Prestigious Stock Exchanges:
A Network Analysis of International Financial Centers

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July 2009

Abstract

In this paper, we use methods from social network analysis to assess the relative importance of financial centers around the world. Using data from virtually the entire universe of global equity activity, we present two sets of complete rankings for up to forty-five separate locations for the period 1990-2006. The first phase of our analysis evaluates international stock exchanges based on their ability to attract global IPOs. We subsequently compare the capacity of these financial centers to provide an efficient trading platform for cross-listed companies. U.S. exchanges are effectively the unique hosts for cross-border equity activity from many other locations. Moreover, they are the destination of choice for most companies coming from locations with highly prestigious exchanges. We find that despite a diminished ability to attract cross-border IPOs, U.S. exchanges have maintained an undisputable lead in global equity activity throughout the entire sample period. We do find evidence of the rising importance of competing exchanges, in particular, London, the Deutsche Börse, and Hong Kong, and also of an expanding role for a number of emerging-market stock exchanges. But this rising pattern shows evidence of improved global competitive conditions in a growing global market rather than a sudden decline in U.S. exchanges.

* The views expressed in this paper are those of the authors and do not necessarily reflect the position of the Federal Reserve Bank of New York or the Federal Reserve System. We thank Nikki Candelore and Vanessa Savino for excellent research support.

1. Introduction

According to growing opinion, capital markets in the United States have been losing ground to overseas competitors. Concerns about U.S. financial leadership have captured headlines in the press[1] and motivated a number of ad-hoc studies.[2]

The concerns about U.S. capital markets, of course, relate to the broader topic of domination of global financial business. New York City became the world's leading financial center in the years following World War II (Cassis 2007). More recently, however, major world events may have affected the relative standing of international financial centers. Especially since the early 1990s, markets have integrated at an almost unprecedented rate, spurred perhaps by such events as the dismantling of the former Soviet Union, China's shift to a market economy, the creation of a single-market region in Europe, and significant innovation in the financial markets. The scale of such changes and their far-reaching scope have encouraged the growth of financial centers historically in competition with the United States for global financial leadership and have fostered the development of several new locations that can now provide the financial services required to attract international business.

In face of such challenges, have the U.S. markets been able to maintain their position of global dominance? In this paper, we present a novel methodological approach—based on social network analysis—for assessing the importance of international financial centers. Existing studies normally base such analysis on the simple comparison of aggregate volumes. Stock exchange dominance, for example, is typically gauged by comparing total market capitalization and trading volumes. Refinements to the use of such metrics have gone as far as measuring the capacity to attract new listings, especially companies with initial public offerings (IPOs), since these new issues foreshadow a stock market's ability to grow organically over time and prosper (see, for

[1] Heather Timmons, "New York Isn't the World's Undisputed Financial Capital," *New York Times*, October 26, 2006; Charles Schumer and Michael Bloomberg, "To Save New York: Learn from London," *Wall Street Journal*, November 1, 2006; Daniel Gross, "The U.S. Is Losing Market Share. So What?" *New York Times*, January 28, 2007.

[2] For instance, in November 2006 a group of business and academic professionals established the Committee on Capital Markets Regulation, which produces extensive reports on the health of U.S. equity markets, arguing that they are indeed losing their edge. A McKinsey & Company report commissioned by New York City and released in January 2007 also explores ways to improve New York's competitive position as a major global financial center.

example, Pagano, Roell, and Zechner 2002; Zingales 2007). According to that view, aggregate listing dynamics incorporate all the information needed to assess which financial centers are growing in importance and which ones are losing stature. Analysis of such variables does indeed suggest that U.S. markets have been losing ground. Indeed, studies have shown that the Eurobond market has become the world's largest bond market in recent years (Peristiani 2007; Peristiani and Santos 2008). As for equity markets, the more competitive European and emerging-market stock exchanges have in fact become better able to retain their home base, while at the same time the New York Stock Exchange (NYSE) and the NASDAQ have witnessed a drop in the number of foreign IPO listings.

While such aggregate measures or other similar exchange-specific characteristics should not be dismissed, we argue that they offer an accurate assessment of market dominance only in limited environments and that their very construction leads them to neglect any information on the network of cross-location flows of financial activity. Knowledge and understanding of such network characteristics allow for a more powerful assessment of relative market dominance under the broadest circumstances. We make our case in more detail in the next section, but as an example, knowing the aggregate volume of IPOs in the United States in a given year does not tell us where companies are coming from, where else foreign companies might also be going, nor the extent to which U.S. companies might be going abroad and where exactly. We claim that gaining a full understanding of the network perspective associated with global equity activity is fundamental to measuring the true degree of dominance of international financial centers.

Using methodologies developed in social network analysis, we construct alternative measures of the relative attractiveness of stock exchanges as locations of destination for IPOs and secondary market trading. We examine forty-five separate exchanges over the 1990–2006 period. Our approach thus allows us, for the first time, to present virtually complete rankings of the relative degree of dominance of financial centers around the world. With such measures, we are able to assess more effectively whether U.S. financial markets have indeed lost their position of global leadership and the extent to which competition from other centers may have strengthened over time.

We find that while the raw volumes of global primary equity activity indicate simultaneously lower inflows to U.S. markets and increased inflows to other locations, our network-based measures demonstrate that U.S. stock exchanges (the NYSE and NASDAQ) maintain a strong dominating position throughout the whole sample period. Our findings reveal that this position of dominance has changed more recently, as a result of increased competition from other exchanges, mainly the London Stock Exchange, the Deutsche Börse, and the Hong Kong Stock Exchange. We also find, however, that the enhanced role of these competing exchanges in attracting IPO activity has not translated (just yet) into a larger share of secondary global trading volume. U.S. stock exchanges continue to be by far the world's leaders.

2. Network Analysis and Market Prestige

In social science applications, the conventional approach is to identify characteristics specific to the object of analysis and draw inferences from the data. In labor studies, for example, employment success is typically associated with basic individual traits such as age, education, gender, race, and the like. A network approach, while not disregarding relevant unit-specific characteristics, also stresses the importance of analyzing existing *patterns of relationships* among the units of analysis. Although a survey of network methodologies is well beyond the scope of this study, we can make our point by referring to a number of existing economic applications. [3] For instance, in those labor studies that have adopted a network approach, in addition to the basic agent-specific variables mentioned above, employment likelihood is also shown to be affected by the position of an agent within a network of individuals and by network-wide characteristics as well (see, for example, Topa 2001; Conley and Topa 2002, 2007; Calvo-Armengol and Jackson 2004; Bayer, Ross, and Topa, Forthcoming). In international trade studies, some have argued that pair-wise connections between countries, such as the development of free-trade agreements, will have not only direct effects on the two sides involved but also important indirect effects on other countries, such as market-wide changes in relative prices (Furusawa and Konishi 2007). In applications to venture capital (VC) financing,

[3] Good examples are Newman (2003), Jackson (2004), Newman, Barabasi, and Watts (2006), and Jackson (2008).

the success of a start-up appears to depend on its own characteristics but also on the network position of the VC firms supplying the funds; and the network characteristics of VC firms also affect the market structure of venture capital (Hochberg, Ljungqvist, and Lu 2007, 2009). On a topic perhaps more closely related to our study, many applications of so-called world-system theories (Wallerstein 1974; Chase-Dunn 1985; Sacks, Ventresca, and Uzzi 2000; Alderson and Beckfield 2004) have made the strong case that to assess the relative status of countries or world cities, "attributional" data are insufficient: "National societies [do not] constitute independent units. … [Their] development can be understood … [only by] taking into account the systematic ways in which societies are linked to one another in the context of a larger network of material exchanges" (Chase-Dunn 1985).

The network literature has also recognized the mutual dependence between attributional data and network characteristics. In other words, the "status" of an individual, from a network perspective, is highly related to individual-specific variables (taller children, for example, are likely to be considered more popular within a network of children, say, a classroom). Hence, a legitimate counterargument to network analysis could be that such an approach is unnecessary since network characteristics are simply a direct consequence of conventional attributional data and therefore do not contain additional independent information. However, extensive work has gone into understanding the process of network formation and the conditions for the existence, uniqueness, and stability of network equilibria (see, for example, Bala and Goyal 2000; Jackson and Watts 2002; Jackson and van den Nouweland 2005), and one of the implications of this body of literature is that one-to-one correspondences between sets of unit-specific attributes and specific network structures may not exist (that is, not all tall children are considered popular, or height may not be as relevant an attribute in particular networks). Therefore, in most applications network analysis is bound to add value above and beyond what attributional data can tell us.

We believe that the arguments that constitute the basis for network analysis fully apply to our application. As noted earlier, the conventional approach for assessing the relative importance of stock exchanges is to look at aggregate, exchange-specific measures of size or liquidity. For instance, the aggregate volume of IPO activity

registered in each exchange is a typical attribute considered in such assessments. A network approach does not necessarily dismiss such attributes, but it offers a different way of assessing the same variable. Network analysis not only focuses on the exchange-specific totals but also seeks an understanding of how those totals were obtained: where did the companies doing the IPOs come from? Did they issue domestically? Did they go abroad? If so, where? Is there any degree of "reciprocation" in IPO flows, that is, if some companies headquartered in location 1 do IPOs in location 2, are there companies from location 2 doing IPOs in location 1, and to what extent? To what extent is a particular exchange the unique destination for companies from a given location? To what extent is an exchange able to attract companies from locations that are themselves considered attractive?

The following example suggests ways in which analysis of network flows adds value in assessing the relative importance of financial centers. Consider the case of ten separate country exchanges and denote the exchange-specific aggregate IPO values with X_i, $i = 1,\ldots,10$. In a network representation, these aggregates would be expanded into a ten-by-ten matrix, as depicted in chart 1. In this matrix, the rows indicate locations of origin, and the columns indicate locations of destination. Hence, the matrix element x_{ij} represents the total volume of IPOs by companies headquartered in location i that takes place in location j. The figures on the main diagonal are instead the total flows of domestic IPO activity. Note also that the value of x_{ij} does not imply anything about the value of x_{ji}, the volume of IPOs by companies from location j that takes place in location i. Hence, the cells in the matrix break down the aggregate IPO flows in separate, location-to-location pairs.[4] Following our matrix convention, the aggregate IPO flows in each location, that is, the values $(X_1, X_{2,}\ldots, X_{10})$ are just the column marginals of the matrix in chart 1.

A network-based approach thus expands the information contained in one-dimensional aggregates to the multidimensional space of location-to-location ties. We argue that analyzing the network characteristics of the same variables greatly enriches our

[4] Most cell values in the matrix are equal to zero, but this is just to simplify the example.

understanding of global equity activity and allows for a superior assessment of the relative importance of the population of stock exchanges.

Now, it is clear that in circumstances where most of the cross-listing flows are directed to just one stock exchange location, the statistics contained in the column marginals will be (trivially) sufficient for assessing global dominance. The exercise, however, is significantly more difficult as the matrix flows become even slightly more complex. Imagine, for instance, the case of two markets with significantly higher column marginals than any other market and, for the sake of the argument, values equal to one another. Consider, for example, the scenario depicted in the matrix in chart 1, and assume that locations 1 and 2 receive the same volumes of aggregate IPO activity, that is, $(X_1 = X_2)$. Based on the raw marginal volumes, locations 1 and 2 should be considered equally dominating locations for global IPO activity. Consideration of the entire matrix of network flows, however, offers important refinements to that assumption. For instance, while both locations 1 and 2 receive similar flows of IPOs from other countries, the matrix also shows that location 4 attracts foreign IPO activity from countries 8, 9, and 10. How does this attraction affect the analysis of locations 1 and 2? All else equal, the flows from locations 8 through 10 to location 4 suggest that location 4 is a relatively attractive destination. But then, being chosen as a destination by companies from a place that is itself relatively prestigious should boost the prestige of that destination location: being the choice of companies from prestigious locations can have, for example, a "certification" effect that can boost its future ability to attract other foreign companies. As the matrix shows, since firms from location 4 cross-list to location 1 (but not to location 2), the prestige of location 4 should at the margin enhance the prestige of location 1 over location 2. In other words, as a principle, the prominence of a financial center should increase not just as a function of the ability of that location to attract companies but also as a function of the *prominence of the places the companies doing the choosing are coming from*. This implication is an example of the network externality mentioned earlier captured by looking at the whole structure of interlocation flows.

To further illustrate these important network effects, consider again the matrix in chart 1 and observe that companies from locations 6 and 7 are cross-listing in location 8. Note that companies from locations 6 and 7 were contributing to the importance of

location 2. The flows in this case show that location 2 is not the *unique* destination for companies from 6 and 7. A decline in a location's uniqueness can be considered as an indication of its weakening influence or of the emergence of other competing markets.

These additional layers of complexity are not trivial. The dominance of an equity market for both IPOs and trading activity reflects a set of characteristics embedded in that market that market participants evidently consider important: reputation, regulatory environment, exchange of information, commonality of investors, lower cost structure, and the like. Peeling off the first layer of analysis and looking at the broader patterns of intermarket flows allow us to assess the relative degree of attractiveness of different environments and also provides clues on possible dynamic evolutions. Hence, giving consideration to the entire matrix of stock exchange flows reveals a wholly integrated view of the competitive structure, allowing a more accurate measure of market dominance. Again, taking this approach is all the more justified in an environment such as that of the past two decades—with global markets growing steadily and with the expansion of many new, more liquid and sophisticated financial centers that adhere to better corporate governance principles and that can rightly compete for global financial activity.

3. Network measures

The example above illustrates how certain relational ties, even if not direct, may have important repercussions for a given unit of analysis. Adopting a network perspective leads to giving full consideration to the entire set of bilateral relationships. Some may be nonexistent, others will be asymmetric in one direction or the other, and still others will be a sign of mutual exchanges; and information can be extracted from the analysis of each possible case. Moving past the comparison of column marginals, however, requires a systematic approach to avoid subjective considerations and to allow consistent assessments across markets and over time. The methodologies developed in the network analysis literature are suited to this task.

Network analysis is widely used in social and behavioral sciences, and its tools are also extensively applied in physics and related hard sciences as well. A vast literature on methods and applications has developed, principally in sociological studies, that is

large enough to be a separately recognized subfield called social network analysis; in this subfield, the principles are exactly the same as those of the broader category of network studies.[5] This extensive literature has generated a wide array of techniques and related measurements for capturing the many facets of information embedded in the network structure.[6] For our purposes, we focus on three alternative measures, each one allowing a progressively deeper probe than the previous one into the complexity of network connections.

3.1 Degree centrality: The first network-based indicator refines the information contained in the aggregate volumes. It seems reasonable to argue that a location should be considered more dominant if it attracts companies from many locations. This measure is known in social network analysis as in-degree centrality. Such a measure could be constructed just by counting the number of locations of origin choosing each location of destination. Alternatively, each connection can be weighted by the total value of equity market activity associated with it. The in-degree measure does just that, as it is calculated as the column sum excluding the main diagonal element,

$$P_d^{in}(n_j) = \sum_{i \neq j} x_{ij}. \quad (1)$$

Hence, with respect to the raw aggregates, the in-degree index is a more direct measure of the ability of an exchange to attract foreign business.

At the same time, we can also measure the degree to which companies of a given location go abroad. This measure, known as out-degree centrality, would be the count (simple or weighted) of foreign destination chosen by domestic companies. In many economic problems, one could in fact argue that dominance would be reflected in the extent of outward ties. For instance, in a study of international trade patterns, outward ties would be captured by the flows of exports to different countries, and a pattern of increasing exports could signify increasing global influence. In our study of dominance in

[5] Examples of social network applications to economics and finance are Smith and White (1992), Brewster Stearns and Allan (1996), Mizruchi and Brewster Stearns (2001), Sorenson and Stuart (2001), Uzzi and Gillespie (2002), Mizruchi (2004), Mizruchi and Davis (2004), Byrd and Mizruchi (2005), Mizruchi and Bey (2005), Brewster Stearns and Mizruchi (2005), Mizruchi, Brewster Stearns, and Marquis (2006), Uzzi (2007), and Neuman, Davis, and Mizruchi (2008).

