The world price of tail risk

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Abstract

For 40,000 stocks from 46 countries, we examine the pricing of co-tail risk arising from the co-movement in left-tail distribution of stock returns and market returns. We find that the co-tail risk with respect to local and global market returns is priced significantly both statistically and economically worldwide. We decompose global co-tail risk into non-local global, U.S. market-related, and non-U.S. global component and find that all these components are significantly priced. The pricing of global co-tail risks is generally stronger in developed markets than in emerging market, implying that the large presence of global investors in developed market makes global co-tail risks more important.

Keywords: tail risk, co-tail risk, international stock markets

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For 40,000 stocks from 46 countries, we examine the pricing of co-tail risk arising from the co-movement in left-tail distribution of stock returns and market returns. We find that the co-tail risk with respect to local and global market returns is priced significantly both statistically and economically worldwide. We decompose global co-tail risk into non-local global, U.S. market-related, and non-U.S. global component and find that all these components are significantly priced. The pricing of global co-tail risks is generally stronger in developed markets than in emerging market, implying that the large presence of global investors in developed market makes global co-tail risks more important.

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I. Introduction

Tail risk entails a significant premium since investors' demand for hedging extreme downside risk is material (Bollerslev and Todorov, 2011; Kelly and Jiang, 2014; Bali, Cakici, and Whitelaw, 2014; Bollerslev, Todorov, and Xu, 2015; Chabi-Yo, Ruenzi, and Weigert, 2015). Tail risks have multiple dimensions: Some arise from stock-specific risk of crash, while some arise from the comovement of stock returns with market returns in a downside – that is, stocks collapse when a market collapses or vice versa. Recently, Bali et al. (2014) show that what they called the hybrid-tail risk, which is a semi-covariance, or a co-tail risk, of stock returns with market return conditional on left-tail movement of stock returns, entails both statistically and economically significant premium in the U.S. market. However, whether the similar pricing implication can be found in the global financial market is uncertain and has not been studied. For example, given that the developed markets are less volatile and exposed to less of regulation relative to emerging market countries in general, stocks from developed and emerging market countries may request different amount of compensation for bearing these tail risks. In this paper, we extend the issue of the pricing of tail risks to global financial market.

The compensation for bearing downside risk is examined and shown to be significant in the U.S. market by Ang, Chen, and Xing (2002). In a recent paper, however, Atilgan, Bali, Demirtas and Gunaydin (2016) could not find evidence of significant compensation for downside risk for stocks from 51 countries around the world. Given higher volatility of stock returns in a global market than in the U.S. market, the mild or non-extreme downside risk is rather common globally, and it is possible that investors around the world do not request much of compensation for bearing the mild and sustainable downside risk. However, if the downside risk is in the extreme, the risk is not sustainable, and investors need to be compensated accordingly for bearing such extreme downside risk. According to Bollerslev and Todorov (2011), required returns to compensate for crash risk take substantial portion of average stock returns. In a subsequent study, Bollerslev, Todorov and Xu (2015) show that time-varying aspect of the premium for extreme downside returns is related to stock return predictability.

One important dimension of extreme downside returns, or left-tail distribution of returns, is on the different degree of return correlation with the market returns in a down market. The correlation between stock returns and market returns is shown to be (much) greater in (extreme) downside in the U.S. market (Ang and Chen, 2002) and in the international financial market (Longin and Solnik, 2001). Extending these studies to asset pricing, more recent study shows that this increased correlation on the downside is compensated in the form of stock returns. Specifically, Chabi-yo, Ruenzi, and Weigert (2015) show that stocks that are sensitive to market crash, or stocks with large lower-tail dependence with the market, are traded at a discount in the U.S. market. We examine the pricing of downside comovement of stock returns with local market returns in global financial markets.

The presence of global investors along with the increased degree of global financial market integration posits additional dimension to consider in the pricing of tail risk: comovement of stock returns with global market return. Reduced regulation for global investment flows made a linkage among stocks across countries higher and hedging global source of risks more important than before. A recent financial market crash of 2008 Subprime mortgage crisis shows that U.S. or local market shock can be spread globally through various channels, both financial and non-financial, and that stock returns are no longer affected solely by local market shocks but by global shocks. Therefore, we ask in this paper whether stocks around the world are compensated for risks arising from their comovment with local or global market shocks since rational investors will request the risk of joint coincidence with lower market returns to be properly rewarded. In a more open economy or in an economy that is sufficiently integrated with global financial market, the co-tail risk with respect to global risk should be compensated, while it is the co-tail risk with respect to local market returns that is important in a more closed economy. Hence, the pricing implication of co-tail risks with respect to global market is also a manifestation of the degree of globalization of a financial market of a country. Since global market shock can affect stocks in a country through its impact on local market returns of the same country, we compute co-tail risks with respect to global market return after orthogonalizing global market return against local market return as in Jorion and Schwartz (1986).

In the next step, we investigate the role of the U.S. market in the pricing of co-tail risks. Given that U.S. stocks take lion's share of world stock market and have dominant impact on global financial market (Lee, 2011), the global co-tail risks may be driven mostly by U.S. market, leaving the non-U.S. global component of global market returns have only marginal impact at best. In doing so, we further decompose non-local global component of global market return, which is obtained by regressing global returns on local market returns, into U.S. market return and non-U.S., or U.S.-unrelated, global market returns. By examining the pricing of co-tail risks with respect to U.S. market and non-U.S. global returns, we can estimate the relative importance of U.S. and other markets in the pricing of extreme returns in global financial markets.

Overall, we ask the following research questions in this paper: Is extreme return of stocks priced globally? Are stocks whose crash tend to jointly coincide with market crash traded at a discount? Is sensitivity of stock returns with local market return in a downside properly compensated? Is global financial market sufficiently integrated so that left-tail dependence of stock returns with global market returns be properly reflected in asset prices? Is lower comovement with the local market compensated more than that with the global financial market? What is the relative importance of U.S.-related tail risk and co-tail risks with respect to non-U.S. global component in asset pricing? Is there differences in the pricing of tail risks between emerging market and developed markets? These are the questions that we seek answers for.

Our empirical tests are based on a broad sample of more than 40,000 stocks from 46 countries, including both emerging market and developed markets. We examine the pricing implication of tail risks both in cross-sectional regressions at the stock-level and in portfolio-level analysis with factor models. We first find that the co-tail risk with respect to local market returns is priced significantly both statistically and economically worldwide. The Fama-MacBeth type cross-sectional regressions across stocks with country dummies show that one unit increase in the co-tail risk with respect to local market returns increases monthly 1.13% of stock returns globally, or 1.55% in developed markets and 0.79% in emerging markets, the magnitude of which is also economically significant. The result is robust to the inclusion of control variables for stock characteristics and other forms of tail risks. Our U.S. results are consistent with those in Bali *et al*. (2014).

The subsequent analyses for global co-tail risk show even stronger results in that the economic magnitude of the premium is larger than that for the co-tail risks with respect to local market return. The coefficient of, or the marginal premium for the unit increase of, global co-tail risk in the cross-sectional regression is 3.04% in all cross-section, while it is 3.46% and 2.86% for developed and emerging markets, respectively. We observe that larger premium in developed markets than in emerging markets for co-tail risks with respect to both local and global market returns.

Global market returns can affect stock returns through its impact on local market returns. Hence, we decompose the global market returns to local- and non-local global components and computed co-tail risks accordingly. Regressions with both local and global co-tail risks show that both risks are fairly priced globally, with the economic magnitude much larger for global co-tail risks than for local co-tail risks. The results are significant in the cross-section of stocks from both developed markets emerging markets. This implies that investors request compensation for bearing risks that arise from the coincidence of lower stock return with both local market return and non-local global market returns.

Since U.S. market returns and global market returns are correlated, we disentangle the U.S. market returns from the global market returns and test U.S.-related and non-U.S.-related (or U.S.-unrelated) co-tail risks. We find that both co-tail risks are significantly priced in global financial markets, with the coefficient of the co-tail risk being much larger for non-U.S. & non-local risk than for co-tail risk with respect to U.S. market returns.

We also performed factor model regressions to examine the pricing of tail risks. The abnormal return or alpha obtained from the global five factor model is monthly 1.15%, or annual 14.80%, for portfolios based on the co-tail risk with respect to global market return. The alphas are also economically and statistically significant regardless of global factor models used in the tests. Consistent with the results from the cross-sectional regressions, the factor model regressions also show that co-tail risks with respect to non-local global, U.S. market-related, and non-U.S. global component are all significantly priced. The pricing of global co-tail risks is generally stronger in developed markets than in emerging market, implying that the large presence of global investors in developed market makes global co-tail risks more important.

