Competitive Track 6: International finance, accounting and corporate governance

A dynamic measure of institutional distance based in information theory: development and tests

Managing distance is at the heart of international business research. Institutional theory provides a sound basis for quantifying institutional contexts. With regards to distance, academic discussion has so far focused on conceptual criticism. We provide empirical tests for the quality of measures of institutional distance. Following the development of those tests, we propose a measure of institutional distance that combines conceptual relevance with empirical robustness. We use permutation entropy, a method rooted in information theory and commonly used in portfolio management, to measure the degree of relatedness of national economies. We compare lead indices of national stock exchanges with regards to their development over time. We apply this measure to problems broadly discussed in international business literature and show that it adds to our understanding in breadth and depth.

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1. INTRODUCTION

Cross-national distance has been one of the key research concepts in international business (IB) research since its association with the liability of foreignness (Hymer, 1976), which puts foreign firms at a disadvantage as opposed to domestic firms (Zaheer, 1995). Distance, in this sense, is a measure for how different countries are, relating to differences beyond the geographic distance between their landmasses (Ghemawat, 2001, Kostova & Zaheer, 1999). Institutional distance, in particular, has been associated with differences in "[…] humanly devised constraints that structure political, economic, and social interaction" (North, 1991 p. 97). Because of much dissimilarity to the simple case of geometric distance that the metaphor draws from, institutional distance has drawn significant criticism. There are conceptual and empirical inconsistencies with respect to the symmetry of the concept and the scope of the term "institutions" as such (Jackson & Deeg, 2008, Shenkar, 2001, Sousa & Bradley, 2008).

The last decades have provided numerous conceptualizations on how to classify institutions as well as abundant measures for institutional distance (e.g. Berry, Guillén, & Nan, 2010, Henisz, 2000, Kogut & Singh, 1988). Institutional theory (Kostova & Roth, 2002, North, 1991) provides the basis for the measures of institutional contexts that these distances employ. Yet, the fundamentals that the establishment of distance, the second component of "institutional distance", between two such institutional contexts founds on are not clearly established, while there is significant criticism (Shenkar, 2001) of the concept and reconciliatory efforts (Zaheer, Schomaker, & Nachum, 2012) . Particularly, empirically testable characteristics are not sufficiently discussed. Looking at the abundance of studies that employ measures of institutional distance (see Bae & Salomon, 2010 for a review), and the relevance for governance decisions (Brouthers, 2002), performance (Evans & Mavondo,

2002), and knowledge transfer (Jensen & Szulanski, 2004), to name a few, and its overall relevance for international business research, the lack of a discussion of its properties is surprising.

We contribute by providing an analysis of the properties that measures of institutional distance possess. In this respect, we go back to the concept of physical distance and develop characteristics that also apply to measures of institutional distance. We build on the discussion by Shenkar (2001), and Zaheer, Schomaker, and Nachum (2012) in the development of quality standards for measures of institutional distance. Then, we characterize some of the popular quantifications of institutional distance in the light of these characteristics. We also propose a measure for an important class of dimensions of institutional distance, which we call "market distance", that reasonably satisfies these properties. We base this measure on the concept of entropy from information theory which has proven highly successful in the risk management of investment portfolios (Zhou, Cai, & Tong, 2013). It directly measures the amount of information that distinguishes two economies. We believe that such a measure is highly valuable in the context of liabilities of foreignness, since a significant part of these liabilities is due to not understanding the business practices in another country (Bell, Filatotchev, & Rasheed, 2011, Zaheer, 1995). The amount of such unknown information is exactly what the market distance measure directly captures. We show some additional characteristics of this measure and possible avenues for additional research that are made possible. Finally, we show empirical applications of the market distance measure and compare the results with other popular quantifications of institutional distance. We also provide the data for other researchers.

We contribute to literature in several ways. First, we clarify the degree to which institutional distance measures comply with characteristics associated with the concept of geometric distance. By doing so, we increase the relevance of studies employing measures of

institutional distance and add to the discussion of its applicability in research. Second, we link institutional theory with information theory in the development of our measure for market distance. We use an entropy-based quantification and consequently provide a connection to portfolio risk management, a research stream that has great potential to add to research on country market portfolios of multinational enterprises (MNEs). Such an approach helps to clearly separate risk of internationalization from potential returns and hence helps to disentangle the multinationality-performance problem. Third, we provide insights into the integration of world financial markets that may spark discussion among scholars and practitioners about how global integration develops over time and between different countries. Along similar lines, we provide a framework that distinguishes quantitatively between economic shocks on the national and global level. In addition to theoretic contributions, we give scholars and practitioners a tool for the evaluation of the risk associated with international expansion. With entropy introduced in international business on the corporate level, risk management tools in MNEs can profit from extensive research about entropic risk in portfolio management. In times of risk-reduction measures on corporate and regulatory level (e.g. Basel III) we believe opening the discussion on advanced risk management tools related with the concept of entropy is called for.

2. LITERATURE REVIEW

Institutional distance has become a key variable in international business research mainly because of the importance of liabilities of foreignness for the financial performance of firms, which is well documented (Zaheer, 1995, Zaheer & Mosakowski, 1997). Typically, when referring to institutional distance, researchers speak about differences, or dissimilarities, between the institutional environments of two countries (Gaur & Lu, 2007). Many scholars have provided measures for different dimensions of institutional distance. The literature is

extensively reviewed by Bae and Salomon (2010), who also provide classifications and examples for empirical applications. This literature review chapter largely follows their review. We review the literature concerning institutional distance in the light of the work we are later using as reference points for our analyses and concerning two measures that we will use as points of reference later in the paper.

In general, there are formal and informal elements to institutional distance. The respective weights that researchers put on the two are largely dependent on the field their research is positioned in. While economics researchers have mainly focused on formal institutions, scholars taking a sociological perspective have put more emphasis on informal elements (Bae & Salomon, 2010). Economic distance lies somewhat in the middle if we conceive a continuum between formal and informal institutions. While it is formal in the sense that economic indicators are rigidly defined and officially measured, it is informal in the sense that economic distance does not directly emerge from codified rules and regulations. It considers differences in how the respective economies are structured, to what degree they are characterized by free markets, and how stable the resulting markets are (Ghemawat, 2001, Miller & Parkhe, 2002). Economic distance has been found to be relevant for MNEs' choice of location (Nachum, Zaheer, & Gross, 2008), likelihood to agglomerate (Martin, Salomon, & Wu, 2010), or financial firms' performance (Miller & Parkhe, 2002). Some scholars argue that economic distance is a consequence of other dimensions of institutions that pre-define economic actors' reactions which in turn determine economic distance. Yet, it is also argued that the chain of causality runs in the opposite direction (Bae & Salomon, 2010). Either way, for the returns from operations in different countries, the ultimate objective of any for-profit MNE, the economic distance between countries is an essential determinant.

Based on theorizing on institutions (Jackson & Deeg, 2008), Berry, Guillén, and Nan (2010) developed a nine-dimensional framework of institutional distance. They built their

dimensions around three theoretical perspectives on cross-national distance: that of "national business systems" (Whitley, 1992), a perspective focusing on national government mechanisms (Henisz & Williamson, 1999, López de Silanes, La Porta, Shleifer, & Vishny, 1998, Porta, Lopez- de- Silanes, & Shleifer, 2006), and national innovation systems (Nelson & Rosenberg, 1993). One of the dimensions of distance they come up with is economic distance. In their consideration income, inflation, imports, and exports are the economic indicators that matter for this dimension of distance (Berry, Guillén, & Nan, 2010). They provide two versions of their annual data for researchers: considering yearly updates of the correlations between the respective measures for the Mahalanobis distances they compute, and not doing so. The economic dimension is associated with "national business systems" and meant to quantify "particular arrangements of hierarchy-market relations becoming institutionalized and relatively successful in particular contexts" (Whitley, 1992 p.10).

Cultural distance is argued to be a dimension of institutional distance that defines how countries differ with regards to how interpersonal interactions should work, which gives normative guidance for the behavior of economic actors in a society (Hofstede, 2001, North, 1991). Differences across different dimensions of cultural distance have been used to measure a compound index of cultural distance (Kogut & Singh, 1988). There is a number of different conceptualizations (e.g. Hofstede, 1980, House, Hanges, Javidan, Dorfman, & Gupta, 2004, Schwartz, 1994) of culture and intense discussion about their relative characteristics (Smith, 2006). It is undisputed, however, that cultural distance is an important driver of decisions in the context of international business. In terms of usage, the Kogut and Singh (1988) index that compounds the Hofstede (1980) dimensions is the most prevalent (Benito & Gripsrud, 1992, Zaheer, Schomaker, & Nachum, 2012), despite some empirical and conceptual inconsistencies (Shenkar, 2001).

In a seminal article, Shenkar (2001) critically discussed the concept of cultural distance with respect to its conceptual and methodological inconsistencies. In this vein, the illusion of symmetry received special attention. Distance between points A and B, in terms of geometric distance, are the same. In terms of cultural distance, this is assumed when computing distances, but whether it conceptually is the case remains unaddressed. In a reconciliatory article with regards to the topics raised by Shenkar (2001), Zaheer, Schomaker, and Nachum (2012) propose four ways to overcome the illusion of symmetry criticized. Avoiding oversimplification, testing whether a measure is symmetric, taking into account firm heterogeneity, and considering the mechanisms behind the workings of distance are proposed to resolve the issues put forward by (Shenkar, 2001). Particularly, the problem of assumed but not empirically substantiated symmetry is to be resolved in this way. Below, we will build on this set of propositions and provide some empirical tests of assumptions behind the concept of institutional distance, for different measures including our entropy-based market distance.