[6] A useful reference textbook on methods and applications in social network analysis is Wasserman and Faust (1994).

equity market activity, the out-degree of a location seems more likely to reflect negatively on the position of dominance of a location, as it implies that domestic companies are choosing foreign locations instead of their own domestic market. The measure of out-degree is calculated for each location as the row sum excluding again the main diagonal element,

$$P_d^{out}(n_i) = \sum_{j \neq i} x_{ij}. \quad (2)$$

3.2 Betweenness: Both the in-degree and the out-degree prestige indicators offer relevant information in assessing the dominance of each actor in a network. By construction, they measure how much activity a location is able to attract from other places (or how much domestic activity migrates abroad), but they do not offer details about where flows are coming from. In other words, they are measures that do not exploit information contained in the matrix cells outside a location's own column (or row). The dominance of a location, however, should reflect the unique set of characteristics it offers. The example in table 1 shows location 2 as the destination of choice for companies originally from locations 6 and 7, and, according to the in-degree measure, location 2 would be equally as dominating as location 1. We can presume that certain attributes of location 2, such as a more effective regulatory environment and a more liquid platform for trading, increase its attractiveness. If other companies from these same locations choose other locations, though, location's 2 position of dominance is diminished, because it loses some of its desirability as a destination of choice among companies that share the same place of origin. In the example of the table, the fact that companies from locations 6 and 7 are also going to location 8 reflects negatively on location's 2 central position. The concept of betweenness captures the role of each network location as powerful "brokers" among all alternative locations. The example can be generalized and formalized by constructing an index of betweenness for each node in a network.

Consider node n_i and every other pair of nodes n_j, n_k, such that $j,k \neq i, j < k$. The pair (n_j, n_k) can be connected to each other through multiple paths passing through other nodes in the network. In the example above, companies from locations 6 and 7 are issuing IPOs in both location 2 and 8. Hence, the total number of paths connecting

locations 6 and 7 would be equal to two. We are interested in knowing how important another node, such as 2, is in brokering the connections between 6 and 7. In this example, one out of two paths passes through node 2; hence, we can say that node 2 "controls" 50 percent of the actual connection between nodes 6 and 7. Now, each path between a pair of nodes may have different relevance based on the magnitude of the flow passing through. For example, the flow of IPO activity that goes to node 2 from nodes 6 and 7 could be much higher than that from 6 and 7 going to 8.

Consequently, in applications like this one, where the size of the pair-wise network connections has a meaning, the betweenness index should be weighed accordingly. Freeman, Borgatti, and White (1991) developed an index of betweenness to use in the case of directed, valued networks, which allows doing just that. Let m_{jk} be the maximum flow of activity between nodes (n_j, n_k). Let instead $m_{jk}(n_i)$ be the maximum flow between nodes (n_j, n_k) that goes through node n_i. Aggregate now across all possible pairs of nodes in the network, other than n_i, and obtain the overall betweenness of node n_i as $\sum_j \sum_k m_{jk}(n_i)$. It should be clear that this value increases in the size of the network and that it also varies according to changes in the magnitude of the individual pair-wise flows. To allow for comparison of node betweenness over time, a normalization is recommended, so that the betweenness index of node n_i is

$$P_b(n_i) = \sum_j \sum_k \frac{m_{jk}(n_i)}{m_{jk}}. \quad (3)$$

3.3 Prestige: The network measures described previously are a significant improvement over the standard aggregate flows typically used in the literature. The degree centrality measures capture the ability of each financial location to attract activity from other locations but also the extent to which domestic companies choose to conduct their activity abroad. The betweenness index measures the brokering role of each financial center, takes a major step forward in using network information, and offers new insights in the assessment of global market dominance. Both indexes have been adopted in economics applications. For instance, Hochberg, Ljungqvist, and Lu (2007) constructed indexes of in-degree and betweenness to assess the relative importance of

venture capital firms. However, there is more information to extract from considering the entire network of financial activity. Intuitively, one would argue, for example, that the status of U.S. stock exchanges should be affected differently if it is the choice of destination for, say, a U.K. company or a Chilean company. The first flow comes from a location of origin that in 2006 was second only to the United States in trading volumes from foreign companies, , while Chile, according to our data sources, had no foreign companies listed in 2006. More precisely, all else equal, it seems plausible to argue that a location's prestige should increase if it is chosen by companies from places that are themselves prestigious. In the example presented earlier, we had hinted already that the importance of location 1 was enhanced because location 4 was itself a location of destination for companies from other places. Accepting this criterion for assessing dominance, therefore, implies solving recursively a system of n equations, each representing a location of destination.

We define the rank prestige of node n_i as:

$$P_r(n_i) = x_{1i}P_r(n_1) + x_{2i}P_r(n_2) + \cdots + x_{Ni}P_r(n_N), \quad (4)$$

where $P_r(n_i)$ is defined by equation (3). Extending this concept to the whole network, we have N equations in N unknowns, the individual rank prestige measures. As shown by Katz (1953), this system has a finite solution if one first standardizes the original network matrix to have column sums equal to one. After this standardization, the system of equations becomes a more common matrix-characteristic equation, where the solution (that is, the vector of rank prestige indicators) is the eigenvector associated with the largest eigenvalue of the standardized matrix. A node will thus have high-rank prestige if it is chosen by few but highly prestigious other nodes or if it is chosen by many other nodes with lower rank.

This more sophisticated criterion by which to judge the importance of each node in a network fully exploits the information contained in the entire network structure. This index offers a more comprehensive picture of overall market dominance than simple measures of aggregate volumes traditionally employed for this task. This method of assessing the relative importance of each node in a network actually has a large number of real-life applications. In fact, the network algorithm used in our study is not conceptually different from the PageRank algorithm that is at the foundation of the

Google search engine (Brin and Page 1998). The intuition provided by the founders, in fact, suits our application very well:

> [An] intuitive justification [for the algorithm] is that a page can have a high PageRank if there are many pages that point to it, or if there are some pages that point to it and have a high PageRank. Intuitively, pages that are well cited from many places around the web are worth looking at. Also, pages that have perhaps only one citation from something like the Yahoo! homepage are also generally worth looking at. If a page was not high quality, or was a broken link, it is quite likely that Yahoo's homepage would not link to it. PageRank handles both these cases and everything in between by recursively propagating weights through the link structure of the web. (Brin and Page 1998, sec. 2.1.2)

4. Data

We measure the flow of IPO activity across the different international stock exchange destinations from the Thompson Financial *Securities Data Corporation* (SDC) new issues database. The SDC database contains information on domestic and international cross-border equity offers by tracing the national origin of the issuing company. Our sample consists of all companies that issued stock in their domestic market and raised capital abroad between 1990 and 2006.

Companies can opt to issue stock abroad using a regular international listing if they can satisfy the requirements of the destination market. For instance, foreign companies listing on the NYSE face certain minimum size and revenue requirements and must meet Level I listing requirements that involve GAAP reporting and registration and reporting rules of the Securities and Exchange Commission (SEC) (Karolyi 2006). In addition to listing directly on the host stock exchange, foreign companies often rely on depository receipts programs to issue stock. This method is commonly used by overseas firms issuing in the United States, the so-called American depository receipts (ADR). Similarly, global depository programs are also more broadly used to list internationally. Our analysis does not differentiate among these various ways companies use to list abroad.

One minor drawback of SDC information is that occasionally the information is not fully transparent for companies that choose multiple international listings, failing to document fully all the cross-listing markets. We correct for these information gaps using the Bloomberg company’s calendar that documents in greater detail all corporate actions.

For simplicity, all international stock exchanges are consolidated at the country level. In the case of the United Kingdom and Germany, the national equity markets are solely represented by the London Stock Exchange and the Deutsche Börse. The U.S. national market is represented by the combination of the NYSE, NASDAQ, AMEX, and OTC Bulletin Board. In the case of multinational exchanges such as Euronext and OMX (Nordic Exchange), we reconstructed the pro forma combination based on the preexisting national markets going back to 1990. Over the entire 1990–2006 period, our sample included more than 35,000 equity offerings in forty-two country-level equity locations amounting to roughly $2.1 trillion in proceeds.

Compared to other recent academic studies, our sample period is fairly broad, encompassing all domestic and international listings over the past two decades. Sarkisian and Schill (2009) investigate trends in cross-listing activities over a much longer period spanning most of the 1900s. In this broader historical context, they are able to identify several waves in cross-listings and numerous changes in the hierarchy of financial centers. They note that cross-listing activities on these international exchanges have fluctuated. Switzerland, for example, was a major host market in the earlier part of the twentieth century. A number of continental European markets (for example, the Netherlands, Belgium, France, and eventually the United Kingdom) took turns sharing this role, before finally the United States formally assumed the mantle as the most dominant financial center in the 1980s.

In the second phase of our analysis, we shift our focus from analyzing the cross-border flow of issuance at the time of the offering to examining the postlisting domestic and cross-country trading activity. A cross-border listing is now broadly defined to include not only IPOs but also firms that simply decide to list their shares for trading without raising additional capital.[7] We obtain information on stock trading for most of the

[7] Occasionally, IPO firms opt to raise some of their proceeds abroad by having a secondary listing on an overseas stock exchange. In other instances, some of the cross-border listings are not initiated by the firm. As of the end of 2006, there were roughly 4,300 active listings by U.S. companies on the Deutsche Börse. Many of these U.S. cross-listings were unsponsored and placed on the "unofficial" section of the Deutsche Börse market. Most of these unofficial listings garner minimal interest from investors and contribute very little to the aggregate trading activity of the host market.

world's international stock exchanges from the Thomson Financial *DataStream* database. *DataStream* provides extensive information on the trading value of all listed stock securities for the vast majority of international stock exchanges. It is natural to expect to find some discrepancies when analyzing databases from two different sources. Excluding the subset of firms that listed on an exchange without raising capital, we find that the sample collected from *DataStream* is generally consistent with the SDC sample.[8] In a handful of cases, we observe no cross-border trading flows, although the SDC data indicate some minor IPO volume of cross-listings in those market locations. Often these cross-listings represent equity funds (such as country closed-end funds) that may not be traded heavily on these smaller markets.[9] The scope of our analysis is somewhat different as it traces a company's trading activity (measured by dollar trading value) on the various exchanges. Consistent with our analysis of cross-listings, the trading activity across different exchanges is cross-tabulated according to the country level and national origin of the firm. The sample consisted of roughly 608,000 firm-year observations, trading in forty locations between 1995 and 2006. The total trading value over the entire 1995–2006 period was roughly $450 trillion.

5. Results

5.1. Evaluating primary market competitiveness

[8] Our analysis focuses primarily on established, more liquid international stock exchanges. When examining IPO flows, some of the smaller or emerging markets are regionally consolidated (for example, Middle East, Africa, and countries of the former east bloc). We also excluded some of the tiny markets in Africa and South and Central America that may have experienced some IPO outflows.

[9] Both our SDC and *DataStream* samples include equity fund flows (for example, country funds and other specialized funds such as REITS). Equity funds are sometimes not included in cross-listing studies because they do not have company-specific information. Equity fund flows, however, are also useful in measuring a stock exchange's ability to attract business from abroad. Equity funds represent a very small fraction of the aggregate volume of IPO proceeds. They are typically less liquid, garnering very little trading interest. Overall, these funds amounted to only about 3.25 percent of the trading value activity of our global *DataStream* sample between 1995 and 2006.

Primary equity markets foster investments in innovation, enhance economic growth, and promote the efficient allocation of resources. As an important barometer of stock market performance and strength, new listings are also a forward-looking indicator of the capacity of a stock market to grow and dominate competitors.

5.1.A. Aggregate volumes

As a benchmark, we begin reporting the aggregate volumes of IPO proceeds generated in each financial location. The details are in table 1. To present smoother time series, the numbers are reported as the total dollar amount generated over a rolling five-year window, so that in each column data for the most recent year are added and data for the most distant are removed. For convenience, figure 1A presents the time series for just the top eight locations (in this and in all other figures, the top locations are chosen based on 2006 rankings). It is evident from table 1 and figure 1A that the United States towers above all other market destinations in IPO volumes, albeit the gap between U.S. stock exchanges and other large competitors narrowed in the last few years of the sample period.

Much of the observed surge and subsequent drop in IPO activity in the United States stems from the boom-and-bust Internet companies. The years of decline are, after all, those following the burst of the technology bubble and the subsequent recession. The Euronext, the Deutsche Börse, and Hong Kong Stock Exchange also experienced their own version of the high-tech boom-and-bust cycle, attracting a large number of new member firms in the late 1990s. The Deutsche Börse, in particular, was the favored destination for a large number of American high-tech companies that opted to have a dual listing on one of the local German stock exchanges. Again, the collapse of the dot-com sector resulted in a significant slowdown in IPO activity for all these markets. Not surprisingly, new listings are also very weak in Japan as the country endured its worst economic recession during most of this period. Although large equity markets in Japan and continental Europe experienced a similar Internet cycle, some market participants viewed this recent decline as a sign that U.S. stock markets were losing ground to overseas and private competitors.

While the aggregate flows of IPOs taking place in the United States may have declined because of global macroeconomic conditions and the investment cycle, our findings in table 1 indicate a certain degree of substitution of destination locations, since the flows of IPOs to some of the closest competitors to the United States have trended upward throughout the sample period. This rising competition from overseas is shown more clearly in figure 1B, which gives a magnified picture of figure 1A by removing the U.S. aggregates. In some cases, the growth over time has been remarkable. By 2006, Germany (essentially, the Deutsche Börse) had grown to almost five times its size in the mid-1990s. Similarly remarkable has been the rise in significance of the other top markets (United Kingdom, 62 percent; Hong Kong, about 500 percent; China (mainland), 200 percent; Euronext, 66 percent). Hence, the aggregate volumes give indications of a potential loss of dominance by U.S. financial markets as established competitors and newly expanding markets increase their visibility.[10]

5.1.B. Degree centrality

Table 2 summarizes the index of in-degree centrality for each location, while figure 2A traces the top eight locations, while figure 2B excludes the United States. As noted earlier, this simple index removes the values on the main diagonal from the column marginals, effectively representing the aggregate volumes of foreign IPOs taking place in each location. Disregarding the information contained in the volumes of domestic IPOs is debatable. On the one hand, focusing on foreign flows illustrates the ability of an exchange to attract what could be considered the customer "base" of foreign competitors. On the other hand, it fails to consider the extent to which domestic companies choose their own exchanges. Put differently, from the perspective of evaluating the importance of an exchange, what matters should be the ability to attract companies overall, irrespective of whether they are domestic or foreign. From this perspective, losing a potentially important domestic company may be more damaging than attracting a few from foreign locations, a fact that would be missed by looking only at off-diagonal sums.

[10] Another sign of concern is that only one of the top twenty global IPOs in 2006 (ranked by volume of proceeds) was listed in United States. The largest company IPO in the United States was MasterCard Inc., which listed on the NYSE on May 24, 2006. These rankings exclude closed-end funds, unit trusts, and other specialized IPOs.

At any rate, given its conceptual simplicity and intuitive appeal, this index has actually been analyzed in a number of recent studies (for example, Zingales 2007) without reference to network analysis. It should be noted, however, that in such studies the focus has been primarily on the U.S. flows. Further, we are not aware of any study that has traced this index for the entire set of financial locations over time. For these reasons, we chose to calculate and report this index, while the following metrics (betweenness and prestige) will instead make use of the information contained in the *full* matrix.

The in-degree measures reveal a more significant loss in the ability of the United States to attract foreign companies. Once domestic volumes are removed, the United States actually drops into third position in 2006, with both Germany and Hong Kong reporting larger volumes of foreign IPOs and the United Kingdom a close fourth. Perhaps even more important to highlight is the tremendous growth by "minor" locations. Higher-growth economies such as Singapore, Taiwan, and Eastern European upstart markets (for instance, Croatia, the Czech Republic, and Romania) have attracted greater interest from foreign investors. In the case of these former eastern bloc countries, in particular, foreign IPO activity accounts for more than 90 percent of the aggregate. Similarly, the volume of issuance in countries such as Australia and New Zealand is many times larger than it was in the mid-1990s.

The information contained in these in-degree indexes is consistent with stories in the financial press highlighting the loss of competitiveness of U.S. markets, although the cross-location comparison reveals a somewhat diffused rise in relevance across other locations rather than a simple reshuffling at the top of the ranking.

We also found additional information by looking at where domestic companies in important locations are going. We shall investigate this aspect more with the following indexes, but, as indicated earlier, the prestige of a given location should be enhanced if it is increasingly attracting companies from locations that are themselves prestigious. For example, is there any indication that more U.S. companies have been choosing to go overseas to raise capital? The out-degree index does not seem to reveal such a trend. The index is reported for all locations in table 3, while figure 3 traces the time series for the top eight locations in 2006. If anything, more U.S. companies were choosing foreign

locations—relative to companies from other countries—in the first part of the sample period, while the trend has been declining since 2002. This finding indicates that U.S. markets may not be losing their edge to the benefit of other locations. This result also lends weight to the argument mentioned earlier that including domestic volumes in these measures gives a fuller picture of the importance of an exchange.