We contribute to the literature in the following way. First, we contribute to the tail risk literature by showing the price implication of tail risks in global financial market. To the best of our knowledge, this is the first paper that investigate the pricing of tail risks globally. Second, we add to the literature on global financial market integration by showing the pricing of global co-tail risks, which manifests the degree of financial globalization of global financial market. Third, we highlight the role and importance of U.S. market in global financial market by examining the pricing of tail risks that are related to U.S. market relative to those that are not related to the U.S. market.

II. Data

We compute daily stock returns from daily total return index (RI), which is adjusted for stock splits and dividend payment, from Datastream for all countries except for the U.S. Following Ince and Porter (2006) and Lee (2011), we set the daily return to be missing if the value of the total return index for either the previous or the current day is below 0.01. We also set the daily return as missing if any daily return greater than or equal to 100% is reversed the following day. Specifically, the daily returns for both days t and t-1 are set to be missing if $R_{i,t}R_{i,t-1} \leq 1.5$ and at least one of the two returns is 200% or greater, where $R_{i,t}$ is a gross return of stock i for day t. We also drop the stocks if the previous year-end price is in the extreme 2.5% (inclusive) at the top or bottom of the cross section for each country to have the sample stocks within a specific price range (Lee, 2011).

For the U.S. we obtain data for stocks in NYSE, Amex, and Nasdaq from CRSP. Following Bali, Cakici and Whitelaw (2014), we exclude stocks for each month if month-end market capitalization is below the smallest decile of NYSE breakpoint.[1] We also discard stocks for the year whose previous year-end price is less than $5 per share.

Following Griffin, Kelly and Nardari (2010), Lee (2011), and Karolyi, Lee and van Dijk (2012), we restrict the sample to common stocks listed on the major exchanges in a country. Most countries in the sample have a single major exchange except for Canada (Toronto Stock Exchange and TSX Venture Exchange), China (Shenzen and Shanghai Stock Exchange), Japan (Tokyo Stock Exchange and Osaka Securities Exchange), Russia (Moscow Interbank Currency Exchange (MICEX) and Russian Trading System (RTS)), Korea (Korean Stock Exchange and KOSDAQ), Taiwan (Taiwan Stock Exchange and Taiwan OTC Exchange) and the U.S. (Amex, NYSE, and Nasdaq)[2]. In addition, we use only common stocks by excluding stocks with special features. Hence, Depository Receipts (DRs), Real Estate Investment Trusts (REITs), and preferred stocks are excluded.[3]

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[1] We thank K. French for providing the data on his website.

[2] The Japan Exchange Group (JPX) was launched on January 1, 2013, by merging the Tokyo Stock Exchange and Osaka Securities Exchange. The Korea Exchange was created on January 27, 2005, by the integration of Korea Stock Exchange, Korea Futures Exchange, and KOSDAQ. The Moscow Exchange was established on December 19, 2011, by merging the two largest Moscow-based exchanges, the Moscow Interbank Currency Exchange (MICEX) and the Russian Trading System (RTS).

[3] We drop non-common shares from the sample by applying the name filtering. For more detailed

Our final sample includes 50,613 stocks from 46 countries for the period from January 1995 to December 2013. Following International Finance Corporation (IFC) of the World Bank Group, we classify 22 sample countries into developed countries (Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Hong Kong, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Singapore, Spain, Sweden, Switzerland, the U.K., and the U.S.) and 24 countries into emerging market countries (Argentina, Brazil, Chile, China, Greece, Hungary, India, Indonesia, Israel, Malaysia, Mexico, Pakistan, Peru, Philippines, Poland, Portugal, Russia, South Africa, South Korea, Sri Lanka, Taiwan, Thailand, Turkey, and Venezuela).

Similarly to daily return computation, we construct monthly stock returns by using the month-end total return index from the screened daily data files of Datastream for all countries except for the U.S., for which we use CRSP data. For monthly returns, we drop stock- month observations if $R_{i,t}R_{i,t-1} \leq 1.5$ and at least one of the two returns 300% or greater, where $R_{i,t}$ is the gross return for month t (Ince and Porter, 2006). We also drop monthly returns of the extreme 0.1% (inclusive) at the top or bottom of the cross section of each country to handle splits, mergers, and potential data errors (Lee, 2011). After all these screening, stocks that have at least 12 months of data from 1995 to 2013 are included into the sample.

Monthly market capitalization and book-to-market ratio are obtained from Datastream for sample countries other than the U.S. For the U.S., monthly stock return, market capitalization and book-to-market ratio are calculated from CRSP monthly file and COMPUSTAT.

III. Tail risk

Markowitz (1959) introduces the notion of semi-variance, or the lower partial moment (LPM), as more appropriate risk measure than variance. The LPM of an asset or portfolio is defined as

information, refer to the footnote 5 of Lee (2011) and the footnote 3 of Karolyi, Lee, and van Dijk (2012).

$$LPM = \int_{-\infty}^{k} (R-k)^2 f_p(R) dR \quad (1)$$

where k is the reference level of returns and $f_p(R)$ represents the probability density function of returns for portfolio p. Since the LPM uses a chosen point of reference (k), the LPM could measure losses relative to some reference point while variance depends on both gains and losses.

According to Bali, Cakici and Whitelaw (2014), we can think of three different dimension of the lower partial moment as proxies for risks for investors with under-diversified position. The first is stock-specific tail risk, motivated by the lower partial moment, or the variance of stock returns in a loss region, proposed by Markowitz (1959). The large fluctuation of returns in the negative region poses greater possibility of crash in stock return, hence indicates greater tail risk. Therefore, we define lower semi-variance (*LSV*) of stock return as a measure of stock-specific tail risk:

$$LSV_i = \sum_{R_i < k_i} (R_i - k_i)^2 \quad (2)$$

k_i is the pre-specified reference level of return for stock i, R_i. Restricting the range to the reference level of k, the *LSV* measures the risk of losses relative to the reference point. This contrasts to variance, which treats gains and losses symmetrically. We set 10th percentile as a reference value but also use 5th to 50th percentile in the robustness tests later. The other two measures of tail risks are based on the conditional covariance of stock and market returns. If a stock return covaries with market return in a down market, the tail risk of a portfolio will be large. Therefore, we measure the tail risk as a lower partial moment of covariance, or the semi-covariance conditional on domestic market return, R_D, (*CTR_M*):

$$CTR\_M_i^D = \sum_{R_D < k_D} (R_i - k_D)(R_D - k_D) \quad (3)$$

We normalize *CTR_M* by dividing it by conditional semi-variance of domestic market return, $\sum_{R_D < k_D} (R_D - k_D)^2$, similarly to market beta. We use the local market index from Datastream for each sample country.

The third is the tail risk associated with the co-movement of stock and market returns conditional on sufficiently negative stock return.

$$CTR\_I_i^D = \sum_{R_i<k_i}(R_i - k_i)(R_D - k_D). \tag{4}$$

CTR_I is the co-lower partial moment, or co-tail risk, between extreme negative stock returns and domestic market returns, conditional on stock return rather than domestic market return. Since individual stocks are generally more volatile than the diversified portfolios, tail events for the portfolio of stocks and diversified portfolios will coincide more with the tail events of stocks than with the tail events of diversified portfolios.

For market portfolio, we employ two kinds of market index return: local market index and the global market index. The local market index matters for investors who hold the local market composition (henceforth local investors), whereas the global market portfolio matters for global investors whose investment position covers multiple countries (henceforth global investors). Therefore, we compute the two co-tail risks in Eqs. (3) and (4) with respect to both domestic and global market returns.

$$CTR\_M_i^G = \sum_{R_G<k_G}(R_i - k_G)(R_G - k_G) \tag{5}$$

$$CTR\_I_i^G = \sum_{R_i<k_i}(R_i - k_i)(R_G - k_G). \tag{6}$$

where R_G is a global market return and k_G is a reference level of the global return. We use the global market index from Datastream.

For each month from January 1995 to December 2013, we compute these tail risk measures for each firm using daily returns over the past six months. We employ the return threshold of 10th percentile for both stock and market return. In the robustness tests in later section, we employ other threshold values. We drop tail risk measures that do not have at least 5 days of observations to enhance the reliability of measures.

[INSERT TABLE 1 HERE]

Table 1 reports the number of stocks, sample beginning-year/month and the summary statistics of tail risk measures and monthly stock returns. The number of stocks in the sample varies across countries and years. The total number of sample stocks is 42,567. The U.S. has the largest number of stocks of 8,992 stocks, and Luxembourg has the smallest coverage of only 20 stocks. The starting year of sample is 1995 for all sample countries except for Ireland, Luxembourg, and Russia, which have data from 2000, 1999, and 1998, respectively.

