Does Stock Price Synchronicity Represent Firm-Specific Information? The International Evidence

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ABSTRACT

Much of prior international accounting research implicitly assumes that stock prices capture similar amounts of firm-specific information across countries. Recent research asserts that stock price synchronicity, defined as the R^2 from asset pricing regressions, is a useful measure of the amount of firm-specific information impounded in stock prices in international markets. However, the results of our empirical tests provide little support for using stock price synchronicity as a measure of firm-specific information internationally. We develop an alternative measure of firm-specific information impounded in stock price based on the percentage of zero-return days, i.e., the zero-return metric, and repeat the analyses. Overall, our results suggest that the zero-return metric is a better measure of firm-specific information impounded into share prices than the synchronicity measure internationally.

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1. Introduction

Prior research documents differences in the value relevance, timeliness, and conservatism of accounting information across countries (see e.g., Alford, Jones, Leftwich, and Zmijewski, 1993; Ball, Kothari, and Robin, 2000; Ball, Robin, and Wu, 2003). An underlying assumption of this line of research is that stock prices reflect similar amounts of information about firm fundamentals--firm-specific information--across countries. There are, however, significant differences in mandated and voluntary information flows across countries that affect the relative amount of firm-specific information present in international markets. Morck, Yeung, and Yu (2000) propose that stock price synchronicity, defined as the R^2 from asset pricing regressions, can be used as a measure of the relative amount of firm-specific information reflected in returns internationally. Morck et al. (2000) interpret higher R^2 values, (greater stock price synchronicity) as returns that reflect more market-wide information and lower R^2 values as returns that reflect more firm-specific information. A low R^2 is potentially due to firms' returns capturing unique firm-specific information or reflecting greater idiosyncratic noise (Roll, 1988). The purpose of this study is to evaluate the information-based explanation for the synchronicity measure by conducting five analyses designed to assess the presence of firm-specific information in six of the largest equity markets: Australia, France, Germany, Japan, the U.K., and the U.S.[1]

Our first analysis builds on the work of Durnev, Morck, Yeung, and Zarowin (2003), who assess whether the R^2 measure is associated with the informativeness of U.S. firms' stock prices. If the R^2 measure consistently reflects the amount of firm-specific information in returns internationally, we expect lower R^2 values to be associated with prices that are more informative regarding future earnings. Overall, the results of our price informativeness tests are not consistent with this expectation. We find that higher R^2 values are associated with more informative prices

[1] The Appendix displays the summary findings in 15 additional countries that have sufficient data to conduct our five analyses.

in Germany and the U.S., and find no statistically significant association between R^2 values and price informativeness in Australia, France, Japan or the U.K. Contrary to Durnev et al. (2003), who suggest that greater firm-specific return variation is associated with more informative stock prices in the U.S., our results suggest that there is no consistent relation between the R^2 measure and the pricing of future earnings information in international markets.[2]

Our second analysis investigates whether stock price synchronicity is associated with analyst forecast errors. Prior research documents a negative relation between firm disclosures and analysts' forecast errors (Lang and Lundholm, 1996; Hope, 2003). The work of Ashbaugh and Pincus (2001) and Lang, Lins, and Miller (2003) indicates that analysts' forecast errors decline when a non-U.S. firm's public information set expands as a result of adopting International Financial Reporting Standards or U.S. Generally Accepted Accounting Principles, respectively. Therefore, if low R^2 values reflect the capitalization of greater amounts of firm fundamentals into share prices following the release of firm-specific information, we expect a positive relation between analysts' forecast errors and R^2 measures. The results of our analysts' forecast errors analysis are consistent with this expectation in Japan, where we document a positive association between firms' R^2 measures and analysts' forecast errors. In Australia, France, Germany, the U.K., and the U.S., however, we find that firms with larger R^2 values have smaller analysts' forecast errors. These opposing findings challenge the notion that the synchronicity measure consistently captures the relative amount of firm-specific information impounded in share price in international markets.

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[2] Durnev et al. (2003) use a matched pair design to assess whether U.S. firms that have lower R^2 values have more future earnings information reflected in their returns after controlling for other variables that proxy for risk. The use of the matched paired design potential limits the ability to generalize the results to the market as a whole. Since we are interested in assessing the association between the R^2 measure and the pricing of future earnings within the respective market, we use a cross-sectional design. Furthermore, we do not add control variables to our price informativeness tests because Morck et al. (2000) view the R^2 as a summary measure of the amount of information reflected in returns. Under this interpretation the inclusion of control variables, such as size, which influence both the R^2 measure and the pricing of future earnings information, is not appropriate. Thus our U.S. results speak to the sensitivity of the Durnev at al. (2003) findings to alternative design choices.

In our third analysis, we investigate whether there is a change in stock price synchronicity surrounding firms' cross listings in the U.S. Cross listing in the U.S. represents a major information event because U.S. foreign registrants are required to provide more disclosures than those required in home markets (Ashbaugh, 2001; Lang et al., 2003). Cross listing also makes these firms more visible to new investors, which increases investors' information search (Karolyi, 2004). If lower R^2 measures represent relatively more firm-specific information in returns, we expect a decline in R^2 values following firms' cross listings in the U.S. However, we find no evidence that Australian, French, German, Japanese, or U.K. firms' R^2 values decline following their cross listing in the U.S. Rather, we find that the R^2 values of French firms and U.K. firms increase after a U.S. listing. The results of this analysis increase doubts about whether the synchronicity measure can be used to capture differences in firm-specific information impounded in international stock prices.

Our fourth analysis tests the association between the synchronicity measure and variables used in prior research to proxy for firm fundamentals. Specifically, we use the reporting of a loss, the disclosure of research and development costs, the standard deviation of sales, and the standard deviation of return-on-assets to proxy for firm fundamentals. We use the percentage of closely held shares and analyst following to proxy for the quantity and quality of firms' information flows. If R^2 values capture the relative amount of firm-specific information reflected in prices internationally, we expect consistent relations between R^2 values and the variables that proxy for firm fundamentals and public information flows within our sample countries. After controlling for firm size, trading volume, and industry regulation, we find significant relations between the R^2 measure and the information proxies (firm fundamentals) within each of our sample countries. However, the relations are inconsistent in that we find positive relations between the R^2 measure and information proxies in some countries and negative relations in other countries. These findings provide additional evidence that the information-based interpretation of the R^2 measure is not valid on a consistent basis in international markets.

The work of Andrade et al. (2005), Barberis et al. (2005), Kumar and Lee (2005), and Greenwood (2005) suggests that non-fundamental factors affect firms' stock price synchronicity. Building on Barberis et al. (2005), we conduct one more analysis to determine whether stock price synchronicity captures firm-specific information flows impounded in share price. Our final stock price synchronicity analysis examines the association between German firms' membership in a German-market index and their R^2 values. The German market provides a unique setting to assess the usefulness of the synchronicity measure as a measure of information because membership in certain German indices during our analysis period required firms to provide additional disclosures that were intended to increase firm-specific information flows.[3] If the synchronicity measure reliably reflects the relative amount of firm-specific information in a market, we expect the R^2 values of German firms that are members of an index to be lower than those of other German firms. Conversely, we find that membership in a German index is associated with significantly higher R^2 values. This finding suggests that non-fundamental factors significantly influence stock price synchronicity in the German market.

Collectively, the results of our analyses indicate that the cross-sectional variation in R^2 values is not consistently related to the price informativeness of future earnings, analysts' forecast errors, non-U.S. firms' cross listing in the U.S., or variables that proxy for firm fundamentals or public information flows. Thus, our findings suggest that firms' synchronicity measures do not consistently capture differences in firm-specific information in international markets.

Having provided evidence that the information-based interpretation of the synchronicity measure is not reliable in international markets, we develop and investigate whether an alternative market measure better captures the relative amount of firm-specific information in returns internationally. Building on the work of Bekaert, Harvey, and Lundblad (2003) and Lesmond, Ogden, and Trzcinka (1999), we use the percentage of zero-return days as a simplified measure of

[3] We limit this analysis to the German market because of the difficulty in identifying non-U.S. firms' index memberships over time.

firm-specific-information. Lesmond et al. (1999) note that the marginal investor will not trade unless the value of an information signal is sufficient to exceed his trading costs. If the marginal investor does not trade, then there is no change in price, and a zero-return results. Zero returns can also occur when trading takes place but price does not change because there is no new valuation-relevant information. We apply these notions to the international setting, assuming that when sufficient valuation-relevant information arrives in the market, investors trade, and a return is generated. Therefore, we conjecture that the proportion of zero-return days (hereafter referred to as the zero-return metric) represents the frequency of a firm's information flows, where a lower zero-return metric (i.e., smaller proportion of zero-return days) reflects more informationally efficient share prices.

We repeat our five analyses using the zero-return metric in place of the synchronicity measure and find the following. In assessing whether the zero-return metric is associated with more informative prices with respect to future earnings, we find, as expected, that the zero-return metric is negatively associated with the amount of earnings-related information reflected in returns in Germany, Japan, the U.K., and the U.S. Consistent with expectations, the results of the analysts' forecast errors analysis indicate that the zero-return metric is positively associated with analysts' forecast errors in Australia, France, the U.K., and the U.S. In addition we find a significant decline in the zero-return metric following the cross listing of French and U.K. firms in the U.S. When we regress the zero-return metric on variables used to proxy for firm fundamentals and public information flows, we find the relations between the zero-return metric and the proxy variables to be consistent with expectations. Based on the results of these analyses, we conclude that the zero-return metric is a better measure of the relative amount of firm-specific information impounded in international share prices than the R^2 measure.

Our study makes several contributions to the literature. First, the results suggest that lower stock price synchronicity does not capture the amount of firm-specific information reflected in stock prices in international markets. Morck et al. (2000) document that stock prices move together more in poor countries relative to rich countries, and state that cross-country differences in property rights explain the cross-country variation in stock price synchronicity. Morck et al. (2000) conclude that strong property rights promote informed arbitrage, which capitalizes detailed firm-specific information into prices, leading to lower stock price synchronicity. The analysis and inferences drawn from Morck et al. (2000) are based on aggregate country-level measures, i.e. country averages. As discussed by Freeman (2004), Freedman, Pisani, and Purves (1998) and Greenland and Robbins (1994), researchers using aggregate data as opposed to firm-specific data can draw different and potentially incorrect inferences. While the results of Morck et al. (2000) speak to aggregate differences in R^2 values across countries, their analysis does not allow them to disentangle whether the synchronicity measure reflects firm-specific information within a country or, consequently, whether the synchronicity measure captures common information across countries.

