross listing abroad makes arbitrage of relative risks in these markets. Moreover, an increase in the interest rate risk factor depresses Tobin's. The data in this paper are from 2000-2005 and

refers roughly to a US credit boom cycle. In times of a credit crunch, the effect should be reversed; see e.g. Lucas (1990), Haslag and Young (1998), He and Krishmurthy (2008).

More recently, Taylor and Williams (2009) examine the recent increase in U.S. interest rate spreads between overnight federal funds and longer term interbank loans caused by counterparty risk, liquidity, leverage and others. They find that increased counterparty risk contributed to the rise in U.S. spreads, but their evidence is that U.S. monetary intervention had no significant effect on mitigating the rise on spreads. We take this as evidence of the importance of interest rate risk as measured by spreads and signal-to-noise ratios have become a more important potential factor in understanding non-neutralities of money; see IMF (2009).[3]

We also present results of the effect of the three interest risk factors by destination of cross-listing, by firm size and on the firm decision to cross-list. The US fed funds risk factor is significant for all three cross-listing destinations, US, Hong Kong and Germany. There is a positive premium for the US and Germany, but a discount for firms listed in Hong Kong.[4] From a perspective of size, our main finding here is that smaller firms, and larger firms to a lower order of magnitude, tend to be more sensitive to the US fed funds rate risk factor and the ones that are cross-listed are even more sensitive to the US fed funds risk benchmark.

Our evidence on the determinants of cross listing from treatment effects shows geography and proximity play a significant role. Countries in Asia, Europe and South America tend to seek more funds abroad through cross-listing relative to other regions in this sample. Also, we find evidence that countries that cross list tend to be more sensitive to the US fed funds risk factor. The evidence from the destination samples is that geography has a positive and robust effect on the probability of cross listing for all destinations. The Hong Kong destination sample shows a robust risk arbitrage effect on the probability of cross listing abroad. Countries that cross list in the US tend to be more sensitive to the US fed funds risk factor. The treatment evidence by size identifies more significantly effects of

[3] See also He and Krishmurthy (2008, 2009) and DeMarzo et al (2009) on issues relating to spreads, risk and the value of firms.

[4] We have no knowledge of other papers in the literature that examine cross listing effects for Hing Kong and Germany destinations. The Hong Kong destination is predominantly from firms from China, while the Germany destination if predominantly from Europe, but varies more broadly. Hence, geography will be an important factor determining cross listing decision.

lagged local interest spreads on the probability of cross listing across all sizes. Our finding is that, in general, if local spreads were lower in the past, the probability of seeking cross-listing in the current period is low. The geography effects remain positive and robust for all sizes and methods. Small firms located in Asia show a higher probability of cross listing abroad, while medium firms located in Europe show a higher relative probability of cross listing abroad. Large firms in Asia, Europe and South America show a higher relative probability of cross listing abroad.

The rest of the paper is organized as follows. In the next section we discuss some basic theoretical models of relevance. Section 3 reviews institutional arrangements of cross-listing in the U.S., Hong Kong, and Germany. Section 4 describes the data while section 5 presents the main empirical results. The last section offers concluding remarks.

2. Models

Tobin's (1969) portfolio choice model of the effects of money on real returns emphasized the wealth effect of monetary policy on asset prices. When the nominal money stock increases and/or the nominal interest rate decreases, asset prices increase and firm's *q* increase thus leading to an increase in the demand for real capital. The real effect occurs through a portfolio channel since money yields zero return and an increase in money increases the demand for other real assets thus decreasing real interest rates. However, this is the demand side effect. There is a capital supply effect in which lower real interest rates dampen asset yields, and thus the initial asset prices and firm value increases are dampened as well. Hence, from the supply side perspective, nominal interest rates and firm value should be positively correlated.[5] Another channel is the nominal interest rate effect on bank interest rates spread due to inflation tax on bank reserves, e.g. Haslag and Young (1998) and also Dotsey and Ireland (1998). In particular, the effect of nominal interest rate on Tobin's q is that nominal interest rate spreads contain information about inflation. In particular, higher inflation implies higher spreads. As a consequence, higher spreads can discourage financial intermediation and lower investment thus affecting firm's market value. The effect of inflation on spreads is discussed in Lucas (2000), Haslag and Young (1998), Yoshino

[5] We may also justify the real effects of money via financial frictions or market imperfections; e.g. Lorenzoni and Walentin (2006).

(1993). One of the main transmission mechanisms for the non-neutrality of money is through interest spreads, see IMF (2009).

More recently, the risk premium channel has been emphasized. An increase in the risk premium can lower investment and affect firm's market value, e.g. He and Krishmurthy (2008), He (2009), Wongswan (2006), Bernanke and Kuttner (2005). There are several sources of increases in banking spreads in the asset pricing literature including bank costs, bank reserves, tax profits, counterpart risk, liquidity, leverage and asset risk among others. In effect, banking spreads may have higher information content than nominal interest rate levels per se. An ideal monetary policy would be one in which there is no noise, only valid price signals. The best possible monetary policy would maximize the signal-to-noise ratio. In summary, monetary policy can be characterized not only by nominal interest rate levels, but also by the risk premium component in the bank interest spread and interest rate signal-to-noise ratio.

In the realm of publicly traded companies, the top exchanges are in the U.S., see Table 1; and the U.S. is the largest economy in the world. Hence, U.S. monetary policy can have an impact on firm value that goes beyond its own borders, not only due to trade interactions but also due to foreign firms demand for capital in the large stock exchanges through ADRs, over the counter trade, cross listing and other mechanisms. In particular, U.S. interest rate policy can generate fluctuations in the value of firms and in the demand for funds in foreign exchange markets through these channels, see e.g. IMF (2009), Taylor and Williams (2009). Given the recent attention to spreads and risk premium, monetary policy can be characterized by the nominal federal funds rate and the market price of interest rate risk.[6] In Figure 1, we note the observed lower average U.S. federal funds rate as well as a lower average relative to its volatility in the 2000-2005 period, mainly after the September 11 event, which is consistent with lower expected inflation as well.

The main hypothesis of this paper regards the local interest rate level, spread, risk and U.S. nominal monetary effects on firm value across countries. When the level of nominal interest rate increases; the domestic cost of funds increases and firms need to cross-

[6] See Kyotaki and Moore (1997, 2005) for credit cycles models, Fostel and Geneakoplos (2008) for leverage cycles models and Taylor and Williams (2009) on interest spreads and counterparty risk. Also, the vast literature on contagion effects emphasizes the international transmission of monetary policy, e.g. Ehrmann and Fratzscher (2004), Bernanke and Kuttner (2005), Wongswan (2006).

list abroad to fulfill the gap between effective and notional demands for investment. Thus, for those firms who seek to cross list abroad we observe an increase firm's *q*, the so-called cross-listing premium, e.g. Doidge et al (2004); as well as a positive correlation between *q* and nominal interest rates. However, when we add measures of local interest spreads, market price of risk increase and U.S. spreads and market price of risk, the interest level effects are not identified. The risk effects are consistent with a predominant effect of U.S. monetary policy on Tobin's q across countries.

Our empirical strategy is to estimate the monetary nominal effects on firm's *q* in two ways. First, we measure the nominal monetary effects on the value of the firm directly, controlling for cross-listing. Second, we estimate the direct effect of nominal monetary effects on cross-listing as a treatment, and then the nominal monetary effects on firm's *q* controlling for the cross-listing treatment. One of our main results is that there is benchmarking by publicly traded firms in US fed funds risk factor.

3. A Brief Overview of International Cross-listings

Firms' tend to cross-list abroad for four common reasons.[7] Market segmentation allows investors to escape cross-border barriers to investment. Liquidity effects reduce costs in the sense that the greater liquidity the lower the spreads. The information or signaling hypothesis is based on the premise that cross-listing signals market participants about the financial health of the firm. Finally, the corporate governance hypothesis or "bonding" assumes that firms, whom domestically have poor governance standards, often list their securities on countries with more rigorous governance procedures.[8]

The US, Hong Kong and Germany are the three destination markets for cross-listing focused in this study.[9] In the US, American Depositary Receipts (ADRs) is the primary way for foreign firms to cross-list. It is a negotiable certificate that represents a

[7] Karolyi (1998, 2005) conducted a thorough review of the cross-listing literature; see also Bianconi and Tan (2010).

[8] For the information hypothesis, see Cantale (1996), Fuerst (1998), Moel (1999), Baker, Nofsinger and Weaver (2002), Lang, Lins and Miller (2003) and Bailey, Karolyi and Salva (2005). For the corporate governance hypothesis, see Coffee (1999, 2002) and Stulz (1999), Doidge, Karolyi and Stulz (2004) and Doidge (2004).

[9] See Doidge et al (2004, 2009). Bianconi and Chen (2009) describe in details the institutional arrangements and costs to cross-list in those destinations.

foreign company's public traded equity. Depositary Receipts are made when brokers purchase a company's shares on the respective domestic home stock market followed by delivering it to the depositary's local custodian bank, such as Goldman Sachs, Union Bank of California, State Street, etc.

In Hong Kong, the stock market is operated by the SEHK (Stock Exchange of Hong Kong). The SEHK is a wholly owned subsidiary of the HK Exchange. Securities transactions on the SEHK are executed by the Automatic Order Matching and Execution System (AMS). The Growth Enterprise Market (GEM), launched by the SEHK, serves as a conduit where emerging enterprises, which do not fulfill the profitability or track record requirements of the existing market of the Stock Exchange of Hong Kong, can obtain a listing and increase capital. To cross-list in Hong Kong, firms can list either on the Main Board or with GEM.

In Germany, firms can cross-list on either the EU-regulated market or the Open market. A listing on the Regulated Market leads to the General Standard or its Prime Standard segment, while admission to trading on the Regulated Unofficial Market leads to the Open Market with its Entry Standard segment.

Generally speaking, the listing requirements for cross-listing in Hong Kong and Germany are less stringent than in the US. Another factor to consider are the listing costs. Entry fees for the U.S. are nearly three times the cost for listing in Germany, and nearly four times that of Hong Kong.[10] Finally, an important factor in the decision to cross-list is geography and proximity as discussed in Bianconi and Tan (2010).

4. Data

We start by defining firm's q. It measures the valuation of firms, computed often as total value divided by total assets. In our analysis, following Doidge et al. (2004), we calculate q as follows:

$$q_{it} = \frac{Total\ \ Liability_{it} + Market\ \ Capitalization_{it}}{Total\ \ Assets_{it}} \qquad (1)$$

[10] See Santos and Scheinkman (2001) for a model of competition among exchanges; Froot and Dabora (1999) and Gagnon and Karolyi (2010) for arbitrage opportunities in dual-listed firms.

