The International Commonality of Idiosyncratic Variances

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Abstract

We document strong global commonality in country idiosyncratic return variances across 23 developed markets, which is stronger than international return commonality. The global common factor of idiosyncratic return variances is highly correlated with that of idiosyncratic cash flow variances, and is also significantly related to variables capturing aggregate discount rate variation and the conditional market variance. Furthermore, aggregate idiosyncratic return and cash flow variances are mostly but not always countercyclical.

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1. Introduction

Idiosyncratic return variances represent the uncertainty in stock returns that cannot be explained by systematic risk factors. The extant finance literature has extensively documented their time-series behavior and relationship with cross-sectional or aggregate returns.[1] Apart from the obvious importance of idiosyncratic return variances in finance, there has been a resurgence of interest in the dynamics and economic effects of idiosyncratic variances in economics as well. For example, Bartram, Brown, and Stulz (2012) and Brown and Kapadia (2007) link idiosyncratic volatility to financial development over time and across countries. A rapidly growing macroeconomic literature, such as Bloom (2009) and Christiano, Motto, and Rostagno (2014), studies the effect of uncertainty shocks on real economic activity and business cycles, and document that heightened uncertainty can entail economic slowdowns through delayed firm investments, or increased precautionary savings by households.

While macroeconomists often employ stock market data to measure uncertainty, they take various short-cuts by using aggregate market volatility or measures of cross-sectional dispersion (see e.g. Bloom (2009)). However, the economic models call for a measure of *idiosyncratic* variance, reflecting non-systematic volatility, and, better still, a measure of firm-specific productivity or output uncertainty. Meanwhile, these studies mostly rely on U.S. data, and our understanding of aggregate idiosyncratic variances is still very limited, especially at the global level. The focus of this article is to analyze the commonality, determinants, and dynamics of

[1] For instance, Campbell, Lettau, Malkiel, and Xu (2001) document an upward trend in idiosyncratic variances, generating a voluminous literature on potential explanations for the trend (Irvine and Pontiff (2009) and Wei and Zhang (2006)). Additional empirical work cast doubt on these findings, however (see e.g. Brandt, Brav, Graham, and Kumar (2010) and Bekaert, Hodrick, and Zhang (2012)). Ang, Hodrick, Xing, and Zhang (2006, 2009) find that firms with higher idiosyncratic variances have lower returns in the U.S. and in all developed countries, whereas Bali and Cakici (2008) questions the robustness of these results. Bali, Cakici, Yan, and Zhang (2005) show that idiosyncratic volatility, contrary to a previous claim by Goyal and Santa-Clara (2003), does not robustly predict aggregate stock returns.

idiosyncratic return and cash flow variances in 23 developed markets aggregated from firm-level stock return and cash flow data.

We start by examining the properties of *country* idiosyncratic return variance, $IVRET^C$, computed as the value-weighted average of firm-level idiosyncratic return variances within each country *C*. While idiosyncratic variances by definition reflect "non-systematic" variation, we find a surprisingly pronounced common component in these country-level uncertainty measures for returns across 23 developed markets. For the G7 countries, for example, the average correlation of country idiosyncratic return variances is 66.5%, which is even higher than the average correlation of country level market returns for the same set of countries of 59.4%. This commonality can be largely explained by the *global* idiosyncratic variance, $IVRET^G$, calculated as the value-weighted average of country idiosyncratic return variances. On average, $IVRET^G$ explains more than 50% of the country idiosyncratic variances. This commonality is not spuriously driven by volatility persistence and survives when investigating changes in idiosyncratic volatility.

We entertain various possible explanations for this global commonality. First, a missed common systematic factor could explain the commonality in idiosyncratic return variances. We show that our results are robust to the use of six different factor models to remove systematic risk, all of which include both global and local factors. Thus, there is no evidence supporting this hypothesis.

Second, we propose a dynamic valuation model to explain the global commonality, with six discount rate and cash flow variables as explanatory variables. The logic of this model is quite simple. Because innovations in returns are driven by discount rate news and cash flow news, comovement in idiosyncratic return variances can arise from the variability of pure idiosyncratic cash flows and any time-varying variability of discount rate and cash flow factors that is not picked up by the factor model to obtain idiosyncratic return variances. To the extent that these variables have an important global component, they may also explain the international commonality that we document.[2]

We start with idiosyncratic cash flow variances. Specifically, we use return on equity (ROE) as the key cash flow variable and propose a new methodology to compute a firm's idiosyncratic cash flows and its variance. We compute the country and global idiosyncratic cash flow variances as the value-weighted average of firm idiosyncratic cash flow variances in the country or the global market, respectively. We show that there is also an important common global component in country-level idiosyncratic cash flow variances in all 23 countries, represented by the global idiosyncratic cash flow variance measure. However, this cash flow commonality is weaker than in returns and it explains only 34.2% of the variation in global idiosyncratic return variances. The remaining five variables that may drive time variation in $IVRET^G$ include the aggregate discount rate, the conditional market variance, aggregate cash flow growth and its conditional variance, and a measure of growth opportunities. The six variables together explain a substantial part of the time-series variation of aggregate idiosyncratic variances, with a linear model delivering an adjusted R^2 of 60.2%. There are three variables that jointly account for almost 90% of the explained variation: the global idiosyncratic cash flow variance, the global discount rate, and the conditional market variance.

Finally, we examine the dynamics of the global idiosyncratic return and cash flow variances by focusing on their cyclical properties. We find them to be mostly but not always countercyclical. In particular, the global idiosyncratic variances are negatively correlated with GDP growth, which indicates counter-cyclicality, before 1997 and between 2005 and 2015; while

[2] To save space, we relegate a detailed discussion of this dynamic valuation model to the Appendix.

they are positively correlated during the internet bubble period of 1997 to 2005 and in the recent period after 2015, indicating cyclicality.[3] The statistical evidence for overall countercyclicality at the global level is strong for cash flow but weaker for return variances. At the country level, there is more uniform evidence in favor of countercyclicality. The finding of time-varying cyclicality is inconsistent with the models in Cao, Simin, and Zhao (2008) and Pastor and Veronesi (2003, 2006), which imply that idiosyncratic volatility is procyclical. The changing cyclicality of idiosyncratic variances is consistent with various state variables of differing cyclicality driving their variation (e.g. counter-cyclical market variances and procyclical growth opportunities). Our finding of idiosyncratic cash flow variances predicting output growth echoes the recent macro literature suggesting a negative link between uncertainty and future economic activity.

Our work relates to a large literature attempting to explain the dynamics of idiosyncratic return variances. In terms of empirical studies, Guo and Savickas (2008) and Bekaert, Hodrick, and Zhang (2012) investigate the time-series dynamics of international aggregate idiosyncratic variances, but neither study examines their commonality in the global market. Attempting to explain the time variation in idiosyncratic return volatility, Bekaert, Hodrick, and Zhang (2012) and Bartram, Brown, and Stulz (2017) propose the conditional market variance, and Zhang (2010) proposes ROE volatility. Theoretical research on idiosyncratic variances includes Cao, Simin, and Zhao (2008) and Pastor and Veronesi (2003, 2006). The former proposes a simple model in which idiosyncratic volatility is related to the growth options available to managers and the authors argue that aggregate idiosyncratic volatility is related to the level and variance of these growth options. Our growth opportunity findings confirm the Cao, Simin, and Zhao (2008) results for the U.S., but

[3] This is consistent with the empirical results in Dew-Becker and Giglio (2021) regarding a measure of cross-sectional uncertainty constructed from stock options on individual firms, which also peaks during the dot com boom and the Great Financial Crisis but was mostly acyclical.

our growth opportunity measure is constructed differently and we verify that it indeed predicts future earnings growth. However, this growth opportunity measure accounts for less than 5% of the explained variation of $IVRET^G$, albeit more so during expansionary periods. Alternatively, Pastor and Veronesi (2003, 2006) formulate asset pricing models with learning in which uncertainty about a firm's profitability increases idiosyncratic uncertainty and risk, suggesting a large role for cash flow uncertainty in explaining idiosyncratic return variances as do we.

The paper is organized as follows. We introduce the data in Section 2. Section 3 establishes the commonality of idiosyncratic return variances. Section 4 explains the dynamics of the global commonality in idiosyncratic return variances. We investigate the cyclicality of idiosyncratic return and cash flow variances in Section 5. Section 6 concludes.

2. Data

2.1 Sample

Our sample covers 23 MSCI developed markets during a sample period from January 1980 to December 2019. For U.S. firms, we obtain return data from CRSP and accounting data from Compustat. For non-U.S. firms, we obtain returns and market values in USD from Datastream and accounting data from Worldscope.[4] We apply the following filters to the data: 1) remove firm-quarters with market capitalization below USD 5 million at the quarter end;[5] 2) remove firm-quarters with negative total assets at the quarter end; 3) remove firm-days with daily returns lower than -100% or higher than 200%, and if the return on date *t* is greater than 100% (lower than -50%)

[4] The data coverage starts later for Finland (1987), Israel (1992), New Zealand (1986), Portugal (1988), Spain (1986), and Sweden (1982).

[5] While this screen retains some micro-cap firms, the median market capitalization of international firms tends to be smaller than that of firms in the U.S. (see Table 1). Because our results are based on value-weighted measures, the inclusion of relatively small firms does not significantly affect our results.

and the return on day *t+1* is lower than -50% (greater than 100%), then both days are eliminated, in a similar spirit to the filters proposed by Ince and Porter (2006) for monthly returns to screen for data errors; 4) remove firm-quarter ROEs with non-positive book value of common equity or ROEs below -100%, following Vuolteenaho (2002); 5) winsorize firm-quarter book-to-market (B/M) ratios and ROEs by country, at the 1% and 99% levels.

Summary statistics for our sample firms are reported in the first two columns of Table 1. For each developed market, we present the time-series average of the number of publicly listed firms, and the time-series average of the cross-sectional medians of market capitalization from the firm-quarter panel. Japan, the U.K., and the U.S. have the largest numbers of firms, with each having over 1,000 publicly listed firms, whereas four countries including Austria, Ireland, New Zealand, and Portugal have fewer than 100 public firms. The average median firm market capitalizations range between \$98 million (Denmark) and \$531 million (Spain).

2.2 Defining Idiosyncratic Return Variances

To compute firm-level idiosyncratic return variances, we need to remove systematic risk from stock returns. Bekaert, Hodrick, and Zhang (2009) examine different asset pricing models and find that the best performing model for describing comovements among international asset returns is the world-local Fama-French (1996) factor model, which includes market, size, and value factors from global and local capital markets. Therefore, we estimate the following specification using daily returns in excess of the risk-free rate, *exret*, for each firm *i* within each quarter q:

$$exret_{it} = \alpha_{iq} + \beta_{iq}^{WMKT} WMKT_t + \beta_{iq}^{WSMB} WSMB_t + \beta_{iq}^{WHML} WHML_t \\ + \beta_{iq}^{MKT} MKT_t + \beta_{iq}^{SMB} SMB_t + \beta_{iq}^{HML} HML_t + u_{it}, \quad t \in q. \qquad (1)$$

The variables WMKT/MKT, WSMB/SMB, and WHML/HML are the global/country level market, size, and value factors, respectively. For each country, we calculate MKT as the value-weighted return of all firms in the country. To obtain SMB, we sort all firms in each country into three size groups at the end of each June of year y. The country size factor, SMB, for July of year y to June of $y+1$ is computed as the value-weighted return difference between firms in size group 1 (smallest 1/3 firms) and size group 3 (largest 1/3 firms). Similarly, the country value factor, HML, for July of year y to June of year $y+1$ is computed as the value-weighted return difference between firms in B/M group 3 (1/3 firms with the highest BM ratios) and B/M group 1 (1/3 firms with the lowest BM ratios), where B/M is calculated using the book equity for the last fiscal year end in year y-1 and market value at the end of December of year y-1. The global variables WMKT, WSMB, and WHML are computed as the value-weighted averages of the country level factors. This model setup allows for time-varying exposures to global and local factors, potentially reflecting changes in the degree of financial integration over time. After estimating equation (1) for each firm each quarter, we obtain the time series of firm-specific residuals, u_{it}. We calculate the idiosyncratic return variance, $IVRET_{iq}$, as the variance of the residual term in equation (1), u_{it}, for firm *i* in each quarter q:

$$IVRET_{iq} = \frac{1}{T-1} \sum_{t \in q} u_{it}^2, \tag{2}$$

where T is the number of days in the quarter. All return variance measures are annualized by multiplying by 250, and we delete the top 1% of IVRETs over the full sample to mitigate the potential effect of outliers.

We report the time-series average of the cross-sectional medians of firm-level $IVRET_{iq}$ in each country in Table 1, Column III. Across all countries, the average median of IVRET is 0.079. By country, the highest value is observed for Canada at 0.142, and lowest for Belgium at 0.050.

The U.S. median is at 0.130, which is relatively high, compared to other countries. We further define country-level idiosyncratic variance, $IVRET_q^C$, for country C in quarter q, as the value-weighted average of the firm-level $IVRET_{iq}$ within the country. The time-series averages of the country idiosyncratic variance measures are reported in the last column of Table 1. Across 23 developed markets, the average country IVRET is 0.051; the country IVRETs range between 0.030 (Switzerland) and 0.072 (Japan). The U.S. IVRET is 0.067, which is the second highest value. The patterns are generally consistent with the summary statistics of country idiosyncratic return variances in Bekaert, Hodrick, and Zhang (2012).

Figure 1, Panel A plots the IVRET time series for the largest 4 countries: Germany, Japan, the U.K., and the U.S. There is substantial time variation in country IVRETs with two noticeable peaks around 2000 (the end of the internet bubble period) and 2008 (the global financial crisis period). The plot also presents some preliminary evidence that country IVRETs tend to move together over time.

Finally, we compute a global idiosyncratic variance measure, $IVRET_q^G$, as the value-weighted average of country level idiosyncratic variance $IVRET_q^C$. In Figure 1, Panel B, we present the time-series pattern for global IVRET, together with NBER recession indicators. There are again two peaks, one just before the 2001 recession (the end of the Tech Boom), and one around the recession in 2008. There is also a local peak in the 1990-1991 recession. $IVRET^G$ has a mean of 0.062, and a standard deviation of 0.036.

3. Commonality in Idiosyncratic Return Variances

In this section, we provide evidence that country idiosyncratic return variances exhibit commonality, which is captured by the global idiosyncratic return variance.

To measure potential commonality among country IVRETs, we calculate the pairwise correlations of each country's IVRET with the IVRET of each of the other countries, and report the average. For comparison, we also compute the average pairwise correlations for market returns of these countries. These pairwise correlations are reported in Table 2, Columns I and II, respectively. Across all countries, the average pairwise correlation of idiosyncratic variances is 0.634, slightly higher than the average pairwise correlation of returns at 0.591. To be more specific, the pairwise idiosyncratic variance correlations are higher than pairwise return correlations in 20 countries, and lower in only three countries. In the case of the U.S., the average correlation with other country's IVRET is 0.655, while the average correlation with other country's market portfolio returns is 0.613. Thus, comovement among country idiosyncratic variances and the U.S. idiosyncratic variance is of the same order of magnitude as comovements among country returns and the U.S. return. Given that *idiosyncratic* variances by definition should reflect *non-systematic* variation, the magnitude of this comovement in country idiosyncratic return variances across countries is indeed surprising. Any theoretical explanation of the determinants and dynamics of idiosyncratic return variances must account for this commonality.

Can the global idiosyncratic return variance capture this surprising comovement in country idiosyncratic variances across countries? Comparing the time-series plots between Panel A and Panel B in Figure 1, country IVRETs and global IVRET do exhibit similar peaks and troughs. More formally, for each country *C*, we project its idiosyncratic return variance, $IVRET_q^C$, on the global counterpart, $IVRET_q^G$, as follows:

$$IVRET_q^C = \alpha_C + \beta_C IVRET_q^G + \varepsilon_q^C. \tag{3}$$

We report the β_C coefficients, their t-statistics and adjusted R^2s for these regressions in Columns III-V of Table 2, Panel A. All country-level idiosyncratic variances load positively on the global measure, with coefficients ranging between 0.170 and 1.226, and the average coefficient being 0.651. All coefficient t-statistics (except Austria's and Israel's) are highly significant at the 5% level. The average adjusted R^2 for individual country regressions is 0.544, indicating that $IVRET^G$ accounts for a large part of each country's IVRET.

As another test of $IVRET^G$'s ability to capture the comovement of country IVRETs, the pairwise correlations of ε_q^C should be substantially lower than the pairwise correlations of country IVRETs. In Column VI, we present the pairwise correlations of the residual ε_q^C. While the original correlations of IVRETs are on average 0.634, the average correlation of these residuals across all countries falls to 0.222, implying that $IVRET^G$ indeed captures a substantial part of the commonality of country IVRETs.

Alternatively, we conduct a principal component (PC henceforth) analysis on the country IVRETs to identify commonality. Because not all countries have data covering 38 years and PC analysis only includes countries with complete time-series, we divide the sample period into three non-overlapping periods (1982-1993, 1994-2006, and 2007-2019) and perform the PC analysis for each subperiod to maximize data usage. Panel B of Table 2 shows the time-series average of the explained variation for the first 5 principal components of the country IVRETs. The first five PCs explain 91% of the total variation in the country IVRETs, indicating that the country IVRETs exhibit a factor structure. The first PC, the most important driver of commonality, explains 70.2% of the cross-country variation of idiosyncratic return variances, and $IVRET^G$ has a correlation of 0.926 with it. That is, $IVRET^G$ captures a large part of the commonality of country IVRETs.[6]

[6] Utilizing our firm-level data, we additionally find that within each country, firm-level idiosyncratic return variances also exhibit strong commonality, thereby extending Duarte, Kamara, Siegel, and Sun (2014) and Herskovic, Kelly, Lustig, and Van Nieuwerbugh (2016), who identify a common factor in the idiosyncratic volatility of individual U.S. firms. The global idiosyncratic variance has substantial explanatory power for firm idiosyncratic variances beyond that of the country idiosyncratic return variance. We leave further analysisfor future work.

Because volatility is reasonably persistent, there is a potential concern that the commonality is biased upward. To address this concern, we examine whether the commonality exists in volatility differences. In Panel C of Table 2, we summarize results using the first difference of IVRET (ΔIVRET).[7] The average pairwise correlation of country ΔIVRET is now 0.559, which remains high. When we regress country ΔIVRET on global ΔIVRET, all country ΔIVRETs load positively on the global measure, with the average coefficient being 0.786, which is even higher than what we find in levels. Global ΔIVRET accounts for a large part of each country's ΔIVRET, with the adjusted R^2 averaging 0.500. As for the principal component analysis, the first PC explains 64.4% of the cross-country variation of ΔIVRET, and has a correlation of 0.908 with $\Delta IVRET^G$. Clearly, the strong commonality in IVRET is not driven by volatility persistence.

4. Explaining the Global Commonality in Idiosyncratic Return Variances

In this section, we investigate the economic sources of the global commonality in idiosyncratic return variances. If we think of innovations in returns as driven by cash flow news and discount rate news, comovement in idiosyncratic variances can arise in a variety of ways. Section 4.1 tests whether a missing common systematic factor can explain the evidence. The remainder of the section postulates six discount rate and cash flow variables that may capture the time variation in the global IVRET and thus explain the international commonality. To motivate the state variables, we sketch a simple pricing model that accommodates time-varying volatility for both the discount rate and cash flow process and includes a growth opportunity variable distinct from other cash flow growth variables. The setup of the model is described in detail in the

[7] To save space, we report detailed results in Online Appendix Table OA1.

Appendix to conserve space.[8] Section 4.2 focuses solely on the aggregate idiosyncratic cash flow variance, because it is potentially the most fundamental source of comovement across idiosyncratic return variances and our measurement is more intricate than in the extant literature. Section 4.3 considers other determinants and describes their construction. Finally, Section 4.4 reports the explanatory power of the various state variables.

4.1 A Missing Common Factor

One simplistic explanation for the strong explanatory power of the global idiosyncratic variance is that the existing factor models used to remove systematic components from returns are missing an internationally correlated risk factor. Reconsider equation (1) but suppose we miss a common factor F_t (assuming that F_t has mean zero), to which each stock has exposure β_{iq}^F. That is,

$$u_{it} = \beta_{iq}^F F_t + \bar{u}_{it}, \tag{4}$$

where $\bar{u}_{it}$ represents a genuinely idiosyncratic residual during quarter *t*. Then equation (2) becomes:

$$IVRET_{iq} = \frac{1}{T-1}\sum_{t\in q} u_{it}^2 = \frac{1}{T-1}(\beta_{iq}^F)^2 \sum_{t\in q} F_t^2 + \frac{1}{T-1}\sum_{t\in q} \bar{u}_{it}^2. \tag{5}$$

If we aggregate firm-level IVRETs to the country level and then compute the commonality of the country IVRETs, the common component in $IVRET^C$ would be related to the value-weighted average of $(\beta_{iq}^F)^2$, the fourth order moments of the missing factor F_t, and the variance of the true idiosyncratic residuals $\bar{u}_{it}^2$. For this omitted risk factor to be important in explaining the

[8] In the Appendix, we formulate a dynamic pricing model, which follows the tradition of dynamic stock valuation models such as Ang and Liu (2004), Bakshi and Chen (2005), and Bekaert and Harvey (2000). We show that, given normally distributed shocks, a firm's price earnings ratio is the infinite sum of exponential affine functions of the state variables and return expressions then follow straightforwardly. Computing the conditional variance of returns involves taking the conditional variance of an infinite sum of exponentials of a linear function of the state variables; thus, all state variables should matter.

commonality in $IVRET^C$, its variance and the magnitude of the squared factor exposures should be large relative to the variance of the truly idiosyncratic components.

