U.S. International Equity Investment

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Abstract

U.S. investors are the largest group of international equity investors in the world, but to date conclusive evidence on which types of foreign firms are able to attract U.S. investment is not available. We use a comprehensive dataset of all U.S. investment in all foreign equities to address this issue. We show that U.S. holdings differ markedly from the weights implied by a market portfolio, with most U.S. investment concentrated in a relatively small number of foreign stocks. We find that the single most important determinant of the amount of U.S. investment a foreign firm receives is whether the firm cross-lists on a U.S. exchange. Correcting for selection biases, cross-listing leads to a doubling (or more) in U.S. investment, an impact greater than all other factors combined. Given the magnitude of the effect, future research on U.S. international investment should take the cross-listing effect into account.

* This paper draws upon some of the analysis presented in our earlier working papers, “Why Do U.S. Cross-listings Matter?” and "Look at Me Now: What Attracts U.S. Shareholders?". The views expressed in this paper are solely the responsibility of the authors and should not be interpreted as reflecting the views of the Board of Governors of the Federal Reserve System or of any other employee of the Federal Reserve System. The statistical analysis of security-level data on U.S. investors’ holdings reported in this study was conducted at the International Finance Division of the Board of Governors of the Federal Reserve System under arrangements that maintained legal confidentiality requirements. Warnock thanks the Darden School Foundation for generous support.
1. Introduction

U.S. investors are the single largest group of international equity investors in the world. As of end-2007, U.S. international equity investment totaled $5.3 trillion, an amount comparable to the securities holdings of all sovereign wealth funds or to the total holdings of global reserves by national governments. The past decade has witnessed a resurgent interest in studying patterns of international investment, and U.S. international equity investment figures prominently in many studies. However, despite the size of the foreign equity portfolio and the renewed focus on international investment research, no study can point to the most important determinants of the amount of U.S. investment that a foreign firm receives.

Perhaps the largest roadblock in the literature to studying U.S. international equity investment is that no dataset used in past studies has been particularly well-suited to tackle this issue. Many existing studies use country-level data (e.g., U.S. investors’ holdings of German equities as compared to Japanese equities), which is publicly available but naturally limited. Some studies utilize firm-level data, but with narrow datasets (e.g., focusing on a small set of foreign countries, or limited to the portfolios of institutional investors with public disclosure obligations) or with simple methodologies that make establishing causation difficult.

In this paper we use the broadest, most comprehensive dataset available on U.S. international equity investment—a confidential security-level dataset of all U.S. investors’ holdings of every foreign equity that forms the backbone of official U.S. data on foreign holdings—to answer one important question: What are the most important determinants of U.S. investment in the equity of foreign firms?

We begin with a natural benchmark, the world market portfolio. The simplest portfolio approach to international investment predicts that all investors hold the world market portfolio—the weight of each and every firm in their portfolio would be equivalent to the firm’s weight in world market capitalization. While it is well-established that U.S. investors, in aggregate, underweight foreign equities (and overweight

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1 On the investments of sovereign wealth funds, see Bernstein, Lerner, and Schoar [2009].
2 See, among many others, Glassman and Riddick [2001], Dahlquist, Pinkowitz, Stulz, and Williamson [2003], Ahearne, Griever, and Warnock [2004], Chan, Covrig and Ng [2005], Fidora, Fratzscher, and Thimann [2008], Kho, Stulz, and Warnock [2009], Lane and Milesi-Ferretti [2008], Bekaert and Wang [2009], Desai and Dharmapala [2009], and Didier, Rigobon, and Schmukler [2010]
domestic stocks) relative to simple benchmarks, the firm-level holdings data show that the aggregate U.S. international equity portfolio differs dramatically from the market portfolio weights. Rather than invest their wealth in proportion to the value weight of the stock in the world market portfolio—which would imply that they hold the same percent share of the market capitalization of each and every foreign firm—U.S. investors ignore many foreign stocks and concentrate disproportionately in others. In particular, although total U.S. investments in publicly traded foreign firms amounted to more than 9 percent of their aggregate market capitalization, we find that roughly one-quarter of these firms received no U.S. investment at all, and the median share stake of U.S. investors across these foreign companies amounted to only 0.4 percent of market capitalization. While market portfolio weights might be a logical starting point, they in no way describe the allocation of U.S. investment among foreign firms.

While median foreign holdings are quite low, a small number of firms receive substantial U.S. investment; five percent of all publicly traded foreign stocks attract U.S. investment that is equal to or exceeds 16.7 percent of market capitalization. That observation, as well as past work that noted an association between U.S. investment and cross-listings, prompts us to explore the differences in U.S. holdings of cross-listed and non-cross-listed foreign firms. In fact, merely distinguishing whether or not a foreign firm cross-lists in the United States reveals a striking contrast. Median U.S. investment in cross-listed firms is 13.6 percent of the firm’s market capitalization, dwarfing the 0.3 percent median holdings in non-cross-listed firms.

This stylized fact, while interesting, cannot be interpreted without reference to the underlying causal links between cross-listing and U.S. investment. In particular, cross-listing is a voluntary decision, and it is typical for large, well-established and highly liquid firms to choose the United States as a cross-listing venue. Thus, the kinds of firms that choose to cross-list might be the types that attract substantial

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3 On the home bias, see Lewis [1999], Ahearne, Griever, and Warnock [2004], and Kho, Stulz, and Warnock [2009], among many others.

4 Our paper is not the first to note that cross-listing can increase U.S. investment. See, for example, Ahearne, Griever, and Warnock [2004], Bradshaw, Bushee, and Miller [2004], Edison and Warnock [2004], Aggarwal, Klapper, and Wysocki [2005], Ferreira and Matos [2008], and Kho, Stulz, and Warnock [2009]. However, due to data limitations, none of these papers can accurately measure and distinguish a cross-listing effect from potential selection biases, nor do they investigate causation.
U.S. ownership even without the cross-listing. Moreover, these firms might choose to cross-list exactly because this attracts large U.S. investment. As we discuss below, distinguishing these effects has important economic implications. What the summary statistics do tell us is that any attempt to understand the most important factors determining which foreign firms are able to attract U.S. investment must also address the firm’s decision of whether or not to cross-list on a U.S. exchange.

Because the econometrics literature suggests that there is no single statistical methodology that perfectly accounts for endogeneity inherent in a firm’s decision to cross-list, we use three complementary techniques to study the impact of selection and isolate the cross-listing effect on U.S. holdings.\(^5\) We first estimate a parametric model that explicitly accounts for the underlying endogeneity between U.S. holdings behavior and the decision to cross-list on a U.S. exchange. The model jointly estimates the cross-listing and holding decisions as a system of simultaneous equations, using a Heckman [1979]-type methodology first proposed by Lee [1978] to study the impact of union membership on wages. This framework not only allows us to adjust for the effects of selection bias, but also produces structural estimates of the relation between holding and listing. We follow the parametric results with two additional methods for selection-bias adjustment: semi-parametric propensity score matching and non-parametric “difference-in-differences” estimates.

The results from all three methodologies present a consistent and compelling picture of the determinants of U.S. investment in international stocks. The firm’s decision to cross-list is the single most important determinant of the amount of U.S. investment it will receive, and the act of cross-listing causes a substantial increase in U.S. investment. Adjusted for sample selection, average U.S. holdings of foreign firms that cross-list on a U.S. exchange are two to three times higher than they would have been had the firm not cross-listed in the United States. We find that the selection adjustments do matter; firms with characteristics (such as size) that help attract ample U.S. investment even without the cross-listing are more likely to elect to cross-list in the United States. However, the selection adjustments notwithstanding, we

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\(^5\) For recent critiques and reviews of selection-bias corrections, see Lalonde [1986], Heckman, Ichimura, Smith, and Todd [1998, and Larcker and Rusticus [forthcoming]].
show that there is a sizeable cross-listing effect. Without the cross-listing, U.S. investors would hold only 5 to 6 percent of the equity in these firms (9 to 10 percent of the “float” available for purchase by outside investors), but with the cross-listing they hold 16 percent of the outstanding equity (or about 25 percent of the float).\^6

Interestingly, we also find evidence that the attractiveness of cross-listed firms does not arise merely from the relative cost of trading on a U.S. exchange. We document that the majority of U.S. investment in these companies is directly in the foreign-traded shares, rather than in the corresponding American Depositary Receipts (ADRs) that are traded on U.S. exchanges.

While identifying the most important factor behind U.S. international equity investment is important in its own right, it also has immediate implications for at least two literatures. Most directly it impacts the literature on international investment. If we had found that most of the large amount of U.S. holdings in cross-listed firms owed to selection—that the biggest and best cross-list and the act of cross-listing is immaterial—then the international investment literature can proceed without paying particular attention to cross-listings. Indeed, some recent research papers on U.S. international investment by prominent researchers exclude a cross-listing measure (Bekaert and Wang [2009], Desai and Dharmapala [2009], and Didier, Rigobon, and Schmukler [2010]). However, because we establish that causation runs from cross-listing to U.S. investment, the decision to cross-list must be considered as an important influence on U.S. investments and must be assessed using appropriate econometric techniques. A U.S. cross-listing is not the only measurable characteristic that influences U.S. portfolio choice among foreign firms; we also report evidence that, all else equal, U.S. investors prefer firms that are large, transparent, and liquid. However, the firm’s decision of whether or not to cross-list appears to have a greater impact than all other identifiable factors combined.

Our results should also influence a related literature on the valuation impact of cross-listing, a literature embroiled in a debate that began with Doidge, Karolyi, and Stulz [2004] and has continued

\^6 Put differently, our estimates imply that of the $5.2 trillion in foreign equity held by U.S. investors in 2007, investment due to cross-listing accounted for $2 trillion, an amount equivalent in size to all foreign exchange reserves held by China and the eurozone or to the holdings of the largest five sovereign wealth funds.
through Gozzi, Levine, and Schmukler [2008] and Sarkissian and Schill [2010]. For that literature, our study underscores the importance of treating cross-listing as an endogenous decision. The debate in the valuation literature might be resolved when researchers assess the weight of evidence from multiple techniques that can adequately deal with endogeneity and selection.