Entropy has long been used in portfolio management as a tool to optimize portfolio diversification (Philippatos & Wilson, 1972). Originally, the term goes back to statistical physics where it is closely associated with the Second Law of Thermodynamics (Clausius, 1865). The main application is as a measure of risk that is applicable to a number of distributions beyond the normal distribution assumed in pioneer portfolio selection models (Markowitz, 1952). In general, the smaller the entropy value in a portfolio, the higher the risk associated with it (Zhou, Cai, & Tong, 2013). There are different ways to calculate entropy in a time series. In information theory, Shannon entropy is the general measure of information content in a time series (Bandt & Pompe, 2002). The interpretation of entropy as information content drives the interpretation in portfolio diversification models. The more information that is needed to describe a portfolio's returns, i.e. the higher its Shannon Entropy, the more diversified it is (Hoskisson, Hitt, Johnson, & Moesel, 1993, Philippatos & Gressis, 1975). We

draw on this common interpretation of entropy in the development of our measure for the differences between markets.

3. A NATURAL MEASURE FOR MARKET DISTANCE

We go back to the initial definition of institutions in theorizing for the measure that we propose. Institutions provide structure for the interaction between economic actors (North, 1991). Clearly, the reactions of economic actors to these constraints are what regulators have in mind when devising institutions. Of course, economic actors are very efficient in using this environment to their advantage, particularly if they are superiously familiar with the environment as opposed to competitors. The use of this superiority has been intensely discussed with respect to liability of foreignness (Zaheer, 1995). Consequently, the effect that institutions have on the economy, and the efficiency associated with them, can be measured by observing market participants. This is also what drives popular measures (or composites of dimensions) of institutional distance, such as economic development (Porta, Lopez- de-Silanes, & Shleifer, 2006), financial market development (Berry, Guillén, & Nan, 2010), administrative constraints (Henisz, 2000) or survey-based evaluations of national differences (Hofstede, 1980, House, Hanges, Javidan, Dorfman, & Gupta, 2004).

The liability of foreignness is the governing principle behind the reasons why companies struggle with their unfamiliarity with the institutions in a foreign country (Bell, Filatotchev, & Rasheed, 2011). One of the four key drivers of the liability of foreignness identified by Zaheer (1995) is unfamiliarity with the environment. In the literature on cultural distance, scholars relate to the ability of an actor to understand information as a key principle behind the notion of cultural differences. It has been documented repeatedly that it is difficult to extract information from a culturally distant country even if full access to the information is given (Lyles & Salk, 1996, Simonin, 1999). These difficulties have been shown to have

significant performance effects (Morosini, Shane, & Singh, 1998). Consequently, a good measure of distance between country markets should be related closely to the availability to find information and the ability to understand it. Many approaches to measuring institutional distance proxy the relationship to information with macroeconomic data (Berry, Guillén, & Nan, 2010, Henisz, 2000, López de Silanes, La Porta, Shleifer, & Vishny, 1998, Porta, Lopez- de- Silanes, & Shleifer, 2006). The measure we propose directly measures the information content that describes the difference between the lead markets of two countries. A successful company has learnt to navigate its home country institutional environment. We provide a direct measure of the degree of complexity that it has to deal with when operating in a different environment where a company's ability to work in the institutional environment is impaired by its liability of foreignness. We believe that such an approach is a valuable addition to earlier work that focusses mainly on difficulty with understanding information. For that purpose we deviate from some of the commonalities of earlier measures of institutional distance.

Popular measures of institutional distance between countries represent (weighted) differences between averages of indicators representative of the respective dimensions (Bae & Salomon, 2010). These averages, however, are only crude representations of typically complex bundles of information. They do not directly represent the measures of institutional distance they are associated with. Of course, the two are related, but the connection is made in the interpretation rather than when measuring the underlying construct. (e.g. GDP per capita differences for economic distance (Berry, Guillén, & Nan, 2010)). Also, the time-varying behavior of the underlying measure over time is mostly ignored when only looking at averages and the distribution of observations is neglected when computing arithmetic means. For, among others, these reasons, finance researchers have resorted to analyzing the co-movement of series of observations to derive the relation, or lack thereof, between for

example securities (Sharpe, 1964). One of the most popular of these measures certainly is the beta coefficient that measures the relatedness of a certain stock's returns with the returns of the overall stock market. We intend to develop something similar for the distance between two economies. Such a measure may help in analyzing market selection, establishment mode, and entry mode decisions as well as decisions related to other functional constraints (e.g. financial constraints). When computing such a distance, however, a measurement and a methodological problem have to be solved.

First, for a measure of the distance between the complete (i.e. representing the economic structure) market of two countries, ideally one would account for all activities. Since this is impractical for several reasons, we resort to an approximation: we identify the economic center of the respective nations. We argue that, in analogy with a center-of-geometry argumentation in geometric distance, the lead indices of national stock markets are the center-of-gravity of economic activity. Using stock market linkages as indicators for the connection of national economies has a long tradition that goes back to Ripley (1973). Of course, there is some overlap between the developments of lead indices, particularly if they are located closely in a geographic sense. The degree to which markets contain the same information, however, is exactly what we are trying to measure. With this direct approach to measuring differences between markets, we hope to forgo difficulties in application and interpretation that are associated with measures that take differences of compound averages of measures associated with a certain dimension of institutional distance.

Second, a straightforward way to estimate the information contained in one time series given another, as argued above, is the correlation between the time series. However, it is an important stylized fact in the financial literature that absolute stock prices are non-stationary and therefore not suitable for computing correlations since these require stationary data. Hence, scholars resort to using returns because they are more likely to fulfill stationarity

requirements (Martens, Kofman, & Vorst, 1998). Yet, it turns out that particularly for long time-periods stock market index returns are not fully stationary either and hence that correlations between returns of such time series may well yield spurious results (CHEN & Keown, 1981, Granger & Hyung, 2004, Rydén, Teräsvirta, & Åsbrink, 1998). Since we, among other things, want to analyze structural deviations between the developments in different countries, we resort to a method that requires even lower stationarity assumptions: permutation entropy. This method only requires that the probability for a return observed at time t being smaller (or larger) than one at time t+k does not depend on t (Bandt & Pompe, 2002). This, as we will see later, is the case for stock market index returns. Having addressed the two first challenges, we proceed to explain the method we employ in computing market distance.

As explained in the review section above, entropy has many applications in portfolio management. Permutation entropy is widely used in signal analysis since it is very well able to filter signal from noise and hence distinguish information content from background fluctuation (Bandt & Pompe, 2002). That is exactly what we want to find out about when comparing economic centers-of-gravity: How much does the economic environment in country A have to do with that of country B. More precisely, the version of Shannon entropy that we are using analyzes the occurance of different sequences of increases and decreases and computes the information contained in such sequences as opposed to purely random sequences given by white noise. Formally, we consider the difference in returns between two lead indices as a time series x_t with N observations of T points in time. Then, we count how often certain sequences (π) occur and normalize by the number of observations (corrected for n, the length of the sequences). This figure (p) we interpret as a probability and compute the Shannon entropy of it. Finally, we also normalize the entropy-measure by the length of the sequences (Bandt & Pompe, 2002).

$$p(\pi) = \frac{\#\{t | t \leq T - n, (x_{t+1}, \dots, x_{t+n}) \; has \; type \; \pi\}}{T - n + 1}$$

$$H(n) = -\sum p(\pi) \cdot \log_2 p(\pi)$$

$$h_n = \frac{H(n)}{n - 1}$$

This procedure we apply to the difference between 30 day (n) moving averages of daily returns of 58 indices from countries of all continents. This results in 754 distances computed, the number of which can easily be increased. For robustness reasons, we also compute distances for seven-day moving averages. For methodological reasons, we add a random variable in the sixth decimal to avoid the exact same returns on days where exchanges do not trade. These days vary of course across countries. The window we used for analysis (T) is 128 days. The permutation order is varied from two (with two possible permutations) to three (with six possible permutations) and four (with 24 possible permutations). These methodological variations, as is shown below, do not alter the overall interpretation of our measure. The resulting measure varies between zero and one, but can also be interpreted in absolute terms.

4. DESCRIPTIVE STATISTICS

The methods we apply have many parameters that can be tweaked. In order to show that the output data are robust against tweaking input parameters, we show descriptive statistics for different calculation methods.