The next five columns report averages of tail risk measures. The two columns on the left under the label "Local" are for co-tail risks with respect to local market returns, while the two columns labeled "Global' are for co-tail risk measures with respect to global market return. The column LSV is for the stock-specific tail risk as specified in Eq. (2). CTR_I^D ranges from -0.322% of Canada to -0.033% of Spain for developed markets, and from -0.181% of China to 1.109% of Venezuela for emerging markets. The local co-tail risk of CTR_I^D is generally greater in emerging-market countries than in developed-market countries. The global co-tail risk of CTR_I^G ranges from -0.257% of Canada to -0.056% of Italy for developed markets, and from -0.251% of Venezuela to -0.032% of Mexico for emerging markets. The global co-tail risk of CTR_I^G is slightly larger in emerging-market countries than in developed-market countries, but seems to be almost similar. The co-tail risk conditioning on market returns, CTR_M^D and CTR_M^G, are generally greater than CTR_I^D and CTR_I^G. The stock-specific tail risk measure of LSV, which always has positive value, ranges from 0.387% of Luxembourg to 2.951% of Canada for developed markets, and from 0.440% of Taiwan to 3.050% of Venezuela for emerging markets.

The last two columns of Table 1 show averages of the cross-sectional averages of monthly returns and the cross-sectional averages of the standard deviation of stock returns. The figures are in percentage and computed on the basis of U.S. dollar. The average of the returns shown in the table ranges from -1.13% to 1.03% for developed markets and from -0.43% to 1.00% for emerging markets. The standard deviations are generally greater in emerging-market countries than in developed-market countries. The standard deviations of returns exceed 15% for 12 emerging-market countries and for 5 developed-market countries.

[INSERT TABLE 2 HERE]

Table 2 reports averages across countries of tail risk measures for each of the portfolios based on firm size. In forming size portfolios, a stock is sorted every year into deciles based on its previous year-end market capitalization in each country. Then, the decile ranks are linked across countries to form equally-weighted country-neutral portfolios. The two columns on the left under the label "Local" are for co-tail risks with respect to local market returns, while the two columns labeled "Global' are for co-tail risk measures with respect to global market return. The column *LSV* is for the stock-specific tail risk as specified in Eq. (2).

CTR_I^D increases monotonically from -0.263 for the smallest portfolio to 0.177 for the largest portfolio in the overall sample, indicating larger co-tail risk for large firms than for small firms (panel A). Likewise, the global co-tail risk of CTR_I^G grows monotonically from -0.240 to -0.052 in the same panel. We observe this monotonic pattern not only in the overall sample countries (panel A), but also in the developed- and emerging-market categories (panels B and C). The local co-tail risk of CTR_I^D is generally larger in emerging markets than in developed markets, while the pattern is reversed for global co-tail risk of CTR_I^G. That is, global co-tail risk is generally larger in developed market than in emerging market. This implies that stocks in emerging market countries generally have high lower co-movement with domestic markets, whereas stocks from developed countries tend to co-move more with global markets in a down side. Considering that financial markets are generally more open in developed countries, large presence of global investors seems to drive the co-movement of stock returns with global market returns.

The co-tail risk conditioning on market returns, CTR_M^D and CTR_M^G, also vary monotonically by firm size. In other words, the risk is generally higher for large stocks than for small stocks. The stock-specific tail risk measure of LSV monotonically decreases from 2.561 for the smallest portfolio to 0.737 for the largest portfolio in the overall sample (panel A). This monotonic relation for LSV is also observed in the developed- and emerging-market categories (panels B and C), but not in the U.S. (panel D). The pattern implies that small stocks are riskier than large stocks in terms of downside return fluctuation.

IV. The world price of tail risk

In this section, we run cross-sectional regressions to examine the pricing of tail risks. Since the relative importance of co-tail risks with respect to local market return and those with respect to global market return depends on the degree of openness of financial market (Errunza and Losq, 1985; Lee, 2011), we test local and global co-tail risks in separate sections based on different assumption on the degree of financial globalization.

4.1. The pricing of co-tail risks with respect to local market returns

When the global financial markets are fully segmented, risks related to local market are important. In this section, the first tests using local tail risk measures are performed under the assumption that world financial markets are fully segmented.

[INSERT TABLE 3 HERE]

Table 3 shows time series averages of the estimated coefficients in Fama-MacBeth type cross-sectional regressions over all sample countries, developed markets, emerging markets, and the U.S. in separate panels. The regressions are performed with country dummies. The cross-sectional regressions show that CTR_I^D is significantly priced in all specifications and in all regions in the table. The premium on CTR_I^D is positive (1.409) and statistically significant with a t-value of 11.11 in overall sample countries. The premium for CTR_I^D is almost twice as big in the developed markets as in the emerging markets. The CTR_I^D is significantly priced at the 1% level, with a coefficient of 2.025 and a t-value of 11.82 in the developed markets (Panel B) and with a coefficient of 0.959 and a t-value of 8.07 in the emerging markets (Panel C). The significant relation is also maintained in the regression including other tail risk measures and control variables. However, the coefficient on CTR_M^D is barely significant. For LSV, the coefficient is significant but negatively related to stock returns. The pattern is consistent across all regions considered in the table. The pricing of CTR_I^D is not affected by the inclusion of other tail risks and the control variables. The coefficient of CTR_I^D is 1.154 with a t-value of 9.45 when the three tail risk proxies are horse-raced. Overall, the exercises in this section show that CTR_I^D is significantly priced, while other tail risk measures are not significant or significant with an unexpected sign. These results are consistent with the U.S. results of Bali et al. (2014).

4.2. The pricing of co-tail risks with respect to global market returns

If the world financial markets are fully integrated, only global returns matter while local returns do not. Based on this assumption, we examine the pricing implication of tail risks with respect to global market returns.

[INSERT TABLE 4 HERE]

Table 4 shows the results from the cross-sectional regressions with country dummies using global tail risk measures. We see that CRT_I^G is highly significant and positive in all panels in the table, even after controlling for size, book-to-market and illiquidity. However, CTR_M^G is not priced in most cases except for emerging market countries. CRT_I^G is significantly priced with a coefficient of 3.826 and a *t*-value of 13.01 in the developed markets (panel B) and with a coefficient of 2.849 and a t-value of 9.01 in the emerging markets (panel C), implying that the premium for tail risk is greater in the developed markets. In the U.S. (panel D), CRT_I^G is also priced with a coefficient of 1.174 and a t-value of 2.24. Again, the pricing of CRT_I^G is not unique to some specific regions, but is a global phenomenon. It is not affected by the inclusion of other tail risk measures and control variables.

Interestingly, the magnitude of the premium for CRT_I^G is more than twice larger than that for its local market counterparty, CRT_I^D. In the cross-sectional regression (panel A), the coefficient on CRT_I^G is 3.301 (t-value of 11.75), which is much bigger than 1.409 for CRT_I^D in the previous Table 3. This phenomenon is also found in both developed and emerging markets (panels B and C). For the U.S., the magnitude of the coefficient is not so different for local and for global co-tail risks, reflecting the significant role of U.S. market in global financial market.

Analyses in this section provide some evidence on the integration of global markets from the perspective of tail risk.

4.3. Local vs. global co-tail risks

In this section, we perform empirical tests for both local and global tail risk measures under the assumption that the degree of integration of world financial markets is mild in that the degree lies somewhere between full segmentation and full integration. Because local and global tail risks are jointly tested under this assumption, the analysis in this subsection provides an opportunity to examine the relative importance of local and global risk. Given the significance in the pricing of tail risks, we focus only on the co-tail risk of *CTR_I* from this section on.

In the previous section, we show that the co-tail risks from both local and global markets are priced. However, we did not elaborate to distinguish the impact of global market and that of local market return. That is, it is possible that global market affects stock returns through its impact on local market return, but the global component of local market returns are not separated out. Therefore, to differentiate the local market from the rest of the world, we decompose a global factor into two groups: local market return and the ‘‘non-local global’’ market return, which is net of local market return. We obtain the non-local global market return in a manner similar to Jorion and Schwartz (1986) and Lee (2011). Specifically, we obtain the non-local global market return for country i, R_{G-M}, by orthogonalizing the global market return to the local market return of country i by taking the residuals from the regression of global market returns on local market return. We compute the co-tail risk measure with respect to this orthogonalized non-local global market return:

$$CRT\_I_i^{G-D} = \sum_{R_i<k_i}(R_i - k_i)(R_{G-D} - k_{G-D}). \tag{7}$$

By distinguishing the local and non-local global component of global market returns, we can now test the relative importance of co-tail risks with respect to local market and the global market in multivariate regressions.

[INSERT TABLE 5 HERE]

Table 5 shows the results from the cross- sectional regressions with country dummies using both local and non-local global co-tail risk measures. Both local and non-local global CTR_I significantly affect the expected returns. Local CRT_I^{D} and non-local global CRT_I^{G-D} are priced at the 1% significance level in the overall world market (panel A), developed market (panel B) and emerging market (panel C). The magnitude of the coefficient on non-local global co-tail risk is much bigger than that on local co-tail risk. In the overall countries, the magnitude is almost five times bigger for non-local global co-tail risk and it is about three times in developed markets. The magnitude of non-local global co-tail risk premium is smaller in the emerging market. However, non-local component is more than ten times larger than the local component. This pattern is also shown after controlling for market beta, firm size, book-to-market, and illiquidity. This finding implies that global investors seek larger compensation for holding stocks whose return plummets in global market downturn than in local market downturn.