Interestingly, none of these important international stock markets (as measured by size or by foreign inflows) has experienced increasing outflows of domestic companies in recent years. Among the top eight locations by outflow volumes, only China (mainland) and Japan exhibit that trend. Moreover, if we look again at the entire matrix of outflows, as reported in table 4, and recalculate percentage changes since 2000, we find that most outflows in recent years are coming from emerging-market locations (Russia, Eastern Europe, and India, among others). In part, some of these flows are more local and regional in nature (for example, mainland Chinese companies moving to Hong Kong or Russian and Eastern European firms cross-listing on European stock exchanges). The observed outflow of a large number of Chinese companies is not surprising as the government made a concerted effort to encourage state-owned and private enterprises to go public. The Hong Kong stock exchange was the most convenient destination for these state-controlled companies seeking capital. These observations should add nuance to the overall assessment of the prestige of international financial centers.

The attractiveness of non-U.S. equity markets as destinations for IPOs thus appears to be driven mainly by outflows from countries with weaker financial infrastructure that do not offer the appropriate level of sophistication and protection to shareholders and investors. These findings are consistent with the bonding hypothesis that asserts that cross-listings are potentially more beneficial for firms domiciled in countries with weak institutional and legal environments (Coffee 1999; and Stulz 1999). By placing their stock in markets with more rigorous laws and stronger corporate governance rules, these firms make a commitment to reducing information asymmetries and thus to strengthening shareholder protection.

5.1.C. Betweenness

These last considerations lead us naturally to our next measure, the betweenness index. This index truly exploits network ties and captures the uniqueness of a given node in a network, which translates, in our case, to the degree to which a financial center is the exclusive location of destination. Consider, for example, our previous finding from the in-degree prestige analysis showing that the Deutsche Börse is the top destination by volume in 2006. How unique is its role as a location of choice for IPO activity?

We present a time series breakdown of the betweenness scores for all stock market destinations in table 4. Figures 4A and 4B illustrate in greater detail the evolution of betweenness for the top eight locations. Based on this index, the United States does not really seem to be losing its central role in global IPO activity. Despite the declining trend in attracting foreign companies, U.S. stock markets have the highest degree of betweenness throughout the whole sample period, and, at least as important, there is no negative trend.

Our findings reveal that about 40 percent of global IPO flows go solely through the United States. At the same time, the betweenness score shows that the significant increase in in-degree prestige for Germany has not translated into a similarly strong and sustained increase in its uniqueness as a location of destination: foreign companies going to the Deutsche Börse are from locations that also have important outflows of domestic companies going somewhere else as well. The index is even more revealing for Hong Kong, which exhibits a very low betweenness index, well below the top eight range. The low betweenness score for Hong Kong is not surprising because the Chinese government has actively encouraged many of the large, state-owned private companies (which represent the bulk of Hong Kong foreign inflows) to seek a secondary listing on U.S. stock exchanges and the London Stock Exchange.

The analysis of the betweenness index vividly illustrates the rising position of the United Kingdom in most recent years. Moreover, outside the top positions, the index reveals an increase in uniqueness for some of the peripheral exchanges, such as Australia, India, and Singapore. These findings are consistent with the conjecture that these locations may be increasing their prestige but at a more local, regional level. The recent rise in prominence of the London Stock Exchange is owed mostly to micro-cap companies listing on the Alternative Investment Market (AIM) segment of the London

Stock Exchange.[11] The cross-listings ratio of London Stock Exchange, excluding these very small AIM firms, however, is actually substantially lower over this period and is in line with other stock exchanges.

5.1.D. Prestige

Finally, we investigate the relative strength of these international exchanges by looking at a network measure of dominance that is by design better able to incorporate and use the information contained in the entire matrix of IPO flows. The prestige index is summarized in table 5 for the entire panel of equity markets and displayed in figures 5A and 5B for the top eight locations. As the figures show, the NYSE and NASDAQ are on the whole much more influential stock markets than other competing locations, with significantly higher scores than the rest of the top-tier cluster of competitors such as the London Stock Exchange, the Deutsche Börse, the Hong Kong Stock Exchange, and Euronext. The prestige score for the United States has dropped significantly—by about a quarter—from the highest levels recorded throughout the 1990s. Its lead over other financial centers remains relatively wide, however, remaining almost three times higher than that of the second-ranked location in 2006, the London Stock Exchange.

Three main factors contribute to the ability of the U.S. exchanges to maintain the highest ranking in global equity activity: The first one is size related. The main driver of the massive volume of IPO activity generated by U.S. companies is certainly the size of the U.S. economy. There may be various reasons why most continue to choose to issue IPOs domestically (for example, the home bias hypothesis), but the end result is that they continue to do so when instead they could migrate abroad. Hence, the sheer size of equity activity continues to make U.S. capital markets very liquid and thus contributes to making U.S. exchanges very attractive to foreign companies. The second factor is that U.S. exchanges are the choice of destination for companies from most locations. According to the microdata, in 2006 U.S. exchanges were the destination of choice for companies from thirty-three out of the forty-five locations, with the most of the

[11] AIM was first launched in 1995 as a market for primarily smaller, venture-capital–backed businesses from all over the world. Since its inception, over 2,100 companies have opted to list on AIM, raising about $2.2 billion in new capital. AIM-listed firms are attracted to the simplified regulatory environment that is specifically designed for the needs of smaller companies that would typically find it more difficult to list on other, more established international stock exchanges.

remaining twelve being very minor to begin with. The third factor is that they are the destination of choice for many companies originally from very prestigious locations. In fact, in 2006, more than 83 percent of total IPO activity on U.S. exchanges was generated by companies from the top five most prestigious locations, while only 72 percent of London volumes came from the same cluster of locations and 45 percent for the Deutsche Börse.

It is also interesting to compare the prestige index with both the raw aggregates of table 1 and the in-degree index of table 2. The comparison suggests, for example, that while the U.S. markets were losing some foreign IPO inflows in more recent years—as shown in table 2—the decline in inflows stems from companies from less prestigious home markets. Similarly, the significant increase in inflows recorded by locations such as Germany, Hong Kong, the United Kingdom, and Euronext, among others, does not appear to translate necessarily into higher-ranked prestige. The upward trends noted in the raw volumes and foreign inflows for non-U.S. exchanges are much less pronounced, if present at all, in the prestige scores. Again, the implication is that the gains in IPO activity for non-U.S. exchanges are coming from lesser locations.

Network-based algorithms for assessing the relative importance of international financial centers have produced information not otherwise available from standard raw aggregate volumes. It is certainly the case that if we focus just on anonymous volumes of foreign IPO "traffic," we confirm the common sentiment among market participants that U.S. exchanges have been losing centrality. A closer look at the network characteristics of cross-border flows, however, reveals important qualifications. U.S. exchanges continue to be the unique location of destination for a very large share of global IPO volumes. And more important, most companies from top-ranking locations continue to choose U.S. exchanges for raising capital.

5.2 Analyzing the competitiveness of secondary markets

Primary market issuance is a very important indicator of the maturity and growth of a stock market. In addition to the ability to support a strong flow of companies raising capital, a successful exchange needs to provide a liquid trading platform for its listed companies. An important dimension of a cross-listing is that it creates an additional layer

of trading. Investors in cross-border firms can continue to trade in the domestic market, but if it is less costly, they also have the opportunity to shift some of their trading activities abroad. The net effect on trading is ambiguous, however, because an international listing may also attract the interest of new investors, which may spillover in both the domestic and the foreign market trading.

Halling, Pagano, Randl, and Zechner (2008) examine more closely these spillovers by analyzing trading volume flows for U.S. cross-listed companies headquartered in developed home markets. They document a significant rise in their aftermarket domestic trading volume, concluding that cross-listings are useful in developing an active market not only abroad but also domestically. The reputational boost gained from complying with the more rigorous U.S. corporate governance rules and regulations allow them to expand by mergers and acquisitions. The authors find, however, that companies from less-developed countries attain most of the aftermarket benefits from greater foreign market liquidity. Moreover, their analysis shows that cross-listing is detrimental to domestic market activity for firms with poor investor protection in their home markets as trading activity appears to migrate to the host market. Focusing on Mexican ADRs, Domowitz, Glenn and Madhavan (2001) furthermore highlight the possibility that trading liquidity may deteriorate in both the domestic and the foreign host markets if there are poor information links between these two locations.

Capital-raising events, such as cross-listing public offerings, may not fully gauge the extent of market dominance. For example, in the 1990s the London Stock Exchange decided to list on its SEAQ International platform several large European public firms without their consent (Benos and Crouhy 1996). This move was very successful as London was able to capture a significant share of the secondary trading volume of these blue-chip French and German companies, forcing many of the continental European markets to reform and upgrade their trading systems to compete. Furthermore, as noted previously, a key indicator of the success of a stock market is not just its capacity to attract new issues but also its ability to grow and prosper from these domestic and foreign listings. If these company listings are ornamental in nature, attracting very little aftermarket trading interest, they are very poor revenue generators and fail to contribute

to the growth of the stock market. The analysis of the value flows of secondary market trading allows us to evaluate the long-term benefits of these listings.

The picture of global dominance, measured by secondary trading volumes instead of IPO activity, shows that U.S. stock exchanges maintain a clear, unambiguous lead throughout this time period. In raw volumes of aggregate trading (table 6 and figures 6A-B), the major U.S. stock exchanges together enjoy a significant lead over their closest rivals, such as the London Stock Exchange and the Japanese market, with Euronext and Hong Kong following in a close third tier. In fact, the volume of trading on U.S. exchanges has been rising steadily over time.

The in-degree index, reflecting the trading value flows of cross-listed companies, shows the same picture as that depicted by the raw volumes of IPOs (see table 7 and figures 7A-B). The London Stock Exchange is a distant second, while Japan and Hong Kong fall off significantly in the ranking hierarchy. South Africa, Germany, Italy, and the OMX (Nordic Exchange) appear to have relatively larger foreign inflows than those of other locations. Interestingly, as shown in the table, Switzerland played a leading role in generating interest in trading in its foreign listings in the mid-1990s. This dominant role rapidly declined in the following years. The surprising position of the Swiss stock market and other smaller, peripheral exchanges such as Singapore and South Africa indicates that these exchanges are well developed and very liquid but that their short-lived advancement in the rankings was driven by a significant inflow of foreign listings that were heavily traded only briefly.

Looking at the betweenness index, we find that U.S. exchanges have attracted a fairly unchanged high share of listings that would not be listed anywhere else (see table 8 and figure 8A-B). The Deutsche Börse made a significant leap in the rankings at the end of the previous decade, and it has maintained a clear second-slot position, followed closely by the London Stock Exchange.

The prestige index confirms that U.S. exchanges are the exclusive dominant location, with Japan, the United Kingdom, Euronext, and Hong Kong at comparable levels forming a second tier of locations (table 9). Interestingly, the index assigns a very low ranking to the German exchanges, despite their high volumes of cross-listed firms and their high degree of uniqueness. This low prestige score based on secondary market

trading highlights the fact that many of the companies listing in Germany were from lesser locations of origins or were unsponsored, meaning that they ended up trading in the illiquid unofficial segment of the market.

Analysis of raw IPO volumes, and even of the IPO in-degree index, provides evidence consistent with many stories in the financial press pointing out that the London Stock Exchange and Hong Kong Stock Exchange have surpassed the NYSE and NASDAQ as the world's preferred host destination. Along with its parallel market AIM, which is geared toward smaller firm listings, the London Stock Exchange was considered an example of a model stock exchange, offering issuers less costly terms of listing as well as easier and less onerous disclosure requirements. Nonetheless, while London has lured hundreds of new companies in the past few years, its share of global trading has remained fairly flat because many of these shares are very illiquid and contribute little to trading volume. In a recent paper, Doidge, Karolyi, and Stulz (2009) argue that there is no deficit in U.S. cross-listing vis-à-vis London. While cross-border listings in the United States continue to enjoy a significant valuation premium, they find no such a premium for foreign firms listed on London's Main Market for any year.

Pagano, Roell, and Zechner (2002) find that, in comparison to European companies listing on European exchanges, foreign firms that list in the United States are typically more high-tech in nature, have higher growth rates, and are more export oriented. Thus, in addition to offering a superior trading platform for foreign stocks, their evidence suggests that firms cross-listing in the United States are more likely to grow and attract greater investor interest going forward. A stock market's ability to attract a large number of cross-border listings indiscriminately is not necessarily the most effective criterion for gauging its international prominence. Instead, as our analysis reveals, it may be more important for stock markets to draw in sound, dynamic companies with the capacity for growth.

6. Determinants of Cross-Market Flows

Using network analysis, we have been able to draw a complete map of global equity activity, determining the relative prominence of financial centers across the globe and the variation of their importance over time. Analyzing the network characteristics of cross-

border equity flows significantly refines the basic information contained in simple aggregate cross-flows that have been extensively used in the financial press to rank the relative strength of large financial centers. In our discussion above, we informally argue that several underlying exchange-specific factors help explain movements in these network-based indexes, and in section 2 we specified that network analysis recognizes the mutual dependence of network characteristics and attributional data. Hence, consistent with the extensive literature analyzing the incentives to cross-list, we expect to find a correlation between these sophisticated measures of cross-border equity flows and basic location-specific variables. To examine this premise more formally, we ran panel regressions to estimate the relationship between the network analysis scores and country-level macroeconomic conditions, financial infrastructure, and institutional and legal governance. For brevity, our regression analysis focuses solely on the prestige index because it is the most complete of our network-based measures and more comprehensively captures all the possible dimensions in these cross-border flows.

The cross-listing literature offers an array of theories that can be used to explain changes in the competitive hierarchy of international stock exchanges. The reasons behind the proliferation of international listings over the past several decades are summarized in a number of survey articles (see Benos and Weisbach 2004; Karolyi 1998, 2006; and Pagano, Roell, and Zechner 2002). Most studies examine the incentives and cost-benefit calculus of cross-listing in a foreign stock market, focusing on incentives to reduce informational asymmetries and raise visibility and on ways to lower the cost of capital, improve liquidity, and enhance firm value. Some of the research also focuses on the importance of international trade, cultural similarities, and geographic proximity.

A key strand in this literature falls under the banner of the bonding hypothesis, which asserts that international listings are more beneficial for firms from countries with weak institutional environments. In a nutshell, the main thesis behind these bonding arguments is that cross-listings strengthen outside investor protection because firms have to raise capital in a market with more rigorous laws and regulations. Specifically, Coffee (1999) and Stulz (1999) argue that by listing on a stock exchange with stricter corporate governance rules, a firm is able to reduce informational asymmetries, improve its credibility, and certify to investors its commitment to safeguarding the interests of

shareholders. A differing viewpoint is that burdensome governance rules, such as the recently enacted Sarbanes-Oxley Act (SOX), may actually discourage cross-listing. A number of recent studies attribute the drop off in foreign listings on U.S. stock exchanges to the passage of the SOX (see, for example, Berger, Li, and Wong 2005; Bianconi and Chen 2009).[12]

The panel regression model is estimated for all country-level stock markets over the period 1995–2006. The specification includes a number of basic explanatory variables to ascertain the impact of macroeconomic and governance conditions. In theory, a panel regression model could also control for fixed effects at the country level and time-series variation. Given that the sample spans only eleven years and forty locations,[13] it is not plausible to include fixed-effects and time variation controls because they inherently explain away most of the macroeconomic and market-level factors.

The regression model controls for real gross domestic product (GDP) per capita as a proxy of a country's economic growth (REAL_GDP). The logarithm of the consumer price index (CPI) measures a country's inflationary pressures. Stock markets operating in a higher economic growth environment, with a more stable inflationary outlook, would be a magnet for foreign firms seeking to raise capital. The regression model controls for the size of the stock market by including the logarithm of market capitalization (MARKET_CAP). Presumably, larger and more developed capital markets are governed by sounder corporate principles. To evaluate the importance of international economic integration, the model includes the Penn Table index of trade openness (OPENNESS), measured by the sum of exports and imports divided by real GDP.

To evaluate the significance of institutional governance factors even further, we control for the strength of the financial and legal regulatory framework and corporate governance. The model includes the composite Heritage World Freedom index

[12] The SOX Act has imposed additional costs on public companies needing to improve internal control and governance processes in their organizations. Section 404 of SOX appears to be the most demanding on firms because it stipulates that the company must file a statement showing that management has maintained adequate internal controls and sound procedures for financial reporting. Furthermore, company management and auditors must certify the effectiveness of the internal control structure and procedures for financial reporting.