The rest of the paper proceeds as follows. Section 2 introduces the data used in the paper. Section 3 provides simple but very informative summary statistics. Section 4 describes the methodologies we use for estimating the average cross-listing effect. Section 5 reports results. Section 6 concludes.

2. Data

2.1 Benchmark Survey Data

Our investigation relies on comprehensive security-level data on U.S. holdings of foreign stocks as obtained confidentially through benchmark surveys conducted jointly by the U.S. Treasury Department and the Federal Reserve Board.\(^7\) The surveys cover holdings at two distinct points in time: December 1997 and March 1994. These surveys are somewhat dated, but have the advantage of occurring prior to the volatile up and down periods during the 2000s. Moreover, since the 1997 survey no such survey has been processed in a way that allows the type of security-level analysis necessary to adequately assess the determinants of U.S. investment.

The survey must be completed by all U.S. financial institutions, both within the United States and abroad, that are entrusted with the management or safekeeping of client equity holdings. Institutions covered include all U.S. custodian banks, other commercial and investment banks, mutual funds, pension funds, insurance companies, endowments, and foundations. Respondents are required to report the foreign stock holdings of all their clients that are U.S. residents, and are subject to penalty under law for noncompliance.\(^8\)

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\(^8\) Custodians are the main source of information, covering 97 percent of the market value of the securities in the 1997 survey. Institutional investors report in detail on their ownership of foreign securities only if they do not entrust the
The survey is the source for official U.S. data on cross-border portfolio investment.\textsuperscript{9} It is designed to pick up all recorded U.S. resident portfolio holdings of foreign equities. The only portfolio investments missed by the survey are “uncountable” holdings – i.e., those that evade detection because the U.S. resident used a foreign custodian, provided a foreign home address, or instructed the custodian not to employ a U.S. sub-custodian. Federal Reserve cross-checks with non-U.S. data collectors suggest that the number of uncountable holdings is small.\textsuperscript{10}

2.2 Sample Selection

We include in our investigation U.S. holdings of all non-U.S. companies tracked by Worldscope. We use the May 1999 release of Worldscope, which contains 1997 financial and accounting data on 13,445 non-U.S. companies domiciled in 52 different countries.

In some of our tests, we normalize firm-level U.S. holdings by measures of the market capitalization (market value of equity) of the company. Datastream, which provides the broadest international coverage of market price data, is our primary source for firm-level market capitalizations. When a value is missing in Datastream, we turn to reports from Morgan Stanley, which provide reliable market data for companies included in the MSCI All-country World index, or Worldscope, which provides December market capitalizations for those companies that complete their fiscal year at the calendar year-end. We also use Morgan Stanley and Worldscope to cross-check the Datastream numbers for recording errors. In total, we are able to calculate market capitalization figures for 12,236 of the original 13,445 Worldscope firms. Because of obvious data errors we discard 15 very small firms for which the reported safekeeping of these securities to U.S.-resident custodians. If they do use U.S.-resident custodians, institutional investors report only the names of the custodians and the amounts entrusted.

\textsuperscript{9} “Portfolio investments” exclude holdings for control purposes, defined to be individual holdings of 10 percent or more of shares outstanding. Excluding these large holdings is likely to have little impact in our sample because it is relatively uncommon for a single U.S. investor to hold more than 10 percent of a publicly traded foreign company.

\textsuperscript{10} Other data sources of U.S. investor holdings are relatively limited. For example, U.S. institutional investors’ holdings as reported to the SEC on Form 13(f) exclude holdings in securities that do not trade in U.S. markets and in foreign securities that underlie ADRs. Only a small fraction of publicly traded firms domiciled outside of the United States actually trade in U.S. markets (3.5 percent in 1997, according to the U.S. Treasury/Federal Reserve survey), and among those that do trade within U.S. borders U.S. investors hold more than half of their ownership in the underlying security, not through ADRs. Thus, Form 13(f) filings cover only a small segment of the securities available to U.S. investors and underestimate U.S. holdings in the firms covered in their sample.
value of U.S. holdings exceeds reported stock market capitalization. The remaining sample of 12,221 firms spans 46 home countries, as listed in Table 1.

We also conduct tests by dividing firm-level U.S. holdings by firm-level “float”, defined to be market capitalization net of the value of holdings by insiders. Dahlquist, Pinkowitz, Stulz, and Williamson [2003] and Kho, Stulz, and Warnock [2009] argue that float-adjusted measures of holdings provide a better sense of stock available for purchase by investors with no inside connection to the firm. For float, we scale market capitalization down by the figure given in Worldscope’s “closely held share” field, which reports the fraction of equity owned by corporate officers, directors and their family members, individual shareholders with more than 5 percent holdings, other corporations, and by the firm’s own pension funds and trusts. However, we first adjust these Worldscope figures to exclude the value of depositary institution holdings, which are sometimes mistakenly counted in the closely held fields.11 Because of missing data on insider holdings, our float-adjusted sample contains 8,528 firms. Note, too, that data on float are not available for our 1994 sample, so when we analyze that sample we scale holdings by market capitalization.

3. Summary Statistics

3.1 U.S. holdings across all foreign firms

Table 2a reports the distribution of U.S. holdings of non-U.S. firms as of December 1997. As a benchmark, note that if U.S. investors followed a simple portfolio model in which the weight of each firm in U.S. portfolios equaled its weight in the “world market portfolio”, U.S. holdings would amount to 49.6 percent of the market capitalization (58.3 percent of float) of each foreign firm.

The table shows that firm-level U.S. holdings differ dramatically from the world market portfolio. Mean U.S. holdings are 3.5 percent of foreign firms’ market capitalization (6.3 percent of float). This

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11 Specifically, we exclude holdings by the Bank of New York, Morgan Guaranty Trust, and Citibank, because these shares are likely to be holdings for ADR programs, and the New Zealand Central Securities Depository. There are other reasons to believe that the Worldscope measure of insider holdings contains measurement error. Worldscope coverage of the “closely held shares” field is uneven, and reporting requirements differ across countries. Moreover, it is unclear whether the classifications within Worldscope of what constitutes a closely held share conform well to theory on who gains private benefits from control and who would be willing to sell to a U.S. investor. For example, the measure includes holdings of large, unaffiliated blockholders.
substantial underinvestment relative to the world market portfolio is, of course, one representation of the home bias. While the home bias is well-established, the extent of the underinvestment is striking, with fully one-quarter of all foreign firms receiving no U.S. investment at all, and median U.S. investment equivalent to only 0.4 percent of market capitalization (1.2 percent of float).\textsuperscript{12}

Although U.S. investor holdings at the end of 1997 were dispersed across thousands of foreign firms, no stakes were reported in 3,451 of the 12,221 stocks in the sample. Furthermore, the percentiles reported in the table make it clear that U.S. investment interest varies widely across the other firms in our sample, with below-average stakes reported for more than three quarters of our sample. The figures for the 90\textsuperscript{th} and 95\textsuperscript{th} percentiles shows that these less popular firms are offset by a significant minority of international companies in which U.S. investors own 20 percent or more of the outstanding float. In other words, the aggregate foreign equity portfolio of a very large, diverse, and quantitatively significant group of investors appears to deviate quite sharply from market weights. This fact seems particularly surprising given that much of this investment is directed by professional managers whose performance tends to be measured against broad market benchmarks. It is also at odds with the notion that U.S. investors, as relatively uninformed outsiders, ought to take a passive approach to portfolio choice in foreign equities.

3.2 U.S. holdings and cross-listing

Why do some foreign firms receive so much more U.S. investment than others? What is the most important determinant of the extent of U.S. investment a foreign firm receives? As a first pass at answering these questions, we continue with simple summary statistics in Table 2b, but this time we split the sample by whether a firm is cross-listed on a U.S. exchange.\textsuperscript{13}

\textsuperscript{12} Note that our sample is quite representative. The 12,221 firms for which we could match Worldscope and U.S. holdings data had an end-1997 market capitalization of $11,079 billion, representing more than 90 percent of the value of all non-U.S. equity (International Finance Corporation, [1998]). U.S. investors’ $1,018 billion stake in these companies accounted for 88 percent of total U.S. foreign equity holdings.

\textsuperscript{13} Most cross-listed firms in the US do so via an ADR, a traded financial claim backed by a set number of equity shares in the underlying company. ADRs are created when firm initiates a relationship with a broker that buys the firm’s shares and instructs a U.S. financial institution, called a “depositary,” to hold the shares in custody and issue negotiable securities backed by the shares, the “receipts,” to an interested investor. Level I ADRs trade OTC, while the “cross-listed” Level II and III ADRs list and trade on one of the major U.S. stock exchanges.
The summary statistics in Table 2b reveal a striking pattern. The vast majority of non-U.S. firms are not cross-listed on a U.S. exchange, so the summary statistics for the non-cross-listed sample closely resemble those for the full sample. In contrast, the summary statistics for cross-listed foreign firms are dramatically different. The median cross-listed foreign firm receives U.S. investment totaling 13.6 percent of market capitalization (20.2 percent of float), with the 90th percentile cross-listed firm having almost 40 percent U.S. ownership. Indeed, U.S. investors hold substantial stakes in almost all cross-listed firms.

Taken at face value, these results suggest that a U.S. cross-listing is an important determinant of whether or not U.S. investors hold shares in a foreign firm. Whether selection can explain this large difference—in that those firms that cross-list in the United States are those that U.S. investors would prefer to hold anyway—or is due to a true “cross-listing” effect is the key question that we address in the next sections.

4. Methodology: Controlling for Selectivity

Selection biases arise when a researcher attempts to compare two different population groups as if they are similar. The problem commonly occurs when heterogeneous participants self-select into groups rather than are randomly assigned to the groups. We cannot observe the amount U.S. investors would have held in cross-listed firms in December of 1997 if those firms had not cross-listed, nor can we directly observe the reasons why the foreign firms decided to cross-list in the United States. Simple estimates of the relation between U.S. investment in foreign firms and cross-listing will be biased if the firm’s propensity to cross-list on a U.S. exchange is correlated with other characteristics of the firm that affect U.S. investors’ holding decisions. Moreover, firms might cross-list in the United States for the specific purpose of increasing U.S. investor interest, in which case the causation between cross-listing and U.S. holdings could run in both directions.