Our study measures and assesses R^2 values at the firm level within a country. By examining the properties of the synchronicity measure across firms within a country, we hold constant market micro-structure and institutional features, which potentially affect security pricing, thereby allowing us to test whether differences in the synchronicity measure within a country reflect more information-laden stock prices. The results of our firm-level analyses suggest that differences in synchronicity across firms are not driven by differences in information. Thus, we conclude that the information-based explanation for the synchronicity measure is not valid internationally, and question whether across-market comparisons can be made using the synchronicity measure.[4]

Second, our research contributes to prior and concurrent research that investigates measures intended to capture the degree to which stock prices are informationally efficient (see

[4] Others have begun to assess the robustness of prior international research that draws inferences based on country-wide measures. For example, Holderness (2005) demonstrates the conclusions regarding the influence of weak legal institutions on ownership structure appear to be due to the use of aggregate (i.e., country-level versus firm-level) measures of ownership structure.

e.g., Gelb and Zarowin, 2002; Kelly, 2005). We develop the zero-return metric as an alternative measure of the relative amount of firm-specific information impounded in share price. Unlike other measures of information efficiency (e.g., the breadth of institutional ownership), the zero-return metric can be constructed for every firm listed in a public equity market. We provide evidence that the zero-return metric is a more valid measure of information-laden stock prices than the synchronicity measure, and link the zero-return metric to factors that capture firm fundamentals and firms' public information flows. Having a simple measure that captures differences in the degree of firms' price informativeness is important to researchers and regulators interested in the integration of capital markets, as well as to investors whose optimal resource allocation depends upon informationally efficient prices.

The paper proceeds as follows. Section 2 provides an overview of the prior literature on the R^2 measure. Section 3 extends the findings of Morck et al. (2000) to our sample period. Section 4 reports the results of the analysis examining the R^2 measure at the firm level. Section 5 describes the zero-return metric that we develop to capture the relative amount of information reflected in stock prices and reports the results of the analysis using the zero-return metric. Section 6 reports the results of sensitivity tests, and Section 7 concludes the study.

2. Overview of the R^2 Measure and Related Literature

Asset pricing models typically regress a firm's returns on a common factor or set of common factors. For example, the capital asset pricing model (CAPM) links a firm's return to the return of the market:

(1) $$RET_{it} = \beta_{0,i} + \beta_{1,i} RETMKT_t + \varepsilon_{it}$$

where RET_{it} is the firms' i return for period t and $RETMKT_t$ is the return on the market for period t. For this model to yield a high explanatory power, the firm must trade with the market, meaning its share price must align with the share prices of other firms in the market, i.e., it must exhibit synchronous stock price movements.

The conventional interpretation of the residual from equation (1) is that after removing the return effects due to systematic factors, the remaining return volatility is due to idiosyncratic, firm-specific events. A low R^2 from equation (1) is potentially due to firms' returns capturing unique firm-specific information or reflecting greater idiosyncratic noise in returns. Blume (1968), King (1966), and Officer (1971) report a decline in the explanatory power of the CAPM overtime. Roll (1988) notes that typical asset pricing regressions yield relatively low explanatory power and proposes that one potential explanation for the decline in explanatory power is the incorporation of private, firm-specific information into prices. Roll (1988) notes that the incorporation of firm-specific information into prices generally increases the volatility of an individual firm's stock price, which results in lower explanatory power from asset pricing regressions such as equation (1). He finds that the low R^2 from asset pricing models is primarily due to high firm-specific returns volatility and that this volatility is not associated with public news announcements. Based on this finding Roll contends that "private information or else occasional frenzy unrelated to concrete information" (p. 566) is driving high firm-specific return volatility.[5]

Morck et al. (2000) is the first in a series of papers to use stock price synchronicity as a measure of the relative amount of firm-specific information reflected in stock prices. Using country-level R^2 values, Morck et al. (2000) find that stock prices in poorer countries with less developed equity markets, weaker protection of investor rights, and weaker legal regimes tend to move together more. They conclude that stronger protection of investor rights promotes informed trading, resulting in more informative stock prices as evidenced by less synchronous trading in these countries.

[5] One potential way in which firm-specific information is impounded into prices is through the actions of traders with private information about firm fundamentals. Actions undertaken by informed market participants such as analysts or insiders will result in firm-specific stock price movements, thus providing a potential explanation for high firm-specific returns volatility.

Jin and Myers (2005) confirm the findings of Morck et al. (2000) and document a decline in country-level R^2 values over time across a sample of 40 countries. In addition, Jin and Myers (2005) find that countries with higher average R^2 values experience more frequent market crashes, which typically result from more opaque information environments. Li, Morck, Yang, and Yeung (2004) investigate the behavior of country-level averages of R^2 values in emerging markets, finding that country-level R^2 values are generally declining over time, and lower country-level R^2 values are associated with greater capital market openness, more efficient legal systems, and less corrupt economies. While the country-level results of Morck et al. (2000), Jin and Meyers (2005), and Li et al. (2004) are consistent with an information-based interpretation of the R^2 measure, the results do not address whether the R^2 measure reflects informationally efficient share prices.[6]

Research examining whether firm-specific synchronicity measures reflect information-laden prices has focused on the U.S. market. One line of research builds on the fact that firm-specific information is impounded into prices through the public disclosure of information or through the actions of informed market participants. Durnev et al. (2003) examine whether firms have low synchronicity because more future earnings information is reflected in their returns. They find that U.S. firms with lower R^2 values have more future earnings information reflected in stock prices, consistent with differences in synchronicity across firms being due to differences in the amount of information reflected in prices. Piotroski and Roulstone (2004) test the association between synchronicity and actions of informed market participants (i.e., analysts, institutional investors, and insiders).[7] They find that actions undertaken by informed market participants are

[6] As noted by Piotroski and Roulstone (2004, p. 1126) "traditional differences at the country level are not likely the cause of observed differences in synchronicity. Instead, differences in R^2's are a result of the economics underlying each firm and the relative flow of information into prices."

[7] Chan and Hameed (2005) investigate the association between the R^2 measure and analyst following in emerging markets, finding that higher analyst following is associated with higher R^2 values. They interpret their findings as being consistent with analyst impounding market wide (not firm-specific) information into returns.

associated with firms' stock price synchronicity. Finally Durnev et al. (2004) investigate whether U.S. firms with lower R^2 values make better capital allocation decisions. They find that firms with lower R^2 values tend to make more efficient investments (less over or under investment). Their finding is consistent with the synchronicity measure representing firm-specific information, in that firms with lower R^2 values suffer from fewer problems with asymmetric information, improving the coordination between capital suppliers and the firm, and resulting in more efficient investments.

Another line of U.S. research explores whether low R^2 values are a result of excess noise-in-returns resulting from factors unrelated to firm fundamentals. Shiller (1981) and West (1988) find that the level of stock price volatility is too high to be explained by the volatility in the underlying fundamentals, e.g. dividends. West (1988) provides a theoretical model where increased firm-specific return volatility is associated with less firm-specific information and more noise-in-returns. In West's model, relatively more information results in prices being closer to fundamental values, and the release of new information results in smaller price movements and lower firm-specific return volatility. West empirically tests his model and reports results indicating that firm-specific return volatility is positively associated with bubbles, fad, and other non-fundamental factors.

Other studies also suggest that behavioral factors, bubbles, herding, and other non-fundamental factors affect stock return volatility (see Shleifer, 2000 for a review), and ultimately the usefulness of the synchronicity measure as a gauge of firm-specific information. Barberis et al. (2005) find significant changes in firms' R^2 values surrounding additions and deletions to the S&P 500 Index in the U.S., consistent with market frictions influencing synchronicity.[8] In addition, Greenwood and Sosner (2002), and Greenwood (2005) find similar results in Japan

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[8] Barberis et al. (2005) develop a model to explain the changes in R^2 values based on market frictions and sentiment. Both their empirical and theoretical work provides evidence inconsistent with the information-based explanation of the R^2 measure.

using additions and deletions from the Nikkei 225 Index. Since additions and deletions to indices do not signal new information to the market regarding firms' fundamentals, the changes in firm's R^2 values surrounding changes in the composition of indices is inconsistent with an information-based explanation of the R^2 measure.

Consistent with the noise-in-returns interpretation of the R^2 measure, Kumar and Lee (2005) find that noise traders (uninformed retail investors) have a significant influence on stock price synchronicity. Andrade et al. (2005) develop a model in which trading imbalances, combined with the limited risk-bearing capacity of arbitrageurs, results in correlated price movements across stocks. An important feature of their model is that synchronous price movements result from cross-stock price pressure, not information. Andrade et al. (2005) test their model in Taiwan, finding that arbitrageurs' limited risk-bearing capacity can explain a significant portion (more than 50%) of observed stock price synchronicity, which is inconsistent with the information-based interpretation of synchronicity. Thus, the findings of Andrade et al. (2005), Barberis et al. (2005), Greenwood and Sosner (2002), Greenwood (2005), and Kumar and Lee (2005) indicate that market frictions, i.e., factors unrelated to information, have a significant influence on stock price synchronicity.

Campbell, Martin, Malkiel, and Xu (2001) document the rise in firm-specific return volatility in the U.S. over time and the resulting decrease in R^2 values. They interpret their findings in the spirit of West's (1988) model contending that the decrease in R^2 values is not likely a result of increased firm-specific information. Brandt et al. (2005) provide further support for West's model, finding that the recent trend in idiosyncratic volatility in the U.S. is most likely due to a speculative bubble similar to that observed in the late 1920s. Wei and Zhang (2004) investigate the potential causes for increased firm-specific volatility over time in the U.S., and find that the variance of firm fundamentals (return on equity) has increased over time, thereby providing a partial explanation for the findings of Campbell et al. (2001). However, Wei and Zhang (2004) further document that the increase in the volatility of firm fundamentals and the association between fundamental volatility and return volatility is driven, for the most part, by newly listed firms. This finding casts doubt on an information-based explanation for declining R^2 values.

Rajgopal and Venkatachalam (2005) document a positive association between information risk, as measured by accrual quality and analyst forecast dispersion, and firm-specific returns volatility. Their findings are consistent with the theoretical work of Pastor and Veronesi (2003), who demonstrate that uncertainty about firms' fundamentals (information risk) influences returns volatility. These studies provide further evidence against the information-based interpretation of the synchronicity measure. If greater firm-specific return volatility is associated with poorer quality information (greater uncertainty) then how can higher firm-specific return volatility also be associated with more firm-specific information being reflected in returns?

Overall, theoretical and empirical studies provide little support for the information-based interpretation of the synchronicity measure. In addition, arguments related to the limits and risk of arbitrage indicate that firm-specific return volatility may hinder informed trading rather than be a consequence of informed trading as claimed by Morck et al. (2000). Subsequent international research tends to assume that Morck et al.'s (2000) country-wide measure of stock price synchronicity is a measure of the relative amount of firm-specific information reflected in firms' stock prices.[9] To date, however, we know of no evidence that validates the information-based explanation for the synchronicity measure internationally.

