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Culture and R^2 ☆

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ABSTRACT

Consistent with predictions from the psychology literature, we find that stock prices co-move more (less) in culturally tight (loose) and collectivistic (individualistic) countries. Culture influences stock price synchronicity by affecting correlations in investors' trading activities and a country's information environment. Both market-wide and firm-specific variations are lower in tighter cultures. Individualism is mostly associated with higher firm-specific variations. Trade and financial openness weakens the effect of domestic culture on stock price comovements. These results hold for various robustness checks. Our study suggests that culture is an important omitted variable in the literature that investigates cross-country differences in stock price comovements.

1. Introduction

The extent to which stock prices move together is an important issue in portfolio analysis and asset pricing. Understanding stock price synchronicity is also essential to the study of market efficiency and resource allocation efficiency in general (e.g., Wurgler, 2000; Morck, Yeung, and Yu, 2013). A good number of studies have examined cross-country differences in stock price synchronicity. They focus on using a country's economic fundamentals, such as Gross Domestic Product (GDP) per capita, institutional development, and the quality of the information environment, to explain stock price comovement.[3] Another important but neglected factor that differentiates one country from another is culture, which imposes informal constraints on human behavior.

In his seminal work on institutions, North (1990, p. 6) states that "Although formal rules may change overnight as the result of political or judicial decisions, informal constraints embodied in customs, traditions and codes of conduct are much more impervious to deliberate policies." The effect of culture on the behavior of individuals is well documented in the management and psychology literature.[4] And the

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[3] For example, see Morck, Yeung, and Yu (2000), Li, Morck, Yang, and Yeung (2004), Jin and Myers (2006), and Bris, Goetzmann, and Zhu (2007).

[4] For example, see Kroeber and Kluckhohn (1952), Hofstede (1980, 2001), Gelfand, Nishii, and Raver (2006), Hofstede, Hofstede, and Minkov (2010), Gelfand et al. (2011), and Norenzayan (2011).

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behavioral finance literature shows that behavioral biases can affect stock price comovements.[5] Combining both strands of literature, it stands to reason that cultural dimensions that introduce systematic biases into investor behavior can also affect stock price comovement.

To examine the effect of culture on stock price comovement, we focus on two cultural dimensions that are likely to generate correlations between investors' trading behaviors. The first dimension, tightness versus looseness, focuses on *external* constraints on human behavior and measures the strength of a country's social norms and the society's tolerance for deviant behavior (Gelfand, Raver, Nishii, Leslie, and Lun, 2011). Gelfand, Nishii, and Raver (2006) argue that individual behaviors tend to be more homogeneous and exhibit a lower degree of variation in culturally tight countries. The convergence in investor behaviors would likely cause positive correlations in investors' stock selections and buy/sell decisions, which can induce comovements in stock returns (e.g., Barberis, Shleifer, and Wurgler, 2005; Kumar, Page, and Spalt, 2009). Based on these arguments, we expect higher stock return comovements in culturally tight countries.

While cultural tightness/looseness captures external constraints on individual behaviors, the second dimension, individualism versus collectivism, focuses on *internal* attributes that guide an individual to differentiate his or her behavior from that of others (e.g., Hofstede, 1980, 2001; Schwartz, 1994; Gelfand, Nishii, and Raver, 2006). The literature suggests that individualistic investors are likely to be more confident in their ability to acquire and analyze information and less concerned about having different opinions from others (Markus and Kitayama, 1991; Heine, Lehman, Markus, and Kitayama, 1999; Chui, Titman, and Wei, 2010). Therefore, one would expect to observe less herding behavior and more firm-specific information being incorporated in stock prices, which would be likely to lead to lower stock price comovements in individualistic countries.

Using the tightness measure of Gelfand, Raver, Nishii, Leslie, and Lun (2011) and the individualism measure of Hofstede (2001), we examine the influence of culture on stock price comovements for a sample of 47 countries from 1990 to 2010. We use R^2 from an expanded market model to measure stock price comovement in a country. As expected, we find that countries that are culturally tighter and less individualistic have higher stock price comovements. The influence of culture on stock price comovements is economically significant. A one standard deviation increase in tightness (individualism) is associated with a 12.9% increase (18.2% decrease) in stock price comovements (R^2) from the mean. The marginal effects of these two cultural variables on R^2 are comparable to those of previously documented determinants of stock price synchronicity, such as GDP per capita (−12.4%), country size (−9.3%), good government index (−15.0%), and the diversity of analyst forecasts (6.1%). These results are robust to controlling for a variety of country-level characteristics that have been shown to affect stock price synchronicity, such as GDP per capita, GDP growth volatility, good government index, informational opaqueness, industry and firm concentrations, country size, and earnings comovements.

We next examine the possible mechanisms through which the two cultural variables affect stock price synchronicity. Evidence from the finance literature suggests that correlated trading and information opacity are likely to lead to higher stock price comovements (e.g., Barberis, Shleifer, and Wurgler, 2005; Jin and Myers, 2006; Kumar, Page, and Spalt, 2009). Consistent with higher stock price comovements in culturally tight countries, we find that the fraction of stocks moving in the same direction is higher and the information environment is more opaque in these countries. In individualistic countries, information transparency is higher and the fraction of stocks moving in the same direction is lower, which is consistent with our observation of lower stock price comovements in these countries. Taken together, these results suggest that differences in stock trading correlations and information environments in different cultures are the likely mechanisms through which the cultural variables influence stock price comovements.

A higher (lower) R^2 could be an outcome of higher (lower) market-wide variations and lower (higher) firm-specific variations. If investors tend to make similar trading decisions and the overall information environment is less transparent in tight cultures, less firm-specific information would be imputed into the stock prices. Further, if investors are reluctant to deviate from aggregate beliefs in the market, that is, prevailing market prices, one would expect lower market-wide variations in stock returns. Consistent with these arguments, we find that both market-wide and firm-specific variations are lower in tighter cultures, but the negative effect of cultural tightness on firm-specific variations is much stronger than that on market-wide variations, leading to higher R^2 in tighter cultures. On the other hand, individualistic investors are more likely to gather and process information on individual firms, allowing more firm-specific information to be incorporated into stock prices. Supporting this view, we find higher firm-specific return variations in individualistic countries. There is no significant relation between individualism and market-wide return variations. These results suggest that individualism leads to a lower R^2 primarily through higher firm-specific variations.

We next examine whether trade or capital market openness mitigates the influence of domestic culture on stock price synchronicity. Trade openness exposes people to different ideas and values and could potentially weaken the effect of a country's own culture on people's behavior. Capital market openness allows foreign investors to participate in domestic markets, mitigating the influence of domestic culture on stock price behavior as well. Consistent with these arguments, we find a weaker influence of a country's cultural tightness and individualism on stock price comovement when the country is more open to international trade, receives more foreign portfolio investments, and is more integrated with the global stock market.

We conduct several robustness checks on our results. First, we repeat our analysis in a joint sample of 28 countries for which both cultural measures are available and confirm that our results are not driven by sample differences. Second, we verify the robustness of our results with a balanced panel of countries that have data available for the entire sample period.

[5] See Hirshleifer (2001) and Shiller (2003) for surveys on the behavioral finance literature. Barberis, Shleifer, and Wurgler (2005) discuss sentiment-based views of stock return comovements.

Third, instead of using panel regressions, we repeat all our regressions using the Fama-MacBeth method and obtain similar results. Fourth, to examine if our results hold at the firm level, we conduct our analysis at the firm level using the hierarchical modeling approach and confirm that tightness and individualism can explain individual stocks' comovements with the market. Fifth, we confirm that our results hold for an alternative stock price comovement measure.

In sum, our paper suggests that culture is an important factor that affects investor behavior and, in turn, stock price comovement. The findings of our paper add to both the literature on cross-country differences in stock price comovement (Roll, 1988; Froot and Dabora, 1999; Morck, Yeung, and Yu, 2000; Li, Morck, Yang, and Yeung, 2004; Jin and Myers, 2006; Bris, Goetzmann, and Zhu, 2007; Karolyi, Lee, and van Dijk, 2012) and the literature that relies on behavioral factors to explain stock price comovement (Barberis and Shleifer, 2003; Barberis, Shleifer, and Wurgler, 2005; Baker and Wurgler, 2006; Kumar and Lee, 2006; Green and Hwang, 2009; Kumar, Page, and Spalt, 2009). Our finding that national cultures affect firm-specific return variations adds to the literature on the determinants of firm-specific (i.e., idiosyncratic) stock price variations (e.g., Durnev, Morck, and Yeung, 2004; Durnev, Morck, Yeung, and Zarowin, 2004; Jin and Myers, 2006; Bartram, Brown, and Stulz, 2012). Our findings on the effect of openness suggest that economic openness mitigates potential behavioral biases associated with a country's national culture, adding to the literature on the consequences of trade and capital market openness (e.g., Frankel and Romer, 1999; Stulz, 1999; Karolyi and Stulz, 2003; Rajan and Zingales, 2003; Stulz and Williamson, 2003).

Shiller and Pound (1989) and Hirshleifer (2001) both argue that it is important to understand how social norms and interactions between people affect investor decisions and point out the lack of studies in this area. Our study complements the literature on behavioral finance by showing that a newly developed cultural dimension, tightness/looseness, which is a proxy for the strength of social norms, is an important factor that affects investor behavior. Our findings also add to a growing body of finance literature that examines how national cultures affect investor behaviors and corporate decisions (e.g., Grinblatt and Keloharju, 2001; Stulz and Williamson, 2003; Guiso, Sapienza, and Zingales, 2004, 2008; Chui, Titman, and Wei, 2010; Li, Griffin, Yue, and Zhao, 2011, 2012; Ahern, Daminelli, and Fracassi, 2012).

A country's information environment is important because it affects the informativeness of asset prices and the efficiency of resource allocations, which is essential to economic growth. Researchers often focus on the influence of formal institutions, such as legal regimes and accounting disclosure standards, when studying a country's information environment (e.g., Bushman, Piotroski, and Smith, 2004; Bris, Goetzmann, and Zhu, 2007; Fernandes and Ferreira, 2009). We find that the information environment is more transparent in individualistic cultures and more opaque in tight cultures. In light of this finding, researchers can consider a country's informal institutions when assessing its information environment, since these institutions are directly related to how information is gathered and processed.

The remainder of the paper is organized as follows. Section 2 discusses the link between culture and stock price comovement in detail and presents the main hypotheses. Section 3 describes the data and variable construction. Section 4 presents our empirical findings on the effect of culture on stock price synchronicity. Section 5 discusses the possible mechanisms through which a country's culture affects stock price synchronicity. Section 6 examines the influence of a country's economic openness on the relation between culture and stock price synchronicity. Section 7 discusses our robustness checks. Lastly, Section 8 provides concluding remarks.

2. Conceptual background and the hypotheses

The notion that culture affects stock price behavior is supported by several recent financial studies. Chui, Titman, and Wei (2010) find that cross-country differences in individualism influence the returns of momentum strategies. Grinblatt and Keloharju (2001) show that culture influences investors' decisions on stockholding and trading. Guiso, Sapienza, and Zingales (2008) document greater investor participation in stock markets in countries with higher levels of trust.

Morck, Yeung, and Yu (2000) find that the comovement of fundamentals only partially explains stock return comovement and suggest that limitations on informed arbitrage may explain the differences in return comovements across countries. Since then, behavioral factors have also been offered to explain stock price comovement (e.g., Barberis and Shleifer, 2003; Barberis, Shleifer, and Wurgler, 2005; Baker and Wurgler, 2006; Kumar and Lee, 2006). Based on the premise that culture serves as an informal institution to regulate investor behavior, we expect culture to influence investors' stock selections and trading decisions. Several studies suggest that the correlated trading of investors in certain categories of stocks may cause stocks to co-move more in these categories (e.g., Barberis, Shleifer, and Wurgler, 2005; Kumar and Lee, 2006; Green and Hwang, 2009; Kumar, Page, and Spalt, 2009; Dorn and Huberman, 2010). Motivated by these studies, we focus on the cultural dimensions that are likely to generate correlations in investors' trading behavior and, in turn, influence stock return comovement.