Our goal in determining whether there is an actual “cross-listing effect” is to estimate the unobservable component of what U.S. holdings would have been in cross-listed firms had they not cross-
listed. Then, the cross-listing effect is an estimate of the treatment effect

\[ E(H^L_i | X = 1) - E(H^L_i | X = 0), \]  

where \( X \) is an indicator variable set to one when a firm has cross-listed on a U.S. exchange, \( E(H^L_i | X = 1) \) is the expected level of U.S. holdings in cross-listed firm \( i \) conditional on it being listed, and \( E(H^L_i | X = 0) \) is the expected level of holdings in cross-listed firm \( i \) if it had not cross-listed.\(^{14}\)

Corrections for selection bias are themselves subject to specification error (Lalonde [1986]; Heckman, Ichimura, Smith, and Todd [1998]; Larcker and Rusticus [forthcoming]). Therefore, while we motivate much of our analysis of holdings and cross-listing using fully parametrized structural models of the holdings and cross-listing decisions, we ultimately incorporate three different estimators—a structural model, p-matching, and differences-in-differences—to robustly measure the cross-listing effect. We first describe the structural model, and then turn to the more general estimation of the cross-listing effect.

4.1 Modeling the holdings and cross-listing decisions: a structural framework


4.1.1 U.S. investors’ preferences for foreign equities

The system begins with a model of U.S investor preferences for holding foreign equity:

\[ H^L_i = \alpha_L + Z^L_i \beta_L + \epsilon^L_i \]  

\[ H^U_i = \alpha_U + Z^U_i \beta_U + \epsilon^U_i. \]  

We separately model the holdings of cross-listed (\( H^L_i \)) and non-cross-listed stocks (\( H^U_i \)) to recognize that decisions to hold these two types of stocks can be fundamentally different. This not only

\(^{14}\) One could also estimate the listing impact from the non cross-listed firms, \( E(H^U_i|X=1) - E(H^U_i|X=0) \), or from both cross-listed and non cross-listed firms to generate an unconditional listing impact, \( E(H|X=1) - E(H|X=0) \). Heckman, Ichimura, Smith, and Todd (1998) provide a nice overview of issues relating to the different measures.
provides more flexibility in estimation, but also can help identify the structural parameters. Note that observations of \( H_i^t \) are \( H_i^u \) are truncated by selection since, at a given point in time, we can only observe a firm as cross-listed or not.

The instrument sets \( Z_i^t \) and \( Z_i^u \) contain firm- and country-level proxies for a variety of factors that could influence the willingness of U.S. investors to invest in a foreign firm. We motivate the contents of these instrument sets in the following paragraphs. Appendix A contains specific definitions for each variable.

U.S. investors may want information—both simple and more fundamental—about a foreign stock before deciding to purchase it. Firm size is a natural variable to include; larger firms are generally believed to be more transparent than smaller firms, in part because they tend to get more coverage both from the press and from securities analysts. An MSCI member dummy is another; MSCI index members are selected on the basis of liquidity, size, and market representation. Illiquidity can reflect asymmetric information (e.g., Easley and O’Hara [2004]) that would put U.S. investors at a disadvantage. An English home language dummy proxies for the simple accessibility of information; U.S. investors may find it easier to process information from companies that are guaranteed to disclose information in English. Firm size and the MSCI member dummy are included in both \( Z_i^t \) and \( Z_i^u \), while the English information dummy is excluded from \( Z_i^u \) since all firms listed on a U.S. exchange must make U.S. disclosures in English.

The quality or relevance of information about a foreign company will depend on, among other things, the accounting and disclosure practices of the company. Therefore, U.S. investors may favor companies that provide an accurate and timely accounting of their financial performance (Leuz and Verrecchia [2004]; Bradshaw, Bushee, and Miller [2004]), and may be attracted to foreign stocks domiciled in countries with forthright accounting practices (Lang, Lins, and Miller [2003]). Thus, we include two measures of accounting quality. The first measure is the national accounting quality index compiled by the Center for Financial Analysis and Research (CIFAR). As reported by Bushman, Piotroski, and Smith [2004], the index averages across firms within a given country the number of items, out of a possible
maximum of 90, that are included as part of a firm’s financial statements. The second measure is a firm-level accounting quality index, constructed as the sum of four indicator criteria based on whether the firm uses a Big Six auditor, received a clean audit report, used international accounting standards or US GAAP, and reported consolidated statements. This variable measures variation in firm-specific accounting quality not picked up by the national accounting quality variable. We exclude the national and firm-specific accounting quality indexes from $Z_i^*$ because U.S.-listed firms are required to meet virtually all conditions in the firm-level index and must reconcile to GAAP.

U.S. investors may care about the safety of their investment in the hands of managers who operate outside U.S. borders. LaPorta, Lopez-de-Silanes, Shleifer, and Vishny [LLSV, 1999, 2002] document substantial cross-country variation in how well legal systems protect outside shareholders from expropriation by firm insiders. Durnev and Kim [2005], among others, show that the quality of corporate governance within a country can vary greatly across firms. Thus, U.S. investors could tilt their investments toward countries with strong legal protections of minority investors and seek out firms with a reputation for good corporate governance. We consider two measures that capture governance/legality issues: the country’s LLSV shareholder rights index and a dummy for dividend-paying firms. U.S. investors may choose to underweight firms from markets with weak protections of minority shareholders. A company’s dividend-paying record can be viewed as a commitment device, with the willingness to dispense cash signaling a commitment not to expropriate funds from minority shareholders. A dividend-payment dummy also helps control for a variable that cannot be included in float-adjusted regressions because it would induce measurement bias: the proportion of shares held by insiders. We include the shareholders

15 See La Porta, Lopez-de-Silanes, Shleifer, and Vishny [1998].
16 See Faccio, Lang, and Young [2001], Kalcheva and Lins [2007], Pinkowitz, Stulz, and Williamson [2006], Easterbrook [1984], and Jensen [1986].
17 Kalcheva and Lins [2007] provide evidence of the link between dividend payments and potential expropriation by insiders. Evidence that outside investors avoid ownership in closely held companies, perhaps fearing the power of insiders to expropriate firm resources at the expense of minority shareholders, is provided in La Porta, Lopez-de-Silanes, Shleifer, and Vishny [1999], Johnson, La Porta, Lopez-de-Silanes, and Shleifer [2000], and Leuz, Lins, and Warnock [2009]. To see the bias if a closely held variable was included in our float-adjusted regressions, let $\hat{F}_j$
rights variable and dividend dummy in both $Z_i^L$ and $Z_i^U$.

Both instrument sets also include some more general control variables. We include the firm’s market-to-book value. We take low market value to be a rough indicator of financial distress, which tends to increase conflicts of interests among stakeholders in the firm in a way that might be particularly problematic for cross-border minority investors. We also include a country’s dividend tax withholding rate faced by U.S. investors. Withholding taxes can cause U.S. investors to face higher tax rates on dividends originating from a given foreign country than on U.S. stock dividends. This would make stocks from the foreign country less attractive to U.S. investors, particularly if other potential investors in stocks from the two countries did not face the same tax rate differential (otherwise, prices could adjust to equilibrate after-tax expected returns). Often a U.S. investor can obtain a tax credit that fully offsets a dividend tax that has been withheld by a foreign government. However, U.S. pension funds are not taxed directly on dividends, so tax credits are of no use to them, and thus taxes charged on foreign dividends generally will represent a differential between the foreign and domestic dividend tax rates that U.S. pensions face (the domestic rate is zero). Thus at least one important investor group is clearly affected by dividend withholding tax rates.

Finally, we include in $Z_i^L$ and $Z_i^U$ dummy variables for firms that might be fundamentally different. We first include a dummy for financial firms. Financial firms can be fundamentally more opaque than other firms, in part because they hold assets that could be more difficult to value than those of non-financial firms, are subject to more regulatory, rather than public disclosure, and may view public information disclosures as potentially risky to their business.\(^{18}\) Institutional similarities and ties within

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represent our market-float adjusted holdings, $\hat{U}_i$ represent the market capitalization (unadjusted) holdings, and $\hat{I}_i$ be our measurement of the proportion of shares held by insiders. Then, by definition,

$$\hat{F}_i = \frac{\hat{U}_i}{1-\hat{I}_i}.$$ 

Suppose that the insider stake is measured with some error so that $\hat{I}_i = I_i + \eta_i$, where $I_i$ is the insiders’ true stake and $\eta_i$ is some white-noise error. Then, $\text{cov}(\hat{F}_i, -\hat{I}_i) > 0$. In other words, measurement error in the proportion of insider holdings imparts a positive bias on the coefficient estimate in the holdings model when scaled by market float. Intuitively, a positive measurement error shock increase the right-hand-side variable (measured proportion of shares held by insiders) as it also increases the dependent variable (holdings, by reducing the denominator).

\(^{18}\) For evidence on the opaqueness of financial firms, see Morgan [2002], or evidence from the recent financial crisis.
North America may make Canadian firms special, so we also include a dummy for Canadian firms.

4.1.2 Firms’ decisions to cross-list

The second part of the simultaneous system involves a firm’s decision to cross-list on a U.S. exchange. We motivate the decision by considering the potential benefits and costs of cross-listing. Let $X^*_i$ represent the net benefits that flow to firm $i$ from cross-listing on a U.S. exchange. We assume that these benefits can be described by the following relation,

$$X^*_i = \alpha_i + \gamma_i[H^L_i - H^U_i] + \gamma_i H^U_i + Z^X_i \beta_i + \epsilon^X_i,$$

(4)

where $H^L_i$ and $H^U_i$ are the endogenously determined proportion of firm $i$’s equity that would be held by U.S. investors if the firm were cross-listed (L) in the United States or not cross-listed (U), respectively. The difference $H^L_i - H^U_i$ models the anticipated impact of listing on U.S. holdings. It is included in (4) to allow for foreign firms to cross-list in the United States precisely because it attracts greater U.S. investor interest. $H^U_i$ also enters equation (4) independently to allow the level of U.S. holdings prior to cross-listing to affect a firm’s decision to cross-list. We posit that firms with large pre-existing U.S. shareholdings could cross-list on a U.S. exchange to reduce trading costs for their shareholder base.