For firm *i* in year *t,* where the denominator is the firm's book value of total assets and the numerator is the firm's book value of total liability plus its market capitalization. Market capitalization is computed as the firm's common shares outstanding multiplied by its current market price. We follow Hirsh and Seaks (1993) and use the logarithm of *q* in the empirical analysis. All financial information used above is obtained at the fiscal year-end from 1999 to 2004.[11]

The sample firms' financial information comes from the *WorldScope* database (July 2000 – July 2005). We focus on the origin countries of firms that were cross-listed in the U.S., Hong Kong, and Germany. Table 2 presents the 29 countries of origin of firms, their distribution across regions as well and cross-listing information and cross-listing by destination.[12]

We started with a data set over the six year period of 90,418 data points. Then, we excluded observations from the finance, insurance, and real estate industries by eliminating firms that have two-digit SIC code from 60 to 67. This is because the valuation ratios of financial institutions are usually not comparable to those of non-financial firms. We compiled the firms that were only listed on their domestic exchanges with 54,885 total firms.

We obtained the firms cross-listed in the U.S. via the *CompuStat* World Database. After finding the names of the cross-listed firms, we then matched names with the *WorldScope* Database in order to compile the financial information. If the firm's name or financial data was not available, then the firm was omitted. In order to maintain consistency, any new listing from a different foreign country over the six year period of time was omitted.

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[11] Due to data constraints, this measure does not use the market value of debt in the numerator and uses total assets instead of replacement cost in the denominator, see e.g. Doidge et al (2004, 2009). However, it does include total liability which is sensitive to leverage.

[12] Note that we do not include the UK destination because of its overlap with the US destination, see e.g. Doidge et al (2009) and Bianconi and Tan (2010). For example, this explains why Greece has many more firms in the sample than Ireland, since the latter cross lists more in the UK. We also do not include Canada because of its geographic proximity to the US. Firms that were domestically listed in the U.S., Hong Kong, and Germany; firms from U.S., Hong Kong, or Germany that were cross-listed elsewhere; firms cross-listed on other exchanges, but not the U.S., Hong Kong, or German exchanges; and firms from Canada, the Russian Federation, Bermuda, Cayman Islands, and other small islands were omitted.

The firms cross-listed in Hong Kong and Germany were found via the Hang Seng index website for Hong Kong and the Dusseldorf and Frankfort exchange websites (Xetra) for Germany. We included the Dusseldorf exchange as well because it is a private exchange that deals in private issues. Due to the fact that we also included private ADRs, we deemed it necessary to include the Dusseldorf exchange. Private listings cross-listed on the Hong Kong Exchange were also included. After finding the names, we again matched names with the *WorldScope* database in order to compile the financial information necessary. We followed La Porta et al (2002) and, to reduce the weight of outliers, maintained q at the 2nd and 98th percentiles by setting extreme values to the 2nd and 98th percentile values, respectively. We then eliminated twin firms, or firms that cross-listed in more than one of the three destination markets. At this point, we had an unbalanced panel data set with 48,307 observations in the firm and time dimension.[13] Finally, we reduced the sample by considering each firm that had observations in all years. As a result, we obtained a balanced panel of 15,876 firms of which 781 are cross-listed. In this sample there are 2,646 firms per year over the six year period, in 2000, 177 were cross-listed, 160 in 2001, 126 in 2002, 120 in 2003, 94 in 2004 and 104 in 2005. Table 2 presents further information of cross-listing by destination and by geographic region.[14]

Besides the dummy variables for cross-listing, we also include several firm-level, country-level and region variables as controls. We introduce 2-digit SIC code dummies to control for industry effects. Twenty and Hundred are dummy variables used to represent firm size based on asset amounts. A value of 1 was given if a firm that has more than $20 million in total assets and $100 million respectively. The independent variable Sox is a time variable used to represent the occurrence of the Sarbanes-Oxley Act. It is given a value of 0 for all firms that are not cross-listed before 2002.[15] Region dummies for Asia, Africa, Europe, North America, South America and Oceania were included to control for geography and proximity effects. GDPG is the GDP growth rate of the firm's source country differentiated by year, thus controlling for some macroeconomic factors. Data for

[13] We first ran several models using the large unbalanced panel including local nominal interest rates and monetary growth data.

[14] We kept Brazil in the balanced panel sample even though the firm is not cross-listed; more cross-listed firms were available in the large unbalanced panel for this country.

[15] See Bianconi and Chen (2009) for an analysis of the SOX variable and its effect on cross-listing.

the country-level variable GDP growth was obtained from the IMF website, the IMF world development indicator report.

For each country, the source for interest rate spread data is the IFS - International Financial Statistics of the IMF. The local interest rate spread is the difference between the deposit rate and the money market rate. For the U.S., the interest rate data is from the Federal Reserve Board. The U.S. spread is the difference between the prime rate and the federal funds rate. The signal-to-noise ratio is the twelve month average federal funds rate divided by its standard deviation for that year.

Table 3 present the definition of variables. Table 4 and 5 the summary statistics and the correlation matrix. First, we note that the average q in the sample is 1.71, the average local interest spread is -0.77 percentage points, the average US Prime-federal funds rate spread is 2.995 percentage points and the average US federal funds rate signal-to-noise ratio is 7.7. The standard deviation of the local spread is about 1.5%, for the US prime over fed funds rate is about 2 tenths of a percent, and 4.69 for the US fed funds risk. We also note in Table 5 that the unconditional correlation between log q and local interest spread is negative and about -15%, with the US prime-federal funds rate spread it is small and negative -4%, and with the US federal funds rate signal-to-noise ratio an even smaller negative -1.5%. The unconditional correlation between cross-listing and local interest spread is small and negative, about -3.2%; with the US prime-federal funds rate spread small and positive 2.7%, and with the US federal funds rate signal-to-noise ratio it is positive and small 3%.

The top part of Figure 1 shows a graph of the US federal funds rate annual average, its volatility and the signal-to-noise ratio (US federal funds rate annual average divided by its volatility); and the lower part shows the US prime rate, federal funds rate spread by year. The US fed funds rate level declines until 2004 and the volatility peaks in 2001, due to September 11, but remains mostly stable afterwards. As noted, the signal-to-noise ratio declines from a peak in 2000; and the prime-fed funds rate spread declines as well. The variability of the US prime-fed funds spread is very small while the fed funds rate signal-to-noise ratio has more variability, from a peak of over 16 in 2000 to about 5 in 2005. Figure 2 shows a graph of firm value q and the local interest spread by country. Argentina, Chile, and Venezuela in South America; China, Korea India and Philippines in Asia; and

Hungary and Portugal in Europe all have lower and less disperse firm *q* value. Japan, Singapore and Israel in Asia; South Africa in Africa; Belgium, Denmark, Finland, France, Greece, Ireland, Italy, Netherlands, Spain, Sweden, CH and the UK in Europe, Brazil in South America; Israel, Italy, Japan, Netherlands, Australia and New Zealand in Oceania all have higher and more disperse firm *q* value in this period. The variability of the local spread is relatively large in Argentina, Finland, Mexico and Venezuela. Figure 3 shows predicted *q* conditional on the interest spreads and US federal funds rate signal-to-noise ratio for the cross listed and non cross-listed samples. The cross-listed sample does predict a higher firm value as is well documented in the literature. Finally, Figure 4 shows a graph of the probability of cross-listing conditional on the three risk factors, the local interest spread, the US prime spread and US federal funds rate signal-to-noise ratio. Note that the year labels indicate that the predicted probabilities of cross-listing were higher in the early years and lower towards later years in the sample, particularly 2005.

5. Econometric Models and Empirical Results

Our empirical models ultimately identify nominal risk factors on firm value. We have a balanced dynamic panel where each firm is counted only in one country of origin each year.

First, we ran several models using the large unbalanced panel (48,307 observations) including local nominal interest rate levels and monetary growth data. We found that local nominal interest rates have a positive contemporaneous effect on firm value with evidence in favor of a positive relationship between firm value and the local nominal interest rate. This is consistent with the supply side effect that higher nominal interest rates can lead to higher real interest rates and higher capital supply via firm's market valuation.[16] However, when adding measures of local spreads and US federal funds spread and signal-to-noise ratio, the level effects become irrelevant. We proceeded using the balanced panel

[16] This is along the lines of Tobin (1969) general equilibrium effects of monetary policy. See also Javier, Lopez-Salido, Nelson (2004) and Ehrmann and Fratzscher (2004), and Bolton, Chen, and Wang (2009) for a recent unified theory of nominal and real effects. Bond et al (2004) examine the effect of expected profit on firm value. We also found that smaller firms are more sensitive to the contemporaneous positive interest rate effect, whereas larger firms have negative lagged interest rate effects. Smaller firms are more sensitive to the positive contemporaneous money growth effects when deciding to cross list; but, larger firms have negative contemporaneous and negative lagged money growth effects; these results are comparable to Chatelain, et al (2001) for a sample for the Euro zone. The results are available upon request.

(15,876 observations) to measure the effects of local spreads and US federal funds spread and signal-to-noise ratio on firm value controlling for cross-listing. We separate the sample based upon cross-listing destination; and later consider sub-samples by firm size according to total assets. We then measure effects of local spreads and US federal funds spread and US fed funds signal-to-noise ratio on the decision to cross list and the effects on firm value, also considering destination and firm size.

5.1 Panel and Dynamic Panel Regressions

We apply two basic methods, panel fixed effects, and the Arellano and Bond (1991) dynamic panel methodology. The panel fixed effects model is given by

$$log\ q_{it} = \beta_0 + \beta_3\, dep\_mkt_{ct} + \beta_4\, dep\_mkt_{ct-1} + \beta_5\, prime\_fed_{US,\,t-1} + \beta_6 fed\_mcv_{US,\,t} + \beta_7 fed\_mcv_{US,\,t-1} + \beta_8\, Cross\text{-}List_{it} + \boldsymbol{\beta'}\boldsymbol{X}_{itc} + a_t + \varepsilon_{it} \quad (2)$$

and the dynamic panel is given by

$$log\ q_{it} = \beta_0 + \beta_1 log\ q_{it-1} + \beta_2 log\ q_{it-2} + \beta_3\, dep\_mkt_{ct} + \beta_4\, dep\_mkt_{ct-1} + \beta_5\, prime\_fed_{US,\,t-1} + \beta_6 fed\_mcv_{US,\,t} + \beta_7 fed\_mcv_{US,\,t-1} + \beta_8\, Cross\text{-}List_{it} + \boldsymbol{\beta'}\boldsymbol{X}_{itc} + a_t + \varepsilon_{it} \quad (3)$$

where i indexes the company and t indexes the year and c indexes the country. $\boldsymbol{X}_{itc}$ is a vector of controls which includes Sarbanes-Oxley, geographic region, SIC industry code dummies, growth of *gdp,* firm size, country and time trend effects, and interactions. The main hypotheses refer to the signs and magnitudes of the β_3 ,…, β_8 The variable GDPG is used to control for country macroeconomic factors. Size refers to the variables Twenty and Hundred, used to control for firm size and thus try to capture growth opportunity of the firm. Specification (2)-(3) refers to overall effects on valuation, and we also condition on cross-listing destination. We also use the Arellano and Bond (1991) dynamic panel estimation since we have a small number of years and a large number of firms. The results for specifications (2)-(3) are shown in Tables 6.[17]