3. Replication

We measure a firm's stock price synchronicity following Morck et al. (2000), who define synchronicity as the percent of the variation in a firm's stock returns explained by variations in

[9] For example, Wurgler (2000) examines the association between country-level measures of stock price synchronicity and country-level measures of the efficiency of capital allocations, and DeFond and Hung (2004) investigate the association between country-level synchronicity measures and CEO turnover internationally.

the firm's domestic market return and the U.S. market return.   Specifically, the synchronicity measure is the R^2 from estimating the following firm-specific regression:

$$(2) \qquad RET_{it} = \beta_{0,i} + \beta_{1,i} RETMKT_{ct} + \beta_{2,i} RETMKTUS_t + \varepsilon_{it}$$

where RET_{it} is the return for firm i for the two week period t, $RETMKT_{ct}$ is the return on the market for country c for period t, and $RETMKTUS_t$ is the return on the U.S. market over period t.[10] Like Morck et al. (2000), we use bi-weekly returns to deal with infrequent trading in international markets. We use value-weighted market returns, where all returns, including the return on the U.S. market, are calculated in the local currency and collected from *Datastream*. We require firms to have a minimum of 30 weeks of non-zero returns to estimate equation (2). We estimate equation (2) by firm over the 52-week period encompassing the firm's fiscal year, which results in 15 to 26 observations per firm each year. To be consistent with Morck et al. (2000), we exclude all return observations with absolute values greater than 0.25.[11] The country-level synchronicity measures are defined as:

$$(3) \qquad R^2_{c,t} = \frac{\sum_i R^2_{i,c,t} \times SST_{i,c,t}}{\sum_i SST_{i,c,t}}$$

where $SST_{i,c,t}$ is the total sum of squared variations from the firm-specific estimates of equation (2) within each country.

Panel A of Table 1 reports the descriptive statistics for the country-wide R^2 measures of 21 developed equity markets, where all firm-year observations relate to firms that have sufficient data to estimate equation (2). We select these 21 countries because they are a subset of the countries studied by Morck et al. (2000) that have firms with sufficient accounting and market

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[10] For the U.S. sample we include only the return on the U.S. market in equation (2).

[11] Including these return observations does not change any inferences drawn from the results.

data to be included in our empirical tests.[12] For brevity, however, we table and discuss only the results of our empirical tests for Australia, France, Germany, Japan, the U.K., and the U.S. The Appendix summarizes our findings in the 15 other countries.

Panel A of Table 1 reports the mean (median) values of the R^2 measure presented in order of average country rank. To calculate the average country rank, each year we rank the 21 sample countries by their R^2 value and report the average country rank across the 13 sample years. The U.S. reports the lowest mean and median R^2 values (mean value of 0.113 and median value of 0.097) as well as the lowest mean country rank of 1.615, followed by Canada, Australia and France. The highest mean country ranks are found in Spain (16.692), Italy (17.077), and Singapore (19.231).

Morck et al. (2000) report that wealthier countries (as measured by gross domestic product), with common law legal regimes, and with greater protection of investor rights have lower stock price synchronicity. To replicate Morck et al. (2000), we estimate the following OLS regression:[13]

$$(4) \qquad R^2_{c,t} = \beta_1 LEGAL_{c,t} + \beta_2 RIGHTS_{c,t} + \beta_3 GDP_{c,t} + \sum_{fye=1990}^{2002} \alpha_{fye} YEAR_t + \varepsilon_{i,t}$$

where LEGAL is equal to one if the country is classified as having a code law legal origin (La Porta et al., 1998); RIGHTS is equal to the investor rights index developed by La Porta et al. (1998), where higher values reflect greater investor rights; GDP is equal to the log of the per capita gross domestic product for the country year; and YEAR is equal to a series of fiscal year fixed effects.

The first three columns in Panel B of Table 1 display the results of estimating partial forms of equation (4) where only one institutional variable and YEAR are included in the model due to the

[12] To be included in the analysis presented in Table 1 we only require firm-year observations to have sufficient weekly returns data to calculate the R^2 measure and to be on Worldscope. The requirement that firm-year observations are on Worldscope reduces our sample sizes compared to Morck et al. (2000). However this requirement ensures that firm-year observations included in Panel A of Table 1 have the necessary financial information available to conduct our other empirical tests.

[13] All regressions are estimated including fixed-year effects and Rodgers (cluster) standard errors which accounts for possible clustering at the firm level. We do not table the fiscal year intercepts, which in general are significant at conventional levels.

high correlation between the institutional variables. Considered in isolation, we find that countries having code law legal regimes and lower levels of investor rights have higher synchronicity values. However, when we estimate equation (4) with all three institutional features (the results of which are reported in column 4 of Panel B), we find a significant positive coefficient only on LEGAL. In general, the results presented in Panel B of Table 1 confirm the findings of Morck et al. (2000). Although the country-level results are consistent with the results presented in Morck et al. (2000), a country-level analysis does not differentiate between differences in R^2 values across firms being due to firms' stock prices reflecting relatively more information about firm fundamentals or differences in R^2 values across firms being due to non-fundamental factors resulting in greater noise-in-returns. In the next section, we explore the interpretation of the Morck et al. results by examining the extent to which the synchronicity measure is associated with factors that represent firm information flows and fundamentals in international equity markets.

4. Within-country Analysis of the Synchronicity Measure

4.1 SAMPLE AND DESCRIPTIVE STATISTICS

Panel A of Table 2 presents the descriptive statistics on the R^2 measure estimated using all firm-year observations from 1990-2002 for Australia, France, Germany, Japan, the U.K., and the U.S. that have the necessary data to conduct our empirical tests. Our empirical tests require returns, collected from Datastream, and accounting data, collected from Worldscope. Firm-year observations meeting the data requirements result in sample sizes of 2,895, 5,368, 3,515, 23,528, 14,248, and 56,925 for Australia, France, Germany, Japan, the U.K., and the U.S., respectively. The sample sizes reported in Table 2 (e.g., Australia n=2,895) are smaller than those reported in Table 1 (e.g., Australia n=8,352) due to the additional data required for our tests. Japanese firms have the highest R^2 values (mean=0.319, median=0.298), and the U.S. has the lowest R^2 values (mean=0.118, median=0.067).

4.2 EMPIRICAL TESTS

We conduct four main analyses to assess the information-based explanation for firms' R^2 values. The analyses are motivated by prior research that links them to firm-specific information flows.

Our first analysis examines the association between the synchronicity measure and accounting measures of stock price informativeness. Earnings are one of the primary sources of firm-specific information, and differences in the amount of earnings information reflected in stock prices is one potential reason for differences in R^2 values across firms. Collins, Kothari, Shanken, and Sloan (1994); Gelb and Zarowin (2002); and Lundholm and Myers (2002) use the amount of information about current and future changes in earnings reflected in returns as a measure of price informativeness. Durnev et al. (2003) use this definition of price informativeness to draw inferences on whether firm-specific stock price movements in the U.S. market reflect firm-specific information or increased noise-in-returns. They find that lower R^2 measures are associated with more price informativeness.

We test the association between the R^2 measure and stock price informativeness by estimating the following OLS model:

$$ABRET_t = \beta_1 \Delta E_t + \beta_2 \Delta E_t * RR_t^2 + \beta_3 \Delta E_{t+1} + \beta_4 \Delta E_{t+1} * RR_t^2 + \beta_5 ABRET_{t+1} + + \beta_6 RR_t^2 + \sum_{fye=1990}^{2001} \alpha_{fye} YEAR_t + \varepsilon_t \quad (5)$$

where $ABRET_t$ is the firm's market adjusted buy and hold return over fiscal year t; RR_t^2 is equal to the firm's decile rank of its R^2 value, determined by ranking observations each year based on the R^2 value within each of the five countries; ΔE_t is equal to the change in net income before extraordinary items scaled by beginning of period market value of equity over fiscal year t; and YEAR is equal to a series of fiscal year fixed effects.

The $ABRET_{t+1}$ term is included in the model to correct for the errors in variables problem identified by Collins et al. (1994).[14] Given the results of Durnev et al. (2003) in the U.S., we

[14] Collins et al. (1994) note that the correct specification of equation (5) would include the expected change in future periods' earnings. Since expectations are unobservable the actual changes in future periods' earnings is used, introducing an errors in variables problem which they demonstrate can be corrected by including next period's return in the model.

expect β_2 and β_4 to be negative if lower R^2 values are associated with more information about current and future changes in earnings being reflected in returns.

Table 3 displays the results of estimating equation (5). In all countries, we find a positive and significant coefficient on the current change in earnings (at p-values of 0.11 or less). The results are mixed with respect to the change in future earnings. In Japan and the U.K., the coefficient on the change in future earnings is positive and statistically significant as expected, whereas in France and Germany the coefficient on the change in future earnings is negative and significant. Turning to the variables of interest, only in France and the U.S. is the R^2 measure significantly associated with the current change in earnings and returns. However, the relation is inconsistent with expectations, as higher R^2 values in France and the U.S. are associated with more information about the current change in earnings being reflected in stock prices. When examining the coefficient on the interaction of future earnings changes and the R^2 measure, we find the coefficient to be positive and significant in Germany and in the U.S., contrary to expectations. This indicates that higher R^2 values are associated with more information about future earnings changes being priced.[15] Overall, the results presented in Table 3 indicate that lower R^2 values are not associated with more earnings information being reflected in returns.[16]

Our second analysis examines the association between the synchronicity measure and analyst forecast errors. Our inquiry is motivated by prior international and U.S. research examining the properties of analyst forecast errors. In general, this literature finds that better information in the form of additional firm disclosures is associated with lower forecast errors (Lang and Lundholm, 1996; Ashbaugh and Pincus, 2001; Hope, 2003; Lang et al., 2003).

[15] We repeat the analysis presented in Table 3 using the unranked R^2 values in each of the five countries, the results of this analysis are similar to those presented in Table 3.

[16] Our findings are consistent, in part, with West's (1988) model. West (1988) claims that lower firm-specific return volatility, higher R^2's, is associated with more information about firm fundamentals being reflected in stock prices.

Following this line of literature, we expect a positive relation between analysts' forecast errors and the synchronicity measure if the synchronicity measure reflects information.

We test the association between firms' R^2 values and forecast errors using the following equation:

$$(6) \qquad F\_ERROR_t = \beta_1 RR_t^2 + \sum_{fye=1990}^{2002} \alpha_{fye} YEAR_t + \varepsilon_t$$

where RR_t^2 is equal to the decile rank of the firm's R^2 value for fiscal year t; F_ERROR_t is equal to the decile rank of the firm's forecast error for fiscal year t where forecast error is defined as $|EPS_{act} - EPS_{forecast}|/|EPS_{forecast}|$ and EPS_{act} is the firm's actual earnings per share and $EPS_{forecast}$ is the mean consensus earnings per share forecast; and YEAR is equal to a series of fiscal-year fixed effects.[17]

Prior research models F_ERROR_t as a function of variables that proxy for a firm's public and private information flows. We estimate equation (6) without these variables due to the fact that Morck et al. (2000) posit that a firm's R^2 value is a summary measure of firm information. By omitting these variables from our analysis, we assess the validity of this claim.