The vector $Z^X_i$ contains firm- and country-specific variables that are associated with benefits and costs of cross-listing, but that are taken to be exogenous. There are both direct and indirect costs associated with listing in the United States that could make firms reluctant to cross-list. Most cross-listed firms face a host of direct registration, disclosure, and compliance costs. They must register with the U.S. Securities and Exchange Commission (SEC) and submit periodic filings that are in English and include financial statements reconciled to U.S. generally accepted accounting principles (GAAP). They must meet the listing requirements of the U.S. exchange, which are often stricter than those in the firms’ home country, and pay both listing fees to the exchange and filing fees to the SEC. Firms that cross-list to raise new capital must also register their securities under the SEC 1933 Securities Act and the 1934 Exchange Act. Indirect costs include the commitments that cross-listed firms make to abide by U.S. regulations and law. Firms that
violate exchange regulations risk fines and the threat of delisting. Those that violate SEC regulations face potential shareholder lawsuits and civil or criminal penalties under U.S. law. Closely held firms may be especially reluctant to cross-list if the increased level of disclosure and legal oversight gives more power to minority shareholders.

The benefits of cross-listing varies across firms and can include product market considerations (to the extent that listing on the NYSE can help make a foreign company a household name in the United States), employee compensation (to the extent that it includes grants of options or stock), and takeover strategy (where a cross-listed stock can serve as a takeover currency). One potential benefit that both practitioners and theorists cite as a reason for cross-listing is to increase the set of investors that can, at low cost, access information and trade shares in the firm. That is, cross-listing reduces “receiver” costs associated with expanding the shareholder base (Merton, [1987]). This in turn may improve risk sharing, pricing, and the liquidity of a firm’s stock. Accordingly, firms seeking to expand their shareholder base through increased U.S. ownership might have the strongest incentive to cross-list. Firms may also list in the U.S. to reduce institutional frictions associated with maintaining their existing investor base. For example, if a firm already has U.S. investors, it may cross-list to make it easier for those investors to manage their stock portfolios. But the other considerations (product market, compensation, takeover currency) might be more important: Any consideration that involves expanding the shareholder base must be weighed against that of relinquishing any private benefits of control.

We also include some of the variables from $Z_i^L$ and $Z_i^U$, as these variables are also likely to influence the cross-listing decision. Firm size will be important for the listing decision if there are economies of scale in the direct costs of listing, including regulatory compliance and accounting disclosure. We include the financial firm dummy for two reasons. First, the direct costs of cross-listing for financial

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19 Lang, Lins, and Miller [2003] argue that foreign firms may cross-list simply to expand their “shareholder base”, the set of investors available to purchase a given firms’ shares. See also Merton [1987], Miller [1999], Foerster and Karolyi [1999], Karolyi and Stulz [2003], and Doigge, Karolyi, and Stulz [2004]. The argument is also popular among U.S. practitioners who encourage foreign clients to cross-list. See Fanto and Karmel [1997], and the ADR websites at JPMorgan (www.adr.com/research/about_types.html) and the Bank of New York (www.adrbny.com).
firms may be higher, because accounting principles for financial instruments and contracts tend to be among the most complicated and contentious. Second, indirect costs may also be greater, if financial firms are wary of the impact of public information disclosures on their businesses, and so they might be less eager to cross-list. We include the Canada dummy because cross-listing should be less costly for Canadian firms because Canadian firms enjoy an exemption from most SEC reporting requirements. Finally, we posit that firms from countries with weak accounting standards will find it more costly to prepare financial statements in accordance with U.S. GAAP.

In addition, we include three variables that are unique to the cross-listing specification: home-country trading volume/GDP (because the benefits from cross-listing might be particularly high for firms that quickly “outgrow” their underdeveloped home equity markets), a Germanic language dummy (because the direct costs of complying with U.S. regulations may be lower for managers who are more comfortable with the English language), and the proportion of shares held by insiders (which proxies for the cost of relinquishing private control benefits through increased disclosure and monitoring associated with cross-listing).

4.1.3 Closing the structural model

We do not observe \( X_i^* \) in equation (4). Instead, we observe realizations of the indicator variable \( X_i \),

\[
X_i = 0 \text{ if } X_i^* < 0 \tag{5}
\]

\[
X_i = 1 \text{ if } X_i^* \geq 0. \tag{6}
\]

\( X_i \) equals one when firm \( i \) is cross-listed on a U.S. exchange, and zero otherwise. Note that equations (4)-(6), coupled with an assumption that the error term \( \varepsilon_i^X \) is normally distributed, imply that the listing decision can be estimated using a probit model.

\( ^{20} \) Under the Multi-Jurisdictional Disclosure System (MJDS) agreement between the SEC and the Canadian Securities Administration, Canadian firms can cross-list on a U.S. exchange without conforming to U.S. GAAP and with only minimal reporting to the SEC.

\( ^{21} \) Importantly, identification in the structural model depends on some variables directly determining one of the two endogenous variables, but not the other. Structural models can be criticized for imposing too much structure, which is one reason we also use semi- and non-parametric techniques, described below.
Taking into account selectivity adjustments, U.S. investor preferences for holding cross-listed and non-cross-listed stocks become:

\[
H^L_i = \alpha_L + Z_i \beta_L - \frac{\phi(\hat{\alpha}_L + Z_i \hat{\beta}_L)}{\Phi(\hat{\alpha}_L + Z_i \hat{\beta}_L)} \lambda^L_i + \eta_i^L
\]  

(7)

and

\[
H^U_i = \alpha_U + Z_i \beta_U + \frac{\phi(\hat{\alpha}_U + Z_i \hat{\beta}_U)}{1 - \Phi(\hat{\alpha}_U + Z_i \hat{\beta}_U)} \lambda^U_i + \eta_i^U.
\]  

(8)

Now, \(H^L_i\) and \(H^U_i\) take on the additional interpretation of being the estimated holdings in firm \(i\) when the firm is cross-listed and when it is not, while \(\phi\) and \(\Phi\) denote the probability density and cumulative density functions of the standard normal distribution. Equations (4), (7), and (8) now constitute a system of equations which can be estimated with maximum likelihood techniques. The estimation procedure is discussed in Appendix B. We note here only that the coefficient on \(\lambda^L\) in (7) is the inverse Mills ratio, which forms the basis for standard corrections for selectivity bias when inclusion in an estimation sample is contingent on a discrete outcome (see Heckman [1979] or Maddala [1983]), while the coefficient on \(\lambda^U\) in (8) is a similar but less frequently used correction for selectivity bias for the non-selected observations.

Importantly, the estimates \(\hat{\alpha}_L, \hat{\beta}_L\) and \(\hat{\alpha}_U, \hat{\beta}_U\) from (7) and (8) are used to calculate fitted values \(\hat{H}^L_i\) and \(\hat{H}^U_i\), which can then be plugged into the structural probit specification, (4). Because \(H^L_i\) and \(H^U_i\) are scaled (by market capitalization or market float) to only take on values between zero and one, we work off of transformations of equations (7) and (8). These transformations, along with other details of the estimation process, are described in the appendix.

4.2 Methodologies to measure the cross-listing effect

One of our primary interests is measuring the magnitude of the cross-listing effect, defined by equation (1) and reproduced here:

\[
E(H^L_i \mid X = 1) - E(H^L_i \mid X = 0).
\]  

(1)
Consistent estimation of (1) and, thus, the cross-listing effect, involves averaging across firms the difference between U.S. holdings in the firm and estimates of what the counterfactual holdings in the cross-listed firms would have been had the firm not cross-listed. Since the first component of (1), $E(H_i^L | X = 1)$, can be estimated as the average the observed holdings in cross-listed firms, we only have to estimate the unobservable second component, $E(H_i^L | X = 0)$.

Because no method is perfect, we consider three methodologies for estimating the unobservable component. The first estimator derives from the structural model from the previous subsection. We estimate $E(H_i^L | X = 0)$ by estimating the fitted holdings from equation (8) for each firm, and then averaging over the resulting fitted holdings.

The second estimator uses the propensity-score method of matching, also termed “p-matching,” originally developed by Rosenbaum and Rubin [1983]. P-matching uses fitted cross-listing probabilities (“propensity scores”) generated from estimates of equation (4) to match each cross-listed firm with a non cross-listed firm. The idea is that the holdings of p-matched non cross-listed firms are likely to be similar to what a listed firm’s holdings would have been if unlisted, so the average holdings of p-matched firms can be used to estimate $E(H_i^L | X = 0)$. The advantage of the p-matching estimator is that it requires no explicit model of holdings, which reduces the risk of specification error (Drake [1993]; Dehejia and Wahba [2002]; and Zhao [2004]). The estimator has also been shown to outperform Lee/Heckman-style corrections in experimental studies of selection bias (Glazerman, Levy, and Myers [2004]). One drawback to the p-matching estimator is that it does not account for unobserved correlation between the holdings and cross-listing decisions.

We generate our third estimate of the average cross-listing effect using the “difference-in-differences” estimator (Heckman and Robb [1985]; Heckman, LaLonde, and Smith [1999]). This estimator requires holdings observations on cross-listed firms prior to their cross-listing. For this, we draw upon U.S.

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22 See Imbens [2004] and Stuart [2004] for recent reviews of matching applications to treatment effect estimators.

23 The asymmetry in our data makes p-matching a particularly attractive method because we have a large set of firms from which to select a match (roughly 30 non cross-listed firms for each of our cross-listed firms).
holdings data from the earlier March 31, 1994 survey. The difference-in-differences estimator compares the change in holdings of a firm that was not cross-listed in 1994 but cross-listed by 1997 to firms that remained non cross-listed between 1994 and 1997. That is, the cross-listing effect is given by

\[ E(H_i^k | X = 1) - E(H_i^k | X = 0) = (\bar{H}_i^{U,1997} - \bar{H}_i^{U,1994}) - (\bar{H}_j^{U,1997} - \bar{H}_j^{U,1994}), \]

where \( i \) indexes a firm that cross-lists between the 1994 and 1997 surveys, \( j \) indexes a firm that remains non cross-listed in both surveys, and bars over the variables reflect sample means across the \( i \) and \( j \) categories.