Table 6, columns 1 and 2 refers to the relationship between nominal risk factors and firm value for the general panel. The regressions include all controls and interaction terms. The first main result is that the current and lagged US federal funds rate signal-to-noise ratio (in the Sharpe sense) have a significant negative effect on firm value across countries, while the (current and lagged) local spread and the (lagged) US prime rate-federal

[17] The method is based on GMM with first differences, and fixed effects are appropriately taken into account. The standard errors are adjusted for clusters in the panel regressions and the time dimension data are stationary as noted in Table 6.

funds rate spread are not significant. There is robust evidence that US fed funds risk benchmarking is occurring during this period. A decrease of one unit in the contemporaneous average US federal funds rate relative to its volatility increases the value of firm on average by 2.65%, say from *q=1* to *q=1.0265* both in the panel and dynamic panel models, columns (1) and (2), and this effects are almost similar for the lagged US fed funds risk factor indicating persistent and cumulative effects. Secondly, the cross-listing premium is significant and well identified, when controlling for the monetary risk factors, interactions and all other controls. The magnitudes are much larger as expected; about 15.3% in the panel fixed effects model and 28.2% in the dynamic panel model.[18]

Columns 3-8 present results conditional on cross-listing in one of the three destinations: US, Hong-Kong and Germany; thus capturing North America, Asia and Europe destination effects. The main identification results of columns (1) and (2) continue to hold. In the US destination, columns (3) and (4), the US fed funds risk benchmarking and the cross-listing premium effects are very similar to the overall sample. In addition, the (lagged) US prime rate-federal funds rate spread in the US destination is significant, a one tenth of a percent (one standard deviation) decline in the (lagged) US prime rate-federal funds rate spread, increases the value of firms in the US destination by 7.9%.

The destinations of Hong Kong and Germany follow.[19] In the Hong Kong destination, the US fed funds risk benchmarking is occurring significantly with magnitudes similar to the overall sample. There is also benchmarking in the (lagged) US prime rate-federal funds rate spread in the Hong Kong destination. Cross-listing in Hong Kong commands a large and significant discount between 44%-60%, a result shared by Bianconi and Chen (2009). In Table 2, we note that the great majority of firms that cross list in Hong Kong are from China, followed by few firms from Japan and Singapore and one from Ireland. The discount in our 2000-2005 sample is occurring predominantly for Chinese firms that cross-list in Hong Kong indicating that during that period the market perceived those firms to be less valuable.

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[18] All dynamic panels in Table 6 required two lags of the dependent variable to account for autocorrelation of the errors.

[19] To our knowledge, this is the first paper that estimates nominal risk factors and cross-listing premium effects in Hong Kong and Germany; see also Bianconi and Chen (2009).

In the Germany destination, the results are consistent with the overall sample. The US fed funds risk benchmarking is occurring significantly with magnitudes similar to the overall sample and but there isn't benchmarking in the (lagged) US prime rate-federal funds rate spread in the Germany destination. Cross-listing in Germany commands a significant premium between 11%-16%. Given that most firms that cross-list in Germany are from Asia and Europe (see Table 2), and corporate governance in Germany is less stringent than the US, and that the costs to cross list in Germany are much smaller relative to the US, we infer that one potential important reason for a premium in the Germany destination is the signaling effect of a firm's potential earnings. The market perceived those firms as more valuable.

Overall in Table 6, we find consistent and robust evidence that the US federal funds rate signal-to-noise ratio (in the Sharpe sense) risk factor provides an important benchmark for firm value across the universe of publicly traded companies. The local source nation interest rate spread is not significant in all cases; and the Sarbanes-Oxley dummy as well.

In Table 7, we consider sub-samples by firm size according to total assets: (i) Less than US$20 million; (ii) Between US$20 and US$100 million; (iii) Greater than US$100 million (all in 2005 US dollars). The table shows the general case with all available controls. Columns (1)-(2) show the sub-sample of total assets less than US$20 million, say small firms. The panel fixed effects case does identify the US federal funds rate signal-to-noise ratio effect between -5.6% and the dynamic panel of the order of -4.1%. The US spread and the local spreads are insignificant. The cross-listing effect is significant ranging from 52% to 187%. The interaction term between cross-listing and the US federal funds rate signal-to-noise ratio is significant. The value of a small firm that is cross-listed is much more sensitive to the US fed funds rate risk factor than one that is not cross-listed, an order of magnitude of -29.2% on average in the panel case only.

Columns (3)-(4) show the sub-sample of total assets more than US$20 million and less than US$100 million, the medium sized firms. The panel fixed effects case identifies the contemporaneous US federal funds rate signal-to-noise ratio of about -2.1% and the dynamic panel of the order of -2.6%; much smaller than the effect for small firms. The cross-listing premium is not significant in this set of firms.

In columns (5)-(6), the sub-sample of total assets more than US$100 million or large firms, the contemporaneous US federal funds rate signal-to-noise ratio of about -1.9% and the dynamic panel of the order of -2.2%, close to the effect on the medium sized firms. The cross-listing effect is significant ranging from 16.4% to 27.6%. The interaction term between cross-listing and the US federal funds rate signal-to-noise ratio is also significant in this case. The value of a large firm that is cross-listed is more sensitive to the US fed funds rate risk factor than one that is not cross-listed, an order of magnitude of -1.6% to -2.5% on average in the panel and dynamic panel cases.

From a perspective of size, the contemporaneous effect of the U.S. federal funds rate signal-to-noise ratio and the cross-listing premium are larger in magnitude for smaller firms with total assets less than US$20 million in the sample. In addition, smaller firms that cross-list are likely more sensitive to the US fed funds risk factor. For the larger firms, those results are qualitatively similar but with a lower order of magnitude. While the medium sized firms show effects of the US fed funds rate risk factor similar to the large firms in magnitude, we do not find a significant cross-listing premium for this set of firms. Our main finding here is that smaller firms, and larger firms to a lower order of magnitude tend to be more sensitive to the US fed funds rate risk factor; and the ones that are cross-listed are even more sensitive to the US risk benchmark. Medium sized firms do not share this evidence in this sample and period.

5.2 Treatment Effects

We can think of firms that cross list as the ones that receive a treatment relative to the ones that do not cross list. Of course, it is possible that firms with higher market valuation self-select into cross-listing. Firms with higher market value may gain more benefits from cross-listing than the costs borne onto them through the added disclosure requirements. Local and US interest rate spreads and US federal funds rate signal-to-noise ratio may affect the decision of firms to cross list abroad. Lower liquidity in domestic markets may lead firms to seek funds abroad through cross listing. In addition, Table 2 shows that geography may matter for the decision to cross list and where to cross list. We apply treatment effect methods where each firm has a valuation outcome with and without this treatment. We use

two methods for treatment effects, the consistent two-step estimator and the propensity score method.[20] In both cases, the models consist of the following two equations:

$$cross_{it} = \beta_0 + \beta_1 dep\_mkt_{ct} + \beta_2 dep\_mkt_{ct-1} + \beta_3 prime\_fed_{US,\,t} + \beta_4 prime\_fed_{US,\,t-1} + \beta_5 fed\_mcv_{US,\,t} + \beta_6 fed\_mcv_{US,\,t-1} + \boldsymbol{\beta' X''}_{it} + u_{it} \quad (4a)$$

$$Log\ q_{it} = \beta_0 + \beta_7 dep\_mkt_{ct} + \beta_8 prime\_fed_{US,\,t} + \beta_9 fed\_mcv_{US,\,t} + \boldsymbol{\psi' Z}_{it} + \varepsilon_{it} \quad (4b)$$

where (4a) is the decision on the unobserved latent variable and (4b) is the valuation equation; ***X"*** and ***Z*** are controls. In the two-step case, the valuation equation includes λ which measures the extent and direction in which unobserved factors that make cross-listing more likely to occur are associated with valuations. In the propensity score method, we estimate the decision equation using the balanced panel and use the predicted propensity to cross-list as an instrument for cross-listing in the valuation equation. Identification is through lagged local and US interest rate spreads and lagged US federal funds rate signal-to-noise ratio.

Table 8 present the results for the general case. Columns (1)-(2) give the two-step method and (3)-(4) the propensity score method. In the two-step method, the decision equation in column (1) shows that the contemporaneous and lagged US prime rate-federal funds rate spread and the contemporaneous and lagged US federal funds rate signal-to-noise ratio are significant in determining a firm's decision to cross-list abroad; but the local interest spread does not influence the probability of cross-listing. In both cases, the contemporaneous effect increases the probability to cross-list while the lagged effect is negative. In addition, geographic location does matter for the decision to cross-list. Firms located in Asia and Europe are more likely to cross-list relative to firms from other regions. Column (2) shows the valuation equation where the US risk factors results are consistent with previous findings. The US prime-federal funds rate spread and federal funds rate signal-to-noise ratio is negative and significant, but the local interest spread is not significant. The cross-listing premium is not identified, but the Sarbanes-Oxley Act has a significant negative effect on firm value in this case. The coefficient on λ is positive and significant indicating that unobserved factors lead to an increase in the probability of cross-listings when firm valuations are high.

[20] See e.g. Wooldridge (2002).

Columns (3)-(4) present the propensity score method. In column (3), the decision equation does not include controls, except for region controls.[21] We notice that the lagged local interest spread negatively and significantly affects the probability of cross-listing. The geographic location does matter for the decision to cross-list and firms located in Asia, Europe and South America are more likely to cross-list relative to firms from other regions. In the valuation equation, column (4), the US prime rate and the US fed funds risk factors have negative and significant effects on firm value. The cross-listing premium is significant and firms that cross-list are more sensitive to the US fed funds risk factor.

The evidence from treatment effects for the general case in Table 7 is that the robust effect on the probability of cross-listing is geography. Countries in Asia, Europe and South America tend to seek more funds abroad through cross-listing relative to other regions in this sample.

Tables 9.1-9.3 present the results by destination. In the US destination sample, Table 9.1, there is a significant contemporaneous positive US prime risk factor effect on the probability of cross-listing in column (1), and a significant geographic effect from countries located in Asia. Column (2) shows a significant contemporaneous and negative US prime rate and US fed funds risk factors on the value of firms. The cross-listing premium is large and significant and the Sox effect is negative and significant as expected. The coefficient on λ is negative and significant indicating that unobserved factors lead to an increase in the probability of cross-listings when firm valuations are low in this case.[22]

Columns (3) and (4) show the propensity score method. In column (3), there is a significant contemporaneous local interest spread negative effect on the probability of cross-listing, a significant (lagged) US fed funds risk factor, and a significant geographic effect from countries located in Europe and South America. Column (4) shows a significant contemporaneous and negative US prime rate and US fed funds risk factors on the value of firms. The cross-listing premium is large and significant, firms that cross-list are more sensitive to the US fed funds risk factor, and the Sox effect is negative and significant as expected.