The first cultural dimension we consider is tightness versus looseness, which was first introduced by Pelto (1968) and Triandis (1989) and recently formalized by Gelfand, Nishii, and Raver (2006) and Gelfand, Raver, Nishii, Leslie, and Lun (2011). A country's culture is defined as tight (loose) if the country has strong (weak) social norms and low (high) tolerance for deviant behavior. We expect that tight (loose) culture would generate high (low) correlations in investors' trading activities for several reasons.

First, as pointed out by Gelfand, Nishii, and Raver (2006, p. 1230), cultural tightness/looseness "is expected to relate to preferred ways of gathering, processing, and evaluating information when solving problems." If investors follow a similar way to gather and process information, they are more likely to arrive at similar investment decisions, which can lead them to converge in stock selections and buy/sell decisions. Second, in countries with strong norms that define appropriate behavior, individuals are likely to share many common experiences and similar perspectives. In contrast, individuals in culturally loose countries would

face fewer social constraints on their behaviors and are thus likely to have more varied and idiosyncratic experiences. As a result, investors' reactions to information in culturally tight countries would be more similar and exhibit lower interpersonal variations than in culturally loose countries. Third, cultural tightness/looseness also affects people's willingness to conform to others' behavior. Investors in a tight culture are more likely to seek conformity in their investment decisions, while investors in a loose culture would be less concerned about deviating from the norm. Conformity in decisions would lead to similar trading strategies and reluctance to deviate from the aggregate market belief. If investors in tight cultures tend to converge in their stock selections and make similar buy or sell decisions, the positive correlation in their trading activities would likely lead to higher stock price comovements. Based on the above arguments, we hypothesize the following.

H1. Stock price comovements are higher in countries with tight cultures than in countries with loose cultures.

The second cultural dimension we consider is individualism versus collectivism. Hofstede (1980, 2001) defines individualism based on the extent to which people are integrated into groups; it reflects the degree to which people focus on their own internal attributes to differentiate themselves from others. Experimental and survey studies suggest that people are more likely to believe that they are above average in individualistic cultures than in collectivistic cultures (Markus and Kitayama, 1991; Heine, Lehman, Markus, and Kitayama, 1999). Consistent with this view, Chui, Titman, and Wei (2010) argue that individualism is related to investors' overconfidence and self-attribution bias and find that momentum profits are positively related to individualism. Because of confidence in their ability, individualistic investors are less concerned about trading based on opinions that differ from the norm. As a result, one would expect less herding behavior in individualistic countries. Supporting this view, Beckmann, Menkhoff, and Suto (2008) find that asset managers from individualistic cultures are less likely to engage in herding.

Furthermore, people from individualistic cultures have analytical thinking styles (Choi and Nisbett, 2000; Nisbett, Peng, Choi, and Norenzayan, 2001). They prefer to use analysis and logic to explain and predict an object's behavior. They are inclined to detach objects from the system and focus on the objects' individual attributes. In contrast, people from collectivistic cultures have holistic thinking styles, possibly leading them to view stocks jointly, as a system, rather than analyzing stocks individually.

Analytical thinking styles and less herding are likely to result in a lower correlation in investors' trading activities in individualistic cultures. In addition, individualistic investors' willingness to collect, analyze, and use their own information for trading would also allow more firm-specific information to be incorporated into stock prices. Both lower trading correlation and more firm-specific stock price variations can lead to lower stock price comovements in individualistic countries. Formally, we hypothesize the following.

H2. Stock price comovements are lower in countries with individualistic cultures than in countries with collectivistic cultures.

The globalization of the economy has significantly increased the international transmission of local cultures to foreign countries. People in an open economy are exposed to the traditions and norms of other societies in addition to their own (e.g., Cowen, 2002). Jones (2006) suggests that trade openness encourages a cultural integration that may be beneficial in reducing the transaction and information costs of trade. Stulz and Williamson (2003) find that the effect of domestic culture on a country's financial development is mitigated when a country is more open to international trade. Collectively, these arguments suggest that trade openness could weaken the influence of national culture on people's behaviors and business activities. We also expect capital market openness to mitigate the influence of domestic culture on stock prices. Foreign investors are not influenced by the same culture as domestic investors. Thus, the trading activities of foreign investors in domestic markets are likely to mitigate the influence of national culture on stock price behaviors. Based on these arguments, we hypothesize the following.

H3. The relation between national culture and stock price comovement is weaker in countries that are more open to trade and integrated with the global stock market.

3. Data and variable construction

3.1. Data

We start with the weekly returns of all the stocks in Datastream from 1990 to 2010. We calculate stock returns using the total return index, a stock price index constructed by Datastream adjusted for dividends and stock splits. We follow Jin and Myers (2006) to filter our sample. We first exclude stocks that are not traded in their home markets. We then exclude stocks that have valid return data for fewer than 30 weeks during a year. For a country to be included in a particular year, we require at least 25 stocks in that country to have valid data that year. To prevent outliers from driving the results, we follow Ince and Porter (2006) and delete an observation if the stock return is above 300% and reverses in the following week. Our final sample includes 47 countries and 932 country–year observations, which covers all the countries in the samples of Jin and Myers (2006) and Morck, Yeung, and Yu (2000).

The data on cultural tightness are from Gelfand, Raver, Nishii, Leslie, and Lun (2011) and are available for 28 of our sample countries. The data on individualism are from Hofstede (2001) and are available for all our sample countries. To measure firm and industry Herfindahl indices and earnings comovement, we obtain accounting data for our sample firms from the Thomson Worldscope database. Our proxy for capital market openness is based on data from the annual *Coordinated Portfolio Investment Survey* (CPIS), published by the International Monetary Fund. The CPIS data report participating countries' year-end

portfolio holdings of equity and debt securities in 234 destination countries for 1997 and from 2001 onward. All our sample countries are included as destination countries in the CPIS data. Other country-level data such as geographical size and GDP per capita are collected from the World Bank's database.

3.2. Stock price synchronicity measures

Following Morck, Yeung, and Yu (2000) and Jin and Myers (2006), we use R^2 from an expanded market model to measure stock price comovement in a country. More specifically, we estimate R^2 based on the following model of Jin and Myers (2006):

$$\begin{aligned} r_{i,j,t} = {} & \alpha_{i,j} + \beta_{1,i} r_{m,j,t} + \beta_{2,i}\left[r_{U.S.,t} + EX_{j,t}\right] + \beta_{3,i} r_{m,j,t-1} \\ & + \beta_{4,i}\left[r_{U.S.,t-1} + EX_{j,t-1}\right] + \beta_{5,i} r_{m,j,t-2} \\ & + \beta_{6,i}\left[r_{U.S.,t-2} + EX_{j,t-2}\right] + \beta_{7,i} r_{m,j,t+1} \\ & + \beta_{8,i}\left[r_{U.S.,t+1} + EX_{j,t+1}\right] + \beta_{9,i} r_{m,j,t+2} \\ & + \beta_{10,i}\left[r_{U.S.,t+2} + EX_{j,t+2}\right] + e_{i,j,t}, \end{aligned} \quad (1)$$

where $r_{i,j,t}$ is the weekly return of stock i of country j in week t of a year, $r_{m,j,t}$ is the weekly market return of country j in week t, and $r_{U.S.,t} + EX_{j,t}$ is the US market return adjusted for change in the exchange rate of country j against the US dollar. The inclusion of lead and lag terms is to correct for nonsynchronous trading, according to Dimson (1979). To measure the comovement of stock prices in a country, for each year we take an equal-weighted average of the R^2s of the individual stocks in the country. A higher average R^2 indicates greater stock price comovement. We measure the market-wide (firm-specific) return variation using the average explained (residual) sum of squares from Eq. (1) for each country.

3.3. Cultural measures: tightness and individualism

The country values for our first cultural measure, tightness, are from Gelfand, Raver, Nishii, Leslie, and Lun (2011). With support from the National Science Foundation, Gelfand et al. conducted a survey on cultural tightness vs. looseness across 33 nations. Appendix A describes the survey method. The final tightness score for a country is based on a six-item Likert scale and is presented in Table 1.[6] A higher score indicates a tighter national culture.

Our second cultural measure, individualism, is from Hofstede (2001). Hofstede provides the individualism scores for 76 nations. In addition to individualism, Hofstede measures four other cultural dimensions: power distance, uncertainty avoidance, masculinity, and long-term orientation. We focus on individualism instead of the other cultural dimensions for a few reasons. First, this variable complements the external focus of cultural tightness and captures internal motivations that guide one's behavior (Gelfand, Nishii, and Raver, 2006). Second, the literature provides evidence that the individualism measure is related to stock price movements (e.g., Chui, Titman, and Wei, 2010). Third, as argued in Ahern, Daminelli, and Fracassi (2012), individualism is a popular cultural dimension that is common to alternative culture definitions, such as in Schwartz (1994), Trompenaars (1993), and Fiske (1991).

While correlated, tightness and individualism differ from each other significantly. Tightness captures *external* conditioning on human behavior, whereas individualism is related to the degree to which people focus on their own *internal* attributes to differentiate themselves from others. As illustrated in Fig. 1, countries exhibit different loadings on these two cultural dimensions. For example, Brazil is collectivistic and loose while Norway is individualistic and tight. Turkey is collectivistic like Brazil but much tighter. As expected, the United States is highly individualistic and loose, as is Australia. Compared with the United States, Germany is substantially less individualistic and tighter. Japan is found to be even less individualistic and tighter than Germany. Singapore and South Korea are culturally quite similar, both being highly collectivistic and tight. China is similarly collectivistic but somewhat less tight than these two Asian countries.

3.4. Measures of openness

3.4.1. Trade openness

To measure trade openness, we use the natural trade openness measure constructed by Frankel and Romer (1999). These authors estimate a country's natural trade openness utilizing the country's geographic attributes, such as distance from potential trade partners, whether it shares borders with potential trade partners, and whether the country is landlocked. This variable captures the potential importance of trade in a country's economy. We choose natural trade openness over actual trade openness because it better captures a county's geographic closeness to its trade partners. Geographic closeness facilitates cultural exchange between countries by increasing the probability and frequencies of business visits and contacts between the trading parties. For example, Japan, China, and the United States are Thailand's top three trading partners; however, Chinese culture has a greater influence on Thailand's culture than Japanese or American culture because of the geographic closeness between China and Thailand. Moreover, a country's natural trade openness is likely to be more exogenous than a country's actual trade openness, which is an outcome of its business activities.

3.4.2. Capital market openness

We construct two variables to measure the degree of openness of a country's stock market. The first variable relies on the portfolio holding data reported by the CPIS survey. For each country in our sample, we calculate capital market openness as the total value of portfolio equity holdings by foreign investors divided by the country's stock market capitalization. The higher the value, the higher is this capital market openness measure. Capital market openness is above one for Luxembourg because a substantial amount of portfolio investments are rerouted to other countries after a temporary stay in Luxembourg. To mitigate the effect of Luxembourg, we set Luxembourg's

[6] A Likert scale is the most widely used approach to scaling responses in survey research. When responding to a Likert questionnaire, respondents specify their responses based on a symmetric agree-disagree scale for a series of statements.

Table 1
Stock price synchronicity (R^2) and cultural measures, by country.

This table presents the sample period used to estimate R^2 for each country, equal-weighted R^2, GDP per capita, and the two cultural measures for 47 countries in our sample. The equal-weighted R^2 is the average of the R^2s of stocks in a country estimated from an expanded market model (see Eq. (1)). The GDP per capita is the average of the yearly GDP per capita for each country. The tightness measure is that of Gelfand, Raver, Nishii, Leslie, and Lun (2011) and captures the extent to which a country has strong norms and low tolerance of deviant behavior. The individualism measure is that of Hofstede (2001) and captures the extent to which people focus on their own internal attributes to differentiate themselves from others.