Table 4 presents the results from estimating equation (6). In Japan, the coefficient on the RR^2 term is positive and significant at the 0.00 level. This indicates that in Japan, consistent with the information-based interpretation of the synchronicity measure, lower R^2 values are associated with lower analyst forecast errors. In Australia, France, Germany, the U.K., and the U.S., however, we find the coefficient on the RR^2 term to be negative and significant at the 0.01 level or better. Thus, in the majority of our sample countries, we find that higher R^2 values are associated with lower analyst forecast errors, which is opposite of what is expected if lower synchronicity measures reflect relatively more firm-specific information.

Our third analysis investigates whether there is a change in firms' synchronicity measures after cross listing in the U.S. Cross listing in the U.S. represents a significant information event as a U.S. listing subjects firms to increased regulation and disclosure requirements that result in

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[17] The sample sizes in the analyst forecast errors test are further reduced due to the requirement that firms be followed by an analyst.

more information about the firm being made available to investors (Ashbaugh 2001, Lang et al. 2003). Furthermore, cross listing in the U.S. enhances firm visibility, increasing the investor base and subsequent information search by investors (see Karolyi (2004) for an overview). If synchronicity is a function of firm-specific information, it follows that non-U.S. firms' R^2 values are expected to decrease after they cross list in the U.S.

Table 5 presents the results of the cross listing analysis, where we define the change in R^2 values as the R^2 value in the 12 months following the cross listing month minus the R^2 value in the 12 months preceding the cross listing month.[18] Panel A of Table 5 presents the mean and median change in R^2 measure (ΔR^2) for all cross listings over the 1990-2002 time period. In none of our sample countries do we find the ΔR^2 to be significantly negative. In fact, contrary to expectations, we find the mean and median ΔR^2 to be positive and significantly different from zero (at the 0.02 level or better) in France and the U.K.

As a robustness check, we examine ΔR^2 for only Level 2 and Level 3 ADRs, since these types of U.S. cross listings are associated with the greatest information disclosures. The results presented in Panel B of Table 5 are similar to the results for U.S. cross listings as a whole. We find that in France and the U.K. the mean and median ΔR^2 are positive and statistically different from zero at the 0.02 level or better. None of the other ΔR^2 measures is significantly different from zero. Overall, the results presented in Table 5 suggest that cross listing in the U.S. is not associated with a decline in the R^2 values as one would expect under an information-based interpretation of the synchronicity measure.[19]

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[18] Cross listing dates and the type of cross listing (e.g. Level 1, 2, 3 or Rule 144A) are provided by J.P. Morgan Chase & Co.

[19] We conduct two additional sensitivity tests. First, we repeat the cross listing analysis estimating equation (2) without the U.S. return due to the potential mechanical effect that cross listing may have on the coefficient on U.S. return. Second, we estimate an OLS fixed effects model for each country using a dummy variable to capture the post period. We draw similar inferences from the results of these two sensitivity tests.

Our last analysis uses the framework of Piotroski and Roulstone (2004) to test the extent to which firm fundamentals are related to the R^2 measure in international markets. Piotroski and Roulstone (2004) use U.S. firms' R^2 values as a benchmark of firm-specific information incorporated into prices, and test the association between R^2 values and variables proxying for firms' information environment. Based on their work, we estimate the following fixed effects model:

$$\begin{aligned} SYNCH_t = {} & \beta_1 LOSS_t + \beta_2 R\&D_i + \beta_3 ANALYST_t + \beta_4 \%CLHLD_t + \beta_5 STDSALES_t + \\ & \beta_6 STDROA_t + \beta_7 REG_t + \beta_8 RELSIZE_t + \beta_9 \%MVE_t + \beta_{10} \%TURNOVER_t + \\ & \sum_{fye=1990}^{2002} \alpha_{fye} YEAR_t + \varepsilon \end{aligned} \quad (7)$$

where $SYNCH_t$ is equal to $\log(R^2/(1-R^2))$ for fiscal year t; LOSS is equal to one if net income before extraordinary items is negative, and zero otherwise; R&D is equal to one if the firm reports a value for research and development expense, and zero otherwise; ANALYST is equal to the log of one plus the number of analysts making a forecast for fiscal year t's earnings; %CLHLD is the proportion of shares that are closely held as of the end of the fiscal year t; STDSALES is the standard deviation of sales scaled by total assets over calculated requiring a minimum of three and maximum of five fiscal years; STDROA is the standard deviation of ROA calculated requiring a minimum of three and maximum of five fiscal years where ROA is equal net income before extraordinary items divided by fiscal year end total assets; REG is equal to one if the firm is a financial institution or utility; RELSIZE is the firm's sales divided by total sales of its primary industry (2-digit SIC code); MVE is defined as the natural log of fiscal year end market value of equity; TURNOVER is the average weekly turnover (number of shares traded divided by number of shares outstanding) over the fiscal year; and YEAR is equal to a series of fiscal year fixed effects.

The dependent variable in equation (7), SYNCH, is the R^2 measure transformed to create a continuous variable that is more normally distributed than the distribution of R^2 values that are bounded by zero and one (Morck et al., 2000; Piotroski and Roulstone, 2004). We use six variables to proxy for firm fundamentals revealed via firms' public and private information flows. LOSS is included in the model, as the reporting of losses is a news event expected to be reflected in returns (Joos and Plesko, 2005; Hayn, 1995). Likewise, the reporting of research and development expenditures is also considered to be a news event reflected in returns (Aboody and Lev, 2000). R&D is an indicator variable identifying whether the firm discloses research and development expenditures. Reporting research and development costs can signals firms' investment strategies, and the disclosure of research and development costs in many countries is voluntary over our analysis period. The number of analysts following the firm, ANALYST, is included in the model as a proxy for the firms' information environment because higher analyst following is associated with richer information environments (Lang and Lundholm, 1996; Bushman, Piotroski, and Smith, 2005). If firms' R^2 values serve as a measure of firm-specific information incorporated into prices, we expect negative coefficients on LOSS, R&D, and ANALYST.

The standard deviation of sales (STDSALES) and the standard deviation of return-on-assets (STDROA) are included in the model to capture the volatility of firm fundamentals. One potential reason for high firm-specific return volatility is the volatility of underlying fundamentals. Wei and Zhang (2004) find that within the U.S., greater volatility in firms' return on equity is associated with increased return volatility. We include both the volatility of return-on-assets and sales due to differences in income smoothing internationally and the potential influence of income smoothing on return-on-assets (Leuz, Nanda, and Wysocki, 2003). If firms' R^2 values reflect firm fundamentals being incorporated into prices, we expect negative coefficients on STDSALES and STDROA.

We use the percent of shares that are closely held, %CLHLD, to proxy for insider ownership (Himmelberg, Hubbard, and Love, 2002; Lins and Warnock, 2004). Greater insider ownership will result in lower R^2 values when insiders are able to gather and trade on private information about firm fundamentals (Roll, 1988). Alternatively, greater insider ownership may result in higher R^2 values if insiders reduce financial information transparency for the purpose of hiding their wealth extraction. Higher R^2 values may also result if insiders own a group of firms and coordinate within the group, such as financing other firms in the group, resulting in a common component to firm's fundamentals. Given the competing explanations, we make no prediction on the relation between %CLHLD and SYNCH.

The remaining variables in equation (7) (REG, RELSIZE, MVE, and TURNOVER) serve as control variables. REG is used to control for the fact that all firms operating in a regulated industry face similar constraints due to regulation, and thus, their prices are expected to have high stock price synchronicity (Piotroski and Roulstone, 2004). RELSIZE is used to control for a firm's industry presence. Because it is more likely the firm's stock price drives industry returns when it has a larger market share, we expect a positive relation between RELSIZE and SYNCH.

We include MVE to control for firm size. Larger firms are generally associated with richer information environments, indicating a negative association between firm size and R^2 values. However, larger firms also potentially have more diversified operations, resulting in these firms trading more in line with the market, and, consequently, in a positive association between firm size and the R^2 measure (Piotroski and Roulstone, 2004). We include TURNOVER in the model to capture the level of trading in a firm's shares. Under the information-based interpretation of the R^2 measure, the association between the R^2 measure and TURNOVER would be negative as more trading represents increased information being impounded into firms' share prices. However if one assumes the R^2 measure proxies for noise trading, trading unrelated to fundamentals, then the association between the R^2 values and TURNOVER is expected to be positive. Given the uncertainty, we make no prediction of the sign of the coefficients on MVE and TURNOVER.

Panel A of Table 6 displays the Pearson correlations between synchronicity and the independent variables of equation (7). In general, there is quite a bit of variation across countries in the sign and significance of the correlations between R^2 values and the variables proxying for firm fundamentals. In contrast, the correlations between R^2 values and the control variables drawn from prior research are more consistent across countries.

Panel B of Table 6 presents the result of estimating equation (7) by country. In general, the explanatory power of the model is relatively low for each country, ranging from 14% in the U.S. to 25% in Germany. For simplicity, rather than discussing each estimated coefficient in isolation, we focus on the proportion of estimated coefficients that are significant with the expected sign for each country-specific regression. Overall, the signs and significance of the estimated coefficients are relatively mixed. We find that 50% of the firm fundamentals are related to the R^2 measure in the U.K., whereas only 20% of the firm fundamentals are significantly related to Japanese firms' R^2 values. The relatively low proportion of significant coefficients with the predicted signs, regardless of country, suggests that the R^2 measure does not reflect firm-specific information in international markets.

Our last analysis builds on the work of Barberis et al. (2005) and Greenwood and Sosner (2002), who find that a firm's membership in an index increases its stock price synchronicity. Index membership may increase the R^2 value due to market frictions and other non-fundamental factors (Barberis et al., 2005). To further investigate the link between stock price synchronicity and firm-specific information, we examine the association between German firms' index membership and SYNCH using the following model.

$$\begin{aligned} SYNCH_t = {} & \beta_1 LOSS_t + \beta_2 R\&D_i + \beta_3 ANALYST_t + \beta_4 \%CLHLD_t \\ & + \beta_5 STDSALES_t + \beta_6 STDROA_t + \beta_7 REG_t + \beta_8 RELSIZE_t \\ & + \beta_9 MVE_t + \beta_{10} TURNOVER_t + \beta_{11} DAX30_t + \\ & \beta_{12} NEWMARKET_t + \beta_{13} NEMAX50_t + \sum_{fye=1990}^{2002} \alpha_{fye} YEAR_t + \varepsilon \end{aligned} \tag{8}$$

where DAX30 is equal to one if the firm is part of the DAX30 index in fiscal year t, and zero otherwise; NEMAX50 is equal to one if the firm is part of the NEMAX50 index in fiscal year t, and zero otherwise; NEWMARKET is equal to one if the firm's shares trade on the New Market in fiscal year t, and zero otherwise. All other variables are as previously defined.

