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Industry Structure and Stock Price Synchronicity

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This paper provides a non-information-based explanation to the stock price synchronicity for firms sorted by country, size-decile and industry sector. Using a panel of listed firms in 40 countries that span over 23 years, we find that the governance and the market size effects are highly collinear in predicting stock price synchronicity at the decile and the industry sector levels. Moreover, the effect is larger in the real estate industry than in the non-real estate industry. The channel of information extraction by large firms and firms in markets with weak governance of property rights cannot be easily disentangled. This study explores the industry structure as an alternative explanation for the stock price synchronicity. Our proposed sales growth co-movement indices of firms exhibit highly significant and positive effects in driving price synchronicity after controlling for observed and unobserved cross-sectional and temporal variations. Firms in a market with highly inter-connected business networks have higher stock price synchronicity (R^2). The results are robust and consistent, which do not hinge on whether a market is informational efficient.

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Keywords

Price Synchronicity, Market Capitalization, Property Rights Protection, Industry Structure, Information Hypothesis, Sales Growth Co-movements

JEL: G14, G15

1. Introduction

Stock price synchronicity as represented by "R^2" of a fitted asset pricing model is correlated with firm-specific price variations. Morck, Yeung, and Yu (2000) (hereinafter referred to as MYY) argue that a high R^2 is caused by information inefficiency in stock markets. Their empirical study which covers international stock price synchronicity across 40 countries in 1995 shows that the R^2 disparity in these countries is significantly and negatively correlated with the "good government index" (GGI), which is a measure for property rights protection and governance, among others. In low GGI countries (with weak property rights protection), investors do not expend enough private resources to extract information about firms; as a result, stock prices in these countries exhibit higher cross-sectional variations as shown by a relatively higher R^2. This is widely known as the information hypothesis that links high R^2 with information inefficiency in the markets.

The information-based hypothesis cannot rule out other alternative explanations for the disparity in international stock price synchronicity (Skaife, Gassen, and LaFond, 2006; Pantzalis and Xu, 2008, etc.). Investor sentiment (Hou, Peng, and Xiong, 2013) and cultural differences (Eun, Wang, and Xiao 2015) are among the other behavioral related stories that have been proposed to explain for the cross-sectional disparity in country R^2. However, few studies have focused on the fundamentals when explaining the country R^2 disparity; this study aims to fill the gap by investigating the industry structures, which are possible fundamental factors, that explain for the R^2 disparity across the countries.

Using the same 40 sample countries but covering an extended 23-year period from 1995 through to 2017, we replicate the MYY tests and affirm the significantly negative GGI effects on cross-country stock price synchronicity. Our country-level evidence does not reject the information hypothesis. However, the GGI effects of the countries are muted in a significant way, when the decile-sector and industry-sector fixed effects are introduced into the panel regressions. Our results show that the GGI effects disappear and offer no incremental explanation for the R^2 disparity.

The size and GGI are two highly correlated information channels that drive the R^2 disparity. Given that analysts do not expend enough resources in searching for information on small firms (Chan and Hameed, 2006), and there is a high concentration of small size firms in emerging markets (with low GGI), we cannot disentangle the size effects from the GGI effects in explaining for the R^2 disparity results. We observe a dichotomy in the GGI classification between developing (small market capitalization) and developed (large market capitalization) countries (Figure 1) which confronts the validity of using the GGI as an instrument in separating the high R^2 in emerging countries and the low R^2 in developed countries. This study aims to search for an instrument that is not correlated with the information-based effects (both the size and the GGI), but more importantly, one that can incrementally explain for the R^2 disparity. We hypothesize that the industry structure offers an alternative explanation to the international R^2 disparity.

According to the model of contestability in Bailey and Baumol (1983), a highly concentrated market with a few large firms is inefficient and uncompetitive. The market is "weakly contestable", where large firms use preemptive pricing strategies to raise the barrier of entry into a market and exclude smaller competitors. We hypothesize that these firms have a dispersed business network, and their stock prices exhibit high idiosyncratic variations and are less synchronized; as a result, R^2 decreases at the firm-decile and industry sector levels. In comparison, a "strongly contestable" market consists of many highly efficient and competitive firms. The entry barrier into the market is relatively low. Firms need to continuously improve marginal returns to scale benefits in order to stay competitive in the market. We thus hypothesize that this market is tightly knitted and integrated, both vertically and horizontally, and firms that are operating in this market rely on strong business networks to generate revenue growth. Therefore, the stock prices of these highly contestable firms are more synchronized, and thus the R^2 increases at the decile and industry sector levels.

Our industry structure explanations for the R^2 disparity do not require any argument of whether a stock market is (perfectly) informationally efficient or imperfectly informationally efficient. We use the co-movement indices[1] of the sales growth of firms as an instrument to capture integration and contestability in the market, and test if the instrument could explain for the R^2 disparity across the sample countries. Our results show that the disaggregated firm R^2s are significantly correlated with changes in the sales growth indices after controlling for the fixed effects associated with year, country, decile, and the industry sector. More importantly, we find that the effect is larger for the real estate industry. The results are robust and can withstand a battery of robustness tests. The high sales growth correlations of interlocking firms, which are the characteristics of a highly contestable market, significantly increase the decile-

[1]The co-movement indices of the sales growth of firms are derived by averaging the pair-wise correlations with each sector level for each country.

and the industry-level R^2. More importantly, the results are orthogonal to the country-level GGI coefficients, which offer no incremental explanations to the R^2.

The paper makes two valuable contributions to the literature on stock price synchronicity. First, while the literature is inconclusive on the effects of information efficiency on the R^2 disparity (MYY, 2000; Durnev, Morch, and Yeung, 2004; Jin and Myers, 2006; Dasgupta, Gan, and Gao, 2010; MYY, 2013), our evidence on the non-information based explanation for the R^2 disparity backed by the industrial organization argument offers a robust alternative to the information story. Stock prices of firms operating in a highly contestable market with a tight business network structure are highly synchronized, which significantly explain for the high R^2. The results are independent of the governance and the size factors. Second, we add to an important strand of the literature on industry structure (Stuckey and White, 1993; D'Aveni and Ilinitch, 1992; Barney, 2002; Fan *et al.*, 2017) and the risk diversification strategies of firms in the different product markets (Hou and Robinson, 2006; Peress, 2010; Hoberg and Phillips, 2010; Opp, Parlour, and Walden, 2011; Lyandres and Watanabe, 2012). We find that the sales growth co-movements, as a proxy of the interdependence of firm networks, are positively correlated with R^2 at the industry level. Using the shocking downfall of Nokia in Finland in our tests, we affirm the hypothesis that the break-out of a highly monopolized structure leads to a more synchronized market.

The remainder of the paper is organized as follows. Section 2 reviews past studies on stock return synchronicity. Section 3 covers the data sources, key variables and regression designs. Descriptive statistics are reported. Section 4 reports the empirical results of a year-by-year cross-sectional model at the country-level and the more disaggregated panel regression models sorted by size and industry sector in verifying the information hypothesis for the stock price synchronicity (R^2). Section 5 explores the industry structure and integration as new channels that drive differential synchronicity in stock prices across the countries. Section 6 concludes the paper.

2. Literature Review

Roll (1988) argues that the R^2 of fitted asset pricing models as a proxy for stock price synchronicity is negatively correlated with information efficiency. There is a clear distinction of a low R^2 in developed countries and high R^2 in emerging and/or less developed countries. MYY (2000) argue that the country stock R^2 is negatively correlated with the GGI, where the GGI is a proxy for the levels of corruption, expropriations of investor property rights and repudiations of contracts, and independent of macroeconomic fundamentals. The opaqueness of firm-specific information in countries with poor property rights protection is a necessary condition that causes high price synchronicity (Jin and Myers, 2006). Inter-corporate income shifting by corporate insiders is common in these countries, which reduces the informativeness of firm-specific factors (Durnev, Morch, and Yeung, 2004). The causal effect of R^2 in the information hypothesis is not conclusive and could be endogenous (MYY, 2013).

Three recent studies have found evidence to reject the hypothesis that a high R^2 of stocks in less developed countries is due to the opaqueness of firm-specific information. Dasgupta, Gan, and Gao (2010) show that the learnings of investors about time-invariant fundamentals increases price synchronicity of older firms relative to those of younger firms. Hou, Peng, and Xiong (2013) propose an investor sentiment story that show a lower R^2 is associated with stronger medium-term price momentum and longer-term price reversal. Eun, Wang, and Xiao (2015) show that cultural differences that correlate with the state of globalization and development of a country also explain for the cross-sectional disparity in the country R^2.

The forecasts and coverage of financial analysts are proxies for information efficiency, which have an impact on stock prices (Ramnath, Rock, and Shane, 2008). A high R^2 indicates that firm-specific risks or more specifically, idiosyncratic risks, are not fully embedded in stock prices, whereas low R^2 stocks embed more relevant firm-specific information in prices. Moreover, firms and industries with low R^2 stocks show a higher correlation between current returns and future earnings (Durnev *et al.*, 2003). Piotroski and Roulstone (2004) and Chan and Hameed (2006) both find positive relationships between price synchronicity and coverage of security analysts, where the former covers US stocks (1984-2000) and the latter covers emerging market stocks (1993-1999). The emerging-market results of Chan and Hameed (2006) appear to be more consistent with the information hypothesis of MYY (2000). However, Piotroski and Roulstone (2004) argue that a high R^2 in their US stocks is caused by analysts who use industry-wide information more than the market-wide information in their coverage.

There are other studies, such as Skaife, Gassen, and LaFond (2006), Pantzalis and Xu (2008) and others, that find empirical support for stock price synchronicity as a measure of firm-specific information. Barberis, Shleifer, and Wurgler (2005) and Ambrose, Lee, and Peek (2007) find that inclusion of stocks in (removed from) the Standard and Poor's 500 index increases (decreases) firm-level transparency, and thus stock return synchronicity. Corporate investment decisions could also increase firm-specific information (Wurgler, 2000; Chen, Goldstein, and Jiang, 2007). Other studies relate price synchronicity to investing styles (Barberis and Shleifer, 2003), wealth effect (Kyle and Xiong, 2001), financial constraints (Yuan, 2005), portfolio rebalancing activities (Kodres and Pritsker, 2002), and strategic trading (Pasquariello and Vega, 2007).

Our paper seeks to find an alternative explanation for the disparity in R^2 across countries, which does not require the stock market to be informationally efficient. Like in the various strands of international studies, Mowday, Steers and Porter (1979) show that industry structure and networks as characterized by firm size (market capitalization), industry integration (D'Aveni and Ilinitch, 1992; Chatterjee, Lubatkin and Schoenecker, 1992; Stuckey and White, 1993; and Acemoglu, Johnson and Mitton, 2009), and ownership concentration (Claessens, Djankov, and Lang, 2000; Claessens *et al.*, 2002; Barney, 2002; Gorga, 2009; Khanna and Thomas, 2009; Lemma and Negash, 2016; and Gordon and Ringe, 2018) could influence the profitability of firms, and consequently, their stock price synchronicity. The goal of this paper is to investigate the industry structures, which are possible fundamental factors, that explain for the R^2 disparity across countries.

3. Data, Empirical Variables, and Descriptive Statistics

3.1. Stock Return Synchronicity as Dependent Variable

We collect weekly stock price data for all public firms on stock exchanges in the same 40 countries as those used in MYY (2000) from Thomson Reuters Datastream and WorldScope. Based on the cut-off date of 31 December 2017, we exclude newly listed stocks with stock return data that are less than ten weeks from the cut-off date. A stock must have at least 40 weeks of return data before it is included in our sample. We exclude stocks with no trading data within a week and stocks with outlier weekly returns that exceed 25% to reduce measurement errors that may bias the results.

Unlike MYY (2000) who use biweekly (fortnightly) returns, we use weekly returns in our empirical analysis. Jin and Myers (2006) also use weekly returns. Since the two-week-long thin-trading problem suggested in MYY is no longer a serious issue for most of the countries in ensuing years after 1995, we believe that use of higher frequency return data can improve estimation and testing efficiencies due to a larger sample size. We calculate the weekly stock return, as the difference in the natural logarithm of stock prices is adjusted for divided and share splits. As in MYY (2000), we also adjust a lag of one day for the U.S. market return relative to the returns of other Far East countries to synchronize their timings as much as possible.

The final sample covers a total of 555,353 stock-year observations across the 40 countries from 1995 to 2017. This averages to about 24,145 stocks each year. The number of stocks in the sample increased at a steady rate over the years from 14,939 stocks in 1995 to 29,815 stocks in 2017.