We provide a number of empirical exercises that greatly lower the chance that an omitted risk factor is driving the strong commonality in IVRET. The first test focuses on the comovements of country level returns, which would also be affected by the omitted factor. For each country *J*, define $\beta_q^{F,J}$ as the value-weighted sum of firm-level exposures to the common factor *F*, and u_t^J as the value-weighted sum of firm-level residuals for all firms in that country. Then for two countries, *J* and *K*, the covariance between the country-level return residuals for quarter q becomes:

$$\operatorname{cov}\left(u_t^J, u_t^K\right) = \beta_q^{F,J} \beta_q^{F,K} \frac{1}{T-1} \sum_{t \in q} F_t^2. \tag{6}$$

If the omitted factor is a level factor (e.g. a market type factor) to which stocks have similar exposures of the same sign, an omitted factor with substantial variance and sizable loadings should also result in strong comovements in the country-level return residuals. That is, relatively high weighted averages of the factor exposures in Equation (6) would tend to coincide with high squared betas in Equation (5).

To exclude this possibility, we calculate the correlations of return residuals across countries. Specifically, for each country *J*, we first calculate the country-level return residual, u_t^J. We then report the average pairwise correlation of this return residual with the other countries in Table 3, Panel A, Column I. After removing the common risk factors, the return residuals themselves show low correlations across countries. On average, the pairwise correlation is merely 0.036. Of course, averages can cancel large correlations with opposite signs, so we also report the minimum and maximum of the pairwise correlations in the remaining columns. We find that the correlations are mostly positive and the average minimum and maximum correlations are -0.015 and 0.115, respectively. The small magnitudes of the residual correlations indicate that a missing factor with same sign factor exposures probably is not the reason for the strong commonality in country IVRETs.

However, many factors in recent risk models are spread factors to which stocks may have positive or negative exposure. It is thus conceivable that the average betas in Equation (6) are small (e.g. because negative and positive betas cancel each other), but the squared betas in Equation (6) are still large.[9] As a second test, we therefore compute IVRET based on the residuals relative to the world-local version of 5 alternative factor models, including the Fama-French (2015) 5-factor model, the Fama-French (2015) 5-factor augmented with a momentum factor, the Hou, Xue, and Zhang (2015) 4-factor model, the Stambaugh and Yuan (2017) model, and the Barillas and Shanken (2018) 6-factor model. We create these factors at the global and country levels from individual stock return data, following the methodology described in the original articles.

We provide a summary of the results using alternative models in Table 3, Panel B.[10] Overall, the commonality of IVRET remains strong, regardless of the factor model used to calculate IVRET. The average pairwise correlation of country IVRET ranges between 0.621 and 0.663, similar to our baseline result of 0.634. The average percent of variation in country IVRETs explained by the first principal component is close to or higher than that obtained from our baseline IVRET, with the Barillas and Shanken (2018) 6-factor model delivering the highest R^2 at 76.5%. The correlation between the first principal component and the global IVRET based on alternative factor models continues to be high, varying between 0.828 and 0.934, compared to 0.926 in our baseline model. Taken together, these results indicate that a missing common factor is unlikely to be the source of the observed commonality in country IVRETs.

[9] We thank a referee for pointing this out and suggesting the subsequent analysis.
[10] Full detailed results are reported in the Online Appendix Table OA2, Panels A through E. The details of the factor construction are in the notes to this table.

4.2 Aggregate Idiosyncratic Cash Flow Variance

Rational pricing indicates that stock prices equal the present value of future expected cash flows, suggesting that idiosyncratic cash flow variability is potentially an important determinant of idiosyncratic return variability (e.g. Irvine and Pontiff (2009)). While there has been some research linking the time variation of U.S. aggregate idiosyncratic return variances to cash flow variances (see e.g. Wei and Zhang (2006), Bekaert, Hodrick, and Zhang (2012)), there has been virtually no research on this link in an international context.[11] In this section, we first propose a method to calculate the idiosyncratic cash flow variance. Then, we examine the commonality in idiosyncratic cash flow variances, following a parallel structure to Section 3, in which we document commonalities of idiosyncratic return variances across countries.

4.2.1 Defining Idiosyncratic Variances of Cash Flows

There is no well-accepted methodology to compute idiosyncratic variances of cash flow variables. Irvine and Pontiff (2009) use a pooled AR(3) model for firms' earnings per share to create earnings innovations, and then use the cross-sectional variance of these innovations as a fundamental idiosyncratic risk variable. Zhang (2010) and Bekaert, Hodrick, and Zhang (2012) use the value-weighted firm-level time-series variance of return on equity computed using the last 12 quarters of data, and the cross-sectional variance of return on equity. Bartram, Brown, and Stulz (2017) use the squares of the change in various measures of cash flows for firm *i* minus the value weighted cash flow change across all firms. These approaches either fail to control for systematic exposure or make other strong implicit assumptions, such as unit betas with respect to simple aggregate benchmarks.

[11] Bekaert, Hodrick, and Zhang (2012)'s last section provides some preliminary analysis for the G7 countries.

We propose a new methodology using ROE as our cash flow variable as in Vuolteenaho (2002). The ROE is defined as earnings divided by last period's book equity. For the U.S. sample, we obtain quarterly "Net Income" (NIQ) and the "Book Value of Common Equity" (CEQQ) from the Compustat quarterly file. To mitigate potential seasonality in our quarterly ROE data, we compute an annualized ROE as the trailing 4-quarter net income divided by common equity at the beginning of the period. Thus, for firm i at quarter q, annualized ROE is computed as follows:

$$ROE_{iq} = \frac{\sum_{t=q-3}^{q} Net\ Income_{i,t}}{Common\ Equity_{i,q-4}}. \tag{7}$$

For firms outside of the U.S., we compute ROE by dividing "Net Income" (WC01651 or DWNP) by the "Book Value of Common Equity" (WC03501 or DWSE). Notice that the coverage of non-U.S. firms' accounting data can be sporadic at the beginning of the sample, with only annual data of the accounting variables being available. Nevertheless, we use the quarterly frequency for our ROE time series data to maximize the number of observations in a 38-year sample. When the quarterly data are available, we compute ROE for non-U.S. firms as in equation (7). When only annual data are available, we transform the annual data to quarterly data by computing ROE for firm i at quarter q in year y as follows:

$$ROE_{iq} = \frac{\frac{q}{4} Net\ Income_{i,y} + (1-\frac{q}{4}) Net\ Income_{i,y-1}}{Common\ Equity_{i,y-1}}. \tag{8}$$

That is, we approximate quarterly observations of net income, using annual net income, as a weighted average of the annual net income from the previous year, *y-1*, and the current year *y*.[12]

[12] For robustness, we also compute all ROE measures using only annual data. In addition, we consider an alternative transformation by computing quarterly observations of annual ROE as weighted average of the annual ROE from the current and previous years: $ROE_{i,q}= q/4*ROE_{i,y}+(4-q)/4*ROE_{i,y-1}$. The results are generally similar to what we report in the main text and are available upon request.

To compute idiosyncratic cash flow shocks, we construct a linear factor model, combining local and global Fama and French (1993) factors, mimicking the approach in Bekaert, Hodrick, and Zhang (2009). That is, these factors capture the market, size, and value dimensions, but for firm-level ROE's. Similar to the construction of return factors in Section 2.2, we construct the country ROE market factor as the value-weighted ROE of all firms in the country. The size ROE factor is the difference between value-weighted ROEs of the smallest 1/3 of firms and largest 1/3 of firms. The value ROE factor is the difference between the value-weighted ROEs of the 1/3 of firms with the highest B/Ms and the 1/3 of firms with the lowest B/Ms. Global ROE factors are value-weighted country-level ROE factors.[13]

We use these ROE factors to estimate a factor model for firm-specific ROE's using both the country and global factors. Given the low frequency nature of the accounting data, we estimate a panel model within each country to increase statistical power. The panel regression is specified as follows:

$$\begin{aligned} ROE_{iq} &= \left(a_{0,i} + a_1 size_{i,q-1} + a_2 BM_{i,q-1}\right) + \left(b_0 + b_1 size_{i,q-1} + b_2 BM_{i,q-1}\right) WMKT_q^{ROE} \\ &+ \left(c_0 + c_1 size_{i,q-1} + c_2 BM_{i,q-1}\right) WSMB_q^{ROE} + \left(d_0 + d_1 size_{i,q-1} + d_2 BM_{i,q-1}\right) WHML_q^{ROE} \\ &+ \left(e_0 + e_1 size_{i,q-1} + e_2 BM_{i,q-1}\right) MKT_{C,q}^{ROE} + \left(f_0 + f_1 size_{i,q-1} + f_2 BM_{i,q-1}\right) SMB_{C,q}^{ROE} \\ &+ \left(g_0 + g_1 size_{i,q-1} + g_2 BM_{i,q-1}\right) HML_{C,q}^{ROE} + u_{iq}^{ROE}. \end{aligned} \tag{9}$$

Here $size_{i,q-1}$ and $BM_{i,q-1}$ are the log size and the book-to-market ratio for firm *i* from the previous quarter q-1, and each country ROE factor is orthogonalized with respect to the global counterpart. The specification in equation (9) allows for time and cross firm variation in the factor

[13] The summary statistics for the country and global ROE factors are reported in the Online Appendix Table OA3, Panel A. The ROE market factors are on average positive for all countries, ranging between 7.79% (Japan) and 19.21% (U.S.). Interestingly, the country size factors are all negative on average, ranging between -20.57% (U.S.) and -4.61% (Austria), indicating small firms have lower ROE's than large firms. The value factors are also all negative ranging between -21.15% (U.K.) and -6.42% (Japan). On average, value firms have lower ROEs than growth firms.

loadings, and the factor loadings are assumed to be linear functions of firm's own size and book-to-market ratio. We also include firm fixed effects to take into account constant firm-level differences in ROE. Compared to alternative methodologies of computing idiosyncratic cash flow variances, this new methodology accounts for systematic risk and variation in factor loadings over time and in the cross-section.[14]

The key deliverable of the model is the idiosyncratic cash flow residual, u_{it}^{ROE}. Because we only observe one residual for each firm in each quarter, we employ a kernel method to estimate the idiosyncratic ROE variance over 20 quarters. Lacking high frequency data, the kernel method exploits the slow-moving ROE dynamics and the persistence of variances, to provide an adequate variance estimate using data over longer windows, centered around the current squared residual.[15] Baele, Bekaert, Inghelbrecht, and Wei (2020) use a similar kernel methodology to compute the persistent component in variances.

We define kernel IVROE as follows:

$$IVROE_{iq} = \sum_{k=-10}^{10} w_k (u_{iq}^{ROE})^2, \tag{10}$$

where the kernel is Gaussian with a bandwidth of 4 quarters[16]:

$$w_k = \frac{w_k^*}{\sum_{k=-10}^{10} w_k^*}, \text{ and } w_k^* = \frac{1}{4 \times \sqrt{2\pi}} e^{-\frac{\left(\frac{k}{4}\right)^2}{2}}. \tag{11}$$

That is, the kernel estimate for quarter q puts the most weight on quarter q's squared residual (the weight is 0.101), but it also uses "nearby" squared residuals up to 10 quarters before and after the

[14] We report the parameter estimates for the panel regression in the Online Appendix Table OA3, Panel B.
[15] Alternatively, we can define a spot measure of IVROE for each quarter q as the squared residual, $(u_{iq}^{ROE})^2$. Our results are qualitatively similar using this measure.
[16] We use this bandwidth because we calculate ROE based on net income over trailing four quarters.

current quarter, with the lowest weight being 0.004. To mitigate the effect of outliers, we delete the top 1% IVROEs over the full sample.

We consider seven alternative approaches for estimating IVROE, with further details provided in the Online Appendix OA-I. In addition to the benchmark panel model, we estimate the panel model using three versions of a 20-quarter estimation (two rolling window approaches and a non-overlapping window approach). We also consider a more parsimonious model, using the country's and the world's ROE as factors, which we estimate at the firm level using the four approaches used for the panel model (full sample and three versions of the 20-quarter estimation). For all these models, we verify that the residuals do not feature substantive common components by tabulating properties of the cross-country residual correlations (see Online Appendix Table OA4).[17] While we show the results for the full sample panel model, we derive all ensuing results for all eight models and they prove remarkably robust. We therefore retain the full sample panel model.

Summary statistics for IVROE are reported in Panel A of Table 4, Columns I and II. For each country, we report the time-series averages of the cross-sectional medians of firm-specific IVROE in Column I. The median IVROE is the highest for Norway at 0.018 and lowest for Japan at 0.002. For the U.S., the median IVROE is 0.007. As shown in Column II, the average country IVROE ranges between 0.005 (Japan and Singapore) and 0.023 (Norway), and the U.S. IVROE is 0.018 on average, putting it approximately at the 75th percentile of all countries.

[17] As shown in Column I, Table OA4, the average cross-country correlation of ROEs for the panel model is 0.334. The cross-country correlations are significantly lower for ROE residuals estimated from the alternative models. The rolling window methodologies, whatever model is used, deliver mostly uncorrelated residuals (the average correlation is below 0.1), whereas the full sample methodologies lead to more positive correlations, which can be on average close to 0.2.

Figure 2, Panel A presents time series of country IVROEs for Germany, Japan, the U.K., and the U.S., respectively. Both the U.K. and the U.S. feature elevated IVROEs around 2001, 2008, and 2017. The IVROE of Germany is highest in 2003, which is about the mid-point of Germany's recession then. The IVROE of Japan exhibits significantly less time variation compared to the IVROE of other countries. We observe that the IVROEs of Germany, the U.K. and the U.S seem to share substantial common variation. In addition, the time-series patterns of country IVROEs have some similarity to the dynamics of country IVRETs in Figure 1, Panel A.

4.2.2 Commonality in Country Idiosyncratic ROE Variances

To examine whether there are commonalities in country IVROEs, we start by reporting the average pairwise correlation coefficients for each country's IVROE in Panel A of Table 4, Column III. The cross-country average of pairwise correlations of country IVROEs is 0.165, with half of the countries having pairwise correlations above 20%. Overall, most of the correlations of IVROE are positive, indicating the existence of commonality. It is also clear that the correlation coefficients are substantially lower than those associated with idiosyncratic return variances.[18]

In parallel to the global IVRET, which captures most of the commonality of the country IVRETs, we compute the global IVROE, $IVROE_q^G$, as the value-weighted average of country level IVROE in quarter q. $IVROE^G$ has a mean of 0.014 and a standard deviation of 0.004. We present the time-series plot for $IVROE^G$ in Figure 2, Panel B. $IVROE^G$ peaks around 2000 and in the global financial crisis in 2008, similar to $IVRET^G$, except that $IVROE^G$ also shows a recent peak after 2016.

[18] The lower correlations of IVROE may arise from the low frequency nature of ROEs. It is also conceivable that ROEs are driven mostly by firm-specific decisions, whereas return variation also relates to discount rate variation and investor expectations. Section 4.3 investigates several alternative factors. Our panel full sample methodology to estimate IVROE does deliver a very conservative estimate of the comovement, as the alternative methodologies all deliver higher average correlations, varying between 0.178 and 0.234.

Can the commonality in IVROE be captured by the global IVROE? Following the specification in equation (3), we estimate the following time-series regression by country:

$$IVROE_q^C = \alpha_C^{ROE} + \beta_C^{ROE} IVROE_q^G + \varepsilon_q^{C,ROE} . \quad (13)$$

The loadings on the global IVROE, β_C^{ROE}, reported in Column IV of Table 4, are positive in 18 out of 23 countries, and are statistically significant in most cases, implying that most of the country-level IVROEs move in the same direction as $IVROE^G$. The adjusted R^2 in Column VI is on average 0.205, varying between 0.426 and 0.753 for the largest countries (Japan, the U.K., and the U.S.), indicating that the global IVROE does explain a significant part of the time variation in country IVROEs. Column VII further presents the pairwise correlations of the residuals $\varepsilon_q^{C,ROE}$, which are on average 0.086, much lower compared to the pairwise correlations of country IVROE of 0.165, confirming that the global IVROE absorbs a significant part of the positive correlations among country IVROEs. In comparison with the results in Table 2, the explanatory power of global IVROE for country IVROE is weaker than that of global IVRET for country IVRET.

In addition to the regression approach for explaining the commonality in country IVROEs, we also adopt a principal component analysis approach and show an alternative perspective for commonality of country IVROEs. In Table 4, Panel B, the first two PCs of country IVROE explain 64.4% and 17.6% of the cross-sectional variation in country IVROEs, respectively, suggesting a factor structure. The first PC has a correlation of 0.644 with the global IVROE, indicating that $IVROE^G$ probably captures the most important part of the country IVROEs' commonality.[19]

[19] ΔIVROE also exhibits commonality. For example, across countries, the average coefficient on global ΔIVROE in the regression of country ΔIVROE on global ΔIVROE is 0.554. The first PC of country ΔIVROE explains 46.9% of the cross-sectional variation in country ΔIVROEs, and has a correlation of 0.332 with the global ΔIVROE. When computing ΔIVROE, we cannot calculate it as the first difference in IVROE because of overlapping data used in constructing IVROE, i.e. we compute ROE as the trailing 4-quarter net income divided by common equity at the beginning of the period to accommodate seasonality, and our original IVROE is constructed using a kernel method

The evidence in this section suggests that similar to idiosyncratic return variances, idiosyncratic cash flow variances also exhibit international commonality, which can be captured by $IVROE^G$. Can $IVROE^G$ explain the time variation in $IVRET^G$? We address this question in Section 4.4, after we introduce other potential determinants of $IVRET^G$.

4.3 Other Determinants of Global IVRET

In this section, we introduce the remaining five discount rate and cash flow variables that might help explain idiosyncratic return variances. We provide economic justification for these variables, relegating technical details on their construction to the Appendix. All state variables are based on the Datastream World Market Index at the quarterly frequency.

We begin with discount rate variables. There is much evidence that discount rates move quite non-linearly over business cycles and may contain both short-term and more persistent components (e.g. Henkel, Martin, and Nardari (2011), Martin (2017), and Bekaert, Engstrom and Xu (2022)). Thus, both the level and variability of discount rates may matter. For measurement purposes, we first estimate the conditional variance of global market returns, *ACV*. Bekaert, Hodrick, and Zhang (2012) find an estimate of aggregate return uncertainty to be significantly linked to aggregate idiosyncratic uncertainty in the U.S., a result recently confirmed by Bartram, Brown, and Stulz (2017). In our model, this variance is spanned by discount rate and cash flow uncertainty so that we can equivalently employ this aggregate market return uncertainty and cash flow uncertainty as the two state variables. To measure the conditional variance, we adapt the

that employs data over (-10, +10) quarters. Therefore, we use spot IVROE as an alternative and calculate ΔIVROE as the change in spot IVROE between the current quarter and 4 quarters before, i.e. $\Delta IVROE_{iq} = (u_{iq}^{ROE})^2 - (u_{iq-4}^{ROE})^2$. Notice that spot IVROE, measuring variance using one observation, provides a noisier measure of the true IVROE than the kernel approach. The results are available upon request.

state-of-the art models using realized variances in Corsi (2009) and Bekaert and Hoerova (2014) to the quarterly frequency.

The second state variable is the global discount rate *ADR*, which is the conditional expected global market gross return. While it is well-known that dividend yields predict equity returns, recent literature has stressed more fast-moving predictable components, using the variance risk premium in particular. Therefore, we compute *ADR* as the fitted value from the following regression specification:

$$\ln(1 + RET_q) = a + bACV_{q-4} + cADY_{q-4} + d\left(VIX_{q-4}^2 - ACV_{q-4}\right) + u_q, \tag{14}$$

where RET_q is the return on the Datastream World Market Index over quarters (q-3, q), ACV is the conditional market variance, ADY is the global dividend yield. The last independent variable is the variance premium measured by the difference between the squared VIX index and the conditional market variance, which was first shown to predict equity returns in Bollerslev, Tauchen, and Zhou (2009). Under the null of the CAPM, the aggregate conditional variance should capture time variation in risk premiums, but the variable has proven to be a weak predictor of future stock returns. By including the highly persistent dividend yield, likely the most popular predictor of stock returns, and the much less persistent variance risk premium, the specification potentially embeds both a persistent and more rapidly mean-reverting component in expected stock returns.

The three remaining state variables characterize cash flow growth dynamics. Given our focus on ROE as the cash flow concept, we focus on global ROE, to verify whether its global component drives time variation in global IVRET. Global ROE is computed as net income (NI) divided by lagged book value (BV) of the Datastream World Market Index, and we code *AROE* as the natural logarithm of (1+ global ROE). Zhang (2010) suggest using the variability of ROE directly as a fundamental source of idiosyncratic return variability in the U.S. To measure the conditional aggregate variance of cash flows, *AEV*, we estimate a GARCH-in-Mean specification for *AROE* using maximum likelihood.