[21] This is a population averaged panel probit model where latent heterogeneity has been averaged out; models with controls did not converge.

[22] This result is consistent with Doidge et al (2004, 2009), Bianconi and Tan (2010).

In the HK destination sample, Table 9.2 column (1) shows significant negative contemporaneous and lagged local interest spreads effects on the probability of cross-listing, as well as a significant positive contemporaneous US fed funds risk factor. This is some evidence of the potential risk arbitrage of local firms when deciding to cross-list abroad. The geographic effect of Asia is predominant in the firm's decision to cross-list in this case. In column (2), there is a significant cross-listing discount in column consistent with other findings above and the findings of Bianconi and Chen (2009). Column (2) also shows robust contemporaneous and negative US prime rate-federal funds rate spread and US federal funds rate signal-to-noise ratio benchmarking on the value of firms. The Sox effect is negative as in Bianconi and Chen (2009) indicating contagion effects of the Sarbanes-Oxley legislation abroad. The coefficient on λ is positive and marginally significant indicating that unobserved factors lead to an increase in the probability of cross-listings when firm valuations are high in this case.

Columns (3) and (4) present the propensity score method for Hong Kong. In column (3) the fit of the decision equation is very good. All risk factors are significant and we find good evidence of risk arbitrage of local firms when deciding to cross-list abroad. The Asia effect continues to be positive, large and significant. Column (4) shows robust contemporaneous and negative US prime rate-federal funds rate spread and US federal funds rate signal-to-noise ratio on the value of firms; the Sox effect is negative, and there is significant cross-listing discount.

Finally, Table 9.3 presents the Germany destination sample. Column (1) shows a significant contemporaneous positive US prime risk factor effect on the probability of cross-listing and a significant geographic effect from countries located in Europe as expected. Column (2) shows a significant negative US prime rate and US fed funds risk factors on the value of firms. The cross-listing premium is negative and significant, and the Sox effect is negative and significant, see e.g. Bianconi and Chen (2009). The coefficient on λ is positive and significant indicating that unobserved factors lead to an increase in the probability of cross-listings when firm valuations are high in this case.

Columns (3) and (4) show the propensity score method. In column (3), there is a significant positive contemporaneous local interest spread and a significant negative lagged local interest spread on the probability of cross-listing; and a significant geographic effect

from countries located in Asia, Africa and Europe. Column (4) shows a negative and significant US prime rate and US fed funds risk factors on the value of firms. The cross-listing premium is not significant, the Sox effect is negative and significant as in Bianconi and Chen (2009).

The evidence from the destination samples is that geography has a positive and robust effect on the probability of cross listing for all destinations. The Hong Kong destination sample shows a robust risk arbitrage effect on the probability of cross listing abroad. The evidence of US risk factors benchmarking on the probability of cross listing by destination is not robust across destinations and methods. However, the cross-listing premium on firm valuation is significant and robust for the US destination, consistent with previous findings of Doidge et al (2004, 2009), Bianconi and Tan (2010).

5.3 Size Effects

Tables 10.1-10.2 show the treatment effects by firm size. Table 10.1 is the two-step method and 10.2 is the propensity score method.

In Table 10.1, columns (1)-(2) show the sample of total assets less than US$20 million, the small frms. In the two-step method, the decision equation in column (1) shows effects of the probability of cross-listing for small firms. We note a significant local interest spread effect both contemporaneously positive and lagged negative; the US prime spread is significant and contemporaneously positive and lagged negative; and the lagged US fed funds risk factor effect is negative and significant. The Asia region has a significant and positive effect; and the Sarbanes-Oxley variable has also a positive and significant effect.[23] The effect on the valuation in column (2) is mixed. The US spread is negative but the signal-to-noise ratio of the US federal funds rate is positive on valuation in this sample. The cross listing premium and the Sox effect are both negative on valuation.

For the medium sized firms, column (3) shows significant monetary risk factors effects, positive region effects from Europe, and positive Sox effects on the probability of cross-listing. The local spread effect is negative both contemporaneously and lagged while the US risk factors are contemporaneously positive and lagged negative. The valuation

[23] The positive effect of the Sox variable on the probability of cross-listing can be attributed to a crowding-in of firms willingness to cross-list when standards are raised, see Bianconi and Chen (2009) for similar results.

equation in column (4) only identifies negative US fed funds risk effects on for medium sized firms.

For large firms, column (5) shows significant monetary risk factors effects, positive region effects from Asia, Africa, Europe, South America and Oceania; and positive Sox effects on the probability of cross-listing. The local spread effect is negative both contemporaneously and lagged, while the US risk factors are lagged positive, and the US fed funds risk factor is contemporaneously negative. The valuation equation in column (6) identifies negative US prime and fed funds risk effects on large firm value, negative local interest risk factor and negative Sox effects. There is a positive and significant cross-listing premium in this case and λ is negative and significant indicating that unobserved factors lead to an increase in the probability of cross-listings when firm valuations are low in this case.

In Table 10.2 shows the propensity score method by size. Columns (1)-(2) show the sample of total assets less than US$20 million, the small firms. The decision equation in column (1) shows effects on the probability of cross-listing for small firms. We note a significant negative lagged local interest spread effect; and the Asia region has a significant and positive effect. The effect on the valuation in column (2) is null.

For the medium sized firms, column (3) shows only a significant lagged local interest spread and a positive region effect from Europe. The valuation equation in column (4) identifies a negative US prime spread effect, a negative US fed funds risk effect and a positive cross listing premium on valuation for medium sized firms.

For large firms, column (5) shows significant local spread effect, negative both contemporaneously and lagged on the probability of cross listing. The US prime risk factor has a positive contemporaneous effect. The positive region effects are from Asia, Europe, and South America. The valuation equation in column (6) identifies negative US prime and fed funds risk effects on large firm value only.

In summary, partitioning the sample by size identifies more significantly effects of local interest spread effects on the probability of cross listing across all sizes; in particular the lagged effects of the local interest spread is negative and robust across all sizes and methods. This indicates that in general, if local spreads were lower in the past the probability of seeking cross-listing in the current period is low, as we would expect

intuitively. However, it is surprising that the evidence is robust for all sizes though. The geography effects remain positive and robust for all sizes and methods. Small firms located in Asia show a higher probability of cross listing abroad, while medium firms located in Europe show a higher relative probability of cross listing abroad. Large firms in Asia, Europe and South America show a higher relative probability of cross listing abroad.

6. Summary and Conclusions

We provide evidence of nominal effects on firm value and cross-listing decisions worldwide using dynamic panel data methods and treatment effects methods. We presented empirical models using a sample of 29 countries where firms cross-listed in a major North-American, Asian and European market for the period 2000-2005.

We found that local nominal interest rates have a positive contemporaneous effect on firm value with evidence is in favor of a positive relationship between firm value and nominal interest rate consistent with the supply side effect that higher nominal interest rates can lead to higher real interest rates and higher capital supply via firm's market valuation. However, when adding risk factors such as measures of local spreads and US federal funds spread and signal-to-noise ratio, the level effects become irrelevant.

Our results on the value of firms are as follows. In Table 6, we find consistent and robust evidence that the US federal funds rate signal-to-noise ratio (in the Sharpe sense) risk factor provides an important benchmark for firm value across the universe of publicly traded companies. However, the local source nation interest rate spread is not significant in all cases. The cross listing premium is significant and robust in general and for the US and Germany destinations, but negative for the Hong Kong destination.

From a perspective of size, our evidence on firm value show that the contemporaneous effect of the U.S. federal funds rate signal-to-noise ratio and the cross-listing premium are larger in magnitude for smaller firms with total assets less than US$20 million in the sample. In addition, smaller firms that cross-list are more sensitive to the US fed funds risk factor. For the larger firms, those results are qualitatively similar but with a lower order of magnitude. While the medium sized firms are sensitive to the US fed funds rate risk factor in a similar fashion as large firms in magnitude, we do not find a significant cross-listing premium for this set of firms. Our main finding here is that smaller firms, and

larger firms to a lower order of magnitude, tend to be more sensitive to the US fed funds rate risk factor and the ones that are cross-listed are even more sensitive to the US fed funds risk benchmark.

Our evidence on the determinants of cross listing from treatment effects shows geography playing a significant role. In Table 8, countries in Asia, Europe and South America tend to seek more funds abroad through cross-listing relative to other regions in this sample. Also, in Table 8 we find evidence that countries that cross list tend to be more sensitive to the US fed funds risk factor. The evidence from the destination samples is that geography has a positive and robust effect on the probability of cross listing for all destinations. The Hong Kong destination sample shows a robust risk arbitrage effect on the probability of cross listing abroad. The evidence of US risk factors benchmarking on the probability of cross listing by destination is not robust across destinations and methods. However, the cross-listing premium on firm valuation is significant and robust for the US destination, consistent with previous findings of Doidge et al (2004, 2009), Bianconi and Tan (2010). And countries that cross list in the US tend to be more sensitive to the US fed funds risk factor.

The treatment evidence by size identifies more significantly effects of local interest spread effects on the probability of cross listing across all sizes; in particular the lagged effects of the local interest spread is negative and robust across all sizes and methods. This indicates that in general, if local spreads were lower in the past, the probability of seeking cross-listing in the current period is low, as we would expect intuitively. However, it is surprising that the evidence is robust for all sizes. The geography effects remain positive and robust for all sizes and methods. Small firms located in Asia show a higher probability of cross listing abroad, while medium firms located in Europe show a higher relative probability of cross listing abroad. Large firms in Asia, Europe and South America show a higher relative probability of cross listing abroad.

The small time and large cross-sectional dimensions make the Arellano-Bond dynamic panel methodology appropriate. On the other hand, we only included country and industry-level effects, but not firm level characteristics. A fruitful avenue for future research would be to expand the number of firms and origin and destination markets to better understand the interest risk effect on the cross-listing decision of firms.