3.2. Stock Price Synchronicity Measures

We calculate the R^2 by fitting the weekly return r_{ijt} of stock *i* in country *j* in week *t* by using the country-level regression model proposed in French and Roll (1986), Roll (1988), and MYY (2000):

$$r_{ijt} = \alpha_{ij} + \beta_{1,ij} r_{m,jt} + \beta_{2,ij}\left[r_{US,t} + e_{jt}\right] + \varepsilon_{ijt} \tag{1}$$

where $r_{m,jt}$ is the continuously compounded local stock market return; $r_{US,t}$ is the continuously compounded US stock market return; e_{jt} is the log of the local currency relative to the U.S. dollar from week t-1 to week t; and $\left[r_{US,t} + e_{jt}\right]$ is the U.S. stock return in a local currency term, which is included to account for the foreign funds flow effect in investing in the U.S. market. α_{ij}, $\beta_{1,ij}$ and $\beta_{2,ij}$ are regression coefficients, and ε_{ijt} is an independent and identically distributed (*i.i.d.)* residual error.

For an individual firm *i* in a country *j*, we fit the weekly return year-by-year to the ordinary least square (OLS) model as in Equation (1) to obtain the firm-year R^2_{ijy}, where *y* indicates the respective year starting from 1995 to 2017, i.e., [1995, 1996, …, 2017]. The firm-year R^2_{ijy} measures the stock return variances of firm *i* in country *j* in relation to the local stock market return $r_{m,jt}$ and currency-adjusted U.S. stock market return $r_{US,t}$.

Next, we calculate the weighted average R^2_{ijy}'s for stocks *i* in country *j* in year *y* by using two different weighting schemes, which include the error-weighted scheme as in MYY (2000), and the equal-weighted scheme. The error-weighted scheme defines the weight as a ratio of the fraction of the total sum of squares (or TSS for each firm) to the overall TSS. The equal-weighted scheme assigns an equal weight to R^2 of each firm and, the error-weighted country-year R^2, or ERW, is given by:

$$ERW_{jy} = \frac{\sum_i R^2_{ijy} \times TSS_{ijy}}{\sum_i TSS_{ijy}} = \frac{\sum_i ESS_{ijy}}{\sum_i TSS_{ijy}} \tag{2}$$

where ESS denotes the explained sum of squares of the regression errors.

As the TSS is generally larger for smaller firms and small firms tend to have a lower R^2, the ERW may bias downward from the EQW; and the EQW values are in general higher than the ERW values. EQW that puts equal weight on the R^2 of all firms in each country is a viable alternative to ERW. The equal weighting scheme is used in some recent studies, such as Eun, Wang, and Xiao (2015). The equal-weighted country-year R^2, or EQW, is given by

$$EQW_{jy} = \frac{\sum_i R^2_{ijy}}{N_{jy}} \tag{3}$$

where N_{jy} denotes the number of firms deployed in the regression in country j in year y.

For regression purposes, we transform the bounded interval of [0,1] of both ERW and EQW *by* using the logistic transformation process as in MYY (2000):

$$\Upsilon_{jy} = \log\left(\frac{R_{jy}^2}{1 - R_{jy}^2}\right) \tag{4}$$

where R_{jy}^2 takes the value of either ERW or else EQW. Υ_{jy} is used as the dependent variable in subsequent regressions. For exposition purposes, we conveniently refer to the log-transformed ERW as LERW, and log-transformed EQW as LEQW.

For the industry level aggregation, we aggregate the firm-year R_{ijy}^2 by industry k following both the error-weighted and equal-weighted schemes. The industry classification is primary based on the 4 digit SIC code (DataStream & Worldscope variable item: WC07021).[2]

3.3. Good Government Index

MYY (2000) construct a GGI based on the three indices of "corruption index", "risk of expropriation index" and "repudiation of contracts by government index" extracted from La Porta *et al*. (1998).[3] The three indices assign scores that range from zero to ten for each country included in the survey. A low score indicates that the government has little respect for private property rights. MYY (2000) use the sum of the three index scores to derive the GGI index in their empirical tests. They find that a low GGI is associated with high stock price synchronicity in the country.

However, it is difficult to replicate exactly the same three indices used in MYY (2000), especially those in the later years, so we use comparable indices that share the same characteristics of the GGI in MYY (2000) to represent the GGI in our study. To construct our GGI, we use two indices: (1) the "corruption perception index" (CPI) published by Transparency International, and (2) a component indicator of "property right" in the Index of Economic Freedom (IEF)[4], an index jointly published by the Wall Street Journal and the Heritage Foundation. We collect the yearly scores of the CPI and property right index of

[2]Furthermore, we integrate those industries with only one firm by using the 2 digit SIC code for each year, and each country.

[3]See La Porta *et al*. (1998) for detailed descriptions of the three indexes.

[4]The IEF assigns the highest score of 100 to a country that fits into the criteria: "Private property is guaranteed by the government. The court system enforces contracts efficiently and quickly. The justice system punishes those who unlawfully confiscate private property. There is no corruption or expropriation."

the IEF for the 40 countries from 1995 to 2017, and construct two normalized indices on the scale of 0 to 10[5], where a score of 0 indicates the highest risk, and 10 indicates the lowest risk of corruption and expropriation by a government. Our GGI index is the sum of the scores of the two normalized indices. A high GGI score indicates that a country *j* has a relatively low level of perceived corruption and expropriation risks either through "outright confiscation" or "forced nationalization" by the government.

3.4. Other Control Variables

Following MYY (2000), we use the same set of structural variables for the price synchronicity regressions (see their Tables 4 and 5). We control the size of the stock market with the natural log of per capita GDP in nominal U.S. dollars (GDP) and the logarithm of the number of stocks listed on each country's exchange (NSTK). For a small market, individual stock returns are more closely associated with the market index, which is the weighted average of the individual stock returns, and this will, in turn, affect the R^2. Other structural variables include variance of the quarterly GDP growth data from the last five years (VGDP), and Herfindahl and earnings co-movement indices.

We use the approach in MYY (2000) to create an earnings co-movement index for firm *i* in country *j* and year *y* by regressing the return on assets, ROA_{ijy} of firm *i* on the market value-weighted average of the ROA of all firms in country *j* of year *y*, $ROA_{m,jy}$:

$$ROA_{ijy} = a_{ij} + b_{ij} ROA_{m,jy} + \epsilon_{ijy} \tag{5}$$

The R^2 obtained from the regressions of the ROA of firms *i* in the same country *j* for year *y*, denoted as $[R_{ijy}^2\ (ROA)]$, is then averaged by using the error-weighting scheme as in returns regressions. The weight for each $R_{ijy}^2\ (ROA)$ is the fraction of the TSS to the total TSS for all firm ROA regressions in country *j*. Thus, the country j earnings co-movement index (ECI) is calculated as:

$$ECI_{jy} = \frac{\sum_i R_{ijy}^2\ (ROA) \times TSS_{ijy}(ROA)}{\sum_i TSS_{ijy}(ROA)} = \frac{\sum_i ESS_{ijy}(ROA)}{\sum_i TSS_{ijy}(ROA)} \tag{6}$$

ECI_{jy} is estimated by using the firm ROA_{ijy} data in the previous 5 years. There are minor differences in the way that we calculate the ECI. MYY (2000) eliminate some of the countries in their ECI calculations because "*...earnings data are available for very few firms...*"; whereas we prefer to use all the firms that are available (Poland has the smallest number of 60 stocks) to create a complete set of ECI variables in all 40 countries for all the years from 1995 to

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[5]For a normalized CPI, a score of 10 indicates that a country is perceived to be the least corrupt; whereas for a normalized property right indicator in the IEF, a score of 10 indicates the lowest risk of expropriation by the government.

2017. We use the ex-ante data, for example, 1991-1994, rather than 1993-1997 when calculating the ECI in 1995.

Let S_{ij} denote the annual sales of a firm *i* in country *j* and S_{kj} denote the aggregate sales of firms in industry k in country j. We calculate the industry-based Herfindahl index as $IHHI_j = \sum_{k=1}^{K}\left(\frac{S_{kj}}{\sum_{i=1}^{N} S_{ij}}\right)^2$ and firm-based Herfindahl index as $FHHI_j = \sum_{i=1}^{N}\left(\frac{S_{ij}}{\sum_{i=1}^{N} S_{ij}}\right)^2$, where K denotes the total number of industry sectors in country *j*, and *N* denotes the total number of firms in country *j*. A large industry-Herfindahl index indicates the lack of industry diversity, while a large firm-based Herfindahl index indicates the dominance of a small number of firms.

In addition, we consider the average capitalization values of firms by multiplying the number of shares of a firm in each country by the year-end stock price of the firm. We convert the values into U.S. dollars by using year-end exchange rates and calculate the natural logarithm of the equal-weighted average of dollar capitalizations for all firms in a country. After grouping the firms in a country into 10 deciles sorted by dollar capitalization, we calculate the associated decile regression variable denoted by ACAP as a log of the equal-weighted average of dollar capitalizations of firms within the decile. The firm-level aggregate market capitalization that is closely correlated with the NSTK offers additional useful information.

The IVOL is a volatility variable that captures the amount of news in the market and calculated as the standard deviation of the 52-week natural log-local stock returns. More news leads to higher market volatility, and hence, higher price synchronicity. We do not differentiate whether the market volatility is due to either market-wide information or idiosyncratic news. A list of the variables with descriptions and the abbreviations is given in Appendix 1.

3.5. Descriptive Statistics

Table 1 shows the descriptive statistics for the key variables used in our study, with Panels A and B corresponding to the results of country-level and industry-level variables, respectively. The error-weighted stock price synchronicity at the country-level, ERW, and the equal-weighted price synchronicity, EQW, average at 0.110 and 0.095, respectively. The industry-level pairs of ERW and EQW are slightly lower, averaging at 0.107 and 0.098, respectively. The average GGI is estimated at 13.00 with a standard deviation of 4.358. The average of the market capitalization variables, ACAP, ranges between 14.651 and 14.661.

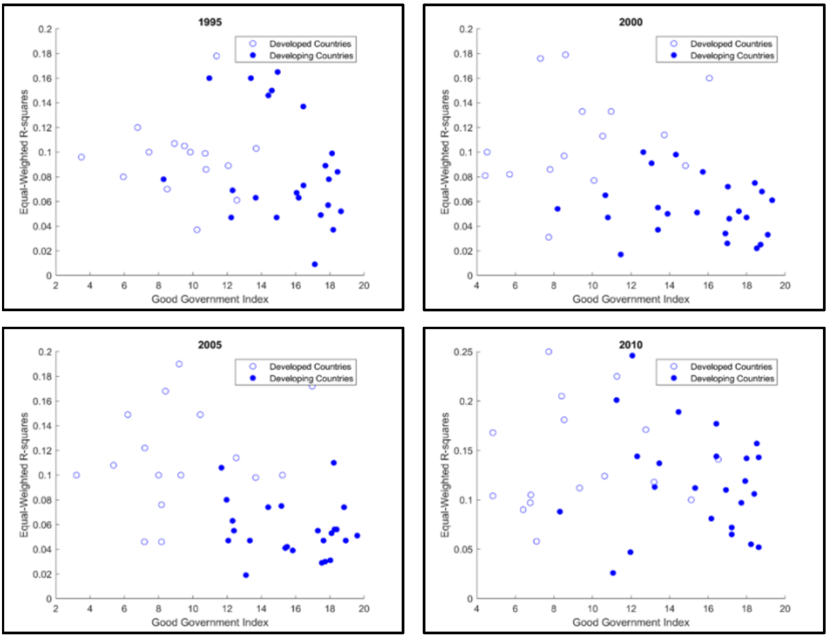
Table 1 Descriptive Statistics

Panel A: Country-Level Variables					
Variable	**Nobs**	**Mean**	**S.D.**	**Min**	**Max**
LERW	920	-2.271	0.696	-4.751	0.020
LEQW	920	-2.428	0.675	-4.677	0.012
ERW	920	0.110	0.070	0.009	0.505
EQW	920	0.095	0.061	0.009	0.503
ISGC	920	0.112	0.110	-0.429	0.915
GGI	920	13.000	4.358	1.230	20.000
LGDPo	920	9.498	1.256	5.970	11.540
LSTK	920	5.535	1.423	1.386	8.797
VGDPG	920	0.010	0.006	0.000	0.063
ECI	920	0.457	0.199	0.036	1.000
IHHI	920	0.171	1.029	0.000	3.042
FHHI	920	0.013	0.019	0.000	0.331
ACAP	920	14.661	1.527	7.625	17.420
IVOL	920	0.214	0.119	0.053	1.323
Panel B: Industry-Level Variable					
Variable	**Nobs**	**Mean**	**S.D.**	**Min**	**Max**
LERW	8,127	-2.403	0.896	-6.416	1.006
LEQW	8,127	-2.511	0.890	-5.933	0.676
ERW	8,127	0.107	0.079	0.002	0.732
EQW	8,127	0.098	0.075	0.003	0.663
ISGC	8,127	0.112	0.183	-0.490	0.990
LSTK	8,127	6.072	1.167	2.639	8.797
ACAP	8,127	14.651	1.841	6.144	18.748

Notes: This table presents the descriptive statistics for key variables used in this study with Panels A and B corresponding to the results at the country and the industry levels, respectively. Nobs denotes number of observations See Appendix 1 for detailed definitions of the variables.