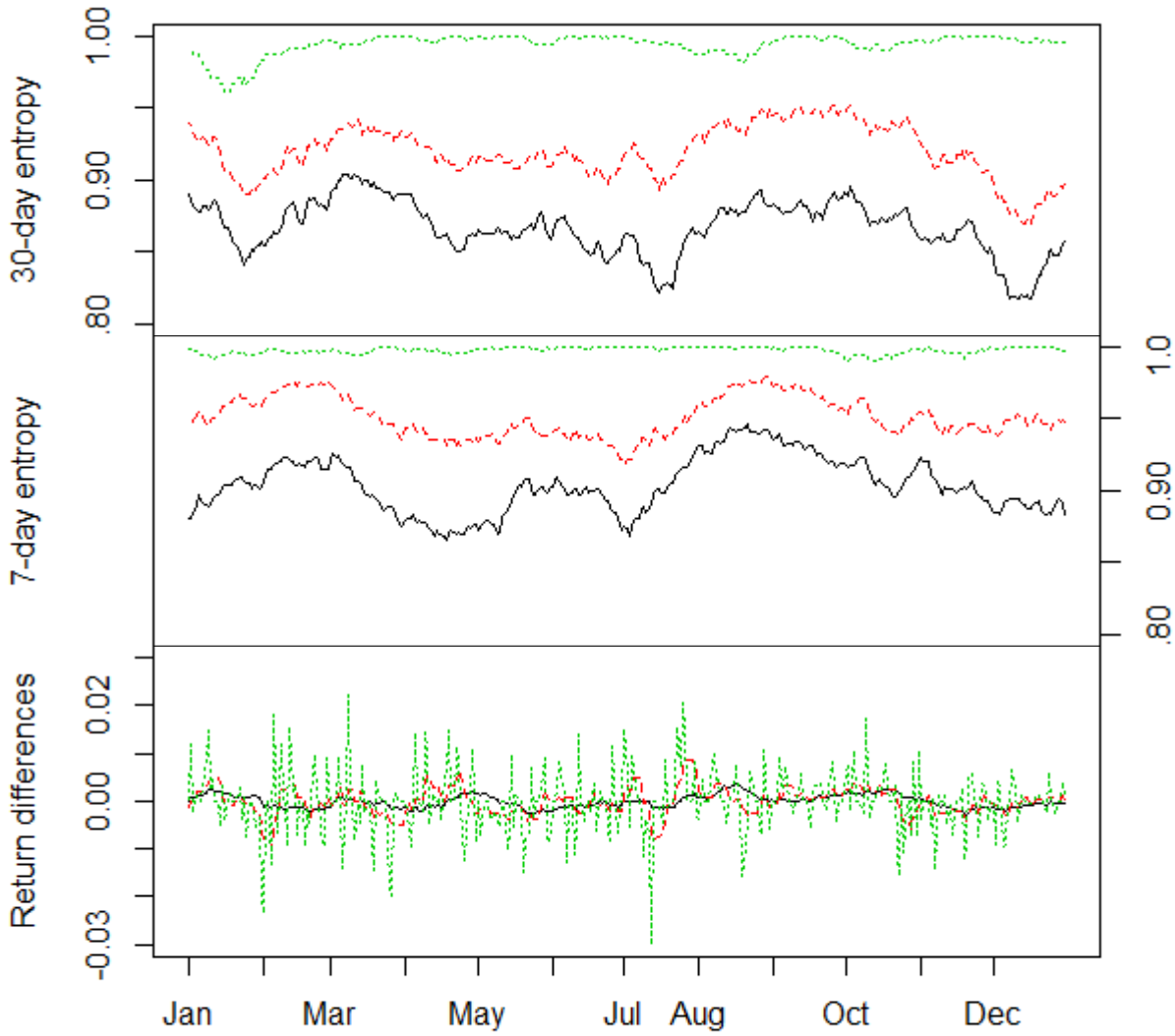

Figure 1 shows the time series for market distance between Spain and Germany for the year 2013. The bottom part of the figure represents the raw difference between the two markets. The part above shows results for the information content based on 7-day moving average returns and different permutation orders and the top part shows the same permutation orders based on a 30-day moving average return difference. Both sets of entropy plots show strong similarity between the results based on permutation orders three and four while the results based on solely up/down permutation (order two) is erratic. Because of the normalization explained above, the maximum entropy that can be observed in our data

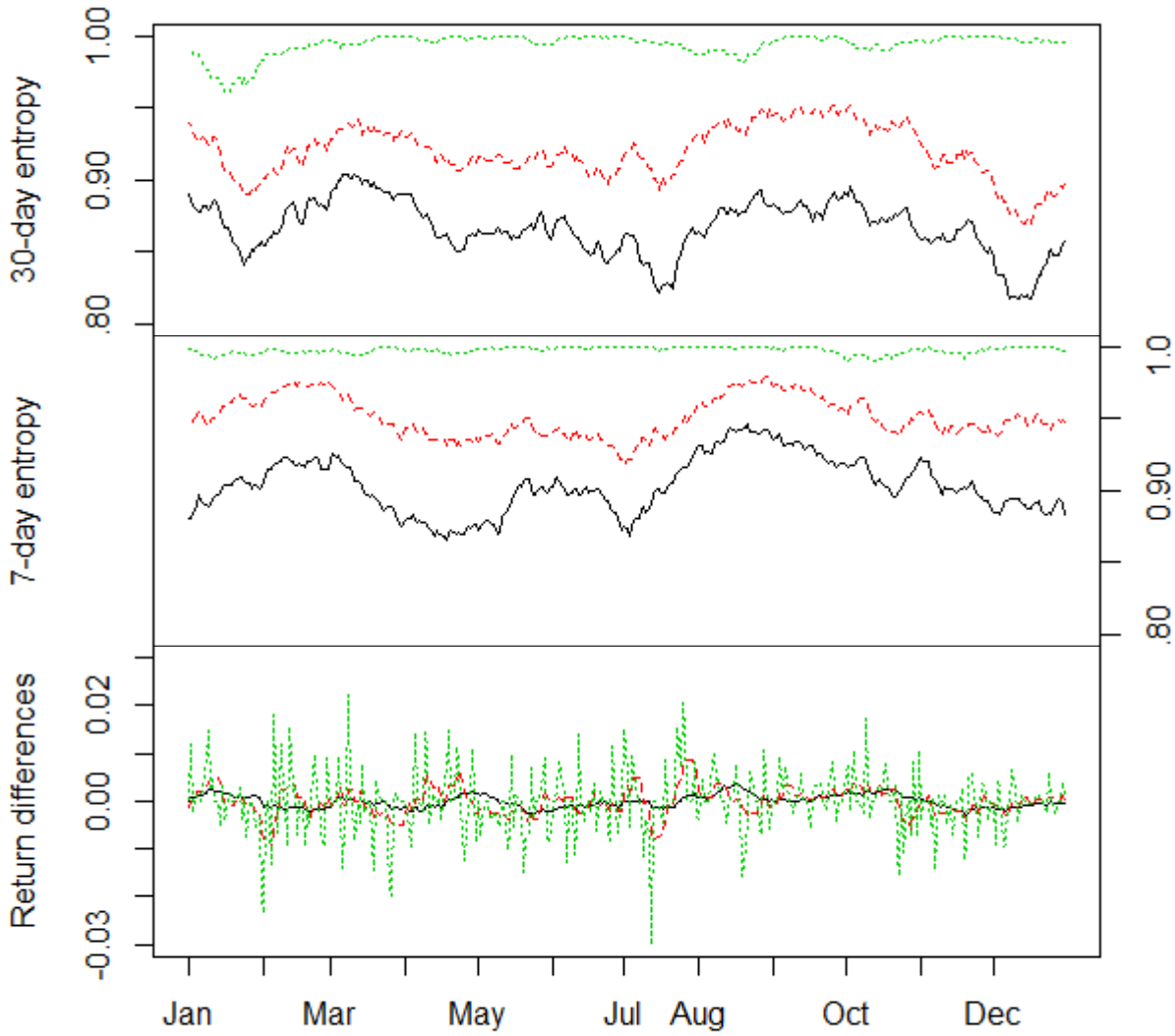

Figure 1is unity, which corresponds to the information contained in white noise. The order-two permutation entropy hence corresponds well to white noise, which is in line with expectation about returns on stock markets.

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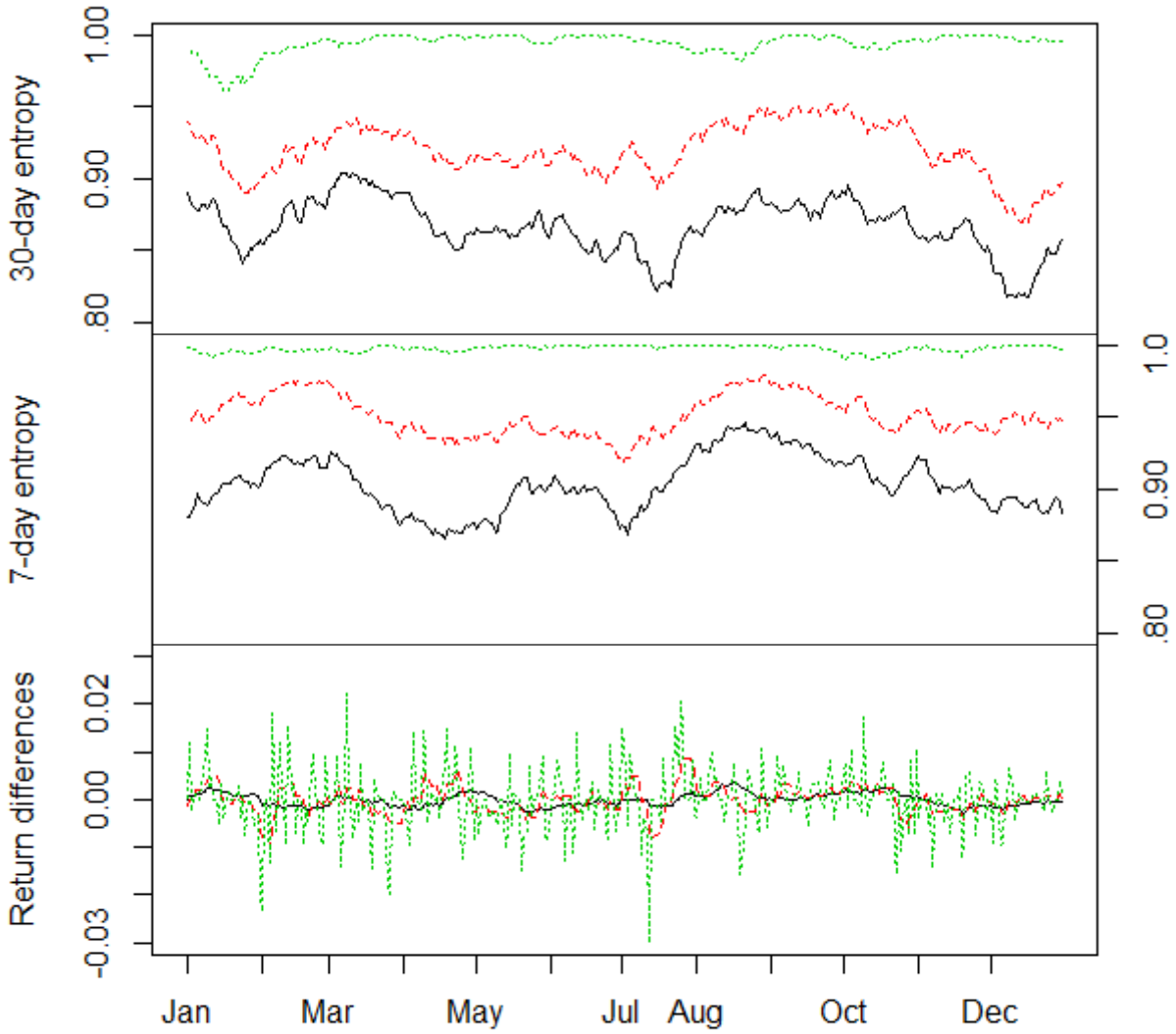

Figure 1 approximately here

When we move to moving averages of longer timespans, however, we can observe structural behavior of the one stock exchange against the other. We can observe, for example, that there was a significant structural move of the German against the Spanish market in end-July / beginning-of-August 2013. This move translates into decreased information content in both the 7-day and 30-day entropy figures. The exact point in time varies because of different lengths of the moving-average period. During this time period, the information content

between the stock exchanges in Germany and Spain dropped, and hence the difference can be explained with less data. This is represented by the drop in entropy that we observe. Less information necessary to explain the difference between stock exchanges means less distance.