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Table 1: Top 10 exchanges by total share trading value

Exchange	USD Bn 2006	USD Bn 2005	% change in USD	% change in local currency
1. NYSE	21,790	17,858	22.0	22.0
2. NASDAQ	11,807	10,087	17.1	17.1
3. London Stock Exchange	7,572	5,678	33.4	30.5
4. Tokio Stock Exchange	5,823	4,482	29.9	36.4
5. Euronext	3,853	2,906	32.6	29.2
6. Deutche Burse	2,737	1,915	42.9	40.0
7. BME Spanish Exchange	1,934	1,566	23.5	21.0
8. Borsa Italiana	1,592	1,294	23.0	20.5
9. SWX Swiss Exchange	1,396	974	43.5	43.2
10. Korea Exchange	1,342	1,211	10.9	3.2

Source: World Federation Exchange 2006 Annual Report

Table 2: Countries of Origin in the Sample

Country	Number of Observations	Number of Firms	Cross-Listed Obs.	US Obs.	HK Obs.	Germany Obs.	Region
CHINA	372	62	69	3	65	1	Asia
ISRAEL	126	21	29	22	--	7	Asia
INDIA	12	2	4	4	--	--	Asia
JAPAN	5,790	965	222	78	4	140	Asia
KOREA	648	108	1	1	--	--	Asia
SINGAPORE	480	80	11	1	5	5	Asia
PHILLIPINES	126	21	1	1	--	--	
SOUTH AFRICA	378	63	9	5	--	4	Africa
GREECE	426	71	3	1	--	2	Europe
NETHERLANDS	360	60	69	23	--	46	Europe
ITALY	270	45	33	8	--	25	Europe
SWITZERLAND	204	34	35	14	--	21	Europe
BELGIUM	180	30	10	--	--	10	Europe
SPAIN	126	21	12	2	--	10	Europe
PORTUGAL	108	18	3	--	--	3	Europe
HUNGARY	42	7	6	1	--	5	Europe
UNITED KINGDOM	3,030	505	138	118	--	20	Europe
FRANCE	870	145	37	19	--	18	Europe
SWEEDEN	480	80	15	11	--	4	Europe
FINLAND	336	56	13	9	--	4	Europe
DENMARK	306	51	2	2	--	--	Europe
IRELAND	138	23	15	14	1	--	Europe
MEXICO	198	33	13	13	--	--	N. America
CHILE	192	32	15	15	--	--	S. America
ARGENTINA	78	13	4	4	--	--	S. America
VENEZUELA	24	4	2	2	--	--	S. America
BRAZIL	6	1	--	--	--	--	S. America
AUSTRALIA	444	74	6	5	--	1	Oceania
NEW ZEALAND	126	21	4	4	--	--	Oceania
Total 29	15876	2646	781	380	75	326	

Table 3: Variables Definition

q	The sum of firm's book value of total liability and its market capitalization divided by the firm's book value of total assets.
dep_mkt	Local interest rate spread: deposit rate - money market rate
prime_fed	US interest spread: prime rate - federal funds rate
fed_mcv	US monthly federal funds rate signal-to-noise ratio: $\frac{average}{std\_dev}$
Cross	Takes the value of 1 if cross-listed in either the US, HK, or Germany and 0 otherwise
HK	Takes the value of 1 if cross-listed in HK and 0 otherwise
US	Takes the value of 1 if cross-listed in US and 0 otherwise
Germany	Takes the value of 1 if cross-listed in Germany and 0 otherwise
Sox	Takes the value of 0 if firm is not listed before the imposition of Sox in 2002
GDPG	GDP growth rate of the source country per year
TWENTY	Takes a value of 1 if firm's assets denominated in 2005 US dollars exceeds $20 million
HUNDRED	Takes a value of 1 if firm's assets denominated in 2005 US dollars exceeds $100 million
Asia, Africa, Europe, North America, South America, Oceania	Region dummies: Takes value of 1 if source country is located in the region

Table 4: Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
tq	15876	1.709465	2.440469	0.251	39.811
logtobinq	15876	0.253222	0.610933	-1.3823	3.684143
dep_mkt	15876	-0.77121	1.469323	-8.74	9.01
prime_fed	15876	2.995	0.018028	2.97	3.03
fed_mcv	15876	7.7	4.686678	3.01	16.43
cross	15876	0.049194	0.216279	0	1
us	15876	0.023936	0.152853	0	1
hk	15876	0.004724	0.068572	0	1
germany	15876	0.020534	0.141823	0	1
sox	15876	0.67939	0.466726	0	1
twenty	15876	0.874087	0.331762	0	1
hundred	15876	0.628685	0.483172	0	1
gdpg	15876	2.663076	2.320939	-11	18

Table 5: Correlation matrix (p-value Ho: ρ=0)

	logtob~q	dep_mkt	prime_~d	Fedmcv	cross1	us	hk1	germany1	sox	twenty	hundred
depmkt	-0.1536	1									
	0										
prime_fed	-0.041	-0.0842	1								
	0	0									
fedmcv	-0.015	-0.0712	-0.2318	1							
	0.058	0	0								
cross	0.0392	-0.0329	0.0271	0.0301	1						
	0	0	0.0006	0.0002							
us	0.0512	-0.0711	0.0174	0.0347	0.6885	1					
	0	0	0.0286	0	0						
hk	-0.0293	-0.0041	0.0217	0.0062	0.3029	-0.0108	1				
	0.0002	0.6021	0.0064	0.4368	0	0.174					
germany	0.0188	0.0285	0.0121	0.0055	0.6366	-0.0227	-0.01	1			
	0.0176	0.0003	0.1283	0.488	0	0.0043	0.2088				
sox	-0.0403	0.0966	-0.572	-0.2943	0.072	0.1076	0.0217	-0.0166	1		
	0	0	0	0	0	0	0.0062	0.0361			
twenty	-0.223	0.2137	0.0331	0.0211	0.0714	0.0545	0.0234	0.0389	-0.0777	1	
	0	0	0	0.0078	0	0	0.0032	0	0		
hundred	-0.2127	0.2221	0.0353	0.0348	0.1296	0.0931	0.0358	0.08	-0.0958	0.4939	1
	0	0	0	0	0	0	0	0	0	0	
gdpg	0.1021	-0.0343	-0.2665	0.1616	0.0167	-0.0051	0.162	-0.0473	-0.0223	-0.048	-0.1101
	0	0	0	0	0.0353	0.5169	0	0	0.0049	0	0

Table 6 – General Models and By Destination

	Dependent Variable: log *q*							
			By Destination					
			US		HK		Germany	
	(1) Panel FE	(2) Dynamic Panel	(3) Panel FE	(4) Dynamic Panel	(5) Panel FE	(6) Dynamic Panel	(7) Panel FE	(8) Dynamic Panel
dep_mkt	0.002	0.017*	0.002	0.015	0.003	0.011	0.003	0.011
	(0.007)	(0.011)	(0.007)	(0.013)	(0.007)	(0.010)	(0.007)	(0.010)
dep_mkt (t-1)	-0.008	0.001	-0.007	0.003	-0.009	0.002	-0.010	0.002
	(0.007)	(0.004)	(0.007)	(0.014)	(0.007)	(0.011)	(0.007)	(0.011)
US prime_fed (t-1)	-3.628	--	-7.949*	--	-10.866*	--	-11.05	--
	(3.653)		(3.975)		(5.133)		(7.074)	
US fed_mcv	-0.027***	-0.026***	-0.029***	-0.026***	-0.030***	-0.026***	-0.030***	-0.026***
	(0.003)	(0.003)	(0.003)	(0.004)	(0.005)	(0.003)	(0.004)	(0.003)
US fed_mcv (t-1)	-0.023*	-0.012***	-0.034***	-0.012***	-0.041***	-0.013***	-0.042***	-0.013***
	(0.010)	(0.002)	(0.010)	(0.002)	(0.013)	(0.002)	(0.018)	(0.002)
Cross-List	0.153*	0.282***	0.148***	0.361***	-0.599***	-0.439***	0.115***	0.159***
	(0.061)	(0.084)	(0.038)	(0.131)	(0.169)	(0.095)	(0.035)	(0.046)
Cross-List × US fed_mcv	-0.010	-0.016	--	-0.016	0.022	--	--	--
	(0.009)	(0.012)		(0.018)	(0.022)			
Sox	-0.130*	0.072	-0.041	0.076	0.031	0.040	0.035	0.040
	(0.076)	(0.305)	(0.086)	(0.368)	(0.115)	(0.346)	(0.160)	(0.341)
Size	y	Y	y	y	y	y	y	y
Industry	y	--	y	--	y	y	y	y
GDP Growth	y	Y	y	y	y	y	y	y
Trend	y	Y	y	y	y	y	y	y
q(t-1)	--	0.002	--	0.003	--	0.010	--	0.007
		(0.016)		(0.016)		(0.016)		(0.016)
q(t-2)	--	0.020	--	0.020*	--	0.019	--	0.020
		(0.012)		(0.012)		(0.012)		(0.011)
Constant	y	Y	y	y	y	y	y	y
F -- χ^2	1.14***	583.7***	1.15***	541.8***	1.14***	1,112***	1.15***	1,155***
AR(2,3) error z	--	-0.514	--	-0.350	--	-0.753	--	-1.112
Sargan χ^2	--	9.89	--	9.71	--	11.26	--	12.03
Clusters (by Firm)	2,646	2,646	2,646	2,646	2,646	2,645	2,646	2,646
Obs	13,230	7,938	12,900	7,764	12,688	7,648	12,894	7,766
R^2 *(overall)*	0.16	--	0.16	--	0.16	--	0.16	--

Notes: Controls: Size =Twenty, Hundred; Industry=SIC Code dummies; Growth of GDP, lagged growth of GDP; time trend. *p < .05. **p < .01. ***p < .001.

Levin-Lin-Chu panel unit-root test for logtobinq: t-star= -239.3 P > t: 0.0000

Table 7 – General Models by Size

	Dependent Variable: Log *q*					
	TA	< 20,000	TA	>20,000 – <100,000	TA	>100,000
	(1) Panel FE	(2) Dynamic Panel	(3) Panel FE	(4) Dynamic Panel	(5) Panel FE	(6) Dynamic Panel
dep_mkt	0.013	-0.003	0.018	0.044*	0.002	-0.007
	(0.059)	(0.039)	(0.015)	(0.020)	(0.009)	(0.011)
dep_mkt (t-1)	-0.017	-0.008	0.011	-0.008	-0.002	-0.003
	(0.043)	(0.037)	(0.020)	(0.023)	(0.008)	(0.009)
US prime_fed (t-1)	23.91	--	4.773	--	-1.822	-0.357
	(21.61)		(15.03)		(4.271)	(5.684)
US fed_mcv	-0.056***	-0.041***	-0.021*	-0.026***	-0.019***	-0.022***
	(0.019)	(0.012)	(0.010)	(0.007)	(0.004)	(0.004)
US fed_mcv (t-1)	0.053	-0.029***	-0.010	-0.012***	-0.018	-0.008
	(0.056)	(0.007)	(0.037)	(0.004)	(0.011)	(0.015)
Cross-List	1.865***	0.524*	0.341	0.162	0.164**	0.276***
	(0.180)	(0.308)	(0.349)	(0.278)	(0.065)	(0.074)
Cross-List × US fed_mcv	-0.292***	-0.039	-0.046	-0.018	-0.016*	-0.025*
	(0.030)	(0.047)	(0.060)	(0.034)	(0.009)	(0.011)
Sox	--	--	-0.329	0.253	-0.087	0.023
			(0.334)	(0.441)	(0.091)	(0.125)
Industry	y	--	y	--	y	--
GDP Growth	y	Y	y	y	y	y
Trend	y	Y	y	y	y	y
q(t-1)	--	0.200***	--	0.084*	--	0.001
		(0.071)		(0.043)		(0.017)
q(t-2)	--	0.135***	--	0.080***	--	--
		(0.046)		(0.029)		
Constant	y	Y	y	y	y	y
F -- χ^2	1.08	206.5***	1.20***	74.17***	1.32***	162.1***
AR(2, 3) error z	--	0.249	--	0.637	--	1.630
Sargan χ^2	--	15.48*	--	13.87	--	20.27*
Clusters (By Firm)	1,098	872	1,949	1,552	2,553	2,444
Obs	1,784	1,105	3,367	2,048	8,079	6,251
R^2 *(overall)*	0.13	--	0.08	--	0.12	--

Notes: TA=Total Assets
Controls: Industry=SIC Code dummy; Growth of GDP, lagged growth of GDP; time trend. *p < .05. **p < .01. ***p < .001.