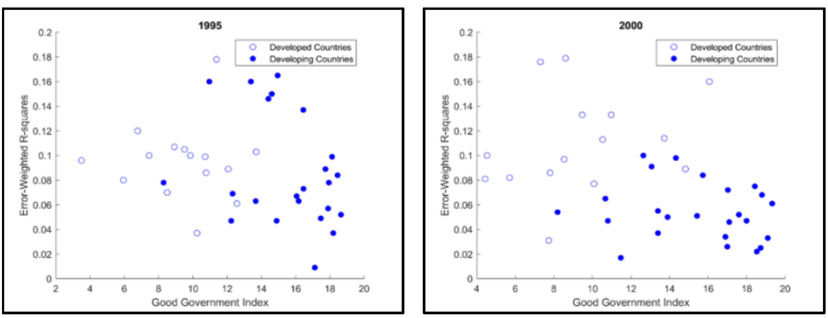
Figure 1 shows the scattered plots of the ERW and EQW with respect to the GGI. In 1995, the developed countries (solid dots) are clustered in the bottom right of the graph whereas the developing countries (circles) are spread out to the left with a few in the top left corner of the graph. The GGI appears to partition the cross-section of points into two clusters such that the cluster on the left (the developing countries) has a high ERW R^2 and the cluster on the right (the developed countries) has a low ERW R^2.

Figure 1(a) Equal Weighted R-square and GGI for 1995, 2000, 2005, and 2010



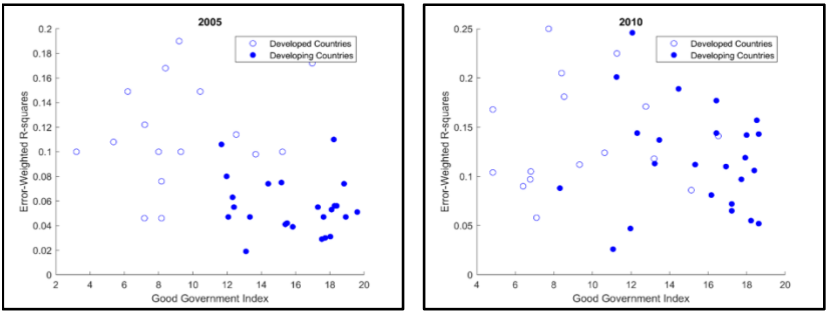
Note: Equal-weighted stock price synchronicity is plotted against the GGI for 40 countries in 1995, 2000, 2005, 2010. GGI incorporates the CPI published by Transparency International and a component indicator that represents "property right" in the IEF, an index jointly published by the Wall Street Journal and the Heritage Foundation. The two series add up to a score between 0 and 20 for the GGI. A higher GGI denotes a higher observance of investor property rights in the country.

Figure 1(b) Error-weighted R-square and GGI for 1995, 2000, 2005, and 2010



(Continued…)

(Figure 1(b) Continued…)



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4. Empirical Methodology and Findings

4.1. Baseline Results – Extension of MYY

We first attempt to replicate the results in MYY (2000) by running a cross-sectional analysis on a year-by-year basis from 1995 to 2017. Due to space limitations, we report the result in Appendix 3. Our results cannot disentangle the GGI effects from the market size effects. Moreover, we find that the size effects significantly weaken the GGI effect in the information channel to explain away most of the R^2 variations in the market.

4.2. The Panel Regression Models

4.2.1. Country-Year Panel

To gain further insight into determining the R^2 variation, instead of a year-by-year analysis at the country-level, we re-run the regressions by using 3 different panels: the country, decile-country, and industry-country panels, with proper control of unobserved within-sample variations by using different controls for the cross-sectional and time fixed effects and also cluster standard errors. For the country-year panel which consists of 40× 23 observations, we also include other country-year control variables, such as the GGI, ACAP, LGDP, LSTK, IVOL, VGDPG, IHHI, FHHI, and ECI. The country-year panel regression specification is written as follows:

$$\psi_{jy} = a_0 + b_1 GGI_{jy} + b_2 ACAP_{jy} + cX_{jy} + \sum_{y=1}^{22} \varphi_y 1_y + \zeta_{yj} \quad (7)$$

where 1_y is a binary indicator for the y^{th} year dummy.

The country-year panel regression results reported in Columns (1) and (2) of Table 2 show significantly negative correlations between the GGI and R^2, which are robust and consistent with those found in the early cross-sectional models at the country-level. The GGI explains about 2.9% and 2.4% of the variations in the country-level LERW and LEQR, respectively. The IVOL coefficients are positive but insignificant in the models, which is also consistent with the early country-year models. The market capitalization and ACAP coefficients are highly significant at less than the 1% level. Unlike the year-by-year regressions, the ACAP and GGI coefficients do not appear to be mutually exclusive, and both are significant factors in explaining for the variations in price synchronicity, although in the opposite direction. Other control variables only partially explain for the country-year R^2 disparity.

4.2.2. The Decile-Country-Year Panel

Next, we disaggregate firms by market size and sort them into the decile-country-year (or decile-country) panel and re-run the panel regression models with additional fixed effects to capture the unobserved country-level differences (such as cultural differences) and the size-related fixed effects. The panel regression specification is written below:

$$\psi_{jy} = a_0 + b_1 GGI_{jy} + b_2 ACAP_{jy} + cX_{jy} + \sum_{y=1}^{22} \varphi_y 1_y + \sum_{j=1}^{39} \alpha_j 1_j + \sum_{d=1}^{9} \beta_d 1_d + \zeta_{jy} \quad (8)$$

where the indicator 1_j is the j^{th} country dummy variable, and 1_d is the d^{th} size decile dummy variable. The sample values of the dependent variable for the regression (8) are a stacked vector of $40 \times 23 \times 10$ observations. To avoid singularity, we exclude the tenth decile dummy, and two country dummies (since the geography (GEO) variable is constant for each country). Like Petersen (2009), we cluster errors in both within-country and within-decile to avoid correlated residual errors in the panel regressions. The results in Table 2 show that the goodness of fit of the decile-country-based panel regressions increases significantly to 0.684 and 0.703 (Columns 3 and 4) compared to the 0.247 and 0.134 of the country-year panel respectively (Columns 1 and 2). It is clearly the case that the restrictions: ($\gamma_{dj} = \gamma$), for all d and all j, can be rejected.

Table 2 Baseline Panel Regressions on Stock Price Synchronicity

	Country Panel		Decile-Country Panel		Industry-Country Panel					
					Full Sample		Real Estate		Non-Real Estate	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	LERW	LEQR	LERW	LERW	LERW	LEQR	LEQR	LEQR	LERW	LEQR
ACAP	0.019***	0.014***	0.003***	0.007***	0.007***	0.006***	0.012***	0.009***	0.004***	0.003***
	(5.88)	(4.16)	(2.91)	(3.51)	(3.51)	(3.00)	(3.12)	(2.99)	(3.11)	(2.90)
GGI	-0.029***	-0.024***	0.005	0.010*	0.010*	0.008	-0.016**	-0.016**	-0.016**	-0.016**
	(-5.41)	(-4.48)	(0.93)	(1.87)	(1.87)	(1.47)	(-2.36)	(-2.30)	(-2.39)	(-2.32)
IVOL	0.015	-0.188	0.776***	0.869***	0.869***	0.588***	0.049	0.009	0.036	-0.003
	(0.05)	(-0.61)	(4.42)	(5.48)	(5.48)	(4.41)	(1.00)	(0.18)	(0.76)	(-0.06)
LGDP	-0.058***	-0.026	-0.026	-0.057*	-0.057*	-0.055*	0.022	0.019	0.023	0.021
	(-2.91)	(-1.30)	(-1.10)	(-1.94)	(-1.94)	(-1.87)	(1.03)	(0.93)	(1.12)	(1.02)
NSTOCK	-0.089***	-0.008	-0.308***	-0.411***	-0.411***	-0.410***	-0.029***	-0.025**	-0.028***	-0.024**
	(-3.55)	(-0.35)	(-7.29)	(-8.44)	(-8.44)	(-8.52)	(-2.99)	(-2.46)	(-2.96)	(-2.44)
VGDPG	1.750	-3.414	-1.669	4.364*	4.364*	4.228*	0.758**	0.846***	0.779***	0.868***
	(0.53)	(-1.06)	(-1.01)	(1.90)	(1.90)	(1.95)	(2.55)	(2.76)	(2.67)	(2.88)
ECI	-0.213*	-0.107	0.067	-0.078	-0.078	-0.029	0.265	0.202	0.299	0.237
	(-1.72)	(-0.84)	(1.44)	(-1.43)	(-1.43)	(-0.56)	(0.66)	(0.49)	(0.73)	(0.57)
IHHI	-0.143	-0.125	-0.350***	-0.321***	-0.321***	-0.343***	-0.242	-0.082	0.201	0.380
	(-1.50)	(-1.35)	(-4.79)	(-4.57)	(-4.57)	(-4.68)	(-0.39)	(-0.13)	(0.31)	(0.55)
FHHI	3.987*	4.261*	-2.941***	-3.326***	-3.326***	-3.767***	-3.837***	-3.686***	-4.127***	-3.987***
	(1.71)	(1.81)	(-3.36)	(-3.12)	(-3.12)	(-3.83)	(-12.30)	(-11.76)	(-13.48)	(-12.97)
Intercept	-0.838***	-1.847***	-132.140***	0.279	0.279	-0.105				
	(-2.93)	(-5.97)	(-10.05)	(0.26)	(0.26)	(-0.09)	-0.016**	-0.016**	-0.016**	-0.016**

(Continued…)

(Table 2 Continued)

N	920	920	9200	8127	8127	8127	8127	9200	8127	8127
R-sq	0.273	0.165	0.687	0.523	0.523	0.538	0.538	0.706	0.523	0.538
Adj. R-sq	0.247	0.134	0.684	0.518	0.518	0.533	0.533	0.703	0.518	0.533
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Fixed Effect	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effect	No	No	No	Yes	Yes	Yes	Yes	No	Yes	Yes
Decile Fixed Effect	No	No	Yes	No	No	No	No	Yes	No	No
Cluster SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table reports the panel regressions of stock price synchronicity on various economy variables. Different panels such as country-, decile-country, and sector-country panels are used. The dependent variable is a logistic transformation of stock price synchronicity. We include information variables such as the good government index (GGI), the local volatility index (IVOL), and a natural log of market capitalization (ACAP). Control variables include the natural log of GDP per capita (LGDP), natural log of number of stock (NSTK), natural log of geographical size (LGEO), variance of GDP growth (VGDPG), industry Herfindahl index (IHHI), firm Herfindahl index (FHHI), and earnings co-movement ratio (ECI). Numbers in parentheses are the t-statistics. ***, **, and * denote significance at the 1%, 5%, and 10% levelss respectively. There are 40 countries, 10 deciles, 12 industries, and 23 years (1995 to 2017).

In the two decile-country panel models, the ACAP coefficients remain highly significant and positive at less than the 1% level, where the models include the decile and the country fixed effects. The GGI and IVOL coefficients are both positive, but only the latter are significant while the former are not significant at less than the 10% level. This seems to suggest that unobserved within-the-country and within-the-firm-decile variations explain away some of the between-the-country price synchronicity effects as represented by the GGI. However, the ACAP coefficients that are highly statistically and economically significant (Columns 3 and 4) imply that the unobserved within-the-country and within-the-firm-decile variations are not correlated with the average capitalization of firms in the countries.

4.2.3. The Industry-Country-Year Panel

Based on the 12 industry sectors defined in the Fama and French (1997), we further sort the firms into the industry-country-year (or industry-country) panel and test the within the-industry sector variations in the return synchronicity. Using the industry-country-year panel for analyses allows us to gain further insight into whether the industry structure explains for the R^2 variation. Both the country and the industry sector fixed effects are added to the panel model. The industry-sector-country-year panel regression specification is written below:

$$\psi_{jy} = a_0 + b_1 GGI_{jy} + b_2 ACAP_{jy} + cX_{jy} + \sum_{y=1}^{22} \varphi_y 1_y + \sum_{j=1}^{39} \alpha_j 1_j + \sum_{k=1}^{11} \gamma_k 1_k + \zeta_{yj} \quad (9)$$

where the indicator 1_k is the k^{th} industry dummy variable. As some of the less developed countries do not have all 12 industry categories, the sample size of the panel is less than 40 × 23 × 12. The panel regression (9) is estimated based on a stacked vector of 8127 observations and the results are reported in Columns (5) and (6) of Table 2. The adjusted R^2 remains significant at 0.518 and 0.533, respectively.