The first analysis reveals a major advantage of the market distance measure based on stock indices: availability of data on, and even below, daily level. For applications in international business research, however, institutional distance measures are typically based on yearly moments of distributions over a year: e.g. annual GDP. Of course, we can also create an annual measure from the market distance data presented above. Figure 2 shows data for Germany based on permutation order four and 30-day moving averages for 2013. Apparently, geographically closer markets have less information in the return difference of their respective stock market and hence less market distance to Germany than more distant countries. The exception to this rule is Sri Lanka, which upon closer analysis of the full data, has strong structural movements against almost all other observed markets. This will be analyzed in detail below. A similar picture emerges for the US market, where several lead indices can be observed as well as other countries (Figure 3).

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When it comes to yearly averages over all observed countries, we also see an interesting pattern. The information content, with one exception, on average increased yearly from 2000 to 2009. Then, after the onset of the financial crisis, information content in the distances between the 527 country pairs that full market data is available for, decreased. For the market distance measure this means that while distance between markets used to increase before the crisis, it has decreased, after a rebound in 2010, ever since. The information content that

distinguishes pairs of markets used to increase while since 2009 it has continuously decreased. There are more structural movements of stock exchanges against each other now than there used to be in 2008. This means that differences between markets are less complex today than they used to be and that markets move structurally against each other more than they used to.

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Another feature of the market distance measure that we propose is the distinction of a single country's structural movement against the world market from structural movements between two specific countries. For the sake of demonstration, we show distance data from two pairs of countries that are economically strongly linked: Germany and Austria, as well as India and Sri Lanka. First, we show index returns for the respective lead indices (ATX in Austria and Colombo All Shares Index in Sri Lanka) in Figure 5. Then, we compute the average information content between the respective indices and the remaining lead indices worldwide in the bottom part of Figure 6. We see that the average entropy for both countries is approximately 0.9, with Sri Lanka's being somewhat lower, indicating more structural movement against the rest of the world than Austria. In the center part of

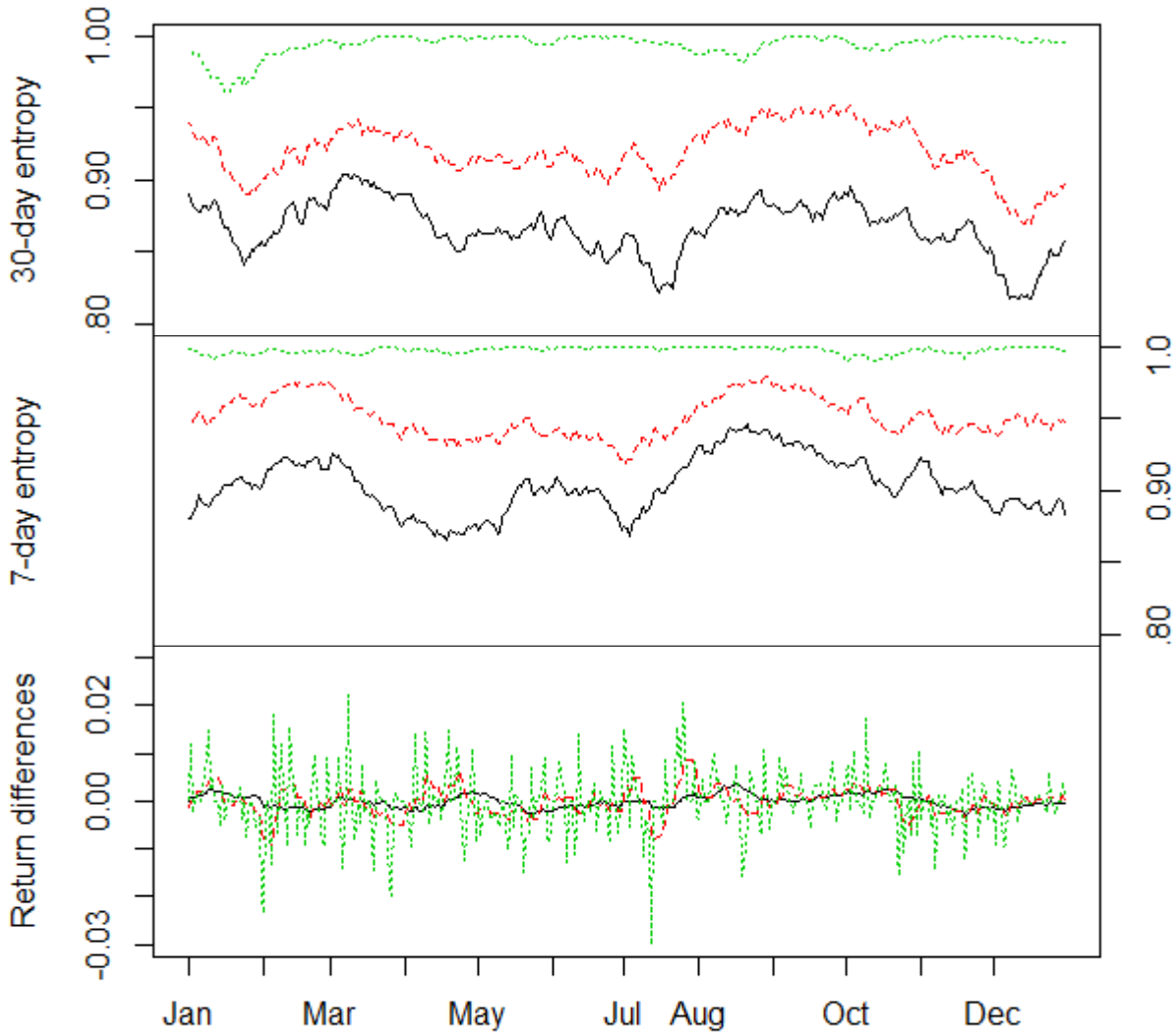

Figure 1Figure 6 we see the information content in the difference between Sri Lanka and India, as well as Austria and Germany, respectively. We can observe that for most of the observed time, the development of the information content between the country pairs mirrors the development of the co-movement with the global average. For an extended time period in the fourth quarter of 2011 and the first quarter of 2012, however, Austria's stock market moved structurally against the German stock exchange but not against the global average. This differential information is depicted in the top part of Figure 6, where the information content between the Austrian and German market reduces in the corresponding time period.

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5. PROPERTIES OF INSTITUTIONAL DISTANCE

The geometric (or physical) distance between two points has a number of properties that are, to some degree, transferred to the concept of institutional distance. The comparison of the concept that the metaphor is drawn from with institutional distance as used in IB research helps to understand its strengths and weaknesses. We address this chapter to the discussion of some of those principles as well as to developing empirical test. In our empirical tests, we compare the market distance measure we propose with the most popular measure of institutional distance (compound cultural distance, as outlined above), and a measure of economic distance that is conceptually close to the market distance measure (Berry, Guillén, & Nan, 2010).

First, geometric distance is symmetric. The distance between points A and B is equal to the distance between points B and A. This holds both in terms of the way it is calculated and in the interpretation, i.e. what it means for its application. Second, geometric distance is transitive. If the distances between points A and B as well as between points B and C are known, there is also information about the distance between points A and C contained in the first two distances. Third, geometric distance comes in a unit of measurement. It is an absolute concept. Distance between points A and B can be interpreted regardless of the availability of a measurement between points C and D. In this chapter, we analyze these three characteristics. For the first, we build arguments based on the highly influential criticism of cultural distance by Shenkar (2001) and the reconciliatory answer by Zaheer, Schomaker, and Nachum (2012). For the second, we build a theoretic argument and propose an empirical means of evaluating measures of institutional distance. For the third, we relate to information

theory to provide an absolute interpretation of the market distance measure that reliefs need to compare measures of institutional distance for interpretation.

Firstly, institutional distance is symmetric. The distance between countries A and B should be the same, regardless of the direction in which the distance is computed. Numerically, this typically is the case for measures of institutional distance (e.g. Berry, Guillén, & Nan, 2010, Henisz, 2000, Kogut & Singh, 1988). In the interpretation, however, there are significant concerns about the symmetry of measures of institutional distance. Empirically, there is no evidence of symmetry in the effect of for example cultural distance on investors from country A investing in country B and the other way around (Shenkar, 2001). It is true that the assumption of symmetry may oversimplify distinctions that are more nuanced than the metaphor to geographical distance, as is argued by Zaheer, Schomaker, and Nachum (2012). Yet, a symmetric distance measurement is highly valued by scholars. Therefore, in addition to the solutions proposed (Zaheer, Schomaker, & Nachum, 2012), we argue that the market distance measure that we propose does not suffer from the shortfalls associated with other measures of institutional distance. First, it is not an aggregate of distances between country averages, but the information content between two distinct constructs and hence does not oversimplify. Second, most of the variation between lead indices follows a process similar to white noise, hence is distributed symmetrically. The values we observe are close to one, hence the assumption of symmetry is also observed empirically. Lead indices include, despite a limited number, heterogeneous samples of firms. All the indices we observe include at least 20 companies. Therefore, firm heterogeneity is accounted for. Fourth, and concerning the arguments put forward by Zaheer, Schomaker, and Nachum (2012), finally, market distance is determined using ideas from a variety of disciplines, particularly portfolio management and statistical physics.