The difference-in-differences estimator incorporates many of the advantages of the p-matching estimator. Moreover, unlike the p-matching estimator, the difference-in-differences estimator accounts for unobservable components of selection bias, assuming that the characteristics of a type-\( i \) firm do not change in a way that is left uncontrolled by the type-\( j \) firms.\(^{24}\) For our application, the key drawback of the difference-in-differences estimator is that it relies on a relatively narrow subset of 132 firms that were traded only in their home market in 1994, but cross-listed by 1997.\(^{25}\)

5. Results

5.1 Results from the structural model

Table 3 reports estimates of our structural model of cross-listing and U.S. holdings as of end-1997 scaled by float.\(^{26}\) Results using holdings scaled by market capitalization (not shown, but available from the authors) are not materially different.

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\(^{25}\) Because the sample size would be reduced to an even greater extent by requiring insider holdings information, we do not report difference-in-differences estimates using the market float measure.

\(^{26}\) To make our results more readily interpretable, we report rescaled functions of the estimates. Specifically, for the coefficients on instruments in the listing decision equation, we calculate the marginal effect of a one-unit change in the instrument on the percentage point probability of cross-listing. Similarly, the coefficients in the holdings equations are scaled to reflect the marginal effect of a change in the instrument on the holdings share of U.S. investors (measured in percentage points). See Appendix B for complete details on transformations and on the estimation technique.
5.1.1 Determinants of holdings in firms that are not cross-listed

While our focus is on the cross-listing effect, it is informative to understand the factors behind U.S. investment in firms that are not cross-listed. Among the 7,788 firms that are not cross-listed (the middle column in Table 3), most of the explanatory variables are significant, often with signs that accord with intuition. U.S investors prefer firms that are larger, non-financial, included in the MSCI World index, have high market-to-book ratios, and pay dividends. They are also attracted to firms from countries that use English as an official language, particularly Canadian firms, and firms with low dividend tax withholding rates. The latter result indicates that an additional reason that a home bias might exist is that U.S. investors shy away from international investments when cross-border dividend withholding rates are high.

A number of the non cross-listed holdings estimates indicate that U.S. investors are sensitive to the amount and quality of information available on foreign-traded firms. The positive and statistically significant sign on the firm-level accounting variable suggests that U.S. investors value high-quality disclosure when choosing a foreign firm in which to invest. This is consistent with Bradshaw, Bushee, and Miller [2004], who show that U.S. investment is higher in firms with greater conformity to U.S. GAAP.

The only surprising result for non-cross-listed firms is the negative association between holdings and the level of shareholder rights protection provided by a firm’s home country. This result holds whether we use the LaPorta, Lopez-de-Silanes, Shleifer, and Vishny [1998] index of anti-director rights (as reported), or country-level estimates of the blockholder premium in share prices from Dyck and Zingales [2004] (not reported). The willingness of American investors to undertake relatively large positions in countries in which minority shareholders are vulnerable suggests a relative lack of concern about institutional enforcement of their property rights, or that U.S. investors do not feel they will be protected regardless of shareholder rights scores.

Finally, the selectivity correction variable is negative and significant, indicating that the set of firms that are unlisted have unobservable characteristics that make their stock less likely to be held by U.S. investors. In other words, holding all else constant, the mean holdings of the unlisted sample would be higher if the sample were drawn randomly from a group of firms with the same observable characteristics.
5.1.2 Determinants of holdings in cross-listed firms

For holdings of cross-listed firms, very few coefficients are significant (the right column of Table 3), suggesting that U.S. investors have relatively indistinct preferences among cross-listed firms. Put another way, among these firms the most important attribute is that they have cross-listed.

5.1.3 The cross-listing decision and U.S. holdings

In accordance with our intuition about factors that reduce the costs of cross-listing, the estimates for the cross-listing equation (the first column) reveal that firms are more likely to cross-list on a U.S. exchange if they are large, have better home-country accounting standards, or are domiciled in Canada. The three variables that uniquely identify the listing equation enter with estimated signs that are in line with our expectations: firms that are closely held, from liquid markets, or from non-Germanic speaking countries are less likely to cross-list on a U.S. exchange. Moreover, both the expected increase in U.S. investment from cross-listing and the level of U.S. holdings prior to listing positively influence the cross-listing probability. These results are consistent with the idea that firms cross-list to both expand their investor base and service their existing U.S. investor base.

5.2 The average cross-listing effect

Estimates of the average cross-listing effect are summarized in Table 4. Requiring a complete set of explanatory variables for the Heckman [1979]-based and p-matching estimators reduces our sample to 8,067 firms, 279 of which cross-listed on a U.S. exchange.

At the end of 1997 U.S. investors held an average of 16.4 percent of the market capitalization of the 279 cross-listed firms (row 1), an average that is slightly less than for the somewhat larger sample in Table 2b. Accordingly, for our Heckman-based and p-matching (cross-sectional) estimates of the average cross-listing effect, we use 16.4 percent as our estimate of \( E(H^+_1 \mid X = 1) \).
The Heckman [1979]-based estimate of $E(H_i^+ \mid X = 0)$ is 5.6 percent of market capitalization (row 2), implying that U.S. holdings in a typical cross-listed stock are 10.8 percentage points higher than they would be without the U.S. listing. Average holdings in non-cross-listed firms is 2.9 percent of market cap, but cross-listed firms, bigger and better, would have had 5.6 percent holdings even without cross-listing. Cross-listing, though, on average increased U.S. holdings by 10.8 percent of market capitalization (or 14.7 percent in terms of float). The Heckman [1979]-corrected estimates suggest a sizeable, statistically significant cross-listing effect.\(^{27}\)

The p-matching and difference-in-differences methodologies produce results that are close to the Heckman [1979]-based estimates. The p-matching produces an estimate of $E(H_i^+ \mid X = 0)$ equal to 6.4 percent of market capitalization or 9.0 percent of market float (row 4), implying a statistically significant listing effect equivalent to 10.0 percent of market capitalization (16.3 percent of market float). The bottom panel of Table 4 reports U.S. holdings of firms in March 1994 that were not cross-listed but that cross-listed by December 1997, amounting to 8.6 percent of market capitalization for the 132 cases in which we had holdings data for the earlier period. Adding the 0.6 percentage increase in the holdings of non cross-listed firms over the period 1994-1997 yields our highest estimate of $E(H_i^+ \mid X = 0)$, 9.2 percent of market capitalization. Nonetheless, with U.S. investors holding 17.1 percent of these firms by the end of 1997, this still implies an average cross-listing effect of 7.9 percent.\(^{28}\) Overall, the three techniques estimate a sizeable average cross-listing effect ranging from 8 to 11 percent of market capitalization (or 15 to 16 percent of float).

5.3 On trading costs and the cross-listing effect

\(^{27}\) The standard error for the listing effect estimate is calculated as the observation-weighted standard deviation of the 279 paired differences.

\(^{28}\) In our sample, 23 of the 132 firms that cross-listed between the two survey dates also undertook seasoned equity offerings (SEOs). It is plausible that the combination of a SEO and cross-listing has different implications for U.S. holdings than a cross-listing alone, particularly if the issue targets U.S. investors. However, when we compare the change in U.S. holdings for cross-listing stocks with and without these SEOs, we find no statistically significant difference. Accordingly, we do not treat cross-listing firms that raise public equity differently from other cross-listing firms. For further evidence on the capital-raising behavior of cross-listed firms, see Reese and Weisbach [2002] and Henderson, Jegadeesh, and Weisbach [2006].
It is natural to wonder whether the cross-listing effect might owe to a reduction in trading costs (relative to the foreign market) or just to the fact that the security is available in the United States. Table 5 illustrates that neither of these explanations seems likely.

First, for cross-listed firms, U.S. investors hold large proportions of their shares (11.1 percent of market capitalization) in the underlying foreign security purchased in the foreign home market and only a small portion (6.4 percent) in the ADR purchased in the US. This fact has an important implication. ADRs enable U.S. investors to forego concerns about trading in other currencies, dealing directly with foreign regulatory authorities, and potentially high execution costs on foreign stock markets. If investors were responding to the reduction in transactions costs associated with being able to trade these stocks on the NYSE, we would expect most of the cross-listed holdings to be in the form of ADRs. In contrast, most U.S. holdings in cross-listed firms are in the underlying foreign security. This is direct evidence against transaction costs as a primary impediment to foreign investment.

Second, additional evidence on the motives for holding cross-listed shares is provided by a set of instruments (Level I ADRs) that are denominated in dollars and trade in the United States, but trade over-the-counter rather than on an organized exchange. There are important differences between the over-the-counter Level I ADRs and their exchange-traded Level II and III cousins. Importantly, because they are not listed on a major U.S. exchange, Level I ADRs are not required to reconcile financial statements with U.S. GAAP, do not submit regular disclosures to the SEC, and do not subject the underlying companies to most U.S. securities laws. Thus, Level I ADRs provide U.S. investors the opportunity to acquire foreign stocks that sit outside the protections of U.S. securities regulation. The middle of Table 5 shows that U.S. investors do hold a greater proportion of shares in a Level I ADR-firm (8.1 percent of market capitalization, 14.6 percent of market float) than in the average foreign firm not traded in the United States, but these holdings are substantially lower than in foreign stocks that trade on organized exchanges (Level II and III ADRs) and are thus required to comply with U.S. securities regulations. Moreover, most of the difference between the holdings of foreign companies with Level I ADRs and non U.S.-traded foreign companies can
6. Conclusion

Using comprehensive survey data, we document that the aggregate foreign equity portfolio of all U.S.-resident investors has deviated sharply from market weights. Cross-sectional analysis of their investment choices indicates that U.S. portfolio flows have tended to gravitate toward larger, more liquid, and more transparent firms. However, our selection bias-corrected estimates indicate that cross-listing is by far the most important determinant of U.S. investment in foreign equities. Non-cross-listed foreign firms have roughly 3 percent U.S. ownership. Cross-listed firms, even prior to the cross-listing, are the biggest and best foreign firms; all of their attractive (pre-cross-listing) attributes result in on average 3.5-6 percent more U.S. investment. On top of that we estimate, using various techniques, that a cross-listing in the United States leads to an increase in U.S. holdings of 8 to 11 percent of firm market capitalization, doubling (or more) the amount prior to cross-listing.