For the 8127 observations in the industry sector-country panel, we find that ACAP coefficients are significant and positive. Thus, we cannot reject the market size effects in explaining for the disparity in international R^2. The IVOL coefficients are significant and positive, whereas the GGI coefficients are only marginally significant in the LERW model, but insignificant in the LEQR model. The coefficient sign changes from negative as in the country-panel regressions (Columns 1 and 2) to positive when the industry fixed effects are included. Clearly, GGI is no longer a good proxy for the poor information extraction of the investor in countries with weak property rights protection after controlling for the within-the-sector variations. The R^2 disparity is negatively correlated with stock market size and the two Herfindahl indices, and positively with GDP growth.

In the analysis that uses the industry sector-country panel, we further investigate the difference between the real estate industry (Columns 7 and 8) and non-real estate industry (Columns 9 and 10). More specifically, we consider the sector ID of 6500 and 6700 as components of the real estate industry. We find that the coefficients of ACAP are greater in magnitude for the analysis in real estate industry than in the non-real estate sectors. One potential explanation is that the real estate business is highly capital intensive, and therefore, government transparency is a crucial factor that attracts real estate investment. This partially explains why the real estate industry shows higher stock price synchronicity with the ACAP than the non-real estate sectors.

4.3. Alternative Explanations for the R^2 Disparity

The results in Table 2 show that the ACAP exhibits a significantly higher positive impact on both the LERW and LEQR. More specifically, when the average firm size increases within the country, there is a tendency toward a higher R^2. The above results hold for the country, decile-country, and industry-country panels as in Eqs. (7), (8), and (9). However, the GGI coefficient is only significantly negative in the country panel. The coefficients are not only insignificant but positive (opposite sign) in the decile- and the industry-panels. The results imply that the GGI as the national-level index cannot explain for the firm R^2 variations across size and industry, thus reflecting the inadequacy of the government corruption and transparency argument in explaining for the R^2 at the disaggregated level.

The country-year panel models are the only models with results (Columns 1 and 2 in Table 2) that do not reject the information hypothesis. However, the hypothesis cannot withstand the robustness tests in the decile-country-year and industry sector-country-year panel models. The information-based results disappear in explaining for the R^2 disparity of firms sorted into portfolios by market capitalization and industry sector. The negative explanatory relationships of GGI and R^2 become insignificant when we control for the within-the-decile and the within-the-sector variations in the panel regression models. In the sector-country panel models, the GGI remains significant but the sign becomes positive (Column 5).

The literature offers three alternative explanations for the (positive and insignificant) GGI and R^2 relationships that are related to the information hypothesis. First, security analyst coverage and market liquidity are positively correlated with the stock price synchronicity (Chan and Hameed, 2006; Chan, Hameed, and Kang, 2013). Second, investor sentiment induced price momentum explains for the low R^2 in small market capitalization stocks (Hou, Peng, and Xiong, 2013). The third and the most closely related to the explanation in this study is the story about corporate structure and industry integration. Khanna and Thomas (2009) use a unique data set of Chile to posit that synchronicity is strongly correlated with interlocking directorates. We add to the literature in the next section by showing new evidence on how the industry structure, or more specifically, firms with an interlocked business network, affect stock price synchronicity.

5. New Evidence for R^2 Disparity - Does the Industry Structure Matter?

In a highly contestable market, Bailey and Baumol (1983) argue that firms need to be competitive and efficient in order to survive in a market with low entry barriers (sunk costs). A highly concentrated (monopoly) market is the least contestable, where large firms use preemptive pricing strategies to raise the barrier of entry into a market and exclude smaller competitors from the market. Stock prices of firms exhibit high idiosyncratic variations and are less synchronized in the market. A "strongly contestable" market is one that consists of many highly efficient and competitive firms with tightly knitted and integrated business networks, both vertically and horizontally. The stock prices of these firms are more synchronized, and thus the R^2 of the stock prices of firms are very contingent on the business networks and sales growth of firms in the market. This story on the business network and sale performance of firms is related to an important strand of the literature on the industry structure (Stuckey and White, 1993; D'Aveni and Ilinitch, 1992; Barney, 2002; Fan *et al.*, 2017).

5.1. Industry Structure and R^2 Disparity

We use the industry sales growth co-movement indices[6] as an instrument to capture integration and contestability in the market, and test if the instrument could explain for the R^2 disparity in the sample countries. The "Industry Sales Growth Co-movement Index", or "ISGC" variable, is constructed as follows. For each country, we classify firms by using the 12 industries in Fama and French (1997) based on the 4 digit SIC code provided by DataStream and WorldScope. Within each industry, we calculate the pair-wise correlation for all firms by using their past five-year sales growth data. The sales growth is the log difference between sales in year *t* and sales in year *t-1*. A firm is included in the calculations only if the firm does not have any missing sales records in the previous five years. Following the spirit of the average correlation measure in Pollet and Wilson (2010), we use equal-weight to calculate the average correlation numbers by country and year in the ISGC correlation matrix.

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[6]The industry structure indices are derived by averaging the pair-wise correlations of the sale growth at the sector-level for each country.

Figure 2 plots the ISGC indices by country, year and industry sector. The results show that the sales growth of firms in the countries like the Czech Republic, Denmark and Columbia are highly correlated, whereas the sales growth of firms is less inter-dependent in countries like Singapore, Australia, and New Zealand. The sales growth co-movements are more cyclical before culminating to the peak in 2009 and 2010, then declined consecutively for the next five years to reach the lowest point in 2016. By industry sector, the sales growth is mostly integrated into the oil, gas and coal extraction and products industries, and lease integrated into the healthcare, medical equipment, and drugs sectors.

We add the ISGC variable to the three panel regression models as in Equations (7) to (9) and re-run the estimations.

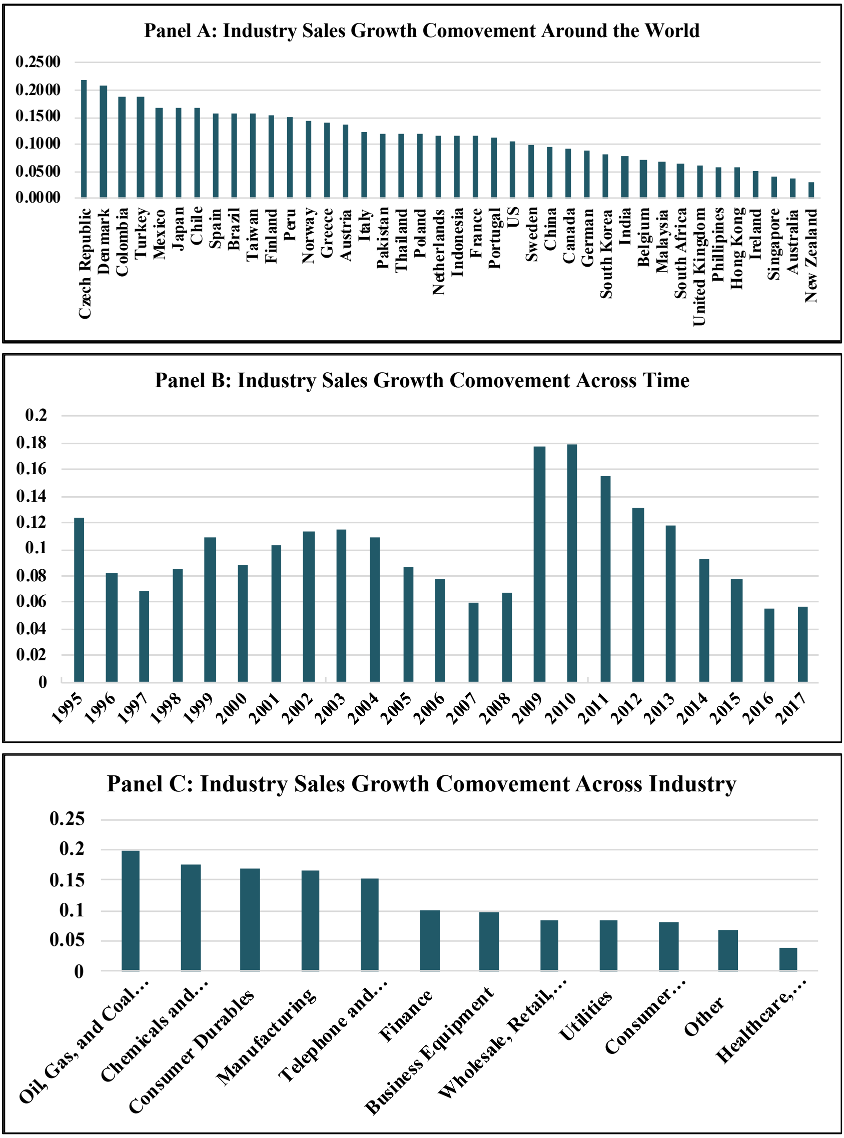
The results are summarized in Table 3. Interestingly, the addition of ISGC does not change the estimations of the GGI and ACAP coefficients in the early panel models in Table 3. We find that the ISGC and ACAP are both highly significant and have a positive impact on the LERW and LEQR in all three panel models. The new ISGC variable, which reflects the integration of the business activities of firms in the industry, offers significant incremental explanations to the R^2 disparity that is not correlated with the market size effects (ACAP). However, the GGI, except in the country-year panel, remains insignificant in explaining for the R^2 disparity; and the GGI coefficient in the industry-country-year LERW panel model (Column 5) is significant but positive (opposite sign). The results weaken the use of the GGI as an instrument of government corruption and transparency to differentiate the R^2 of firms sorted by size and industry. Similarly, we also look at the heterogeneity between real estate and non-real estate industries in Columns (7)-(10). The results do not rule out that the industry structure of a market, where the sales growth of contestable firms is highly integrated, is a robust non-information instrument for the R^2 disparity.

The other control variables have an impact that is broadly similar to that reported for the early panel regressions in Table 3. LGDP, NSTK, and IHHI have significantly negative impact on all of the panels, whereas IVOL, VGDPG, ECI, and FHHI have a significantly positive impact.

5.2. Robustness Tests

We conduct a battery of robustness tests on the ISGC variable to ensure that this new instrument offers an incremental explanation to the R^2 disparity that does not require the stock markets to be informationally efficient. To test the potential endogeneity of the ISGC with firm stock prices, we replace the contemporary ISGC variable with the lagged ISGC variable and only present the results for the decile-country industry sector-country panel regressions in

Figure 2 Industry Sales Growth Co-movement Index



Note: Industry sales growth co-movement index (ISGC) presented across country (Panel A), time (Panel B), and industry (Panel C)

Table 3 Industry Integration and Stock Price Synchronicity

	Country Panel		Decile-Country Panel		Industry-Country Panel					
					Full Sample		Real Estate		Non-Real Estate	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	LERW	LEQR	LERW	LEQR	LERW	LEQR	LERW	LEQR	LERW	LEQR
ISGC	1.234***	1.210***	0.401***	0.522***	0.233***	0.196**	0.253***	0.226**	0.193***	0.153**
	(5.32)	(5.18)	(2.69)	(3.61)	(2.91)	(2.44)	(3.11)	(2.64)	(3.21)	(2.34)
ACAP	0.017***	0.013***	0.003***	0.003***	0.007***	0.006***	0.009***	0.008***	0.005***	0.005***
	(5.94)	(4.03)	(2.90)	(2.98)	(3.56)	(3.05)	(3.36)	(3.21)	(3.36)	(3.32)
GGI	-0.026***	-0.021***	0.005	0.006	0.009*	0.007	-0.028***	-0.022***	-0.026***	-0.020***
	(-4.92)	(-4.02)	(0.95)	(1.21)	(1.76)	(1.38)	(-3.94)	(-3.33)	(-3.55)	(-2.93)
IVOL	-0.233	-0.432	0.704***	0.482***	0.841***	0.565***	0.112**	0.070*	0.125***	0.083*
	(-0.78)	(-1.41)	(4.09)	(2.95)	(5.35)	(3.96)	(2.53)	(1.67)	(2.85)	(1.95)
LGDP	-0.055***	-0.023	-0.024	-0.023	-0.054*	-0.053*	0.023	0.017	0.019	0.013
	(-2.83)	(-1.21)	(-1.03)	(-1.04)	(-1.83)	(-1.78)	(0.94)	(0.73)	(0.77)	(0.55)
NSTK	-0.087***	-0.006	-0.306***	-0.315***	-0.404***	-0.404***	-0.140***	-0.134***	-0.151***	-0.146***
	(-3.58)	(-0.25)	(-7.35)	(-7.37)	(-8.36)	(-8.43)	(-4.59)	(-4.56)	(-4.71)	(-4.76)
VGDPG	0.745	-4.400	-1.634	-1.873	4.362*	4.226*	-2.674	3.821	5.440	11.650
	(0.23)	(-1.42)	(-0.99)	(-1.14)	(1.91)	(1.96)	(-0.12)	(0.18)	(0.24)	(0.54)
ECI	-0.197	-0.090	0.074	0.083*	-0.078	-0.029	0.796***	0.828***	0.833***	0.864***
	(-1.61)	(-0.72)	(1.58)	(1.86)	(-1.44)	(-0.57)	(3.17)	(3.38)	(3.32)	(3.53)
IHHI	-0.173*	-0.155*	-0.342***	-0.336***	-0.326***	-0.348***	0.044	-0.073	-0.128	-0.241
	(-1.89)	(-1.75)	(-4.81)	(-4.64)	(-4.64)	(-4.74)	(0.11)	(-0.17)	(-0.31)	(-0.57)
FHHI	4.139*	4.409*	-2.910***	-2.961***	-3.227***	-3.683***	0.193	0.471	0.277	0.549
	(1.82)	(1.89)	(-3.35)	(-3.40)	(-3.07)	(-3.81)	(0.29)	(0.70)	(0.41)	(0.81)