Lastly, we propose a measurement of the growth opportunity variable (*AGO*) of Cao, Simin and Zhao (2008). Both Zhang (2010) and Cao, Simin and Zhao (2008) use the market to book asset ratio (*maba*) to measure growth opportunities and explain time-variation in U.S. idiosyncratic volatilities. It is conceivable that growth opportunities have a global component that may explain commonality in IVRET across countries, but *maba* is a valuation ratio that should reflect variation in discount rates, cash flows from assets in place and growth opportunities and their variability. We improve upon the measurement of *AGO* through the lens of a simple pricing model, which predicts the earnings yields to be a function of all the state variables introduced here, and computes *AGO* as the unobserved residual. The growth opportunity variable should represent the part of the earnings yield that is unrelated to discount rates, cash flows and their variances, and by definition increases expected earnings growth and also the variability of the firm's future cash flows. Using the model's implication for the earnings yield (AEY), we then obtain *AGO* as the residual from the following regression:

$$AEY_q = a + bAROE_q + cACV_q + dADR_q + eAEV_q - AGO_q. \tag{15}$$

We further confirm the validity of *AGO* as a growth opportunity variable by verifying its ability to predict earnings growth.[20]

4.4 Explaining the Global Component in Idiosyncratic Return Variances

[20] In each quarter, we calculate EBIT growth for the Datastream Total Market Index as the growth rate of trailing 4-quarter EBIT over the same quarter of the previous year. A projection of this annual earnings growth rate at t+k on AGO_t yields statistically significant coefficients on AGO_t (at the 10% level or better) for k = 4 through 6. The predictive power is strongest for earnings growth one year ahead (k = 4) with a coefficient (t-statistic) of 7.185 (2.55) and an adjusted R^2 of 0.162. We report the regression results in Online Appendix Table OA5, Panel A.

Table 5, Panel A reports the summary statistics and correlations for the global IVRET and all the state variables. Compared to global IVRET, global IVROE has a lower mean and standard deviation, at 1.44% and 0.33%, respectively. The conditional variance of global returns *ACV* has a mean of 1.80% and a standard deviation of 2.12%. The discount rate *ADR* is on average 7.97%, with a 6.07% volatility. The latter is quite high, consistent with recent work by Martin (2017) and Bekaert, Engstrom, and Xu (2022). In comparison, the *AROE* has a higher mean at 11.13%, and a lower volatility of 2.20%, which is consistent with the smooth nature of cash flow variables. Note that the mean of the growth opportunity variable is zero (as it represents the residual from a regression).

We first link the state variables to global IVRET by presenting correlations, which are presented in the last row of Panel A of Table 5. The correlations with the global IVRET range between -0.453 and 0.522, with the highest correlation achieved by the global IVROE, suggesting that $IVROE^G$ might have the highest explanatory power for global IVRET. The lowest correlation is recorded for the discount rate *ADR* at -0.453, which is surprising because it is typically surmised that discount rates are countercyclical (see e.g. Campbell and Cochrane, 1999). We verified that the negative correlation with idiosyncratic variances is mostly driven by the extreme low discount rate period occurring during the Tech Boom, which coincided with very elevated idiosyncratic variances. The correlation between global IVRET and the conditional market variance is 0.426, which is pretty high, implying that the market uncertainty is positively related to idiosyncratic uncertainty (see e.g. Bartram, Brown, and Stulz (2017) and Barinov and Chabakauri (2021) for U.S. evidence).

To further investigate what explains the global component of the idiosyncratic return variances, we project it on the six state variables suggested by the model one by one, and we include all the state variables together in the final regression. From Table 5, Panel B, all the six state variables have significant coefficients (at the 10% level) in univariate regressions I to VI, which is consistent with the correlation results above. Global IVROE has a positive and highly significant coefficient, and by itself produces an adjusted R^2 of 0.267. The coefficient on the conditional market variance is also positive and significant, but compared to global IVROE, its explanatory power is weaker with an adjusted R^2 of 0.175. High discount rates are associated with low IVRET. The coefficient is -0.286 with a t-statistic of -5.68, and the adjusted R^2 is 0.199. The remaining three state variables also have significant coefficients but they generally only have limited explanatory power. For instance, better growth opportunities are associated with high IVRET, with a coefficient of 0.816 (t=2.14) and an adjusted R^2 of 0.028. This result is consistent with the finding in Cao, Simin, and Zhao (2008) and Bekaert, Hodrick, and Zhang (2012) that the market to book ratio is significantly correlated with the aggregate idiosyncratic return variance, which they interpret as a growth opportunity effect. Our result is stronger in that we use a price variable cleansed of discount rate effects and shown to predict future earnings growth.[21]

In regression VII, when all the state variables are included, the adjusted R^2 is 0.602, and all state variables are statistically significant except *AEV*.[22] We report a covariance decomposition for regression VII in the last column. That is, for each state variable $X_{t,k}$, we report the estimate of $cov(\widehat{y_t}, \widehat{\beta_k} X_{k,t})/var(\widehat{y_t})$, where $\widehat{y_t}$ is the fitted value of the regression for the dependent variable, and $\widehat{\beta_k}$ is the regression coefficient for state variable k. This decomposition adds to 100% across

[21] To verify the robustness of our results to an alternative growth opportunity variable, we recalculate our results using the market to book ratio for the Datastream World Market Index, and report the results in Online Appendix Table OA5, Panel B and Panel C. We find the M/B ratio to be a significant determinant of the global IVRET variable, but it fails to predict future earnings growth, so that it is not clear it really captures growth opportunities.

[22] While the R^2 is high for the linear regression, it may not fully reflect the explanatory power of these state variables (in the pricing model formulated in the Appendix, higher-order functions of the state variables also affect returns). To allow nonlinearities, we project the global IVRET on the levels, squares and cross-products of the state variables. The adjusted R^2 increases to 0.824. The regression results are reported in the Online Appendix Table OA6.

the different explanatory variables. Three state variables contribute meaningfully to variation in idiosyncratic variances, global IVROE (accounting for 34.2% of the explained variation), the discount rate (accounting for 29.2%), and the conditional market variance (accounting for 23.7%).[23]

Overall, our results suggest that the time-series variation of the global idiosyncratic return variance is most substantially related to the global idiosyncratic cash flow variance, aggregate discount rate variation, and the conditional market variance.

5. Cyclicality of Idiosyncratic Variances

Our results in previous sections demonstrate the commonality in idiosyncratic variances and the importance of their global components. To further characterize the dynamics of idiosyncratic variances, we study their cyclical patterns in this section. Previous literature has not reached a consensus on the cyclicality of idiosyncratic variances. The models of Cao, Simin and Zhao (2008) and Pastor and Veronesi (2003, 2006) suggest that the idiosyncratic variances are procyclical, meaning they are high in good economic times, but low during recessions because of the convex relation between future payoffs and variability. The macro literature, on the other hand, proposes that high uncertainty predicts future economic slowdowns.[24] The time-series plots of idiosyncratic variances in Figures 1 and 2 also seem to suggest that they tend to increase in

[23] Our results are robust to our seven alternative methods to estimate IVROE. The coefficient on global IVROE is always significant, and the variation explained by global IVROE based on the covariance decomposition is 26.4% when averaged across the seven alternative methods. We also estimate the model in Panel B of Table 5 using $\Delta \mathrm{IVRET}^{\mathrm{G}}$ and $\Delta \mathrm{IVROE}^{\mathrm{G}}$. The results are qualitatively similar: $\Delta \mathrm{IVROE}^{\mathrm{G}}$ explains 30.1% of the variation in $\Delta \mathrm{IVRET}^{\mathrm{G}}$, with a coefficient of 8.504 and t-stat of 7.43. The covariance decomposition in the last column suggests that $\Delta \mathrm{IVROE}^{\mathrm{G}}$ is still the most important explanatory variable. The results are available upon request.

[24] Kozeniauskas, Orlik, and Veldkamp (2018) examine the relation between various types of uncertainty, including uncertainty based on firm-specific data. Aggregate idiosyncratic variances are a good proxy for this micro uncertainty.

recessions.[25] In this section, we formally examine the cyclicality of idiosyncratic variances in our global sample.

To measure business cycles, we focus on NBER business cycle dates and GDP growth following Campbell, Lettau, Malkiel, and Xu (2001). We define *NBER expansion* as a dummy variable that is one during an NBER-dated expansion and zero during an NBER-dated recession. For global GDP growth, we obtain seasonally adjusted nominal GDP and GDP deflator data aggregated over all OECD countries from the OECD. We first compute real GDP by deflating nominal GDP by the GDP deflator. Next, we calculate the annualized growth rate of real GDP in quarter q as follows:

$$\Delta GDP_q^G = \frac{\sum_{k=0}^{3} GDP_{q-k}^G}{\sum_{k=4}^{7} GDP_{q-k}^G} - 1. \tag{16}$$

To establish cyclicality, following the approach adopted by Campbell et al. (2001), we first compute the correlations between our global IVRET and IVROE measures and both business cycle indicators, at different leads and lags up to one year. Positive correlations indicate cyclicality, and negative correlations indicate counter-cyclicality. In addition, we also connect global IVRET and IVROE to future and current GDP growth:

$$\Delta GDP_{q+4}^G = \alpha_1^{GDP} + \beta_1^{GDP,IVRET} IVRET_q^G + \beta_1^{GDP,\Delta GDP} \Delta GDP_q^G + \beta_1^{GDP,MKT} MKT_q^G + e_{1,q+4}, \tag{17}$$

$$\Delta GDP_q^G = \alpha_2^{GDP} + \beta_2^{GDP,IVRET} IVRET_q^G + \beta_2^{GDP,\Delta GDP} \Delta GDP_{q-4}^G + \beta_2^{GDP,MKT} MKT_{q-4}^G + e_{2q}. \tag{18}$$

where MKT_q^G is the global market return using the Datastream Total Market Index. A positive $\beta^{GDP,IVRET}$ implies that global IVRET is procyclical with respect to the global business cycle; a

[25] Our pricing model in the Appendix features both mechanisms. Increases in idiosyncratic variability raise prices, through the usual pricing effect, but our pricing model also features time-varying aggregate uncertainty; an increase in aggregate uncertainty may directly increase discount rates and therefore decrease prices. With both effects present, the model is potentially consistent with the simultaneous occurrence of high levels of idiosyncratic variability and high prices in, for example, the Tech boom of the 1990s, together with the elevated levels of systematic and idiosyncratic variability in, for instance, the 2008 financial crisis.

negative coefficient suggests counter-cyclicality. The second specification examines the contemporaneous relationship; the first specification verifies whether IVRET predicts further GDP growth. Similar specifications are applied to global IVROE.

5.1 Cyclicality of IVRET

We first report the correlation between global IVRET and NBER expansion at leads and lags up to a year in the first column of Table 6, Panel A. We find that all correlations between global IVRET and NBER expansion are negative, mostly statistically significant, implying that global IVRET exhibits counter-cyclicality with respect to the U.S. cycle. When we use GDP growth as business cycle indicator, the pattern is slightly different from that using NBER dates. The correlations monotonically decrease from the top to the bottom: global IVRET is positively correlated with lag 4-quarter GDP growth, with a coefficient of 0.237; then it gradually decreases to 0.117 at lag 1; the contemporaneous relation is 0.040 (statistically insignificant); the correlation slowly turns negative to -0.053 for one-quarter ahead GDP growth; eventually, the correlation becomes significantly negative at -0.144 for 4-quarter ahead GDP growth. The negative correlations with future GDP growth confirm several recent macro papers, such as Bloom (2009) and Jurado, Ludvigson, and Ng (2015), which suggest that "uncertainty" is negatively linked to future economic activity. However, we also observe positive correlations for lagged GDP growth, inconsistent with counter-cyclical behavior for IVRET.

We report the regression results in Panel B of Table 6. In the first regression, we find that when used to predict future GDP growth, global IVRET has a coefficient of -0.034, with an insignificant t-stat of -0.61. In regression II, when used to explain contemporaneous GDP growth, global IVRET has a coefficient of -0.021 with a t-stat of -0.39. Thus, while the negative coefficients indicate counter-cyclicality, we find no statistical evidence in favor of counter-cyclicality of IVRET at the global level.

5.2 Cyclicality of IVROE

In the remaining columns in Table 6, Panels A and B, we report analogous results for global IVROE. All correlation coefficients are negative for both business cycle indicators. The regressions based on equations (17) and (18) also deliver significantly negative coefficients on global IVROE, as shown in Column III (IV) of Panel B: the coefficient of IVROE is -0.619 (-0.533) with a t-statistic of -2.47 (-2.03), for the predictive (contemporaneous) regression. We observe stronger counter-cyclicality for global IVROE than for IVRET, especially when using the GDP growth measure. The strong counter-cyclicality of IVROE is interesting, because IVROE matches well with uncertainty concepts in the macroeconomic literature. For example, the "risk shock" in Christiano, Motto, and Rostagno (2014) measures uncertainty about the productivity of a firm's capital investment, which is more closely related with the IVROE concept than, with say, return variances or aggregate GDP uncertainty. We are not aware of anyone in the macroeconomic literature measuring uncertainty shocks using a cash flow concept such as ROE.

5.3 Robustness Checks and Further Discussion

In this section, we first investigate the cyclicality of idiosyncratic variances at the country level. While $IVRET^G$ and $IVROE^G$ explain a significant portion of the cross-sectional variation in country idiosyncratic variances, our global GDP growth measure may still miss considerable country-specific variation in business cycles. Recall that for global idiosyncratic variances, countercyclicality is only statistically present for cash flows, but not for returns; the country-by-country evidence, however, is more uniform. In Table 6, Panel C, we report the summary statistics of correlations between country IVRET (IVROE) and country GDP growth.[26] We observe a clear pattern of counter-cyclicality with respect to future GDP growth: for example, out of the 23 countries, 21 (16) show negative correlations between IVRET (IVROE) and lead 4-quarter GDP growth, and 15 (11) of these correlation coefficients are statistically significant.

In our analysis above, we use NBER recession dates and GDP growth rates to measure cyclicality. As robustness checks, we also compute cyclicality using two alternative cyclicality measures. Our first alternative measure is the output gap, computed as the difference between the quarterly GDP level and a quadratic trend, estimated over the full sample. Our second alternative measure uses Hodrick-Prescott (1997) filtered GDP levels (HPGDP henceforth), where the smoothing parameter is set to 1600. These measures are positively correlated with GDP growth rates, but the correlations are below 0.50. From Panel D of Table 6, the results with alternative cycle measures are mostly consistent with those in Panel A and B, in the sense that IVRET and IVROE are mostly counter-cyclical, but statistical significance is lacking.

One possible explanation for the lack of statistical significance over the full sample is that the cyclicality of IVROE and IVRET varies over time. To better understand whether this is the case, we compute rolling-window correlations between global idiosyncratic variances and GDP growth rates. That is, in each quarter q, we calculate the correlation over the quarters (q-19, q) between the global idiosyncratic variance with global GDP growth at quarter q. We plot the rolling correlations for IVROE and IVRET in Figure 3, Panels A and B, respectively. For IVRET, 55.7% of the correlations are negative, but they become positive around the internet bubble period between 1995 and 2005, and turn slightly positive again after 2015. For IVROE, more than 60% of the correlations are negative, except for a short period between 1997 and 2005, and after 2015.

[26] The country-by-country results are reported in the Online Appendix Table OA7.

Thus, while countercyclicality dominates slightly when using GDP growth rates to measure cyclicality, IVRET and IVROE quite often are procyclical as well. This is not surprising from the perspective of the six economic state variables we introduced earlier to explain the time variation of IVRET (see also the pricing model in the Appendix). Idiosyncratic variances can be procyclical or countercyclical depending on the cyclicality of the state variables and variation in their relative importance over time. For instance, the model can generate temporary procyclicality when the relative importance of procyclical variables (to which IVRET is positively exposed), such as the growth opportunity variable (AGO), increases. In fact, one test of the model is to verify that the residuals no longer show any cyclical behavior, suggesting the model is able to capture the cyclical patterns.[27]

Our relevant empirical results are in Table 7. In Panel A, we first document the cyclicality of the state variables by calculating the correlation between the state variables and the global GDP growth rate. We show that the conditional variance (ACV) and discount rate (ADR) are countercyclical, while the ROE (AROE) and growth opportunity (AGO) variables exhibit procyclicality. Because IVRET loads on the discount rate with a negative sign, its variation induces procyclical behavior (such as during the Tech Boom). We then take the residual from the regression of $\mathrm{IVRET}^{\mathrm{G}}$ on the six state variables, i.e. $\mathrm{IVRET}^{\mathrm{G}}$ residual, and examine its relation with GDP growth in Table 7, Panel B: the correlation between $\mathrm{IVRET}^{\mathrm{G}}$ residual and GDP growth is economically low and statistically insignificant. Thus, the state variables proposed by our model capture the time variation in the cyclicality of $\mathrm{IVRET}^{\mathrm{G}}$. In addition, as we did for IVRET we compute rolling-window correlations over quarters (q-19, q) between the predicted $\mathrm{IVRET}^{\mathrm{G}}$ from

[27] We thank a referee for pointing this out and suggesting the subsequent analysis.

the regression of IVRET on the six state variables ($\widehat{\text{IVRET}}^{\text{G}}$) and global GDP growth. We thus obtain a time series of correlations between $\widehat{\text{IVRET}}^{\text{G}}$ and global GDP growth. We find that these rolling-window correlations are highly correlated with the rolling window correlations between global IVRET and global GDP growth, with a correlation coefficient of 0.713 and p-value<0.001. We also graph them in Figure 3, Panel A; the correlation is 49.1% (50.9%) of the time negative (positive), and clearly matches the correlation using IVRET directly quite well throughout the sample.

Of course, these calculations assume that the dependence of IVRET^{G} on the state variables is stable over time. It is conceivable that the state variable exposures are themselves cycle dependent. To verify this, we re-estimate the regression of IVRET^{G} on the state variables during NBER expansion periods. The results (available upon request) show that IVROE^{G} remains the most important variable to explain the time variation in IVRET^{G}; in fact, the coefficients are quite similar to the full sample coefficients, with some exceptions, including reduced dependence on the conditional variance variables and increased dependence on the growth opportunity variable. For example, the adjusted R^2 of the regression of IVRET^{G} on the procyclical growth options variable (AGO) increases from 0.028 (full sample period) to 0.151 (expansion period). In the regression with all state variables, AGO now accounts for 19.2% of the explained variation, compared to 4.7% in the full sample result.

6. Conclusion

This article first shows that aggregate idiosyncratic return variances at the country level are highly correlated, often more highly correlated than are actual returns. The global idiosyncratic return variance, which we dub $IVRET^G$ explains a substantial fraction of country-level idiosyncratic return variances. We find that this commonality does not mechanically arise from a missing risk factor. Instead, the global idiosyncratic cash flow variance, $IVROE^G$, explains a substantial fraction of the variation in $IVRET^G$. The idiosyncratic cash flow variance is calculated in a novel way using the residuals from a factor model with time-varying factor loadings. Idiosyncratic cash flow variances at the country level exhibit similar but somewhat weaker international commonality than do idiosyncratic return variances.

In addition to $IVROE^G$, the global discount rate and the conditional market variance help explain a substantial fraction of the variation in $IVRET^G$. Other variables such as the growth opportunity measure, proposed in Cao, Simin, and Zhao (2008), or aggregate cash flow variability (Zhang (2010)) are much less important in relative terms. If we include all state variables together, with only linear terms, they explain more than 60% of the variation in idiosyncratic return variances. These state variables, with their own cyclicality patterns, can explain the time-varying cyclicality of $IVRET^G$. In particular, we find the global idiosyncratic return variance to be countercyclical (procyclical) 56% (44%) of the time.

Our results may prove useful input for a rapidly growing macroeconomics literature linking economic and financial uncertainty (shocks) to economic activity (see Bloom (2009), Christiano, Motto, and Rostagno (2014), and Jurado, Ludvigson, and Ng (2015)). While most of the literature resorts to aggregate return uncertainty variables, the economic concepts are more appropriately linked to cash flow uncertainty or ROE uncertainty. ROE volatility may also be a proxy for the volatility of investment shocks, which Justiniano and Primiceri (2008) argue played an important role in the Great Moderation and reflect shocks to the return on capital or the marginal efficiency of the investment technology in a DSGE model.