Country	Period for R^2 estimation	Equal-weighted R^2	GDP per capita	Tightness	Individualism
United States	1990–2010	0.170	38,247	5.1	91
Australia	1990–2010	0.244	31,152	4.4	90
Canada	1990–2010	0.249	33,256		80
Germany	1990–2010	0.254	32,311	7.0	67
Luxembourg	1992–2009	0.254	65,611		60
Brazil	1992–2010	0.255	5,012	3.5	38
Denmark	1990–2010	0.255	44,273		74
Ireland	1990–2002	0.255	30,811		70
Czech Republic	1994–2007	0.256	11,086		58
South Africa	1990–2010	0.258	4,328		65
New Zealand	1990–2010	0.260	22,050	3.9	79
United Kingdom	1990–2010	0.261	32,844	6.9	89
Peru	1991–2010	0.262	2,655		16
Russian Federation	1997–2010	0.263	5,107		39
France	1990–2010	0.264	31,705	6.3	71
Chile	1990–2010	0.275	6,510		23
Belgium	1990–2010	0.287	32,629	5.6	75
Portugal	1990–2010	0.288	15,363	7.8	27
Philippines	1990–2010	0.288	1,071		32
Pakistan	1993–2010	0.296	632	12.3	14
Indonesia	1990–2010	0.297	1,204		14
Austria	1990–2010	0.297	34,458	6.8	55
India	1990–2010	0.300	589	11.0	48
Switzerland	1990–2010	0.300	47,219		68
Norway	1990–2010	0.305	59,404	9.5	69
Columbia	1992–2010	0.311	2,801		13
Mexico	1990–2010	0.314	6,715	7.2	30
Israel	1990–2010	0.315	17,739	3.1	54
Finland	1991–2010	0.315	33,007		63
Netherlands	1990–2010	0.316	34,520	3.3	80
Hong Kong	1990–2010	0.319	21,937	6.3	25
Sweden	1990–2010	0.320	35,196		71
Venezuela	1994–2009	0.324	5,523		12
Thailand	1990–2010	0.333	2,535		20
Hungary	1994–2010	0.334	8,906	2.9	80
Poland	1995–2010	0.350	7,535	6.0	60
Japan	1990–2010	0.361	31,886	8.6	46
South Korea	1990–2010	0.365	14,676	10.0	18
Spain	1990–2010	0.366	22,848	5.4	51
Singapore	1990–2010	0.370	23,742	10.4	20
Argentina	1993–2010	0.380	4,438		46
Italy	1990–2010	0.381	28,407	6.8	76
Greece	1990–2010	0.387	17,466	3.9	35
Malaysia	1990–2010	0.391	4,614	11.8	26
Taiwan	1990–2010	0.450	13,049		17
Turkey	1990–2010	0.452	4,167	9.2	37
China	1993–2010	0.549	1,472	7.9	20

capital market openness to one in regression analyses. Our results are robust to excluding Luxembourg from our analysis.

To construct a second measure of capital market openness, we follow the approach of Pukthuanthong and Roll (2009) and construct a stock market integration measure. One advantage of this measure is that it covers the whole sample period, whereas the CPIS survey is available only for the later period of our sample (2001–2010). A market that is better integrated with the global market is likely to be more accessible to foreign investors. To construct the measure, we first collect the daily returns for each of our 47 sample countries' market indexes, in US dollars, from Datastream. To extract global factors, we follow Pukthuanthong and Roll (2009) and choose the 17 markets with the longest return series in Datastream.[7] We extract the first four principal components from the daily returns of the 17 market indexes and use them as the global

[7] The 17 countries are Australia, Austria, Belgium, Canada, Denmark, France, Germany, Hong Kong, Ireland, Italy, Japan, the Netherlands, Singapore, South Africa, Switzerland, the United Kingdom, and the United States.

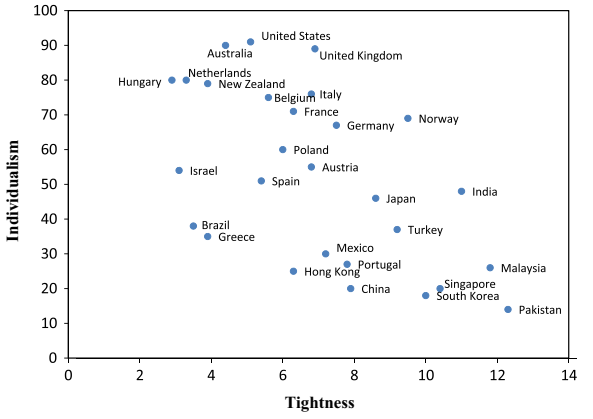

Fig. 1. Tightness and individualism. This figure plots the tightness and individualism scores of the 28 countries with values available for both cultural variables. The tightness measure is from Gelfand, Raver, Nishii, Leslie, and Lun (2011) and captures the extent to which a country has strong norms and low tolerance of deviant behavior. The individualism measure is from Hofstede (2001) and captures the extent to which people focus on their own internal attributes to differentiate themselves from others.

factors to estimate the following model:

$$r_{j,t} = \alpha_j + \beta_{1,j} PC_{1,j,t} + \beta_{2,j} PC_{2,j,t} + \beta_{3,j} PC_{3,j,t} + \beta_{4,j} PC_{4,j,t} + e_{j,t}, \quad (2)$$

where $r_{j,t}$ is the daily return for country j on day t, and $PC_{1,t}$, $PC_{2,t}$, $PC_{3,t}$, and $PC_{4,t}$ are the first to fourth principal components on day t. When extracting the principal components of country j, we include the lagged returns of the US and Canadian markets to account for time zone differences and exclude the returns of country j's own market index when j is one of the 17 countries. For example, the returns of Austria's market index are excluded from the estimation of Austria's principal components. We use the R^2 estimated from Eq. (2) to measure the degree to which a market is integrated with the global market.

3.5. Other variables

Based on the findings of previous studies (i.e., Morck, Yeung, and Yu, 2000; Jin and Myers, 2006), we control for the good government index, information opaqueness, GDP per capita, GDP growth volatility, the number of stocks traded in a country, country geographic size, industry and firm Herfindahl indices, and earnings comovement in our regression analysis.

The good government index is the sum of the percentile ranks of two indices constructed by Kaufmann, Kraay, and Mastruzzi (2009): government effectiveness and control of corruption.[8] These two indices are available from 1996 to 2008 and were updated every two years from 1996 to 2002 and every year from 2003 to 2008. We use 1996s values for 1990–1996 and 2008s values for 2008–2010. We assign the average of the values of the year before and after to the missing years in between. Following Jin and Myers (2006), we construct an opaqueness measure, the diversity of analyst forecasts, as a country's average dispersion of analyst forecasts of a firm's earnings, divided by the mean forecast and then by the square root of the number of analysts following the firm.[9] The data on analysts' earnings forecasts are from the Institutional Brokers' Estimate System (I/B/E/S) international edition. Jin and Myers (2006) argue that a country's information environment is more opaque if there is more diversity in analysts' opinions.

We include Ln(GDP per capita) and Ln(number of stocks) as controls for the countries' economic and financial development, respectively. We control for macroeconomic instability by including GDP growth volatility, which is measured by the standard deviation of growth in GDP per capita. We include Ln(country size) to control for the possibility that smaller countries might have more concentrated economic activities, which can lead to greater stock price comovements. Country size is a country's geographical size in square miles. Industry and firm Herfindahl indices are included to control for stock price comovement due to economic specialization. Finally, we control for synchronicity in firm fundamentals by including a proxy for earnings comovement, following Morck, Yeung, and Yu (2000). For each year, we first estimate R^2 and the total sum of squares (SST) for each individual stock i in country j by regressing its return on assets (ROA) on the market ROA, using a five-year rolling window:

$$ROA_{i,j,t} = a_{i,j} + b_{i,\,t} ROA_{m,j,t} + \varepsilon_{i,j,t}, \quad (3)$$

where the market $ROA_{m,j,t}$ is the asset-weighted average of the ROAs for all firms in country j. For each country, we then calculate the earnings comovement as an SST-weighted average of the R^2s for all individual stocks in that country.

3.6. Descriptive statistics

Table 1 provides the list of our sample countries, the time period for which return data are available for each country, and the countries' corresponding values of R^2, tightness, and individualism measures. The first four columns of Table 1 contain some observations that are not consistent with one of the key findings of Morck, Yeung, and Yu (2000) that stock price synchronicity is

[8] We obtain similar results if we use the good government index of Morck et al. (2000). We choose to use the index from the World Bank because (i) it is available for more countries in our sample and (ii) it is updated every one to two years and has time series variations. The good government index of Morck et al. (2000) is based on the work of La Porta, Lopez-de-Silanes, Shleifer, and Vishny (1998). It is available for 49 countries and is a fixed number throughout our entire sample period.

[9] Our results are robust to controlling for other opaqueness measures used by Jin and Myers (2006): the rating on the level and effectiveness of financial disclosure from the Global Competitiveness Reports (GCR) for 1999 and 2000, the number of professional auditors in Bhattacharya, Daouk, and Welker (2003), the accounting standard index of La Porta et al. (1998), and the Global Opacity Index for 2000 from PriceWaterhouseCoopers (PWC) (2001). The values for the GCR-based opacity measure are obtained from Gelos and Wei (2005). We choose to report the results on analyst diversity rank because it is the only time-varying measure and available for most of the country–year observations in our sample. The other measures are time invariant and cover a smaller sample of countries.

Table 2
Summary statistics.

This table presents summary statistics for key variables in our sample. The sample consists of country-year observations for 47 countries from 1990 to 2010. The equal- and variance-weighted R^2s are the averaged R^2s of stocks in a country estimated from an expanded market model (see Eq. (1)). Transformed R^2s are the logistic transformation of the R^2s using Eq. (4). The terms Ln(market-wide variation) and Ln(firm-specific variation) are the natural logarithms of the average explained sum of squares and the residual sum of squares, respectively, from Eq. (1). The tightness measure is from Gelfand, Raver, Nishii, Leslie, and Lun (2011) and captures the extent to which a country has strong norms and low tolerance of deviant behavior. The individualism measure is from Hofstede (2001) and captures the extent to which people focus on their own internal attributes to differentiate themselves from others. Trade openness is from Frankel and Romer (1999). Capital market openness is calculated as the total value of portfolio equity holdings by foreign investors divided by the country's stock market capitalization. Capital market integration measures the degree of market integration as in Pukthuanthong and Roll (2009). The term Ln(number of stocks) is the natural logarithm of the number of stocks in a national stock market. The fraction of stocks moving in the same direction is calculated based on Eq. (6). The transformed fraction of stocks moving in the same direction is the logistic transformation of the variable using Eq. (7). GDP growth volatility is the standard deviation of the growth rate of GDP per capita. Ln(country size) is the natural logarithm of the geographical size of a country in square miles. The industry Herfindahl index is the sum of the squared market shares of all industries in a country. The firm Herfindahl index is the sum of the squared market shares of all the firms in a country. Earnings comovement is the *SST*-weighted average of the R^2s of firms in a country, estimated from Eq. (3). The good government index is the sum of the percentile ranks of two indices of Kaufmann, Kraay, and Mastruzzi (2009), government effectiveness and control of corruption. The diversity of analyst forecasts is the average dispersion of analyst forecasts of stocks in a country, as calculated by Jin and Myers (2006). We winsorize the price comovement measures and control variables at the 1st and 99th percentiles.