(Continued…)

(Table 3 Continued)

Intercept	-0.918*** (-3.27)	-1.924*** (-6.36)	-128.743*** (-9.75)	-155.167*** (-12.09)	0.164 (0.16)	-0.202 (-0.17)	-2.869*** (-8.74)	-2.656*** (-8.70)	-2.825*** (-8.58)	-2.612*** (-8.48)
N	920	920	9200	9200	8127	8127	8127	8127	8127	8127
R-sq	0.273	0.165	0.687	0.706	0.523	0.538	0.523	0.538	0.523	0.538
Adj. R-sq	0.247	0.134	0.684	0.703	0.518	0.533	0.518	0.533	0.518	0.533
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Fixed Effect	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effect	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Decile Fixed Effect	No	No	Yes	Yes	No	No	No	No	No	No
Cluster SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table reports the panel regressions of stock price synchronicity on industrial sales growth co-movement index (ISGC). Different panels such as country-, decile-country, and sector-country panels are used. The dependent variable is a logistic transformation of stock price synchronicity. The key explanatory variable is the ISGC. We include information variables such as the good government index (GGI), the local volatility index (IVOL), and a natural log of market capitalization (ACAP). Control variables include natural log of GDP per capita (LGDP), natural log of number of stock (NSTK), natural log of geographical size (LGEO), variance of GDP growth (VGDPG), industry Herfindahl index (IHHI), firm Herfindahl index (FHHI), and earnings co-movement ratio (ECI). Numbers in parentheses are the t-statistics. ***, **, and * denote significance at 1%, 5%, and 10% levels respectively. There are 40 countries, 10 deciles, 12 industries, and 23 years (1995 to 2017).

Table 4 to save space. The results show that the lagged ISGC coefficients are highly significant and positive in the model, and we find no evidence to suggest that high stock price firms generate higher sales growth, and vice versa. Also, in Columns (5)-(8), we still find that the ISGC coefficients are larger in the real estate industry relative to the non-real estate industry. As we hypothesize, the sales growth co-movements are associated with the presence of close-knitted business networks in the market.

As shown in Figure 3, the sales growth co-movements are the largest in 2007 when the GFC occurred. In a highly contestable market, the negative market shocks in 2007 coupled with the low entry (or exit) barriers could have pushed inefficient firms out of the market. As a result, firms that survived the shocks could be those that are closely inter-dependent in the business networks. However, we argue that the "meltdown" of the market during the GFC periods in 2007 and 2008 has a stronger impact in markets with more closely knitted business and sales networks, and the shocks amplify the correlations between ISGC and R^2 in the market. Table 5 only shows the results of the decile-country-year panel models. In Columns (1) and (2), which represent the modified Equation (9) without the two GFC periods (2007 and 2008), we find that the ISGC variables are still significant, but the magnitude of the coefficients is smaller relative to the results in Columns (3) and (4) in Table 3. We estimate the decile-country-year panel models with the full samples, but add a "shock" dummy, which has a value of 1 to indicate the two GFC years (i.e., 2007 and 2008), and an interactive term, [i.e. "ISGC×shock"]. The results in Columns (3) and (4) show that the ISGC variable is still significant and positive, and the ISGC effects are amplified when negative shocks occur during the GFC in 2007 and 2008. In Columns (5) and (6), we replace the "shock" dummy with two post-GFC years (i.e., 2009 and 2010), and find that the interactive term is not significant, but the ISGC coefficients are still significant and positive. The results imply that the negative shocks do not persist into the post-GFC periods. More importantly, we show that the sales growth effects that are dependent on the industry structure are exogenous and robust in explaining for the R^2, and the effects are not muted; instead, they were amplified during the GFC periods.

In Table 6, the robustness tests aim to further disentangle the industry structure effects from other effects associated with poor governance (GGI), market size (ACAP) and market concentration (IHHI). Using the median indicator for each of the three factors, we split the sample into two groups, and rerun the decile-country-year panel regressions for the "high" group and the "low" groups by the respective indicator. The results are summarized in Table 6. We find that the ISGC effects are still highly significant and positive, although the magnitude of the coefficients is higher in the high GGI, small ACAP, and low IHHI groups. The results imply that the business network effects exist, although with different degrees of integration.

Table 4 Using Lagged ISGC in Surmounting Endogeneity Concern

	Country Panel		**Industry-Country Panel**					
			Full Sample		Real Estate		Non-Real Estate	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	LERW	LEQR	LERW	LERW	LEQR	LEQR	LERW	LEQR
Lag ISGC	1.272***	1.141***	0.227***	0.227***	0.245**	0.213**	0.187***	0.163**
	(4.96)	(4.27)	(2.78)	(2.78)	(2.40)	(2.41)	(2.99)	(2.31)
ACAP	0.017***	0.013***	0.006***	0.006***	0.006***	0.006***	0.006***	0.006***
	(5.78)	(4.05)	(3.38)	(3.38)	(2.99)	(2.99)	(3.38)	(2.99)
GGI	-0.026***	-0.021***	0.003	0.003	-0.028***	-0.022***	-0.026***	-0.020***
	(-4.82)	(-3.91)	(0.63)	(0.63)	(-3.94)	(-3.33)	(-3.55)	(-2.93)
IVOL	-0.130	-0.321	0.853***	0.853***	0.112**	0.070*	0.125***	0.083*
	(-0.42)	(-1.01)	(4.74)	(4.74)	(2.53)	(1.67)	(2.85)	(1.95)
LGDP	-0.058***	-0.025	-0.065**	-0.065**	0.023	0.017	0.019	0.013
	(-2.90)	(-1.26)	(-2.17)	(-2.17)	(0.94)	(0.73)	(0.77)	(0.55)
NSTOCK	-0.078***	0.007	-0.410***	-0.410***	-0.140***	-0.134***	-0.151***	-0.146***
	(-3.18)	(0.29)	(-8.69)	(-8.69)	(-4.59)	(-4.56)	(-4.71)	(-4.76)
VGDPG	1.671	-3.951	5.487**	5.487**	-2.674	3.821	5.440	11.650
	(0.52)	(-1.28)	(2.09)	(2.09)	(-0.12)	(0.18)	(0.24)	(0.54)
ECI	-0.125	-0.002	-0.170***	-0.170***	0.796***	0.828***	0.833***	0.864***
	(-1.00)	(-0.01)	(-2.95)	(-2.95)	(3.17)	(3.38)	(3.32)	(3.53)
IHHI	-0.215**	-0.177*	-0.364***	-0.364***	0.044	-0.073	-0.128	-0.241
	(-2.30)	(-1.95)	(-4.89)	(-4.89)	(0.11)	(-0.17)	(-0.31)	(-0.57)

(Continued…)

(Table 4 Continued)

FHHI	5.184*	5.305*	-4.468***	-4.468***	0.193	0.471	0.277	0.549
	(1.86)	(1.90)	(-2.79)	(-2.79)	(0.29)	(0.70)	(0.41)	(0.81)
Intercept	-1.001***	-2.048***	0.011	0.011	-2.869***	-2.656***	-2.825***	-2.612***
	(-3.45)	(-6.51)	(0.01)	(0.01)	(-8.74)	(-8.70)	(-8.58)	(-8.48)
N	880	880	6972	6972	6972	6972	6972	6972
Adj. R-sq	0.289	0.170	0.521	0.521	0.538	0.538	0.521	0.538
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country Fixed Effect	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effect	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Decile Fixed Effect	No	No	No	No	No	No	No	No
Cluster SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table reports the panel regressions of stock price synchronicity on lagged industrial sales growth co-movement index (ISGC). Country and sector-country panels are used. The dependent variable is a logistic transformation of stock price synchronicity. The key explanatory variable, Lag LSGC is one year lagged industrial sales growth comovement index. We include information variables such as the good government index (GGI), the local volatility index (IVOL), and a natural log of market capitalization (ACAP). Control variables include the natural log of GDP per capita (LGDP), natural log of number of stock (NSTK), natural log of geographical size (LGEO), variance of GDP growth (VGDPG), industry Herfindahl index (IHHI), firm Herfindahl index (FHHI), and earnings co-movement ratio (ECI). Numbers in parentheses are the t-statistics. ***, **, and * denote significance at 1%, 5%, and 10% levels respectively. There are 40 countries, 12 industries, and 23 years (1995 to 2017).

Table 5 Industry Integration and Stock Price Synchronicity Conditional on GFC

	Removal of GFC period Decile-Country Panel		Shock = GFC Decile-Country Panel		Shock = Post GFC Decile-Country Panel	
	(1) LERW	(2) LEQR	(3) LERW	(4) LEQR	(5) LERW	(6) LEQR
ISGC*Shock			2.122***	1.813***	-0.263	-0.222
			(5.15)	(4.40)	(-0.93)	(-0.84)
Shock			0.344***	0.337***	0.560***	0.524***
			(3.78)	(3.77)	(5.18)	(4.97)
ISGC	0.353**	0.487***	0.341**	0.471***	0.438***	0.554***
	(2.32)	(3.29)	(2.25)	(3.21)	(2.80)	(3.77)
ACAP	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***
	(3.02)	(3.08)	(2.92)	(3.00)	(2.90)	(2.98)
GGI	0.004	0.005	0.005	0.006	0.005	0.006
	(0.74)	(0.91)	(0.86)	(1.13)	(0.95)	(1.21)
IVOL	0.772***	0.535***	0.728***	0.502***	0.706***	0.483***
	(4.01)	(2.97)	(4.19)	(3.06)	(4.10)	(2.97)
LGDP	-0.030	-0.028	-0.023	-0.023	-0.024	-0.024
	(-1.30)	(-1.24)	(-1.02)	(-1.04)	(-1.07)	(-1.07)
NSTOCK	-0.307***	-0.317***	-0.303***	-0.313***	-0.307***	-0.316***
	(-7.13)	(-7.14)	(-7.28)	(-7.31)	(-7.34)	(-7.37)
VGDPG	-2.224	-2.515	-1.163	-1.471	-1.655	-1.891
	(-1.32)	(-1.53)	(-0.72)	(-0.90)	(-1.00)	(-1.15)
ECI	0.023	0.032	0.079*	0.087**	0.076	0.084*
	(0.48)	(0.67)	(1.71)	(1.97)	(1.62)	(1.89)

(Continued…)

(Table 5 Continued)

IHHI	-0.383***	-0.376***	-0.358***	-0.350***	-0.343***	-0.336***
	(-5.15)	(-4.95)	(-5.04)	(-4.83)	(-4.82)	(-4.65)
FHHI	-3.390***	-3.401***	-2.907***	-2.959***	-2.936***	-2.983***
	(-4.09)	(-3.99)	(-3.38)	(-3.42)	(-3.35)	(-3.40)
Intercept	-124.716***	-150.671***	-128.019***	-154.557***	-129.268***	-155.621***
	(-9.45)	(-11.71)	(-9.69)	(-12.04)	(-9.75)	(-12.09)
N	9200	9200	9200	9200	9200	9200
Adj. R-sq	0.684	0.703	0.686	0.706	0.685	0.705
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Country Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effect	No	No	No	No	No	No
Decile Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Cluster SE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table reports the panel regressions of stock price synchronicity on industrial sales growth co-movement index (ISGC) conditional on the 2007-2008 GFC for the decile-country panel. The dependent variable is a logistic transformation of stock price synchronicity. The key explanatory variable is the ISGC. We include information variables such as the good government index (GGI), the local volatility index (IVOL), and a natural log of market capitalization (ACAP). Control variables include natural log of GDP per capita (LGDP), natural log of number of stock (NSTK), natural log of geographical size (LGEO), variance of GDP growth (VGDPG), industry Herfindahl index (IHHI), firm Herfindahl index (FHHI), and earnings co-movement ratio (ECI). Numbers in parentheses are the t-statistics. ***, **, and * denote significance at 1%, 5%, and 10% levels respectively.