Our results present a clear challenge for future research on international investment. Cross-listing, which we find to be the most important factor behind U.S. international equity investment, must be considered in any analysis. Moreover, given that cross-listing is a decision often made by the biggest and best foreign firms, econometric techniques must be used that can appropriately deal with issues of selection bias. This point has implications that reach far outside the literature on international investment. For example, the corporate finance literature on the valuation impact of cross-listing has yet to fully deal with selection bias. Our hope is that this paper can spark innovations in that literature as well.

29 Specifically, using selection-bias estimators we found (but do not report) that U.S. investors would have held between 5 and 6 percent of the shares in Level 1 ADR-firms even without the Level 1 program, implying a modest “Level 1” effect of 2 to 3 percent of market capitalization. It is not surprising that sample selection adjustments account for most of the increased holdings in the Level I ADRs, as many Level I ADR programs have been initiated by U.S. investors or depository banks, not by the foreign companies themselves. In this paper’s main analysis we treat Level I firms as non cross-listed firms.
30 See the debate that began with Doidge, Karolyi, and Stulz [2004] and has continued through Gozzi, Levine, and Schmukler [2008] and Sarkissian and Schill [2010], among others.
References


Table 1: Sample Count by Country, December 31, 1997

The table shows the number of firms by country for the 12,221 non-U.S. stocks in our end-1997 sample.

<table>
<thead>
<tr>
<th>Country</th>
<th>Number of Firms</th>
<th>Country</th>
<th>Number of Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>41</td>
<td>Korea</td>
<td>313</td>
</tr>
<tr>
<td>Australia</td>
<td>284</td>
<td>Luxembourg</td>
<td>22</td>
</tr>
<tr>
<td>Austria</td>
<td>106</td>
<td>Malaysia</td>
<td>442</td>
</tr>
<tr>
<td>Belgium</td>
<td>134</td>
<td>Mexico</td>
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<tr>
<td>Brazil</td>
<td>149</td>
<td>Netherlands</td>
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<td>Canada</td>
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<td>New Zealand</td>
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<tr>
<td>Chile</td>
<td>92</td>
<td>Norway</td>
<td>184</td>
</tr>
<tr>
<td>China</td>
<td>111</td>
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<tr>
<td>Colombia</td>
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<td>Finland</td>
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<td>France</td>
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<td>Greece</td>
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<td>Japan</td>
<td>2,402</td>
<td>Venezuela</td>
<td>14</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>12,221</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 2a: Summary Statistics for Firm-Level U.S. Holdings: All Firms

The table reports firm-level U.S. holdings scaled by market capitalization and float as of December 31, 1997 for our sample of firms. Data on the value of U.S. holdings are from the U.S. Treasury/Federal Reserve Board survey of U.S. holdings of foreign securities. Market capitalization figures are from Worldscope. We calculate market float by scaling market capitalization down by the figure given in Worldscope’s “closely held share” field.

<table>
<thead>
<tr>
<th>ALL FIRMS</th>
<th>U.S. holdings / Market Capitalization</th>
<th>U.S. holdings / Market Float</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>3.5%</td>
<td>6.3%</td>
</tr>
<tr>
<td>Percentiles:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0%</td>
<td>0.0%</td>
<td>0.0%</td>
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<tr>
<td>25%</td>
<td>0.0%</td>
<td>0.0%</td>
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<tr>
<td>50%</td>
<td>0.4%</td>
<td>1.2%</td>
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<td>75%</td>
<td>3.9%</td>
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<td>90%</td>
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<td>19.1%</td>
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<td>16.7%</td>
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</tbody>
</table>
Table 2b: Summary Statistics for Firm-Level U.S. Holdings: Split by Cross-Listing Status

The table reports firm-level U.S. holdings scaled by market capitalization and float as of December 31, 1997 for our samples of cross-listed and non cross-listed firms. Data on the value of U.S. holdings are from the U.S. Treasury/Federal Reserve Board survey of U.S. holdings of foreign securities. Market capitalization figures are from Worldscope. We calculate market float by scaling market capitalization down by the figure given in Worldscope’s “closely held share” field. We classify a non-U.S. firm as cross-listed if its shares are listed on the NYSE, AMEX, or NASDAQ.

<table>
<thead>
<tr>
<th>U.S. Holdings scaled by:</th>
<th>FIRMS THAT ARE NOT CROSS-LISTED</th>
<th>CROSS-LISTED FIRMS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Market Cap</td>
<td>Float</td>
</tr>
<tr>
<td>Mean</td>
<td>2.9%</td>
<td>5.6%</td>
</tr>
<tr>
<td>Percentiles:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>25%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>50%</td>
<td>0.3%</td>
<td>1.0%</td>
</tr>
<tr>
<td>75%</td>
<td>3.3%</td>
<td>6.8%</td>
</tr>
<tr>
<td>90%</td>
<td>9.1%</td>
<td>17.2%</td>
</tr>
<tr>
<td>95%</td>
<td>14.2%</td>
<td>25.7%</td>
</tr>
<tr>
<td>#firms</td>
<td>11,723</td>
<td>8,235</td>
</tr>
</tbody>
</table>
Table 3: Jointly Estimated Determinants of U.S. Investment and Firms’ Cross-listing Decision

The table reports estimates of a simultaneous system that includes a probit specification of a firm’s decision to cross-list and two equations that determine the holdings share of U.S. investors—one conditional on cross-listing on a U.S. exchange as of December 31, 1997, and one conditional on not cross-listing. The dependent variable in the latter two equations is a nonlinear transformation of U.S. holdings in the firm, scaled by market float (Appendix B describes the transformation). For ease of interpretation, the reported figures are rescaled to reflect the median (over the firms in the sample) marginal impact of a unit change in the variable in question, on either the probability of cross-listing (in percent) or on U.S. holding (in percent). \( E[\text{Gain in U.S. Holdings Share from Cross-Listing}] \) is the endogenously estimated forecast of the change in holdings that would resulting from cross-listing for a given firm and \( E[\text{U.S. Holdings Share without Cross-Listing}] \) is an analogously defined estimate of what U.S. holdings would be if a firm did not cross-list. The selectivity correction variable is normalized by its own standard deviation. The other variables, which are assumed to be exogenous to the system, are defined in Appendix A. Bootstrapped estimates of p-values corresponding to a null hypothesis of a zero median impact appear in parentheses below each reported coefficient estimate.
Table 3 (cont.): Jointly Estimated Determinants of U.S. Investment and Firms’ Cross-listing Decision

<table>
<thead>
<tr>
<th>Percentage-point impact of:</th>
<th>Cross-Listing Probability</th>
<th>U.S. Holdings / Market Float if:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Not Cross-Listed</td>
</tr>
<tr>
<td>E[Gain in U.S. Holdings (% Share) from Cross-Listing]</td>
<td>0.152</td>
<td>(0.035)</td>
</tr>
<tr>
<td>E[U.S. Holdings (% Share) without Cross-Listing]</td>
<td>0.375</td>
<td>(0.011)</td>
</tr>
<tr>
<td>Selectivity correction</td>
<td>-0.368</td>
<td>(0.037)</td>
</tr>
<tr>
<td>Size</td>
<td>0.253</td>
<td>(0.018)</td>
</tr>
<tr>
<td>Proportion of Share Held by Insiders (%)</td>
<td>-0.006</td>
<td>(0.057)</td>
</tr>
<tr>
<td>National accounting quality</td>
<td>0.101</td>
<td>(0.000)</td>
</tr>
<tr>
<td>Firm-level accounting quality</td>
<td>0.803</td>
<td>(0.000)</td>
</tr>
<tr>
<td>Tax rate</td>
<td>-0.077</td>
<td>(0.000)</td>
</tr>
<tr>
<td>Shareholder rights</td>
<td>-0.717</td>
<td>(0.000)</td>
</tr>
<tr>
<td>Market value/Book value</td>
<td>0.017</td>
<td>(0.006)</td>
</tr>
<tr>
<td>Trading volume</td>
<td>-0.805</td>
<td>(0.002)</td>
</tr>
<tr>
<td>Dummy variables:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSCI member</td>
<td>5.395</td>
<td>(0.000)</td>
</tr>
<tr>
<td>Dividend-paying firm</td>
<td>0.974</td>
<td>(0.000)</td>
</tr>
<tr>
<td>Financial firm</td>
<td>-0.768</td>
<td>(0.111)</td>
</tr>
<tr>
<td>Canadian firm</td>
<td>2.576</td>
<td>(0.001)</td>
</tr>
<tr>
<td>English language country</td>
<td>2.555</td>
<td>(0.000)</td>
</tr>
<tr>
<td>Germanic language country</td>
<td>0.482</td>
<td>(0.074)</td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.28</td>
<td>(0.000)</td>
</tr>
<tr>
<td>Number of observations</td>
<td>8,067</td>
<td>(0.000)</td>
</tr>
</tbody>
</table>
Table 4: Average Cross-Listing Effect for Cross-Listed Stocks

The table reports estimates of the average cross-listing effect using three alternative treatment estimators. The “Heckman-based” estimates in Panel A are based on fitted holdings from the non cross-listed holdings equation (8) using data on the cross-listed firms; the corresponding parameter estimates appear in the middle column of Table 3. The “p-matching” estimates (rows 4 and 5) are U.S. holdings of a sample of non cross-listed firms that have been paired with the cross-listed sample on the basis of fitted probabilities from probit model estimates of the cross-listing decision (reported in the first column of Table 3). Panel B presents “differences-in-differences” estimates using data on U.S. holdings for March 31, 1994 and December 31, 1997. The sample in Panel B is restricted to stocks that were not cross-listed in U.S. markets in the earlier period, with the columns distinguishing between stocks that cross-listed before the second period and those that did not. Standard errors are shown in parentheses.