	Obs.	Mean	Median	Std. dev.	25th Pctl.	75th Pctl.
Price comovement measures:						
Equal-weighted R^2	932	0.312	0.290	0.084	0.254	0.357
Variance-weighted R^2	932	0.273	0.254	0.101	0.211	0.320
Transformed equal-weighted R^2	932	−0.813	−0.896	0.382	−1.079	−0.589
Transformed variance-weighted R^2	932	−1.040	−1.075	0.529	−1.317	−0.753
Ln(market-wide variation)	932	−1.536	−2.114	2.252	−2.701	−1.254
Ln(firm-specific variation)	932	−0.490	−1.203	2.493	−1.862	−0.182
Cultural variables:						
Tightness	571	6.903	6.800	2.632	5.100	9.200
Individualism	932	49.378	51.000	24.702	25.000	71.000
Openness variables:						
Trade openness	918	22.559	13.970	39.030	7.250	26.920
Capital market openness	501	0.245	0.204	0.191	0.123	0.305
Capital market integration	918	0.394	0.380	0.251	0.174	0.580
Other variables:						
Fraction of stocks moving in the same direction	932	0.655	0.649	0.052	0.620	0.684
Transformed fraction of stocks moving in the same direction	932	−0.842	−0.857	0.500	−1.152	−0.541
Ln(number of stocks)	932	5.699	5.497	1.215	4.952	6.458
Ln(GDP per capita)	932	9.363	9.800	1.262	8.467	10.378
GDP growth volatility	932	0.022	0.017	0.017	0.011	0.027
Ln(country size)	932	11.688	11.780	2.219	10.385	13.064
Industry Herfindahl index	929	0.112	0.092	0.075	0.064	0.137
Firm Herfindahl index	929	0.040	0.025	0.044	0.013	0.050
Earnings comovement	901	0.389	0.368	0.200	0.245	0.495
Good government index	932	1.023	1.022	0.571	0.494	1.543
Diversity of analyst forecasts	896	0.047	0.037	0.046	0.028	0.054

higher in countries with a lower GDP per capita. For example, Japan has a high GDP per capita but its stock price comovement, as measured by R^2, is also very high. On the other hand, New Zealand's GDP per capita is about the median among the sample countries, but its R^2 is in the bottom quartile. China has a much lower GDP per capita than Taiwan, but the R^2s for these two countries are very close to each other, as the highest and third highest, respectively, among the 47 sample countries. These observations cannot be easily explained by differences in these countries' economic fundamentals or institutional developments nor could they be explained by the information opaqueness story offered by Jin and Myers (2006). Japan has a highly developed financial system and good accounting transparency, as in developed Western countries, but it differs from these countries with its tight and collectivistic culture. In contrast, New Zealand has a loose and individualistic culture. While China and Taiwan are quite different in terms of per capita income and institutional development, they share essentially the same culture. These observations suggest that national culture may influence stock price comovement within a country.

Consistent with our hypotheses, Table 1 shows that countries that are culturally tight (loose) and less (more) individualistic tend to have higher (lower) R^2s. For example, the two countries with the lowest stock price comovements are the United States and Australia, which are countries that also have the two highest scores for individualism and relatively low scores for tightness. Malaysia, Turkey, and China, which rank among the countries with the highest stock price comovements, also have high values for tightness and low values for individualism.

Table 2 presents the summary statistics for all the variables in our study. The top panel of the table includes descriptive statistics for the two price synchronicity variables, the equal- and variance-weighted R^2s. The mean (median) equal-weighted R^2 for our sample is 0.312 (0.290). Because our R^2 measures are bounded within the interval

Table 3
Variable correlations.

This table presents the correlation matrix for the variables in our sample. The sample consists of country-year observations for 47 countries from 1990 to 2010. The equal-weighted and variance-weighted R^2s are the averaged R^2s of stocks in a country estimated from an expanded market model (see Eq. (1)). The tightness measure is from Gelfand, Raver, Nishii, Leslie, and Lun (2011) and captures the extent to which a country has strong norms and low tolerance of deviant behavior. The individualism measure is from Hofstede (2001) and captures the extent to which people focus on their own internal attributes to differentiate themselves from others. See Table 2 for the definitions of the other variables. [a], [b], and [c] denote statistical significance at the 1%, 5%, and 10% levels.

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)
Transformed equal-weighted R^2 (a)	1.000																
Transformed variance-weighted R^2 (b)	0.742[a]																
Ln(market-wide variation) (c)	−0.181[a]	−0.295[a]															
Ln(firm-specific variation) (d)	−0.326[a]	−0.479[a]	0.979[a]														
Tightness (e)	0.247[a]	0.189[a]	−0.105[b]	−0.139[a]													
Individualism (f)	−0.350[a]	−0.247[a]	0.030	0.081[b]	−0.561[a]												
Good government index (g)	−0.224[a]	−0.100[a]	−0.175[a]	−0.138[a]	−0.279[a]	0.643[a]											
Analyst diversity rank (h)	0.202[a]	0.160[a]	0.028	−0.009	0.215[a]	−0.541[a]	−0.488[a]										
Ln(trade openness) (i)	0.023	0.069[b]	−0.318[a]	−0.305[a]	−0.119[a]	0.168[a]	0.506[a]	−0.064[c]									
Capital market openness (j)	−0.038	0.068	−0.166[a]	−0.165[a]	−0.316[a]	0.365[a]	0.493[a]	−0.223[a]	0.618[a]								
Capital market integration (k)	−0.052	−0.064[c]	−0.132[a]	−0.107[a]	−0.230[a]	0.427[a]	0.500[a]	−0.331[a]	0.276[a]	0.411[a]							
Ln(GDP per capita) (l)	−0.190[a]	−0.063[c]	−0.136[a]	−0.109[a]	−0.449[a]	0.644[a]	0.859[a]	−0.380[a]	0.540[a]	0.549[a]	0.553[a]						
Variance in GDP growth (m)	0.102[a]	0.082[b]	0.102[a]	0.074[b]	0.240[a]	−0.295[a]	−0.302[a]	0.246[a]	−0.070[b]	−0.134[a]	−0.290[a]	−0.242[a]					
Ln(number of stocks) (n)	−0.120[a]	−0.142[a]	0.216[a]	0.225[a]	0.227[a]	0.197[a]	0.151[a]	−0.254[a]	−0.361[a]	−0.273[a]	0.089[a]	0.108[a]	−0.207[a]				
Ln(country size) (o)	−0.111[a]	−0.135[a]	0.338[a]	0.337[a]	0.000	0.038	−0.448[a]	0.060[c]	−0.881[a]	−0.454[a]	−0.179[a]	−0.420[a]	0.059[c]	0.219[a]			
Industry Herfindahl index (p)	0.121[a]	0.115[a]	−0.002	−0.028	−0.104[b]	−0.149[a]	−0.131[a]	0.212[a]	0.327[a]	0.272[a]	−0.219[a]	−0.096[a]	0.290[a]	−0.632[a]	−0.164[a]		
Firm Herfindahl index (q)	0.124[a]	0.125[a]	−0.028	−0.055[c]	−0.198[a]	−0.042	−0.103[a]	0.127[a]	0.307[a]	0.415[a]	−0.242[a]	−0.109[a]	0.191[a]	−0.634[a]	−0.198[a]	0.785[a]	
Earnings comovement (r)	0.008	0.049	0.003	−0.006	−0.028	−0.032	−0.079[b]	−0.001	−0.060[c]	0.014	−0.082[b]	−0.087[a]	0.011	−0.042	0.055[c]	0.020	−0.024

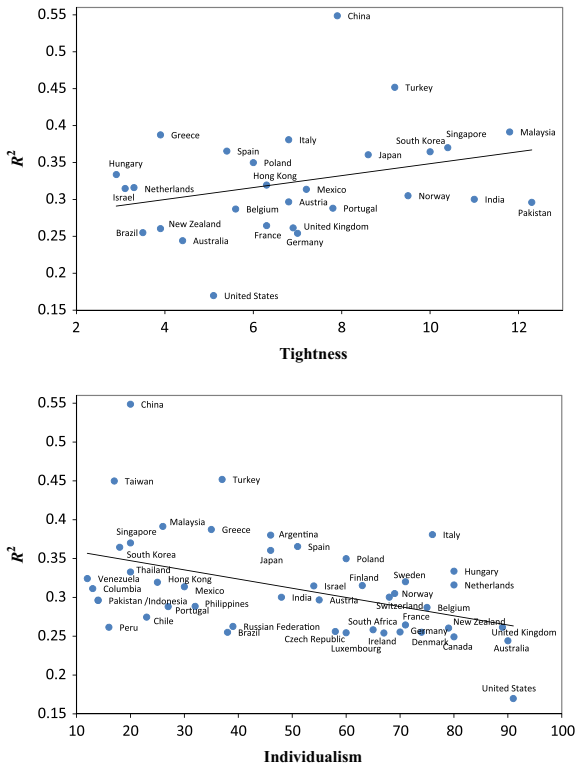

Fig. 2. Culture and R^2. The two panels of the figure plot the R^2s of the sample countries against tightness and individualism scores of each country, respectively. The R^2 for each country is the average of the equal-weighted annual R^2s of stocks in a country estimated from an expanded market model (see Eq. (1)). The data are for 1990 to 2010. The tightness measure is from Gelfand, Raver, Nishii, Leslie, and Lun (2011) and captures the extent to which a country has strong norms and low tolerance of deviant behavior. The individualism measure is from Hofstede (2001) and captures the extent to which people focus on their own internal attributes to differentiate themselves from others.

[0, 1], we follow Morck, Yeung, and Yu (2000) and apply a logistic transformation to these variables:

$$Transformed\ R^2 = Ln\left(\frac{R_j^2}{1-R_j^2}\right). \tag{4}$$

The summary statistics of the transformed variables are also presented in Table 2. The means and medians of these variables are comparable to those reported by Morck, Yeung, and Yu (2000) and Jin and Myers (2006). The mean (median) log-transformed market-wide variation and firm-specific variation are −1.536 (−2.114) and −0.490 (−1.203), respectively. The mean for the tightness variable is 6.9 and the median is very close to the mean, at 6.8. The tightness value ranges from 2.9 for Hungary to 12.3 for Pakistan. The mean individualism score for our sample is about 49 and the median is 51. The individualism score ranges from 12 for Venezuela to 91 for the United States. In Table 2, we also report the summary statistics of the three openness variables and the control variables.

Table 3 presents the correlations between our variables. Confirming the pattern in Table 1, the correlation between R^2 and tightness is positive (0.247) and the correlation between R^2 and individualism is negative (−0.350). Both correlations are statistically significant at the 1% level. Fig. 2 graphically highlights these correlations. The top panel plots the average of annual R^2s of each country against its tightness score and shows a clear positive correlation. The bottom panel indicates a clear negative correlation between R^2 and individualism. Table 3 also shows that the two cultural variables are significantly negatively correlated (−0.561). The correlations between tightness and the two variations, market-wide and firm-specific, are negative and statistically significant. The correlation between individualism and firm-specific variation is positive and statistically significant. We find an insignificant correlation between individualism and market-wide stock return variation.