[13] Given that our IPO data covers forty-five locations while our trading data only forty, for consistency we run the regressions for the common subset of forty locations. Running the regressions for the IPO-based prestige using all forty-five locations would not change the quality of the results.

(FREEDOM_SCORE) that rates countries across several dimensions (regulation, trade, fiscal, government, monetary, investment, financial, property rights, and corruption). In addition to this wide-ranging measure, we also explore the importance of individual components such as government spending index (GOVERNMENT_SCORE) and freedom of capital flows (INVESMENT_SCORE).[14]

Table 10 reports the regression findings that analyze the factors influencing cross-market IPO flows. The sample size for the reported specifications varies because information is not fully available for the various explanatory variables across all countries. Other things equal, the regression results reveal a strong relationship between the ability of the country to attract IPO listings and market capitalization. Market capitalization is a fairly good proxy of financial strength and capital market development. The regression coefficient of real GDP per capita is positive and statistically significant, indicating that countries with stronger economic growth are better able to attract IPO listings. Weak macroeconomic conditions promote capital flight and increase incentives by home investors and firms to look abroad. One notable finding of the network analysis is that some foreign equity issuers are largely shifting back to their home markets. This rising home bias does not necessarily mean that the U.S. stock markets are less appealing. Rather, as suggested by a significant real GDP per capita, this move is a sign that fast-growing countries have the capital depth to compete with their larger, more established rivals.

According to the bonding hypothesis, public markets with strong institutional environments and robust governance rules are better positioned to attract foreign companies because they make it possible for these firms to certify their quality. Capital markets with stronger corporate governance requirements provide a more transparent financial setting for global investors and are therefore a more attractive place for internationally active firms to raise capital. The importance of financial integration is further underscored by the significance of the trade openness score. The positive and significant coefficient of GOVT_SCORE, an indicator of fiscal discipline, supports the

[14] The specification also investigated the importance of other individual components of the Freedom Index. For example, we controlled for regulation and fiscal discipline. In general, these variables are found to be less significant, but their overall impact was consistent with the aggregate index.

bonding hypothesis premise. In general, however, the various Heritage Foundation indexes are not always statistically significant.

While our regression analysis investigating IPO cross-listing flows provides some limited support for the bonding hypothesis, we find that these financial and legal governance infrastructure factors are more closely related to flows of cross-market trading values that measure the effectiveness of stock markets in providing a more liquid environment. As shown in the table, the FREEDOM_SCORE and all other individual components are positive and statistically significant. These findings suggest that post-IPO stock-trading flows are higher in markets with strong fundamentals.

Overall, our regression analysis reveals that larger equity markets operating in countries or regions with higher economic growth and stronger economic fundamentals are better able to attract foreign listings and retain their own domestic issuing companies. Corporate issuers also tend to flock to equity markets operating in economic regions with open trade policies and stronger commitment to internationalization.

6. Conclusions

We have used social network analysis methodologies to construct indexes of market dominance in global equity activity for up to forty-five separate locations from 1990 to 2006. Our main argument is that aggregate cross-border equity flows—customarily used to assess market dominance—are informative only in limited circumstances, when most of such flows are directed to just one or two locations. As soon as global market activity expands and the number of financial centers able to offer the services needed to attract equity activity increases, it becomes necessary, we argue, to pay attention to the growing complexity of the network of flows in and out of each location.

The rising globalization trends witnessed over the past two decades justify this approach. Significant political events in many parts of the world and strong economic growth among developed and emerging-market economies have led to deeper pools of capital and to more liquid and sophisticated financial markets adhering to better corporate governance principles.

To the best of our knowledge, ours is the first attempt to obtain indexes of equity market dominance. Moreover, we do not focus on just a handful of the largest markets,

but instead we analyze the broadest possible number of international stock markets that represent nearly the universe of domestic and cross-border listings. We have constructed separate indexes based on IPO activity and on secondary market trading. The level of primary market issuance conveys information on the maturity and growth of a stock market. At the same time, the analysis of the volumes of trading generated by such cross-listing firms indicates the ability to attract IPO companies that are more dynamic and internationally active and that therefore have a higher capacity for growth.

Analysis of aggregate global IPO inflows alone, captured by raw volumes and in-degree measures, reveals that U.S. exchanges held a clear position of dominance throughout the 1990s. Our findings also confirm the view advocated by some financial commentators and academics that U.S. markets are losing some of their luster as the preferred destination of foreign companies, documenting the expanding role of several large competing financial centers, such the London Stock Exchange, the Deutsche Börse, and the Hong Kong Stock Exchange. A more careful examination of the network characteristics of cross-border flows, measured by our betweenness and prestige indexes, however, paints a more favorable picture for U.S. stock exchanges: they managed to maintain a more clear-cut lead in global equity activity throughout the entire sample period. U.S. exchanges are still the unique destination for a considerable share of global equity activity and continue to attract companies from other prestigious locations.

We also identify important ranking dynamics across a number of other financial centers, both well-established and emerging ones. London, Germany, and Hong Kong continue to enjoy high prestige, but other locations—Australia, Singapore, and Taiwan, for example, have made significant improvements in the ranking. Hence, while the analysis documents that U.S. stock exchanges have so far kept a leading position in primary equity activity, competition from these new and up-and-coming financial centers is rising. The greater propensity of foreign companies to issue domestically does not necessarily mean that U.S. stock markets are becoming less attractive in an absolute sense; instead, this trend may indicate that capital markets in developed countries have simply caught up with their U.S. counterparts.

Although cross-border IPO listings in the United States have dropped off more recently, this decline does not appear to have adversely affected in any way the

dominating position enjoyed by U.S. stock markets in global secondary equity trading activity. We find no evidence that secondary stock markets in the United States have lost any significant volume of business to competing locations, such as the London Stock Exchange, Euronext, or the Deutsche Börse. Not only do U.S. exchanges control the largest share of global trading overall, but that trend is increasing over time. Our network indexes of uniqueness and prestige reveal that U.S. exchanges have maintained a strong lead over all other competing international markets.

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Chart 1. Hypothetical matrix of global equity activity

Locations of origin	Locations of destination									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	$\mathbf{X_{11}}$	$\mathbf{X_{12}}$	0	0	0	0	0	0	0	0
2	$\mathbf{X_{21}}$	$\mathbf{X_{22}}$	0	0	0	0	0	0	0	0
3	$\mathbf{X_{31}}$	$\mathbf{X_{32}}$	0	0	0	0	0	0	0	0
4	$\mathbf{X_{41}}$	0	0	0	0	0	0	0	0	0
5	$\mathbf{X_{51}}$	0	0	0	0	0	0	0	0	0
6	0	$\mathbf{X_{62}}$	0	0	0	0	0	$\mathbf{X_{68}}$	0	0
7	0	$\mathbf{X_{72}}$	0	0	0	0	0	$\mathbf{X_{78}}$	0	0
8	0	0	0	$\mathbf{X_{84}}$	0	0	0	0	0	0
9	0	0	0	$\mathbf{X_{94}}$	0	0	0	0	0	0
10	0	0	0	$\mathbf{X_{94}}$	0	0	0	0	0	0
	$\mathbf{X_1}$	$\mathbf{X_2}$	$\mathbf{X_3}$	$\mathbf{X_4}$	$\mathbf{X_5}$	$\mathbf{X_6}$	$\mathbf{X_7}$	$\mathbf{X_8}$	$\mathbf{X_9}$	$\mathbf{X_{10}}$

Table 1. Aggregate IPO activity by country of issuance
(Volume of proceeds measured in $ millions)

1990-1995		1996-2000		2001-2006	
United States	180,221	United States	360,623	United States	230,232
United Kingdom	54,988	Germany	111,735	United Kingdom	89,611
Japan	54,173	United Kingdom	87,913	Germany	75,474
Euronext	31,098	Japan	63,149	Hong Kong	61,188
Germany	26,412	Euronext	49,851	Japan	57,028
China	15,112	China	42,691	Euronext	51,663
Australia	13,300	Italy	28,904	China	45,132
Mexico	13,289	Australia	28,244	Canada	45,088
Canada	11,368	Canada	24,078	Australia	29,186
Italy	10,481	Nordic Exchanges	20,955	South Korea	22,702
Nordic Exchanges	9,778	South Korea	17,037	Italy	16,497
Hong Kong	9,649	Hong Kong	16,759	Singapore	14,103
India	7,004	Switzerland	13,757	Russia	12,588
South Korea	6,561	Taiwan	11,317	Middle East	12,430
Thailand	6,268	Spain	8,525	India	10,445
Taiwan	6,250	Greece	5,071	Brazil	9,924
Indonesia	5,831	Singapore	4,800	Switzerland	7,543
Singapore	5,314	Malaysia	4,750	Spain	7,499
Malaysia	4,801	India	4,631	Thailand	7,005
Switzerland	3,531	Indonesia	4,528	Taiwan	6,803
Philippines	2,658	Turkey	3,389	Norway	6,182
Argentina	2,576	Formerly Eastern Bloc	3,087	Malaysia	5,877
New Zealand	1,361	Ireland	2,863	Poland	4,794
Pakistan	1,325	Poland	2,690	Nordic Exchanges	4,284
Norway	1,302	Norway	2,296	Austria	3,719
Spain	1,071	Philippines	1,993	Formerly Eastern Bloc	3,346
Middle East	742	Thailand	1,904	New Zealand	3,005
Turkey	574	Austria	1,661	Turkey	2,380
Chile	517	Hungary	1,288	Greece	1,762
Poland	506	Argentina	953	Mexico	1,377
Hungary	383	Mexico	883	Ireland	1,042
Austria	325	South Africa	708	Philippines	911
Israel	314	Brazil	650	Indonesia	833
Brazil	281	New Zealand	493	Egypt	624
Egypt	263	Egypt	470	Chile	599
Ireland	205	Middle East	431	South Africa	494
South Africa	160	Chile	353	PK	260
Other Africa	144	Pakistan	307	AF	212
Venezuela/Colombia	111	Africa Other	302	Argentina	169
Greace	39	Venezuela/Colombia	252	SL	116
Peru/Ecuador	37	Peru/Ecuador	226	Israel	81
Formerly Eastern Bloc	31	Israel	185	Bangladesh	0
Sri Lanka	24	Russia	128	Hungary	0
Bangladesh	2	Bangladesh	16	Peru	0
Russia	0	Sri Lanka	15	Venezuela/Colombia	0

Notes: The figures measure the total volume of IPO issues by country location. The values represent the aggregate volume issued during each specified period. Source: Thomson Financial Securities Data Corporation and Bloomberg.

Table 2. Country rankings based on the in-degree index of IPO activity

1995		2000		2006	
United States	58,762	United States	126,165	Germany	58,585
Germany	17,841	Germany	70,689	Hong Kong	51,141
United Kingdom	10,324	United Kingdom	28,575	United States	45,062
Hong Kong	3,948	Euronext	6,769	United Kingdom	28,025
Japan	3,375	Hong Kong	6,628	Euronext	11,011
Switzerland	2,554	Formerly Eastern Bloc	3,002	Singapore	8,038
Euronext	1,621	Switzerland	2,748	Formerly Eastern Bloc	3,087
Canada	915	Australia	2,493	Taiwan	1,787
India	614	Nordic Countries	1,393	New Zealand	1,599
Nordic Countries	554	Italy	1,266	Japan	1,351
Mexico	349	Canada	1,241	Australia	1,350
Australia	336	Singapore	939	Canada	1,318
China	253	Spain	518	India	702
Spain	176	India	513	Nordic Exchanges	300
Singapore	166	Japan	337	Poland	240
South Africa	160	South Korea	236	Switzerland	181
South Korea	156	New Zealand	149	Argentina	114
Norway	155	Indonesia	128	Australia	98
Philippines	91	China	116	China	82
Brazil	82	Malaysia	108	Russia	55
Thailand	57	Egypt	100	Austria	36
Israel	55	Brazil	82	South Korea	31
Egypt	50	Thailand	71	Thailand	21
Malaysia	45	Taiwan	62	Norway	3
New Zealand	37	Norway	54	Israel	3
Italy	37	Hungary	42	Ireland	0
Formerly Eastern Bloc	31	Poland	19	Africa	0
Indonesia	20	Greece	8	Bangladesh	0
Chile	6	Austria	1	Brazil	0
Pakistan	2	Argentina	0	Chile	0
Austria	2	Russia	0	Egypt	0
Taiwan	0	Israel	0	Greece	0
Poland	0	Ireland	0	Hungary	0
Argentina	0	Africa	0	Indonesia	0
Russia	0	Bangladesh	0	Italy	0
Ireland	0	Chile	0	Middle East	0
Africa	0	Middle East	0	Mexico	0
Bangladesh	0	Mexico	0	Peru	0
Greece	0	Peru-Ecuador	0	Philippines	0
Hungary	0	Philippines	0	Pakistan	0
Middle East	0	Pakistan	0	South Africa	0
Peru-Ecuador	0	South Africa	0	Sri Lanka	0
Sri Lanka	0	Sri Lanka	0	Spain	0
Turkey	0	Turkey	0	Turkey	0
Venezuela/Colombia	0	Venezuela/Colombia	0	Venezuela/Colombia	0

Notes: The in-degree index measures the aggregate volumes of foreign IPOs taking place in each location (aggregate volumes minus domestic volumes). Sources: Thomson Financial Securities Data Corporation and Bloomberg.

Table 3. Country rankings based on the out-degree index of IPO activity

1995		2000		2006	
United States	12981.9	Euronext	40633.1	China	78462.5
United Kingdom	12533.3	Germany	29785.8	Euronext	21323.0
Euronext	11172.2	United States	25576.3	United States	12435.3
Indonesia	10867.3	Hong Kong	18576.5	Hong Kong	11365.3
Mexico	7389.1	China	17415.1	Russia	8844.4
Italy	6790.1	United Kingdom	16332.5	United Kingdom	7283.8
China	5989.9	Australia	11809.1	Switzerland	6809.8
Nordic Exchange	5164.9	Switzerland	10927.1	South Korea	6422.5
Argentina	3819.2	Canada	10022.2	Australia	5547.1
Canada	3264.2	Italy	9671.4	Japan	5203.6
Hong Kong	2340.5	Nordic Exchange	8201.7	Italy	4095.3
Germany	2267.3	South Korea	4579.4	Nordic Exchange	3282.3
Chile	1848.5	Spain	4487.9	Canada	3227.0
Thailand	1484.6	Norway	3973.6	Norway	3136.2
Austria	1484.6	Israel	3755.7	Brazil	3116.3
South Korea	1446.3	Indonesia	3662.3	Middle East	3111.8
Spain	1353.5	Taiwan	3396.3	India	2832.7
Norway	1137.4	Ireland	3162.8	Thailand	2776.9
Japan	1079.3	Singapore	2415.0	Spain	2687.1
Philippines	916.1	Brazil	2119.3	Germany	2341.1
Australia	872.2	Austria	2021.9	Ireland	2115.5
Israel	768.3	Japan	1738.8	Greece	2104.3
Singapore	751.2	New Zealand	1724.4	Taiwan	1867.7
Malaysia	651.7	Chile	1657.4	Singapore	1756.7
New Zealand	650.2	South Africa	1585.3	Austria	1613.6
Brazil	644.2	Argentina	1540.8	Israel	1248.1
Switzerland	446.6	Greece	1533.5	Mexico	1135.2
Ireland	436.6	India	1487.7	Indonesia	1109.4
Africa Other	383.6	Peru/Ecuador	1361.7	South Africa	1049.8
Middle East	363.8	Mexico	1335.8	Africa Other	937.2
India	353.3	Venezuela/Colombia	1179.4	Formerly Eastern Bloc	891.7
Venezuela/Colombia	263.6	Russia	1146.2	Argentina	731.0
Greece	165.8	Philippines	976.5	Turkey	576.9
Turkey	140.3	Hungary	957.4	Peru/Ecuador	514.1
Hungary	140.3	Thailand	790.6	Egypt	483.9
Peru/Ecuador	114.9	Turkey	668.2	Philippines	431.4
Russia	97.6	Poland	658.3	Venezuela/Colombia	315.1
Taiwan	92.8	Malaysia	568.8	Hungary	292.8
Poland	56.4	Egypt	350.5	New Zealand	274.6
Sri Lanka	41.8	Africa Other	319.2	Malaysia	270.0
Bangladesh	5.3	Formerly Eastern Bloc	205.2	Chile	83.0
Pakistan	2.1	Middle East	136.7	Poland	58.9
South Africa	0.0	Sri Lanka	0.0	Sri Lanka	34.2
Formerly Eastern Bloc	0.0	Bangladesh	0.0	Bangladesh	21.2
Egypt	0.0	Pakistan	0.0	Pakistan	0.0

Notes: The out-degree index of a location measures the aggregate volume of IPOs by companies headquartered in the same location but choosing foreign locations. Sources: Thomson Financial Securities Data Corporation and Bloomberg.