Secondly, in a measure of institutional distance that claims to measure a certain dimension of distance, distances between points A and B as well as between B and C should tell an observer a lot about distance between A and C. From simple geometry, we can conclude that if A, B, and C lie on a straight line (i.e. are measurement points from a one-dimensional construct), we can exactly compute $\overline{AC}$ if we know distances $\overline{AB}$ and $\overline{BC}$ except for a dummy variable indicating which case we are observing.

$$\overline{AC} = \begin{cases} |\overline{AB} + \overline{BC}| \\ |\overline{AB} - \overline{BC}| \end{cases}$$

We can use this information to test whether a certain measure of institutional distance fulfils this first property which we call *transitivity*. We computed distances between three countries A, B, and C for different measures of institutional distance and look at how well the distances between the countries A and B, as well as B and C explain the distance between countries A and C. We find that, in general, the first two distances have strong explanatory power for all measures of distance investigated. The results for the market distance measure that we propose, however, are exceptional. In Table 1 we show regression results for the distance AC, given distances AB and BC. We generated 6,569 random country triplets and looked up distances in the respective databases of Berry, Guillén, and Nan (2010) and Hofstede (1980). From the former, we chose the economic distance dimension since it is closest to what we believe our market distance measure captures. From the latter, we compounded the four dimensions by a variance-weighted average (Kogut & Singh, 1988). We find that, logically, for all three the first two distances ($\overline{AB}$ and $\overline{BC}$) are important explanatory variables of $\overline{AC}$. If we look at explained variance, we see that for cultural distance, the two distances explain approximately 82%, for economic distance 57%, and for market distance 99.9% of variance. Given that theoretically they should explain the full variance except for one bit of information indicating whether the sum or the difference of the distances is the appropriate measure, a

figure close to 100% is to be expected. Consequently, we conclude that the market distance measure is the most transitive of the three investigated.

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insert Table 1 approximately here

Thirdly, it should be possible to interpret a measure of institutional distance without a point of reference. Most measures of institutional distance are indices between zero and one or similar. This makes it necessary to compare the distance between two countries contingent on a reference pair of countries for interpretation. Naturally, this distorts the interpretation because the choice of reference pair is subjective. Particularly, it relates back to the ideas of one-dimensionality and symmetry. A reference-point for interpretation invokes a focus on certain characteristics that are typical for the reference case. Such special characteristics, in turn, are a sign of more than one dimension since in a one-dimensional measure there are no different characteristics. Also, if a reference pair is necessary for interpretation, symmetry becomes even more important for a measure to be consistent. That is because the symmetry of the example rests on the symmetry of the reference point. Overall, it is beneficial if there is an absolute interpretation to a measure for institutional distance. Since market distance is based in information theory (Shannon, 2001), its value is associated with an amount of information content in bits. For the fourth order entropy based on 30-day moving averages, the information content associated with an entropy-value of 0.9 is associated with 26.1 bits of information (0.9*(n-1)=0.9*29). This means that the average information between the respective stock exchanges per day for a given year is 26.1 bits. This number seems to be quite low for complex systems such as stock exchanges. The reason for the low value is that our measure only looks at possible permutations of sequences of increases or decreases and

not the absolute values. Overall, we believe that the absolute interpretation as such provides room for valuable further discussion.

6. EMPIRICAL ILLUSTRATIONS

The value of a measurement, beside the insights it provides about the underlying construct, mainly lies in its ability to contribute to the explanation of a phenomenon. Following the approach used by Berry, Guillén, and Nan (2010) and Drogendijk and Slangen (2006), we introduce a number of empirical illustrations of the explanatory power of the market distance measure in this chapter. We present two examples in this vein. One where we illustrate how the market distance measure explains part of a phenomenon where other popular measures of institutional distance fail to do so. Another, where the market distance measure explains variation on top of the explanation given by other popular measures of institutional distance. We conclude this chapter with a comparison of different measures of institutional distance.

In the first example, we look at the stakes acquired in foreign companies in international acquisitions. Literature about the governance mode of international expansion is vast. Starting with Anderson and Gatignon (1986), scholars have employed transaction cost economics to evaluate firms' decisions concerning forming a joint venture versus fully owning a foreign subsidiary. Different arguments have been put forward why uncertainty, both internal and external, should impact the choice of governance mode (Hennart, 1988, Kogut & Singh, 1988). In a meta-analytical review, Zhao, Luo, and Suh (2004) summarize conflicting results of uncertainty on the choice between joint venture and wholly owned subsidiary. Researchers have argued that part of the reason for those conflicting results may be issues with the typically-employed measurement of internal uncertainty: cultural distance (Tihanyi, Griffith, & Russell, 2005). One of the conceptual issues with cultural distance as a measure of uncertainty is that it captures difficulties in understanding the environment in a different

country (Manev & Stevenson, 2001) while it does not directly capture the underlying differences. This is where the market distance measure may provide additional insights: it directly measures the degree of difference between two economies. We use this illustration to exemplify how the market distance measure can explain variation that other measures of institutional distance do not capture.

We argue that, in analogy to the dichotomous choice between joint ventures and wholly owned subsidiaries, the level of control acquired in international acquisitions can be analyzed in terms of transaction cost theory: Specificity of assets and uncertainty help to understand the degree of control, on a continuous scale, that firms aim to take in an international acquisition. Therefore, the first empirical illustration that we present looks at international acquisitions. We analyze a sample of 936 cross-border acquisitions between 104 pairs of countries from 2009 to 2013 with differing degrees of ownership acquired. We measure asset specificity in terms of expenses for research and development and immaterial assets, as well as industry characteristics. We control for several firm-level determinants such as firm size, profitability, the number of firms in the corporate group, and diversification of firm operations as well as capital structure. In addition, we adopt controls concerning the size of the overall acquisition and different kinds of risks in the target country. We then compare different measures of distance for equivalent samples and look at their ability to explain the stakes acquired in the respective cross-border corporate acquisitions. We conduct hierarchical linear analysis with clustering at the country-pairing level.

With regards to distance, we find that the measure for cultural distance that we employ, a Kogut and Singh (1988) aggregate of the Hofstede (1980) dimensions of cultural differences, does not add to the explanatory power of our firm level model. The corresponding information criterion as shown in Table 2 does not decrease if the distance measure is added. The same holds for the measure of economic distance proposed by Berry, Guillén, and Nan

(2010). These measures are very valuable instruments and have proven highly beneficial to IB research, yet they are not designed to grasp the information content that distinguishes two economies. We do find significant improvement in the BIC, and other measures of model fit (AIC, R^2, Deviance) if we add the market distance measure to the regression model. The more distant a market, the lower the share acquired in a foreign company by an international investing company.

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insert Table 2Table 1 approximately here

In the second illustration, we analyze the decision whether firms expand abroad through greenfield or acquisition. This topic has received substantial attention in IB research (e.g. Kogut & Singh, 1988, Larimo, 2003). This decision has repeatedly been argued to be affected by distance (Brock, 2005, Drogendijk & Slangen, 2006) because of difficulties with integrating an organization from a distant country into the existing organizational structure. In addition, problems with interaction between employees and inter-firm communication (Bandyopadhyay & Robicheaux, 1993) are argued to increase with cross-national distance. These difficulties are argued to lead to firms' increasingly favoring a greenfield approach the more distant the target country. We test this well-understood effect in the following to illustrate the potential of our market distant measure to explain variation in addition to that explained by other measures of institutional distance.

For this purpose, we use a sample of 2,372 investments in foreign markets between 2009 and 2013, approximately half of which are greenfield investments and half are acquisitions (brownfield investments). The investments occurred between 144 pairs of countries. We downloaded the data from the fDi Markets and zephyr databases, respectively. Financials and

company information was supplemented from data in the orbis database. All firm-level control variables are lagged by one year to avoid simultaneity issues. We estimate all models using logistic regression. We find that both cultural distance as used before and economic distance are good explanatory variables of the choice between greenfield and brownfield investments. The larger the distance between the respective countries, the more likely are firms to opt for greenfield investments, in line with the abovementioned reasoning. The improvement in model fit is very similar for the two measures, as can be seen in Table 3. If we add market distance to a model with either of the two distance measures, we observe a highly significant improvement in model fit, as expressed by the Akaike Information Criterion. We conclude that market distance, even if we already account for cultural or economic distance, adds a lot of explanatory value to the respective models. If we compare the gain to that of cultural distance or economic distance, we can see that it is substantially higher for the addition of market distance than for either economic or cultural distance. If we apply all three measures, economic and cultural distance fall just below the significance cutoff for the 0.05 level, but market distance remains strongly positive. The direction of the effect of market distance is also interesting: it is opposite to that of the other two effects. This leads us to the conclusion that market distance can supplement our understanding of governance decisions that are partially explained by other measures of cross-national institutional distance.

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insert Table 3Table 2Table 1 approximately here

The difference in the direction of effects observed in Table 3 raises the question of the relationship between the measures of distance that were employed for comparison so far.

Correlations between different popular measures of institutional distance are displayed in Table 4. It is evident that market distance is, despite slightly, negatively correlated with both the cultural and economic distance measures. Therefore, it is straightforward that it has the potential to explain some behaviors that are not explained by the latter two measures. Yet, it is positively correlated with the geographic distance between the capitals of two countries and the political distance. These measures are also negatively correlated with cultural and economic distance. Hence, market distance can be understood in a tradition of distance measures that are to some degree driven by physical distance between countries, but also political differences.

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insert Table 4Table 2Table 1 approximately here

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7. CONCLUSION AND OUTLOOK

We started out this project with the aim to analyze institutional distance literature and find relevant discussion papers that criticize or highlight properties of institutional distance that are helpful in evaluating measures of the concept. We have found the articles by Shenkar (2001) and Zaheer, Schomaker, and Nachum (2012) illustrative of the discussion and as good starting points for our own analysis. From this stepping stone, we have developed additional criteria that can be used to evaluate measures of institutional distance. Most notably, we have proposed the empirically testable criteria of transitivity and interpretation without comparison. Of course, there is more to these concepts than can be captured in one article, but we believe that we make a contribution to the literature on institutional distance in general with our proposition and evaluation.