4. Effect of culture on stock price synchronicity

4.1. Empirical design

To study the relation between culture and stock price comovement, we estimate a model similar to those of Morck, Yeung, and Yu (2000) and Jin and Myers (2006):

$$\begin{aligned} T\left(R_{j,t}^2\right) = {} & \alpha + \beta_1 Culture + \beta_2 Good\ government\ index \\ & + \beta_3 Analyst\ diversity\ rank + \beta_4\ \mathrm{Ln}(GDP\ per\ capita) \\ & + \beta_5\ \mathrm{Ln}(number\ of\ stocks) + \beta_6 GDP\ growth\ volatility \\ & + \beta_7\ \mathrm{Ln}(country\ size) + \beta_8 Industry\ Herfindahl \\ & + \beta_9 Firm\ Herfindahl + \beta_{10} Earnings\ comovement + \varepsilon_{j,t}, \end{aligned} \tag{5}$$

where $T(R_{j,t}^2)$ is the logistic transformation of $R_{j,t}^2$. We estimate the model on the panel of 47 countries and 21 years. In our model, the residuals are likely to be correlated both across countries and over time within a country.[10] Thus, to correct for the correlations of residuals in both dimensions, we estimate standard errors with country clustering and year cluster boostrapping. We cannot use year-clustered standard errors to control for within-year correlations because clustered standard errors are biased when the number of clusters is small (e.g., Kezdi, 2004; Nichols and Schaffer, 2007; Hansen, 2007; Petersen, 2009).[11] Cameron, Gelbach, and Miller (2008) recommend a wild bootstrapping method where clusters of residuals are resampled to estimate the standard error. This method corrects for within-cluster correlations and generates reliable inferences when the number of clusters is as small as six. We use this bootstrapping method to control for cross-sectional correlations within a year. Throughout the paper, we report *p*-values of the regression coefficients based on

[10] Prior studies on R^2 mostly used the Fama-MacBeth (1973) method. This approach addresses the within-year correlation of the residuals, which is likely to be present in R^2 studies as events in a given year may simultaneously influence stock market behavior across different countries. However, the Fama-MacBeth standard errors may be biased when the residuals are correlated across years within a country (Petersen, 2009).

[11] Kezdi (2004) and Nichols and Schaffer (2007) show that 50 clusters are large enough for accurate inference. However, the number of year clusters in our sample is only 21.

Table 4
Culture and stock price synchronicity (R^2).

This table presents the results based on the panel regressions of R^2 on tightness and individualism. Except for regressions on tightness, the sample consists of country-year observations for 47 countries from 1990 to 2010. The sample for regressions on tightness consists of country-year observations for 28 countries from 1990 to 2010. The dependent variable is the transformed equal-weighted R^2. The equal-weighted R^2s are the averaged R^2s of stocks in a country estimated from an expanded market model (see Eq. (1)). The transformed R^2s are the logistic transformation of R^2s using Eq. (4). The tightness measure is from Gelfand, Raver, Nishii, Leslie, and Lun (2011) and captures the extent to which a country has strong norms and low tolerance of deviant behavior. The individualism measure is from Hofstede (2001) and captures the extent to which people focus on their own internal attributes to differentiate themselves from others. See Table 2 for the definitions of the other variables. We present in parentheses the *p*-values based on standard errors with country clustering and year cluster bootstrapping with 1,000 iterations. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels.

	Benchmark regressions			Tightness	Individualism	Both cultural variables		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Tightness				0.040**		0.029*	0.050**	
				(0.030)		(0.071)	(0.016)	
Individualism					−0.006***	−0.004**		−0.006**
					(0.007)	(0.029)		(0.015)
Tightness (Residual)								0.029*
								(0.072)
Individualism (Residual)							−0.004**	
							(0.049)	
Analyst diversity rank			0.002	0.002	−0.001	0.000	0.000	0.000
			(0.486)	(0.537)	(0.825)	(0.865)	(0.976)	(0.913)
Good government index		−0.214**	−0.203*	−0.397**	−0.134	−0.335*	−0.335*	−0.335*
		(0.033)	(0.063)	(0.015)	(0.285)	(0.057)	(0.065)	(0.058)
Ln(GDP per capita)	−0.080**	−0.004	0.002	0.079	0.056	0.099*	0.099*	0.099*
	(0.029)	(0.962)	(0.993)	(0.134)	(0.270)	(0.057)	(0.098)	(0.058)
GDP growth volatility	0.368	−0.115	−0.020	0.285	−0.788	−0.244	−0.244	−0.244
	(0.851)	(0.987)	(0.993)	(0.985)	(0.752)	(0.794)	(0.976)	(0.797)
Ln(number of stocks)	−0.005	0.004	0.014	−0.012	0.017	−0.007	−0.007	−0.007
	(0.828)	(0.790)	(0.664)	(0.731)	(0.455)	(0.922)	(0.699)	(0.884)
Ln(country size)	−0.034**	−0.042**	−0.043**	−0.031*	−0.016	−0.014	−0.014	−0.014
	(0.035)	(0.033)	(0.049)	(0.060)	(0.416)	(0.383)	(0.667)	(0.377)
Ind. Herfindahl index	0.290	0.195	0.596	0.913	0.329	0.664	0.664	0.664
	(0.574)	(0.703)	(0.310)	(0.373)	(0.555)	(0.525)	(0.488)	(0.551)
Firm Herfindahl index	−0.171	0.045	0.145	1.410	1.111	1.950	1.950*	1.950
	(0.969)	(0.937)	(0.915)	(0.328)	(0.474)	(0.156)	(0.098)	(0.145)
Earnings comovement	−0.013	−0.010	−0.003	0.026	0.015	0.029	0.029	0.029
	(0.913)	(0.803)	(0.993)	(0.821)	(0.898)	(0.752)	(0.715)	(0.768)
Constant	0.336	−0.105	−0.305	−1.154**	−0.875	−1.289**	−1.302**	−1.302**
	(0.332)	(0.689)	(0.558)	(0.030)	(0.109)	(0.028)	(0.033)	(0.014)
Observations	901	901	876	552	876	552	552	552
R-squared	0.078	0.104	0.126	0.284	0.170	0.302	0.302	0.302

the standard errors estimated with country clustering and year cluster bootstrapping with 1,000 iterations.

4.2. Effects of culture on stock price synchronicity

To establish a benchmark for our study, we first estimate the regressions using only the variables from Morck, Yeung, and Yu (2000) and Jin and Myers (2006) and report these results in the first three models of Table 4. We obtain results that are qualitatively similar to those reported in these two studies.[12] We present the results for cultural tightness and individualism in models (4) and (5) of Table 4. The coefficient of the tightness variable is positive and statistically significant at the 5% level. This finding is consistent with our hypothesis that stock price comovement is higher in culturally tighter countries. As expected, the coefficient of individualism is negative and statistically significant at the 1% level. This result suggests that stock price comovement is lower when investors are more individualistic. The influence of culture on stock price comovement is economically significant as well. A one standard deviation increase in tightness (individualism) is associated with a 12.9% increase (18.2% decrease) in the dependent variable, log-transformed stock price comovement. The marginal effect of the cultural variables is comparable to those of the other variables. For example, based on the estimates from model (4) of Table 4, a one standard deviation increase in country size is associated with a 9.3% decrease in stock price comovement from the mean. The same marginal effect from the mean is −12.4% for the GDP per capita in model (1), 6.1% for the analyst diversity rank in model (3), and −15.0% for the good government index in model (2). Including the cultural variables also improves the goodness of fit of the regression models. For example, adding individualism to the model increases the *R*-squared value of the regression from 0.126

[12] While the coefficient of analyst diversity rank is insignificant in model (3) of Table 4, we get positive and statistically significant coefficients as in Jin and Myers (2006) for two alternative information opacity measures: the GCR-based opacity measure and the PWC global opacity index. Panel C of Table 8 also shows that the coefficient of analyst diversity rank is statistically significant at the 5% level when we use the Fama-MacBeth method to estimate the regressions.

to 0.170, a 35% increase. Including tightness increases the regression *R*-squared value from 0.126 to 0.284 and including both cultural variables further increases the regression *R*-squared value to 0.302.[13]

In model (6) of Table 4, we include both cultural variables in the same regression. Similar to the results in model (4), the coefficient of tightness is positive and statistically significant. For individualism, we again find a negative and statistically significant coefficient, as in model (5). To mitigate the effect of possible multicollinearity between tightness and individualism, we create an orthogonal variant of individualism (tightness) by regressing individualism (tightness) on tightness (individualism) and replacing individualism (tightness) in model (6) with the residual from this regression. Model (7) of Table 4 presents the regression results for tightness and orthogonalized individualism and model (8) presents the results for individualism and orthogonalized tightness. The estimated coefficients of the cultural variables and the residuals of the cultural variables all have the expected signs and are statistically significant. These results support the notion that tightness and individualism capture different dimensions of national culture and the effect of one cultural variable does not subsume that of the other.

5. How culture influences stock price synchronicity

Our evidence so far shows that the two cultural variables significantly influence stock return comovements. In this section, we explore the possible mechanisms through which the two cultural variables affect R^2. Specifically, motivated by the findings in the literature, we study whether national cultures are related to cross-country differences in stock trading correlations and information transparency. We also discuss and examine how market-wide and firm-specific variations are influenced by culture. A higher (lower) R^2 could be an outcome of higher (lower) market-wide variations or lower (higher) firm-specific variations. Many studies show that both market-wide and firm-specific variations reflect investors' trading activities and information efficiency in the stock market (e.g., Morck, Yeung, and Yu, 2000; Wurgler, 2000; Durnev, Morck, Yeung, and Zarowin, 2004; Jin and Myers, 2006; Bris, Goetzmann, and Zhu, 2007). If culture introduces biases into trading behavior and information processing, then different cultures may influence market-wide and firm-specific variations differently and result in culture-specific stock price comovements.

5.1. Influence of culture on stock trading correlation

If investors tend to make similar trading decisions in culturally tight countries, we expect higher stock trading correlation in these countries. On the other hand, if individualistic investors are less likely to herd and more willing to process information to trade on their own, we expect lower correlation in their trading activities in individualistic countries. We use the fraction of stocks moving in the same direction to measure the correlation in investors' buy and sell decisions. A higher percentage of stocks moving in the same direction suggests that more investors buy or sell at the same time. We follow Morck, Yeung, and Yu (2000) and calculate the measure as follows:

$$f_{j,t} = \frac{max[n_{j,t}^{up}, n_{j,t}^{down}]}{n_{j,t}^{up} + n_{j,t}^{down}}, \tag{6}$$

where $n_{j,t}^{up}$ is the number of stocks in country j with a positive return in week t and $n_{j,t}^{down}$ is the number of stocks with a negative return in the same week. We measure the fraction of stocks moving in the same direction in country j in a year by taking the average of $f_{j,t}$ over the year. Since this variable is bounded between 0.5 and 1, we follow Morck, Yeung, and Yu (2000) to transform the variable into a continuous variable:

$$\textit{Transformed fraction of stocks moving in the same direction} = Ln\left(\frac{f_{j,t} - 0.5}{1 - f_{j,t}}\right). \tag{7}$$

Morck, Yeung, and Yu (2000) use this variable as an alternative measure of stock price synchronicity. We use it as a measure for stock trading correlation, since it directly captures the extent to which investors trade similarly. It is natural to expect that a higher fraction of stocks moving in the same direction would lead to a higher R^2.

We present the regression results in Table 5. The coefficient of tightness is positive and the coefficient of individualism is negative. Both coefficients are statistically significant. These results support our expectations that stock trading correlations would be higher in culturally tight countries and lower in individualistic countries.

5.2. Influence of culture on information opaqueness

People from individualistic cultures tend to be more analytical. They are more likely to gather and process information independently and are confident to act on different information and opinions. In contrast, individuals in collectivistic and tight cultures have holistic thinking styles and are less likely to analyze information independently (e.g., Choi and Nisbett, 2000; Nisbett, Peng, Choi, and Norenzayan, 2001). As a result, less information would be produced and analyzed in these countries. Moreover, if individuals in a tight culture are reluctant to deviate from the norm, they would be less likely to act on information that might lead to different opinions. As Gelfand, Nishii, and Raver (2006) suggest, individuals in these cultures often seek conformity and avoid deviation when they gather and process information to make decisions. Based on these arguments, we expect the information environment to be less (more) opaque in individualistic (tight) cultures. We use the analyst diversity rank to measure information opaqueness in a country. The higher the analyst diversity rank, the more opaque is the country's information environment.

[13] The tightness measure is available for a subsample of 552 observations. To examine the influence of tightness on the *R*-squared of the model, we estimate model (3) of Table 4 in this subsample and obtain an *R*-squared value of 0.126.

Table 5
Culture, stock trading correlations, and information opacity.