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Appendix

Table A1. Variable Definition

Variable	Definition
Return	Return in USD. (Source: CRSP, Datastream)
Market value	Market capitalization in USD millions. (Source: CRSP, Datastream)
MKT, SMB HML, WMKT WSMB, WHML	MKT, SMB, and HML are the country level market, size, and value factors, respectively. MKT is the value-weighted average of returns of all firms in the country. To obtain SMB, we sort all firms in each country into three size groups at the end of each June of year y. The country size factor, SMB, for July of year y to June of $y+1$ is computed as the value-weighted return difference between firms in size group 1 (smallest 1/3 firms) and size group 3 (largest 1/3 firms). Similarly, the country value factor, HML, for July of year y to June of year $y+1$ is computed as the value-weighted return difference between firms in B/M group 3 (1/3 firms with the highest BM ratios) and B/M group 1 (1/3 firms with the lowest BM ratios), where B/M is calculated using the book equity for the last fiscal year end in year y-1 and market value at the end of December of year y-1. The global variables WMKT, WSMB, and WHML are computed as the value-weighted averages of the country level factors.
IVRET	Idiosyncratic return variance. For each firm in each quarter, we calculate firm IVRET as the annualized variance of the residual u_{it} from the regression of daily excess returns on global-local Fama-French three factors: $exret_{it} = \alpha_{iq} + \beta_{iq}^{WMKT} WMKT_t + \beta_{iq}^{WSMB} WSMB_t + \beta_{iq}^{WHML} WHML_t + \beta_{iq}^{MKT} MKT_t + \beta_{iq}^{SMB} SMB_t + \beta_{iq}^{HML} HML_t + u_{it}$ Country idiosyncratic return variance, $IVRET^C$, is the value-weighted average of firm IVRETs within the country. Global idiosyncratic return variance, $IVRET^G$, is the value-weighted average of $IVRET^C$.
ROE	Return on equity, calculated as the trailing 4-quarter net income divided by common equity at the beginning of the period. For the U.S. sample, we obtain quarterly "Net Income" (NIQ) and the "Book Value of Common Equity" (CEQQ) from the Compustat quarterly file. For firms outside of the U.S., we compute ROE by dividing "Net Income" (WC01651 or DWNP) by the "Book Value of Common Equity" (WC03501 or DWSE). (Source: Compustat, Worldscope)

Variable	Definition
MKT^{ROE}, SMB^{ROE} $HML^{ROE}, WMKT^{ROE}$ $WSMB^{ROE}, WHML^{ROE}$	MKT^{ROE}, SMB^{ROE}, and HML^{ROE} are the country level market, size, and value factors, respectively. MKT^{ROE} is the value-weighted ROE of all firms in the country. SMB^{ROE} is the difference between value-weighted ROEs of the smallest 1/3 of firms and largest 1/3 of firms. HML^{ROE} is the difference between the value-weighted ROEs of the 1/3 of firms with the highest B/Ms and the 1/3 of firms with the lowest B/Ms. Global ROE factors $WMKT^{ROE}, WSMB^{ROE}, WHML^{ROE}$ are the value-weighted averages of the country level ROE factors.
IVROE	Idiosyncratic ROE variance. For each firm in each quarter, we calculate firm IVROE as the kernel estimate of the squared residual u_{it} from the panel regression of ROE on global and local ROE factors within each country: $$ROE_{iq} = \left(a_{0,i} + a_1 size_{i,q-1} + a_2 BM_{i,q-1}\right) +\left(b_0 + b_1 size_{i,q-1} + b_2 BM_{i,q-1}\right)WMKT_q^{ROE} +\left(c_0 + c_1 size_{i,q-1} + c_2 BM_{i,q-1}\right)WSMB_q^{ROE} +\left(d_0 + d_1 size_{i,q-1} + d_2 BM_{i,q-1}\right)WHML_q^{ROE} +\left(e_0 + e_1 size_{i,q-1} + e_2 BM_{i,q-1}\right)MKT_{C,q}^{ROE} +\left(f_0 + f_1 size_{i,q-1} + f_2 BM_{i,q-1}\right)SMB_{C,q}^{ROE} +\left(g_0 + g_1 size_{i,q-1} + g_2 BM_{i,q-1}\right)HML_{C,q}^{ROE} + u_{iq}^{ROE}$$ The kernel estimate of IVROE is the idiosyncratic ROE variance over 20 quarters: $$IVROE_{iq} = \sum_{k=-10}^{10} w_k (u_{iq}^{ROE})^2,$$ where the kernel is Gaussian with a bandwidth of 4 quarters: $$w_k = \frac{w_k^*}{\sum_{k=-10}^{10} w_k^*}, \text{ and } w_k^* = \frac{1}{4\times\sqrt{2\pi}} e^{-\frac{\left(\frac{k}{4}\right)^2}{2}}.$$ Country idiosyncratic ROE variance, $IVROE^C$, is the value-weighted average of firm IVROEs within the country. Global idiosyncratic ROE variance, $IVROE^G$, is the value-weighted average of $IVROE^C$.
ACV	Conditional market variance, defined as the fitted value of the following regression: $$RV_q^q = a + bVIX_{q-1}^2 + cRV_{q-1}^q + dRV_{q-1}^m + eRV_{q-1}^w + v_q$$ where RV_q^q is the average of squared daily returns of the World Market Index from Datastream in quarter q, RV_q^m is the average of squared daily returns in the last month in quarter q, and RV_q^w is the average of squared daily returns in the last week in quarter q. (Source: Datastream)

Variable	Definition
ADR	Global discount rate, defined as the fitted value from the following predictive regression for annual returns: $$\ln(1+RET_q) = a + bACV_{q-4} + cADY_{q-4} + d\left(VIX_{q-4}^2 - ACV_{q-4}\right) + u_q$$ where RET_q is the return on the Datastream World Market Index over quarters (q-3, q), and ADY is the dividend yield of the Datastream World Market Index. (Source: Datastream)
AROE	The natural logarithm of (1+ global ROE), where global ROE is net income (NI) divided by lagged book value (BV) of the Datastream World Market Index. (Source: Datastream)
AEV	Global cash flow uncertainty, defined as the fitted value of V_q estimated from the following GARCH-in-Mean system using Maximum Likelihood: $$AROE_q = a + bAROE_{q-4} + cAEY_{q-4} + dACV_{q-4} + eADR_{q-4} + fV_{q-4} + u_q$$ where $u_q \sim N\left(0, V_{q-4}\right), V_{q-4} = E_{q-4}\left[u_q^2\right] = \exp[\alpha + \beta ln(u_{q-4}^2) + \gamma AEY_{q-4} + \rho ACV_{q-4} + \varphi ADR_{q-4}]$, and AEY is the earnings yield on the World Market Index. (Source: Datastream)
AGO	Global growth opportunity, defined as the residual from the following regression: $$AEY_q = a + bAROE_q + cACV_q + dADR_q + eAEV_q - AGO_q$$ where AEY is the earnings yield on the World Market Index. (Source: Datastream)
$\Delta\mathrm{GDP}^G$	Global GDP growth. We obtain seasonally adjusted nominal GDP and GDP deflator data aggregated over all OECD countries from the OECD, and compute real GDP by deflating nominal GDP by the GDP deflator. We calculate the annualized growth rate of global real GDP, $\Delta\mathrm{GDP}^G$, in quarter q as follows: $$\Delta GDP_q^G = \frac{\sum_{k=0}^{3} GDP_{q-k}^G}{\sum_{k=4}^{7} GDP_{q-k}^G} - 1$$ (Source: OECD)

A. Model

This appendix sketches a dynamic pricing model to help interpret the dynamics of the global idiosyncratic return variance. The model is designed to be simple and tractable, and connect the global idiosyncratic return variance to aggregate and firm-specific variability of earnings growth, time-varying expected earnings growth, and time-varying discount rates, in the tradition of dynamic stock valuation models such as Ang and Liu (2004), Bakshi and Chen (2005), and Bekaert and Harvey (2000). Relative to extant dynamic valuation models, both the discount rate and cash flow process are more elaborate to accommodate time-varying volatility. The model further includes a growth opportunity variable distinct from other cash flow growth variables, as in Cao, Simin, and Zhao (2008).

We do make the simplifying assumption that firms operate in an integrated world economy. While a hybrid model with both local and global factors may be preferred, our previous results in Section 3 suggest that the global factor tends to be dominant and explains a large portion of aggregate idiosyncratic return variances in all 23 countries. We therefore focus our attention on a model that explains variation in this global idiosyncratic return variance as a function of more fundamental variables.

A1. Model Setup and Implications

We describe the global aggregate environment in Section A1.1, model dynamics at the firm level in Section A1.2, and discuss the model implications in Section A1.3. Readers not interested in the technical details of the model can skip to Section A1.3; or to Section A2, which outlines how the various state variables are measured. Section A2 also describes relevant estimation results.

A1.1 The Aggregate Environment

The global economy features an aggregate discount rate (ADR), a discount rate variance variable (ADRV), an aggregate growth opportunity (AGO), an aggregate earnings or cash flow process (AE), as well as aggregate uncertainty about earnings or cash flow shocks measured by their volatility (AEV). We use "A" to denote aggregate variables and "F" to denote firm level variables. The model consists of standard dynamic processes for discount rates and cash flows, while incorporating time-varying volatilities. One can view the model as a dynamic version of the Gordon growth model, thus there is no explicit pricing kernel.

We start with the discount rate, *ADR*. The time variation in *ADR* is driven partially by aggregate cash flow uncertainty, *AEV*, and partially by pure discount rate shocks, ε_{ADR}, which can be attributable to changes in sentiment, or economically motivated changes in aggregate risk aversion (see Bekaert, Engstrom, and Xu (2021) for more discussion). The conditional mean of the discount rate features an autoregressive term, but also depends on *AEV*. The discount rate's conditional variability depends on both aggregate cash flow uncertainty and discount rate specific volatility, *ADRV*:

$$ADR_t = \mu_{ADR} + \rho_{ADR} ADR_{t-1} + \phi_{ADR,AEV} AEV_{t-1}$$
$$+\sigma_{ADR}\sqrt{ADRV_{t-1}}\varepsilon_{ADR,t} + \sigma_{ADR,AEV}\sqrt{AEV_{t-1}}\varepsilon_{AEV,t}. \quad \text{(A.1)}$$

The model subsumes several discount rate models such as a constant; a pure sentiment shock model ($\phi_{ADR,AEV} = \sigma_{ADR,AEV} = 0$) where the discount rate is persistent but is shocked by sentiment news; a model in which the discount rate is driven by aggregate cash flow variability ($\rho_{ADR} = \sigma_{ADR} = \sigma_{ADR,AEV} = 0$). In the latter case, aggregate return variability should be driven by cash flow variability, and thus the model is consistent with the implications of the CAPM for the aggregate risk premium (see e.g., French, Schwert, and Stambaugh (1987)). All shocks (ε's) in the model follow independent N (0,1) distributions.

The discount rate specific uncertainty, *ADRV*, follows a simple autoregressive square root process:

$$ADRV_t = \mu_{ADRV} + \rho_{ADRV} ADRV_{t-1} + \sigma_{ADRV}\sqrt{ADRV_{t-1}}\varepsilon_{ADRV,t}. \tag{A.2}$$

The aggregate cash flow uncertainty, *AEV*, follows a square root process as well. The conditional mean of aggregate cash flow uncertainty has an autoregressive component, but also depends on a growth opportunity state variable, *AGO*, as suggested by Cao, Simin, and Zhao (2008)[28]:

$$AEV_t = \mu_{AEV} + \rho_{AEV} AEV_{t-1} + \phi_{AGO} AGO_{t-1} + \sigma_{AEV}\sqrt{AEV_{t-1}}\varepsilon_{AEV,t}. \tag{A.3}$$

The growth opportunity variable, *AGO*, is modeled as a first order autoregressive process:

$$AGO_t = \rho_{AGO} AGO_{t-1} + \sigma_{AGO}\varepsilon_{AGO,t}. \tag{A.4}$$

Of course, growth options should, by definition, increase earnings growth in the future when they are realized, and thus, growth options should affect expected earnings growth. We first define aggregate earnings growth, *AEG*, as follows:

$$AEG_t = ln\frac{EA_t}{EA_{t-1}}, \tag{A.5}$$

where EA is total earnings. Then we model the conditional mean of aggregate earnings growth, *AEG*, as driven by *AGO* and the one-period lagged aggregate ROE, *AROE*, measured as net income divided by book equity. This assumption follows a long tradition in the accounting literature (Nissim and Ziv, 2001). In this study, we choose ROE as the key cash flow variable, because earnings growth rates can be quite noisy, especially at firm level. In the earnings growth model, ROE naturally captures the profitability of assets in place:

[28] They rely on the standard intuition that a firm's equity is a call option on the firm's assets, giving a firm's manager an incentive to increase the variance of the firm. The manager can do so by selecting investments with the most non-systematic risk from the opportunity set. That is, while assets in place generate a particular conditional variance of future cash flows, the arrival of a growth option adds to the uncertainty of the future cash flows, thus increasing the conditional variability of the firm's future cash flows. We assume such a mechanism at the aggregate level.

$$AEG_t = \mu_{AEG} + \phi_{AEG,AROE} AROE_{t-1} + \phi_{AEG,AGO} AGO_{t-1}$$

$$+\sigma_{AEG}\, \varepsilon_{AEG,t} + \sigma_{AEG,AEV} \sqrt{AEV_{t-1}} \varepsilon_{AEV,t}. \tag{A.6}$$

Note that the time-variation in earnings variance is driven by *AEV* but there is also a homoskedastic shock.

The conditional mean of *AROE* depends on its own past, the aggregate discount rate, and the growth opportunity variable. Moreover, its conditional variance depends on cash flow uncertainty:

$$AROE_t = \mu_{AROE} + \rho_{AROE} AROE_{t-1} + \phi_{AROE,ADR} ADR_{t-1} + \phi_{AROE,AGO} AGO_{t-1}$$

$$+\sigma_{AROE} \varepsilon_{AROE,t} + \sigma_{AROE,AEV} \sqrt{AEV_{t-1}} \varepsilon_{AEV,t} \tag{A.7}$$

While the fundamental cash flow variable is at first glance earnings growth, the time variation in its conditional mean is spanned by *AROE* (to reflect the growth in earnings of assets in place) and the unobserved growth opportunity variable, *AGO*. The *AROE* process depends on the *AGO* variable as well, and then we let it also depend on both past roe and the discount rate. It is natural to expect firms with high ROE's relative to their costs of capital to grow and expand future earnings. However, ROE may also be expected to be mean reverting for a variety of reasons (abnormal values being caused by temporary factors; high ROEs should invite competition etc., see Nissim and Ziv (2001) for some evidence). This could lead to negative $\phi_{AEG,AROE}$ coefficient. Note that *AEV* spans time variation in the conditional variance of both *AEG* and *AROE* and thus captures time variation in aggregate cash flow uncertainty.

Altogether, the pricing model so far is characterized by five state variables that we collect in the state vector $X_t = [ADR_t, ADRV_t, AGO_t, AROE_t, AEV_t]'$.

In general, we assume that earnings are positive and are all paid out. Imagine the "global market" claim to all earnings; $EA_{t+j}, j = 0, 1, \ldots, \infty$.

By definition of the discount rate:

$$P_t = E_t[\exp(-ADR_t)(P_{t+1} + EA_{t+1})] \tag{A.8}$$

Or, to allow for a stationary representation,

$$PE_t = \frac{P_t}{EA_t} = E_t\{\exp(-ADR_t)[\exp(AEG_{t+1}) + \exp(AEG_{t+1})PE_{t+1}]\} \tag{A.9}$$

So,

$$PE_t = E_t\{\sum_{j=1}^{\infty} \exp[\sum_{i=1}^{j}(-ADR_{t+i-1} + AEG_{t+i})]\} \tag{A.10}$$

Thus, the PE solution is of the following form:

$$PE_t = \sum_{j=1}^{\infty} q_{t,j}, \tag{A.11}$$

where

$$q_{t,j} = E_t\{\exp[\sum_{i=1}^{j}(-ADR_{t+i-1} + AEG_{t+i})]\} \tag{A.12}$$

First note:

$$q_{t,1} = \exp(ADR_t + \mu_{AEG} + \phi_{AEG,AROE}AROE_t + 0.5\sigma_{AEG}^2 + AGO_t + 0.5\sigma_{AEG,AEV}^2 AEV_t) \tag{A.13}$$

The general form of the solution will be:

$$q_{t,j} = \exp(A_j + B_j ADR_t + C_j AGO_t + D_j AEV_t + F_j AROE_t + G_j ADRV_t) \tag{A.14}$$

The expressions for the various coefficients are easily found by induction, and follow difference equations, which can be filled in recursively.

Using $q_{t,n+1} = E_t[\exp(-ADR_t + AEG_{t+1})\ q_{t+1,n}]$ and properties of the log-normal distribution, we find:

$$A_{n+1} = \mu_{AEG} + \frac{1}{2}\sigma_{AEG}^2 + A_n + B_n\,\mu_{ADR} + D_n\,\mu_{AEV} + F_n\,\mu_{AROE} + G_n\,\mu_{ADRV} \tag{A.15}$$

$$B_{n+1} = -1 + B_n\,\rho_{ADR} + F_n\,\phi_{AROE,ADR} \tag{A.16}$$

$$C_{n+1} = 1 + C_n\,\rho_{AGO} + C_n^2\,\frac{\sigma_{AEG}^2}{2} + D_n\,\phi_{AGO} + F_n\,\phi_{AROE,AGO} \tag{A.17}$$

$$D_{n+1} = \frac{\sigma^2_{AEG,AEV}}{2} + B_n\left(\phi_{ADR,AEV} + \sigma_{AEG,AEV}\,\sigma_{ADR,AEV}\right) + B_n^2\,\frac{\sigma^2_{ADR,AEV}}{2}$$

$$+D_n\left(\rho_{AEV} + \sigma_{AEV}\,\sigma_{AEG,AEV}\right) + D_n^2\,\frac{\sigma^2_{AEV}}{2} + F_n\sigma_{AROE,AEV}\,\sigma_{AEG,AEV}$$

$$+B_n\,D_n\,\sigma_{ADR,AEV}\,\sigma_{AEV} + B_n\,F_n\,\sigma_{ADR,AEV}\,\sigma_{AROE,AEV} + D_n\,F_n\,\sigma_{AEV}\,\sigma_{AROE,AEV} \quad \text{(A.18)}$$

$$F_{n+1} = \phi_{AEG,AROE} + F_n\,\rho_{AROE} + F_n^2\,\frac{\sigma^2_{AROE}}{2} \quad \text{(A.19)}$$

$$G_{n+1} = \frac{1}{2}B_n^2\sigma^2_{ADR} + \frac{1}{2}G_n^2\sigma^2_{ADRV} + B_nG_n\sigma_{ADR}\sigma_{ADRV} = \frac{1}{2}\left(B_n\sigma_{ADR} + G_n\sigma_{ADRV}\right)^2 \quad \text{(A.20)}$$

Here, $Z_0 = 0$, for Z=A, B, C, D, F, G. The main intuition is mostly quite clear. For example, the B_n coefficients measure discount rate effects and are clearly negative with the persistence of the discount rate playing a large role in determining the total pricing effect. Note that the discount rate volatility effect on prices is positive, which is a pure Jensen's inequality effect. Analogously, the effect of *AGO* on prices should be positive. There are potentially countervailing effects if D_n and F_n are negative. The sign of F_j depends on how ROE affects earnings (which may have negative effects).

The coefficient of D_n is difficult to sign.

First, $D_1 = \frac{\sigma^2_{AEG,AEV}}{2} > 0$. This may be counter-intuitive: uncertainty increases prices, but it is similar to the uncertainty term stressed by Pastor and Veronesi (2009, PV hereafter). However, our model is more complex here.

First, because the σ's are positive, there are several additional "Jensen's inequality terms" that strengthen the "PV" effect. It is not clear that $\sigma_{AEG,AEV}$ and $\sigma_{ADR,AEV}$ will be "small", so these terms may be important. They will be counteracted by the positive effect of volatility on the discount rate, which unambiguously causes uncertainty to decrease prices, as $B_j < 0, \phi_{ADR,AEV} >$

$0, and\ C_j > 0$. They are difficult to sign as they depend on the sign of D_j and F_j and how they interact.

We conclude that if our prior is that uncertainty decreases prices, cash flow uncertainty should substantially increase discount rates ($\phi_{ADR,AEV}$ positive and large).

A1.2 Modeling Firms

Firms differ from one another because they have different sensitivities to the aggregate state variables we introduced, and also face idiosyncratic uncertainty about their cash flows with time-varying volatility FV_i, which follows a square root process:

$$FV_{it} = (1-\rho_i)\mu_i + \rho_i FV_{it-1} + \sigma_i\sqrt{FV_{it-1}}\varepsilon_{FV,it}. \tag{A.21}$$

Given the aggregate pricing environment, a firm is characterized by three main "systematic" exposures: its discount rate exposure, its cash flow exposure, and its aggregate volatility exposure. Specifically, for firm *i*, the firm discount rate, FDR_i, follows:

$$FDR_{it} = (1-\beta_i)r_f + \beta_i ADR_t, \tag{A.22}$$

which is a version of the conditional CAPM, assuming a constant interest rate.

Furthermore, the firm-specific earnings growth rate, FEG_i, follows:

$$FEG_{it} = \gamma_i AEG_t + \sqrt{FV_{it-1}}\varepsilon_{FEG,it}. \tag{A.23}$$

By modelling the cash flow exposure this way, the γ coefficient captures both exposures to the cash flow level variable and cash flow variability, *AEV*. Therefore, a firm is characterized by just two "systematic" exposures: discount rate exposure, β, and cash flow exposure, γ. Because firm-specific cash flow uncertainty varies through time, it affects the firm's valuation ratios and firm-specific return volatility. It would be trivial to allow additional exposures, but this simple model suffices to generate meaningful dynamics for aggregate idiosyncratic earnings variability. For this model, only one additional state variable is priced for each firm, namely firm-specific earnings volatility. The aggregate market portfolio and its return and return volatility are thus exposed to aggregate frim-specific earnings variability.

A1.3 Model Solution and Implications

Given normally distributed shocks, a firm's price earnings ratio is the infinite sum of exponentiated affine functions of the state variables, that is, the five aggregate state variables, and idiosyncratic cash flow variability. Return expressions then follow straightforwardly.

Consider the price earnings ratio for a portfolio with unit exposure to *ADR* and *AEG* and no idiosyncratic cash flow shocks. This portfolio consequently contains only systematic risk and can be viewed as a benchmark global "market" portfolio. Because of the non-linearities in the model, this portfolio's return and all its moments are a function of all state variables. We can then approximate the gross return for this portfolio as a linear function of the state variables. Conditional on this linearization, the conditional variance of this market portfolio is a function of any state variable that has a time-varying conditional variance. In this model, aggregate cash flow and discount rate uncertainty are therefore the only variables that matter. Exploiting this fact, we use the conditional market variance together with the conditional variance of cash flows as empirical proxies spanning these two types of uncertainty in the model. For an individual firm, the variability of firm-specific earnings growth is an additional variable driving its return variability, conditional on a similar linearization.