Table 4. Country rankings based on the betweenness index of IPO activity

1995		2000		2006	
United States	41.22	United States	42.35	United States	36.89
United Kingdom	24.19	United Kingdom	16.30	United Kingdom	29.26
Germany	18.03	Germany	13.72	Germany	17.56
Euronext	9.21	Euronext	8.62	Euronext	7.96
Thailand	7.33	Australia	2.47	Singapore	6.32
India	4.43	Singapore	1.10	India	4.55
Bangladesh	2.27	India	0.90	Australia	4.35
Pakistan	1.52	Hong Kong	0.89	China	2.37
Mexico	1.50	Indonesia	0.68	Formerly Eastern Bloc	2.28
Chile	1.34	Spain	0.67	Mexico	0.44
Nordic Exchange	0.94	South Korea	0.61	Switzerland	0.37
Australia	0.94	Chile	0.59	Argentina	0.31
Hong Kong	0.93	Nordic Exchange	0.52	South Korea	0.24
Switzerland	0.72	Canada	0.30	Hong Kong	0.23
China	0.67	Taiwan	0.29	Nordic Exchanges	0.17
Singapore	0.42	China	0.19	Japan	0.13
Japan	0.37	Italy	0.17	Ireland	0.10
Austria	0.29	Norway	0.13	Norway	0.10
South Korea	0.22	Thailand	0.08	Canada	0.10
Philippines	0.21	Switzerland	0.08	Thailand	0.10
New Zealand	0.18	Malaysia	0.08	Poland	0.05
Spain	0.18	Argentina	0.08	Russia	0.05
Indonesia	0.16	Philippines	0.04	Taiwan	0.05
Malaysia	0.13	Poland	0.04	Austria	0.03
Brazil	0.12	Japan	0.03	Italy	0.03
Norway	0.07	New Zealand	0.03	New Zealand	0.02
Taiwan	0.05	Brazil	0.02	Philippines	0.02
Canada	0.04	Israel	0.01	Malaysia	0.01
Argentina	0.02	Ireland	0.01	Spain	0.01
Sri Lanka	0.02	Formerly Eastern Bloc	0.00	ME	0.01
Italy	0.01	South Africa	0.00	Indonesia	0.01
Hungary	0.00	Greece	0.00	Israel	0.01
Middle East	0.00	Russia	0.00	Greece	0.01
Israel	0.00	Turkey	0.00	Turkey	0.01
Ireland	0.00	Egypt	0.00	South Africa	0.00
Greece	0.00	Africa other	0.00	Venezuela/Colombia	0.00
Venezuela/Colombia	0.00	Mexico	0.00	Africa	0.00
Russia	0.00	Middle East	0.00	Bangladesh	0.00
Africa Other	0.00	Austria	0.00	Brazil	0.00
Turkey	0.00	Hungary	0.00	Chile	0.00
Formerly Eastern Bloc	0.00	Peru/Ecuador	0.00	Egypt	0.00
Egypt	0.00	Bangladesh	0.00	Hungary	0.00
Peru/Ecuador	0.00	Pakistan	0.00	Peru/Ecuador	0.00
Poland	0.00	Sri Lanka	0.00	Pakistan	0.00
South Africa	0.00	Venezuela/Colombia	0.00	Sri Lanka	0.00

Notes: The betweenness index captures the degree to which a financial center is the exclusive location of destination. Values are normalized, so that the figures measure the percentage of total pair-wise flows that go exclusively to a location. Sources: Thomson Financial Securities Data Corporation and Bloomberg.

Table 5. Country rankings based on the prestige index of IPO activity

1995		2000		2006	
Country	Prestige	Country	Prestige	Country	Prestige
United States	0.211	United States	0.222	United States	0.152
Japan	0.059	Germany	0.064	United Kingdom	0.055
United Kingdom	0.059	United Kingdom	0.049	Germany	0.046
Euronext	0.033	Japan	0.035	Hong Kong	0.037
Germany	0.029	Euronext	0.027	Japan	0.035
China	0.016	China	0.023	Euronext	0.032
Australia	0.014	Italy	0.016	China	0.027
Mexico	0.014	Australia	0.015	Canada	0.027
Canada	0.012	Canada	0.013	Australia	0.017
Italy	0.011	Nordic Exchanges	0.011	South Korea	0.013
Hong Kong	0.01	Hong Kong	0.009	Italy	0.01
Nordic Exchanges	0.01	South Korea	0.009	Singapore	0.008
India	0.007	Switzerland	0.008	Russia	0.007
South Korea	0.007	Taiwan	0.006	Middle Eastern	0.007
Indonesia	0.006	Spain	0.005	Brazil	0.006
Thailand	0.006	Greece	0.003	India	0.006
Taiwan	0.006	Singapore	0.003	Switzerland	0.004
Malaysia	0.005	Malaysia	0.003	Norway	0.004
Singapore	0.005	Indonesia	0.002	Spain	0.004
Switzerland	0.004	India	0.002	Thailand	0.004
Argentina	0.003	Ireland	0.002	Taiwan	0.004
Philippines	0.003	Turkey	0.002	Austria	0.003
Chile	0.001	Formerly Eastern Bloc	0.002	Nordic Exchanges	0.003
Middle East	0.001	Norway	0.001	Poland	0.003
Norway	0.001	Austria	0.001	Austria	0.002
New Zealand	0.001	Philippines	0.001	Formerly Eastern Bloc	0.002
Pakistan	0.001	Poland	0.001	New Zealand	0.002
Poland	0.001	AR	0.001	Greece	0.001
Spain	0.001	Hungary	0.001	Ireland	0.001
Turkey	0.001	Thailand	0.001	Mexico	0.001
Other Africa	0	Brazil	0	Turkey	0.001
Austria	0	Israel	0	Philippines	0.001
Bangladesh	0	Chile	0	Africa Other	0
Brazil	0	Mexico	0	Argentina	0
Formerly Eastern Bloc	0	New Zealand	0	Egypt	0
Egypt	0	Peru/Ecuador	0	Indonesia	0
Greece	0	Russia	0	Israel	0
Hungary	0	South Africa	0	South Africa	0
Ireland	0	Venezuela/Colombia	0	Bangladesh	0
Israel	0	Africa other	0	Chile	0
Peru/Ecuador	0	Bangladesh	0	Hungary	0
Russia	0	Egypt	0	Peru/Ecuador	0
South Africa	0	Middle East	0	Pakistan	0
Sri Lanka	0	Pakistant	0	Sri Lanka	0
Venezuela/Colombia	0	Sri Lanka	0	Venezuela/Colombia	0

Notes: The prestige index for location *i* is obtained as a weighted average of the prestige index of all locations in the matrix, where the weights are represented by the total volumes from each location directed toward location *i.* Sources: Thomson Financial Securities Data Corporation and Bloomberg.

Table 6. Aggregate volume of traded value flows
(Traded value measured in $ billions)

1995		2000		2006	
United States	6514.4	United States	36020.8	United States	43364.9
United Kingdom	1460.8	Euronext	2846.4	Japan	6051.1
Japan	1023.8	United Kingdom	2779.2	United Kingdom	5809.2
Switzerland	526.0	Japan	2323.9	Euronext	3130.4
Taiwan	365.7	Hong Kong/China	1518.3	Hong Kong/China	3011.4
Mexico	249.0	Korea	1383.2	Korea	1579.2
Germany	234.9	Taiwan	1041.0	Italy	1513.6
Hong Kong/China	194.9	Italy	830.3	Canada	1353.9
Korea	188.5	Nordic Exchanges	730.7	Nordic Exchanges	1250.6
South Africa	184.4	Canada	703.6	Spain	1037.6
Canada	170.4	Germany	635.5	Australia	951.8
Thailand	156.3	Spain	446.0	Taiwan	919.2
Norway	143.4	India	433.1	Mexico	879.5
Australia	125.9	Australia	254.8	Germany	643.7
Nordic Exchanges	112.3	Turkey	198.7	India	511.2
Hungary	96.9	Singapore	114.5	Norway	430.0
Malaysia	84.6	Brazil	103.9	Denmark	371.3
Singapore	69.9	Switzerland	97.8	South Africa	326.6
Turkey	51.5	Norway	93.9	Turkey	257.6
Brazil	46.2	Greece	93.7	Brazil	248.4
Euronext	39.4	South Africa	88.7	Singapore	215.1
Philippines	21.1	Denmark	75.4	Israel	160.4
Denmark	19.4	Malaysia	57.7	Ireland	153.7
Indonesia	15.5	Mexico	51.9	Switzerland	124.9
Chile	15.0	Israel	28.1	Greece	106.4
Peru	14.8	Austria	25.6	Austria	96.4
Italy	13.3	Chile	19.1	Malaysia	71.3
Sri Lanka	11.7	Peru	18.0	Poland	61.6
India	11.3	Ireland	16.9	Egypt	45.3
New Zealand	7.7	New Zealand	14.2	Indonesia	44.5
Argentina	6.2	Indonesia	12.9	Peru	38.2
Austria	2.4	Hungary	12.8	Hungary	36.2
Poland	1.4	Egypt	10.8	Chile	36.1
Spain	1.1	Thailand	9.3	New Zealand	25.2
Greece	0.8	Poland	7.6	Philippines	12.8
Israel	0.3	Argentina	7.4	Thailand	9.9
Egypt	0.1	Philippines	7.2	Luxembourg	4.5
Luxembourg	0.1	Sri Lanka	3.4	Argentina	3.3
Ireland	NA	Luxembourg	1.6	Sri Lanka	1.2
Russia	NA	Russia	0.3	Russia	0.2

Notes: The figures measure the aggregate value of trading activity by country location in a year. Sources: Thomson Financial Securities Data Corporation, Datastream and Bloomberg.

Table 7. Country rankings based on the in-degree index of traded value flows

1995		2000		2006	
Switzerland	379.4	United States	1912.3	United States	2629.9
United Kingdom	357.2	Germany	121.0	United Kingdom	233.9
United States	335.3	Euronext	70.8	South Africa	86.4
Singapore	20.8	United Kingdom	52.2	Germany	79.9
South Africa	18.7	Nordic Exchanges	37.9	Italy	73.6
Australia	10.6	Australia	30.7	Nordic Exchanges	57.5
Nordic Exchanges	7.9	Switzerland	26.9	Euronext	30.9
Japan	7.9	South Africa	25.4	Australia	27.0
Canada	5.6	Italy	24.5	Norway	19.4
Hong Kong	5.2	Canada	10.9	Spain	14.1
Germany	4.3	Norway	9.6	Switzerland	12.0
Euronext	1.4	Japan	3.2	Canada	9.5
New Zealand	1.2	New Zealand	2.6	Denmark	6.1
Peru	1.0	Singapore	2.3	Singapore	6.0
Malaysia	0.6	Greece	2.1	Austria	3.6
Denmark	0.4	Denmark	1.6	New Zealand	2.4
Norway	0.1	Spain	1.5	Mexico	1.8
Mexico	0.0	Argentina	0.9	Israel	1.7
Philippines	0.0	Ireland	0.8	Hong Kong	1.4
Spain	0.0	Hong Kong	0.6	Poland	1.4
Italy	0.0	Peru	0.5	Japan	1.0
Argentina	0.0	Austria	0.4	Taiwan	0.7
Austria	0.0	Malaysia	0.4	Peru	0.6
Brazil	0.0	Philippines	0.2	Malaysia	0.5
Chile	0.0	Luxembourg	0.1	Ireland	0.4
Egypt	0.0	Brazil	0.0	Argentina	0.3
Greece	0.0	Chile	0.0	Luxembourg	0.3
Hungary	0.0	Egypt	0.0	Philippines	0.0
India	0.0	Hungary	0.0	Brazil	0.0
Indonesia	0.0	India	0.0	Chile	0.0
Israel	0.0	Indonesia	0.0	Egypt	0.0
South Korea	0.0	Israel	0.0	Greece	0.0
Luxembourg	0.0	South Korea	0.0	Hungary	0.0
Poland	0.0	Mexico	0.0	India	0.0
Sri Lanka	0.0	Poland	0.0	Indonesia	0.0
Taiwan	0.0	Russia	0.0	South Korea	0.0
Thailand	0.0	Sri Lanka	0.0	Russia	0.0
Turkey	0.0	Taiwan	0.0	Sri Lanka	0.0
Ireland	NA	Thailand	0.0	Thailand	0.0
Russia	NA	Turkey	0.0	Turkey	0.0

Notes: The in-degree index measures the aggregate trading activity of foreign cross-listed stocks taking place in each location (aggregate trading activity minus domestic trading activity). Sources: Thomson Financial Securities Data Corporation and Bloomberg.

Table 8. Country rankings based on the betweenness index of trading value flows

1995		2000		2006	
United States	33.07	United States	39.239	United States	41.00
United Kingdom	20.57	Germany	25.637	Germany	15.78
Singapore	9.03	Singapore	4.827	United Kingdom	8.62
Hong Kong	3.38	Luxembourg	4.776	Euronext	4.29
Germany	2.18	United Kingdom	4.706	Singapore	4.13
Euronext	1.74	Euronext	4.518	Australia	3.69
Switzerland	1.72	Australia	3.599	Canada	2.92
Nordic Exchanges	1.24	Switzerland	2.432	Japan	2.84
Australia	1.19	Spain	2.367	Spain	1.97
South Africa	0.82	Canada	1.834	Austria	1.96
Japan	0.51	Austria	1.516	Nordic Exchanges	1.89
Norway	0.49	Japan	1.184	Poland	1.78
Denmark	0.44	OMX	0.966	Taiwan	1.54
Malaysia	0.44	Hungary	0.762	Hungary	1.53
New Zealand	0.35	South Africa	0.705	Luxembourg	1.48
Indonesia	0.25	Norway	0.697	Switzerland	1.44
Canada	0.21	Hong Kong	0.345	South Africa	0.94
Philippines	0.19	Denmark	0.342	Brazil	0.77
Luxembourg	0.08	Greece	0.187	Norway	0.64
Spain	0.07	New Zealand	0.15	Italy	0.48
Italy	0.02	Philippines	0.15	Ireland	0.33
Austria	0.01	Brazil	0.149	New Zealand	0.29
Argentina	0.01	India	0.129	Israel	0.23
Chile	0.00	Korea	0.128	Thailand	0.21
India	0.00	Poland	0.126	Hong Kong	0.21
Israel	0.00	Taiwan	0.126	Greece	0.19
Korea	0.00	Malaysia	0.083	Argentina	0.18
Mexico	0.00	Italy	0.077	Korea	0.17
Brazil	0.00	Indonesia	0.064	Indonesia	0.16
Egypt	0.00	Argentina	0.064	Mexico	0.16
Greece	0.00	Ireland	0.055	Chile	0.15
Hungary	0.00	Mexico	0.04	Peru	0.15
Peru	0.00	Peru	0.04	Philippines	0.12
Poland	0.00	Thailand	0.029	India	0.11
Sri Lanka	0.00	Israel	0.012	Malaysia	0.05
Taiwan	0.00	Chile	0.006	Denmark	0.05
Thailand	0.00	Russia	0.006	Russia	0.02
Turkey	0.00	Turkey	0.006	Egypt	0.01
Ireland	NA	Egypt	0	Turkey	0.01
Russia	NA	Sri Lanka	0	Sri Lanka	0.00

Notes: The betweenness index captures the degree to which a financial center is the exclusive location of destination for trading. Values are normalized, so that the figures measure the percentage of total pair-wise flows that go exclusively to a location. Sources: Thomson Financial Securities Data Corporation, Datastream and Bloomberg.

Table 9. Country rankings based on the prestige index of trading value flows.