This table presents the results of the panel regressions of stock trading correlation and information opacity on tightness and individualism. The sample for regressions on tightness (individualism) consists of country-year observations for 28 (47) countries from 1990 to 2010. The dependent variables are the transformed fraction of stocks moving in the same direction in the first two models and analyst diversity rank in the last two models. The tightness measure is from Gelfand, Raver, Nishii, Leslie, and Lun (2011) and captures the extent to which a country has strong norms and low tolerance of deviant behavior. The individualism measure is from Hofstede (2001) and captures the extent to which people focus on their own internal attributes to differentiate themselves from others. See Table 2 for the definitions of the other variables. We present in parentheses the *p*-values based on standard errors with country clustering and year cluster bootstrapping with 1,000 iterations. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels.

	Fraction of stocks moving in the same direction		Analyst diversity rank	
	(1)	(2)	(3)	(4)
Tightness	0.038**		0.367	
	(0.038)		(0.349)	
Individualism		−0.008***		−0.237***
		(0.010)		(0.006)
Analyst diversity rank	0.003	0.001		
	(0.231)	(0.483)		
Good government index	−0.437**	−0.179*	−14.304***	−9.180***
	(0.020)	(0.064)	(0.007)	(0.005)
Ln(GDP per capita)	0.009	0.025	0.694	3.197***
	(0.816)	(0.522)	(0.681)	(0.005)
GDP growth volatility	4.986**	1.993	83.761	22.438
	(0.038)	(0.335)	(0.122)	(0.559)
Ln(number of stocks)	−0.018	−0.012	−2.065**	−1.275
	(0.731)	(0.759)	(0.043)	(0.149)
Ln(country size)	−0.031**	−0.012	−0.818	0.459
	(0.019)	(0.483)	(0.270)	(0.578)
Ind. Herfindahl index	0.424	−0.331	11.343	17.171
	(0.718)	(0.690)	(0.610)	(0.390)
Firm Herfindahl index	1.868	2.402*	−52.654	−12.103
	(0.212)	(0.089)	(0.312)	(0.689)
Earnings comovement	−0.025	0.046	−1.615	−1.913
	(0.827)	(0.512)	(0.475)	(0.318)
Constant	−0.537	−0.416	49.054**	14.275
	(0.275)	(0.315)	(0.050)	(0.260)
Observations	552	876	552	876
R-squared	0.375	0.376	0.341	0.390

Models (3) and (4) of Table 5 present the regression results for information opaqueness. As expected, the coefficient of individualism is negative and statistically significant at the 1% level. The coefficient of tightness is positive but not statistically significant. A closer look at the data suggests that the insignificance of the tightness coefficient is due to Brazil. Brazil's culture is both loose and collectivistic, which offer conflicting predictions for information opaqueness. If we exclude Brazil from the regression, the coefficient of tightness in model (3) is 0.749 (*p*-value = 0.027).[14] The more transparent information environments in individualistic and loose cultures suggest that such cultures may stimulate the production and aggregation of information, which is important for the informativeness of stock prices, efficient allocation of resources, and economic growth in general. Our results on information opaqueness raise the possibility that the findings documented by Jin and Myers (2006) may be partly driven by a more fundamental factor, national culture. Broadly, our findings suggest that it is important to consider cultural differences when studying cross-country differences in institutional and stock market development.

5.3. Influence of culture on market-wide and firm-specific variations

Our stock price synchronicity measure is determined by the relative magnitudes of market-wide variation and firm-specific variation. In this section, we examine how tightness and individualism affect these two components of R^2. Higher information opacity and stock trading correlation in culturally tight countries suggest that less firm-specific information may get incorporated into stock prices. Moreover, if investors in tight cultures are reluctant to trade on information that would suggest a deviation from the aggregated market belief, that is, prevailing market prices, one would expect to observe lower variations in market-wide returns.[15] On the other hand, divergence in stock trading and better information transparency in individualistic countries would allow more firm-specific information to be incorporated into stock prices and result in more firm-specific return variations.

[14] Greece is the other country that is loose and collectivistic (as shown in Fig. 1). If we exclude both Brazil and Greece from the regressions, the coefficient of tightness in model (3) would further increase to 1.078 (*p*-value = 0.009).

[15] We note that the same argument does not necessarily apply to collectivism. While cultural tightness reflects constraints on the whole society, collectivism reflects individuals' tendency to commit to their own social groups. As different social groups may have different opinions about market prices, the aggregated influence of collectivism on market-wide variations is difficult to predict.

Table 6
Culture and market-wide and firm-specific variations.

This table presents the results of the panel regressions of market-wide and firm-specific variations on tightness and individualism. The sample for regressions on tightness (individualism) consists of country-year observations for 28 (47) countries from 1990 to 2010. The dependent variable is the natural log of market-wide variation (firm-specific variation), which is the average explained (residual) sum of squares from Eq. (1). The tightness measure is from Gelfand, Raver, Nishii, Leslie, and Lun (2011) and captures the extent to which a country has strong norms and low tolerance of deviant behavior. The individualism measure is from Hofstede (2001) and captures the extent to which people focus on their own internal attributes to differentiate themselves from others. See Table 2 for the definitions of the other variables. We present in parentheses the *p*-values based on standard errors with country clustering and year cluster bootstrapping with 1,000 iterations. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels.

	Market-wide variation		Firm-specific variation	
	(1)	(2)	(3)	(4)
Tightness	−0.191**		−0.255**	
	(0.041)		(0.024)	
Individualism		0.007		0.015*
		(0.294)		(0.071)
Analyst diversity rank	0.009	0.008	0.006	0.008
	(0.480)	(0.455)	(0.735)	(0.494)
Good government index	0.021	−0.487	0.424	−0.426
	(0.933)	(0.355)	(0.337)	(0.474)
Ln(GDP per capita)	−0.099	0.070	−0.225	−0.026
	(0.667)	(0.849)	(0.614)	(0.782)
GDP growth volatility	14.734	3.794	18.187	6.103
	(0.108)	(0.555)	(0.121)	(0.423)
Ln(number of stocks)	0.816	0.672	0.851	0.666
	(0.120)	(0.114)	(0.120)	(0.109)
Ln(country size)	0.243**	0.257***	0.279**	0.271**
	(0.013)	(0.007)	(0.012)	(0.045)
Ind. Herfindahl index	5.532	3.867	4.471	3.549
	(0.253)	(0.214)	(0.446)	(0.353)
Firm Herfindahl index	3.982	6.810	2.085	5.037
	(0.573)	(0.355)	(0.819)	(0.538)
Earnings comovement	0.110	0.036	−0.088	−0.106
	(0.787)	(0.990)	(0.988)	(0.894)
Constant	−8.165	−9.895	−6.322	−8.415
	(0.213)	(0.134)	(0.325)	(0.128)
Observations	552	876	552	876
R-squared	0.203	0.185	0.210	0.181

Following Morck, Yeung, and Yu (2000), we decompose our stock price synchronicity measure as the difference between the log-transformed market-wide variation and firm-specific variation. Table 6 presents regression results for the influence of culture on market-wide and firm-specific variations. The dependent variable is the logarithm of market-wide variation in models (1) and (2) and the logarithm of firm-specific variation in models (3) and (4). The coefficient of tightness is negative and statistically significant for both market-wide and firm-specific variations. This result is consistent with our expectations. We note that the reduction in firm-specific variation is greater than that in market-wide variation. For example, based on the coefficients in Table 6, a one standard deviation increase in tightness decreases firm-specific variations by 67.1%. In comparison, the same increase in tightness decreases market-wide variations by 50.3%. As a result of the more significant reduction in firm-specific variation, countries with tighter culture exhibit higher R^2s.

The coefficient of individualism is positive and statistically significant for firm-specific variation. This finding is consistent with our expectation that more firm-specific information gets incorporated into stock prices in more individualistic countries because individualistic investors are more likely to gather and analyze information on their own for investment decisions. The coefficient of individualism is not significant when the dependent variable is market-wide return variation. Individualistic investors focus more on firm-specific information (detach objects from the system) and are less likely to think holistically. Thus, it is not clear how their trading activities might affect market-wide variation. These results suggest that individualism lowers R^2 primarily through higher firm-specific variation.

6. Openness, culture, and stock price synchronicity

To empirically examine how openness affects the influence of culture on stock price comovement in different countries, we estimate the following model:

$$\begin{aligned} T(R^2_{j,t}) = {} & \alpha + \beta_1 Culture + \beta_2 Culture{*}Openness \\ & + \beta_3 Openness + \beta_4 Good\ government\ index \\ & + \beta_5 Analyst\ diversity + \beta_6\ \mathrm{Ln}(GDP\ per\ capita) \\ & + \beta_7\ \mathrm{Ln}(number\ of\ stocks) + \beta_8 GDP\ growth\ volatility \\ & + \beta_9 Ln(country\ size) + \beta_{10} Industry\ Herfindahl \\ & + \beta_{11} Firm\ Herfindahl + \beta_{12} Earnings\ comovement + \varepsilon_{j,t}, \end{aligned} \tag{8}$$

where openness is the measure for either trade openness or capital market openness. We expect the coefficient β_2 to be negative for tightness and positive for individualism to support our hypothesis that openness mitigates the effects of national culture on stock price comovement. The summary statistics for the three openness measures are presented in Table 2. The trade openness measure has a mean of 22.559 and a median of 13.970. The mean (median) is 0.245 (0.204) for capital market openness and 0.394 (0.380) for capital market integration. The significant difference between the mean and median of the trade openness measure suggests possible skewness in the variable. To mitigate the influence of skewness, we take the natural log of the trade openness measure and use the log values in the regressions.

In Panel A of Table 7, we present results based on the interaction between the culture variables and the openness variables. In all six models, the coefficients of tightness and individualism have the same sign as those in Table 4 and are statistically significant. In models (1), (3), and (5), the coefficient of the interaction term between tightness and openness is negative and statistically significant except for model (5). In models (2), (4), and (6), the coefficient of the interaction term is positive and statistically significant at the 10% level for trade openness and at the 5% level for both measures of capital market openness. To control for the possibility that the influence of openness on the culture-R^2 relation may not be monotonic, we alternatively interact the culture variables with an openness dummy that equals one if the respective openness variable has a value in the top tercile of our sample in each year. Panel B of Table 7

Table 7
Openness, culture, and stock price synchronicity (R^2).

This table presents the results of the panel regressions of R^2 on tightness, individualism, and the interactions between openness and the culture variables. The sample for regressions on tightness (individualism) consists of country-year observations for 28 (47) countries from 1990 to 2010. The dependent variable is the transformed equal-weighted R^2. The equal-weighted R^2s are the averaged R^2s of stocks in a country estimated from an expanded market model (see Eq. (1)). The transformed R^2 is the logistic transformation of R^2s using Eq. (4). The tightness measure is from Gelfand, Raver, Nishii, Leslie, and Lun (2011) and captures the extent to which a country has strong norms and low tolerance of deviant behavior. The individualism measure is from Hofstede (2001) and captures the extent to which people focus on their own internal attributes to differentiate themselves from others. In Panel A, Ln(trade openness) is the natural log of trade openness, which is from Frankel and Romer (1999) and is estimated based on a country's geographic attributes and population. Capital market openness is calculated as the total value of portfolio equity holdings by foreign investors divided by the country's stock market capitalization. Capital market integration is constructed as in Pukthuanthong and Roll (2009) and measures the extent to which the domestic stock market is integrated with the global stock market. In Panel B, the openness variables are binary variables that equal one if the corresponding openness measure is in the top tercile of each year and zero otherwise. See Table 2 for the definitions of the other variables. We present in parentheses the *p*-values based on standard errors with country clustering and year cluster bootstrapping with 1,000 iterations. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels.