In the U.S., local CRT_I^{D} is priced at the 10% significance level (a coefficient of 0.738 with a *t*-value of 1.85). However, the co-tail risk with respect to non-local global factor is not statistically significant. This finding shows that the local tail risk is more important than global tail risk in the U.S., implying the dominating role of the U.S. in the global stock market. Given this finding, we examine in the next section the degree to which the U.S. market plays in the pricing of global co-tail risk by further decomposing non-local global co-tail risks into U.S.-related and U.S.-unrelated components.

4.4. Cross-country differences in the pricing of co-tail risks

The above results show that the co-tail risk is priced in local and global market. In this section, we examine what drive the relative importance of local and global co-tail risks. To see the cross-country differences in the pricing of co-tail risks, we use country-level proxies for the degree of development of fund industry, transparency, political risk, and international capital flow.

First, we predict that the co-tail risk would be greater for countries where the fund industry has developed. It is the same view as Bali et al. (2014) that co-tail risk conditioning on individual stock is an appropriate measure of risk in the framework that investors hold both individual equity and well-diversified portfolios, i.e. mutual funds or ETFs. We employ three measure for the development of fund industry. Two measures are country's fund industry sizes, which are equity mutual funds' assets under management as of 2002 scaled by both GDP and primary securities (Khorana, Servaes, and Tufano, 2005). The third is the ETF size, which is the dollar trading volume in exchange traded country funds for 28 countries traded on U.S. markets scaled by the dollar market capitalization of each country (Karyolyi, Lee, and van Dijk, 2012).

Second, we use two measures of transparency. One is the index of accounting standards, which is constructed based on the coverage of items in companies' 1990 annual reports (La Porta, Lopez-de-Silanes, Shleifer, and Vishny, 1998). The higher values indicate higher accounting standards. The other measure is the index of credibility of disclosure, which denotes the percentage of firms in the country that are audited by the big five accounting firms (Bushman, Piotroski, and Smith, 2004). This variable has a value of one, two, three, or four if the percentage falls in the range of 0–25%, 25–50%, 50–75%, or 75–100%, respectively.

Third, we employ the measure of political risk. The index of expropriation risk from La Porta, Lopez-de-Silanes, Shleifer, and Vishny (1998) is adapted. This variable measures the threat of outright confiscation or forced nationalization by the state, and higher values indicate lower risks. The scale ranges from zero to ten.

Finally, we consider two measures of cross-border investment flows. One is the amount of stocks in a country held by US institutions (Ferreira and Matos, 2008). The other measure is the overall capital restrictions index of a country for all asset categories. The higher values indicate higher restrictions. This is obtained from NBER.

[INSERT TABLE 6 HERE]

To see the effect of these proxies in pricing of local and global co-tail risks, the interaction term between co-tail risk measure and country-level proxies are added in the cross-sectional regression. Specifically, we perform cross-sectional regressions of the expected returns on the set of explanatory variables: co-tail risks of local CRT_I^{D} and non-local global CRT_I^{G-D}, and the two interaction terms incorporating the country-level proxy, X. We also include beta, size, book-to-market, and illiquidity to control for firm characteristics.

Table 6 shows that the interaction terms of local CRT_I^{D} and X are significant for six country-specific variables, except for two variables related to transparency. The results imply that the local co-tail risk of CRT_I^{D} is significantly priced in countries with high fund industry development, low political risk, a large amount of stocks held by US institutions, and low restriction on international capital flows.

Similarly, the non-local global co-tail risk of CRT_I^{G-D} is significantly priced in countries with high fund industry development, a large amount of stocks held by US institutions, and low restriction on international capital flows. The results are consistent with our prediction that global co-tail risk is important in countries with high fund industry development and large cross-border investments, because global investors, who request compensation for bearing tail risk, could be more prevalent in such countries.

4.5. Further decomposition of non-local global co-tail risk: U.S. vs. Non-U.S. global

In this section, we decompose the global factors into the U.S. and the non-U.S. to investigate whether the U.S. market, which is the largest financial market in the world, drives the pricing of global co-tail risk. We compare the pricing of tail risks with respect to the U.S. market with the pricing of tail risks with respect to global market that is independent of both local and U.S. factors.

To differentiate the U.S. market from the rest of the world, we decompose non-local global market return into two groups: U.S. market return and the "non-local and non-US global" return, which is net of both local and U.S. market return. The non-local & non-US global return, $R_{(G-D)-US}$, is obtained from residuals from the regression of non-local global returns on the U.S. market return. We compute co-tail risks with respect to the U.S. market return (R_{US}) and non-local and non-US global return ($R_{(G-D)-US}$) and test the relative importance of U.S. market and the global market in the regression framework.

$$CRT\_I_i^{US} = \sum_{R_i<k_i}(R_i - k_i)(R_{US} - k_{US}) \tag{8}$$

$$CRT\_I_i^{(G-D)-US} = \sum_{R_i<k_i}(R_i - k_i)\left(R_{(G-D)-US} - k_{(G-D)-US}\right) \tag{9}$$

[INSERT TABLE 7 HERE]

Table 7 reports the results from the cross- sectional regressions with country dummies. We see that both U.S. and non-local & non-US global co-tail risks significantly affect the expected returns: CRT_I^{US} is priced at the 1% significance level in the overall world market with a coefficient of 1.168 and $CRT\_I^{(G-D)-US}$ is also priced at the 1% level with a coefficient of 3.796. Both co-tail risks are also significant in developed markets. The magnitude of premiums is smaller in the emerging markets, however, both tail risks are significant. The pricing of co-tail risks is robust to the regions and to the inclusion of control variables. The findings provide supporting evidence on the critical role of U.S. market in global financial market. However, the findings also show that global investors request compensation for bearing tail risk that arises from the lower partial comovement of stock returns with non-U.S. global component. Interestingly, the premium of non-local & non-US global co-tail risk is almost three times larger than that of U.S. co-tail risk, suggesting larger requested compensation for bearing risks from non-U.S. global component.

4.6. Robustness checks

In the previous sections, we compute tail risk measures using the 10% tails of the relevant return distributions over the preceding six months. The choice of 10% and six months is somewhat arbitrary. The choice of tail size or the reference value entails the trade-off since large tail size helps minimize the estimation errors by allowing a sufficient number of observations but the "tail" goes closer to general, and maybe mild, downside risk rather than to more extreme downside risk. In this section, we estimated *CTR_I*s using different tail sizes from 5 to 50-percentile of the daily return distribution over the past six months.

[INSERT TABLE 8 HERE]

Table 8 shows the cross-sectional regression of *CTR_I*s from alternative choices of tail size with the control variables (BETA, SIZE, BM, and ILLIQ) and country dummies. This table is different from the previous table because it shows the analysis result that includes three *CTR_I* variables at once. The results for control variables are not tabulated for brevity.

We see that the pricing implication of co-tail risks, both local and global, is robust up to 40% of cutoff points. The coefficient and the *t*-value peak when *CTR_I* is calculated using the 5% tail. As tail size increases, however, the coefficient goes smaller and becomes insignificant. When *CTR_I* is measured over the full lower half of the distribution, that is, when it becomes a downside risk rather than tail risk measure, the coefficient become negative. This should not be surprising because the co-tail risks are measured to capture extreme downside comovement of returns. The results in this table shows that the local and global co-tail measures are not sensitive to the choice of tail size.

[INSERT TABLE 9 HERE]

Next, we estimated *CTR_I*s using different tail sizes from 5 to 50-percentile of the daily return distribution over the preceding year rather than past six months. Table 9 shows the cross-sectional regression of *CTR_I*s from alternative measure of tail size with the control variables (BETA, SIZE, BM, and ILLIQ) and country dummies. The results for control variables are not tabulated for brevity.

We see that the pricing implication of co-tail risks is robust up to 30% of cutoff points for local co-tail risks, and 40% for global co-tail risks. The coefficient and the *t*-value peak when *CTR_I* is calculated using the 5% tail. Co-tail risk is stronger in developed markets than in emerging markets. It is common that as tail size increases, the coefficient goes smaller and becomes insignificant.