<table>
<thead>
<tr>
<th>Panel A: Heckman-based and P-Matching Methods</th>
<th>U.S. investors’ aggregate holdings as percentage of:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Market capitalization</td>
</tr>
<tr>
<td>1. Mean holdings of cross-listed stocks, $E(H_i^L</td>
<td>X = 1)$</td>
</tr>
<tr>
<td>2. Heckman-based estimate of $E(H_i^L</td>
<td>X = 0)$</td>
</tr>
<tr>
<td><strong>3. Heckman-based estimate of cross-listing effect,</strong> $E(H_i^L</td>
<td>X = 1) - E(H_i^L</td>
</tr>
<tr>
<td>(0.7)</td>
<td>(1.2)</td>
</tr>
<tr>
<td>4. P-matching estimate of $E(H_i^L</td>
<td>X = 0)$</td>
</tr>
<tr>
<td><strong>5. P-Matching estimate of cross-listing effect,</strong> $E(H_i^L</td>
<td>X = 1) - E(H_i^L</td>
</tr>
<tr>
<td>(0.8)</td>
<td>(1.3)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Panel B: Difference-in-Differences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stocks Cross-listed on U.S. exchange by December 1997</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>6. Holdings: March 31, 1994</td>
</tr>
<tr>
<td>7. Holdings: December 31, 1997</td>
</tr>
<tr>
<td>8. Change in holdings (1994-1997)</td>
</tr>
<tr>
<td><strong>9. Difference-in-differences estimate of cross-listing effect,</strong> $E(H_i^L</td>
</tr>
<tr>
<td>10. Number of Observations</td>
</tr>
</tbody>
</table>

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Table 5: Additional Summary Statistics (Holdings in ADR Form and of Level I ADRs)

The table reports two new pieces of information. For cross-listed firms, it reports the amount of U.S. holdings in the actual ADR (as opposed to the underlying foreign equity). For Level I ADRs, which trade only on over-the-counter markets and are not considered to be cross-listed on a U.S. exchange, it reports the amounts held by U.S. investors, as well as the portions held in ADR form and in the underlying foreign equity. For comparison, the table includes data on non-cross-listed firms as well. For further details, see notes to Tables 2a and 2b.

<table>
<thead>
<tr>
<th></th>
<th>Firm Market Capitalization Available (46 countries)</th>
<th>Firm Market Float Available (46 countries)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firms Cross-Listed on a U.S. Exchange</td>
<td>498</td>
<td>293</td>
</tr>
<tr>
<td>Average share held by U.S. investors</td>
<td>17.5%</td>
<td>26.3%</td>
</tr>
<tr>
<td>Average share held in ADR form</td>
<td>6.4%</td>
<td>12.4%</td>
</tr>
<tr>
<td>Average share held in underlying equity</td>
<td>11.1%</td>
<td>13.9%</td>
</tr>
<tr>
<td>Firms with Level 1 ADRs</td>
<td>672</td>
<td>524</td>
</tr>
<tr>
<td>Average share held by U.S. investors</td>
<td>8.1%</td>
<td>14.6%</td>
</tr>
<tr>
<td>Average share held in ADR form</td>
<td>1.7%</td>
<td>2.8%</td>
</tr>
<tr>
<td>Average share held in underlying equity</td>
<td>6.4%</td>
<td>11.8%</td>
</tr>
<tr>
<td>All firms without a U.S. cross-listing</td>
<td>11,723</td>
<td>8,235</td>
</tr>
<tr>
<td>Average share held by U.S. investors</td>
<td>2.9%</td>
<td>5.6%</td>
</tr>
</tbody>
</table>
## Appendix A: Variables and Instruments

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Included in:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Firm-level variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td>Logarithm of the 1997 book value of a firm’s assets from Worldscope, included as a measure of firm size.</td>
<td>$Z_i^R, Z_i^X, Z_i^L, Z_i^U$</td>
</tr>
<tr>
<td>Financial firm</td>
<td>Dummy variable that takes on the value of one when a firm is identified by Worldscope as belonging to industry SIC Codes 60-69 in 1997.</td>
<td>$Z_i^R, Z_i^X, Z_i^L, Z_i^U$</td>
</tr>
<tr>
<td>Proportion of shares held by insiders (%)</td>
<td>Worldscope’s 1997 value for the number of closely held shares as a percentage of common shares outstanding, adjusted to remove those stakes mistakenly counted as insider ownership by Worldscope. These include holdings by the Bank of New York, Morgan Guarantee Trust, and Citibank, because these shares are holdings for ADR programs, and the New Zealand Central Securities Depository.</td>
<td>$Z_i^R, Z_i^X, Z_i^L, Z_i^U$</td>
</tr>
<tr>
<td>MSCI index member</td>
<td>Dummy variable equal to one when a firm is included as a member of the MSCI All-country World index at the end of 1997.</td>
<td>$Z_i^R, Z_i^X, Z_i^L, Z_i^U$</td>
</tr>
<tr>
<td>Dividend-paying firm</td>
<td>Dummy variable equal to one when a firm pays a dividend in 1997, as reported by Worldscope.</td>
<td>$Z_i^R, Z_i^X, Z_i^L, Z_i^U$</td>
</tr>
<tr>
<td>Market-to-book value ratio</td>
<td>Year-end closing share price divided by the per-share book value of equity in 1997, as reported by Worldscope.</td>
<td>$Z_i^R, Z_i^X, Z_i^L, Z_i^U$</td>
</tr>
<tr>
<td>Variable</td>
<td>Definition</td>
<td>Included in:</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td><strong>Canadian firm</strong></td>
<td>Dummy variable set equal to one for Canadian firms.</td>
<td>$Z_{i}^{R}$, $Z_{i}^{N}$, $Z_{i}^{L}$, $Z_{i}^{U}$</td>
</tr>
<tr>
<td><strong>Firm-level accounting quality</strong></td>
<td>Index ranging from zero to four, calculated using criteria from Aggarwal, Klapper, and Wysocki [2005]. Four components takes a value of one if the firm (1) used a BigSix auditor, (2) received a clean audit report, (3) used international accounting standards or US GAAP, and (4) reported consolidated statements. The index is the sum of the four components.</td>
<td>$Z_{i}^{R}$, $Z_{i}^{U}$</td>
</tr>
<tr>
<td><strong>Country-level variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Trading volume</strong></td>
<td>Home-country trading value/GDP(%). 1997 dollar volume of trading in the home market of a firm, normalized by the dollar value of the country’s 1997 gross domestic product (GDP). The volume data are obtained from the International Finance Corporation [1998] and the GDP figures are collected from the International Monetary Fund’s <em>International Financial Statistics</em>.</td>
<td>$Z_{i}^{R}$, $Z_{i}^{N}$</td>
</tr>
<tr>
<td><strong>Tax Rate</strong></td>
<td>Home-country dividend withholding tax rate faced by U.S. investors. For countries maintaining a bilateral tax treaty with the United States, we use the treaty tax rate, as reported in the IRS publication 901, <em>U.S. Tax Treaties</em>. For countries with no U.S. tax treaty, we calculate dividend withholding rates from 1997 gross and net dividend payments to holders of ADRs, as reported in Bloomberg’s <em>Corporate Action Calendar</em>.</td>
<td>$Z_{i}^{R}$, $Z_{i}^{L}$, $Z_{i}^{U}$</td>
</tr>
<tr>
<td><strong>Germanic language country</strong></td>
<td>Dummy variable set equal to one for firms domiciled in a country in which a Germanic language—Danish, Dutch, English, German, Norwegian, or Swedish—is an official language.</td>
<td>$Z_{i}^{R}$, $Z_{i}^{N}$</td>
</tr>
<tr>
<td><strong>English language country</strong></td>
<td>Dummy variable that equals one if the company’s domicile is a country in which English is an official language.</td>
<td>$Z_{i}^{R}$, $Z_{i}^{U}$</td>
</tr>
</tbody>
</table>
### Appendix A (continued): Variables and Instruments.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Included in:</th>
</tr>
</thead>
<tbody>
<tr>
<td>National accounting quality</td>
<td>Values for 1995 reported by Bushman, Piotroski, and Smith [2004]. Compiled by the Center for Financial Analysis and Research, the index averages across firms within a given country the number of items, out of a possible maximum of 90, that are included as part of a firm’s financial statements.</td>
<td>$Z_{i}^{n}$, $Z_{i}^{x}$, $Z_{i}^{u}$</td>
</tr>
<tr>
<td>Shareholder rights index</td>
<td>Calculated by La Porta, Lopez-de-Silanes, Shleifer, and Vishny [1998]. Index takes on a value between 0 and 6 depending on how many of the following applies to a country’s equity market: percentage of outstanding shares required to call an extraordinary meeting less than or equal to 10 percent, cumulative voting or proportional representation of minority interests on board, voting by mail permitted, mechanisms in place for oppressed minority investors, preemptive right that can only be waived by a shareholder vote, and protection of shareholders from requirements that shares be deposited before a shareholder meeting.</td>
<td>$Z_{i}^{n}$, $Z_{i}^{l}$, $Z_{i}^{u}$</td>
</tr>
</tbody>
</table>
Appendix B: Estimating the Structural Model

Because the holdings variables $H^L_i$ and $H^U_i$ are measured as shares of a firm’s equity value, they are well-defined only over the range from zero to one. This implies that (6) and (7) cannot be estimated consistently using ordinary least squares because the limited range induces dependence between the instruments $Z_i$ and the residual.\(^{31}\) We circumvent this problem by transforming the holdings data by the inverse of the logistic function. However, because the inverse logistic is defined only on the open interval from zero to one, and we have a number of firms in our sample with no reported U.S. holdings, we shift the domain of the inverse logistic to the left by a small fixed amount, $S$,

$$F^{-1}(H) = \ln(H + S) - \ln(1 - H - S).$$

We assume a shift parameter ($S$) of 10 percent. This function has the favorable property of being nearly linear in $H$ between 0 and 80 percent, the range in which most of our observations fall. The smoothness of the function reduces the chance that our results will be significantly distorted by some quirk of the chosen functional form. After incorporating the inverse shifted logistic transformation, we rewrite our holdings equations as

$$F^{-1}(H^L_i) = \alpha^L_i + Z^L_i \beta^L + \epsilon^L_i,$$  \hspace{1cm} (B-2)

$$F^{-1}(H^U_i) = \alpha^U_i + Z^U_i \beta^U + \epsilon^U_i.$$  \hspace{1cm} (B-3)

Lee [1978] proposes a multi-stage method for consistently estimating a system like ours in which a first-stage, reduced-form probit generates Heckman [1979]-type correction terms for the holdings equations (B-2) and (B-3). The corrected second-stage estimation of the holdings equations produces consistent estimates of the relation between the instruments and (transformed) holdings, and makes it possible to calculate fitted holdings values as a function of the instruments. The final stage of estimation involves using the fitted holdings for estimation of the structural probit in equation (7).