Panel A: The influence of openness on the R^2-culture relation

	Ln(trade openness)		Capital market openness		Capital market integration	
	(1)	(2)	(3)	(4)	(5)	(6)
Tightness	0.120**		0.044***		0.056**	
	(0.014)		(0.000)		(0.014)	
Tightness × Openness	−0.028*		−0.088**		−0.044	
	(0.098)		(0.029)		(0.322)	
Individualism		−0.014**		−0.008**		−0.011***
		(0.021)		(0.013)		(0.005)
Individualism × Openness		0.003*		0.017**		0.011**
		(0.074)		(0.013)		(0.038)
Openness	0.071	−0.181	0.558*	−0.833	0.446*	−0.320
	(0.392)	(0.339)	(0.087)	(0.120)	(0.098)	(0.306)
Analyst diversity rank	0.002	−0.001	0.006**	0.000	0.003	0.000
	(0.364)	(0.540)	(0.029)	(0.800)	(0.224)	(0.929)
Good government index	−0.359**	−0.148	−0.327**	−0.126	−0.404**	−0.129
	(0.014)	(0.106)	(0.029)	(0.107)	(0.014)	(0.322)
Ln(GDP per capita)	0.124***	0.082**	0.058**	0.046	0.077	0.047
	(0.000)	(0.032)	(0.029)	(0.307)	(0.196)	(0.432)
GDP growth volatility	0.908	−0.125	−1.627	−3.087	0.837	−0.504
	(0.797)	(0.931)	(0.609)	(0.160)	(0.573)	(0.732)
Ln(number of stocks)	−0.043	0.055	−0.030	0.020	−0.000	0.026
	(0.126)	(0.106)	(0.145)	(0.427)	(0.867)	(0.346)
Ln(country size)	−0.052*	−0.017	−0.016	−0.011	−0.029**	−0.011
	(0.070)	(0.637)	(0.174)	(0.400)	(0.042)	(0.628)
Ind. Herfindahl index	1.109	0.880	0.527	0.932	1.071	0.468
	(0.254)	(0.169)	(0.348)	(0.347)	(0.238)	(0.355)
Firm Herfindahl index	1.013	0.939	−0.142	−1.190	1.477	1.419
	(0.503)	(0.413)	(0.964)	(0.293)	(0.224)	(0.284)
Earnings comovement	0.026	0.029	0.014	−0.046	0.042	0.004
	(0.713)	(0.698)	(0.725)	(0.413)	(0.531)	(0.995)
Constant	−1.468*	−0.914	−1.066**	−0.732*	−1.444**	−0.807
	(0.071)	(0.212)	(0.029)	(0.067)	(0.042)	(0.213)
Observations	552	865	307	494	552	864
R-squared	0.300	0.199	0.231	0.140	0.294	0.229

Panel B: Openness measured as binary variables

	Ln(trade openness)		Capital market openness		Capital market integration	
	(1)	(2)	(3)	(4)	(5)	(6)
Tightness	0.058***		0.034***		0.054**	
	(0.000)		(0.000)		(0.023)	
Tightness × Openness	−0.049**		−0.023*		−0.048**	
	(0.040)		(0.060)		(0.047)	
Individualism		−0.006**		−0.006**		−0.010**
		(0.019)		(0.012)		(0.033)
Individualism × Openness		0.004**		0.006***		0.007***
		(0.039)		(0.000)		(0.000)
Openness	0.137	−0.371**	0.072	−0.269**	0.288**	−0.413**
	(0.283)	(0.029)	(0.328)	(0.024)	(0.047)	(0.033)
Analyst diversity rank	0.003	−0.000	0.005***	0.000	0.002	−0.002
	(0.121)	(0.933)	(0.000)	(0.802)	(0.279)	(0.133)
Good government index	−0.281**	−0.121	−0.324**	−0.084	−0.418**	−0.320
	(0.040)	(0.317)	(0.030)	(0.168)	(0.023)	(0.133)

Table 7 (*continued*)

Panel B: Openness measured as binary variables

	Ln(trade openness)		Capital market openness		Capital market integration	
	(1)	(2)	(3)	(4)	(5)	(6)
Ln(GDP per capita)	0.088	0.071	0.061**	0.039	0.107*	0.136*
	(0.101)	(0.125)	(0.030)	(0.216)	(0.093)	(0.067)
GDP growth volatility	−0.076	−1.136	−1.926	−3.017	0.432	0.142
	(0.949)	(0.558)	(0.377)	(0.108)	(0.674)	(0.800)
Ln(number of stocks)	−0.027	0.020	−0.041*	0.015	−0.013	−0.072
	(0.343)	(0.473)	(0.090)	(0.563)	(0.814)	(0.138)
Ln(country size)	−0.040*	−0.036	−0.019	−0.005	−0.028	0.003
	(0.081)	(0.135)	(0.203)	(0.766)	(0.140)	(0.678)
Ind. Herfindahl index	1.678	0.887	0.532	0.880	0.944	−0.056
	(0.101)	(0.116)	(0.388)	(0.144)	(0.256)	(0.933)
Firm Herfindahl index	0.704	0.722	−0.088	−0.852	1.551	1.703
	(0.646)	(0.663)	(0.828)	(0.348)	(0.233)	(0.441)
Earnings comovement	0.016	0.008	0.020	−0.062	0.030	0.083
	(0.808)	(0.875)	(0.435)	(0.263)	(0.860)	(0.267)
Constant	−1.288**	−0.768	−0.877**	−0.825*	−1.521**	−0.839
	(0.020)	(0.115)	(0.030)	(0.072)	(0.023)	(0.167)
Observations	552	865	307	494	552	864
R-squared	0.308	0.194	0.238	0.141	0.298	0.366

presents these regression results. The coefficients of the interaction terms have the predicted signs and are statistically significant in all models. The statistical significance is generally higher in Panel B than in Panel A. For example, the coefficient of the interaction term between tightness and openness is insignificant in model (5) of Panel A, but the same coefficient is statistically significant at the 5% level in Panel B. The negative (positive) coefficient of the interaction term between tightness (individualism) and openness indicates a weaker cultural effect on stock price comovement when the country is more open. Overall, the results in Table 7 are consistent with our hypothesis that openness mitigates the effect of domestic culture on stock price comovement.

7. Robustness checks

7.1. Alternative measures of stock price synchronicity

We repeat our analysis using the variance-weighted R^2. We use the total variance of each firm as the weight to calculate a variance-weighted R^2 for each country. Panel A of Table 8 presents the regression results based on this alternative measure. Consistent with our earlier findings, the coefficient of tightness is positive and that of individualism is negative. Both coefficients are statistically significant.

7.2. Alternative samples

We next verify that our results hold in two subsamples. Some countries in our sample have values for individualism but not for tightness. In all our previous analyses, our regressions are run on two separate samples, one for individualism and another for tightness. We repeat our regressions on individualism in the smaller sample of tightness and report the results in the second column of Panel B of Table 8. Consistent with the findings in previous tables, the coefficient of individualism is negative and significant. To maximize our sample size, the tests we conducted so far are based on an unbalanced panel. As a robustness check, we rerun our regression on balanced panels that includes countries with data on R^2, culture variables, and other control variables for the entire sample period. Panel B of Table 8 reports the regression results based on balanced panels. We again find that stock price synchronicity tends to be higher in culturally tighter and more collectivistic countries. Nichols and Schaffer (2007) and Kezdi (2004) show that clustered standard errors could be biased when the sample is unbalanced. To mitigate this concern, we verify that all our other results also remain similar when the regressions are estimated in balanced panels.

7.3. Alternative estimation method

Many earlier studies, including Morck, Yeung, and Yu (2001) and Jin and Myers (2006), use the Fama-MacBeth method to estimate the effect of their hypothesized factors on R^2. As a robustness check, we repeat all our analyses using the Fama-MacBeth method with the Newey-West correction for the serial correlation of coefficients in the past six years. We present the Fama-MacBeth results for our base model in Panel C of Table 8. All our findings are robust when we use this alternative estimation method. Petersen (2009) shows that the adjusted Fama-MacBeth standard errors work well when the group effect (in our case, country effect) follows a first-order autoregressive process. But when the group effect has a fixed component, the adjusted standard error could be biased. Given the caveat, results from the Fama-MacBeth regressions should be interpreted with caution.

7.4. Evidence at the stock level

Our analysis focuses on the relation between country-level stock price synchronicity and national cultures.

Table 8
Robustness checks.

This table presents several robustness checks for our results. The tightness measure is from Gelfand, Raver, Nishii, Leslie, and Lun (2011) and captures the extent to which a country has strong norms and low tolerance of deviant behavior. The individualism measure is from Hofstede (2001) and captures the extent to which people focus on their own internal attributes to differentiate themselves from others. Panel A presents the panel regression results based on an alternative measure of stock price synchronicity. The dependent variable is the transformed variance-weighted R^2, which is the weighted-average of R^2s of stocks in a country using the total variance of each stock as the weight. Panel B presents the panel regression results based on alternative samples. The joint sample consists of country-year observations for 28 countries that have values for both tightness and individualism from 1990 to 2010. The balanced panel sample for regressions on tightness (individualism) consists of country-year observations for 18 (23) countries with data for the entire sample period, from 1990 to 2010. Panel C presents the results from Fama-MacBeth regressions. Panel D presents the results based on hierarchical regression estimations with country-level random effects. In Panel A and C, the sample for regressions on tightness (individualism) consists of country-year observations for 28 (47) countries from 1990 to 2010. In Panel D, the sample for regressions on tightness (individualism) consists of firm-year observations for 28 (47) countries from 1990 to 2010. The dependent variable is the transformed equal-weighted R^2 in Panels B, C, and D. In Panels A and B, we present in parentheses the *p*-values based on standard errors with country clustering and year cluster bootstrapping with 1,000 iterations. In Panel C, we present in parentheses the *p*-values based on standard errors with Newey-West correction for the serial correlation of coefficients in the past six years. See Table 2 for the definitions of the other variables. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels.

Panel A: Alternative measure of stock price synchronicity

	Variance-weighted R^2	
Tightness	0.056***	
	(0.008)	
Individualism		−0.007**
		(0.027)
Analyst diversity rank	0.003	0.001
	(0.486)	(0.863)
Good government index	−0.418**	−0.090
	(0.016)	(0.497)
Ln(GDP per capita)	0.129	0.108
	(0.142)	(0.115)
GDP growth volatility	−2.607	−2.170
	(0.353)	(0.459)
Ln(number of stocks)	−0.049	−0.004
	(0.405)	(0.895)
Ln(country size)	−0.030	−0.011
	(0.251)	(0.678)
Ind. Herfindahl index	1.076	0.220
	(0.394)	(0.694)
Firm Herfindahl index	1.334	1.544
	(0.518)	(0.366)
Earnings comovement	0.238*	0.160*
	(0.071)	(0.093)
Constant	−1.790*	−1.542*
	(0.063)	(0.071)
Observations	552	876
R-squared	0.191	0.117

Panel B: Alternative samples: Joint sample and balanced panels

	Joint sample		Balanced panels	
Tightness	0.040**		0.062**	
	(0.030)		(0.024)	
Individualism		−0.006**		−0.006**
		(0.013)		(0.026)
Analyst diversity rank	0.002	0.000	−0.003	−0.002
	(0.537)	(0.954)	(0.167)	(0.353)
Good government index	−0.397**	−0.275*	−0.578**	−0.312*
	(0.015)	(0.052)	(0.024)	(0.052)
Ln(GDP per capita)	0.079	0.065*	0.089	0.121
	(0.134)	(0.053)	(0.286)	(0.131)
GDP growth volatility	0.285	0.135	−2.260	−0.623
	(0.985)	(0.889)	(0.262)	(0.889)
Ln(number of stocks)	−0.012	0.005	−0.036	−0.067
	(0.731)	(0.837)	(0.261)	(0.155)
Ln(country size)	−0.031*	−0.014	−0.052**	−0.014
	(0.060)	(0.471)	(0.024)	(0.378)
Industry Herfindahl index	0.913	0.687	−1.468	−0.226
	(0.373)	(0.497)	(0.190)	(0.732)
Firm Herfindahl index	1.410	1.597	7.233***	1.136
	(0.328)	(0.118)	(0.000)	(0.627)
Earnings comovement	0.026	0.028	0.146***	0.090
	(0.821)	(0.902)	(0.000)	(0.209)