[INSERT TABLE 10 HERE]

Finally, we include additional control variables. The pricing effect of downside beta (Ang, Chen, and Xing 2006), momentum (Jegadeesh and Titman1993), coskewness (Harvey and Siddique 1999, 2000), idiosyncratic volatility (Ang et al. 2006, 2009), and preference for lottery-like assets (Bali, Cakici, and Whitelaw 2011) are considered. The downside beta(DBETA) is obtained from the regression of daily stock excess returns on local market excess return over the past one year, conditioning on the market excess returns below its average. The momentum (MOM) is calculated as the 6-month cumulative return from month t-7 to t-2. The coskewness (COSKEW) is the expected value of the product of the deviation of individual stock return and the deviation of market return divided by the product of the standard deviation of individual stock return and the variance of market return over the past one year. The idiosyncratic volatility (IVOL) is the standard deviation of regression residuals, where daily stock returns are regressed on the Fama-French three factor model over the past one month. The preference for lottery-like assets is measured by the maximum daily return (MAX) within the past one month.

Table 10 reports the cross-sectional regressions that include all three tail risk measures and the standard control variables with each of the additional control variables. The coefficients on these additional variables are in consistent with the existing literature except for DBETA. In line with Jegadeesh and Titman (1993), we find a strong positive relation between intermediate-term momentum and future stock returns. The average slope on COSKEW, IVOL and MAX is negative and highly significant consistent with the findings of Harvey and Siddique (1999, 2000), Ang et al. (2006) and Bali, Cakici, and Whitelaw (2011).

Even after MOM, COSKEW, IVOL or MAX are controlled for, the coefficients of local CRT_I^{D} and non-local global CRT_I^{G-M} are priced at the 1% significance level in the overall world market. Among additional control variable, the IVOL reduces the coefficient on co-tail risk the greatest. In the specification including all control variables, co-tail risk remains economically and statistically significant.

V. Asset pricing of tail risk: Factor model regression

So far, we have presented empirical results in the cross-sectional regression framework. In this section, we show how much trading alpha, or risk-adjusted return, can be generated by trading on the basis of local and global co-tail risks. Using stocks from all sample countries other than the U.S. we perform factor model regressions for co-tail risks that are shown to be priced in the preceding sections. In the analysis, we also exclude four countries of the Ireland, Luxembourg, Hungary and Venezuela, whose annual average number of stocks is less than 50. Finally, 41 countries are used for the factor model regression.

In each month *t*, a stock is ranked into deciles in a given country on the basis of *CTR_I,* which is estimated using the daily returns over the past six months. Subsequently, stocks with the same rank are combined to form ten equally-weighted portfolios across countries in the regions specified in the column of the table. Each portfolio return (in U.S. dollars) in excess of the risk-free rate is regressed in a factor model framework. We test three global factor models: Global one factor model or Global CAPM (Eq. 10), Global three factor model (Eq. 11), and Global five factor model (Eq. 12) as specified below:

$$R_{p,t} - R_{f,t} = \alpha_p^1 + \beta_p^{G,1}\left(R_{G,t} - R_{f,t}\right) + \varepsilon_{p,t}^1 \quad (10)$$

$$R_{p,t} - R_{f,t} = \alpha_p^2 + \beta_p^{G,2}\left(R_{G,t} - R_{f,t}\right) + \beta_p^{S,2} SMB_t + \beta_p^{H,2} HML_t + \varepsilon_{p,t}^2 \quad (11)$$

$$R_{p,t} - R_{f,t} = \alpha_p^5 + \beta_p^{G,5}\left(R_{G,t} - R_{f,t}\right) + \beta_p^{S,5} SMB_t$$

$$+\beta_p^{H,5} HML_t + \beta_p^{R,5} RMW_t + \beta_p^{C,5} CMA_t + \varepsilon_{p,t}^5 \quad (12)$$

The global factors of SMB (small cap minus big), HML (high book-to-market minus low), RMW (robust operating profitability minus weak), and CMA (conservative investment minus aggressive) are developed by Fama and French (1993, 2015) and are obtained from K. French's website.

[INSERT TABLE 11 HERE]

Table 11 shows the estimated alphas with the *t*-values in italics from the regression of each of the 10 portfolios that are formed based on global co-tail risk (panel A), co-tail risk with respect to the U.S. market (panel B), and non-local & non-US global co-tail risk (panel C). The U.S. stocks are dropped from the sample. Rows labeled "Global one-factor alpha", "Global three-factor alpha", and "Global five-factor alpha" indicate the intercepts from the models in Eqs. (10)-(12), respectively. The last column of the table (labeled "High–Low") shows the difference in the estimated intercepts that are obtained from the regressions of the portfolios with the highest co-tail risk and of those with the lowest co-tail risk.

Panel A of Table 11 shows the intercepts of portfolios based on global co-tail risk, CRT_I^G. The alphas in general are monotonically increasing from the lowest CRT_I^G-portfolio to the highest CRT_I^G-portfolio. The High–Low spread produces significant monthly abnormal return of 1.257%, 1.187% and 1.087% relative to the one-factor model, the three-factor model, and the five-factor model, respectively. On an annual basis, these returns range from 13% to 15%, which are highly significant economically. In developed markets, the High–Low spread is 1.630% for the three-factor alpha and 1.438% for the five-factor alpha. All alphas from the developed markets are highly significant both statistically and economically. In emerging markets, the High–Low spreads are 0.801% and 0.782% for the three- and five-factor model, respectively, which are also statistically significant. This may be consistent with the cross-sectional regression result that the premium of co-tail risk is larger in the developed markets.

In panel B, the portfolios are formed based on the CTR_I with respect to U.S. market return, CRT_I^{US}. The High–Low spread is 1.199% over all countries in the five-factor model, and it is highly significant at the 1% level (t-value of 10.25). Consistent with the preceding results for developed and emerging markets, the High–Low spreads from the five-factor model are 1.629% and 0.826%, respectively, and are highly significant at the conventional 1% level. There is monotonic pattern of the alphas along with the portfolios and the pattern is stronger for developed markets than for emerging markets.

Regarding global co-tail risk with respect to non-local and non-US factors (panel C), a significant High–Low spread of 1.455% arises from the five-factor model, which is significant at the 1% level and also significant economically. In developed markets, where a significant pricing of global co-tail risk is shown in the previous cross-sectional analysis, the High-Low spread from the five-factor model is 1.817%, which is significant at the 1% level. In the emerging markets, the spread of 1.142% from the five-factor model is significant.

Overall, a factor model regression framework provides supporting evidence of the pricing of co-tail risk by showing that trading based on global *CTR_I* generates substantial abnormal returns that are significant both statistically and economically. The trading alphas from the developed markets are highly significant both statistically and economically, while alphas from emerging markets are smaller. This highlights the role of global investors in the pricing of global co-tail risks, who are generally more present in developed market than in emerging market due to restrictions and low degree of financial liberalization in the latter.

VI. Conclusion

In this paper, we examine the pricing of tail risk in global financial markets. We find that co-tail risks, which are defined as lower semi-covariance of stock returns and market returns conditional on downside movement of stock return is statistically and economically significantly priced in world financial markets. The co-tail risks with respect to local market, U.S. market, and non-U.S. and non-local global component of global returns are all significantly priced. The pricing is stronger in developed market than in emerging markets, implying that the existence of global investors due to less of regulation on investment flows in developed markets may drive stronger pricing of tail risks in developed markets. The pricing is robust to the inclusion of stock characteristics and to the methodology – cross-sectional regression vs. factor model regressions.

Other than the variation in the pricing across developed and emerging market countries, we did not investigate fully the cross-country differences in the pricing implication in this paper. Though the topic is not fully exploited in this paper, we believe that it will be a promising topic to pursue for future research.

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Table 1. The summary statistics of tail risk measures and returns by country.

The table shows the number of stocks and tail risk measures by country, the averages of the cross-sectional averages of monthly returns, and the cross-sectional averages of the standard deviation of returns (all in percentage) that are based on US dollar. N denotes the total number of stocks across all sample periods in a given country. For each country, tail risk measures are averaged by stocks and months.