1995		2000		2006	
Country	Prestige	Country	Prestige	Country	Prestige
United States	0.359	United States	0.500	United States	0.398
United Kingdom	0.063	Euronext	0.028	Japan	0.042
Japan	0.044	United Kingdom	0.027	United Kingdom	0.040
Switzerland	0.023	Japan	0.022	Hong Kong	0.021
Taiwan	0.015	Canada	0.007	Euronext	0.021
Germany	0.010	Hong Kong	0.014	South Korea	0.011
Mexico	0.010	South Korea	0.013	Italy	0.010
Hong Kong	0.008	Nordic Exchanges	0.007	Canada	0.009
South Korea	0.008	Taiwan	0.010	Nordic Exchanges	0.008
South Africa	0.008	Italy	0.008	Spain	0.007
Canada	0.007	Germany	0.006	Australia	0.006
Norway	0.006	Spain	0.004	Mexico	0.006
Thailand	0.006	India	0.004	Taiwan	0.006
Nordic Exchanges	0.005	Israel	0.000	Germany	0.004
Australia	0.005	Australia	0.003	India	0.003
Hungary	0.004	Brazil	0.001	Norway	0.003
Malaysia	0.003	Singapore	0.001	Brazil	0.002
Singapore	0.003	Turkey	0.002	Denmark	0.002
Euronext	0.002	Denmark	0.001	South Africa	0.002
Brazil	0.002	Greece	0.001	Turkey	0.002
Turkey	0.002	Ireland	0.000	Austria	0.001
Italy	0.001	Malaysia	0.001	Greece	0.001
Chile	0.001	Mexico	0.000	Ireland	0.001
Denmark	0.001	Norway	0.001	Israel	0.001
Indonesia	0.001	South Africa	0.001	Singapore	0.001
Peru	0.001	Switzerland	0.001	Switzerland	0.001
Philippines	0.001	Argentina	0	Argentina	0
Argentina	0	Austria	0	Chile	0
Israel	0	Chile	0	Egypt	0
Spain	0	Egypt	0	Hungary	0
Austria	0	Hungary	0	Indonesia	0
Egypt	0	Indonesia	0	Luxembourg	0
Greece	0	Luxembourg	0	Malaysia	0
India	0	New Zealand	0	New Zealand	0
Luxembourg	0	Peru	0	Peru	0
New Zealand	0	Philippines	0	Philippines	0
Poland	0	Poland	0	Poland	0
Sri Lanka	0	Russia	0	Russia	0
Ireland	NA	Sri Lanka	0	Sri Lanka	0
Russia	NA	Thailand	0	Thailand	0

Notes: The prestige index for location *i* is obtained as a weighted average of the prestige index of all locations in the matrix, where the weights are represented by the total volumes of traded value flows from each location directed toward location *i*. Sources: Thomson Financial Securities Data Corporation, Datastream and Bloomberg.

Table 10. Determinants of the country-level prestige index

Explanatory variable	Prestige – IPO flows			Prestige – Trading value flows		
	(1)	(1)	(2)	(3)	(2)	(3)
CONSTANT	-0.170***	-0.306***	-0.342***	-0.356***	-0.157***	-0.176***
	(0.04)	(0.09)	(0.09)	(0.09)	(0.03)	(0.04)
Log (MARKET_CAP)			22.49***	23.29***	12.97***	13.51***
			(4.86)	(4.95)	(2.16)	(2.29)
OPENNESS	0.345**	0.791**	1.051***	1.086***	0.539***	0.557***
	(0.16)	(0.37)	(0.38)	(0.38)	(0.16)	(0.16)
Log (REAL_GDP)	16.00***	23.61***				
	(3.39)	(7.03)				
Log (CPI)	2.03	1.645	2.286	1.269	-3.21	-3.03
	(1.61)	(3.54)	(5.53)	(5.46)	(3.17)	(3.20)
FREEDOM_SCORE	0.0695	0.743***				
	(0.12)	(0.28)				
GOVT_SCORE				0.559***		0.207**
				(0.17)		(0.081)
INV_SCORE			0.426**		0.0459	
			(0.19)		(0.07)	
Observations	378	348	301	301	308	308
R-squared	0.13	0.09	0.28	0.29	0.39	0.4

Notes: The dependent variable is the country's prestige index measure either according to IPO flows or trading value flows. MARKET_CAP = the log of the market capitalization of a stock exchange is the total number of issued shares of domestic companies, including their several classes, multiplied by their respective prices at a given time. OPENNESS = exports plus imports divided as a percentage of GDP. REAL_GDP = real GDP per capital. CPI= country's consumer price index. FREEDOM_SCORE = equally weighted average of a country's regulation, trade, fiscal, government, monetary, investment, financial, property rights, corruption, and labor score. GOVT_SCORE = Government score measured by the total amount of government spending at all levels as a portion of GDP. INV_SCORE = Investment score representing an assessment of the free flow of capital, especially foreign capital. The symbols (*), (**), and (***) indicated statistical significance at the 10-, 5-, and 1-percent level, respectively.

Figure 1A Aggregate IPO volumes, top 8 locations of destinations

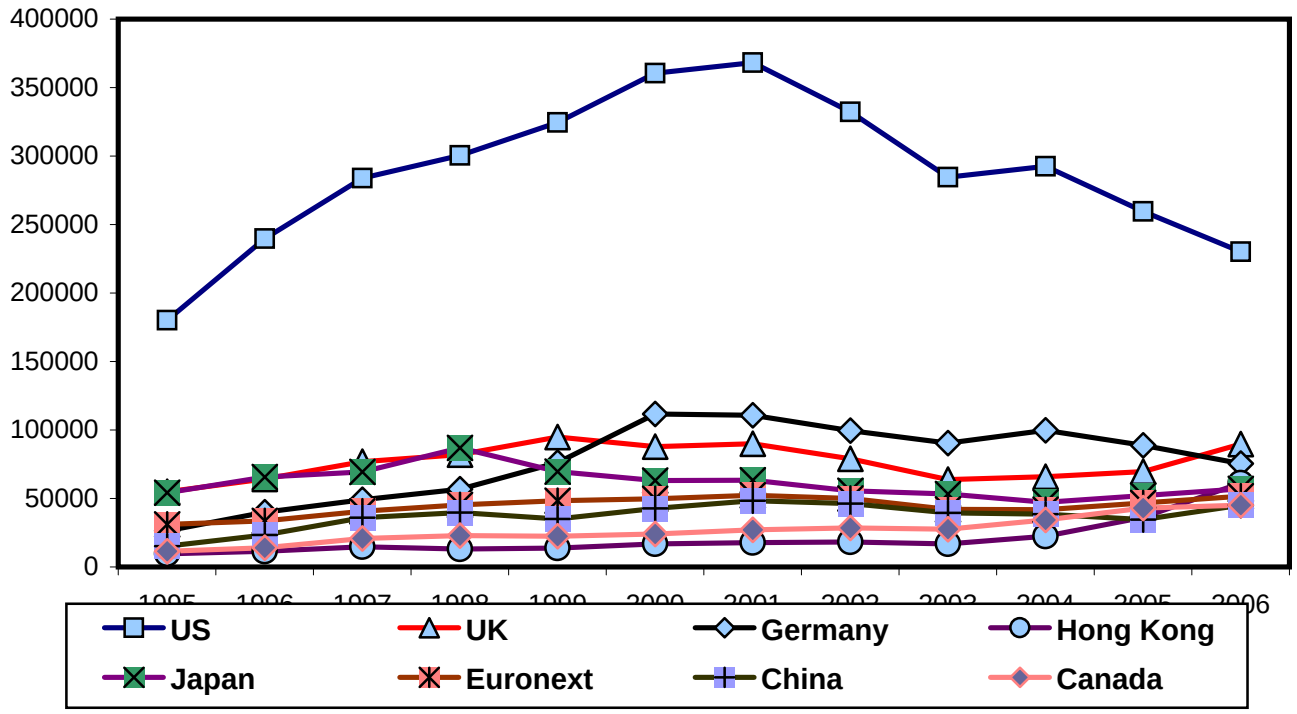

Figure 1B. Aggregate IPO volumes, Top 8 locations excluding U.S.

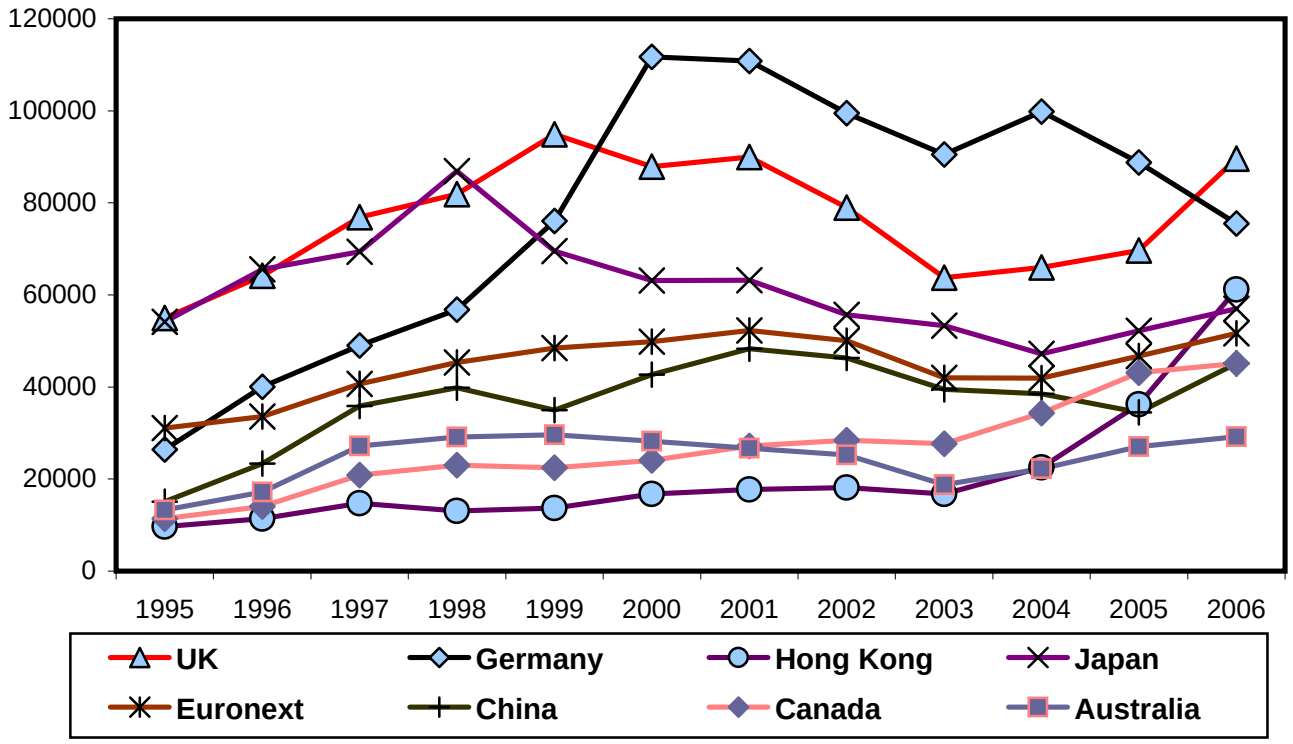

Figure 2A. In-degree index on IPO activity, top 8 locations of destination

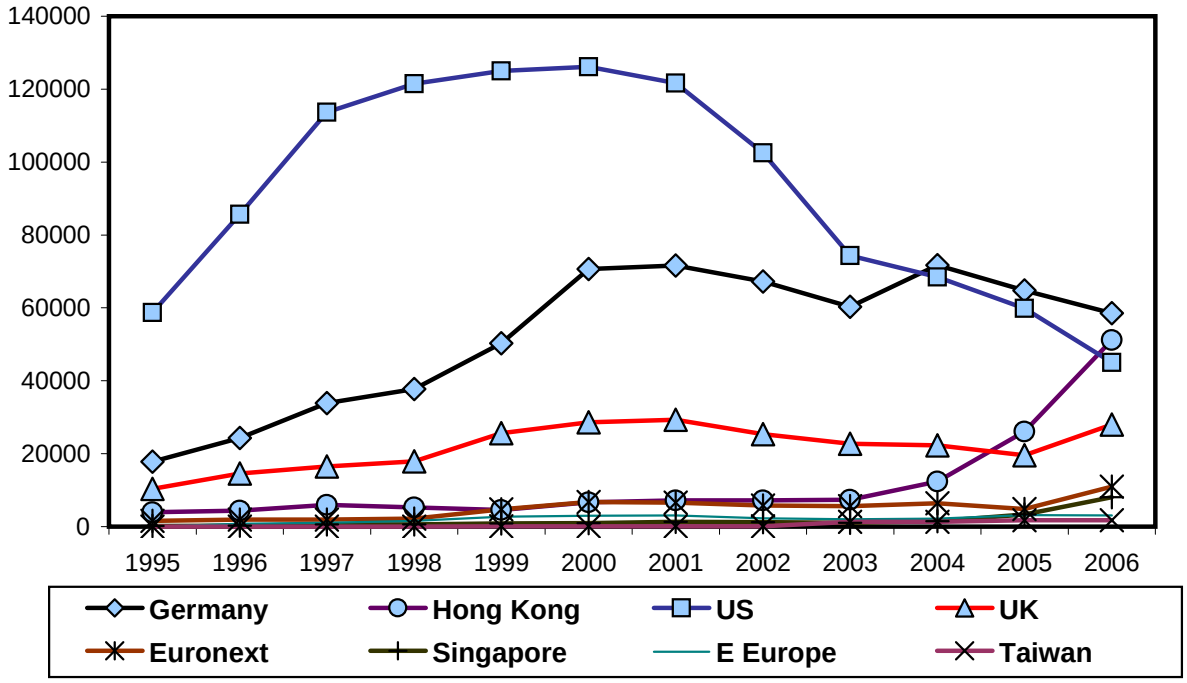

Figure 2B. In-degree index on IPO activity, top 8 locations excluding U.S.