Table 6 Industry Integration and Stock Price Synchronicity Conditional on Good Government Index, Market Cap, and Industry Competitiveness

	High GGI	Low GGI	High ACAP	Low ACAP	High IHHI	Low IHHI
	(1)	(2)	(3)	(4)	(5)	(6)
	LERW	LERW	LERW	LERW	LERW	LERW
ISGC	1.716***	1.045***	1.058***	1.377***	0.781**	2.201***
	(5.60)	(3.55)	(3.37)	(4.21)	(2.54)	(6.04)
ACAP	0.002	0.017***	0.026***	0.011***	0.013***	0.018***
	(0.39)	(4.55)	(5.05)	(2.90)	(3.63)	(3.00)
GGI	-0.064***	-0.013	-0.033***	-0.021***	-0.032***	-0.021**
	(-3.96)	(-0.98)	(-4.45)	(-2.71)	(-5.00)	(-2.33)
IVOL	-0.143	-0.662*	-0.152	-0.403	1.158***	-0.856***
	(-0.26)	(-1.81)	(-0.28)	(-1.17)	(3.32)	(-2.72)
LGDP	-0.051**	0.016	-0.035	-0.045	-0.004	-0.106***
	(-2.00)	(0.51)	(-1.27)	(-1.37)	(-0.17)	(-3.10)
NSTOCK	-0.193***	-0.012	-0.067**	-0.114***	-0.010	-0.078**
	(-5.57)	(-0.37)	(-2.09)	(-3.01)	(-0.26)	(-2.32)
VGDPG	0.586	-0.409	1.915	-3.559	-0.257	-3.156
	(0.09)	(-0.11)	(0.47)	(-0.67)	(-0.04)	(-0.86)
ECI	-0.234	-0.141	-0.309*	0.003	0.300**	-0.590***
	(-1.51)	(-0.84)	(-1.84)	(0.02)	(2.03)	(-2.91)
IHHI	-0.068	-0.220	-0.245*	-0.030	-0.025	-0.199
	(-0.58)	(-1.59)	(-1.83)	(-0.23)	(-0.22)	(-1.41)
FHHI	3.571	2.387	3.224	4.321	2.549	7.371*
	(1.42)	(1.18)	(1.11)	(1.30)	(1.11)	(1.77)
Intercept	0.365	-3.104***	-1.212***	-0.906**	-1.727***	-0.490
	(0.71)	(-5.53)	(-2.87)	(-2.09)	(-4.07)	(-1.35)

(Continued…)

(Table 6 Continued)

N	460	460	460	460	460	460
adj. R-sq	0.461	0.143	0.266	0.310	0.333	0.301
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Cluster SE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table reports a sub-sample analysis by examining the association between ISGC and stock price synchronicity in samples with (i) high/low good government index (GGI), (ii) high/low market capitalization (ACAP), and (iii) high/low industry Herfindahl index (IHHI). We partition the sample by using the cross-sectional median for the country panel. The key explanatory variable is the ISGC. We include information variables such as the good government index (GGI), the local volatility index (IVOL), and a natural log of market capitalization (ACAP). Control variables include natural log of GDP per capita (LGDP), natural log of number of stock (NSTK), natural log of geographical size (LGEO), variance of GDP growth (VGDPG), industry Herfindahl index (IHHI), firm Herfindahl index (FHHI), and earnings co-movement ratio (ECI). Numbers in parentheses are the t-statistics. ***, **, and * denote significance at 1%, 5%, and 10% levels respectively.

The results again affirm the hypothesis that the sales correlations could offer incremental explanations for the R^2 disparity in the market, and the effects are not conditional on having informational efficiency as the pre-requisite in the market.

5.3. Finland Case

Next, we conduct a simple experiment with the industry sector-country-year of Finland as the treatment, where Finland exhibits a dominant influence in the telecommunication sector via Nokia, which accounted for 4% of the Finnish GDP, 21% of its total export, and 70% of the market capitalization of the Helsinki Stock Exchange, prior to the sales of the mobile business to Microsoft in 2013. The dominance of Nokia in the Finnish industry sector created a high entry barrier for other firms. As a result, this industry sector is weakly contestable and stock price synchronicity was low in the pre-2013 periods.

We use the interactive variable of “Finland” and the post-2013 dummy to represent the treatment effect in the industry-country-year panel regression (Equation 9) with the full samples (Columns (1) and (2) and the sub-samples excluding the GFC periods (Columns (3) and (4) (Table 7). The results show that the GGI in the models without GFC periods is significant and negative when the industry structure is not explicitly controlled for in the models, thus indicating that countries with poor governance discourage extraction of firm information by analysts which causes the R^2 to increase. However, we also show that the industry structure story as represented by “Finland×Post-2013” shows that the breakout of “Nokia” via mobile sales results in a more correlated industry structure in Finland, where stock prices of Finnish firms have become more synchronized after 2013, relative to other countries. More tests could be conducted in the future to further examine how Nokia’s business is interconnected with other Finnish firms on the Helsinki Stock Exchange.

The robustness test results do not nullify the hypothesis that the industry structure could offer alternative and incremental explanations for the R^2 disparity after controlling for the year, country, decile, and industry sector fixed effects. The high correlations of the sales growth of interlocking firms, which is a characteristic of a highly contestable market, significantly increase variations in the industry-level R^2. The results are orthogonal to the country-level GGI coefficients, which offer no incremental explanations for the R^2 variations in the decile and industry sector panels. The results are robust and can withstand a battery of robustness tests.

Table 7 Industry Integration and Stock Price, Case of Finland

	Full Sample Industry-Country Panel		**Without the GFC periods** Industry-Country Panel	
	(1)	(2)	(3)	(4)
	LERW	LERW	LEQR	LEQR
Finland ×Post 2013	0.581***	0.622***	0.330**	0.368**
	(3.56)	(4.16)	(2.07)	(2.09)
CAP	0.014***	0.008***	0.015***	0.009***
	(14.77)	(5.81)	(16.45)	(6.18)
GGI	-0.034***	-0.033***	-0.033***	-0.033***
	(-11.97)	(-5.66)	(-12.20)	(-5.98)
IVOL	-0.370***	-0.315	0.010	0.068
	(-4.50)	(-1.13)	(0.13)	(0.22)
LGDP	-0.024**	-0.015	-0.053***	-0.042**
	(-2.35)	(-0.74)	(-5.24)	(-2.21)
NSTOCK	0.024**	0.009	-0.083***	-0.093***
	(2.25)	(0.33)	(-8.03)	(-3.43)
VGDPG	-3.571**	-4.106	1.901	1.365
	(-2.11)	(-1.26)	(1.15)	(0.43)
ECI	-0.303***	-0.316**	-0.372***	-0.390***
	(-5.10)	(-2.24)	(-6.41)	(-2.99)
IHHI	-0.029	0.000	0.034	0.058
	(-0.59)	(0.00)	(0.71)	(0.57)
FHHI	12.257***	12.458***	10.908***	11.097***
	(11.61)	(5.27)	(10.57)	(4.87)
Intercept	-1.975***	-1.971***	-0.918***	-0.940***
	(-14.42)	(-5.89)	(-6.85)	(-3.04)
N	8127	8127	8127	8127
Adj. R-sq	0.077	0.123	0.130	0.174
Industry Fixed Effect	No	Yes	No	Yes
Cluster SE	Yes	Yes	Yes	Yes

Notes: This table reports the panel regressions of stock price synchronicity by considering Finland as a special case in the results of industry integration for the sector-country panel. We employ a post 2013 dummy as an exogenous shock where Nokia is acquired by Microsoft. The dependent variable is a logistic transformation of stock price synchronicity. The key explanatory variable is the ISGC. We include information variables such as the good government index (GGI), the local volatility index (IVOL), and a natural log of market capitalization (ACAP). Control variables include natural log of GDP per capita (LGDP), natural log of number of stock (NSTK), natural log of geographical size (LGEO), variance of GDP growth (VGDPG), industry Herfindahl index (IHHI), firm Herfindahl index (FHHI), and earnings co-movement ratio (ECI). Numbers in parentheses are the t-statistics. ***, **, and * denote significance at 1%, 5%, and 10% levels respectively.

5.4. Other Possible Explanations

We employ the methodology in Diebold and Yilmaz (2009, 2012, 2014) to calculate the return volatility spillovers across firms in industry *i*, country *j*, and year *t*. We use the intra-industry return spillovers as an alternative instrument for the inter-connectedness of firms in the industry. If firms within an industry are structurally correlated, they are more likely to be subject to the same risk. The index captures the contributions to the forecast error variance of firm m that comes from innovations or shocks of firm n. We derive two industry spillover indices - **Average Industry Return Spillover** (AIS) and **Median Industry Return Spillover** (MIS), to represent the interdependence of financial products in different markets. More specifically, the spillover index measures the extent to which the return volatility of firm m is caused by the return volatility of firm n. We test the main hypothesis that stock price synchronicity is positively associated with the industry spillover index.

When we use the stock return data in calculating the volatility spillover indices, we need to ensure the orthogonality of the intra-industry spillover indices from the R^2 measures, even though both are determined by using different methodologies. We use two unique country-level instruments (IVs) – (i) patent application and (ii) electricity production (White, Joskow, and Hausman, 1996; Hou and Robinson, 2006). The IVs are correlated with the industry structure, but orthogonal to stock price synchronicity in the panel regressions. Electricity production and patent application[7] that capture the productivity, innovation, and sophistication of firms in industries in the sample countries should be valid IVs that are correlated with the industry structure, but not correlated with informativeness in the stock markets. The IVs are collected on TheGlobalEconomy.com,[8] which is a dataset that covers economic indicators for more than 200 countries.

Table 8 reports the results of the two-stage least square (2SLS) country-year panel regressions[9], where Column (1) of the left panel and Column (4) of the right panel report the results of the Stage-1 regressions that regress the two

[7]The two instrumental variables are defined as follows: (i) patent applications are worldwide patent applications filed through the Patent Cooperation Treaty Procedure or with a national patent office for exclusive rights for an invention--a product or process that provides a new way of doing something or offers a new technical solution to a problem. A patent provides protection for the invention to the owner of the patent for a limited period, generally 20 years, and (ii) electricity production: total electricity net generation (excludes the energy consumed by the generating units). For more details, please refer to http://www.theglobaleconomy.com/.

[8]TheGlobalEconomy.com dataset presents over 300 carefully selected indicators from multiple official sources such as the World Bank, International Monetary Fund, United Nations, and World Economic Forum. Source: http://www.theglobaleconomy.com/.

[9]Due to space constraint, we only report the results for the LERW panel regression results in this paper. The results are, however, for the LEQR panel models, which are not reported, and available upon request.

Table 8 Instrumental Industry Spillover Effect on Stock Price Synchronicity

	(1)	(2)	(3)	(4)	(5)	(6)
	First Stage	Second Stage		First Stage	Second Stage	
	AVS	LEQW	LERW	MVS	LEQW	LERW
Fitted Industry Spillover		0.417***	0.467***		0.333***	0.373***
		(6.66)	(7.20)		(6.48)	(7.02)
Patent	0.186***			0.154**		
	(3.53)			(2.51)		
Electricity production	0.247***			0.415***		
	(2.93)			(4.22)		
GGI	-0.050***	0.001	-0.002	-0.027	-0.010	-0.014*
	(-3.52)	(0.14)	(-0.27)	(-1.62)	(-1.50)	(-1.95)
LGDP	-0.045	-0.004	0.000	-0.087	0.013	0.019
	(-0.83)	(-0.16)	(0.02)	(-1.46)	(0.56)	(0.76)
LNSTOCK	0.966***	-0.537***	-0.600***	0.919***	-0.445***	-0.496***
	(14.26)	(-7.00)	(-7.49)	(11.10)	(-6.76)	(-7.23)
VGDPG	-62.246	14.699	8.959	16.801	-13.669	-22.802
	(-1.23)	(0.65)	(0.38)	(0.26)	(-0.59)	(-0.96)
ECI	-0.533	0.829***	0.793***	-0.214	0.704***	0.653***
	(-1.14)	(3.58)	(3.37)	(-0.41)	(3.04)	(2.76)
IHHI	3.507***	-1.151**	-1.172**	1.888*	-0.456	-0.394
	(3.85)	(-2.45)	(-2.55)	(1.71)	(-1.04)	(-0.91)
FHHI	1.883	-0.548	-0.983	3.021**	-0.665	-1.115
	(1.58)	(-0.79)	(-1.42)	(2.19)	(-0.94)	(-1.58)
ACAP	-0.000***	0.000***	0.000***	-0.000**	0.000***	0.000**
	(-3.56)	(4.37)	(3.93)	(-2.57)	(2.86)	(2.21)
IVOL	0.104	0.046	0.083*	0.265**	0.006	0.039
	(1.05)	(1.10)	(1.88)	(2.27)	(0.14)	(0.83)
Skewness	0.051	0.047	0.058	0.183	0.008	0.014
	(0.32)	(0.83)	(1.00)	(1.13)	(0.13)	(0.24)
Intercept	2.544**	-2.173***	-2.322***	2.657*	-2.382***	-2.556***
	(2.02)	(-6.79)	(-6.87)	(1.84)	(-7.43)	(-7.53)
Year FE	YES	YES	YES	YES	YES	YES
Cluster SE	YES	YES	YES	YES	YES	YES
N	920	920	920	920	920	920
adj. R-sq	0.567	0.212	0.215	0.508	0.209	0.212

Notes: This table presents the results of two-stage regressions at the country level, with Columns (1) and (4) corresponding to the results of the first-stage regressions and Columns (2), (3), (5), and (6) corresponding to the second-stage results. The two instrumental variables (IVs) used are Number of Patent Applications and Electricity Production. The headers in the third row denote the dependent variable used in the specifications. Year fixed effect is included in all regressions. Heteroscedasticity-consistent standard errors clustered at the country-year level are shown in parentheses under the coefficients estimated. We use ***, **, and * to denote significance at the 1%, 5%, and 10% levels, respectively.

instrumented *MIS* and *AIS* variables, respectively, against the two IVs and other control variables. The coefficients on "Patent Application" and "Electricity Production" are positive and highly significant, thus suggesting that the instruments are strongly correlated with the intra-industry spillovers.[10] Columns (2) and (3) of the left panel and Columns (5) and (6) of the right panel show that the coefficients on the two instrumented intra-industry spillovers variables (*MIS* and *AIS*) are positive and significantly predicting the stock price synchronicity in the Stage-2 regressions. We cannot reject the relationship between stock price synchronicity and intra-industry spillovers. The stock prices of firms move more synchronously in a market with a highly inter-dependent and integrated industry structure.