We focus on German market indexes for two reasons. First, focusing on firms' membership in a German index provides a high powered setting to examine the effect of index membership on stock price synchronicity, as firms' membership in some indexes in Germany requires increased information flows. Specifically, the New Market (NEWMARKET) is a segment of the Frankfurt Exchange that is of particular relevance to our study, since listing in this segment requires firms to provide additional information disclosures and follow stricter corporate governance policies. Specifically, New Market firms are expected to adopt either International Financial Reporting Standards or U.S. Generally Accepted Accounting Principles, publish quarterly financial statements (only half-year reports are mandatory for other publicly traded German firms), hold regular analyst meetings, and accept the German code of corporate governance (a self-regulatory set of rules aimed at strengthening the position of shareholders). If the synchronicity measure reflects the amount of firm-specific information captured in returns, we expect the coefficient on NEWMARKET to have a negative sign. On the other hand, the New Market is heavily covered by index-oriented traders. Thus, if the R^2 metric is influenced by non-fundamental noise effects, we expect NEWMARKET to have a positive sign.

The other reason we limit this analysis to the German market is because it is difficult to identify non-U.S. index membership over time. Limiting our analysis to one country ensures more reliable identification of index membership. We identify index membership by referring to the original historic index membership lists of the Deutsche Börse AG. The NEMAX50 comprises the 50 largest firms (measured by dispersed market capitalization) of the New Market segment of the Frankfurt Stock Exchange. The DAX30 comprises the 30 German companies that have the highest dispersed market capitalization.

Table 7 presents the results from estimating equation (8). With the exception of the coefficient on R&D, which is no longer significant, the results on the other independent variables are similar to those reported in Panel B of Table 6 and are not discussed further. The coefficients on the three indicator variables identifying index membership are all positive and highly significant, indicating that index membership is associated with higher R^2 values. These results are consistent with the findings of Barberis et al. (2005) in the U.S. and Greenwood and Sosner (2002) and Greenwood (2005) in Japan. This finding is particularly important, as it identifies other factors not related to firm fundamentals that significantly contribute to differences in stock price synchronicity across firms. Finding that German firms' membership in an index is positively related to SYNCH is consistent with market frictions and/or market sediment, not information, being a significant determinant of stock price synchronicity.

In summary, the results presented in Tables 3 - 7 do not support the information-based interpretation of stock price synchronicity in international markets. Collectively, the results of our empirical tests suggest that using the R^2 measure as a metric of firm-specific information internationally is not valid.

5. An Alternative Measure of Firm-specific Information in Returns

The arrival of new information about a firm in the market can generate new uncertainties and expectations regarding the firm's future cash flows. If the value of an information signal is insufficient to exceed the costs of trading, then the marginal investor will not trade (Lesmond et al., 1999). If the marginal investor does not trade, then a zero return is generated.[20] Building on this concept, we use the percent of zero return days (hereafter referred to as the zero-return metric) as an alternative measure of the relative amount of information reflected in stock prices.[21] The zero-return metric is defined as the number of zero-return trading days over the fiscal year divided by the total trading days of the firm's fiscal year, where zero-return days are those in which the price of the stock does not change compared to the price of the previous day.[22]

[20] Bekaert et al. (2003) and Lesmond (2005) use the percent of zero returns days as measure of liquidity internationally, and document that this measure is positively correlated with other more data intensive measures of liquidity. However Bekaert et al. (2003) note that one potential reason for a zero return unrelated to liquidity is a lack of news.

[21] The work of Easley, Kiefer, O'Hara, and Paperman (1996) in the U.S. supports our use of the percent of zero returns weeks as a measure of the frequency of information arrival. Specifically, they find that firms which trade more frequently (high volume firms) have a higher probability of information events relative to low volume firms, indicating that as expected the increased frequency of information arrival results in increased trading.

[22] By defining our zero return metric in this way, we misclassify daily observations with trade during the day but with identical beginning-of-day and end-of-day prices as zero return days, which may add additional noise to the measure. We believe that the probability of such an event is low because there are no tick size limitations in our sample countries. However, we test whether our results are sensitive to this design choice by defining our non-trading variable using the turnover data provided by *DataStream*. Our inferences remain unchanged when we use this alternative measure. The advantage of using price data rather than volume data is that in some countries, *DataStream* codes zero trading volume as zero while in other countries it presumably codes zero volume as missing values.

Panel A of Table 8 presents the descriptive statistics on the zero-return metric for the six sample countries. Note that we use the same firm-year observations as in the empirical tests of the synchronicity measure to facilitate comparisons of the two measures. Both the mean and median values of the zero-return metric are largest in the U.K. (mean=0.505, median=0.554). The mean zero-return metric is 0.33 in Germany, followed by 0.331 in Australia, 0.300 in France, 0.264 in Japan, and 0.195 in the U.S.

Panel B of Table 8 presents the Pearson and Spearman correlations between the zero-return metric and the synchronicity measure. In all six countries the correlations are significantly negative, and the magnitude of the correlations is relatively large, in absolute terms, ranging from -0.262 in the U.S. to -0.473 in France. The consistently negative correlations indicate that lower R^2 values are, on average, associated with a larger proportion of zero-return weeks.

There are two potential explanations for the negative relation between the zero-return metric and stock price synchronicity. First, recall we require a firm to have a minimum of 30 weeks of non-zero returns to calculate its R^2 measures for each year, resulting in 15 to 26 observations per firm each year. When a firm has more zero bi-weekly returns, then the number of observations used in estimating equation (2) is lower, which can reduce the explanatory power of the model and result in a lower R^2 value. At the same time, the zero-return metric will be moving toward one as the proportion of weeks where the firm's stock does not trade increases. The second potential reason for the negative correlations relies on infrequent, small, non-information-based trading. If some firms in a sample country trade relatively infrequently and in small amounts, there is the potential for the bi-weekly returns to be driven by small, somewhat immaterial trades. This will result in regressing relatively small bi-weekly returns on the market return, producing a low R^2 that is unrelated to firm-specific information.

Panel C of Table 8 displays the results of the price informativeness tests using the zero-return metric. Specifically, we test the association between the zero-return metric and the amount of earnings information reflected in stock prices using the following equation:

$$ABRET_t = \beta_1 \Delta E_t + \beta_2 \Delta E_t * R\%ZR_t + \beta_4 \Delta E_{t+1} + \beta_5 \Delta E_{t+1} * R\%ZR_t + \beta_6 ABRET_{t+1} + \beta_7 R\%ZR_t + \sum_{fye=1990}^{2001} \alpha_{fye} YEAR_t + \varepsilon_t \quad (9)$$

where $R\%ZR_t$ is equal to the decile rank of the zero-return metric for fiscal year t; and all other variable are as previously defined.

If the zero-return metric captures the degree of firm-specific information reflected in returns, we expect a negative association between the zero-return metric and the amount of earnings information reflected in returns.

In all countries, we find that larger zero-return metrics are associated with less information about the current change in earnings being reflected in returns. In Germany, Japan, the U.K., and the U.S., we find that less information about the change in next-period earnings is reflected in returns when firms trade less frequently. The results presented in Panel C of Table 8 suggest that our simple zero-return metric is associated with the amount of earnings-related information reflected in returns.

Panel D displays the results of estimating equation (10) below to test whether there is an association between the zero-return metric and analysts' forecast errors:

$$F\_ERROR_t = \beta_1 R\%ZR_t + \sum_{fye=1990}^{2002} \alpha_{fye} YEAR_t + \varepsilon_t \quad (10)$$

where all variables are as previously defined. If the zero-return metric is a function of firm-specific information flows, we expect a positive association between the zero-return metric and analysts' forecast errors. We estimate equation (10) without control variables to be comparable to the R^2 analysis reported in Table 4. The results of the OLS regressions indicate that in Australia, France, the U.K., and the U.S., larger zero-return metrics are associated with larger analyst forecast errors. We find no significant association between the zero-return metric and analyst forecast errors in Germany and Japan. These findings are in contrast to those reported in Table 4, where we find inconsistent associations between R^2 values and analyst forecast errors across the sample countries.

Panels E and F of Table 8 present the results of the cross listing analysis, where we define the change in zero-return metric values as the zero-return metric value in the 12 months following the cross listing month minus the zero-return metric value in the 12 months preceding the cross listing month.[23] Panel E presents the mean and median changes in all cross listings over the 1990-2002 time period. The only country for which the change in the zero-return measure is significant is France, where both the mean and median values indicate a decline in the zero-return measure following cross listing. Panel F examines only the Level 2 and 3 ADRs since these types of cross listing are associated with the greatest information disclosures. The results presented in Panel F provide some evidence suggesting that French and U.K. firms trade more frequently following their cross listing in the U.S., as the mean and median ΔR^2 are negative and statistically different from zero at the 0.01 level or better.

Our final analysis tests the extent to which firm fundamentals are related to the zero-return metric in our sample countries. Panel G presents the results from estimating the following model:

$$\begin{aligned}\text{\%ZERORET}_t = {} & \beta_1 LOSS_t + \beta_2 R\&D_i + \beta_3 ANALYST_t + \beta_4 \%CLHLD_t + \beta_5 STDSALES_t \\ & + \beta_6 STDROA_t + \beta_7 REG_t + \beta_8 RELSALES_t + \beta_9 \%MVE_t \\ & + \beta_{10} \%TURNOVER_t + \sum_{fye=1990}^{2002} \alpha_{fye} YEAR_t + \varepsilon\end{aligned} \tag{11}$$

where $\%ZERORET_t$ is equal to log(%ZR/(1-%ZR)) for fiscal year t, and %ZR is the percent of zero-return days.[24] All other variables are as previously defined.

The explanatory power of the zero-return metric model ranges from a low of 53% in Japan to a high of 78% in the U.S. In all countries the explanatory power of the zero-return metric model is higher than the explanatory power of the SYNCH model reported in Table 6. The results

[23] There is limited variance in the dependent variable in this analysis as cross-listed firms are, on average, large and well-traded. Thus, the level of zero-return days is low ex ante as well as ex post the cross listing, biasing against finding a result.