			Local		Global				
Country	N	First Year	CTR_I^D	CTR_M^D	CTR_I^G	CTR_M^G	LSV	Ret. Mean	Ret. SD
Developed markets (22 markets)									
AUSTRALIA	2,608	1995	-0.176	0.789	-0.223	0.493	2.419	-0.76	19.34
AUSTRIA	141	1995	-0.061	0.289	-0.098	-0.001	1.037	0.10	10.25
BELGIUM	195	1995	-0.082	0.193	-0.087	0.145	0.763	0.16	10.00
CANADA	3,668	1995	-0.322	0.570	-0.257	0.827	2.951	-1.13	21.62
DENMARK	302	1995	-0.109	0.114	-0.113	-0.007	1.050	0.09	11.10
FINLAND	176	1995	-0.175	-0.137	-0.095	0.421	0.795	0.42	10.86
FRANCE	1,316	1995	-0.162	-0.026	-0.125	0.280	1.091	0.08	13.43
GERMANY	1,018	1995	-0.216	0.151	-0.160	0.623	1.898	-0.75	16.06
HONG KONG	1,164	1995	-0.147	0.602	-0.198	0.086	1.782	-0.31	18.04
IRELAND	70	2000	-0.171	0.254	-0.167	0.508	1.580	0.18	13.73
ITALY	465	1995	-0.034	0.354	-0.056	0.638	0.639	-0.07	11.23
JAPAN	3,364	1995	-0.042	0.549	-0.137	0.136	0.811	-0.23	11.83
LUXEMBOURG	20	1999	-0.060	-0.001	-0.095	-0.519	0.387	0.89	6.50
NETHERLANDS	257	1995	-0.088	0.385	-0.087	0.544	1.074	0.16	11.19
NEW ZEALAND	206	1995	-0.039	0.596	-0.121	-0.077	0.927	0.37	10.94
NORWAY	388	1995	-0.102	0.510	-0.108	1.164	1.418	0.06	14.06
SINGAPORE	666	1995	-0.076	0.827	-0.151	0.397	1.321	0.01	13.96
SPAIN	224	1995	-0.033	0.344	-0.057	0.521	0.616	0.32	10.39
SWEDEN	728	1995	-0.193	0.277	-0.130	1.015	1.498	-0.06	15.77
SWITZERLAND	352	1995	-0.071	0.313	-0.085	-0.093	0.691	0.43	9.79
UK	2,368	1995	-0.193	0.095	-0.164	0.160	1.886	-0.38	14.96
US	8,992	1995	-0.060	1.041	-0.069	1.085	1.064	1.03	14.85
Emerging markets (24 markets)									
ARGENTINA	93	1995	0.074	0.801	-0.072	1.055	0.961	-0.30	13.13
BRAZIL	448	1995	0.042	0.518	-0.055	-1.120	1.445	0.23	15.80
CHILE	186	1995	-0.004	0.601	-0.062	0.054	0.718	0.46	9.98
CHINA	2,458	1995	-0.181	-0.221	-0.168	-0.729	0.708	0.81	13.34
GREECE	395	1995	0.010	1.051	-0.118	0.642	0.895	-0.42	16.79
HUNGARY	61	1995	0.078	0.371	-0.095	0.644	1.130	-0.36	12.25
INDIA	2,635	1995	-0.075	0.706	-0.142	0.123	1.195	-0.23	19.44
INDONESIA	409	1995	0.118	0.561	-0.137	0.193	1.343	0.03	15.53
ISRAEL	486	1995	-0.059	0.719	-0.130	0.440	1.179	0.30	14.43
MALAYSIA	1,057	1995	0.167	0.948	-0.187	0.159	1.571	-0.41	14.65
MEXICO	172	1995	0.110	0.845	-0.032	1.512	1.069	0.42	12.35
PAKISTAN	206	1995	-0.023	0.634	-0.189	-1.515	0.998	0.11	14.32
PERU	94	1995	-0.007	0.969	-0.119	-0.049	1.300	0.77	14.10

PHILIPPINE	260	1995	-0.123	0.767	-0.211	-0.350	1.858	-0.43	16.57
POLAND	520	1995	-0.059	0.546	-0.094	1.391	1.453	-0.36	16.61
PORTUGAL	117	1995	-0.032	0.457	-0.083	0.076	0.764	0.02	10.29
RUSSIA	260	1998	0.047	0.550	-0.141	1.418	2.121	0.32	17.09
S.AFRICA	796	1995	-0.158	0.352	-0.174	0.396	2.081	-0.25	17.27
S.KOREA	988	1995	0.063	0.479	-0.158	0.428	1.189	-0.30	17.52
SRI LANKA	226	1995	0.048	1.304	-0.238	-1.573	1.534	0.11	13.86
TAIWAN	925	1995	0.031	0.734	-0.108	-0.019	0.440	-0.14	13.72
THAILAND	674	1995	-0.051	0.416	-0.172	0.042	1.322	-0.21	15.52
TURKEY	388	1995	0.549	0.807	-0.117	1.216	1.652	0.03	18.51
VENEZUELA	25	1995	1.109	0.925	-0.251	-0.889	3.050	1.00	15.16
Total	42,567								

Table 2. Average of tail risk measures by firm size.

The table shows the averages of tail risk measures for each portfolio formed based on market capitalization in a given region specified in each panel. In forming size portfolios, a stock is sorted every year into deciles based on its previous year-end market capitalization in each country. Then, the decile ranks are linked across countries to form equally-weighted country-neutral portfolios. For each stock i, five measures of tail risk of month t are estimated using the daily returns over the past six months. LSV is a lower semi-variance of stock return in Eq. (2). CTR_M^D (CTR_M^G) is a co-tail risk which is computed as a semi-covariance of stock return and local (global) market return, conditional on local (global) market downside return, as specified in Eq. (3) (Eq. (5)). Both CTR_M^D and CTR_M^G are scaled by conditional semi-variance of local and global market returns, respectively. CTR_I^D (CTR_I^G) is a co-tail risk which is computed as a semi-covariance of stock return and local (global) market return, conditional on downside stock return, as specified in Eq. (4) (Eq. (6)). We obtain local and global market returns from Datastream.

	Local		Global		
rank(size)	CTR_I^D	CTR_M^D	CTR_I^G	CTR_M^G	LSV
Panel A: All countries					
1(Small)	-0.263	0.199	-0.240	-0.765	2.561
2	-0.133	0.286	-0.190	0.057	1.848
3	-0.088	0.369	-0.165	0.128	1.487
4	-0.064	0.423	-0.145	0.248	1.277
5	-0.019	0.461	-0.132	0.303	1.195
6	0.007	0.512	-0.117	0.323	1.042
7	0.011	0.550	-0.104	0.378	1.033
8	0.064	0.636	-0.091	0.494	0.930
9	0.104	0.776	-0.077	0.626	0.853
10(Large)	0.177	0.980	-0.052	0.778	0.737
Panel B: Developed markets(excluding US)					
1(Small)	-0.355	-0.104	-0.269	-0.217	2.983
2	-0.245	0.109	-0.199	0.000	1.818
3	-0.194	0.140	-0.169	0.192	1.486
4	-0.161	0.182	-0.151	0.204	1.232
5	-0.131	0.242	-0.134	0.277	1.152
6	-0.097	0.306	-0.112	0.326	0.960
7	-0.068	0.377	-0.095	0.403	0.933
8	-0.036	0.485	-0.077	0.592	0.813
9	0.004	0.660	-0.059	0.724	0.737
10(Large)	0.066	0.968	-0.031	0.956	0.589
Panel C: Emerging markets					
1(Small)	-0.190	0.424	-0.221	-1.309	2.261
2	-0.037	0.416	-0.186	0.072	1.906
3	0.005	0.550	-0.165	0.035	1.497
4	0.021	0.604	-0.141	0.249	1.314
5	0.082	0.627	-0.132	0.290	1.227
6	0.101	0.667	-0.124	0.285	1.107
7	0.083	0.680	-0.114	0.322	1.116
8	0.156	0.752	-0.105	0.380	1.030
9	0.197	0.864	-0.094	0.515	0.955
10(Large)	0.282	0.991	-0.073	0.609	0.871

Panel D: U.S.					
1(Small)	-0.089	1.174	-0.085	0.750	0.900
2	-0.093	0.893	-0.092	0.923	1.101
3	-0.095	0.856	-0.096	1.016	1.246
4	-0.087	1.104	-0.091	1.129	1.305
5	-0.081	1.099	-0.086	1.153	1.316
6	-0.064	1.137	-0.076	1.192	1.223
7	-0.050	1.063	-0.064	1.197	1.116
8	-0.036	1.008	-0.049	1.168	0.976
9	-0.014	1.084	-0.034	1.208	0.832
10(Large)	0.005	0.992	-0.019	1.111	0.625

Table 3. Cross-sectional regressions of local co-tail risk.
For each stock *i*, the measures of tail risk of month *t* are estimated using the daily returns over the past six months. *LSV* is a lower semi-variance of stock return in Eq. (2). CTR_M^D is a co-tail risk which is computed as a semi-covariance of stock return and local market return, conditional on local market downside return, as specified in Eq. (3). CTR_M^D is scaled by conditional semi-variance of local market return. CTR_I^D is a co-tail risk which is computed as a semi-covariance of stock return and local market return, conditional on downside stock return, as specified in Eq. (4). We obtain local market return from Datastream. Cross-sectional regressions with country dummies are performed for each month over all the sample countries (panel A), developed countries (panel B), emerging markets (panel C), and the U.S. (panel D). The table shows the averages of the estimated coefficients together with the *t*-values in italics. BETA is the market beta, obtained from the regression of daily stock returns on local market return over the past one year. SIZE is the log of the previous year-end market capitalization in U.S. dollars, and BM is the book-to-market ratio at the end of the previous year. ILLIQ is the Amihud illiquidity measure, absolute return over the currency value of trading volume, averaged over the past one year and multiplied by 10^3. Adj. R^2 and N are the averages of adjusted R^2s and the number of stocks used in regressions, respectively. Asterisks of ***, **, and * denote significance at 1%, 5%, and 10% level, respectively.