6. Conclusions

The information hypothesis predicts that stock prices move more synchronously in countries with poor governance. MYY (2000) explain that in countries with poor protection of private property rights and rampant inter-corporation income shifting practices, investors trade on market-wide information, and will not expend effort in extracting firm-specific information. As a result, the price synchronicity is relatively high in the market. The information story proposed by MYY, which attributes differential R^2 to corruption and non-transparencies in the markets, lays the grounds for stock price synchronicity. However, the widely popular information hypothesis has been challenged in recent years by several studies, which find evidence that rejects the association of stock price synchronicity with stock price informativeness (Skaife, Gassen, and LaFond, 2006; Pantzalis and Xu, 2008; Dasgupta, Gan, and Gao, 2010; Hou, Peng, and Xiong, 2013).

This study aims to add to the understanding of price synchronicity by reexamining the GGI puzzle in explaining for the disparity in stock return R^2. We replicate the tests in MYY (2000) by using the same sample of 40 countries but extend the sample periods from 1995 to 2017. Using an equal-weighted R^2 as an alternative measure to the error-weighted R^2 in MYY (2000), we find that the GGI is a consistent and robust predictor for the R^2 disparity, but only in the periods before 2009. The GGI effects become less effective in the post-GFC periods.

When we sort the sample firms into size deciles and run the panel regressions on the R^2 controlling for country-, size-decile-, industry sector- and time-fixed effects, our results show that the GGI is insignificant in explaining for the R^2 variations within the country and across different countries. We show instead that the stock market size (ACAP) significantly impacts price synchronicity in

[10] We also use two other IVs, which are CO_2 emissions and electricity consumption and the results (not reported here) again survive the validity tests.

a differential way across countries. Clearly, small (capitalization) firms have smaller contributions to the weighted R^2 of a country compared with large firms in the same country. We find it challenging to disentangle the size effects from the GGI effects because the results do not necessarily require a market to be informationally efficient or less so.

We explore the industry structure as an alternative explanation to the GGI-price synchronicity relationships. In a highly contestable market, efficient firms survive the competition of new entries by growing business networks, whereas in a weakly contestable market, few large firms use preemptive pricing strategies to raise entry barrier and eliminate competition. In a closely-knitted business structure, the sales growth of firms is more inter-connected and stock prices also move more synchronously. Thus, the R^2 disparity could be explained by the differences in the industry structure, which has nothing to do with the information efficiency in the market.

We propose to use industry sales growth co-movements ("ISGCs") to directly measure the inter-connectedness of the industry structure within a country. Using the panel regression models, including studying disaggregated R^2, we find that the ISGC measure is highly significant and positive in predicting the stock return synchronicity (R^2) after controlling for observable and unobservable variations at the country, decile, and industry sector levels and temporal variations. We find that the explanatory effects of the information-based variables are weakened, and in some instances, disappear. Our empirical results are robust and able to rigorously withstand various tests.

The industry structure story offers a non-information-based explanation backed by theories of industrial organization and evidenced strongly by empirical data. This study paves the way for more future research on structural differences across different countries as the industry structures have implications on the risk diversification strategies of firms and characterize the market risk of stocks in subtle ways, thus leading to a differing R^2.

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Appendices

Appendix 1 List of Key Variables and their Abbreviations

Variable	Abbreviation
Error Weighted Stock Price Synchronicity (R^2)	ERW
Log-Transform of ERW	LERW
Equal Weighted Stock Price Synchronicity (R^2)	EQW
Log-Transform of EQW	LEQW
Log-per Capita GDP	GDP
Log Number of Listed Stocks in the Country	NSTK
Log-Geography Size	GEO
Variance of GDP Growth	VGDP
Industry-level Herfindahl Index	IHHI
Country-level Herfindahl Index	FHHI
Earning Co-movement Index	ECI
Good Government Index	GGI
Log-Average Market Capitalization of Stocks in Country	ACAP
Local Stock Index Volatility	IVOL

Notes: The table summarizes the list of variables used in the empirical tests. They are represented by the abbreviations as shown in the right column.

Appendix 2 Calculation of Herfindahl indices and ROA

We use yearly total sales of all listed firms on each country's exchange to calculate the proxies for economic specialization or diversification. Let S_{ij} denote the annual sales of a firm *i* in country *j* and S_{kj} denote the aggregate sales of firms in industry *k* in country *j*. We calculate the industry-based Herfindahl index as $IHHI_j = \sum_{k=1}^{K} \left(\frac{S_{kj}}{\sum_{i=1}^{N} S_{ij}} \right)^2$ and firm-based Herfindahl index as $FHHI_j = \sum_{i=1}^{N} \left(\frac{S_{ij}}{\sum_{i=1}^{N} S_{ij}} \right)^2$ respectively, where *K* denotes the total number of industry sectors in country *j*, and *N* denotes the total number of firms in country *j*. A large industry-Herfindahl index indicates a lack of industry diversity, while a large firm-based Herfindahl index indicates dominance of a small number of firms.

We use the approach in MYY (2000) to calculate an earnings co-movement index for each firm i in each country j and year y by first regressing the returns of firm i on assets or ROA_{ijy} on the market value-weighted average of the returns on assets of all firms in country j of year y , $ROA_{m,jy}$.

$$ROA_{ijy} = a_{ij} + b_{ij} ROA_{m,jy} + \epsilon_{ijy} \qquad \text{(A2.1.)}$$

The R^2 obtained from the regressions of Equation (5) of all firms i in the same country j for year y, denoted as $R^2_{ijy}\ (ROA)$, is then averaged in an analogous way to the error-weighting scheme for returns regressions. The weight for each ROA R^2 is the fraction of TSS to the total TSS for all firm ROA regressions in country j. Thus, the country j earnings co-movement index (ECI) is calculated as:

$$ECI_{jy} = \frac{\sum_i R^2_{ijy}(ROA) \times TSS_{ijy}(ROA)}{\sum_i TSS_{ijy}(ROA)} = \frac{\sum_i ESS_{ijy}(ROA)}{\sum_i TSS_{ijy}(ROA)} \qquad \text{(A2.2.)}$$

The $ECI_{j,y}$ is estimated by using firm ROA_{ijy} data from the previous 5 years. All the data used in calculating the structural variables are collected from Datastream. There are minor differences in the way we calculate the ECI here. MYY (2000) eliminate some countries in their ECI calculations because "*…earnings data are available for very few firms…*", whereas we prefer to use all the firms that are available (Poland has the smallest number of stocks (60)), and we have a complete set of ECI variables in all 40 countries for all of the years from 1995 to 2017. We use ex-ante data, for example, 1991-1994 for calculating the ECI in 1995, rather than 1993-1997 for calculating the ECI in 1995.

Appendix 3 Replication of Results in MYY (2000)

We use the log-transformed ERW and EQW as alternative dependent variables in the regressions and analyze the substantive impact of the GGI on the two response variables. Other explanatory variables are included to control for observable cross-country variations in the stock price synchronicity.
The generic empirical framework is set up as follows:

$$\Upsilon_{jy} = a_0 + b_1 GDP_{jy} + b_2 NSTK_{jy} + cX_{jy} + \delta GGI_{jy} + \zeta_{jy} \qquad \text{(A3.1.)}$$

where GDP_{jy} is the natural log-per capita GDP; $NSTK_{jy}$ is the log-number of stocks that represents the size of an economic activity; GGI_{jy} is the good government index that measures the level of property rights protection in a country; and X_{jy} is a vector of the structural variables that include the capitalization, $ACAP_{jy}$, stock market volatility, $IVOL_{jy}$, macroeconomic risk factor, $VGDP_{jy}$, industry- and firm-levels Herfindahl indexes, $IHHI_{jy}$ and $FHHI_{jy}$, and the earnings co-movement index, ECI_{jy}, such that the subscript indicates country j in year y. The regression coefficients are estimated by using OLS and denoted by a_0, b_1, b_2, δ, and a vector c. ζ_{jy} is an *i.i.d.* error term for country j in year y.

The regressions as in Equation (A3.1.) essentially replicate that of MYY, but with an additional control variable of the ACAP. We report the year-by-year cross-sectional regression results from 1995 to 2017 in Table A1.[11] The empirical results show that except for 2008, 2010, 2011, and 2012, all the regressions have adjusted R^2 that are reasonably high thus evidencing good fit.

[11]We also perform regressions by using the LEQW and different sets of explanatory variables, but the results are similar, so we do not report them here to save space. These results are readily available from the authors.

Table A1 Annual Cross-Sectional Regressions of Country LERW for 1995 - 2017

Year	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Intercept	-1.66	1.32	-3.14	-2.82	-1.47	1.17	1.90	1.92	0.25	0.03	-0.30	-1.44
	(0.36)	(0.19)	(0.00)	(0.03)	(0.04)	(0.04)	(0.00)	(0.00)	(0.77)	(0.98)	(0.81)	(0.30)
GDP	-0.01	-0.06	0.09	-0.05	-0.09	-0.11	-0.09	0.00	0.07	0.04	0.00	0.02
	(0.80)	(0.12)	(0.01)	(0.35)	(0.03)	(0.00)	(0.09)	(0.91)	(0.14)	(0.04)	(0.97)	(0.61)
NSTK	-0.23	-0.46	-0.18	-0.16	-0.08	0.01	-0.02	0.00	-0.05	-0.07	-0.08	-0.07
	(0.12)	(0.00)	(0.00)	(0.01)	(0.18)	(0.72)	(0.75)	(0.96)	(0.46)	(0.39)	(0.31)	(0.53)
VGDP	-3.46	-45.27	-49.74	-14.38	12.87	10.01	-1.57	-0.07	1.03	28.75	26.72	14.25
	(0.89)	(0.00)	(0.00)	(0.00)	(0.01)	(0.04)	(0.46)	(0.99)	(0.77)	(0.00)	(0.00)	(0.00)
IHHI	0.56	0.24	-0.16	-0.85	-0.60	-0.08	0.13	-0.21	-0.35	-0.09	-0.01	0.00
	(0.06)	(0.13)	(0.57)	(0.01)	(0.23)	(0.66)	(0.59)	(0.31)	(0.05)	(0.77)	(0.97)	(0.97)
FHHI	5.16	-2.64	26.12	12.93	16.52	12.92	0.19	28.76	27.01	21.08	17.67	28.72
	(0.01)	(0.03)	(0.00)	(0.00)	(0.00)	(0.06)	(0.98)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
ECI	-1.01	0.29	-0.05	0.29	0.52	0.03	0.29	0.03	0.10	-1.08	-0.40	-0.12
	(0.00)	(0.04)	(0.76)	(0.23)	(0.03)	(0.94)	(0.38)	(0.93)	(0.71)	(0.00)	(0.14)	(0.61)
GGI	-0.03	-0.04	-0.06	-0.06	-0.12	-0.04	-0.06	-0.09	-0.09	-0.08	-0.07	-0.03
	(0.02)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
ACAP	0.10	-0.01	0.12	0.14	0.12	-0.10	-0.11	-0.14	-0.06	-0.08	-0.08	0.02
	(0.21)	(0.80)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.07)	(0.03)	(0.02)	(0.65)
IVOL	0.10	0.62	0.06	-0.32	-0.37	0.11	0.67	0.54	0.50	0.23	0.37	0.69
	(0.42)	(0.00)	(0.70)	(0.02)	(0.00)	(0.35)	(0.00)	(0.00)	(0.00)	(0.25)	(0.10)	(0.00)
F-Statistics	8.45	10.63	14.62	12.80	42.20	3.96	6.67	5.54	12.25	8.52	6.46	8.29
Sample	40	40	40	40	40	40	40	40	40	40	40	40
Adj R^2	0.34	0.39	0.43	0.34	0.53	0.10	0.19	0.13	0.29	0.32	0.45	0.36