In order to implement the Lee [1978] estimation framework, we need to make a few additional assumptions and a slight modification to our specification. Both of these issues relate to the joint statistical distribution of the residuals in the three equations. First, the error terms from the listing equation ($\epsilon^X_i$) and the two holdings equations ($\epsilon^L_i$, $\epsilon^U_i$) must be jointly normally distributed,

$$(\epsilon^X_i, \epsilon^L_i, \epsilon^U_i) \sim N(0, \Omega),$$  \hspace{1cm} (B-4)

where $\Omega$ is a 3 x 3 variance covariance matrix. The second issue arises because the first step in the original Lee [1978] procedure involves estimating a reduced form probit for the binary variable into which the linear equations for the other dependent variable have been substituted. In our model, equations (B-2) and (B-3) are not linear in holdings, thus we must recast the interaction elements in our listing decision equation in terms of the transformed holdings variable so that our reduced-form listing equation will be tractable. In particular,

$$X^*_i = \alpha_x + \gamma_0 \left[ F^{-1}(H^L_i) - F^{-1}(H^U_i) \right] + \gamma_1 F^{-1}(H^U_i) + Z^X_i \beta_x + \epsilon^X_i.$$  \hspace{1cm} (B-5)

Under assumption (B-4), the probit model implied by equations (B-5), (8), and (9) can be estimated jointly with the linear specifications in equations (B-2) and (B-3), as long as certain identification restrictions are met. Lee [1978] has shown that multi-stage estimation will produce estimates of structural parameters that

---

31 See, for example, the introductory discussion of truncated variables in Maddala [1983]. In principal, U.S. holdings could be negative, but in practice, short positions are not reflected in the holdings survey. Similarly, with short positions held by others, it is conceivable that $H$ could exceed 1, but in practice it is below 0.9.
are consistent in the presence of selection bias.

One advantage of this framework is that although we only observe $H_i^L$ for firms that have a U.S. listing and $H_i^U$ for firms that do not, we can use our parameter estimates to make inferences about what U.S. holdings of a firm’s stock would have been had the firm made the counterfactual choice about whether to cross-list. Furthermore, we can generate estimates of the cross-listing effect—i.e., the impact of cross-listing on U.S. holdings ($H_i^L - H_i^U$)—either unconditionally or conditional on specific firm characteristics.

In the first stage of the Lee [1978] methodology, the two holdings equations (B-2) and (B-3) are substituted into the listing probit (B-5) to form a reduced-form listing equation that can be estimated on a stand-alone basis by numerical maximum likelihood. The set of independent variables ($Z^R$) for the first-stage reduced-form probit specification consists of all of the instruments in the structural equations for listing and holdings:

$$Z^R = Z^X \cup Z^L \cup Z^U.$$  \hspace{1cm} (B-6)

We can write the first-stage equation as

$$X_i^* = \alpha_R + Z_i^R \beta_R - \epsilon_i^R,$$ \hspace{1cm} (B-7)

where

$$\epsilon_i^R = \gamma_0 \epsilon_i^L + Z_i^R (\gamma_0 - \gamma_1) \epsilon_i^U + \epsilon_i^X.$$ \hspace{1cm} (B-8)

The estimates from the probit model embodied in equations (B-7), (B-8), and (B-9) can be used to construct the selectivity-bias correction in the holdings-equations residuals ($\epsilon^L$ and $\epsilon^U$). It can be shown that for listed firms ($X^* = 0$),

$$E(\epsilon_i^L \mid X^* \geq 0) = -\text{cov}(\epsilon_i^X, \epsilon_i^L) \frac{\phi(\alpha_R + Z_i^R \beta_R)}{\Phi(\alpha_R + Z_i^R \beta_R)},$$ \hspace{1cm} (B-9)

where the variance of $\epsilon^X$ has been normalized to one and $\phi$ and $\Phi$ denote the probability density function and cumulative density function, respectively, of the standard normal distribution. The ratio

$$\frac{\phi(\alpha_R + Z_i^R \beta_R)}{\Phi(\alpha_R + Z_i^R \beta_R)}$$ \hspace{1cm} (B-10)

is often referred to as the “inverse Mills ratio”. Estimates of the ratio form the basis for standard corrections for selectivity bias when inclusion in an estimation sample is contingent on a discrete outcome (see Heckman [1979] or Maddala [1983]). Intuitively, the inverse Mills ratio accounts for the unobserved correlation between the listing decision and holdings. There is also a similar, but less frequently used correction for selectivity bias for the non-selected observations,

$$E(\epsilon_i^U \mid X^* < 0) = \text{cov}(\epsilon_i^X, \epsilon_i^U) \frac{\phi(\alpha_R + Z_i^R \beta_R)}{1 - \Phi(\alpha_R + Z_i^R \beta_R)}.$$ \hspace{1cm} (B-11)

The second stage of the Lee procedure involves estimating the holdings equations by ordinary least squares by rewriting them as
\[ F^{-1}(H_L^L) = \alpha_L + Z_i^L \beta_L - \frac{\phi(\alpha_R + Z_i^L \beta_R)}{\Phi(\alpha_R + Z_i^L \beta_R)} \lambda_L + \eta_i^L \]  
(B-12)

and

\[ F^{-1}(H_U^L) = \alpha_U + Z_i^U \beta_U + \frac{\phi(\alpha_R + Z_i^U \beta_R)}{1 - \Phi(\alpha_R + Z_i^U \beta_R)} \lambda_U + \eta_i^U. \]  
(B-13)

Note that \( \lambda_k = \text{cov}(\epsilon_{i_k}^L, \epsilon_{i_k}^U) \) for \( k = L, U \) and \( E(\eta_i^L \mid X^* \geq 0) = E(\eta_i^U \mid X^* < 0) = 0 \). We use our first-stage estimates of the parameters \( \alpha_R \) and \( \beta_R \) in (B-12) to construct the selectivity variables, and then substitute these variables into equations (B-12) and (B-13). The coefficient associated with the selectivity adjustment provides an estimate of the unobserved covariance between the listing decision and each of the holding equations. The final stage of the Lee procedure involves using the consistent estimates of \( \alpha_L, \alpha_U, \beta_L, \) and \( \beta_U \) from (B-12) and (B-13) to construct fitted values of \( (F^{-1}) \) using the original holdings equations (B-12) and (B-13). The fitted holdings are inserted back into the structural listing decision equation (B-5), which is then estimated as a probit model via numerical likelihood maximization.

As noted by Lee [1978], it is possible to construct consistent standard errors for equations (B-12) and (B-13) after making a correction for heteroscedasticity associated with the selectivity terms. However, inferences about the distribution of the estimated parameters in the listing decision equation (B-5) are complicated by the use of the generated variables \( E(F^{-1}|Z) \) in the final-stage probit estimation. Furthermore, for judgments about how the cross-listing effect on U.S. holdings varies across different types of firms (i.e., the conditional cross-listing effect), we construct statistics that involve parameter estimates from more than one equation. Accordingly, we opt to estimate the distribution of the full set of model parameters via non-parametric bootstrap simulations. Specifically, for each of the three versions of the model we estimated, we randomly drew 1,000 hypothetical samples with the same number of observations (with replacement), re-estimating the full model and computing the statistics of interest with each simulation.

Because our structural equations (B-5), (B-12), and (B-13) are nonlinear, the estimated parameters of the model are difficult to interpret. Therefore, we report rescaled functions of the estimates that are more readily interpretable. Specifically, for the coefficients on instruments in the listing decision equation, we calculate the marginal effect of a one-unit change in the instrument on the percentage point probability of cross-listing, estimated using each of 8,067 firms in the sample,

\[ 100 \times \hat{\Phi}' \ast \hat{\beta}, \]  
where

\[ \hat{\Phi}' = \Phi'(\hat{\omega} + \gamma \epsilon^L)F^{-1}(\hat{H}_i^L) - F^{-1}(\hat{H}_i^U) + \gamma F^{-1}(\hat{H}_i^U) + Z_i \hat{\beta}_X. \]  
(B-14)

We then report in Table 4 the median of the marginal effect estimates. The formulae for scaling the estimated impact of holdings on the cross-listing decision are somewhat more complicated:

\[ \frac{\hat{\Phi}'_i}{F'(\hat{H}_i^L)} \ast \gamma_0; \]  
(B-16)

\[ \frac{\hat{\Phi}'_i}{F'(\hat{H}_i^L)} \ast \gamma_1 + \left( \frac{\hat{\Phi}'_i}{F'(\hat{H}_i^L)} - \frac{\hat{\Phi}'_i}{F'(\hat{H}_i^U)} \right) \ast \gamma_0. \]  
(B-17)

The reported figures represent the median marginal impact on the cross-listing probability of changes in \( (H^L - H^U) \) and \( (H^U) \), all else equal. The extra term in (B-17) reflects the fact that a unit change in \( (H^U) \) with \( (H^L - H^U) \) held constant implies a unit change in \( (H^L) \).

Similarly, the coefficients \( \hat{\beta} \) in the holdings equations are scaled to reflect the marginal effect of...
a change in the instrument on the holdings share of U.S. investors (measured in percentage points),

\[
100 \times F'\left(\hat{\alpha}_c + Z_i \hat{\beta}_c\right) \times \hat{\beta}_c, \quad F'(\bullet) > 0, \quad C \in \{L, U\}. \tag{B-18}
\]

We then report the median estimated effect, which varies with the slope of the logistic transformation function (F).