If we control for all systematic sources of return variability perfectly, the time variation in the conditional idiosyncratic return variability would primarily be a function of idiosyncratic cash flow variability. However, standard models to compute idiosyncratic variability, such as our Fama-French model, are unlikely to adjust for all systematic sources of returns, consistent with the model. Moreover, absent the linearization, computing the conditional variance of returns involves taking the conditional variance of an infinite sum of exponentials of a linear function of the state variables; thus, all state variables should matter.[29] This implies that the total volatility and idiosyncratic volatility for every firm depend on all the state variables introduced here. Finally, idiosyncratic variances represent realized, not conditional variances. It is therefore quite likely that all state variables affecting returns will have an effect on the idiosyncratic variance as computed in this article and the literature.

The pricing model thus suggests that the following variables span the aggregate idiosyncratic return variance: the aggregate discount rate, the conditional market variance, aggregate growth opportunities, the aggregate return on equity, the conditional variance of aggregate cash flows, and, importantly, the aggregate idiosyncratic cash flow variance. Our empirical approach then links the aggregate idiosyncratic return variance to the empirical proxies for these variables in a regression framework.

A2. Estimation of State Variables

We describe the estimation of five state variables: the conditional market variance (ACV), the aggregate discount rate (ADR), the aggregate ROE (AROE), the conditional aggregate variance of the cash flows (AEV), and the growth opportunity variable (AGO). The sample period is from 1986 to 2019 and the regressions are estimated at the quarterly frequency. The estimation of the idiosyncratic earnings variability is discussed at length in the main text.

A2.1 Conditional Market Variance (ACV)

We first define the quarterly realized variance, RV_q^q, as the average of squared daily returns of the World Market Index from Datastream in quarter q. Suppose week w is the last week in

[29] Veronesi (1999) and Pastor and Veronesi (2006) suggest that in a learning story, the dependence of endogenous variables on state variables may be different in good times and bad times. Such a channel to generate business cycle dependence is missing in our model.

quarter q, and month *m* is the last month in quarter q. Then our benchmark model for the quarterly conditional variance is specified as follows:

$$RV_q^q = a + bVIX_{q-1}^2 + cRV_{q-1}^q + dRV_{q-1}^m + eRV_{q-1}^w + v_q \qquad \text{(A.24)}$$

The quarterly realized variance, RV_q^q, is projected on the weekly, monthly and quarterly realized variances of daily returns, and the square of CBOE S&P 500 Volatility Index (we use the square of CBOE S&P 100 Volatility Index before 1990, and we scaled the index level by 100) at the end of the previous quarter. All return variances are annualized by multiplying by 250.

The regression results are as follows, with the first row presenting the coefficients and the second row the t-statistics.

a	b	c	d	e	Adj. R^2
0.011	-0.091	0.208	0.052	0.384	0.463
3.78	-1.02	2.05	0.74	8.84	

We use the fitted value of the regression as our measure of ACV. The insignificant coefficient on the VIX is surprising from the perspective of models that use monthly realized variances (see e.g. Bekaert and Hoerova, 2014). However, there is strong correlation between some of the dependent variables and a regression with only the past VIX and past quarterly realized variance does yield a positive and significant coefficient on the VIX.

A2.2 Aggregate Discount Rate (ADR)

We compute ADR as the fitted value from the following predictive regression for annual returns:

$$\ln(1 + RET_q) = a + bACV_{q-4} + cADY_{q-4} + d\left(VIX_{q-4}^2 - ACV_{q-4}\right) + u_q \qquad \text{(A.25)}$$

where RET_q is the return on the Datastream World Market Index over quarters (q-3, q), ACV is the conditional market variance, and ADY is the dividend yield of the Datastream World Market Index.

The regression results are as follows, with the first row presenting the coefficients and the second row the t-statistics.

a	**b**	**c**	**d**	**Adj. R^2**
-0.202	0.417	11.671	0.375	0.093
-2.67	0.52	3.27	0.87	

The dividend yield appears to be the most important predictor at this frequency. We construct ADR as the fitted value of the regression above.

A2.3 Aggregate ROE (AROE)

We focus on global ROE, which is computed as net income (NI) divided by the lagged book value (BV) of the World Market Index from Datastream. *AROE* is the natural logarithm of 1+ROE.

A2.4 Conditional Aggregate Variance of Cash Flows (AEV)

To obtain the time-series of this conditional variance, we estimate the following GARCH-in-Mean system using Maximum Likelihood:

$$AROE_q = a + bAROE_{q-4} + cAEY_{q-4} + dACV_{q-4} + eADR_{q-4} + fV_{q-4} + u_q \qquad \text{(A.26)}$$

where $u_q \sim N(0, V_{q-4}),\ V_{q-4} = E_{q-4}[u_q^2] = \exp[\alpha + \beta ln(u_{q-4}^2) + \gamma AEY_{q-4} + \rho ACV_{q-4} + \varphi ADR_{q-4}]$ with AEY_q representing the earnings yield on the World Market Index. The parameters are estimated using the Maximum Likelihood method. The fitted value of V_q is the conditional variance of cash flows.

To obtain parameter starting values for the Maximum Likelihood routine, we proceed as follows:

1) Estimate $AROE_q = a + bAROE_{q-4} + cAEY_{q-4} + dACV_{q-4} + eADR_{q-4} + u_q$;

2) Obtain the residual u from the OLS regression above and then regress $\ln(u_q^2) = \alpha + \beta ln(u_{q-4}^2) + \gamma AEY_{q-4} + \rho ACV_{q-4} + \varphi ADR_{q-4} + \varepsilon_q$ to obtain the starting values for α, β, γ, ρ, φ;

3) use the starting values obtained in 2) and calculate $\widehat{V_{q-4}} = \exp[\alpha + \beta ln(u_{q-4}^2) + \gamma AEY_{q-4} + \rho ACV_{q-4} + \varphi ADR_{q-4}]$, then run $AROE_q = a + bAROE_{q-4} + cAEY_{q-4} + dACV_{q-4} + eADR_{q-4} + f\widehat{V_{q-4}} + u_q$ to obtain the starting value of a, b, c, d, e, f.

The estimation results are as follows, with the first row presenting the coefficients and the second row t-statistics.[30]

a	**b**	**c**	**d**	**e**	**f**
0.047	0.464	-0.152	0.115	0.105	60.309
93.12	100.17	-17.99	5.76	28.07	9.93
α	**β**	**γ**	**ρ**	**φ**	**log likelihood**
-6.364	0.210	10.417	-14.487	-7.187	435.559
-84.26	26.87	7.56	-3.71	-9.48	

A2.5 Growth Opportunity (AGO)

We obtain *AGO* using the following regression:

$$AEY_q = a + bAROE_q + cACV_q + dADR_q + eAEV_q - AGO_q \quad \text{(A.27)}$$

As defined above, the growth opportunity is the negative of the residual of the projection of global earnings yield on the four state variables. That is, the growth opportunity variable represents the part of the earnings yield that is unrelated to discount rates, cash flows and their variances, and we define it such that it is negatively correlated with the earnings yield.

The regression results are as follows, with the first row presenting the coefficients and the second row the t-statistics.

[30] We tried several different starting values but this estimation proved to yield the global maximum.

a	b	c	d	e	Adj. R^2
0.039	0.162	0.287	0.032	-39.726	0.395
7.05	4.46	7.55	1.97	-3.25	

Both the conditional market variance and the discount rate yield highly significant positive coefficients; higher expected returns decrease earnings yields. The ROE effect can be explained by mean reversion in ROE, which may imply it negatively affects earnings growth.

Table 1. Summary Statistics

This table presents the summary statistics for the firms in each developed market. Column I presents the time-series average of the number of firms in each year. Column II presents the time-series average of the cross-sectional median of MV in US$ millions at quarter end. Column III presents the time-series average of the cross-sectional median of firm IVRET in each quarter. For each firm in each quarter, we calculate its IVRET as the annualized variance of the residuals from the quarterly regression of daily excess returns on global and local Fama-French 3 factors. Columns IV presents the time-series average of country IVRET. For each country in each quarter, we calculate its IVRET as the value-weighted average of firm-level IVRET within the country. The first three rows summarize the average, 25th percentile, and 75th percentile of the respective statistics across countries.

	I	II	III	IV
Country/Region	# of Firms	MV ($millions)	Firm IVRET	Country IVRET
Across Countries				
Average	536	228	0.079	0.051
P25	110	149	0.057	0.041
P75	570	326	0.094	0.061
By Country				
Australia	571	158	0.133	0.052
Austria	72	226	0.051	0.048
Belgium	101	233	0.050	0.035
Canada	786	141	0.142	0.064
Denmark	133	98	0.061	0.050
Finland	114	187	0.087	0.061
France	478	181	0.080	0.053
Germany	383	159	0.060	0.050
Hong Kong	570	176	0.120	0.066
Ireland	42	384	0.080	0.061
Israel	217	165	0.060	0.044
Italy	224	235	0.065	0.044
Japan	2,499	326	0.087	0.072
Netherlands	110	413	0.057	0.040
New Zealand	75	134	0.056	0.038
Norway	121	143	0.099	0.063
Portugal	52	176	0.061	0.049
Singapore	286	155	0.094	0.041
Spain	126	531	0.052	0.034
Sweden	251	149	0.093	0.054
Switzerland	206	375	0.053	0.030
UK	1,007	149	0.059	0.046
US	3,896	356	0.130	0.067

Table 2. Commonality in Idiosyncratic Return Variances (IVRET)

This table presents evidence of commonality in country idiosyncratic return variances (IVRET), calculated as the value-weighted firm-level IVRET in each country. Panel A presents the average pairwise correlation and the regression results. Column I (II) presents the average pairwise correlation of country IVRET (market return). For each country, we calculate the pairwise correlations of its IVRET (market return) with the IVRET (market return) of each of the other countries, and present the average pairwise correlation. Columns III-V show the regression results of country IVRET on global IVRET, where global IVRET is the value-weighted country IVRET of all countries. The t-statistics are adjusted for serial correlation using Newey and West (1987) standard errors with four lags. Column VI presents the average pairwise correlation of the residuals from this regression. The first three rows summarize the average, 25th percentile, and 75th percentile of the respective statistics across countries. Panel B presents the principal component analysis results. The first row the time-series average of the % of variation in country IVRETs explained by each principal component over 1982-1993, 1994-2006, and 2007-2019. The second row presents the time-series average of the correlation between each principal component and the global IVRET over 1982-1993, 1994-2006, and 2007-2019. Panel C presents evidence of commonality in ∆IVRET.

Panel A. Average Pairwise Correlation and Regression of Country IVRET on Global IVRET

	I	II	III	IV	V	VI
Country/	Pairwise Correlation		Regression of Country IVRET on Global IVRET			
Region	IVRET	Market Return	Coef.	t-stat	Adj. R^2	Residual Pairwise Correlation
Across Countries						
Average	0.634	0.591	0.651	6.18	0.544	0.222
P25	0.602	0.566	0.479	2.46	0.375	0.154
P75	0.698	0.631	0.790	8.03	0.698	0.357
By Country						
Australia	0.649	0.612	0.564	2.18	0.375	0.357
Austria	0.639	0.488	0.624	1.91	0.348	0.360
Belgium	0.706	0.619	0.704	2.31	0.500	0.386
Canada	0.724	0.624	0.845	7.29	0.792	0.270
Denmark	0.675	0.605	0.687	8.03	0.694	0.201
Finland	0.353	0.591	0.445	3.62	0.127	0.104
France	0.664	0.651	0.772	11.79	0.777	0.100
Germany	0.663	0.609	0.790	5.64	0.612	0.230
Hong Kong	0.583	0.483	0.722	3.63	0.384	0.241
Ireland	0.678	0.566	1.015	2.52	0.435	0.371
Israel	0.639	0.599	0.256	1.67	0.271	0.391
Italy	0.614	0.578	0.552	7.56	0.571	0.154
Japan	0.602	0.422	0.972	11.25	0.778	-0.125
Netherlands	0.705	0.674	0.713	7.73	0.698	0.286
New Zealand	0.547	0.546	0.170	2.16	0.213	0.320
Norway	0.719	0.585	0.855	5.31	0.678	0.317
Portugal	0.386	0.631	0.231	2.46	0.120	0.171
Singapore	0.590	0.485	0.527	5.09	0.494	0.154
Spain	0.685	0.650	0.388	9.70	0.677	0.201
Sweden	0.674	0.683	0.662	7.30	0.631	0.240
Switzerland	0.698	0.619	0.479	3.31	0.534	0.358
UK	0.735	0.662	0.777	10.54	0.857	0.279
US	0.655	0.613	1.226	19.22	0.952	-0.260

Panel B. Principal Component Analysis of Country IVRETs

	PC 1	PC 2	PC 3	PC 4	PC 5
% Variation Explained	70.2%	7.7%	5.7%	4.3%	3.1%
Correlation with Global IVRET	0.926	0.033	0.218	0.069	0.132

Panel C. Commonality in ΔIVRET

Average Pairwise Correlation and Regression of Country ΔIVRET on Global ΔIVRET

	I	II	III	IV	V	VI
Country/	Pairwise Correlation		Regression of Country **Δ**IVRET on Global **Δ**IVRET			
Region	**Δ**IVRET	Market Return	Coef.	t-stat	Adj. R^2	Residual Pairwise Correlation
Across Countries						
Average	0.559	0.591	0.786	6.05	0.500	0.148
P25	0.514	0.566	0.557	3.83	0.402	0.099
P75	0.627	0.631	1.039	7.58	0.579	0.224

Principal Component Analysis of Country ΔIVRETs

	PC 1	PC 2	PC 3	PC 4	PC 5
% Variation Explained	64.4%	8.7%	5.6%	4.5%	3.5%
Correlation with Global **Δ**IVRET	0.908	0.158	0.249	0.093	0.106

Table 3. A Missing Common Factor

This table provides evidence that a missing common factor is not likely to drive the strong commonality in IVRET. Panel A presents the summary statistics of cross-country correlations of return residuals. We obtain firm-level return residual $u_{i,t}$ from the following regression of daily excess returns on world and local Fama and French 3 factors :

$$exret_{it} = \alpha_{iq} + \beta_{iq}^{WMKT} WMKT_t + \beta_{iq}^{WSMB} WSMB_t + \beta_{iq}^{WHML} WHML_t$$
$$+\beta_{iq}^{MKT} MKT_t + \beta_{iq}^{SMB} SMB_t + \beta_{iq}^{HML} HML_t + u_{it}$$

For each country, we calculate the value-weighted return residual as the value-weighted average of $u_{i,t}$ within the country, and report the summary statistics of pairwise correlation of return residuals with the other countries. Panel B presents evidence of the commonality in IVRET calculated from the world-local version of five alternative models, including the Fama-French (2015) 5-factor model (FF5), Fama-French (2015) 5-factor augmented with a momentum factor (FF5+MOM), Hou, Xue, and Zhang (HXZ, 2015) 4-factor model, Stambaugh and Yuan (SY, 2017) model, and Barillas and Shanken (BS, 2018) 6-factor model. It summarizes the average pairwise correlation of country IVRETs, the time-series average of the % of variation in country IVRETs explained by each principal component, and the time-series average of the correlation between each principal component and the global IVRET over 1982-1993, 1994-2006, and 2007-2019. Column I summarizes our baseline results in Table 2 for comparison.

Panel A. Cross-Country Correlations of Return Residuals

	I	II	III
Country/Region	Average	Min	Max
Across Countries			
Average	0.036	-0.015	0.115
P25	0.025	-0.023	0.074
P75	0.049	-0.006	0.154

Panel B. Alternative Factor Models

	I	II	III	IV	V	VI
	Baseline	FF5	FF5+MOM	HXZ	SY	BS
Average Pairwise Correlation	0.634	0.621	0.624	0.641	0.629	0.663
% Variation Explained by 1st PC	70.2%	72.0%	71.8%	71.2%	69.3%	76.5%
1st PC Correlation with $IVRET^G$	0.926	0.934	0.934	0.921	0.925	0.828

Table 4. Commonality in Idiosyncratic ROE Variances (IVROE)

This table presents evidence of commonality in country idiosyncratic ROE variances (IVROE), calculated as the value-weighted firm-level IVROE in each country. IVROE is transformed using the kernel method. Panel A presents the summary statistics of IVROE, the average pairwise correlation and the regression results. Column I presents the time-series average of cross-sectional median of firm-level IVROE for each country. Column II presents the time-series average of country IVROE, which is the value-weighted average of firm-level IVROE within the country. Column III presents the average pairwise correlation of country IVROE. For each country, we calculate the pairwise correlations of its IVROE with the IVROE of each of the other countries, and present the average pairwise correlation. Columns IV-VI show the regression results of country IVROE on global IVROE, where global IVROE is the value-weighted country IVROE of all countries. The t-statistics are adjusted for serial correlation using Newey and West (1987) standard errors with four lags. Column VII presents the average pairwise correlation of the residuals from this regression. Panel B presents the principal component analysis results for country IVROE. The first row the time-series average of the % of variation in country IVROE explained by each principal component over 1982-1993, 1994-2006, and 2007-2019. The second row presents the time-series average of the correlation between each principal component and the global IVROE over 1982-1993, 1994-2006, and 2007-2019.

Panel A. Commonality in Country IVROE

	I	II	III	IV	V	VI	VII
Country/ Region	Firm IVROE	Country IVROE	Pairwise Corr.	Regression of Country IVROE on Global IVROE			
				Coef.	t-stat	Adj. R^2	Residual Pairwise Corr.
Across Countries							
Average	0.007	0.013	0.165	0.498	2.63	0.205	0.086
P25	0.004	0.009	0.011	0.151	0.62	0.022	0.021
P75	0.008	0.016	0.274	1.072	4.38	0.313	0.185
By Country							
Australia	0.008	0.010	0.352	0.404	2.84	0.195	0.258
Austria	0.003	0.007	-0.039	-0.147	-0.74	0.015	-0.013
Belgium	0.005	0.009	0.262	0.159	0.62	0.004	0.238
Canada	0.009	0.014	0.339	1.074	3.88	0.474	0.215
Denmark	0.006	0.024	0.006	3.362	3.69	0.313	-0.189
Finland	0.008	0.013	-0.080	-0.562	-1.93	0.097	0.028
France	0.005	0.009	0.102	-0.069	-0.34	-0.004	0.118
Germany	0.007	0.016	0.258	0.710	4.38	0.213	0.148
Hong Kong	0.007	0.010	0.192	0.653	1.56	0.160	0.087
Ireland	0.006	0.012	0.000	0.219	1.51	0.006	-0.035
Israel	0.009	0.022	0.257	0.691	1.09	0.044	0.169
Italy	0.005	0.009	0.108	0.210	1.23	0.050	0.021
Japan	0.002	0.005	0.293	0.259	7.63	0.426	0.147
Netherlands	0.006	0.015	0.294	1.318	4.55	0.297	0.175
New Zealand	0.004	0.009	0.255	1.264	6.22	0.286	0.122
Norway	0.018	0.023	-0.092	-2.483	-3.12	0.355	0.108
Portugal	0.006	0.010	0.274	0.325	1.45	0.022	0.229
Singapore	0.004	0.005	0.260	0.151	1.25	0.046	0.209
Spain	0.004	0.010	0.228	0.447	1.22	0.046	0.162
Sweden	0.012	0.018	0.011	-0.133	-0.34	-0.003	0.041
Switzerland	0.003	0.009	0.298	0.917	2.70	0.226	0.185
UK	0.007	0.016	0.129	1.607	8.34	0.698	-0.151
US	0.007	0.018	0.083	1.072	12.87	0.753	-0.294

Panel B. Principal Component Analysis of Country IVROEs

	PC 1	PC 2	PC 3	PC 4	PC 5
% Variation Explained	64.4%	17.6%	6.6%	3.8%	2.3%
Correlation with Global IVROE	0.644	0.616	0.096	0.116	0.158

Table 5. Explaining the Global Idiosyncratic Returns Variance ($\mathrm{IVRET}^{\mathrm{G}}$) using State Variables

This table presents the results of using state variables to explain global idiosyncratic return variance ($\mathrm{IVRET}^{\mathrm{G}}$). Panel A shows the summary statistics of $\mathrm{IVRET}^{\mathrm{G}}$ and state variables and their correlations. State variables are estimated using data on the Datastream World Market Index. ACV is the conditional variance of global returns. ADR represents the global discount rate. We calculate ROE as the net income divided by lagged book value and AROE is the natural logarithm of 1+ROE. AEV is the conditional aggregate variance of the cash flows. AGO is the growth opportunity measure. In the correlation matrix, bold denotes significance at the 10% level. Panel B presents the regression results of $\mathrm{IVRET}^{\mathrm{G}}$ on state variables. T-stats are in parentheses. The last column reports the covariance decomposition results for regression VII.