Table 8 (*continued*)

Panel B: Alternative samples: Joint sample and balanced panels

	Joint sample		Balanced panels	
Constant	−1.154**	−0.814**	−0.655	−0.711
	(0.030)	(0.039)	(0.476)	(0.329)
Observations	552	552	378	483
R-squared	0.284	0.284	0.450	0.321

Panel C: Alternative estimation method: Fama-MacBeth estimation

	Benchmark regressions			Tightness	Individualism
Tightness				0.036**	
				(0.029)	
Individualism					−0.005***
					(0.002)
Analyst diversity rank			0.004**	0.003	0.002
			(0.010)	(0.499)	(0.177)
Good government index		−0.241***	−0.211**	−0.325*	−0.148*
		(0.002)	(0.048)	(0.058)	(0.078)
Ln(GDP per capita)	−0.084***	0.011	0.029	0.080	0.071
	(0.000)	(0.507)	(0.408)	(0.310)	(0.148)
GDP growth volatility	0.260	−0.025	0.264	−1.585	−0.557
	(0.881)	(0.988)	(0.845)	(0.522)	(0.712)
Ln(number of stocks)	−0.006	0.006	0.018***	−0.038***	0.021***
	(0.257)	(0.435)	(0.005)	(0.000)	(0.004)
Ln(country size)	−0.045***	−0.051***	−0.049***	−0.032**	−0.026***
	(0.002)	(0.001)	(0.003)	(0.032)	(0.004)
Ind. Herfindahl index	0.479	0.368	0.456	−0.054	0.246
	(0.325)	(0.473)	(0.322)	(0.879)	(0.672)
Firm Herfindahl index	−0.735	−0.086	0.905	2.160	1.457
	(0.373)	(0.939)	(0.541)	(0.192)	(0.325)
Earnings comovement	0.058	0.069	0.135	0.212*	0.131
	(0.379)	(0.334)	(0.206)	(0.054)	(0.106)
Constant	0.471	−0.177**	−0.631***	−1.065**	−1.050***
	(0.137)	(0.013)	(0.000)	(0.040)	(0.000)
Observations	901	901	876	552	876
R-squared	0.239	0.280	0.346	0.543	0.383

Panel D: Stock-level results: Hierarchical models

	Independent variables not demeaned		Independent variables demeaned	
Tightness	0.079***		0.757***	
	(0.004)		(0.000)	
Individualism		−0.008***		−0.081***
		(0.003)		(0.000)
Analyst diversity rank	−0.001***	−0.001***	−0.002***	−0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
Good government index	−0.005	−0.072***	−0.213***	−0.196***
	(0.789)	(0.000)	(0.000)	(0.000)
Ln(GDP per capita)	0.114***	0.124***	−0.024	0.382***
	(0.000)	(0.000)	(0.386)	(0.000)
GDP growth volatility	−3.675***	−3.303***	2.495***	1.922***
	(0.000)	(0.000)	(0.000)	(0.000)
Ln(number of stocks)	−0.120***	−0.184***	−0.426***	−0.387***
	(0.000)	(0.000)	(0.000)	(0.000)
Ln(country size)	0.047	0.053*	0.403***	1.454***
	(0.158)	(0.060)	(0.000)	(0.000)
Industry Herfindahl index	2.925***	1.320***	−1.078***	−0.022
	(0.000)	(0.000)	(0.000)	(0.840)
Firm Herfindahl index	−2.785***	−0.850***	−2.631***	−1.095***
	(0.000)	(0.001)	(0.000)	(0.000)
Firm size (country mean)			0.089***	0.124***
			(0.000)	(0.000)
Leverage (country mean)			−0.854***	−0.939***
			(0.000)	(0.000)
ROA (country mean)			−0.451***	−0.502***
			(0.000)	(0.000)
Earnings comovement (country mean)			0.534***	0.534***
			(0.000)	(0.000)

Table 8 (*continued*)

Panel D: Stock-level results: Hierarchical models

	Independent variables not demeaned		Independent variables demeaned	
Firm size	0.176***	0.179***	0.173***	0.177***
	(0.000)	(0.000)	(0.000)	(0.000)
Book leverage	−0.225***	−0.245***	−0.228***	−0.243***
	(0.000)	(0.000)	(0.000)	(0.000)
ROA	−0.105***	−0.124***	−0.087***	−0.091***
	(0.000)	(0.000)	(0.000)	(0.000)
Earnings comovement	0.082***	0.084***	0.058***	0.061***
	(0.000)	(0.000)	(0.000)	(0.000)
Observations	181,109	227,250	181,109	227,250

As a robustness check for our analysis, we examine if our results hold at the stock level. In these stock-level regressions, the dependent variable is a stock's R^2 obtained from the market model in Eq. (1). In addition to all the country-level variables in our previous regressions, we include several firm-level controls: firm size, financial leverage, and ROA. Because both country- and firm-level variables are included in the regressions, we estimate the regression coefficients using a hierarchical linear model. Martin, Cullen, Johnson, and Parboteeah (2007) and Li, Griffin, Yue, and Zhao (2011, 2012) suggest that a hierarchical linear model is better suited to separating the effects that take place at the country level from those that take place at the firm level.

We present estimations from the hierarchical linear models in Panel D of Table 8. In models (1) and (2), we include both country-level and firm-level factors and estimate the model with country-level random effects to capture the difference in the precision of firm-level data across countries. In these models, the coefficient of tightness is 0.079 and the coefficient of individualism is −0.008, both significant at the 1% level. These findings are consistent with our hypotheses that stock price comovement is higher in culturally tighter and less individualistic countries. In models (3) and (4), we center all the independent variables by their grand mean. In addition, we center those demeaned firm-level variables by their country mean. We also include the country means of these grand-mean-centered firm-level variables in the regression model. This decomposition process allows us to control for the differential effects of firm-level characteristics on stock price comovement at the firm and country levels (Li, Griffin, Yue, and Zhao, 2012). The models are again estimated with country-level random effects. As shown in models (3) and (4), the estimation from this specification again confirms the significant effects of cultural tightness and individualism on stock price comovement.

7.5. Endogeneity concerns

We believe that endogeneity is unlikely to be a concern for our findings. First, reverse causality, i.e., a country's stock price comovement changes the country's culture traits, seems implausible. Cultural values as informal institutions regulating human behavior have long existed before the creation of financial markets. Second, we control for several other country-level factors such as countries' geographic sizes and economic developments. It is difficult to think of any omitted variables, more exogenous than culture, that can cause changes in both culture and stock price comovement. Third, our finding that economic openness mitigates the effects of domestic culture on stock price comovement also helps mitigate the omitted variable concern. For an omitted variable to explain our results, it has to affect both culture and stock price comovement less when the country is economically more open.

For these reasons, endogeneity is unlikely to affect our findings. As a robustness check, however, we repeat our analysis using the instrumental variables/two-stage least squares (IV/2SLS) estimation method.[16] We follow Ahern, Daminelli, and Fracassi (2012) and use the genetic distance data from Spolaore and Wacziarg (2009) to construct the IVs for cultural variables. Specifically, we use the dominant genetic distance between each sample country and the countries taking values at the two ends of the respective culture value spectrum. The IVs for tightness are each country's dominant genetic distances from Pakistan and Ukraine. The IVs for individualism are dominant genetic distances from the United States and Pakistan. The dominant genetic distance values measure the difference in gene distributions between two countries' largest ethnic groups. A larger distance reflects a longer separation between the two groups. The IV/2SLS results support our earlier finding that culture has significant influence on R^2.[17]

8. Conclusion

Hofstede, Hofstede, and Minkov (2010) argue that culture is the "software of mind," pointing out the importance of culture in understanding human behavior. The psychology literature suggests that people tend to behave similarly (differently) and think more holistically (analytically) in culturally tight (individualistic) countries. We expect these cultural differences to influence investor behaviors in the stock market and result in higher stock price comovements in culturally tighter and more collectivistic countries. Consistent with this expectation, we find higher stock price

[16] We cannot completely rule out the possibility that future research may uncover a latent factor causing changes in both culture and stock price behavior.

[17] Detailed information on the IVs, the IV/2SLS results, and the results from the weak-IV-robust inference tests are available upon request.

synchronicity in countries with a tight and collectivistic culture. On the other hand, stock prices tend to co-move less in countries with a loose and individualistic culture.

We further find that culture affects stock price synchronicity by influencing the degree of correlated trading of investors and a country's information environment. Both market-wide and firm-specific variations are lower in culturally tight countries and the higher return comovements in these countries are primarily driven by significantly lower firm-specific variations. Consistent with the argument that individualistic investors are more likely to gather and analyze private information, we find that individualism reduces R^2 mainly by increasing firm-specific variations. We also find that the effect of culture on stock price comovement is weaker in countries that are more open to international trade and investment. These results are consistent with the view that economic openness encourages cultural exchange and mitigates the influence of domestic culture on people's behavior.

Overall, our study suggests that culture is an important omitted variable in studies that examine cross-country differences in stock price comovement. Researchers thus may want to consider culture when they draw cross-country inferences from stock markets. For example, culture may help explain different stock price behaviors in the domestic and foreign exchanges for cross-listed stocks. Karolyi, Lee, and van Dijk (2012) examine cross-country differences in commonality in liquidity and find that investor behaviors, instead of financial intermediaries, contribute more to commonality in liquidity. Their findings combined with our results suggest that national culture, which affects investor behaviors, may influence commonality in liquidity as well. The findings of our paper also have implications for practitioners. Specifically, when constructing portfolios of securities, fund managers and investors may want to consider the effect of a country's national culture on stock price comovement because it could affect the efficiency of portfolio diversification. In addition, our findings on the relation between economic openness and culture raise an interesting research question: How cross-country cultural contagion associated with international trade and financial integration may affect the welfare of investors of the affected countries. This and other related questions remain challenges for future research.

Appendix A. Survey method to estimate cultural tightness/looseness

This appendix presents the six scale items that are asked in the survey conducted by Gelfand, Raver, Nishii, Leslie, and Lun (2011). This survey was given to a total of 6,960 respondents in 33 countries across five continents. After removing incomplete surveys with unusable data, the final sample for analysis consists of 6,823 participants. All data were collected during 2000–2003.

The six scale items asked in the survey are the following:

1. There are many social norms that people are supposed to abide by in this country.
2. In this country, there are very clear expectations for how people should act in most situations.
3. People agree upon what behaviors are appropriate versus inappropriate in most situations in this country.
4. People in this country have a great deal of freedom in deciding how they want to behave in most situations [reverse coded].
5. In this country, if someone acts in an inappropriate way, others will strongly disapprove.
6. People in this country almost always comply with social norms.

For each statement, the survey respondent chooses from the following symmetric disagree–agree scale:

1	2	3	4	5	6
Strongly disagree	Moderately disagree	Slightly disagree	Slightly agree	Moderately disagree	Strongly agree

Gelfand, Raver, Nishii, Leslie, and Lun (2011) calculate a country's final tightness score in two steps. In the first step, they compute a within-subject standardized score for each survey response in a country. To do so, they first calculate the mean for each person's responses to all of the items in the survey. Then they standardize all items in the survey by subtracting the score for each item from that person's mean response to all items. In the second step, they calculate the mean of the standardized scores for each country. The final score is the mean standardized score multiplied by 10. See Gelfand, Raver, Nishii, Leslie, and Lun (2011) for details on how the final score is calculated. Their paper also provides detailed discussions on the reliability and validity of the survey method and the calculation of the tightness score.

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