[24] In order to implement the log transformation, we modify %ZR to be the amount of non-traded days plus one divided by the total number of days in the fiscal year plus two.

displayed in Panel G of Table 8 also suggest that the zero-return metric is a better indicator of firm-specific information reflected in returns, as the signs and significance of the control variables are also more consistent across countries. In fact, the last row of Panel G of Table 8 indicates that the signs (and significance) of every coefficient are consistent with expectations when estimating the determinant model using U.K. or U.S. firms. These findings provide additional evidence suggesting that the zero-return metric more appropriately captures the relative amount of information impounded into share prices than the synchronicity measure.[25]

Table 9 summarizes our empirical tests. In Panel A of Table 9, we recapitulate the results of our empirical analysis where we test whether the synchronicity measure is a measure of firm-specific information impounded in share prices. Panel B of Table 9 summarizes our findings related to the zero-return metric. Based on the results of our empirical analysis, we conclude that the easy to calculate zero-returns metric better captures differences in the relative amount of firm-specific information reflected in returns than the synchronicity measure.[26]

6. *Additional Analysis*

To examine the robustness of our inferences, we make the following modifications to equation (2) in calculating the synchronicity measure: use equal weighted returns; drop the U.S. market return from equation (2); include industry wide returns in equation (2), where industries are defined based on 2-digit SIC codes; estimate equation (2) using weekly instead of bi-weekly returns; and include lagged returns as additional explanatory variables. Overall, repeating the analysis with the alternative synchronicity measures results in similar inferences.

We also examine the influence of zero returns on the synchronicity measure as one potential explanation for why the synchronicity measure does not capture information. To

[25] As a robustness test we use TURNOVER instead of the zero return measure and repeat the test in Tables 3-6. While performing better than the original R^2 measure, TURNOVER does not perform nearly as well as the zero-return metric.

[26] We draw the same inferences when comparing the synchronicity results to the zero-return results across the 15 other countries that we examine. Appendix A summarizes the inferences drawn from the empirical analyses using firm-year observations from the other fifteen countries identified in Table 1.

investigate the effect of infrequent trading on the usefulness of the synchronicity measure, we conduct a sensitivity analysis where we modify the R^2 measure, specifically, we calculate for each firm-year observation:

$$(12)\quad R2TRADE_t = \frac{R_t^2}{1 - \%\mathrm{ZR}_t(1 - R_t^2)}$$

where all variables are as previously defined. As %ZR approaches zero, $R2TRADE_t$ becomes R_t^2, and as %ZR approaches one, $R2TRADE_t$ becomes one. We repeat the analyses presented in Tables 3-6 using this modified R^2 measure. The results are similar to those previously reported. Thus, our additional analyses provide further evidence that the R^2 measure does not appear to reflect differences in the informational efficiency of firms' share prices internationally.

Much of our analysis relies on proxies for firms' public and private information flows. In the mid-1990s the quality of firms' actual information flows was assessed via AIMR scores.[27] As an additional robustness test, we examine the association between AIMR scores and the R^2 measure and the zero-return metric. We limit this analysis to the U.S. because AIMR scores were available primarily for U.S. firms. Inconsistent with the information-based interpretation of the R^2 measure, we find a positive association between AIMR scores and the R^2 measure. The interpretation of this finding is that firms with better disclosures as judged by AIMR had more stock synchronicity than firms with fewer disclosures. In contrast, we find a negative association between the zero-return metric and AIMR scores, indicating that firms that analysts rate as having better disclosures more often generate returns.

To further our interpretation of the zero-return metric as a measure that captures the relative amount of firm-specific information reflected in returns, we conduct one last analysis. We examine the association between the average magnitude of returns and the zero-return metric

[27] AIMR scores represent the annual reviews of corporate reporting and disclosure practices prepared by the corporate information committee of the Association for Investment Management Research.

across countries. If the zero-return measure captures the extent to which information about the firm is accumulating outside of the price formation process, we should observe a positive association between the zero-return measure and the magnitude of returns. In Australia, France, Germany, Japan, the U.K. and U.S., we find that the magnitude of the returns (when returns occur) is positively associated with the zero-return measure. This finding is consistent with the zero-return metric capturing the relative amount of information reflected in returns.

7. Conclusions

Morck et al. (2000) document differences in stock price synchronicity across countries, claiming that these differences are due to the variation in property rights and the influence that property rights have on informed investors' trading incentives. Prior international research assumes that the country-level R^2 values reflect the amount of information impounded in stock prices and uses this measure to explain cross-country differences in events of interest to finance and accounting researchers. This paper investigates the validity of the information-based interpretation of stock price synchronicity in six markets. Collectively, the results of our analysis suggest that the variation in stock price synchronicity across firms in international markets is not due to differences in firm-specific information.

We offer the zero-return metric, defined as the percent of zero-return days, as an alternative measure of the relative amount of firm-specific information reflected in stock prices internationally. Based on the results of a multitude of tests, we conclude that the zero-return metric is more useful in capturing the differences in information environments across firms than the synchronicity measure. Contemporaneous research uses the percent of zero-return days as a measure of liquidity, where smaller values represent more liquid stocks (Bekaert et al., 2005). Bekaert et al. (2005) document that in emerging markets the percent of zero-return days is a priced risk factor. Easley and O'Hara (2005) provide a theoretical foundation for information being a priced risk factor. Thus, it is not clear whether the zero-return metric is impounded into share prices because it proxies for liquidity or it proxies for information or both. Future research can further probe the usefulness of the zero-return metric in market analysis.

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Appendix A

Summary of Results – Additional Countries

Panel A: The R^2 Measure

Country	Future Earnings	Analyst Forecast Errors	Cross Listing in the U.S.	Determinant Model
Belgium	No	No	No	No
Canada	Yes	No	N/A	No
Denmark	Yes	No	No	No
Finland	No	No	No	No
Hong Kong	No	No	No	No
Ireland	No	No	No	No
Italy	No	No	No	No
The Netherlands	No	No	No	No
Norway	No	No	No	No
Singapore	No	No	No	No
South Africa	No	No	Yes	No
South Korea	No	No	No	No
Spain	No	No	No	No
Sweden	No	No	No	No
Switzerland	No	No	No	No

Appendix A *Continued*

Panel B: The Zero-Return Metric

Country	Future Earnings	Analyst Forecast Errors	Cross Listing in the U.S.	Determinant Model
Belgium	Yes	Yes	No	Yes
Canada	Yes	Yes	N/A	Yes
Denmark	Yes	No	No	Yes
Finland	Yes	No	Yes	Yes
Hong Kong	No	Yes	No	Yes
Ireland	No	Yes	No	Yes
Italy	No	No	No	Yes
The Netherlands	Yes	Yes	No	Yes
Norway	Yes	Yes	No	Yes
Singapore	Yes	Yes	No	Yes
South Africa	Yes	No	No	Yes
South Korea	No	No	No	No
Spain	Yes	Yes	No	Yes
Sweden	No	No	No	Yes
Switzerland	No	No	No	Yes

This table summarizes the results of the empirical analysis. "Yes" indicates that the test results are consistent with the information-based interpretation, and "No" indicates that there is no result or the results are not consistent with the information-based interpretation.

TABLE 1
Country-Wide R^2 Measures

Panel A: Descriptive Statistics on Country-wide R^2 Measures (1990-2002)

Country	Mean	Median	Mean Rank	n
USA	0.113	0.097	1.615	75,206
Canada	0.146	0.148	3.385	10,753
Australia	0.148	0.149	4.077	8,352
France	0.173	0.165	6.000	8,545
Ireland	0.184	0.184	7.231	905
Germany	0.187	0.202	7.385	8,373
South Africa	0.183	0.174	7.923	4,214
Denmark	0.189	0.189	8.077	2,106
UK	0.198	0.213	8.154	18,913
Switzerland	0.214	0.182	10.308	2,629
Netherlands	0.221	0.217	11.846	2,581
Norway	0.249	0.228	12.769	1,485
Belgium	0.247	0.233	13.231	1,522
Sweden	0.253	0.250	13.923	2,712
Finland	0.261	0.247	15.000	1,195
Hong Kong	0.271	0.251	15.154	5,997
South Korea	0.284	0.271	15.923	8,343
Japan	0.294	0.284	16.000	36,553
Spain	0.285	0.270	16.692	1,489
Italy	0.313	0.278	17.077	2,844
Singapore	0.359	0.324	19.231	3,243

Panel B: Institutional Explanations for R^2 Measure

$$R^2_{c,t} = \beta_1 LEGAL_{c,t} + \beta_2 RIGHTS_{c,t} + \beta_3 GDP_{c,t} + \sum_{fye=1990}^{2002} \alpha_{fye} YEAR_t + \varepsilon_{c,t}$$

	1	2	3	4
LEGAL	0.043***			0.052***
RIGHTS		-0.010***		0.010
GDP			0.003	-0.013
$AdjR^2$	0.30	0.27	0.24	0.31
n	273	273	273	273

Variable definitions:

As in Morck et al (2000) $R^2_{c,t} = \frac{\sum_i R^2_{i,c,t} \times SST_{i,c,t}}{\sum_i SST_{i,c,t}}$ where $SST_{i,c,t}$ is the total sum of squared variations and $R^2_{i,c,t}$ is equal to the R^2 from the following regression:

$RET_{it} = \beta_{0,i} + \beta_{1,i} RETMKT_{ct} + \beta_{2,i} RETMKTUS_t + \varepsilon_{it}$ for all countries but the U.S. For the U.S. we estimate the regression:

$RET_{it} = \beta_{0,i} + \beta_{1,i} RETMKT_{ct} + \varepsilon_{it}$

where RET_{it} is the return for firm i for the two week period t, $RETMKT_{ct}$ is the return on the market for country c for period t, and $RETMKTUS_t$ is the return on the US market over period t. All returns are expressed in the local currency. LEGAL is equal to one if the country is classified as having a code law legal origin (La Porta et al. 1998). RIGHTS is equal to the investor rights index developed by La Porta et al. (1998), where countries receive one point for each of the following, allowing voting by mail, the requirement of investors to deposit their shares prior to shareholder meetings, if cumulative voting or proportional representation of minority shareholder on the board is allowed, if there are mechanisms in place to for oppressed minority shareholders, the minimum ownership required to call an extraordinary shareholder meeting, and if shareholders have preemptive rights. GDP is equal to the log of the per capita gross domestic product for the country year. YEAR is equal to a series of fiscal year fixed effects. Mean Rank is equal to the mean yearly rank for the country, where the 20 sample countries are ranked each year from 1990 to 2002. ***, **, * indicates significance at the 0.01, 0.05 and 0.10 levels two-tailed, respectively.