Panel A. Summary Statistics and Correlations

	$\mathrm{IVRET}^{\mathrm{G}}$	$\mathrm{IVROE}^{\mathrm{G}}$	ACV	ADR	AROE	AEV	AGO
Mean	6.21%	1.44%	1.80%	7.97%	11.13%	0.02%	0.00%
Standard Deviation	3.83%	0.33%	2.12%	6.07%	2.20%	0.01%	0.88%
Correlation with Global IVRET	1	**0.522**	**0.426**	**-0.453**	**-0.185**	**0.195**	**0.188**

Panel B. Regression of $\mathrm{IVRET}^{\mathrm{G}}$ on State Variables

	I	II	III	IV	V	VI	VII	Covariance Decomposition
$\mathrm{IVROE}^{\mathrm{G}}$	6.099						4.752	34.2%
	(6.84)						(7.02)	
ACV		0.768					0.622	23.7%
		(5.26)					(5.78)	
ADR			-0.286				-0.253	29.2%
			(-5.68)				(-6.79)	
AROE				-0.322			-0.350	6.0%
				(-2.10)			(-3.42)	
AEV					59.335		21.420	2.2%
					(2.23)		(1.19)	
AGO						0.816	0.671	4.7%
						(2.14)	(2.74)	
Adj. R^2	0.267	0.175	0.199	0.026	0.030	0.028	0.602	100%

Table 6. Cyclicality of Idiosyncratic Variances

This table examines the cyclicality of idiosyncratic variances. Panel A reports the correlation between global idiosyncratic variance measures and business cycle variables. NBER expansion is a dummy variable that is one during an NBER-dated expansion and zero during an NBER-dated recession. GDP growth is the growth rate of trailing 4-quarter global real GDP compared to the same quarter of previous year. Global real GDP is constructed using nominal GDP and GDP deflator data for the OECD total from OECD. The cyclicality measures are measured with a lag of j quarters relative to the idiosyncratic variance measures; thus the correlations with positive j at the top of each panel measure the extent to which the idiosyncratic variance measure leads the business cycle, whereas the correlations with negative j at the bottom measure the extent to which the idiosyncratic measure lags the cycle. Panel B reports the results of regressions of global GDP growth rate on global idiosyncratic variance, lagged global GDP growth rate, and global market return. The t-statistics are adjusted for serial correlation using Newey and West (1987) standard errors with four lags. Panel C presents the summary statistics of the correlation between country idiosyncratic variances and country GDP growth rates. GDP growth is the growth rate of trailing 4-quarter real GDP compared to the same quarter of previous year. We obtain nominal GDP and GDP deflator data for each country from Datastream and OECD. Panel D presents the regression results using alternative business cycle variables. Output gap is computed as the difference between the ln(real GDP) and a quadratic trend, estimated over the full sample. HPGDP is the cyclical component of ln(real GDP) using Hodrick-Prescott (1997) filter, where the smoothing parameter is set to 1600. We regress global cyclicality measure on global idiosyncratic variance, lagged global cyclicality measure, and global market return. The t-statistics are adjusted for serial correlation using Newey and West (1987) standard errors with four lags.

Panel A. Correlation between Global Idiosyncratic Variances and Business Cycle Variables

	I		II		III		IV	
Cycle Variable	NBER Expansion		GDP Growth		NBER Expansion		GDP Growth	
IV Variable	IVRET^{G}		IVRET^{G}		IVROE^{G}		IVROE^{G}	
Variance Lead (Quarters)	Corr.	p-value	Corr.	p-value	Corr.	p-value	Corr.	p-value
+4	-0.089	0.28	0.237	0.00	-0.012	0.88	-0.149	0.07
+3	-0.199	0.02	0.206	0.01	-0.045	0.59	-0.188	0.02
+2	-0.225	0.01	0.171	0.04	-0.073	0.38	-0.230	0.00
+1	-0.285	0.00	0.117	0.15	-0.090	0.27	-0.275	0.00
0	-0.342	0.00	0.040	0.63	-0.104	0.20	-0.321	0.00
-1	-0.366	0.00	-0.053	0.52	-0.171	0.04	-0.365	0.00
-2	-0.350	0.00	-0.130	0.11	-0.238	0.00	-0.405	0.00
-3	-0.221	0.01	-0.165	0.04	-0.258	0.00	-0.438	0.00
-4	-0.201	0.02	-0.144	0.08	-0.281	0.00	-0.463	0.00

Panel B. Predicting and Explaining GDP Growth

	I		II		III		IV	
	GDP(q+4)		GDP(q)		GDP(q+4)		GDP(q)	
Dep. Var.	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
IVRET^{G}_{q}	-0.034	-0.61	-0.021	-0.39				
IVROE^{G}_{q}					-0.619	-2.47	-0.533	-2.03
Lag GDP Growth	0.400	2.79	0.366	2.61	0.810	7.47	0.765	8.85
Lag Mkt Ret	0.056	2.72	0.063	2.48	0.013	2.24	0.018	3.16
Adj. R^2	0.191		0.254		0.695		0.707	

Panel C. Correlation between Country Idiosyncratic Variances and Country GDP Growth Rates

	I	II	III	IV	V	VI	VII	VIII	IX
	+4	+3	+2	+1	0	-1	-2	-3	-4
IVRET									
Number of Negative Correlations									
	5	6	7	10	14	20	22	22	21
Number of Negative Correlations Significant at 10% Level									
	2	3	3	3	7	11	15	15	15
IVROE									
Number of Negative Correlations									
	10	11	11	12	15	15	15	16	16
Number of Negative Correlations Significant at 10% Level									
	4	5	5	6	8	8	9	10	11

Panel D. Alternative Business Cycle Variables

	I		II		III		IV	
	Output Gap (q+4)		Output Gap (q+4)		HPGDP (q+4)		HPGDP (q+4)	
Dep. Var.	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
IVRET_q^G	-0.089	-1.19			-0.064	-1.10		
IVROE_q^G			0.135	0.48			-0.134	-0.89
Lag GDP Growth	0.822	8.09	0.891	11.06	0.401	2.53	0.687	5.60
Lag Mkt Ret	0.029	1.72	0.017	1.78	0.016	1.31	0.008	1.62
Adj. R^2	0.584		0.747		0.176		0.432	

Table 7. State Variables and Cyclicality

This table examines how the state variables in the pricing model capture the time variation in the cyclicality of the global idiosyncratic return variance ($IVRET^{G}$). Panel A presents the correlation between state variables and GDP growth. Panel B presents the cyclicality of $IVRET^{G}$ residual, which is the residual from a regression of $IVRET^{G}$ on state variables, reporting the correlation between $IVRET^{G}$ residual and GDP growth. The cyclicality measures are measured with a lag of *j* quarters relative to the idiosyncratic variance measures; thus the correlations with positive *j* at the top of each panel measure the extent to which the idiosyncratic variance measure leads the business cycle, whereas the correlations with negative *j* at the bottom measure the extent to which the idiosyncratic measure lags the cycle.

Panel A. Cyclicality of State Variables: Correlation with GDP Growth

	I		II		III		IV		V	
IV Variable	ACV		ADR		AROE		AEV		AGO	
Variance Lead (Quarters)	Corr.	p-value	Corr.	p-value	Corr.	p-value	Corr.	p-value	Corr.	p-value
4	0.002	0.98	-0.521	0.00	0.199	0.01	0.253	0.00	0.098	0.27
3	-0.032	0.72	-0.638	0.00	0.273	0.00	0.189	0.03	0.031	0.73
2	-0.080	0.36	-0.727	0.00	0.341	0.00	0.085	0.34	-0.003	0.97
1	-0.157	0.07	-0.742	0.00	0.392	0.00	-0.030	0.74	0.016	0.86
0	-0.268	0.00	-0.662	0.00	0.417	0.00	-0.138	0.12	0.104	0.25
-1	-0.398	0.00	-0.504	0.00	0.410	0.00	-0.206	0.02	0.239	0.01
-2	-0.459	0.00	-0.323	0.00	0.348	0.00	-0.193	0.03	0.373	0.00
-3	-0.433	0.00	-0.162	0.06	0.245	0.00	-0.138	0.12	0.466	0.00
-4	-0.315	0.00	-0.065	0.46	0.117	0.15	-0.072	0.42	0.479	0.00

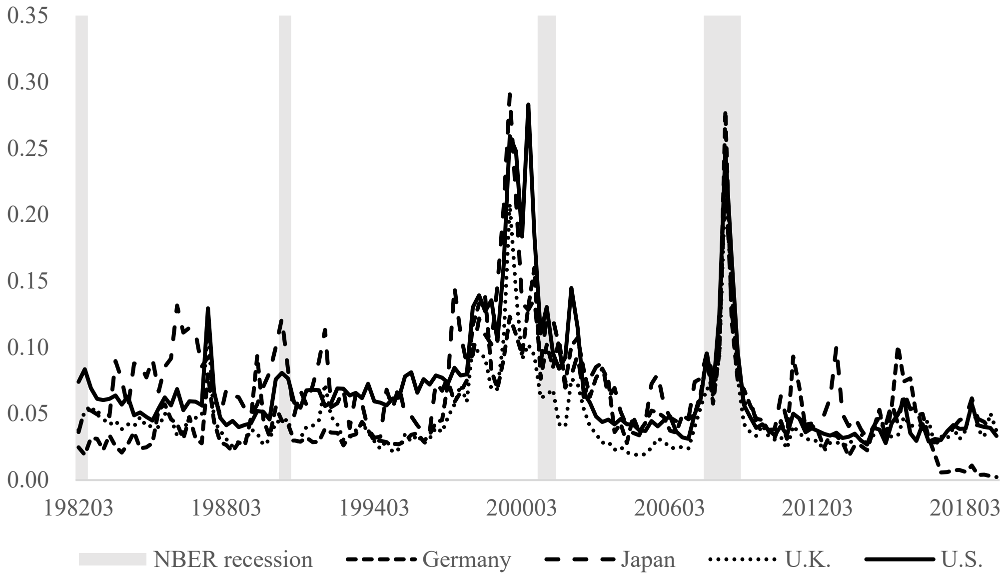
Panel B. Correlation between $IVRET^{G}$ Residual and GDP Growth

Cycle Variable	GDP Growth	
IV Variable	$IVRET^{G}$ Residual	
Variance Lead (Quarters)	Corr.	p-value
+4	0.103	0.25
+3	0.068	0.45
+2	0.041	0.65
+1	0.022	0.80
0	0.010	0.91
-1	-0.001	0.99
-2	-0.026	0.77
-3	-0.048	0.59
-4	-0.056	0.53

Figure 1. Time-Series Plot of Country and Global Idiosyncratic Return Variances (IVRET)

This figure presents the time-series plots of country and global idiosyncratic return variances (IVRET). Panel A shows the time-series plots of country IVRET for Germany, Japan, the U.K., and the U.S., which is value-weighted firm-level IVRET within each country. Panel B shows the time-series plot of global IVRET, which is value-weighted country IVRET. The shaded areas represent NBER recession periods.

Panel A. Country IVRET



Panel B. Global IVRET

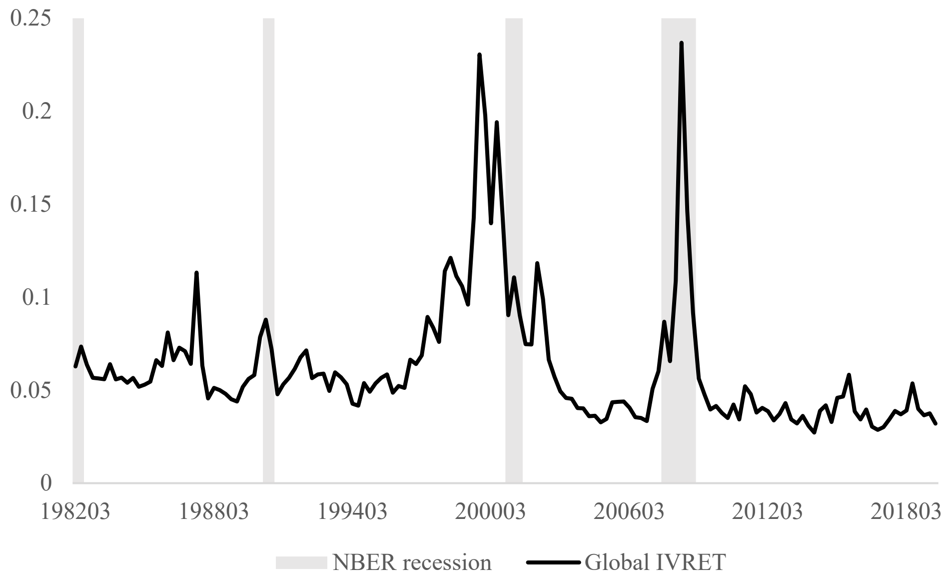
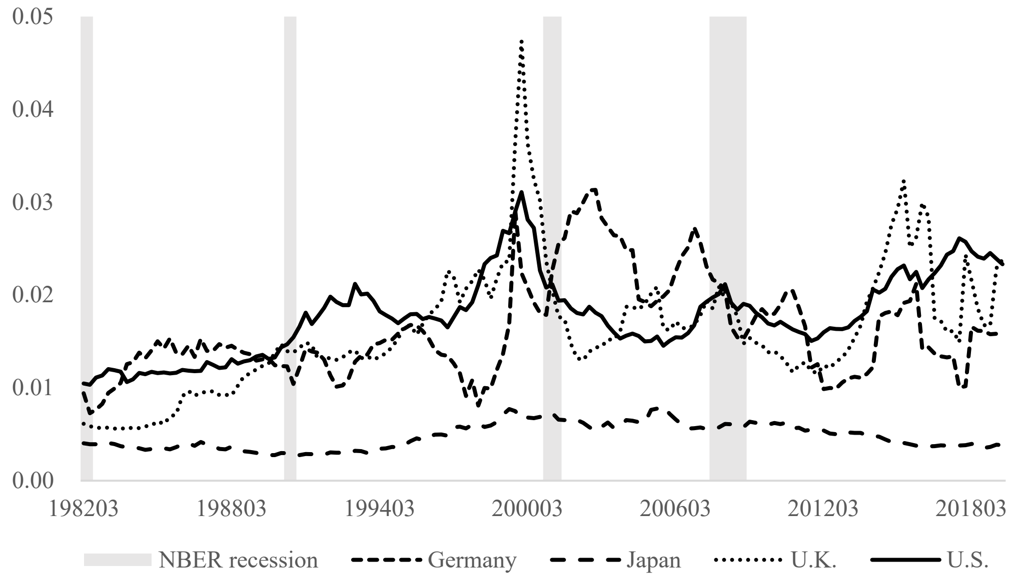


Figure 2. Time-Series Plot of Country and Global Idiosyncratic ROE Variances (IVROE)

This figure presents the time-series plots of country and global idiosyncratic ROE variances (IVROE). IVROE is transformed using the kernel method. Panel A shows the time-series plots of country IVROE for Germany, Japan, the U.K., and the U.S., which is value-weighted firm-level IVROE within each country. Panel B shows the time-series plot of global IVROE, which is value-weighted country IVROE. The shaded areas represent NBER recession periods.

Panel A. Country IVROE



Panel B. Global IVROE

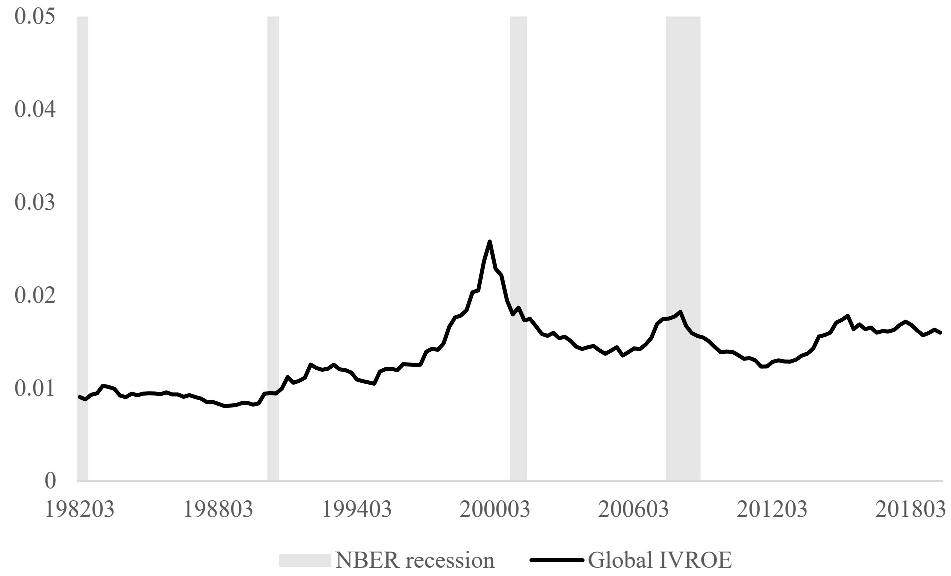
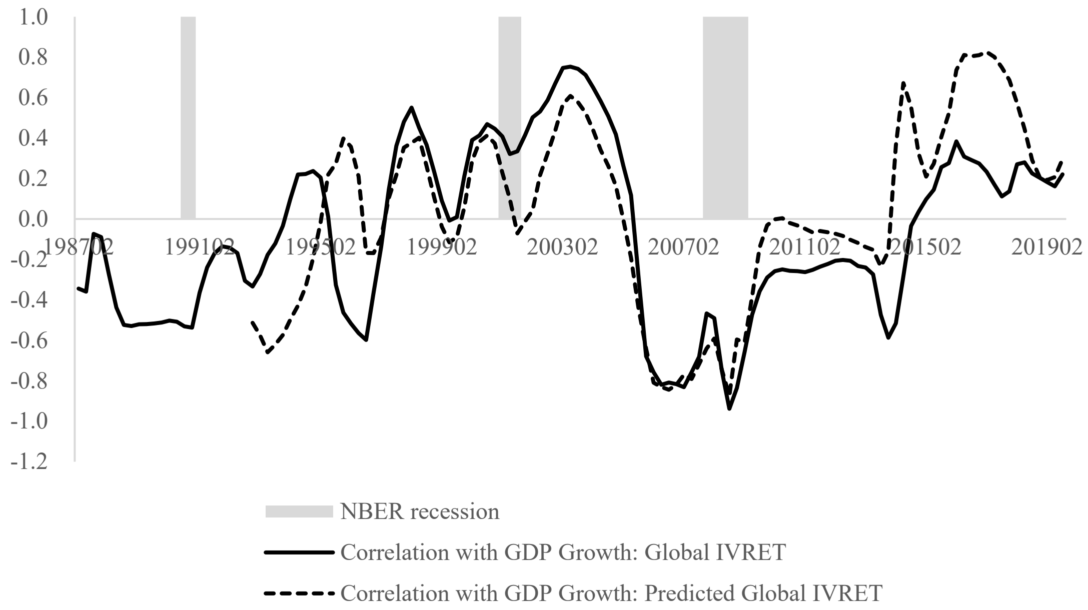


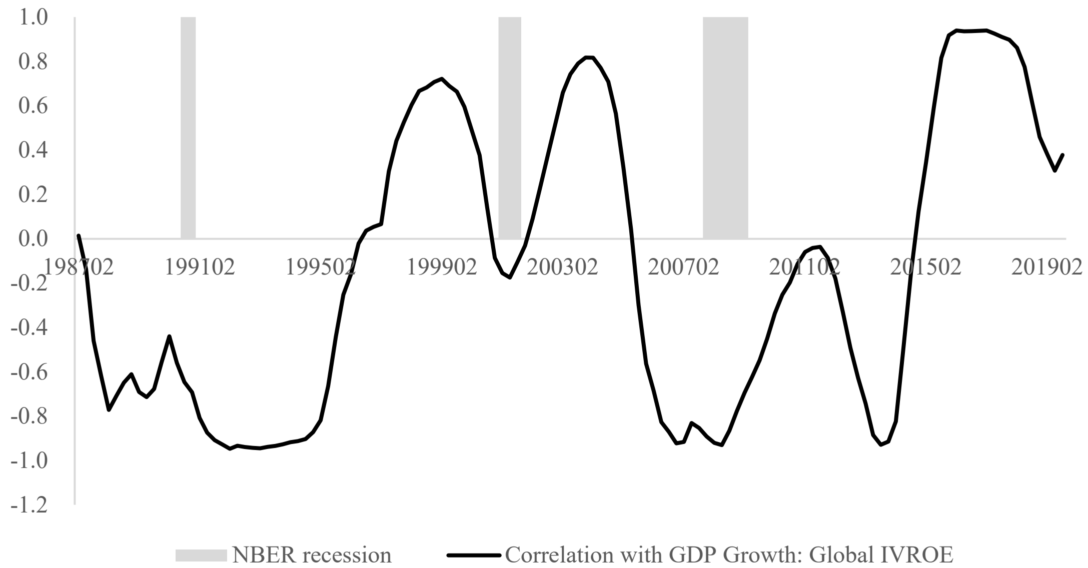
Figure 3. Cyclicality of Global Idiosyncratic Variances

This figure presents the time-series plots of the rolling-window correlation between global idiosyncratic variances and GDP growth rates. In each quarter q, calculate the correlation over the quarters (q-19, q) between global idiosyncratic variance with contemporaneous global GDP growth. GDP growth is the growth rate of trailing 4-quarter real GDP compared to the same quarter of previous year. Global real GDP is constructed using nominal GDP and GDP deflator data for the OECD total from OECD. Panel A shows the time-series plot for global idiosyncratic return variance (IVRET). We also show the same plot for the fitted value of the regression on the state variables with GDP growth. Panel B shows the time-series plots for global idiosyncratic ROE variance (IVROE). The shaded areas represent NBER recession periods.

Panel A. Rolling-Window Correlation between Global IVRET and GDP Growth



Panel B. Rolling-Window Correlation between Global IVROE and GDP Growth



Online Appendix

OA-I. Alternative Methods to Estimate Idiosyncratic ROE Variances (IVROE)

We consider seven alternative methods to estimate IVROE.