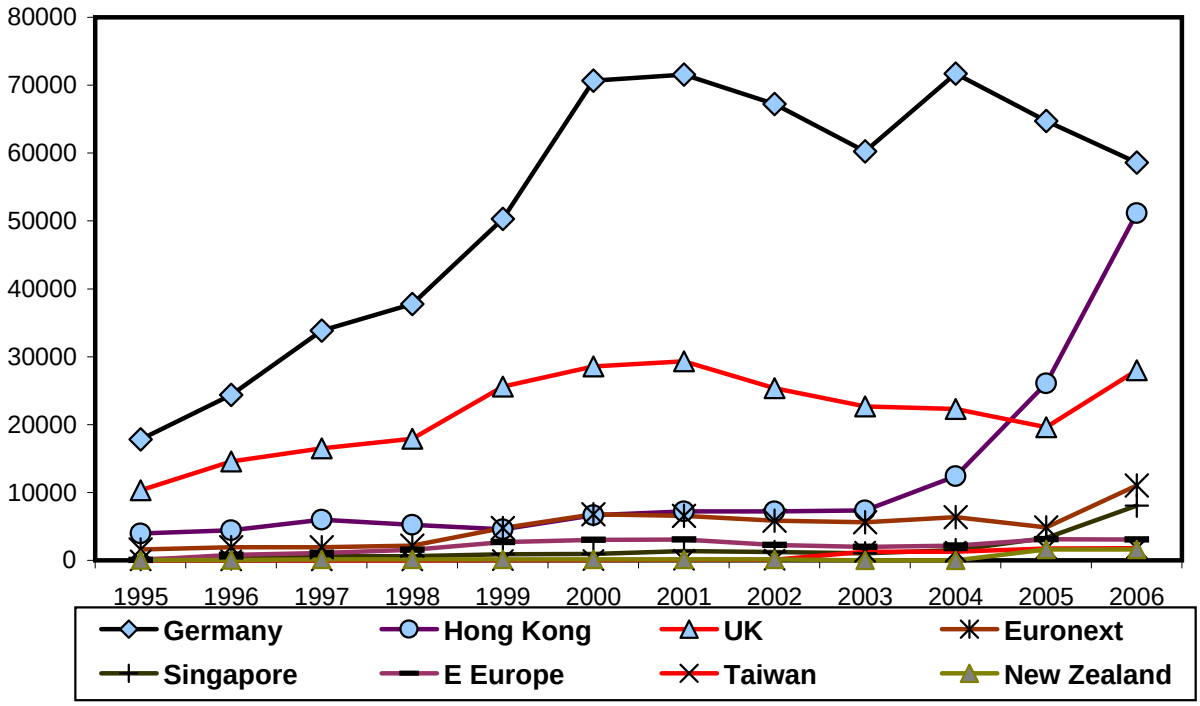

Figure 3. Out-degree index of IPO activity, Top 8 locations of destination

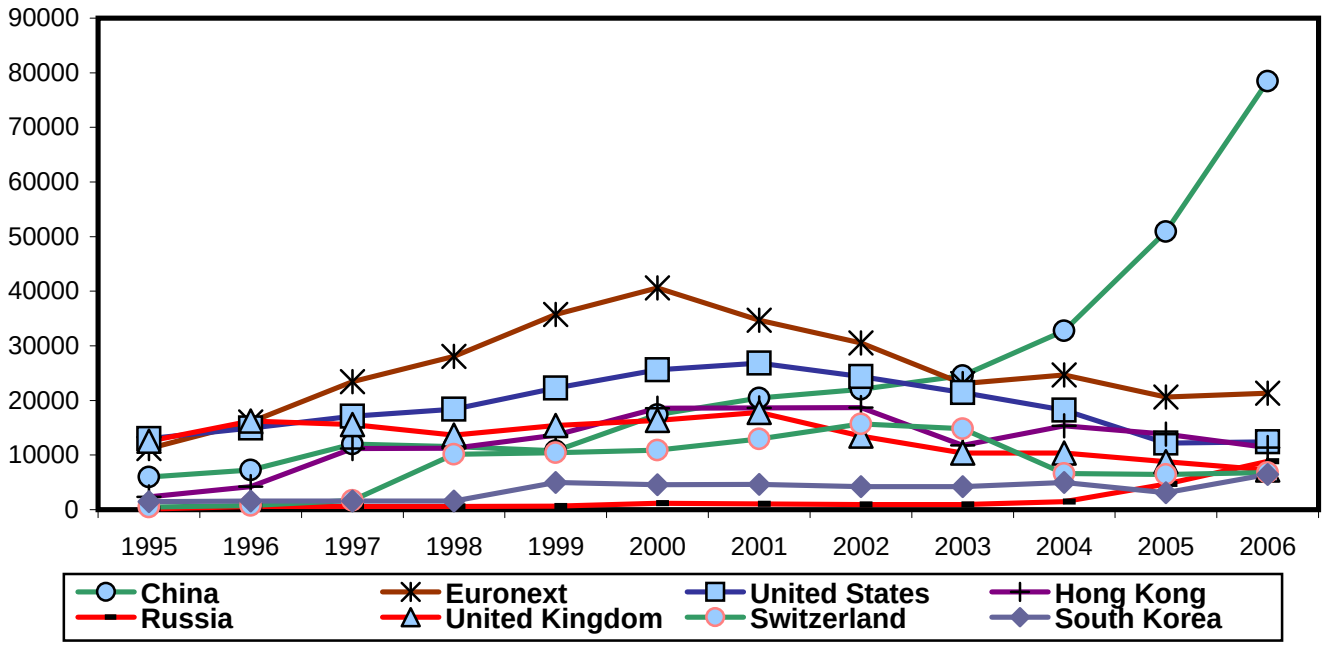

Figure 4A. Betweenness index of IPO activity, top 8 locations of destination

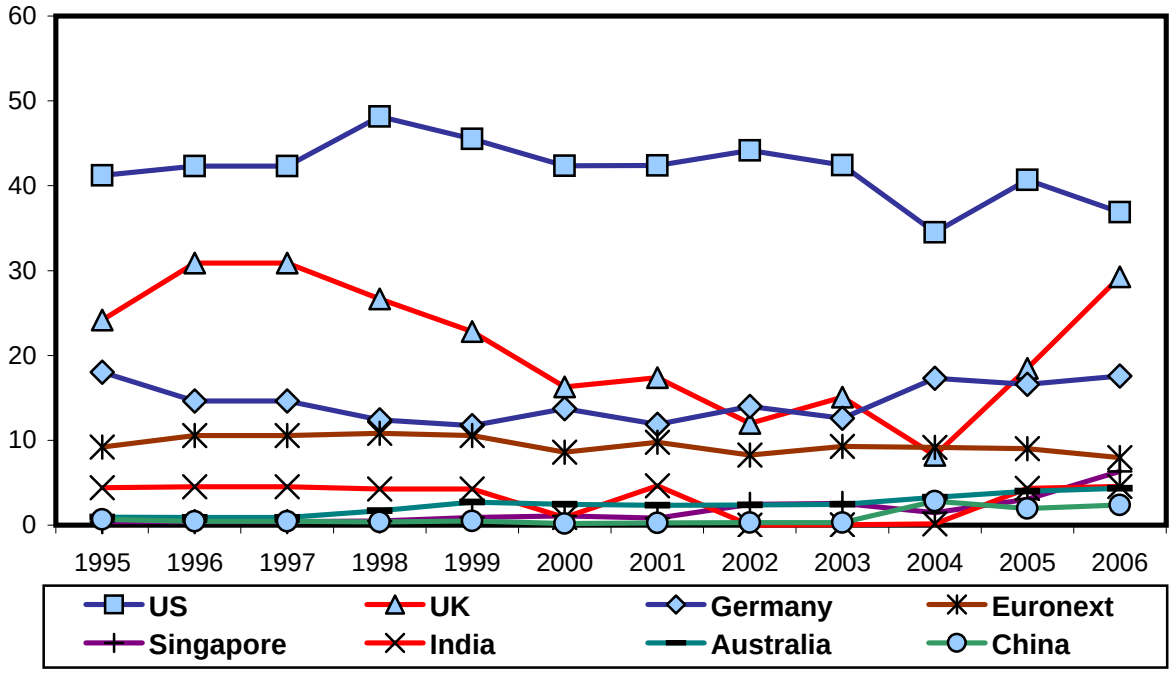

Figure 4B. Betweenness index of IPO activity, top 8 locations excluding U.S.

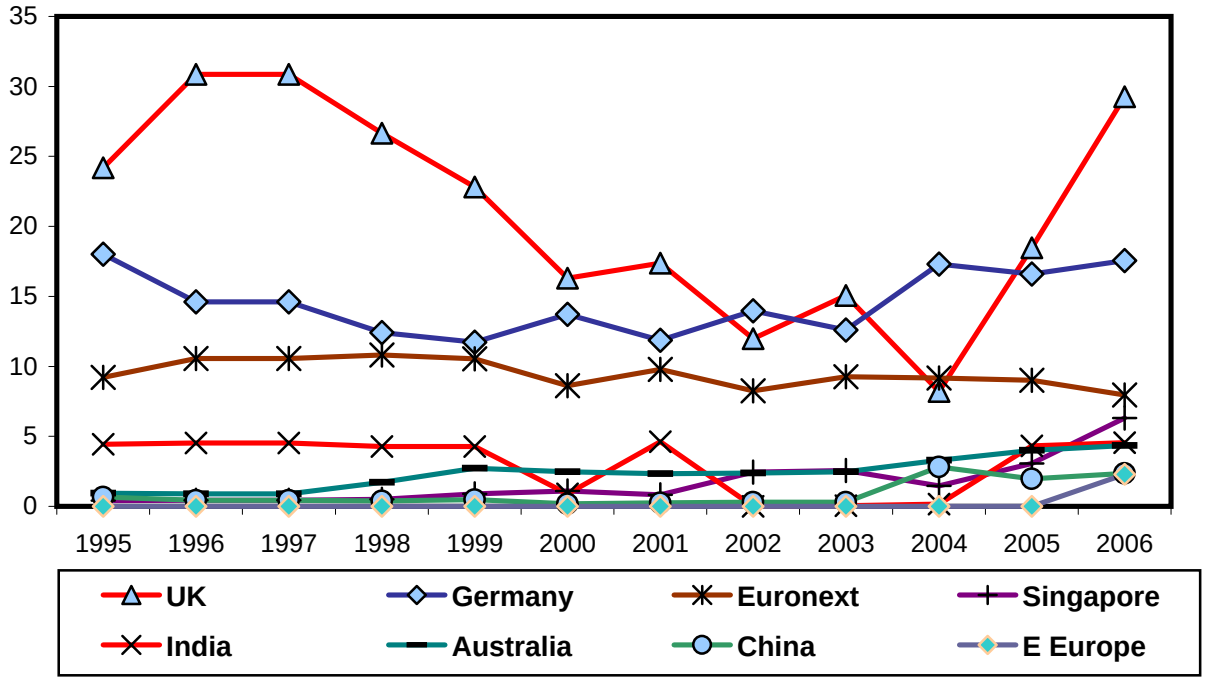

Figure 5A. Prestige index of IPO activity, top 8 locations of destination

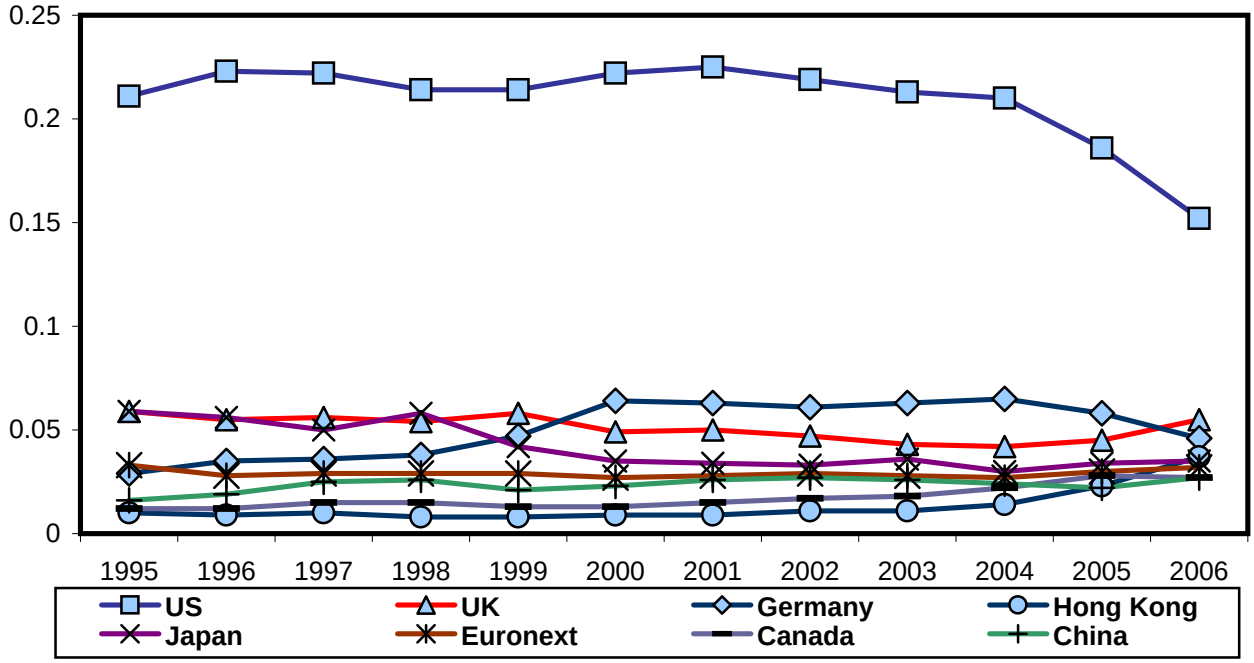

Figure 5B. Prestige index of IPO activity, top 8 locations excluding U.S.

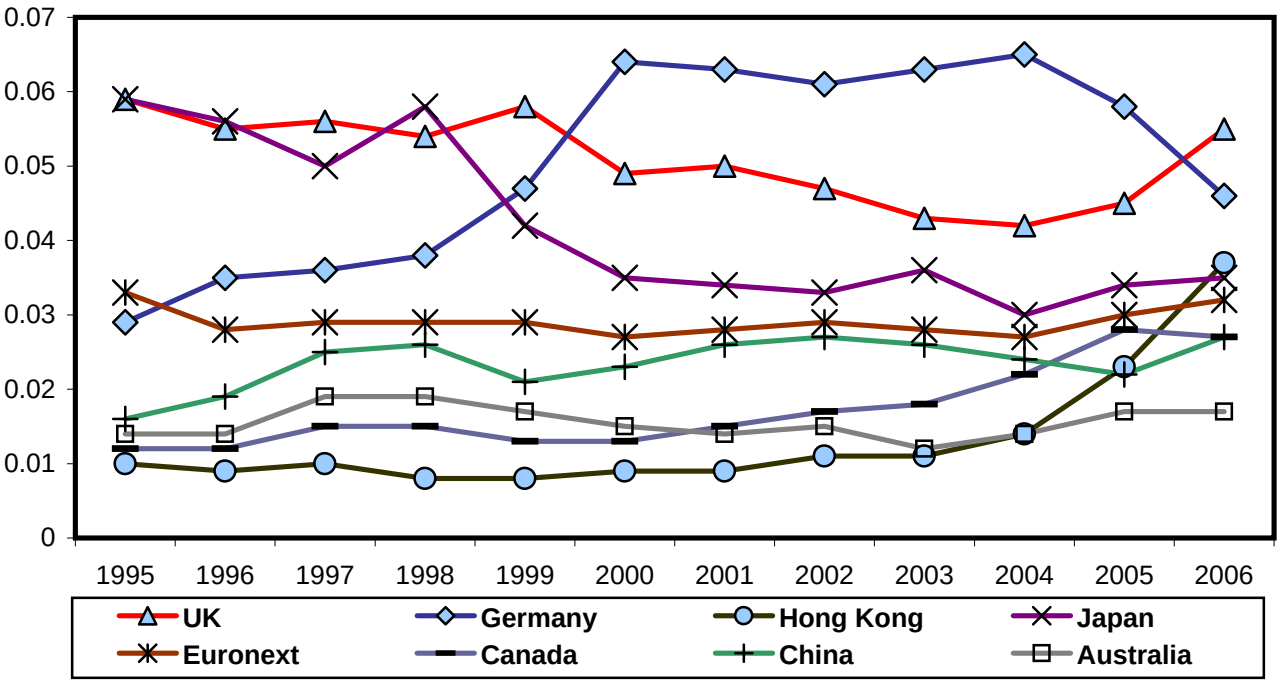

Figure 6A. Aggregate secondary market trading values, top 8 locations of destinations

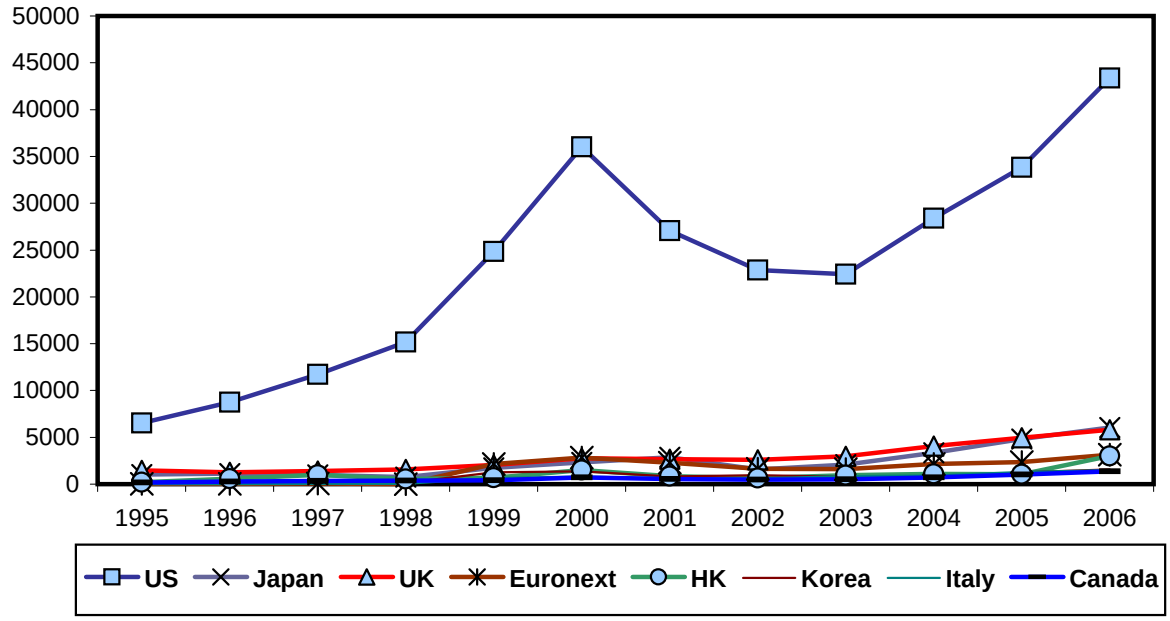

Figure 6B. Aggregate secondary market trading values, top 8 locations excluding U.S.