TABLE 2

Descriptive Statistics on Firm-Specific R^2 Measures

Country	25th	Mean	Median	75th	Std. Dev	n
Australia	0.072	0.192	0.158	0.277	0.152	2,895
France	0.056	0.183	0.137	0.268	0.162	5,368
Germany	0.066	0.203	0.156	0.301	0.172	3,515
Japan	0.155	0.319	0.298	0.463	0.199	23,528
U.K.	0.072	0.217	0.168	0.315	0.183	14,248
U.S.	0.016	0.118	0.067	0.174	0.136	56,925

Variable definitions:
R^2 is equal to the R^2 from the following regression:
$RET_{it} = \beta_{0,i} + \beta_{1,i} RETMKT_{ct} + \beta_{2,i} RETMKTUS_t + \varepsilon_{it}$ for all countries but the U.S. For the U.S. we estimate the regression:

$$RET_{it} = \beta_{0,i} + \beta_{1,i} RETMKT_{ct} + \varepsilon_{it}$$

where RET_{it} is the return for firm i for the two week period t, $RETMKT_{ct}$ is the return on the market for country c for period t, and $RETMKTUS_t$ is the return on the US market over period t. All returns are measured in the local currency.

TABLE 3

The R^2 Measure and the Price Informativeness of Earnings

$$ABRET_t = \beta_1 \Delta E_t + \beta_2 \Delta E_t * RR_t^2 + \beta_3 \Delta E_{t+1} + \beta_4 \Delta E_{t+1} * RR_t^2 + \beta_5 ABRET_{t+1} + \beta_6 RR_t^2 + \sum_{fye=1990}^{2001} \alpha_{fye} YEAR_t + \varepsilon_t$$

	ΔE_t	$\Delta E_t * RR_t^2$	ΔE_{t+1}	$\Delta E_{t+1} * RR_t^2$	$ABRET_{t+1}$	RR_t^2	$AdjR^2$
Expected sign if RR^2 is information-based	+	–	+	–	?	?	
Australia	0.149	0.001	0.071	-0.020	0.043	0.000	0.04
	0.11	*0.97*	*0.34*	*0.17*	*0.12*	*0.94*	
France	0.163	0.043	-0.098	0.011	0.054	0.004	0.08
	0.02	*0.01*	*0.01*	*0.22*	*0.00*	*0.03*	
Germany	0.194	0.019	-0.183	0.046	0.085	0.007	0.06
	0.10	*0.44*	*0.06*	*0.01*	*0.00*	*0.00*	
Japan	0.402	0.011	0.086	0.013	-0.105	-0.005	0.17
	0.00	*0.35*	*0.06*	*0.17*	*0.00*	*0.00*	
U.K.	0.392	0.007	0.120	-0.001	0.034	0.002	0.10
	0.00	*0.59*	*0.00*	*0.92*	*0.00*	*0.20*	
U.S.	0.593	0.058	0.021	0.038	-0.064	0.006	0.12
	0.00	*0.00*	*0.56*	*0.00*	*0.00*	*0.00*	

Variable definitions:

$ABRET_t$ is the market adjusted buy and hold return over fiscal year t. RR_t^2 is equal to the decile rank of the R^2 value for fiscal year t. ΔE_t is equal to the change in net income before extraordinary items scaled by beginning of period market value of equity for fiscal year t. YEAR is equal to a series of fiscal year fixed effects. P-values are based on Rodgers (cluster) standard errors which accounts for possible clustering at the firm level.

TABLE 4

R^2 Measure and Analysts' Forecast Errors

$$F\_ERROR_t = \beta_1 RR_t^2 + \sum_{fye=1990}^{2002} \alpha_{fye} YEAR_t + \varepsilon_t$$

	Expected sign if RR^2 is information-based	Australia	France	Germany	Japan	U.K.	U.S.
RR_t^2	+	-0.086	-0.076	-0.060	0.042	-0.085	-0.148
		0.00	*0.01*	*0.00*	*0.00*	*0.00*	*0.00*
Adj R^2		0.01	0.01	0.00	0.00	0.01	0.02
n		2,085	3,323	2,574	12,401	9,408	38,527

Variable definitions:

RR_t^2 is equal to the decile rank of the R^2 value for fiscal year t. F_ERROR_t is equal to the decile rank of $|EPS_{act} - EPS_{forecast}|/|EPS_{forecast}|$ for fiscal year t, where EPS_{act} is the firm's actual earnings per share and $EPS_{forecast}$ is the mean consensus earnings per share forecast. Analyst earnings forecasts are provided by IBES. YEAR is equal to a series of fiscal year fixed effects. P-values are based on Rodgers (cluster) standard errors which accounts for possible clustering at the firm level.

TABLE 5

U.S. Cross Listing Analysis

Panel A: Change in R^2 after Cross Listing in the U.S. (All ADRs)

	Mean ΔR^2	*p-value*	Median ΔR^2	*p-value*	n
Expected sign if R^2 is information-based	–		–		
Australia	-0.020	*0.49*	-0.010	*0.66*	55
France	0.080	*0.02*	0.045	*0.02*	31
Germany	0.041	*0.41*	0.007	*0.52*	22
Japan	-0.003	*0.95*	0.012	*0.94*	43
U.K.	0.055	*0.02*	0.026	*0.05*	89

Panel B: Change in R^2 after Cross Listing in the U.S. (Level 2 and 3 ADRs)

	Mean ΔR^2	*p-value*	Median ΔR^2	*p-value*	n
Expected sign if R^2 is information-based	–		–		
Australia	-0.037	*0.54*	0.002	*0.71*	14
France	0.110	*0.01*	0.078	*0.02*	17
Germany	0.122	*0.12*	0.243	*0.20*	9
Japan	0.004	*0.95*	-0.004	*0.89*	17
U.K.	0.086	*0.01*	0.048	*0.02*	43

Variable definitions:
ΔR^2 is equal to the R^2 in the year following cross listing in the U.S. minus the R^2 in the year before cross listing in the U.S.

TABLE 6

Stock Price Synchronicity and Firms' Information Flows and Fundamentals

Panel A: Pearson Correlations of Firms' Information Flows and Fundamentals with R^2 Values

	Australia	France	Germany	Japan	U.K.	U.S.
Variables proxying for firm fundamentals						
LOSS	-0.113***	-0.075***	-0.047***	0.002	-0.065***	-0.076***
R&D	0.111***	0.118***	0.150***	0.057***	-0.028***	0.052***
ANALYST	0.294***	0.425***	0.351***	0.077***	0.010	0.254***
%CLHLD	-0.172***	-0.269***	-0.288***	-0.192***	-0.209***	
STDSALES	-0.036*	-0.001	0.014	-0.028***	-0.142***	-0.062***
STDROA	-0.110***	-0.126***	-0.026	-0.017***	-0.123***	-0.056***
Control variables						
REG	0.053***	-0.048***	-0.009	0.018***	0.274***	0.011***
RELSIZE	0.154***	0.261***	0.135***	0.076***	0.063***	0.078***
MVE	0.322***	0.394***	0.274***	0.263***	0.247***	0.277***
TURNOVER	0.113***	0.265***	0.219***	0.025***	0.088***	0.079***

TABLE 6 Continued

Panel B: Stock Price Synchronicity and Firm Fundamentals (OLS Regression)

$$SYNCH_t = \beta_1 LOSS_t + \beta_2 R\&D_i + \beta_3 ANALYST_t + \beta_4 \%CLHLD_t + \beta_5 STDSALES_t + \beta_6 STDROA_t + \beta_7 REG_t + \beta_8 RELSIZE_t + \beta_9 MVE_t + \beta_{10} TURNOVER_t + \sum_{fye=1990}^{2002} \alpha_{fye} YEAR_t + \varepsilon$$

	Predicted sign	Australia	France	Germany	Japan	U.K.	U.S.
LOSS	-	0.053	-0.034	-0.039	0.140***	0.053	-0.042*
R&D	-	0.147**	0.016	0.154**	0.128***	-0.003	0.219***
ANALYST	-	0.131***	0.261***	0.184***	0.069***	-0.294***	0.207***
%CLHLD	+/-	-0.403***	-0.710***	-0.964***	-1.045***	-0.715***	
STDSALES	-	0.242*	0.473***	0.378**	-0.062	-0.103	0.137***
STDROA	-	0.168	0.253	1.144**	3.083***	-0.093	0.006
REG	+	0.173**	0.028	0.157**	-0.060**	0.635***	0.185***
RELSIZE	+	0.202*	0.095	-0.120	-0.125	-0.113	-0.179
MVE	+/-	0.153**	0.134***	0.162***	0.138***	0.261***	0.206***
TURNOVER	+/-	18.841	9.727**	0.436***	9.674	16.191***	2.186***
$AdjR^2$		0.16	0.24	0.25	0.21	0.22	0.14
% of coefficients with the correct sign		40%	30%	40%	20%	50%	45%

Variable definitions:

SYNCHt is equal to log(R2/(1-R2)) for fiscal year t; LOSS is equal to one if net income before extraordinary items is negative, and zero otherwise; R&D is equal to one if the firm reports a value for research and development expense, and zero otherwise; ANALYST is equal to the log of one plus the number of analysts making a forecast for fiscal year t's earnings; %CLHLD is the proportion of shares that are closely held as of the end of the fiscal year t; STDSALES is the standard deviation of sales scaled by total assets calculated requiring a minimum of three and maximum of five fiscal years; STDROA is the standard deviation of ROA calculated requiring a minimum of three and maximum of five fiscal years where ROA is equal net income before extraordinary items divided by fiscal year end total assets; REG is equal to one if the firm is a financial institution or utility; RELSALES is the firm's sales divided total sales of its primary industry (2 digit SIC); MVE is defined as the natural log of fiscal year end market value of equity; TURNOVER is the average weekly turnover (number of shares traded divided by number of shares outstanding) over the fiscal year; and YEAR is equal to a series of fiscal year fixed effects.***, **, * indicates significance at the 0.01, 0.05 and 0.10 levels, respectively. P-values are based on Rodgers (cluster) standard errors which accounts for possible clustering at the firm level.