Methods I-III are based on panel regressions. Specifically, for each country, we estimate the following panel regression:

$$ROE_{iq} = \left(\alpha_{0,i} + a_1 size_{i,q-1} + a_2 BM_{i,q-1}\right) + \left(b_0 + b_1 size_{i,q-1} + b_2 BM_{i,q-1}\right) WMKT_q^{ROE}$$

$$+\left(c_0 + c_1 size_{i,q-1} + c_2 BM_{i,q-1}\right) WSMB_q^{ROE} + \left(d_0 + d_1 size_{i,q-1} + d_2 BM_{i,q-1}\right) WHML_q^{ROE}$$

$$+\left(e_0 + e_1 size_{i,q-1} + e_2 BM_{i,q-1}\right) MKT_{C,q}^{ROE} + \left(f_0 + f_1 size_{i,q-1} + f_2 BM_{i,q-1}\right) SMB_{C,q}^{ROE}$$

$$+\left(g_0 + g_1 size_{i,q-1} + g_2 BM_{i,q-1}\right) HML_{C,q}^{ROE} + u_{iq}^{ROE}$$

where $\alpha_{0,i}$ represents firm fixed effects, and $size_{i,q-1}$ ($BM_{i,q-1}$) is the log size (book-to-market ratio) for firm *i* from the previous quarter *q-1*.

We estimate the panel regression using different windows. Our baseline results in the main text are based on regressions using the full sample period. The alternative Method I estimates the panel regression using 20-quarter rolling window and uses the last quarter's residual, $(u_{iq}^{ROE})^2$, in each rolling window (q-19, q) as IVROE for firm *i* in quarter *q*. Method II uses the variance of u_{iq}^{ROE} in each rolling window (q-19, q) as IVROE for firm *i* in quarter *q*. Method III estimates the panel regression for each 20-quarter nonoverlapping window (1985-1989,1990-1994,1995-1999,2000-2004,2005-2009,2000-2014,2015-2019), and uses $(u_{iq}^{ROE})^2$as IVROE for firm *i* in quarter *q*.

Methods IV-VII are based on firm-level regressions. Specifically, for each firm, we estimate the following time-series regression:

$$ROE_{iq} = \alpha_i + b_i WMKT_q^{ROE} + c_i MKT_{C,q}^{ROE} + u_{iq}^{ROE}.$$

Similar to the panel regression approach, we estimate the firm-level regressions using different windows. Method IV use the full sample period and IVROE for firm *i* in quarter *q* is the squared residual $(u_{iq}^{ROE})^2$. Methods V uses 20-quarter rolling window and uses the last quarter's $(u_{iq}^{ROE})^2$ in each rolling window (q-19, q) as IVROE for firm *i* in quarter *q*. Method VI uses the variance of u_{iq}^{ROE} in each rolling window (q-19, q) as IVROE for firm *i* in quarter *q*. Method VII estimates the firm-level regression for each 20-quarter nonoverlapping window and uses $(u_{iq}^{ROE})^2$as IVROE for firm *i* in quarter *q*.

Table OA1. Commonality in Change in Idiosyncratic Return Variances (ΔIVRET)

This table presents evidence of commonality in the change in country idiosyncratic return variances (**ΔIVRET**), calculated as the change in value-weighted firm-level IVRET in each country. Panel A presents the average pairwise correlation and the regression results. Column I (II) presents the average pairwise correlation of country **ΔIVRET** (market return). For each country, we calculate the pairwise correlations of its **ΔIVRET** (market return) with the **ΔIVRET** (market return) of each of the other countries, and present the average pairwise correlation. Market return is the market return in US$ over each quarter. Columns III-V show the regression results of country **ΔIVRET** on global **ΔIVRET**, where global **ΔIVRET** is the change in value-weighted country IVRET of all countries. The t-statistics are adjusted for serial correlation using Newey and West (1987) standard errors with four lags. Column VI presents the average pairwise correlation of the residuals from this regression. Panel B presents the principal component analysis results. The first (second) row the time-series average of the % of variation in country **ΔIVRETs** explained by each principal component (the correlation between each principal component and the global **ΔIVRET**) over 1982-1993, 1994-2006, and 2007-2019.

Panel A. Average Pairwise Correlation and Regression of Country ΔIVRET on Global ΔIVRET

	I	II	III	IV	V	VI
Country/	Pairwise Correlation		Regression of Country **ΔIVRET** on Global **ΔIVRET**			
Region	**ΔIVRET**	Market Return	Coef.	t-stat	Adj. R^2	Residual Pairwise Correlation
Across Countries						
Average	0.559	0.591	0.786	6.05	0.500	0.148
P25	0.514	0.566	0.557	3.83	0.402	0.099
P75	0.627	0.631	1.039	7.58	0.579	0.224
By Country						
Australia	0.625	0.612	0.884	3.51	0.534	0.247
Austria	0.622	0.488	1.068	2.52	0.504	0.249
Belgium	0.619	0.619	1.043	2.36	0.526	0.239
Canada	0.662	0.624	1.102	10.47	0.821	0.142
Denmark	0.572	0.605	0.630	6.15	0.438	0.200
Finland	0.384	0.591	0.509	6.20	0.179	0.099
France	0.619	0.651	0.780	9.90	0.591	0.181
Germany	0.596	0.609	0.916	4.02	0.537	0.187
Hong Kong	0.546	0.483	1.039	4.48	0.469	0.139
Ireland	0.627	0.566	1.347	4.18	0.564	0.226
Israel	0.644	0.599	0.557	3.11	0.510	0.224
Italy	0.530	0.578	0.690	5.88	0.402	0.143
Japan	0.505	0.422	0.933	10.39	0.579	-0.072
Netherlands	0.602	0.674	0.758	5.84	0.525	0.198
New Zealand	0.380	0.546	0.205	5.68	0.212	0.071
Norway	0.634	0.585	1.020	4.66	0.528	0.259
Portugal	0.220	0.631	0.227	3.10	0.044	0.084
Singapore	0.514	0.485	0.501	3.83	0.398	0.136
Spain	0.439	0.650	0.368	3.83	0.328	0.040
Sweden	0.595	0.683	0.780	7.58	0.540	0.171
Switzerland	0.630	0.619	0.685	5.74	0.590	0.221
UK	0.682	0.662	0.893	11.28	0.782	0.224
US	0.606	0.613	1.139	14.53	0.900	-0.194

Panel B. Principal Component Analysis of Country ΔIVRETs

	PC 1	PC 2	PC 3	PC 4	PC 5
% Variation Explained	64.4%	8.7%	5.6%	4.5%	3.5%
Correlation with Global ΔIVRET	0.908	0.158	0.249	0.093	0.106

Table OA2. Commonality in Idiosyncratic Return Variances (Alternative Factor Models)

This table presents evidence of commonality in country idiosyncratic return variances (IVRET) calculated based on the global-local version of five alternative factor models, including the Fama-French (2015) 5-factor model (FF5), Fama-French (2015) 5-factor augmented with a momentum factor (FF5+MOM), Hou, Xue, and Zhang (HXZ, 2015) 4-factor model, Stambaugh and Yuan (SY, 2017) model, and Barillas and Shanken (BS, 2018) 6-factor model. For the FF5 and FF5+MOM models, we construct the global and local factors in a similar approach to the world-local Fama-French (1996) factor model in the text. To obtain RMW, we sort all firms in each country into three groups at the end of each June based on operating profitability and RMW is computed as the value-weighted return difference between firms in the highest and lowest operating profitability groups. To obtain CMA, we sort all firms in each country into three groups at the end of each June based on investment and CMA is computed as the value-weighted return difference between firms in the lowest and highest investment groups. To obtain MOM, we sort all firms in each country into three groups at the end of each month based on prior (2-12) return and MOM is computed as the value-weighted return difference between firms in the highest and lowest prior return groups. The global factors are computed as the value-weighted averages of the country level factors. For the other models, at the end of June, firms in each country are classified into small and big size groups, with big stocks defined as those that account for the top 90% of the market capitalization in the country, and small stocks as those that account for the bottom 10%. We sort portfolios and construct the country-level factors in a similar approach to the original papers. For the SY (2017) model, we follow Lu, Stambaugh, and Yuan (2018) to construct anomaly variables in each country and drop financial distress and O-score from the second cluster. The global factors are computed as the value-weighted averages of the country level factors. For each model, we present two parts of results. In the first part, Column I (II) presents the average pairwise correlation of country IVRET (market return). For each country, we calculate the pairwise correlations of its IVRET (market return) with the IVRET (market return) of each of the other countries, and present the average pairwise correlation. Market return is the market return in US$ over each quarter. Columns III-V show the regression results of country IVRET on global IVRET, where global IVRET is the value-weighted country IVRET of all countries. The t-statistics are adjusted for serial correlation using Newey and West (1987) standard errors with four lags. Column VI presents the average pairwise correlation of the residuals from this regression. The first three rows summarize the average, 25^{th} percentile, and 75^{th} percentile of the respective statistics across countries. The second part presents the principal component analysis results. The first (second) row the time-series average of the % of variation in country IVRETs explained by each principal component (the correlation between each principal component and the global IVRET) over 1982-1993, 1994-2006, and 2007-2019.

Panel A. Fama-French (2015) 5-Factor Model

A1. Average Pairwise Correlation and Regression of Country IVRET on Global IVRET

	I	II	III	IV	V	VI
Country/	Pairwise Correlation		Regression of Country IVRET on Global IVRET			
Region	IVRET	Market Return	Coef.	t-stat	Adj. R^2	Residual Pairwise Correlation
Across Countries						
Average	0.621	0.591	0.603	6.24	0.525	0.237
P25	0.600	0.566	0.425	2.10	0.339	0.194
P75	0.690	0.631	0.791	7.49	0.734	0.359
By Country						
Australia	0.634	0.612	0.549	2.10	0.339	0.370
Austria	0.635	0.488	0.597	1.94	0.344	0.362
Belgium	0.702	0.619	0.584	2.43	0.499	0.398
Canada	0.715	0.624	0.800	7.49	0.784	0.292
Denmark	0.672	0.605	0.619	6.30	0.654	0.251
Finland	0.300	0.591	0.425	4.25	0.114	0.049
France	0.653	0.651	0.791	13.21	0.784	0.101
Germany	0.643	0.609	0.722	5.78	0.596	0.226
Hong Kong	0.563	0.483	0.717	3.46	0.340	0.256
Ireland	0.644	0.566	0.792	2.00	0.331	0.395
Israel	0.616	0.599	0.215	1.52	0.216	0.413
Italy	0.615	0.578	0.515	7.41	0.554	0.195
Japan	0.592	0.422	0.966	12.06	0.787	-0.121
Netherlands	0.708	0.674	0.608	9.06	0.734	0.307
New Zealand	0.510	0.546	0.143	1.90	0.161	0.331
Norway	0.701	0.585	0.791	6.23	0.683	0.299
Portugal	0.371	0.631	0.168	1.70	0.093	0.194
Singapore	0.600	0.485	0.486	5.13	0.514	0.185
Spain	0.666	0.650	0.346	6.58	0.609	0.238
Sweden	0.690	0.683	0.603	5.66	0.603	0.318
Switzerland	0.682	0.619	0.402	3.46	0.510	0.359
UK	0.718	0.662	0.765	11.63	0.861	0.271
US	0.645	0.613	1.257	22.21	0.957	-0.233

A2. Principal Component Analysis of Country IVRETs

	PC 1	PC 2	PC 3	PC 4	PC 5
% Variation Explained	72.0%	8.5%	5.6%	4.2%	2.5%
Correlation with Global IVRET	0.934	0.043	0.230	0.100	0.052

Panel B. Fama-French 5-Factor+Momentum Model

B1. Average Pairwise Correlation and Regression of Country IVRET on Global IVRET

	I	II	III	IV	V	VI
Country/	Pairwise Correlation		Regression of Country IVRET on Global IVRET			
Region	IVRET	Market Return	Coef.	t-stat	Adj. R^2	Residual Pairwise Correlation
Across Countries						
Average	0.624	0.591	0.587	6.18	0.523	0.246
P25	0.609	0.566	0.428	2.08	0.328	0.211
P75	0.692	0.631	0.743	6.92	0.733	0.345
By Country						
Australia	0.635	0.612	0.546	2.06	0.336	0.374
Austria	0.641	0.488	0.589	1.95	0.349	0.370
Belgium	0.711	0.619	0.534	2.58	0.517	0.410
Canada	0.718	0.624	0.781	6.38	0.766	0.310
Denmark	0.682	0.605	0.603	6.52	0.662	0.271
Finland	0.316	0.591	0.428	4.13	0.130	0.051
France	0.651	0.651	0.768	11.70	0.772	0.109
Germany	0.652	0.609	0.730	5.96	0.615	0.237
Hong Kong	0.563	0.483	0.707	3.32	0.328	0.266
Ireland	0.634	0.566	0.694	2.08	0.317	0.391
Israel	0.616	0.599	0.212	1.50	0.211	0.418
Italy	0.611	0.578	0.471	6.92	0.514	0.216
Japan	0.590	0.422	0.952	11.99	0.784	-0.123
Netherlands	0.718	0.674	0.591	8.58	0.733	0.340
New Zealand	0.496	0.546	0.136	1.84	0.145	0.329
Norway	0.697	0.585	0.788	6.55	0.677	0.295
Portugal	0.395	0.631	0.171	1.86	0.113	0.202
Singapore	0.609	0.485	0.479	4.59	0.502	0.211
Spain	0.676	0.650	0.349	6.63	0.623	0.252
Sweden	0.692	0.683	0.586	6.11	0.609	0.321
Switzerland	0.676	0.619	0.359	4.02	0.515	0.345
UK	0.717	0.662	0.743	11.54	0.861	0.270
US	0.648	0.613	1.275	23.24	0.958	-0.213

B2. Principal Component Analysis of Country IVRETs

	PC 1	PC 2	PC 3	PC 4	PC 5
% Variation Explained	71.8%	8.9%	5.9%	4.2%	2.5%
Correlation with Global IVRET	0.934	0.048	0.236	0.093	0.049

Panel C. Hou, Xue, Zhang (2015) 4-Factor Model

C1. Average Pairwise Correlation and Regression of Country IVRET on Global IVRET

	I	II	III	IV	V	VI
Country/	Pairwise Correlation		Regression of Country IVRET on Global IVRET			
Region	IVRET	Market Return	Coef.	t-stat	Adj. R^2	Residual Pairwise Correlation
Across Countries						
Average	0.641	0.591	0.669	6.41	0.552	0.226
P25	0.618	0.566	0.503	2.31	0.379	0.171
P75	0.699	0.631	0.823	8.64	0.756	0.351
By Country						
Australia	0.656	0.612	0.622	2.31	0.395	0.357
Austria	0.642	0.488	0.649	1.91	0.350	0.361
Belgium	0.691	0.619	0.779	2.10	0.454	0.384
Canada	0.724	0.624	0.823	9.26	0.815	0.250
Denmark	0.699	0.605	0.703	6.20	0.679	0.264
Finland	0.376	0.591	0.503	3.14	0.142	0.114
France	0.663	0.651	0.779	12.22	0.764	0.089
Germany	0.688	0.609	0.881	5.81	0.648	0.258
Hong Kong	0.578	0.483	0.726	3.92	0.379	0.237
Ireland	0.665	0.566	0.999	2.30	0.398	0.375
Israel	0.651	0.599	0.251	1.79	0.293	0.393
Italy	0.618	0.578	0.530	7.76	0.537	0.181
Japan	0.598	0.422	0.946	11.86	0.770	-0.149
Netherlands	0.730	0.674	0.786	8.64	0.756	0.307
New Zealand	0.623	0.546	0.236	3.70	0.369	0.309
Norway	0.727	0.585	0.888	5.39	0.682	0.326
Portugal	0.349	0.631	0.200	1.98	0.083	0.171
Singapore	0.577	0.485	0.559	6.36	0.496	0.118
Spain	0.696	0.650	0.399	7.75	0.653	0.234
Sweden	0.688	0.683	0.671	8.15	0.664	0.240
Switzerland	0.701	0.619	0.458	3.60	0.549	0.351
UK	0.737	0.662	0.787	11.14	0.864	0.272
US	0.665	0.613	1.220	20.17	0.952	-0.237

C2. Principal Component Analysis of Country IVRETs

	PC 1	PC 2	PC 3	PC 4	PC 5
% Variation Explained	71.2%	7.8%	5.0%	4.5%	2.8%
Correlation with Global IVRET	0.921	0.038	0.227	0.112	0.089

Panel D. Stambaugh-Yuan (2017) Model

D1. Average Pairwise Correlation and Regression of Country IVRET on Global IVRET

	I	II	III	IV	V	VI
Country/	Pairwise Correlation		Regression of Country IVRET on Global IVRET			
Region	IVRET	Market Return	Coef.	t-stat	Adj. R^2	Residual Pairwise Correlation
Across Countries						
Average	0.629	0.591	0.662	6.48	0.544	0.216
P25	0.591	0.566	0.483	2.33	0.370	0.154
P75	0.688	0.631	0.820	8.38	0.747	0.343
By Country						
Australia	0.656	0.612	0.639	2.33	0.411	0.349
Austria	0.639	0.488	0.625	1.98	0.354	0.358
Belgium	0.681	0.619	0.755	2.15	0.458	0.369
Canada	0.712	0.624	0.834	8.56	0.787	0.241
Denmark	0.688	0.605	0.698	6.72	0.665	0.253
Finland	0.352	0.591	0.483	3.54	0.138	0.085
France	0.663	0.651	0.799	13.09	0.775	0.092
Germany	0.674	0.609	0.820	6.63	0.647	0.238
Hong Kong	0.572	0.483	0.723	3.77	0.370	0.239
Ireland	0.656	0.566	1.024	2.29	0.395	0.364
Israel	0.581	0.599	0.259	1.72	0.232	0.338
Italy	0.605	0.578	0.510	7.53	0.521	0.173
Japan	0.601	0.422	0.948	12.57	0.768	-0.123
Netherlands	0.736	0.674	0.740	6.80	0.747	0.347
New Zealand	0.591	0.546	0.222	3.24	0.326	0.288
Norway	0.709	0.585	0.888	5.88	0.672	0.295
Portugal	0.330	0.631	0.185	2.00	0.077	0.154
Singapore	0.583	0.485	0.548	7.33	0.524	0.110
Spain	0.684	0.650	0.408	8.11	0.647	0.220
Sweden	0.659	0.683	0.676	8.38	0.634	0.202
Switzerland	0.701	0.619	0.440	3.82	0.571	0.343
UK	0.728	0.662	0.763	11.07	0.851	0.264
US	0.657	0.613	1.230	19.43	0.949	-0.233

D2. Principal Component Analysis of Country IVRETs

	PC 1	PC 2	PC 3	PC 4	PC 5
% Variation Explained	69.3%	9.8%	6.1%	4.5%	3.1%
Correlation with Global IVRET	0.925	0.022	0.215	0.087	0.067

Panel E. Barillas-Shanken (2018) 6-Factor Model

E1. Average Pairwise Correlation and Regression of Country IVRET on Global IVRET

	I	II	III	IV	V	VI
Country/	Pairwise Correlation		Regression of Country IVRET on Global IVRET			
Region	IVRET	Market Return	Coef.	t-stat	Adj. R^2	Residual Pairwise Correlation
Across Countries						
Average	0.663	0.591	0.633	6.07	0.575	0.245
P25	0.635	0.566	0.491	2.45	0.379	0.186
P75	0.730	0.631	0.780	7.41	0.766	0.393
By Country						
Australia	0.678	0.612	0.530	1.99	0.379	0.396
Austria	0.687	0.488	0.649	1.95	0.398	0.404
Belgium	0.741	0.619	0.650	2.45	0.537	0.427
Canada	0.755	0.624	0.787	7.51	0.833	0.301
Denmark	0.730	0.605	0.696	6.58	0.734	0.291
Finland	0.371	0.591	0.494	3.96	0.152	0.093
France	0.710	0.651	0.760	13.76	0.879	0.107
Germany	0.684	0.609	0.780	6.34	0.682	0.208
Hong Kong	0.597	0.483	0.678	3.27	0.361	0.269
Ireland	0.690	0.566	0.877	2.27	0.407	0.404
Israel	0.668	0.599	0.259	1.83	0.306	0.414
Italy	0.656	0.578	0.496	7.41	0.616	0.186
Japan	0.635	0.422	0.959	10.78	0.814	-0.126
Netherlands	0.770	0.674	0.750	5.60	0.766	0.393
New Zealand	0.571	0.546	0.192	2.59	0.251	0.327
Norway	0.753	0.585	0.869	5.94	0.760	0.333
Portugal	0.384	0.631	0.192	2.04	0.108	0.188
Singapore	0.618	0.485	0.491	4.26	0.508	0.177
Spain	0.700	0.650	0.380	6.26	0.627	0.269
Sweden	0.705	0.683	0.641	6.81	0.671	0.258
Switzerland	0.721	0.619	0.408	3.79	0.601	0.354
UK	0.758	0.662	0.774	9.51	0.866	0.295
US	0.678	0.613	1.245	22.66	0.965	-0.332

E2. Principal Component Analysis of Country IVRETs

	PC 1	PC 2	PC 3	PC 4	PC 5
% Variation Explained	76.5%	7.1%	4.4%	3.7%	2.6%
Correlation with Global IVRET	0.828	0.224	0.186	0.143	0.114

Table OA3. Estimation of Idiosyncratic ROE Variances (IVROE)

This table presents the summary statistics of ROE factors and the results from the regressions to estimate idiosyncratic ROE variances (IVROE). Panel A presents the summary statistics of ROE factors. For each country at the end of each June, we sort stocks into 3 portfolios based on size or B/M ratio, i.e. Size1, Size2, Size3, B/M1, B/M2, B/M3. The size used to form portfolios in June of year t is market value at the end of June of t. The B/M ratio used to form portfolios in June of year t is book equity for the fiscal year ending in calendar year t-1, divided by market equity at the end of December of t-1. MKT_ROE is the value-weighted ROE of all firms in the sample. SMB_ROE is the difference between value-weighted ROE of firms in Size1 (smallest) and value-weighted ROE of firms in Size3 (largest). HML_ROE is the difference between value-weighted ROE of firms in B/M3 (highest) and value-weighted ROE of firms in B/M1 (lowest). Global ROE factors are value-weighted country-level ROE factors (including countries when they have data available). All statistics are in percent. Panel B presents the coefficients and t-statistics from the following firm-quarter panel regression estimated country by country: $ROE_{iq} = (a_{0,i} + a_1 \times size_{i,q-1} + a_2 \times BM_{i,q-1}) + [b_0 + b_1 \times size_{i,q-1} + b_2 \times BM_{i,q-1}] \times WMKT^{ROE}_q + [c_0 + c_1 \times size_{i,q-1} + c_2 \times BM_{i,q-1}] \times WSMB\_ROE_q + [d_0 + d_1 \times size_{i,q-1} + d_2 \times BM_{i,q-1}] \times WHML\_ROE_q + [e_0 + e_1 \times size_{i,q-1} + e_2 \times BM_{i,q-1}] \times MKT\_ROE_q + [f_0 + f_1 \times size_{i,q-1} + f_2 \times BM_{i,q-1}] \times SMB\_ROE_q + [g_0 + g_1 \times size_{i,q-1} + g_2 \times BM_{i,q-1}] \times HML\_ROE_q + u_{i,q}$ where MKT_ROE, SMB_ROE and HML_ROE are orthogonalized to the global factors. Standard errors are clustered by both firm and quarter. The columns P25, Median and P75 shows the 25th percentile, median and 75th percentile of the statistics across all countries.