Table 8: Treatment Effects: General Case

	(1) Two-Step	(2)	(3) Panel	(4)
	Dependent Variable: *Cross*	Dependent Variable: *Log q*	Dependent Variable: *Cross*	Dependent Variable: *Log q*
	First Stage Probit	Second Stage	First Stage Probit	Second Stage FE
dep_mkt	-0.014	-0.001	-0.014	0.006
	(0.030)	(0.007)	(0.016)	(0.007)
dep_mkt (t-1)	0.027	--	-0.116***	--
	(0.040)		(0.021)	
US prime_fed	15.10***	-2.915***	2.491	-49.71***
	(5.706)	(0.471)	(2.145)	(5.832)
US prime_fed (t-1)	-14.67*	--	-0.674	--
	(7.243)		(3.509)	
US fed_mcv	0.052**	-0.025***	0.016	-0.129***
	(0.023)	(0.002)	(0.016)	(0.015)
US fed_mcv (t-1)	-0.042*	--	0.007	--
	(0.023)		(0.007)	
Cross-List	--	-0.147	--	2.776***
		(0.137)		(0.830)
Cross-List × US fed_mcv	--	--	--	-0.307***
				(0.093)
Sox	--	-0.124***	--	-0.055*
		(0.030)		(0.034)
Asia	0.805***	--	0.530***	--
	(0.278)		(0.111)	
Europe	0.619*	--	0.548***	--
	(0.352)		(0.096)	
South America	--	--	0.684***	--
			(0.157)	
Size	--	y	--	y
Industry	Y	y	--	y
GDP Growth	--	y	--	y
Trend	--	y	--	y
Country	Y	y	--	--
Constant	Y	y	--	y
λ	--	0.012*	--	--
		(0.066)		
F--χ^2	6,431***	--	122.6***	1.16***
R^2 *(overall)*	--	--	--	0.16
Clusters (By Firm)	--	--	2,646	2,646
Obs	13,230	13,230	15,876	13,230

Notes: Controls: Industry=SIC Code dummy; Growth of GDP, lagged growth of GDP; time trend; Size =Twenty, Hundred.*p < .05. **p < .01. ***p < .001, robust.

Table 9.1: Treatment Effects: By Destination

	US Destination			
	(1) Two-Step	(2)	(3) Panel	(4)
	Dependent Variable: *Cross*	Dependent Variable: *Log q*	Dependent Variable: *Cross*	Dependent Variable: *Log q*
	First Stage Probit	Second Stage	First Stage Probit	Second Stage FE
dep_mkt	-0.015	0.001	-0.069***	-0.002
	(0.034)	(0.006)	(0.019)	(0.011)
dep_mkt (t-1)	0.029	--	-0.034	--
	(0.043)		(0.021)	
US prime_fed	12.85*	-3.088***	-1.363	-47.35***
	(7.574)	(0.488)	(2.745)	(6.019)
US prime_fed (t-1)	-10.73	--	4.054	--
	(9.640)		(4.551)	
US fed_mcv	0.031	-0.026***	-0.007	-0.123***
	(0.030)	(0.002)	(0.021)	(0.015)
US fed_mcv (t-1)	-0.033	--	0.020**	--
	(0.031)		(0.009)	
Cross-List	--	0.685***	--	2.393*
		(0.191)		(1.247)
Cross-List × US fed_mcv	--	--	--	-0.721***
				(0.131)
Sox	--	-0.125***	--	-0.060***
		(0.032)		(0.033)
Asia	1.281*	--	--	--
	(0.670)			
Europe	--	--	0.200***	--
			(0.056)	
South America	--	--	0.674***	--
			(0.147)	
Size	--	y	--	y
Industry	Y	y	--	y
GDP Growth	--	y	--	y
Trend	--	y	--	y
Country	Y	y	--	--
Constant	Y	--	y	y
λ	--	-0.236***	--	--
		(0.086)		
F--χ^2	6,060***	--	138.2***	1.18***
R^2 *(overall)*	--	--	--	0.15
Clusters (By Firm)	--	--	2,646	2,646
Obs	12,900	12,900	15,475	12,900

Notes: Controls: Industry=SIC Code dummy; Growth of GDP, lagged growth of GDP; time trend; Size =Twenty, Hundred.*p < .05. **p < .01. ***p < .001, robust.

Table 9.2: Treatment Effects: By Destination

	HK Destination			
	(1) Two-Step	(2)	(3) Panel	(4)
	Dependent Variable: *Cross*	Dependent Variable: *Log q*	Dependent Variable: *Cross*	Dependent Variable: *Log q*
	First Stage Probit	Second Stage	First Stage Probit	Second Stage FE
dep_mkt	-0.440***	-0.000	-0.445***	0.002
	(0.074)	(0.003)	(0.078)	(0.007)
dep_mkt (t-1)	-0.426***	--	-0.270***	--
	(0.071)		(0.092)	
US prime_fed	18.53	-3.352***	24.36***	-48.34***
	(20.57)	(0.524)	(7.005)	(5.851)
US prime_fed (t-1)	-22.50	--	-29.74***	--
	(26.40)		(9.546)	
US fed_mcv	0.142*	-0.025***	0.159***	-0.136***
	(0.085)	(0.002)	(0.051)	(0.014)
US fed_mcv (t-1)	-0.036	--	-0.057***	--
	(0.083)		(0.020)	
Cross-List	--	-0.708***	--	-1.557***
		(0.201)		(0.480)
Cross-List × US fed_mcv	--	--	--	0.238
				(0.085)
Sox	--	-0.147***	--	-0.127***
		(0.034)		(0.035)
Asia	3.625***	--	4.270***	
	(0.548)		(1.708)	
Size	--	y	--	y
Industry	Y	y	--	y
GDP Growth	--	y	--	y
Trend	--	y	--	y
Country	Y	y	--	--
Constant	Y	--	y	y
λ	--	0.156*	--	--
		(0.092)		
F--χ^2	5,903***	--	190.2***	1.15***
R^2 *(overall)*	--	--	--	0.16
Clusters (By Firm)	--	--	2,646	2,646
Obs	12,688	12,688	15,170	12,688

Notes: Controls: Industry=SIC Code dummy; Growth of GDP, lagged growth of GDP; time trend; Size =Twenty, Hundred.*p < .05. **p < .01. ***p < .001, robust.

Table 9.3: Treatment Effects: By Destination

	Germany Destination			
	(1) Two-Step	(2)	(3) Panel	(4)
	Dependent Variable: *Cross*	Dependent Variable: *Log q*	Dependent Variable: *Cross*	Dependent Variable: *Log q*
	First Stage Probit	Second Stage	First Stage Probit	Second Stage FE
dep_mkt	-0.029 (0.061)	-0.001 (0.007)	0.106*** (0.015)	-0.001 (0.007)
dep_mkt (t-1)	0.070 (0.101)	--	-0.209*** (0.024)	--
US prime_fed	13.32* (7.963)	-3.338*** (0.535)	2.099 (2.976)	-49.01*** (5.824)
US prime_fed (t-1)	-14.65 (10.03)	--	-0.338 (4.863)	--
US fed_mcv	0.049 (0.032)	-0.024*** (0.002)	0.013 (0.022)	-0.141*** (0.015)
US fed_mcv (t-1)	-0.044 (0.032)	--	0.000 (0.009)	--
Cross-List	--	-0.162* (0.073)	--	0.122 (0.852)
Cross-List × US fed_mcv	--	--	--	0.154 (0.125)
Sox	--	-0.150*** (0.035)	--	-0.107*** (0.036)
Asia	--	--	1.591*** (0.439)	--
Africa	--	--	1.195*** (0.464)	--
Europe	5.741*** (0.470)	--	1.633*** (0.427)	--
Size	--	y	--	y
Industry	Y	y	--	y
GDP Growth	--	y	--	y
Trend	--	y	--	y
Country	Y	y	--	--
Constant	Y	y	y	y
λ	--	0.228*** (0.076)	--	--
F--χ^2	6,401***	--	128.5***	1.15***
R^2 *(overall)*	--	--	--	0.16
Clusters (By Firm)	--	--	2,646	2,646
Obs	12,894	12,894	15,421	12,894

Notes: Controls: Industry=SIC Code dummy; Growth of GDP, lagged growth of GDP; time trend; Size =Twenty, Hundred.*p < .05. **p < .01. ***p < .001, robust.

Table 10.1: Treatment Effects: By Size

	Two Step Case					
	(1) TA <	(2) 20,000	(3) TA	(4) >20,000; <100,000	(5) TA >	(6) 100,000
	Dependent Variable: *Cross*	Dependent Variable: *Log q*	Dependent Variable: *Cross*	Dependent Variable: *Log q*	Dependent Variable: *Cross*	Dependent Variable: *Log q*
	First Stage Probit	Second Stage	First Stage Probit	Second Stage	First Stage Probit	Second Stage
dep_mkt	0.186***	-0.010	-0.012	-0.001	-0.041*	-0.043***
	(0.094)	(0.014)	(0.042)	(0.003)	(0.021)	(0.004)
dep_mkt (t-1)	-0.308***	--	-0.221***	--	-0.188***	--
	(0.088)		(0.060)		(0.026)	
US prime_fed	96.43	-10.44***	183.4***	-1.649	--	-4.345***
	(58.88)	(1.918)	(34.81)	(1.091)		(0.582)
US prime_fed (t-1)	-96.80	--	-191.2***	--	23.32***	--
	(63.61)		(36.15)		(2.800)	
US fed_mcv	0.216	-0.067***	0.380***	-0.020***	-0.073***	-0.012***
	(0.158)	(0.009)	(0.086)	(0.005)	(0.014)	(0.003)
US fed_mcv (t-1)	-0.253*	--	-0.520***	--	0.106***	--
	(0.185)		(0.107)		(0.008)	
Cross-List	--	-0.470	--	-0.336	--	0.724***
		(0.682)		(0.260)		(0.084)
Sox	2.161**	-0.305**	3.701***	-0.058	1.780***	-0.241***
	(1.029)	(0.124)	(0.629)	(0.069)	(0.117)	(0.037)
Asia	0.843***	--	--	--	1.039***	--
	(0.237)				(0.246)	
Africa	--	--	--	--	0.950***	--
					(0.308)	
Europe	--	--	0.548***	--	1.249***	--
			(0.162)		(0.230)	
South America	--	--	--	--	1.320***	--
					(0.284)	
Oceania	--	--	--	--	0.675*	--
					(0.303)	
Industry	--	--	--	--	--	--
GDP Growth	y	Y	y	y	y	y
Trend	--	Y	--	y	--	y
Country	--	--	--	--	--	--
Constant	y	--	y	--	y	--
λ	--	0.197	--	0.202*	--	-0.287***
		(0.287)		(0.109)		(0.042)
F--χ^2	1,082***	--	932.1***	--	1,543***	--
Obs	1,784	1,784	3,367	3,369	8,079	8,079