Intercept		CTR_I^D		LSV		CTR_M^D	BETA		SIZE		BM		ILLIQ		Adj.R^2	N
Panel A. All countries																
-1.642		1.409	***				-0.521	***	0.060	*	0.056	***	0.000	*	0.173	16,812
-1.14		*11.11*					*-2.64*		*1.94*		*7.28*		*1.73*			
-1.509				-0.102	***		-0.379	**	0.091	***	0.057	***	0.000		0.173	16,812
-1.11				*-10.25*			*-2.01*		*2.86*		*7.41*		*1.24*			
-2.252						-0.011	-0.405	**	0.117	***	0.058	***	0.000		0.172	16,811
-1.64						*-0.57*	*-2.23*		*3.53*		*7.54*		*0.49*			
-1.381		1.154	***	-0.061	***	-0.025	-0.431	**	0.056	*	0.056	***	0.000	*	0.174	16,811
-0.98		*9.45*		*-6.85*		*-1.31*	*-2.38*		*1.82*		*7.26*		*1.88*			
Panel B. Developed countries (excluding US)																
-1.915	**	2.025	***				-0.938	***	0.126	***	0.057	***	0.001	**	0.118	8,508
-2.34		*11.82*					*-4.17*		*3.43*		*4.90*		*2.50*			
-3.053	***			-0.114	***		-0.688	***	0.173	***	0.057	***	0.000	**	0.117	8,508
-3.56				*-10.60*			*-3.28*		*4.54*		*4.94*		*2.00*			
-3.881	***					-0.011	-0.759	***	0.208	***	0.063	***	0.000		0.116	8,508
-4.31						*-0.62*	*-3.67*		*5.27*		*5.33*		*0.73*			
-1.817	**	1.806	***	-0.048	***	-0.028	-0.839	***	0.120	***	0.055	***	0.001	***	0.120	8,508
-2.24		*9.77*		*-4.69*		*-1.42*	*-3.98*		*3.33*		*4.81*		*2.77*			

Panel C. Emerging countries									
-0.635	0.959 ***			-0.660 ***	0.029	0.067 ***	0.000	0.270	5,775
-0.51	*8.07*			*-3.44*	*0.89*	*7.11*	*0.76*		
-0.740		-0.119 ***		-0.515 ***	0.049	0.068 ***	0.000	0.270	5,775
-0.59		*-9.13*		*-2.79*	*1.47*	*7.30*	*0.62*		
-1.349			-0.004	-0.562 ***	0.070 **	0.072 ***	0.000	0.270	5,775
-1.08			*-0.16*	*-3.12*	*2.08*	*7.60*	*0.37*		
-0.329	0.785 ***	-0.091 ***	-0.034	-0.620 ***	0.025	0.068 ***	0.000	0.272	5,775
-0.26	*6.13*	*-6.70*	*-1.38*	*-3.38*	*0.76*	*7.23*	*0.94*		
Panel D. US									
3.070 **	0.960 **			0.088	-0.097	0.067	0.228	0.058	2,529
2.00	*2.22*			*0.22*	*-1.32*	*0.58*	*0.16*		
2.864 *		-0.050 *		0.106	-0.091	0.075	0.131	0.057	2,529
1.78		*-1.82*		*0.28*	*-1.19*	*0.64*	*0.09*		
2.610			-0.045	0.188	-0.081	0.094	0.458	0.056	2,529
1.57			*-1.09*	*0.50*	*-1.05*	*0.80*	*0.32*		
3.012 **	0.779 *	-0.031	-0.053	0.166	-0.096	0.056	0.036	0.062	2,529
1.98	*1.78*	*-1.33*	*-1.19*	*0.44*	*-1.34*	*0.49*	*0.03*		

Table 4. Cross-sectional regressions of global co-tail risk.

For each stock *i*, the measures of tail risk of month *t* are estimated using the daily returns over the past six months. *LSV* is a lower semi-variance of stock return in Eq. (2). CTR_M^G is a co-tail risk which is computed as a semi-covariance of stock return and global market return, conditional on global market downside return, as specified in Eq. (5). CTR_M^G is scaled by conditional semi-variance of global market return. CTR_I^G is a co-tail risk which is computed as a semi-covariance of stock return and global market return, conditional on downside stock return, as specified in Eq. (6). We obtain global market return from Datastream. Cross-sectional regressions with country dummies are performed for each month over all the sample countries (panel A), developed countries excluding U.S. (panel B), emerging markets (panel C), and the U.S. (panel D). The table shows the averages of the estimated coefficients together with *t*-values in italics. BETA is the market beta, obtained from the regression of daily stock returns on local market return over the past one year. SIZE is the log of the previous year-end market capitalization in U.S. dollars, and BM is the book-to-market ratio at the end of the previous year. ILLIQ is the Amihud illiquidity measure, absolute return over the currency value of trading volume, averaged over the past one year and multiplied by 10^3. Adj. R^2 and N are the averages of adjusted R^2s and the number of stocks used in regressions, respectively. Asterisks of ***, **, and * denote significance at 1%, 5%, and 10% level, respectively.

Intercept	CTR_I^G	LSV	CTR_M^G	BETA	SIZE	BM	ILLIQ	Adj.R^2	N
Panel A. All countries									
-0.449	3.301 ***			-0.451 **	0.048	0.056 ***	0.000	0.173	16,812
-0.34	*11.75*			*-2.33*	*1.59*	*7.32*	*1.54*		
-1.509		-0.102 ***		-0.379 **	0.091 ***	0.057 ***	0.000	0.173	16,812
-1.11		*-10.25*		*-2.01*	*2.86*	*7.41*	*1.24*		
-2.221			-0.016	-0.397 **	0.117 ***	0.057 ***	0.000	0.172	16,810
-1.62			*-1.14*	*-2.20*	*3.56*	*7.37*	*0.54*		
-0.421	3.169 ***	-0.027 ***	-0.034 **	-0.378 **	0.045	0.054 ***	0.000	0.175	16,810
-0.32	*10.55*	*-3.59*	*-2.41*	*-2.14*	*1.53*	*7.12*	*1.52*		
Panel B. Developed countries (excluding US)									
-1.668 **	3.826 ***			-0.809 ***	0.117 ***	0.055 ***	0.001 ***	0.118	8,508
-2.08	*13.01*			*-3.73*	*3.26*	*4.78*	*2.70*		
-3.053 ***		-0.114 ***		-0.688 ***	0.173 ***	0.057 ***	0.000 **	0.117	8,508
-3.56		*-10.60*		*-3.28*	*4.54*	*4.94*	*2.00*		
-3.880 ***			-0.020	-0.720 ***	0.207 ***	0.062 ***	0.000	0.116	8,508
-4.33			*-1.62*	*-3.45*	*5.25*	*5.25*	*0.79*		
-1.616 **	3.825 ***	-0.022 **	-0.045 ***	-0.705 ***	0.113 ***	0.054 ***	0.001 ***	0.120	8,508
-2.03	*11.83*	*-2.29*	*-3.45*	*-3.41*	*3.17*	*4.67*	*2.93*		

Panel C. Emerging countries									
-0.154	2.849 ***			-0.520 ***	0.026	0.068 ***	0.000	0.270	5,775
-0.12	*9.01*			*-2.82*	*0.80*	*7.23*	*0.84*		
-0.740		-0.119 ***		-0.515 ***	0.049	0.068 ***	0.000	0.270	5,775
-0.59		*-9.13*		*-2.79*	*1.47*	*7.30*	*0.62*		
-1.317			0.002	-0.575 ***	0.070 **	0.071 ***	0.000	0.270	5,774
-1.05			*0.14*	*-3.16*	*2.09*	*7.60*	*0.47*		
-0.088	2.576 ***	-0.053 ***	-0.018	-0.535 ***	0.026	0.068 ***	0.000	0.272	5,774
-0.07	*7.31*	*-3.93*	*-1.12*	*-2.98*	*0.80*	*7.31*	*0.93*		
Panel D. US									
3.033 **	1.174 **			0.099	-0.096	0.067	0.404	0.057	2,529
1.97	*2.24*			*0.26*	*-1.31*	*0.58*	*0.28*		
2.864 *		-0.050 *		0.106	-0.091	0.075	0.131	0.057	2,529
1.78		*-1.82*		*0.28*	*-1.19*	*0.64*	*0.09*		
2.715			-0.042	0.153	-0.084	0.079	0.310	0.057	2,528
1.65			*-0.98*	*0.41*	*-1.09*	*0.67*	*0.22*		
3.092 **	1.148 **	-0.020	-0.047	0.131	-0.098	0.040	0.084	0.063	2,528
2.04	*2.13*	*-0.88*	*-0.99*	*0.36*	*-1.37*	*0.35*	*0.06*		

Table 5. Cross-sectional regressions of local and non-local global tail risk.