Panel A. Summary Statistics of ROE Factors

Country/	MKT_ROE		SMB_ROE		HML_ROE	
Region	Mean (%)	Std Dev (%)	Mean (%)	Std Dev (%)	Mean (%)	Std Dev (%)
Australia	13.57	4.29	-16.66	15.34	-10.27	7.60
Austria	10.22	4.49	-4.72	5.36	-7.34	8.07
Belgium	14.18	4.77	-7.34	7.05	-9.15	7.22
Canada	11.36	4.44	-15.17	11.78	-9.67	7.29
Denmark	19.87	10.35	-14.73	13.82	-17.94	17.24
Finland	16.83	9.79	-10.37	9.44	-17.99	11.81
France	13.16	3.46	-7.39	3.98	-10.60	5.12
Germany	13.34	3.83	-8.26	6.00	-3.87	7.88
Hong Kong	17.37	5.35	-13.14	8.06	-15.17	6.13
Ireland	14.56	6.73	-9.18	8.95	-12.52	10.52
Israel	14.16	5.85	-8.70	7.89	-11.96	8.89
Italy	10.96	4.52	-9.90	5.71	-11.89	6.50
Japan	7.79	3.55	-4.61	2.52	-6.42	3.75
Netherlands	16.34	5.40	-8.29	6.42	-15.52	8.20
New Zealand	15.25	7.24	-12.22	7.72	-18.68	12.07
Norway	15.05	7.66	-12.62	10.70	-15.43	15.19
Portugal	15.03	4.24	-11.00	5.60	-14.19	8.53
Singapore	13.78	3.39	-12.21	4.45	-9.99	4.35
Spain	16.27	5.37	-12.62	8.91	-15.31	7.76
Sweden	18.34	5.26	-15.01	9.20	-11.67	9.68
Switzerland	14.37	5.14	-9.52	6.20	-9.12	7.30
UK	18.22	3.60	-13.09	8.28	-21.15	7.91
US	19.21	3.23	-20.57	5.87	-19.45	5.46
Global	15.71	2.83	-14.84	5.44	-14.83	4.05

Panel B. Regression Results

	P25		Median		P75		U.S.	
Variable	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
Size	-0.007	-0.48	0.007	0.72	0.017	2.48	0.017	4.87
BM	-0.055	-3.48	-0.010	-1.15	0.002	0.04	-0.135	-8.45
WMKT	0.079	0.13	0.371	1.19	1.108	2.94	0.417	2.48
Size×WMKT	-0.014	-0.42	0.048	0.61	0.122	2.26	0.048	2.26
BM×WMKT	-0.259	-2.19	-0.150	-1.08	0.008	0.13	-0.212	-2.19
WSMB	0.155	0.14	0.728	1.47	1.397	3.74	1.149	5.85
Size×WSMB	-0.123	-1.79	-0.016	-0.50	0.039	1.21	-0.073	-3.00
BM×WSMB	-0.270	-2.41	-0.112	-1.79	0.034	0.51	-0.436	-4.35
WHML	-0.440	-1.85	-0.193	-0.61	0.198	0.44	-0.397	-2.27
Size×WHML	-0.059	-0.98	0.010	0.28	0.061	1.63	0.093	4.56
BM×WHML	0.012	0.42	0.110	1.27	0.200	1.96	0.188	1.83
MKT	-0.061	-0.12	0.509	1.69	0.936	2.72	-0.282	-1.06
Size×MKT	-0.013	-0.26	0.013	0.32	0.100	1.50	0.011	0.32
BM×MKT	-0.194	-2.80	-0.032	-0.39	0.008	0.11	0.201	1.26
SMB	0.538	2.47	0.860	3.65	1.154	5.40	-0.019	-0.11
Size×SMB	-0.133	-4.79	-0.077	-2.77	-0.055	-1.76	-0.008	-0.38
BM×SMB	-0.115	-2.34	-0.056	-1.11	-0.012	-0.79	0.186	1.90
HML	-0.185	-1.25	-0.105	-0.64	-0.043	-0.17	-0.185	-1.11
Size×HML	0.010	0.59	0.019	0.99	0.033	1.49	0.012	0.59
BM×HML	0.013	0.40	0.035	0.83	0.066	1.54	-0.343	-3.40
Overall R^2	0.447		0.462		0.526		0.514	

Table OA4. Cross-Country Correlations of ROE and ROE Residuals

This table presents the average cross-country correlations of ROE and ROE residuals. Column I represents the average cross-country correlations of country ROEs, calculated as the value-weighted average of firm ROEs. Columns II-IV present the results using the panel model. Specifically, for each country, we estimate $ROE_{iq} = (a_{0,i} + a_1 \times size_{i,q-1} + a_2 \times BM_{i,q-1}) + [b_0 + b_1 \times size_{i,q-1} + b_2 \times BM_{i,q-1}] \times WMKT^{ROE}_q + [c_0 + c_1 \times size_{i,q-1} + c_2 \times BM_{i,q-1}] \times WSMB\_ROE_q + [d_0 + d_1 \times size_{i,q-1} + d_2 \times BM_{i,q-1}] \times WHML\_ROE_q + [e_0 + e_1 \times size_{i,q-1} + e_2 \times BM_{i,q-1}] \times MKT\_ROE_q + [f_0 + f_1 \times size_{i,q-1} + f_2 \times BM_{i,q-1}] \times SMB\_ROE_q + [g_0 + g_1 \times size_{i,q-1} + g_2 \times BM_{i,q-1}] \times HML\_ROE_q + u_{i,q}$. Columns V-VII present the results using the firm regression model. Specifically, for each firm, we estimate $ROE_{iq} = a + b^{*}WMKT\_ROE_q + c^{*}MKT\_ROE_q + u_{i,q}$. We estimate the models using different windows and obtain the residuals $u_{i,q}$, and calculate the country-level value-weighted ROE residual as the value-weighted $u_{i,q}$ within each country. For each country, we report the average pairwise correlation of ROE residuals with the other countries. Column II (V) reports the results using full sample. Column III (VI) reports the results using 20-quarter rolling windows. Column IV (VII) reports the results using seven non-overlapping samples of 20 quarters (1985-1989, 1990-1994, 1995-1999, 2000-2004, 2005-2009, 2000-2014, 2015-2019).

	I	II	III	IV	V	VI	VII
		ROE Residual Corr. (Panel)			ROE Residual Corr. (Firm)		
Country/ Region	ROE Corr.	Full Sample	Rolling Window	Non-Overlap Window	Full Sample	Rolling Window	Non-Overlap Window
Across Countries							
Average	0.334	0.172	0.029	0.056	0.186	0.083	0.202
P25	0.277	0.103	-0.016	0.022	0.087	0.025	0.146
P75	0.401	0.241	0.069	0.094	0.275	0.125	0.264
By Country							
Australia	0.462	0.232	0.087	0.117	0.281	0.166	0.322
Austria	0.475	0.004	0.062	0.022	0.035	0.025	0.186
Belgium	0.277	0.253	0.004	0.102	0.229	0.018	0.141
Canada	0.401	0.237	0.028	0.107	0.275	0.061	0.198
Denmark	0.053	-0.063	-0.027	0.052	0.060	0.095	0.218
Finland	0.365	0.013	0.069	0.049	-0.024	0.099	0.157
France	0.357	0.340	0.060	0.102	0.254	0.083	0.262
Germany	0.385	0.147	0.010	-0.004	0.307	0.111	0.214
Hong Kong	0.013	0.190	0.035	0.015	0.087	-0.051	0.112
Ireland	0.245	0.167	0.092	0.080	0.191	0.068	0.203
Israel	0.311	0.012	-0.030	0.010	0.303	0.105	0.129
Italy	0.423	0.305	0.029	0.075	0.233	0.185	0.286
Japan	0.231	0.209	0.007	0.044	0.180	0.105	0.202
Netherlands	0.390	0.162	-0.034	0.060	0.254	0.048	0.146
New Zealand	0.265	0.103	-0.016	0.053	0.005	-0.030	-0.046
Norway	0.386	0.274	-0.025	-0.017	0.225	0.047	0.235
Portugal	0.357	0.161	0.108	0.094	0.242	0.130	0.216
Singapore	0.358	0.270	0.003	0.030	0.135	0.025	0.061
Spain	0.472	0.157	0.085	0.094	0.275	0.125	0.264
Sweden	0.436	0.230	0.115	0.143	0.307	0.148	0.301
Switzerland	0.314	0.093	-0.058	-0.025	0.175	0.023	0.191
UK	0.386	0.241	0.030	0.041	0.084	0.125	0.299
US	0.316	0.211	0.032	0.049	0.157	0.194	0.338

Table OA5 Validity of Growth Opportunity Variable (AGO)

This table presents evidence for the validity of growth opportunity variable (AGO) and the regression results using alternative AGO extracted from the market to book ratio (M/B) of Datastream Total Market Index. Panel A presents the regression results of future EBIT growth on AGO. In each quarter, we calculate EBIT of the Datastream Total Market Index as the trailing 4-quarter EBIT. EBIT growth is the growth rate of EBIT over the same quarter of the previous year. AGO is the growth opportunity variable extracted from aggregate earnings yield. The t-statistics are adjusted for serial correlation using Newey and West (1987) standard errors with 10 lags and are shown in parentheses. Panel B presents the regression results of future EBIT growth on the alternative AGO measure extracted from M/B. M/B is calculated as (market value of equity+book value of total assets−book value of total equity)/book value of total assets. AGO is the residual from a regression of M/B on ACV, ADR, AROE, and AEV. The t-statistics are adjusted for serial correlation using Newey and West (1987) standard errors with 10 lags and are shown in parentheses. Panel C presents the results from regressions of global IVRET on the alternative AGO measure and other state variables.

Panel A. Predictability of Future EBIT Growth using AGO

	EBIT Growth$_{t+4}$	EBIT Growth$_{t+5}$	EBIT Growth$_{t+6}$	EBIT Growth$_{t+7}$	EBIT Growth$_{t+8}$
Coefficient	7.185	6.913	5.086	2.701	0.004
t-stat	(2.55)	(2.43)	(2.17)	(1.41)	(0.00)
Adj.R^2	0.162	0.146	0.075	0.015	-0.009

Panel B. Predictability of Future EBIT Growth using Alternative AGO

	EBIT Growth$_{t+4}$	EBIT Growth$_{t+5}$	EBIT Growth$_{t+6}$	EBIT Growth$_{t+7}$	EBIT Growth$_{t+8}$
Coefficient	0.232	0.131	0.011	-0.117	-0.211
t-stat	(1.25)	(0.73)	(0.07)	(-0.76)	(-1.30)
Adj.R^2	0.038	0.006	-0.008	0.003	0.029

Panel C. Regression of $\mathrm{IVRET^G}$ on Alternative AGO and Other State Variables

	I	II	III
$\mathrm{IVROE^G}$	6.099		6.342
	(6.84)		(11.11)
ACV			0.594
			(6.82)
ADR			-0.235
			(-7.79)
AROE			-0.358
			(-4.32)
AEV			24.136
			(1.65)
AGO		0.060	0.095
		(2.98)	(8.64)
Adj. R^2	0.267	0.059	0.739

Table OA6. Explaining the Global Idiosyncratic Returns Variance ($IVRET^G$) using State Variables
This table presents the results of using the levels, squares and cross-products of state variables to explain global idiosyncratic return variance ($IVRET^G$). State variables are estimated using data on the Datastream World Market Index. ACV is the conditional variance of global returns. ADR represents the global discount rate. We calculate ROE as the net income divided by lagged book value and AROE is the natural logarithm of 1+ROE. AEV is the conditional aggregate variance of the cash flows. AGO is the growth opportunity measure.

	Coefficient	t-stat
$IVROE^G$	9.367	2.11
ACV	3.040	2.44
ADR	0.565	2.94
AROE	-0.140	-0.24
AEV	-36.124	-0.39
AGO	-1.803	-1.91
ACV^2	4.929	4.14
ADR^2	0.575	2.68
$AROE^2$	-0.012	-0.01
AEV^2	42458.092	0.61
AGO^2	68.303	5.87
$IVROE^G \times ACV$	-203.574	-2.44
$IVROE^G \times ADR$	-64.881	-5.85
$IVROE^G \times AROE$	-13.263	-0.35
$IVROE^G \times AEV$	2593.107	0.42
$IVROE^G \times AGO$	167.883	2.84
Adj. R^2	0.824	

Table OA7. Cyclicality of Country Idiosyncratic Variances

This table presents the correlation between country idiosyncratic variances and country GDP growth rates. GDP growth is the growth rate of trailing 4-quarter real GDP compared to the same quarter of previous year. We obtain nominal GDP and GDP deflator data for each country from Datastream and OECD. The GDP growth rates are measured with a lag of *j* quarters relative to the idiosyncratic variance measures; thus the correlations with positive *j* measure the extent to which the idiosyncratic variance measure leads the business cycle, whereas the correlations with negative *j* measure the extent to which the idiosyncratic measure lags the cycle. Negative correlations that are statistically significant at 10% level or lower are indicated in bold. Panel A presents the results for country idiosyncratic return variance (IVRET). Panel B presents the results for country idiosyncratic ROE variance (IVROE). Both IVROE and GDP growth rates are transformed using the kernel method.

Panel A. Country IVRET

Country/	I	II	III	IV	V	VI	VII	VIII	IX
Region	+4	+3	+2	+1	0	-1	-2	-3	-4
Australia	0.156	0.119	0.086	0.053	0.016	-0.018	-0.057	-0.090	-0.106
Austria	0.214	0.196	0.156	0.087	-0.027	**-0.169**	**-0.291**	**-0.343**	**-0.308**
Belgium	0.280	0.224	0.154	0.057	-0.066	**-0.190**	**-0.274**	**-0.273**	**-0.181**
Canada	0.180	0.164	0.124	0.079	0.038	-0.013	-0.048	-0.071	-0.049
Denmark	0.086	0.064	0.023	-0.046	**-0.171**	**-0.276**	**-0.369**	**-0.431**	**-0.410**
Finland	-0.131	**-0.160**	**-0.203**	**-0.265**	**-0.336**	**-0.412**	**-0.469**	**-0.484**	**-0.452**
France	0.364	0.345	0.316	0.278	0.235	0.183	0.143	0.127	0.138
Germany	0.101	0.082	0.046	-0.013	-0.090	**-0.187**	**-0.250**	**-0.265**	**-0.235**
Hong Kong	**-0.150**	-0.112	-0.095	-0.110	**-0.165**	**-0.238**	**-0.284**	**-0.313**	**-0.305**
Ireland	-0.093	**-0.140**	**-0.195**	**-0.258**	**-0.337**	**-0.400**	**-0.439**	**-0.451**	**-0.427**
Israel	0.258	0.267	0.232	0.153	0.024	-0.114	**-0.206**	**-0.260**	**-0.245**
Italy	0.155	0.122	0.088	0.050	-0.008	-0.077	-0.107	-0.093	-0.030
Japan	0.007	-0.005	-0.024	-0.058	-0.095	-0.130	-0.134	-0.109	-0.068
Netherlands	0.349	0.291	0.226	0.148	0.051	-0.058	**-0.154**	**-0.220**	**-0.235**
New Zealand	**-0.248**	**-0.294**	**-0.374**	**-0.439**	**-0.492**	**-0.515**	**-0.486**	**-0.413**	**-0.304**
Norway	0.140	0.087	0.013	-0.071	**-0.140**	**-0.205**	**-0.261**	**-0.277**	**-0.260**
Portugal	0.342	0.316	0.262	0.183	0.090	0.005	-0.027	-0.017	0.026
Singapore	-0.002	-0.018	-0.038	-0.072	-0.105	**-0.159**	**-0.188**	**-0.179**	**-0.137**
Spain	0.333	0.301	0.257	0.205	0.131	0.050	-0.014	-0.046	-0.028
Sweden	0.096	0.043	-0.021	-0.096	**-0.193**	**-0.282**	**-0.338**	**-0.349**	**-0.298**
Switzerland	0.291	0.261	0.220	0.150	0.037	-0.113	**-0.252**	**-0.349**	**-0.340**
UK	0.107	0.094	0.074	0.040	-0.020	-0.090	**-0.145**	**-0.171**	**-0.143**
US	0.255	0.225	0.191	0.137	0.069	-0.002	-0.070	-0.109	-0.099

Panel B. Country IVROE

Country/	I	II	III	IV	V	VI	VII	VIII	IX
Region	+4	+3	+2	+1	0	-1	-2	-3	-4
Australia	0.122	0.085	0.048	0.013	-0.021	-0.054	-0.085	-0.114	**-0.140**
Austria	-0.024	-0.030	-0.032	-0.029	-0.018	-0.001	0.021	0.045	0.069
Belgium	0.154	0.117	0.076	0.031	-0.015	-0.058	-0.092	-0.114	-0.121
Canada	0.251	0.224	0.192	0.154	0.112	0.068	0.024	-0.016	-0.050
Denmark	0.019	0.026	0.024	0.016	0.001	-0.017	-0.040	-0.065	-0.091
Finland	**-0.320**	**-0.309**	**-0.296**	**-0.283**	**-0.271**	**-0.260**	**-0.250**	**-0.240**	**-0.228**
France	0.439	0.412	0.387	0.363	0.342	0.325	0.313	0.306	0.305
Germany	**-0.265**	**-0.262**	**-0.260**	**-0.261**	**-0.267**	**-0.278**	**-0.294**	**-0.311**	**-0.326**
Hong Kong	-0.046	-0.031	-0.015	-0.002	0.007	0.013	0.015	0.015	0.015
Ireland	0.002	0.007	0.015	0.028	0.047	0.071	0.100	0.131	0.162
Israel	0.054	-0.016	-0.080	-0.133	**-0.175**	**-0.192**	**-0.201**	**-0.201**	**-0.191**
Italy	-0.084	-0.074	-0.058	-0.035	-0.008	0.025	0.061	0.100	0.141
Japan	**-0.655**	**-0.640**	**-0.623**	**-0.602**	**-0.578**	**-0.551**	**-0.522**	**-0.492**	**-0.461**
Netherlands	0.205	0.143	0.077	0.010	-0.058	-0.123	**-0.185**	**-0.239**	**-0.283**
New Zealand	0.359	0.340	0.323	0.309	0.297	0.284	0.269	0.252	0.229
Norway	0.085	0.041	0.005	-0.023	-0.041	-0.051	-0.051	-0.044	-0.030
Portugal	**-0.236**	**-0.292**	**-0.347**	**-0.401**	**-0.453**	**-0.500**	**-0.540**	**-0.571**	**-0.591**
Singapore	0.169	0.156	0.131	0.096	0.056	0.015	-0.023	-0.054	-0.073
Spain	-0.044	-0.084	-0.122	**-0.155**	**-0.184**	**-0.206**	**-0.222**	**-0.229**	**-0.228**
Sweden	-0.104	**-0.217**	**-0.331**	**-0.442**	**-0.545**	**-0.636**	**-0.710**	**-0.766**	**-0.802**
Switzerland	0.348	0.329	0.299	0.262	0.219	0.173	0.126	0.082	0.044
UK	0.168	0.124	0.074	0.023	-0.030	-0.079	-0.125	**-0.163**	**-0.195**
US	-0.018	-0.053	-0.092	-0.135	**-0.181**	**-0.228**	**-0.275**	**-0.319**	**-0.356**