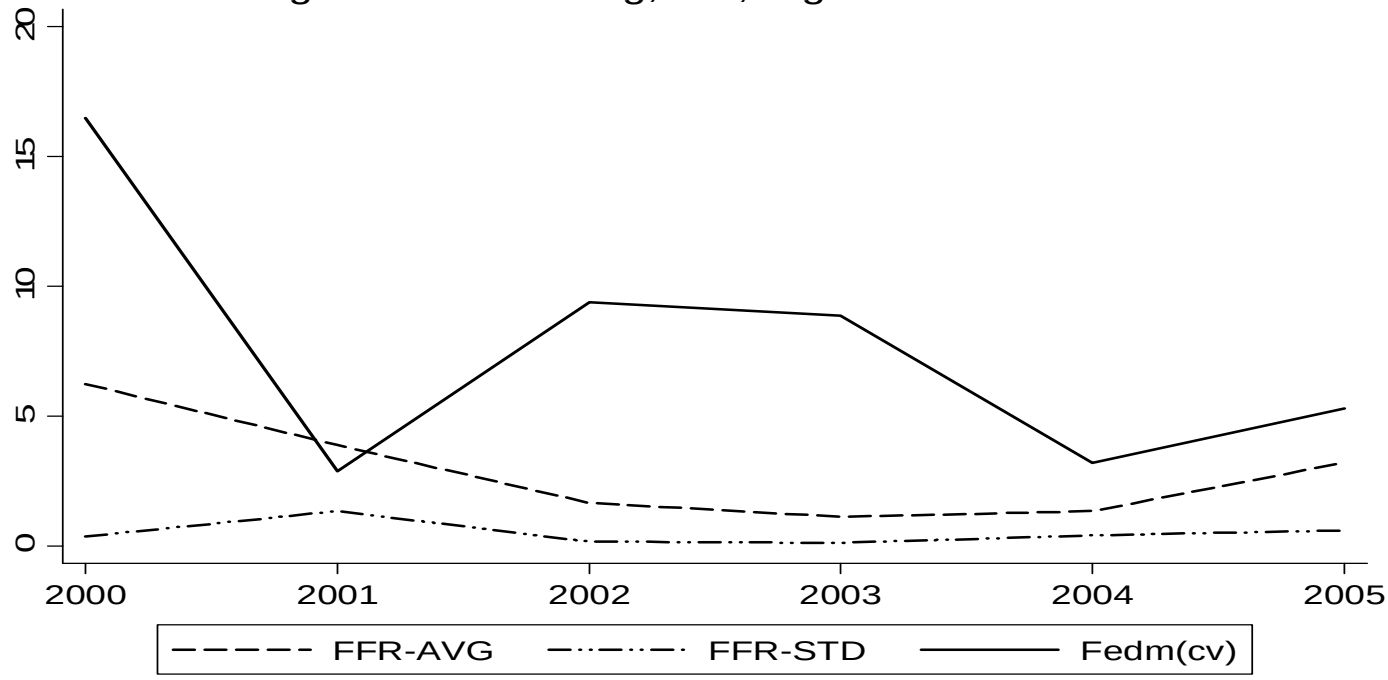
Notes: Controls: Industry=SIC Code dummy; Growth of GDP, lagged growth of GDP; time trend;*p < .05. **p < .01. ***p < .001, robust.

Table 10.2: Treatment Effects: By Size

	Propensity Score – Panel FE					
	(1) TA <	(2) 20,000	(3) TA	(4) >20,000; <100,000	(5) TA >	(6) 100,000
	Dependent Variable: *Cross*	Dependent Variable: *Log q*	Dependent Variable: *Cross*	Dependent Variable: *Log q*	Dependent Variable: *Cross*	Dependent Variable: *Log q*
	First Stage Probit	Second Stage	First Stage Probit	Second Stage	First Stage Probit	Second Stage
dep_mkt	0.074	-0.022	-0.005	0.018	-0.042*	0.010
	(0.064)	(0.063)	(0.029)	(0.015)	(0.019)	(0.010)
dep_mkt (t-1)	-0.261***	--	-0.120***	--	-0.091***	--
	(0.053)		(0.034)		(0.023)	
US prime_fed	-2.160	-18.01	-5.080	-55.77***	5.090*	-45.09***
	(8.846)	(30.86)	(6.232)	(21.13)	(2.549)	(6.688)
US prime_fed (t-1)	-4.106	--	-4.731	--	0.559	--
	(15.54)		(9.477)		(4.236)	
US fed_mcv	0.034	-0.102	0.003	-0.122*	0.019	-0.117***
	(0.074)	(0.078)	(0.042)	(0.056)	(0.020)	(0.017)
US fed_mcv (t-1)	0.018	--	0.019	--	-0.005	--
	(0.035)		(0.019)		(0.008)	
Cross-List	--	0.930	--	9.066*	--	1.092
		(2.101)		(5.302)		(0.722)
Cross-List × US fed_mcv	--	-0.532	--	-1.612**	--	-0.115*
		(0.601)		(0.636)		(0.063)
Sox	--	-0.177	--	-0.034	--	0.008
		(0.196)		(0.048)		(0.040)
Asia	0.867***	--	--	--	0.291*	--
	(0.242)				(0.142)	
Europe	--	--	0.346***	--	0.539***	--
			(0.125)		(0.120)	
South America	--	--	--	--	0.613***	--
					(0.172)	
Industry	--	Y	--	y	--	y
GDP Growth	--	Y	--	y	--	y
Trend	--	Y	--	y	--	y
Constant	y	Y	y	y	y	y
F--χ^2	60.60***	1.08	28.74***	1.21***	167.9***	1.27***
R^2 (overall)	--	0.13	--	0.08	--	0.12
Clusters (By Firm)	1,150	1,098	2,061	1,949	2,605	2,553
Obs	1,999	1,784	3,896	3,367	9,981	8,079

Notes: Controls: Industry=SIC Code dummy; Growth of GDP, lagged growth of GDP; time trend;*p < .05. **p < .01. ***p < .001, robust.