TABLE 7

Index Analysis using German Market

$$SYNCH_t = \beta_1 LOSS_t + \beta_2 R\&D_i + \beta_3 ANALYST_t + \beta_4 \%CLHLD_t + \beta_5 STDSALES_t + \beta_6 STDROA_t + \beta_7 REG_t + \beta_8 RELSIZE_t + \beta_9 MVE_t + \beta_{10} TURNOVER_t + \beta_{11} DAX30_t + \beta_{12} NEWMARKET_t + \beta_{13} NEMAX50_t + \sum_{fye=1990}^{2002} \alpha_{fye} YEAR_t + \varepsilon$$

	Expected sign	Coefficient
LOSS	-	-0.098
R&D	-	0.083
ANALYST	-	0.165***
%CLHLD	+/-	-0.775***
STDSALES	-	0.235*
STDROA	-	0.729*
REG	+	0.151**
RELSIZE	+	-0.140
MVE	+/-	0.120***
TURNOVER	+/-	0.262**
DAX30	-	0.708***
NEWMARKET	-	0.394***
NEMAX50	-	0.549***
$AdjR^2$		0.26

Variable definitions:

DAX30 is equal to if the firm is part of the DAX30 index in fiscal year t, zero otherwise. NEMAX50 is equal to one if the firm is part of the NEMAX50 index in fiscal year t, zero otherwise. NEWMARKET is equal to one if the firm is part of the Ner Market of Frankfurt Stock Exchange in fiscal year t, zero otherwise. SYNCHt is equal to log(R2/(1-R2)) for fiscal year t; LOSS is equal to one if net income before extraordinary items is negative, and zero otherwise; R&D is equal to one if the firm reports a value for research and development expense, and zero otherwise; ANALYST is equal to the log of one plus the number of analysts making a forecast for fiscal year t's earnings; %CLHLD is the proportion of shares that are closely held as of the end of the fiscal year t; STDSALES is the standard deviation of sales scaled by total assets calculated requiring a minimum of three and maximum of five fiscal years; STDROA is the standard deviation of ROA calculated requiring a minimum of three and maximum of five fiscal years where ROA is equal net income before extraordinary items divided by fiscal year end total assets; REG is equal to one if the firm is a financial institution or utility; RELSALES is the firm's sales divided total sales of its primary industry (2 digit SIC); MVE is defined as the natural log of fiscal year end market value of equity; TURNOVER is the average weekly turnover (number of shares traded divided by number of shares outstanding) over the fiscal year; and YEAR is equal to a series of fiscal year fixed effects. ***, **, * indicates significance at the 0.01, 0.05 and 0.10 levels. P-values are based on Rodgers (cluster) standard errors which accounts for possible clustering at the firm level.

TABLE 8

Zero-return Metric Analysis

Panel A: Descriptive Statistics on the Zero-return Metric

Country	25th	Mean	Median	75th	Std. Dev	n
Australia	0.165	0.331	0.281	0.450	0.208	2,895
France	0.119	0.300	0.225	0.427	0.229	5,368
Germany	0.123	0.330	0.242	0.496	0.253	3,515
Japan	0.135	0.264	0.196	0.327	0.189	23,528
U.K.	0.281	0.505	0.554	0.723	0.254	14,248
U.S.	0.087	0.195	0.179	0.268	0.140	56,925

Panel B: Correlations between the Zero-return Metric and R^2 Values

	Australia	France	Germany	Japan	U.K.	U.S.
Pearson	-0.310	-0.391	-0.390	-0.343	-0.326	-0.262
	0.00	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Spearman	-0.345	-0.473	-0.459	-0.281	-0.326	-0.343
	0.00	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*

Panel C: Zero-return Metric and the Price Informativeness of Earnings

$$ABRET_t = \beta_1 \Delta E_t + \beta_2 \Delta E_t * R\%ZR_t + \beta_4 \Delta E_{t+1} + \beta_5 \Delta E_{t+1} * R\%ZR_t + \beta_6 ABRET_{t+1} + \beta_7 R\%ZR_t + \sum_{fye=1990}^{2001} \alpha_{fye} YEAR_t + \varepsilon_t$$

	ΔE_t	ΔE_t *$R\%ZR_t$	ΔE_{t+1}	ΔE_{t+1} * $R\%ZR_t$	$ABRET_{t+1}$	$R\%ZR_t$	AdjR^2
Expected sign if R%ZR is information-based	+	−	+	−	?	?	
Australia	0.486	-0.052	-0.133	0.022	0.046	-0.009	0.05
	0.03	*0.08*	*0.27*	*0.18*	*0.09*	*0.00*	
France	0.576	-0.046	0.003	-0.012	0.057	-0.007	0.08
	0.00	*0.00*	*0.96*	*0.21*	*0.00*	*0.00*	
Germany	0.557	-0.059	0.247	-0.052	0.081	-0.005	0.07
	0.00	*0.02*	*0.02*	*0.00*	*0.00*	*0.02*	
Japan	0.875	-0.079	0.372	-0.043	-0.106	-0.011	0.18
	0.00	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	
U.K.	0.859	-0.077	0.194	-0.016	0.039	-0.015	0.12
	0.00	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	
U.S.	1.792	-0.152	0.556	-0.062	-0.061	-0.017	0.13
	0.00	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	

TABLE 8 *Continued*

Panel D: Zero-return Metric and Analysts' Forecast Errors

$$F\_ERROR_t = \beta_1 R\%ZR_t + \sum_{fye=1990}^{2002} \alpha_{fye} YEAR_t + \varepsilon_t$$

	Expected sign if R%ZR is information-based	Australia	France	Germany	Japan	U.K.	U.S.
$R\%ZR_t$	+	0.148	0.109	0.024	0.012	0.180	0.343
		0.00	*0.00*	*0.49*	*0.31*	*0.00*	*0.00*
Adj R^2		0.02	0.01	0.00	0.00	0.03	0.09
n		2,085	3,323	2,574	12,401	9,408	38,527

Panel E: Change in Zero-return Metric after Cross Listing in the U.S. (All ADRs)

	Mean ΔZR	*p-value*	Median ΔZR	*p-value*	n
Expected sign if Zero-Return Metric is information-based	–		–		
Australia	0.015	*0.39*	-0.006	*0.61*	48
France	-0.011	*0.01*	-0.012	*0.00*	29
Germany	0.042	*0.22*	0.004	*0.28*	23
Japan	-0.002	*0.78*	0.000	*0.93*	41
U.K.	0.015	*0.36*	0.000	*0.74*	84

Panel F: Change in Zero-return Metric after Cross Listing in the U.S. (Level 2 and 3 ADRs)

	Mean ΔZR	*p-value*	Median ΔZR	*p-value*	n
Expected sign if Zero-Return Metric is information-based	–		–		
Australia	-0.002	*0.86*	-0.004	*0.84*	7
France	-0.014	*0.01*	-0.008	*0.01*	17
Germany	0.001	*0.73*	0.000	*0.80*	9
Japan	-0.006	*0.37*	-0.004	*0.73*	17
U.K.	-0.043	*0.01*	-0.019	*0.00*	35

TABLE 8 *Continued*

Panel G: Zero-return Metric and Firm Fundamentals (OLS Regression)

$$\%ZERORET_t = \beta_1 LOSS_t + \beta_2 R\&D_i + \beta_3 ANALYST_t + \beta_4 \%CLHLD_t + \beta_5 STDSALES_t + \beta_6 STDROA_t + \beta_7 REG_t + \beta_8 RELSIZE_t + \beta_9 \%MVE_t + \beta_{10} \%TURNOVER_t + \sum_{fye=1990}^{2002} \alpha_{fye} YEAR_t + \varepsilon$$

	Predicted sign	Australia	France	Germany	Japan	U.K.	U.S.
LOSS	-	-0.322***	-0.027	-0.101***	-0.138***	-0.230***	-0.020***
R&D	-	-0.061	0.048	-0.194***	-0.129***	-0.114***	-0.150***
ANALYST	-	-0.286***	-0.498***	-0.594***	-0.034***	-0.061***	-0.157***
%CLHLD	+/-	0.791***	1.055***	1.308***	0.842***	0.706***	
STDSALES	-	-0.270***	-0.303**	-0.774***	-0.261**	-0.051	-0.151***
STDROA	-	-0.635***	-1.230**	-1.644***	-3.206***	-0.410***	-0.069***
REG	+	0.043	0.155**	0.075	0.207***	-0.164***	0.037***
RELSIZE	+	0.035	0.210*	0.238**	0.511***	-0.117	0.451***
MVE	+/-	-0.315***	-0.178***	-0.140***	-0.280***	-0.479***	-0.246***
TURNOVER	+/-	-71.097***	-8.401**	-0.242**	-163.039***	-87.993***	-5.747***
AdjR^2		0.70	0.65	0.67	0.53	0.75	0.78
% of coefficients with the correct sign		70%	80%	90%	100%	70%	100%

TABLE 8 *Continued*

Variable definitions:

%ZR is equal to the percent of days in over the fiscal year for which the stock price does not change; $ABRET_t$ is the market adjusted buy and hold return over fiscal year t; $R\%NT_t$ is equal to the decile rank of the %ZR value for fiscal year t; ΔE_t is equal to the change in net income before extraordinary items scaled by beginning of period market value of equity for fiscal year t; F_ERROR_t is equal to the decile rank of $|EPS_{act} - EPS_{forecast}|/|EPS_{forecast}|$ for fiscal year t, where EPS_{act} is the firm's actual earnings per share and $EPS_{forecast}$ is the mean consensus earnings per share forecast; ΔR^2 is equal to the R^2 in the year following cross listing in the U.S. minus the R^2 in the year before cross listing in the U.S. $\%ZERORET_t$ is equal to log(%ZR/(1-%ZR)) for fiscal year t; LOSS is equal to one if net income before extraordinary items is negative, and zero otherwise; R&D is equal to one if the firm reports a value for research and development expense, and zero otherwise; ANALYST is equal to the log of one plus the number of analysts making a forecast for fiscal year t's earnings; %CLHLD is the proportion of shares that are closely held as of the end of the fiscal year t; STDSALES is the standard deviation of sales scaled by total assets calculated requiring a minimum of three and maximum of five fiscal years; STDROA is the standard deviation of ROA calculated requiring a minimum of three and maximum of five fiscal years where ROA is equal net income before extraordinary items divided by fiscal year end total assets; REG is equal to one if the firm is a financial institution or utility; RELSIZE is the firm's sales divided total sales of its primary industry (2 digit SIC); MVE is defined as the natural log of fiscal year end market value of equity; TURNOVER is the average weekly turnover (number of shares traded divided by number of shares outstanding) over the fiscal year; and YEAR is equal to a series of fiscal year fixed effects. ***, **, * indicates significance at the 0.01, 0.05 and 0.10 levels, respectively. Regression model p-values are based on Rodgers (cluster) standard errors which accounts for possible clustering at the firm level.

TABLE 9

Summary of Results

Panel A: The Synchronicity Measure as a Measure of Firm-specific Information Impounded in Share Prices

	Future Earnings	Analyst Forecast Errors	Cross Listing in the U.S.	Determinant Model
Australia	No	No	No	No
France	No	No	No	No
Germany	No	No	No	No
Japan	No	Yes	No	No
U.K.	No	No	No	Yes
U.S.	No	No	n/a	No

Panel B: The Zero-Return Metric as a Measure of Firm-specific Information Impounded in Share Prices

	Future Earnings	Analyst Forecast Errors	Cross Listing in the U.S.	Determinant Model
Australia	No	Yes	No	Yes
France	No	Yes	Yes	Yes
Germany	Yes	No	No	Yes
Japan	Yes	No	No	Yes
U.K.	Yes	Yes	Yes	Yes
U.S.	Yes	Yes	n/a	Yes

This table summarizes the results of the empirical analysis. "Yes" indicates that the test results are consistent with the information-based interpretation, and "No" indicates that there is no result or the results are not consistent with the information-based interpretation.