Making use of the properties that we developed and the criteria put forward by Zaheer, Schomaker, and Nachum (2012), we propose a measure for institutional distance that does not suffer from usual shortfalls. Permutation entropy provides a method to evaluate time series with regards to their information content. Hence, the time series that stands for the absolute difference between stock market indices can be analysed with regards to the information content that distinguishes the return of two equity markets. It is superior to correlation-based measures because of methodological reasons and in the interpretation that it provides. We connect this measure, which we call "market distance", with the institutional distance literature by relating to the channel of the difference between institutional environments, not so much the ability to understand that difference. We relate to the empirical literature on institutional distance by providing empirical illustrations that the market distance measure has potential to explain phenomena *instead* of other measures of cross-national institutional distance as well as *in addition* to the explanation given by other measures. We are hence convinced that the measure, in the annual average form that we used it in the illustrations, has potential to contribute to IB literature.

Yet, annual averages are only a very narrow field of application of market distance. Due to the rich underlying data, we can provide scholars also with monthly, weekly, and even daily time series. In addition, the method we propose can also be deepened to the industry level (as illustrated in the US example with 5 different indices), and even firm level (if the firm is listed). Deepening may provide rich insights with regards to risk management because of the close connection to portfolio management where entropic measures of risk are commonplace. On another dimension, determining the entropy in a time series of returns also opens up a deeply-rooted theoretic perspective that eventually draws on statistical physics. With entropy defined, scholars can also define an analogy to temperature in financial time series. While that may sound somewhat far-fetched on first sight, it turns out that other fields have benefitted

from a similar approach and that an interpretation of, particularly, a temperature measure may not be very difficult and hard to understand. Anyways, research that would just clarify the potential of such an avenue, we feel, is warranted given the applications of entropy that have become apparent in this article. On a higher level, linking two fields of researched with established methods and theory can be highly beneficial to the understanding of International Business.

Despite the potential of the measures it proposes, this paper also has some limitations both in terms of scope and depth. Additional properties of institutional distance that are empirically testable may well exist. We focus on the discussion of previous literature concerning the concept of institutional distance and add empirically testable measures that are derived from the origin of the distance analogy: geometric distance. We are convinced that scholars will find more empirically testable measures when looking at other origins of distance measures. In terms of depth, we are well aware that the empirical illustrations that we provide are less rigorous than empirical tests provided by other articles that mainly focus on the respective issues at hand. We concentrate on the fact that market distance may add to research problems relevant in IB. Illustrations with regards to empirical problems relevant in the finance literature were discarded for reasons of conciseness. In conclusion, we hope to have contributed to literature in several ways, spurring the interest of scholars in the theoretic foundations of the distance part of institutional distance as well as the potential of measures of distance based on the information content and particularly entropic ones.

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9. APPENDICES

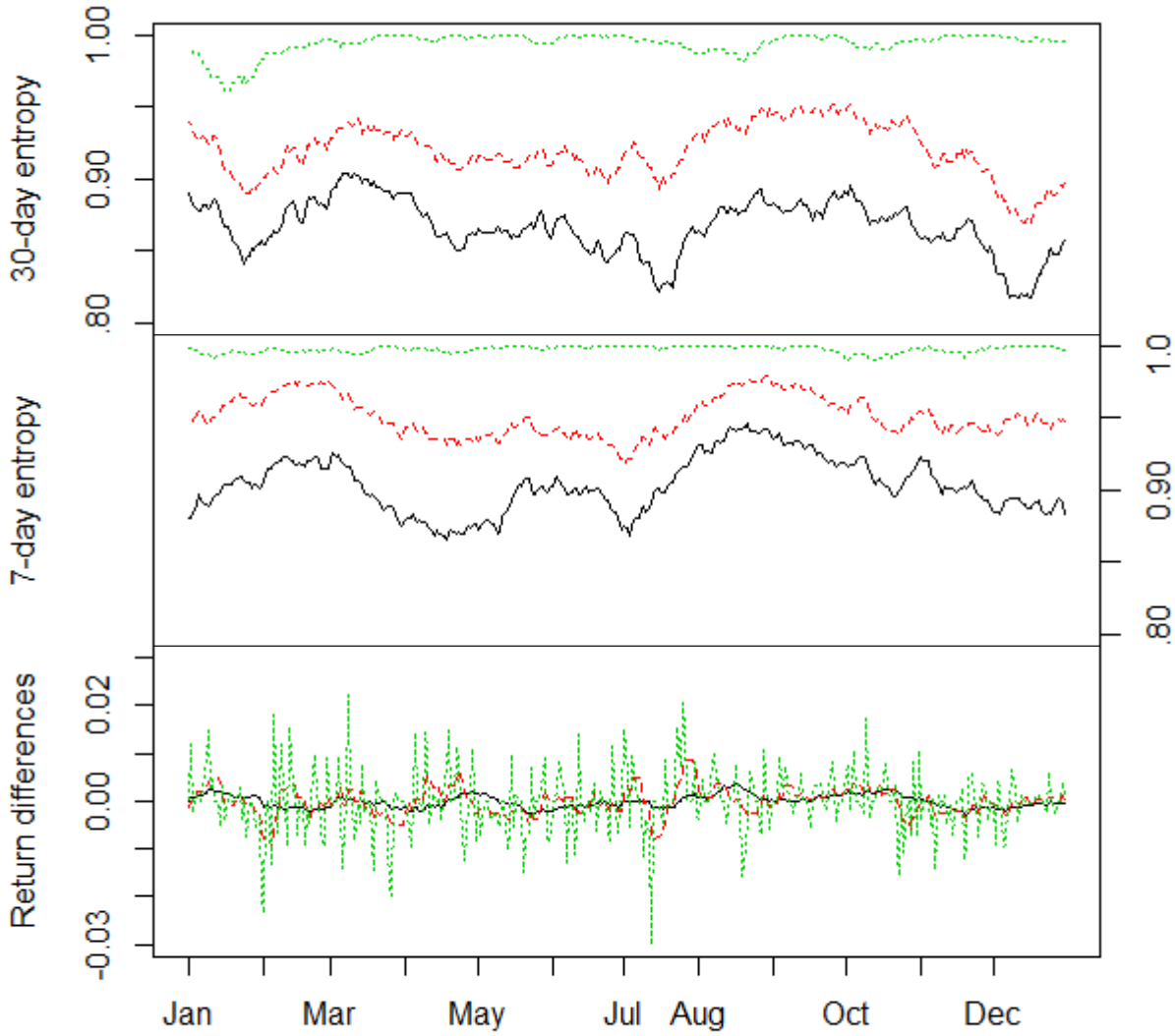

Figure 1: A measure for market distance between Spain and Germany for 2013. Return difference data in continuous time (bottom figure) based on respective lead index data. Dotted (green) line is day-to-day returns, dashed (red) line is 7-day moving average, and full (black) line is 30-day moving average. Second-from-bottom is permutation entropy based on the 7-day moving average and permutation order 2 (green, dotted line), order 3 (red, dashed line), and order 4 (full, black line). Top figure is permutation entropy based on the 30-day moving average with same color coding of permutation orders.

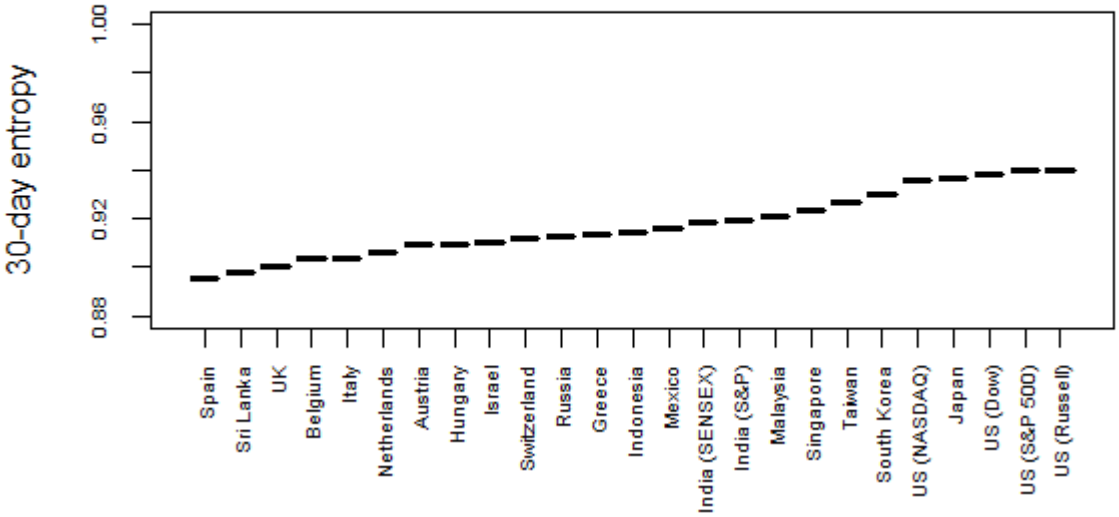

Figure 2: Annual average entropy for Germany, based on permutation order 4 and 30-day moving averages for 2013.