Fig 1: US FFR - Avg, Std, Signal-to-Noise Ratio



US Prime Interest Rate - Federal Funds Rate Spread

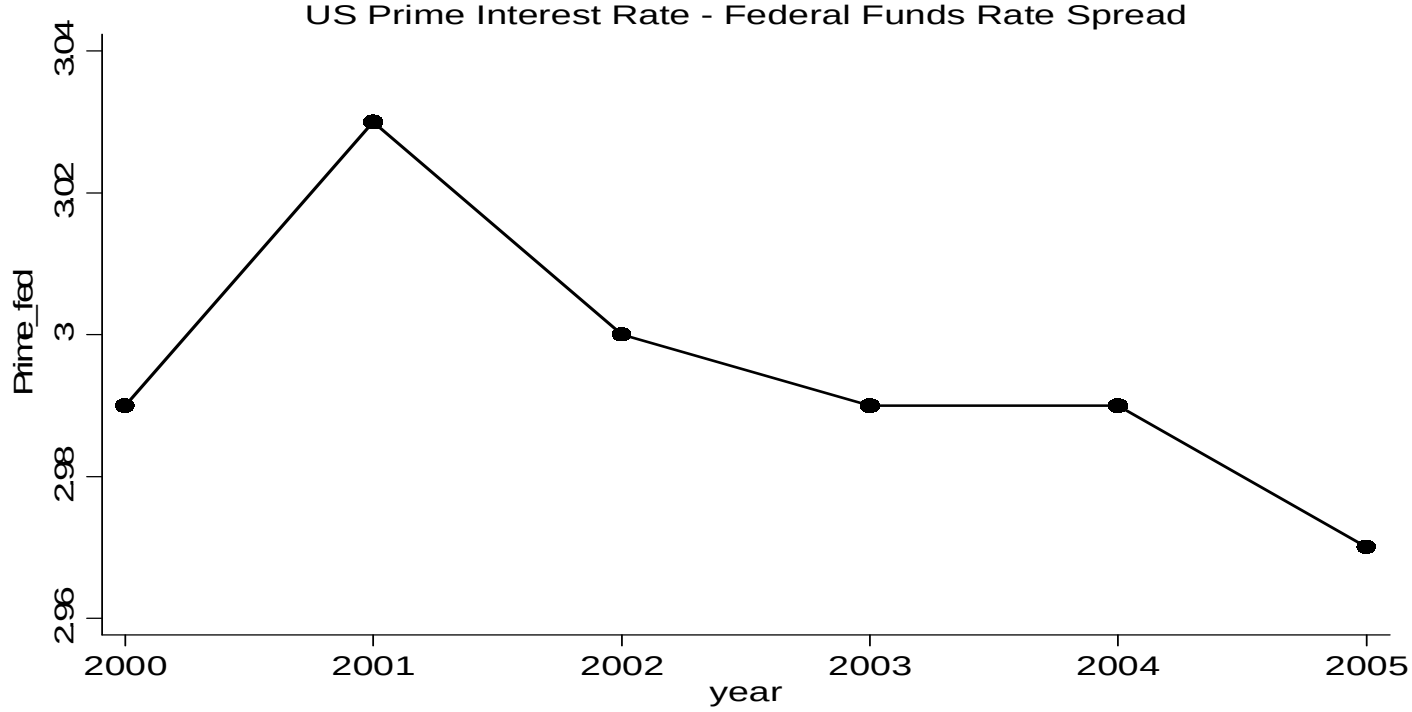


Fig. 2: Firm Value and Local Interest Spread

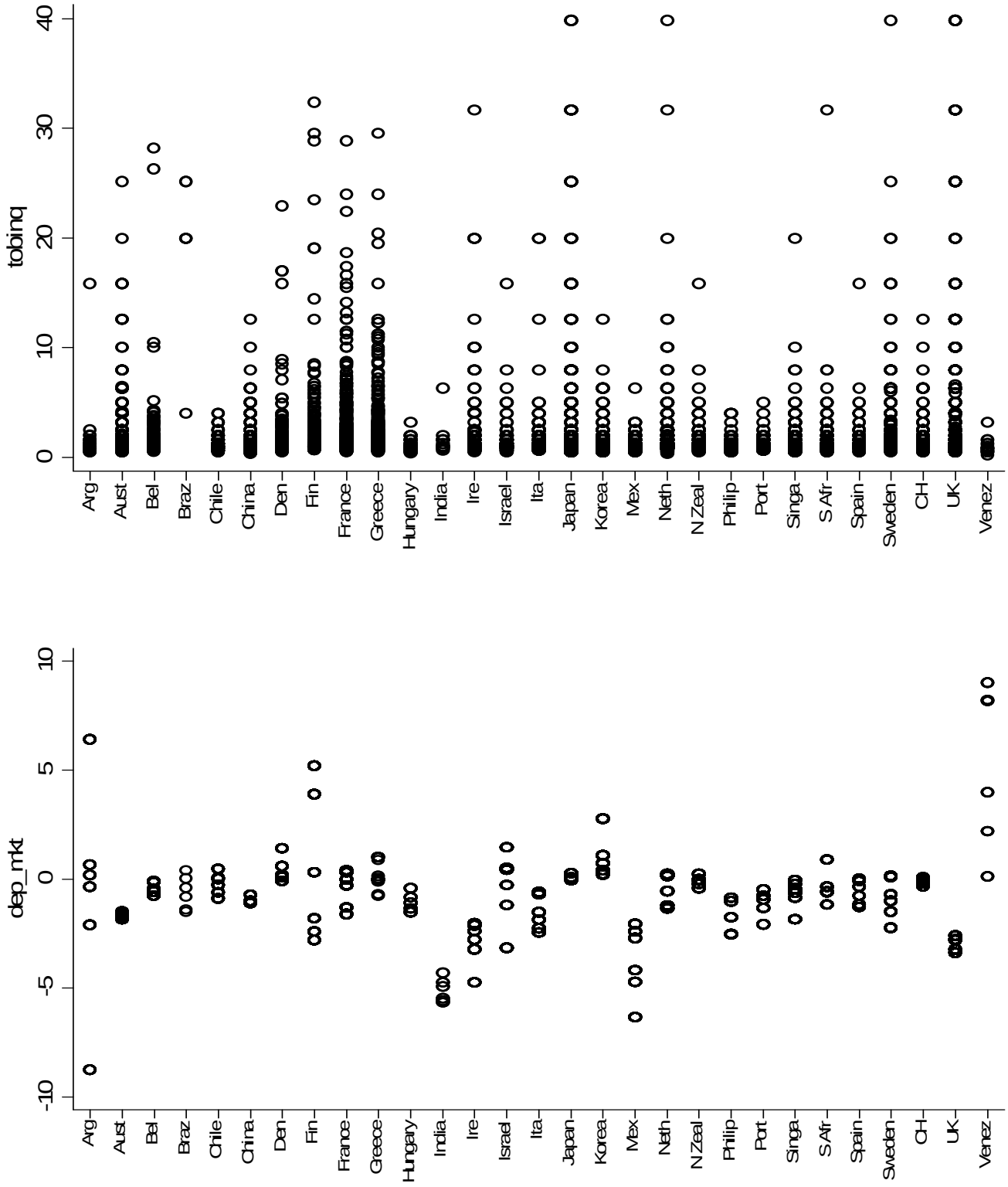
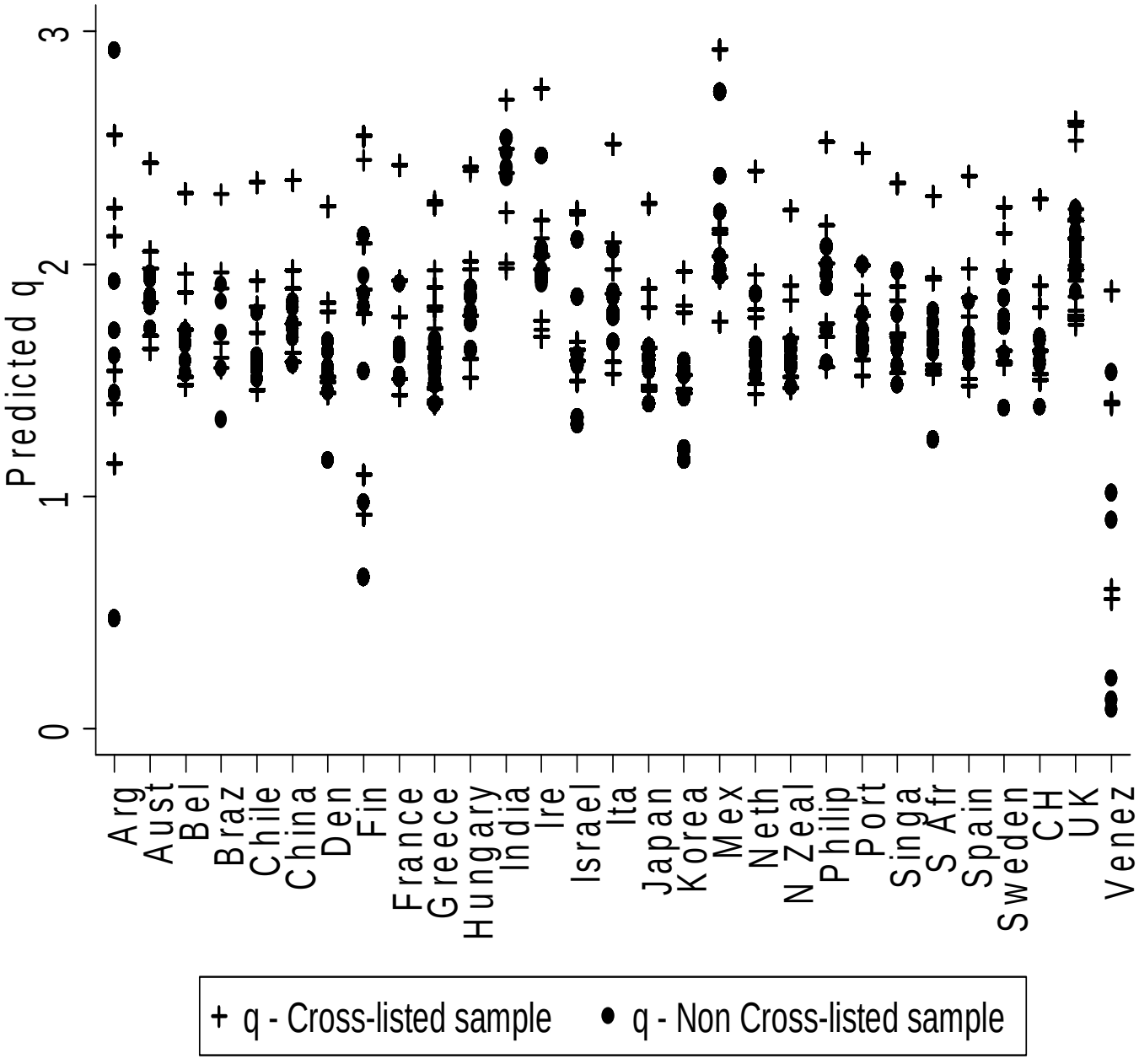
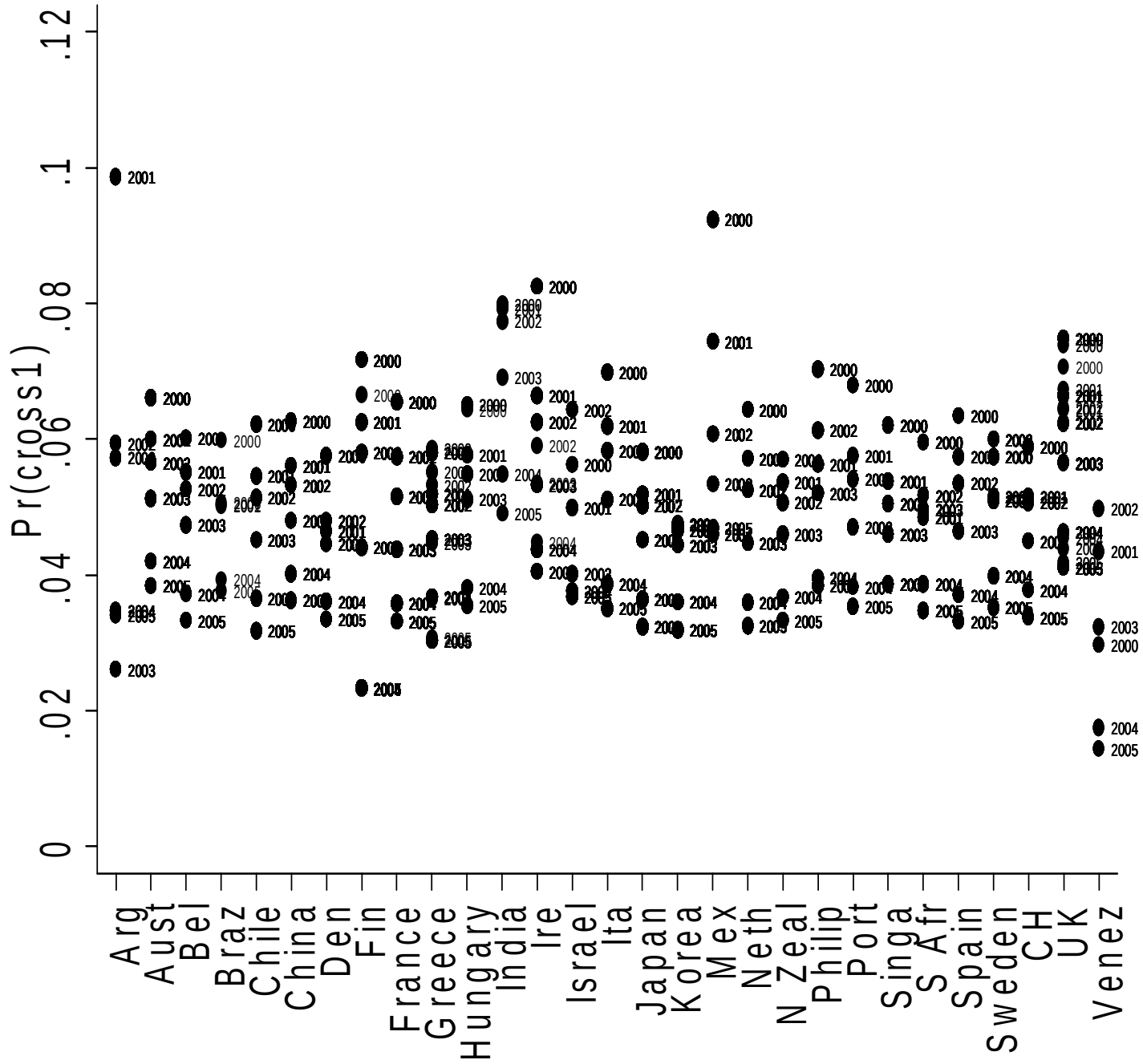


Fig. 3: Predicted q Conditional on Interest Spreads and Fedmcv



Note: Based on simple linear regression models conditional on contemporaneous dep_mkt, prime_fed and Fed_mcv.

Fig 4: Probability of Cross-Listing Conditional on Interest Spreads and Fedcmv



Note: Based on probit model conditional on contemporaneous dep_mkt, prime_fed, fed_mcv.