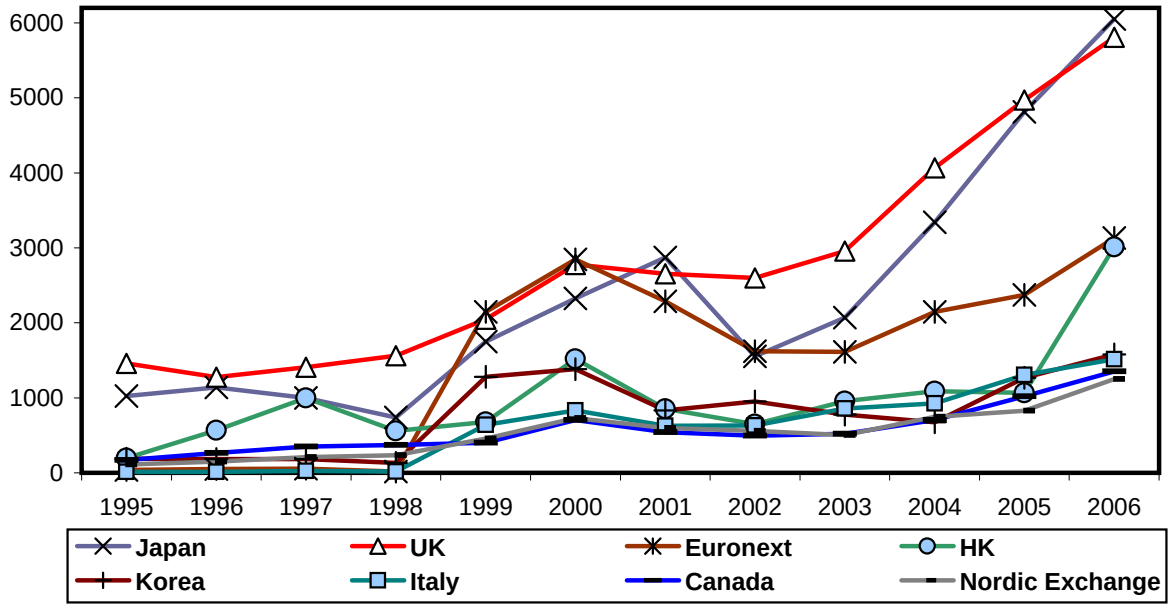

Figure 7A. In-degree index of secondary market trading values
Top 8 locations of destination

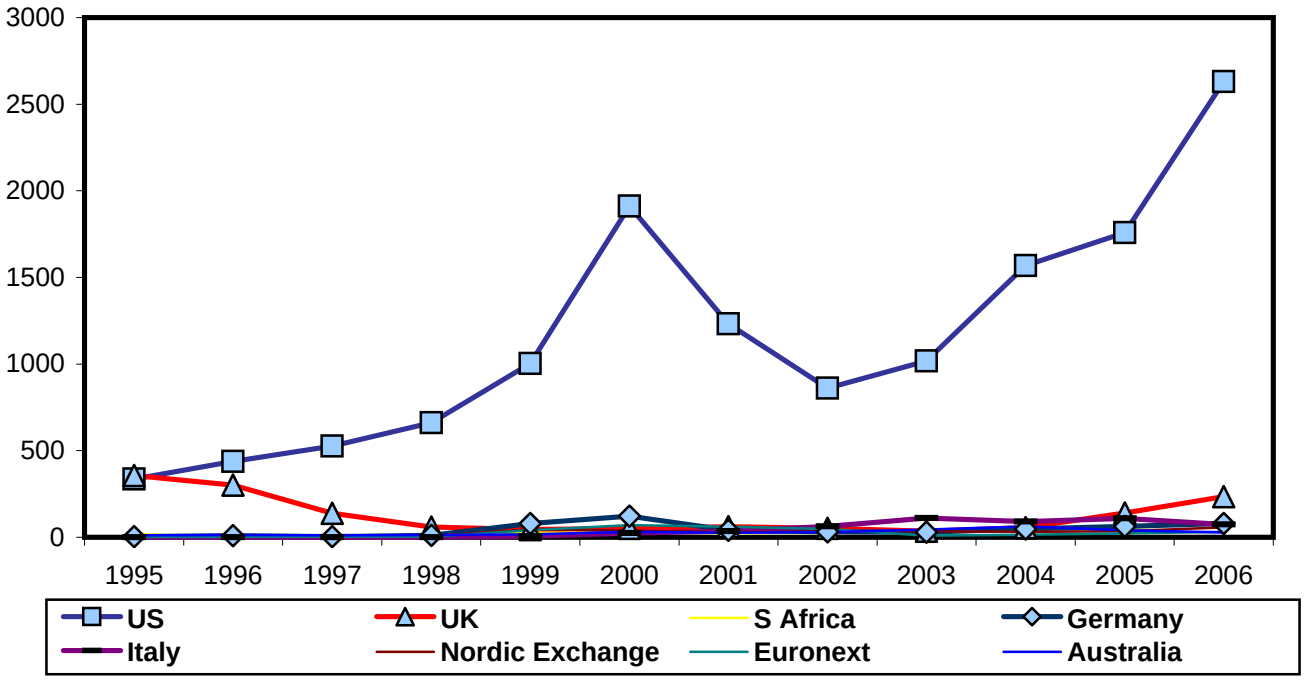

Figure 7B. In-degree index of secondary market trading value
Top 8 Locations excluding U.S.

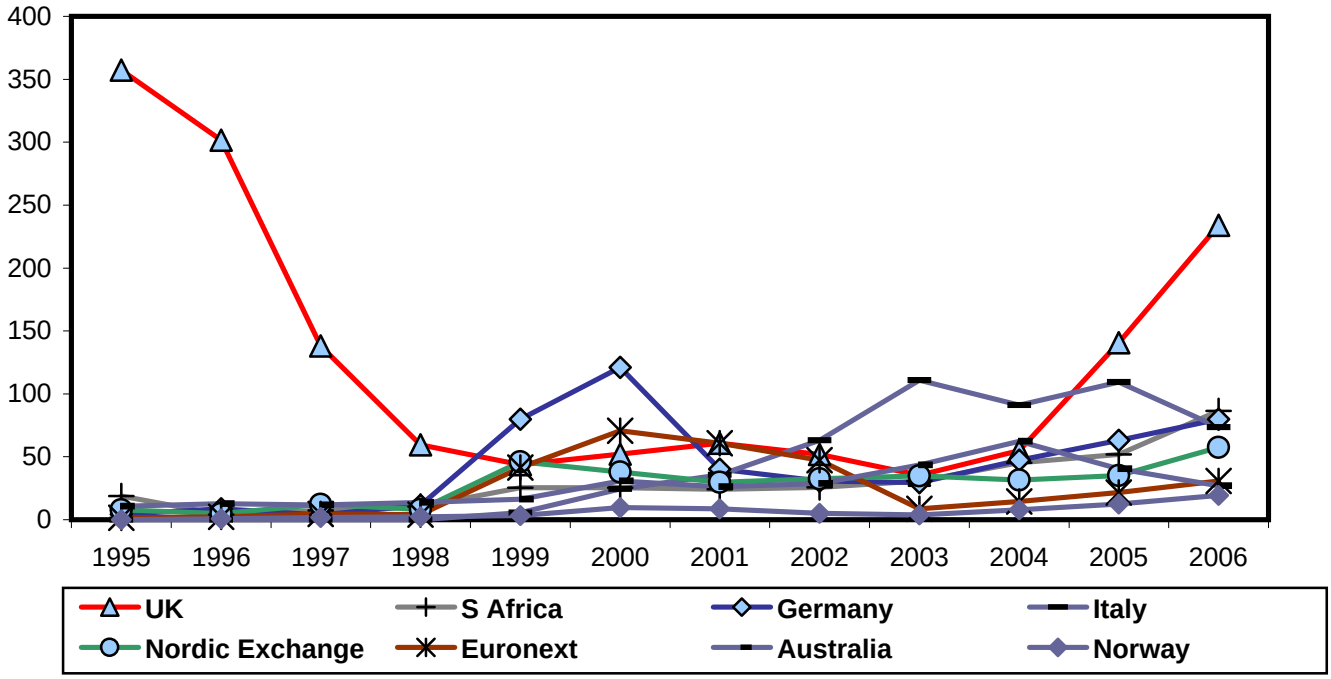

Figure 8A. Betweenness index of secondary market trading value
Top 8 destinations of locations

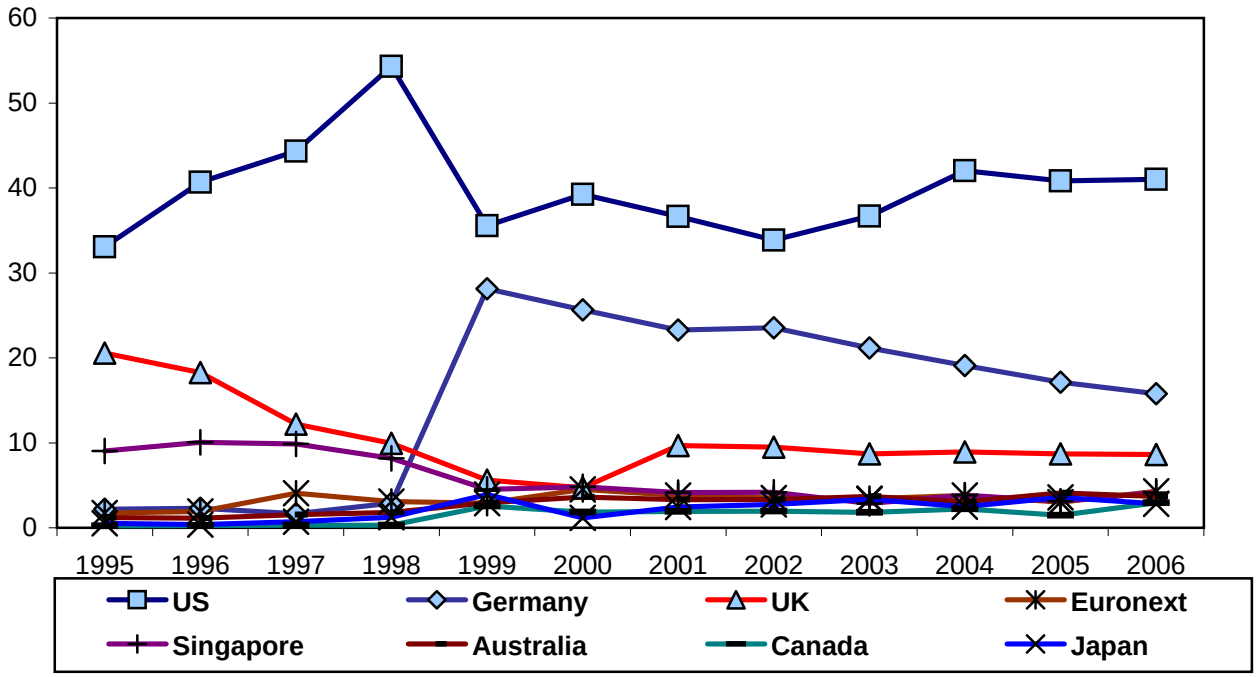

Figure 8B. Betweenness index of secondary market trading values
Top 8 locations excluding U.S.

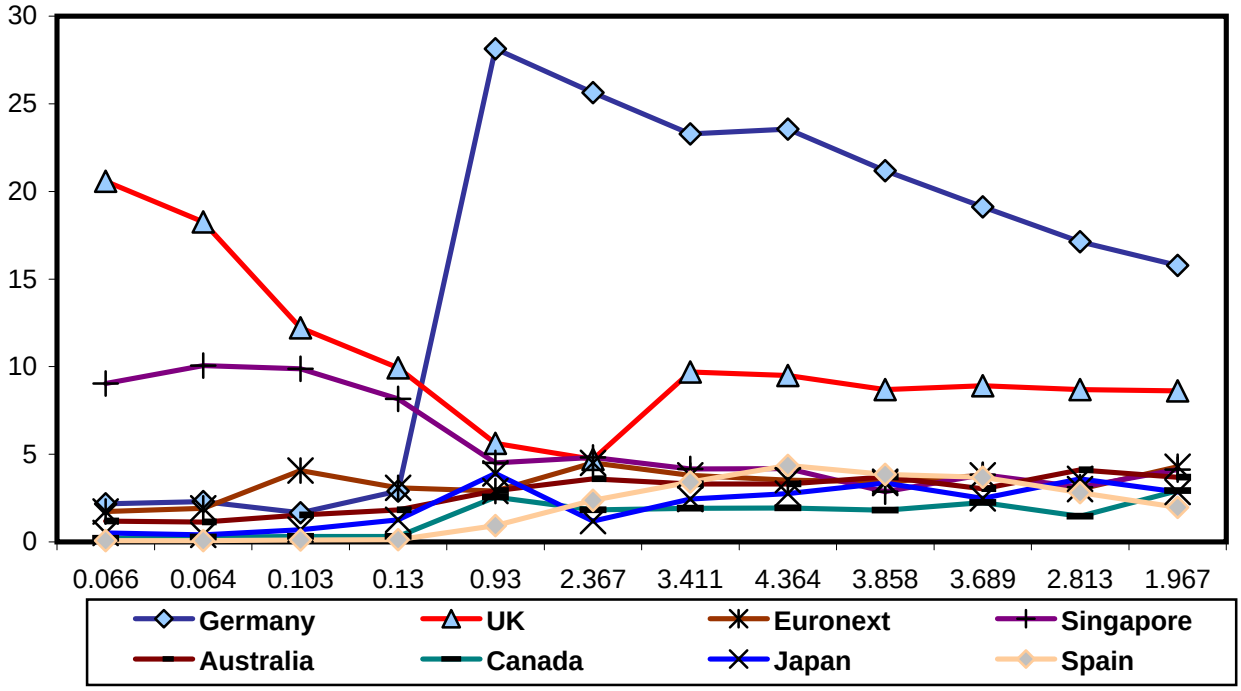

Figure 9A. Prestige index of secondary market trading values
Top 8 locations destination

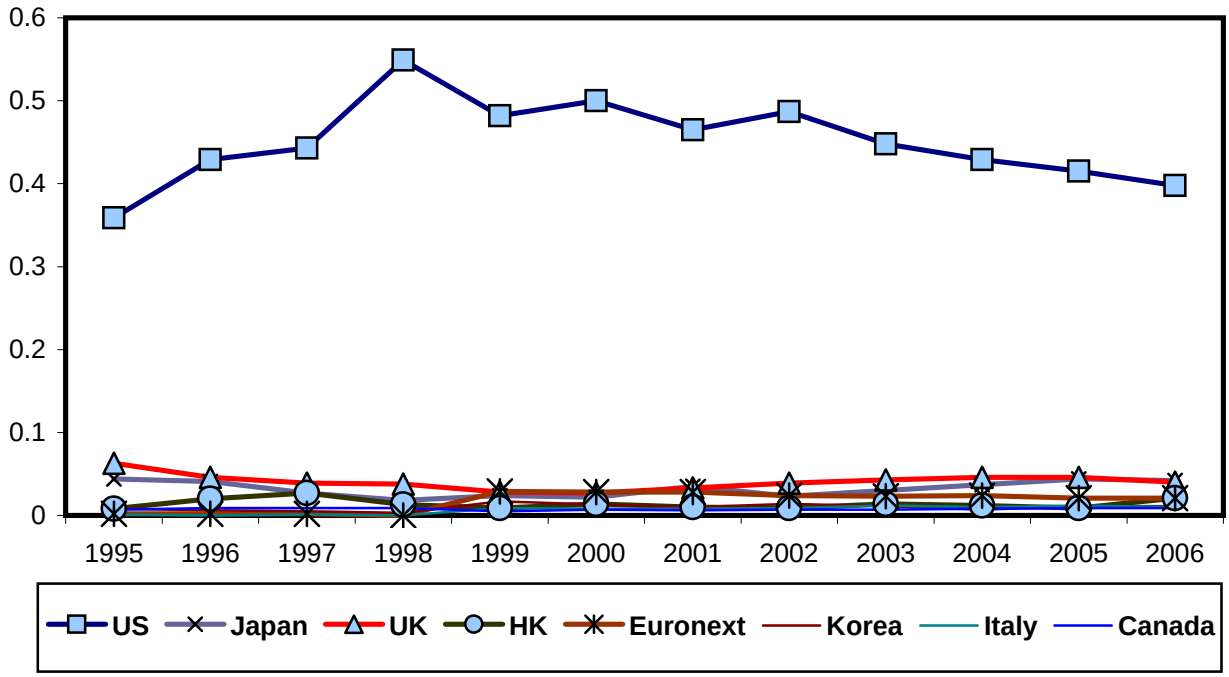

Figure 9B. Prestige index of secondary market trading values
Top 8 locations exluding U.S.