(Continued…)

Table A1 (Continued)

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Intercept	0.27	-0.05	-1.61	-3.90	-1.92	-3.62	-1.28	-2.86	-3.45	-5.51	-3.15
	(0.67)	(0.97)	(0.06)	(0.00)	(0.03)	(0.05)	(0.12)	(0.02)	(0.01)	(0.01)	(0.00)
GDP	-0.06	0.09	-0.06	-0.04	0.05	-0.03	-0.23	-0.14	-0.04	0.04	-0.09
	(0.12)	(0.02)	(0.13)	(0.27)	(0.32)	(0.33)	(0.00)	(0.00)	(0.20)	(0.70)	(0.03)
NSTK	-0.21	-0.13	0.00	0.03	-0.01	-0.05	-0.05	-0.03	-0.03	0.06	-0.13
	(0.02)	(0.28)	(0.95)	(0.71)	(0.85)	(0.57)	(0.48)	(0.69)	(0.69)	(0.21)	(0.01)
VGDP	0.68	11.17	10.49	-18.29	-26.84	-17.09	-51.62	-41.72	-22.09	-52.61	-46.74
	(0.96)	(0.41)	(0.45)	(0.07)	(0.01)	(0.22)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
IHHI	-0.19	0.19	0.35	0.41	0.37	0.49	-0.10	0.49	0.28	-0.15	0.19
	(0.12)	(0.26)	(0.00)	(0.00)	(0.06)	(0.26)	(0.67)	(0.00)	(0.00)	(0.65)	(0.35)
FHHI	6.64	11.20	27.86	20.04	16.93	6.12	2.50	2.68	8.44	61.55	8.68
	(0.00)	(0.00)	(0.00)	(0.00)	(0.04)	(0.34)	(0.44)	(0.58)	(0.02)	(0.00)	(0.06)
ECI	-0.88	-0.42	-0.51	0.50	-1.04	-0.47	0.50	0.04	-0.97	0.56	-0.08
	(0.00)	(0.01)	(0.01)	(0.04)	(0.01)	(0.00)	(0.01)	(0.80)	(0.00)	(0.00)	(0.72)
GGI	0.00	-0.06	0.00	0.00	-0.02	0.01	-0.01	0.02	0.00	-0.02	-0.02
	(0.69)	(0.00)	(0.58)	(0.71)	(0.03)	(0.49)	(0.57)	(0.01)	(0.86)	(0.06)	(0.19)
ACAP	0.04	-0.10	0.01	0.08	0.02	0.11	0.11	0.12	0.13	0.14	0.10
	(0.33)	(0.02)	(0.90)	(0.14)	(0.71)	(0.02)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
IVOL	0.35	0.60	-0.26	-0.27	0.03	0.15	0.16	0.45	0.17	0.18	0.14
	(0.28)	(0.00)	(0.15)	(0.17)	(0.86)	(0.41)	(0.44)	(0.00)	(0.00)	(0.50)	(0.35)
F-Statistics	3.02	6.59	3.30	3.09	2.74	3.47	6.80	13.69	21.08	6.81	14.45
Sample	40	40	40	40	40	40	40	40	40	40	40
Adj R^2	0.24	-0.01	0.09	0.00	-0.08	-0.09	0.15	0.28	0.28	0.28	0.27

Notes: Cross-sectional regression output of stock price synchronicity on economy variables across 40 countries in each year from 1995 through to 2017. Regressions follow Table 4 in MYY (2000). The dependent variable is a logistic error-weighted R-square. The numbers in parentheses are the p-values.

The GGI coefficient is significantly negative for 16 of the 23 years at the 10% level. Most of the GGI coefficients are insignificant after 2009, which are the periods after the GFC that caused extensive disarray to the world capital markets.

Like Jin and Myers (2006), the IVOL coefficients are significantly positive in nearly half of the LERW models (11 out of 23 years). The positive IVOL coefficients indicate that market volatility adds new information to price synchronicity, which is orthogonal to the GGI effects. Other economic variables only partially explain for the disparity in the international R^2. Unlike MYY, we include a market size variable, ACAP, which stands out as highly significant in explaining for R^2. The ACAP coefficient is significantly different from zero in 16 out of 23 years at the 10% (two-tail) level. However, the ACAP coefficients switch signs in some years, – we will resolve this in the next table as the ACAP variable at the country level may be too aggregated.

We explore the market capitalization effects by dividing sample firms in each country into 10 deciles ranked by market capitalization. We assign stock i in country j and year y to each decile portfolio of stocks by market capitalization and form a sample size of 40 × 23, or 920 observations. The first decile ($d=1$) in country j contains the top 10% of the firms in j with the highest capitalization measured in year y. The second decile (d=2) in country j contains the next 10% of the firms in j with the second highest capitalization measured in year y. For the corresponding decile-country stock return synchronicity variables, we then average the R_{ijy}^2 of firm i sorted into the same decile to derive at the equal-weighted decile R_{djy}^2.

We re-run the decile-sorted regression as in Equation (A3.1.) by using the log-transformed EQW for each decile in country j, and year y is defined as $\Upsilon_{djy} = \log(\frac{R_{djy}^2}{1-R_{djy}^2})$ as the dependent variable. The control variables are kept at the country level. The results reported in Table A2 show that the disaggregation by the market capitalization of firms into decile groups improves the goodness of fit of the R^2 models. The GGI coefficients are significantly negative at the 10% (two-tail) level in 9 out of 23 years, but significantly positive in 3 years in the post-GFC periods (i.e., 2012, 2014, and 2015). In comparison, the ACAP coefficient is significantly positive for all the years at less than 1% two-tail level. The results show strong large firm effects on the R^2 of firms sorted into the size-decile, *ceteris paribus*; and are consistent with the hypotheses on the coverage and liquidity of analysts (Chan and Hameed, 2006; and Chen, Goldstein, and Jiang, 2007). Our results cannot disentangle the GGI effects from the market size effects, but we find that the size effects significantly weaken the GGI effect in the information channel thus explaining away most of the R^2 variations in the market.

Table A2 Annual Cross-Sectional Regressions of Country-Decile Portfolios LERW for 1995 - 2017

Year	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Intercept	-4.00	-4.90	-6.32	-7.16	-3.83	-3.38	-5.34	-8.40	-6.85	-7.92	-7.65	-6.13
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
GDP	-0.07	-0.04	-0.05	-0.03	-0.18	-0.26	-0.26	-0.14	-0.07	-0.09	-0.19	-0.09
	(0.16)	(0.37)	(0.21)	(0.49)	(0.00)	(0.00)	(0.00)	(0.02)	(0.26)	(0.04)	(0.00)	(0.05)
NSTK	-0.05	0.11	0.19	0.14	0.17	0.27	0.43	0.55	0.35	0.40	0.27	0.08
	(0.48)	(0.12)	(0.01)	(0.09)	(0.02)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.28)
VGDP	-11.98	-12.63	4.56	-0.17	0.16	2.77	2.86	9.44	6.28	22.35	19.18	-1.34
	(0.40)	(0.18)	(0.61)	(0.98)	(0.97)	(0.45)	(0.38)	(0.04)	(0.13)	(0.02)	(0.04)	(0.88)
IHHI	1.03	-0.33	0.62	0.55	-0.05	0.04	0.35	0.38	0.04	-0.03	0.29	0.07
	(0.00)	(0.15)	(0.01)	(0.03)	(0.84)	(0.85)	(0.12)	(0.14)	(0.87)	(0.90)	(0.09)	(0.72)
FHHI	-1.23	8.23	27.99	14.10	11.05	24.32	30.82	36.04	19.72	17.95	5.44	-9.71
	(0.74)	(0.00)	(0.00)	(0.02)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.18)	(0.47)
ECI	-0.19	0.32	-0.49	0.69	0.09	-0.26	0.62	0.97	-0.34	-0.60	0.27	-0.31
	(0.42)	(0.20)	(0.05)	(0.02)	(0.83)	(0.33)	(0.03)	(0.01)	(0.33)	(0.10)	(0.35)	(0.30)
GGI	-0.06	-0.08	-0.05	-0.05	-0.06	-0.01	-0.01	-0.04	-0.06	-0.06	-0.02	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.67)	(0.49)	(0.03)	(0.00)	(0.00)	(0.18)	(0.97)
ACAP	0.25	0.29	0.26	0.26	0.27	0.19	0.24	0.30	0.30	0.30	0.29	0.32
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
IVOL	0.41	0.24	0.01	-0.16	0.30	0.39	0.79	0.09	0.29	-0.08	0.04	0.30
	(0.03)	(0.25)	(0.97)	(0.39)	(0.11)	(0.01)	(0.00)	(0.60)	(0.05)	(0.57)	(0.83)	(0.07)
F-Statistic	2.80	3.07	3.75	2.66	6.15	2.01	2.67	2.84	4.44	5.10	5.07	4.52
Sample Size	400	400	400	400	400	400	400	400	400	400	400	400
Adj R^2	0.34	0.41	0.41	0.35	0.43	0.29	0.39	0.40	0.44	0.46	0.50	0.51

(Continued…)

Table A2 (Continued)

Year	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Intercept	-5.53	-7.80	-7.75	-9.64	-8.04	-10.00	-4.82	-6.21	-7.22	-10.04	-7.60
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
GDP	-0.10	-0.06	-0.09	-0.06	-0.06	-0.09	-0.25	-0.17	-0.11	0.00	-0.07
	(0.04)	(0.14)	(0.02)	(0.16)	(0.15)	(0.03)	(0.00)	(0.00)	(0.03)	(0.94)	(0.28)
NSTK	0.05	0.21	0.29	0.32	0.19	0.29	0.07	0.10	0.13	0.31	0.07
	(0.34)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.32)	(0.04)	(0.06)	(0.00)	(0.18)
VGDP	-7.47	4.89	-32.03	-73.38	-105.13	-53.65	-92.84	-88.10	-71.87	-95.33	-72.57
	(0.45)	(0.71)	(0.07)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
IHHI	0.02	0.34	0.58	0.58	1.45	0.90	0.59	0.82	0.76	-0.21	0.05
	(0.90)	(0.15)	(0.01)	(0.01)	(0.00)	(0.00)	(0.02)	(0.00)	(0.00)	(0.23)	(0.80)
FHHI	-1.21	9.53	24.36	18.03	-8.35	4.54	-14.87	-4.13	-5.53	69.74	3.83
	(0.68)	(0.00)	(0.00)	(0.00)	(0.17)	(0.61)	(0.17)	(0.58)	(0.43)	(0.00)	(0.54)
ECI	-0.29	0.28	-0.27	0.93	-0.16	-0.26	-1.04	-0.78	-1.35	0.10	-0.29
	(0.26)	(0.39)	(0.31)	(0.06)	(0.63)	(0.40)	(0.01)	(0.01)	(0.00)	(0.79)	(0.20)
GGI	0.00	-0.03	-0.01	0.00	0.01	0.05	0.01	0.04	0.03	0.00	-0.01
	(0.67)	(0.08)	(0.41)	(0.67)	(0.21)	(0.00)	(0.64)	(0.01)	(0.00)	(0.76)	(0.62)
ACAP	0.30	0.27	0.31	0.35	0.33	0.37	0.35	0.32	0.36	0.36	0.31
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
IVOL	0.05	-0.45	-0.68	-0.65	-0.56	-0.25	0.01	0.12	0.01	0.01	-0.02
	(0.80)	(0.08)	(0.00)	(0.00)	(0.00)	(0.08)	(0.95)	(0.30)	(0.95)	(0.95)	(0.92)
F-Statistic	4.15	3.01	4.53	5.19	6.67	6.18	7.01	7.47	8.08	7.59	5.23
Sample Size	400	400	400	400	400	400	400	400	400	400	400
Adj R^2	0.50	0.38	0.50	0.52	0.56	0.54	0.57	0.59	0.61	0.60	0.53

Notes: Cross-sectional regression output of stock price synchronicity on economy variables across 40 countries in each year from 1995 through to 2017. Regressions follow Table 4 of MYY (2000). The dependent variable is a logistic equal-weighted R-square. The numbers in parentheses are the p-values.