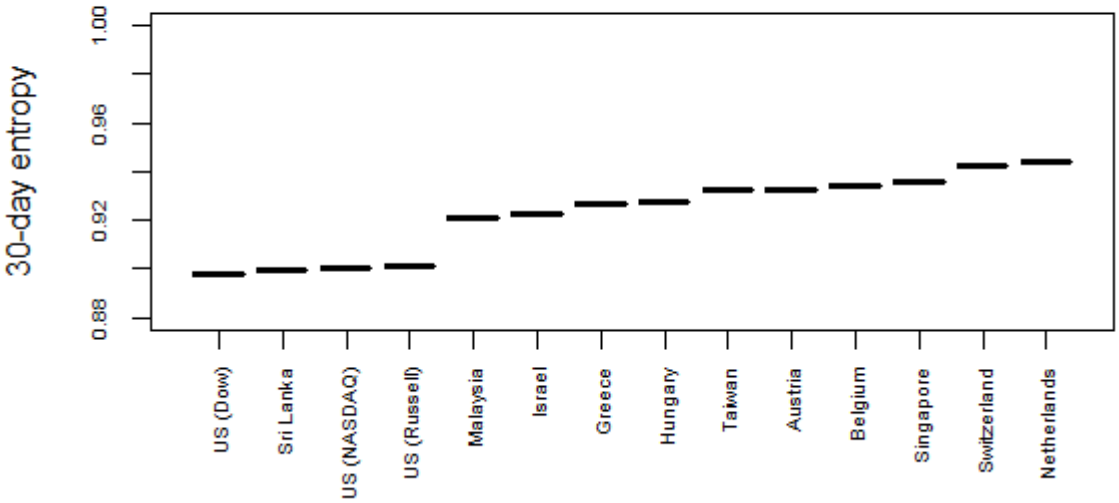

Figure 3: Annual average entropy for the US S&P500, based on permutation order 4 and 30-day moving averages for 2013.

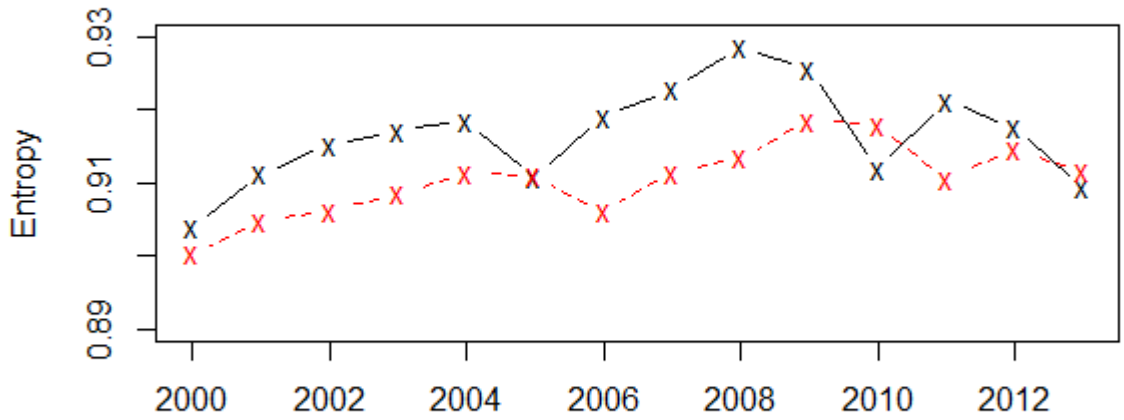

Figure 4: Average annual entropy of 527 market pairs based on permutation order 4 and 30-day moving averages (red, dashed line) and 7-day moving averages (black line).

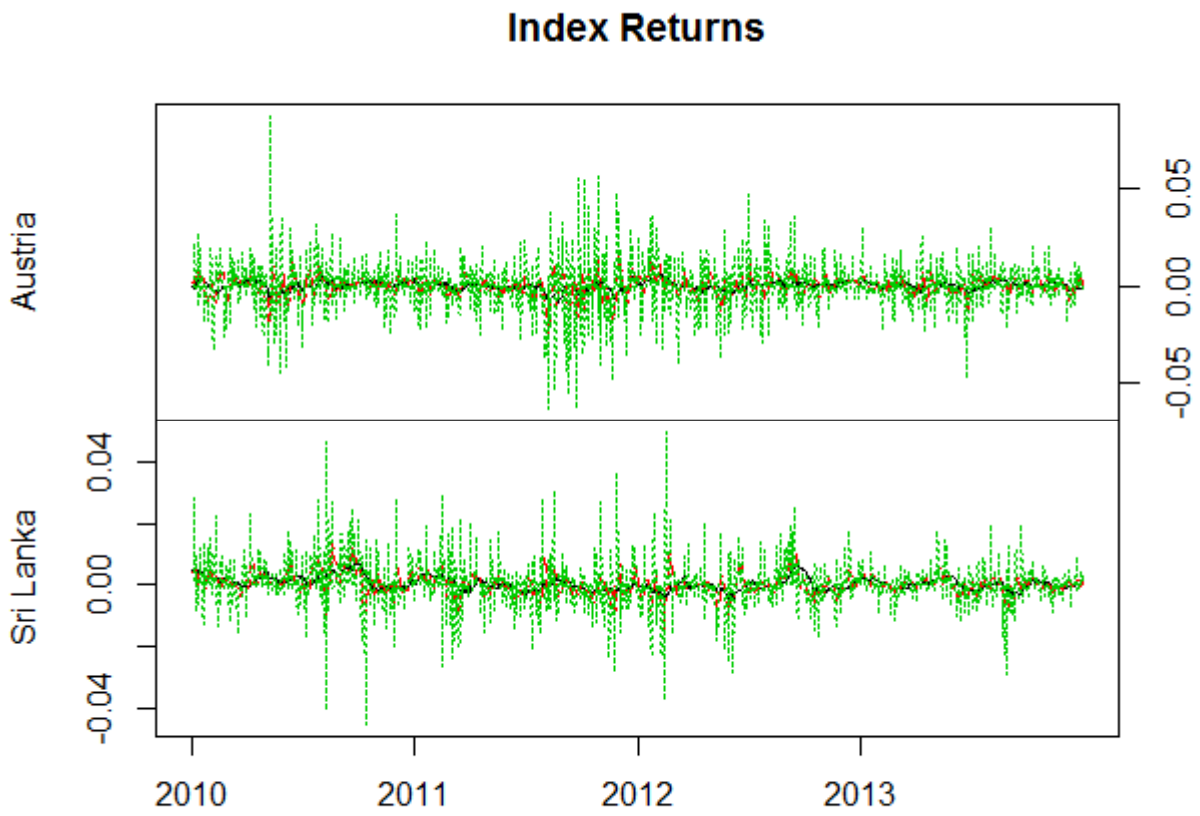

Figure 5: Index returns of the Austrian and Sri Lankian lead indices. Green (dotted) are day-to-day returns, red (dashed) are 7-day moving averages, and black (solid) are 30-day moving averages.

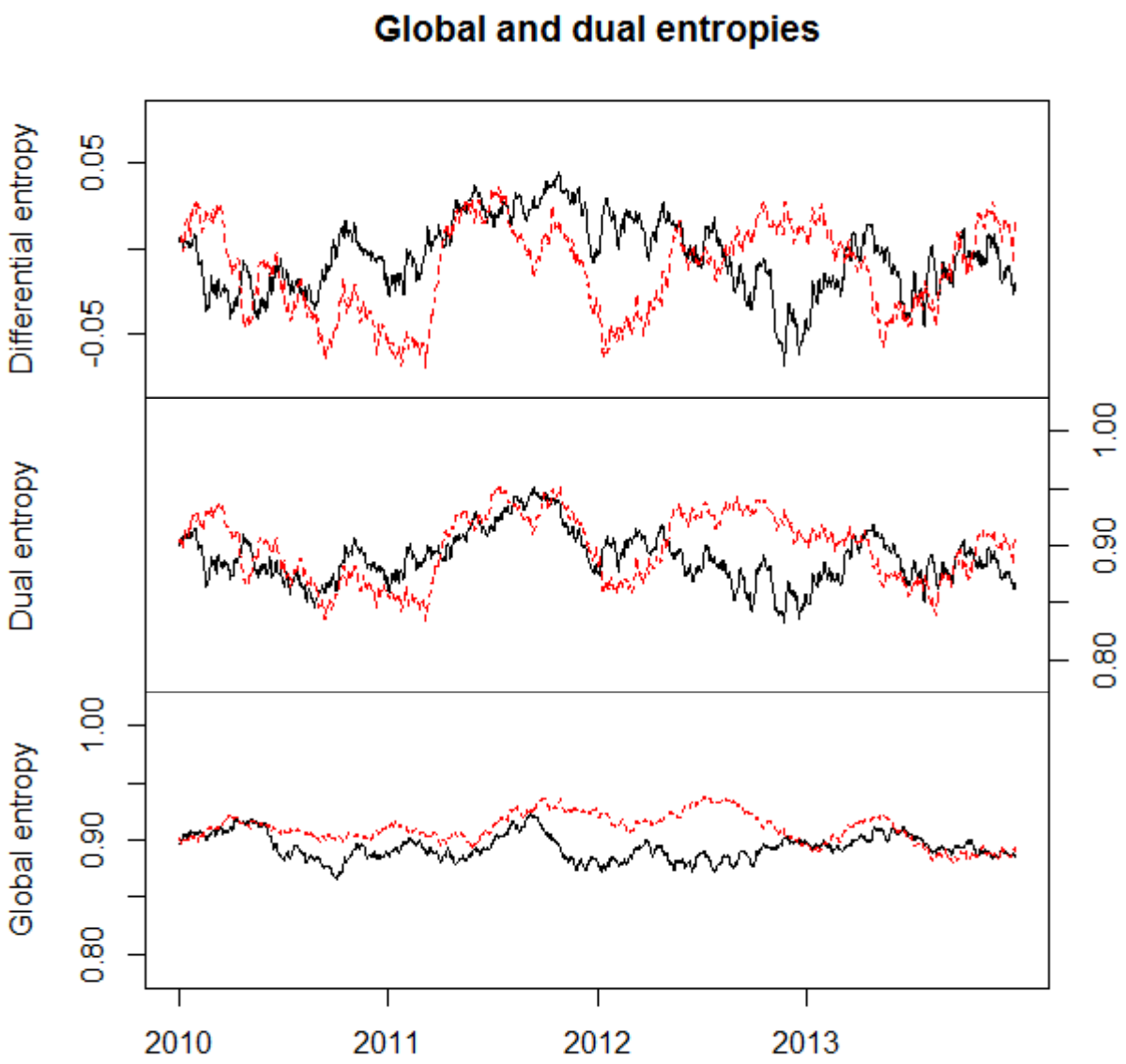

Figure 6: Comparison of dual and global entropies. Bottom figure is average differential entropy (30 days, order 4) between Sri Lanka and 38 other countries (black, solid), and Austria and 38 other countries (red, dashed), excluding the respective other country between January 2010 and December 2013. Middle figure is the average entropy between the respective countries (Sri Lanka in black, solid and Austria in red, dashed) and their larger and economically closely linked neighbor: India and Germany, respectively. Top figure is the difference between the dual and global entropies, again black for the difference between the Sri Lanka – India and Sri Lanka – world average entropies. Red for the difference between the Austria – Germany, and Austria – world average entropies.

	Cultural Distance	*Economic Distance*	*Market Distance*
AB	0.4842***	0.3937***	0.5109***
	(44.66)	(34.43)	(47.75)
BC	0.4482***	0.4349***	0.4888***
	(41.52)	(37.82)	(45.70)
adj. R^2	0.8178	0.5679	0.9995
N	6569	6569	6569
countries	38	148	55

Table 1: Explanation of distance AC from distances AB and BC. Cultural distance is a Kogut and Singh (1988) compound of the four dimensions of cultural distance by Hofstede (1980). Economic distance is the economic dimension of the Berry, Guillén, and Nan (2010) framework of institutional distance. Market distance are annual averages of the 30-day moving average returns based on order 4 permutation entropy that is presented in this article. *** indicates significance on the $p<0.0001$ level.

DV=Acquired Stake	*(1)*	*(2)*	*(3)*
Constant	70.988	178.344***	260.561***
	(39.348)	(40.554)	(71.020)
Assets	-10.175***	-9.037***	-8.727***
	(0.962)	(1.045)	(0.925)
Profitability	0.832	8.466	2.261
	(9.705)	(10.155)	(9.315)
R&D	4.007	-5.816	10.203
	(20.706)	(22.312)	(21.755)
Immaterial	23.764**	14.977	17.172*
	(7.255)	(8.201)	(7.217)
Group	6.252***	4.492*	4.887**
	(1.681)	(1.843)	(1.573)
Country Experience	2.407	2.969	2.861
	(5.210)	(5.314)	(4.815)
Equity Ratio	0.027	0.016	0.010
	(0.063)	(0.067)	(0.062)
Diversification	1.891**	1.912*	1.677*
	(0.674)	(0.772)	(0.689)
Transaction Volume	6.402***	5.935***	5.840***
	(0.552)	(0.602)	(0.551)
WoS Experience	0.001	-0.003	-0.016
	(0.042)	(0.047)	(0.043)
JV Experience	-0.017	-0.017	-0.015
	(0.049)	(0.053)	(0.050)
Economic Risk	0.759*	0.970*	0.577
	(0.355)	(0.464)	(0.346)
Political Risk	0.132	-0.314	-0.109
	(0.301)	(0.316)	(0.276)
Financial Risk	-0.941*	-1.892**	-1.048*
	(0.456)	(0.595)	(0.445)
Cultural Distance	2.514		
	(3.108)		
Economic Distance		0.171	
		(0.207)	
Market Distance			-141.079*
			(71.639)
N	857	811	936
G	71	94	104
BIC empty	7,890.025	7,558.116	8,761.802
BIC with distance	7,892.019	7,565.441	8,754.389

Table 2: Regression results for acquired stakes in international corporate acquisitions. Assets are lagged logarithms of total assets, Profitability is lagged EBIT over lagged total assets, R&D is lagged R&D expenditure

over lagged total assets, Immaterial is lagged immaterial assets over lagged total assets. Group indicates amount of companies in corporate group, Country Experience is a dummy indicating whether the company had a subsidiary in the respective country before the acquisition. Equity Ratio indicates lagged equity over lagged total assets, WoS Experience is number of wholly owned subsidiaries owned by the company one year before the acquisition, JV Experience is the corresponding figure for commonly owned subsidiaries. Economic, Political, and Financial Risk are the PRS scores for the corresponding risk categories for the host country. Cultural Distance is a Kogut and Singh (1988) aggregate of the Hofstede (1980) dimensions. Economic Distance is the Berry, Guillén, and Nan (2010) measure with the corresponding name (with annually adapted covariance matrix). Market distance is annual averages of order four permutation entropy and 30-day moving averages as presented above. All distance measures are lagged by one year. Standard errors in brackets. *, **, and *** indicate significance on the 0.05, 0.01, and 0.001 levels for two-sided tests. N is the number of acquisitions, G is the number of country pairs. BIC empty stands for Bayesian Information Criterion in the corresponding model without distance measure. BIC with distance for the Bayesian Information Criterion for the model displayed. Industry dummies applied but output suppressed. Level-two clustering according to country pairs.

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Constant	-4.927***	-4.732**	-4.669**	-25.095***	-25.268***	-24.695***
	(1.470)	(1.490)	(1.467)	(2.863)	(2.873)	(2.881)
Assets	0.065	0.080*	0.065	0.058	0.048	0.058
	(0.040)	(0.041)	(0.040)	(0.041)	(0.041)	(0.041)
Profitability	2.186***	2.033***	2.281***	2.189***	2.350***	2.235***
	(0.489)	(0.480)	(0.494)	(0.498)	(0.505)	(0.501)
R&D	-0.053	-0.266	-0.125	-0.623	-0.513	-0.637
	(1.026)	(1.034)	(1.029)	(1.070)	(1.064)	(1.069)
Immaterial	1.610***	1.338***	1.523***	1.335***	1.472***	1.318***
	(0.329)	(0.339)	(0.331)	(0.344)	(0.336)	(0.344)
Group	-0.183*	-0.189*	-0.194*	-0.159*	-0.160*	-0.163*
	(0.076)	(0.076)	(0.076)	(0.077)	(0.077)	(0.077)
Country Experience	0.463*	0.426	0.448*	0.299	0.314	0.298
	(0.220)	(0.220)	(0.220)	(0.224)	(0.224)	(0.224)
Equity Share	0.009**	0.009**	0.009**	0.008**	0.008*	0.008**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Diversification	0.110***	0.110***	0.120***	0.109***	0.114***	0.113***
	(0.032)	(0.032)	(0.032)	(0.032)	(0.032)	(0.032)
WoS Experience	-0.006***	-0.007***	-0.006***	-0.005***	-0.005**	-0.005***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
JV Experience	0.009***	0.010***	0.009***	0.008***	0.008***	0.008***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Economic Risk	-0.032	-0.028	-0.026	-0.031	-0.030	-0.029
	(0.016)	(0.016)	(0.016)	(0.016)	(0.017)	(0.017)
Political Risk	0.051***	0.047***	0.048***	0.035***	0.037***	0.035***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Financial Risk	0.009	0.013	0.014	0.042*	0.043*	0.043*
	(0.016)	(0.016)	(0.016)	(0.017)	(0.017)	(0.017)
Cultural Distance		-0.163**		-0.113*		-0.102
		(0.051)		(0.052)		(0.053)
Economic Distance			-0.037**		-0.021	-0.015
			(0.014)		(0.014)	(0.015)
Market Distance				21.993***	22.199***	21.671***
				(2.598)	(2.610)	(2.610)
N	2,372	2,372	2,372	2,372	2,372	2,372
Log Likelihood	-1,367.59	-1,362.39	-1,364.09	-1,323.07	-1,324.40	-1,322.51
AIC	2,795.18	2,786.79	2,790.18	2,710.15	2,712.80	2,711.03

Table 3: Regression results for the choice between greenfield and acquisition. Assets are lagged logarithms of total assets, Profitability is lagged EBIT over lagged total assets, R&D is lagged R&D expenditure over lagged total assets, Immaterial is lagged immaterial assets over lagged total assets. Group indicates amount of companies in corporate group, Country Experience is a dummy indicating whether the company had a subsidiary in the respective country before the acquisition. Equity Ratio indicates lagged equity over lagged total assets, WoS Experience is number of wholly owned subsidiaries owned by the company one year before the acquisition, JV Experience is the corresponding figure for commonly owned subsidiaries. Economic, Political, and Financial Risk are the PRS scores for the corresponding risk categories for the host country. Cultural Distance is a Kogut and Singh (1988) aggregate of the Hofstede (1980) dimensions. Economic Distance is the Berry, Guillén, and Nan (2010) measure with the corresponding name (with annually adapted covariance matrix). Market distance is annual averages of order four permutation entropy and 30-day moving averages as presented above. All distance measures are lagged by one year. Standard errors in brackets. *, **, and *** indicate significance on the 0.05, 0.01, and 0.001 levels for two-sided tests. N is the number of observations. AIC stands for Akaike Information Criterion. Industry dummies are applied but suppressed.

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
(1) Market Distance	1.00	-0.24	-0.14	-0.17	0.41	0.52
(2) Cultural Distance	-0.24	1.00	0.36	0.03	0.21	0.01
(3) Economic Distance	-0.14	0.36	1.00	0.17	0.09	0.07
(4) Financial Distance	-0.17	0.03	0.17	1.00	0.27	0.14
(5) Political Distance	0.41	0.21	0.09	0.27	1.00	0.62
(6) Geographic Distance	0.52	0.01	0.07	0.14	0.62	1.00

Table 4: Correlations between different measures of institutional distance. Market distance is the above-described annual averages of order-4 permutation entropy based on 30-day moving averages. Cultural distance is the Kogut and Singh (1988) aggregate of the Hofstede (1980) dimensions. Economic, Financial, and Political Distance are the Berry, Guillén, and Nan (2010) measures with the corresponding names. Geographic Distance is the physical distance between countries, also taken from the Berry, Guillén, and Nan (2010) framework.