For each stock i, the measures of tail risk of month t are estimated using the daily returns over the past six months. CTR_I^{D} is a co-tail risk which is computed as a semi-covariance of stock return and local market return, conditional on downside stock return, as specified in Eq. (4). Non-local global tail risk, CTR_I^{G-D}, is a co-tail risk which is computed as a semi-covariance of stock return and non-local global market return, conditional on downside stock return, as specified in Eq. (7). Non-local global market returns are obtained by orthogonalizing global market returns against the local market returns. Both local and global market returns are obtained from the Datastream. Cross-sectional regressions with country dummies are performed for each month over all the sample countries (panel A), developed countries (panel B), emerging markets (panel C), and the U.S. (panel D). The table shows the averages of the estimated coefficients together with t-values in italics. BETA is the market beta, obtained from the regression of daily stock returns on local market return over the past one year. SIZE is the log of the previous year-end market capitalization in U.S. dollars, and BM is the book-to-market ratio at the end of the previous year. ILLIQ is the Amihud illiquidity measure, absolute return over the currency value of trading volume, averaged over the past one year and multiplied by 10^3. Adj.R^2 and N are the averages of adjusted R^2s and the number of stocks used in regressions, respectively. Asterisks of ***, **, and * denote significance at 1%, 5%, and 10% level, respectively.

Intercept	Local CTR_I^{D}	Non-local global CTR_I^{G-D}	BETA	SIZE	BM	ILLIQ	Adj.R^2	N
Panel A. All countries								
0.499	0.607 ***	3.201 ***					0.166	19,395
0.47	*4.91*	*8.32*						
-0.585	0.963 ***	2.900 ***	-0.409 **	0.039	0.054 ***	0.000 *	0.174	16,812
-0.43	*8.64*	*9.96*	*-2.17*	*1.29*	*7.13*	*1.96*		
Panel B. Developed countries (excluding US)								
0.252	1.119 ***	3.623 ***					0.094	9,388
0.69	*6.14*	*7.52*						
-1.328 *	1.477 ***	2.770 ***	-0.774 ***	0.103 ***	0.052 ***	0.001 ***	0.120	8,508
-1.71	*9.47*	*8.19*	*-3.69*	*2.93*	*4.59*	*2.81*		
Panel C. Emerging countries								
0.335	0.210	2.516 ***					0.257	7,065
0.32	*1.34*	*7.96*						
0.034	0.671 ***	2.256 ***	-0.587 ***	0.016	0.066 ***	0.000	0.271	5,775
0.03	*5.31*	*6.94*	*-3.14*	*0.49*	*7.09*	*0.96*		

Panel D. US											
1.086	***	0.738	*	1.107						0.019	2,942
4.03		*1.85*		*0.74*							
3.195	**	0.452		1.402	**	0.162	-0.103	0.063	0.408	0.059	2,529
2.11		*1.15*		*2.22*		*0.41*	*-1.42*	*0.55*	*0.29*		

Table 6. Cross-country differences in the pricing of local and global co-tail risks

For each stock i, the measures of tail risk of month t are estimated using the daily returns over the past six months. CTR_I^D is a co-tail risk which is computed as a semi-covariance of stock return and local market return, conditional on downside stock return, as specified in Eq. (4). Non-local global tail risk, CTR_I^{G-D}, is a co-tail risk which is computed as a semi-covariance of stock return and non-local global market return, conditional on downside stock return, as specified in Eq. (7). Non-local global market returns are obtained by orthogonalizing global market returns against the local market returns. Both local and global market returns are obtained from the Datastream. Cross-sectional regressions with country dummies are performed for each month over all the sample countries. The table shows the averages of the estimated coefficients together with t-values in italics. The interaction variable X is as follows. The fund industry size is the equity mutual funds' assets under management as of 2002, and is scaled by GDP and primary securities (Khorana, Servaes, and Tufano, 2005). The ETF volume is the dollar trading volume in exchange traded country funds for 28 countries traded on U.S. markets, and is scaled by the dollar market capitalization of each country (Karyolyi, Lee, and van Dijk, 2012). The index of accounting standards is constructed from the coverage of items in companies' 1990 annual reports (La Porta, Lopez-de-Silanes, Shleifer, and Vishny, 1998). The index of credibility of disclosure denotes the percentage of firms in the country that are audited by the big five accounting firms (Bushman, Piotroski, and Smith, 2004). The index of expropriation risk measures the threat of outright confiscation or forced nationalization by the state (La Porta, Lopez-de-Silanes, Shleifer, and Vishny, 1998). Amount of stocks held by US institutions is the log of the market value of stock holdings (in billions of US dollars) in a country held by US institutions (Ferreira and Matos, 2008). Overall capital restrictions index is the restriction index for all asset categories from NBER. BETA is the market beta, obtained from the regression of daily stock returns on local market return over the past one year. SIZE is the log of the previous year-end market capitalization in U.S. dollars, and BM is the book-to-market ratio at the end of the previous year. ILLIQ is the Amihud illiquidity measure, absolute return over the currency value of trading volume, averaged over the past one year and multiplied by 10^3. Adj.R^2 and N are the averages of adjusted R^2s and the number of stocks used in regressions, respectively. Asterisks of ***, **, and * denote significance at 1%, 5%, and 10% level, respectively.

	Local		Global							
Intercept	CTR_I^D	CTR_I^D *X	CTR_I^{G-D}	CTR_I^{G-D}*X	Beta	Size	BM	ILLIQ	Adj. R^2	N
X=Fund industry size scaled by GDP										
-2.161 **	1.171 ***	0.362 ***			-0.523 ***	0.114 ***	0.065 ***	0.006	0.040	16,662
-2.16	*4.88*	*2.95*			*-2.49*	*2.57*	*5.90*	*0.35*		
-1.384			3.555 ***	0.280 ***	-0.315	0.091 ***	0.068 ***	0.005	0.040	16,662
-1.51			*7.17*	*2.25*	*-1.64*	*2.23*	*6.15*	*0.26*		
X=Fund industry size scaled by primary securities										
-2.421 ***	1.117 ***	0.986 ***			-0.517 ***	0.130 ***	0.063 ***	-0.002	0.041	16,129
-2.44	*4.52*	*2.41*			*-2.49*	*2.95*	*5.66*	*-0.09*		
-1.487			3.706 ***	0.745 *	-0.306	0.099 ***	0.065 ***	-0.002	0.041	16,129
-1.64			*7.49*	*1.82*	*-1.61*	*2.46*	*5.89*	*-0.13*		
X=ETF volume										
-2.801 ***	1.245 ***	0.030 ***			-0.585 ***	0.148 ***	0.067 ***	0.016	0.038	14,469
-2.61	*5.35*	*2.27*			*-2.53*	*3.13*	*6.12*	*0.91*		
-1.934 *			3.855 ***	0.022	-0.352	0.123 ***	0.070 ***	0.012	0.038	14,469
-1.98			*7.84*	*1.59*	*-1.70*	*2.84*	*6.32*	*0.74*		

X=Accounting standards										
-3.796 ***	1.084 ***	0.006			-0.531 ***	0.153 ***	0.065 ***	0.007	0.036	15,229
-2.78	*5.02*	*1.45*			*-2.48*	*3.35*	*6.19*	*0.40*		
-2.190			3.899 ***	0.003	-0.326	0.119 ***	0.066 ***	0.006	0.037	15,229
-1.65			*7.90*	*0.67*	*-1.70*	*2.89*	*6.46*	*0.33*		
X=Credibility of disclosure										
-2.873 ***	1.162 ***	0.046			-0.517 ***	0.146 ***	0.063 ***	0.011	0.041	15,282
-2.63	*5.62*	*1.03*			*-2.41*	*3.31*	*5.79*	*0.61*		
-1.764 *			3.900 ***	0.015	-0.309	0.120 ***	0.066 ***	0.005	0.043	15,282
-1.72			*8.00*	*0.33*	*-1.61*	*2.93*	*6.06*	*0.32*		
X=Risk of expropriation										
-3.916 ***	1.154 ***	0.069 *			-0.485 ***	0.124 ***	0.069 ***	0.021	0.037	15,516
-2.74	*5.77*	*1.88*			*-2.31*	*2.89*	*6.77*	*1.15*		
-2.403 *			3.565 ***	0.034	-0.296	0.110 ***	0.069 ***	0.016	0.038	15,516
-1.78			*7.74*	*0.92*	*-1.54*	*2.68*	*6.85*	*0.86*		
X=Amounts of stocks held by US institutions										
-2.012 **	1.819 ***	0.064 ***			-0.559 **	0.077 *	0.073 ***	0.021	0.043	12,579
-2.02	*6.53*	*4.02*			*-2.16*	*1.80*	*4.21*	*1.11*		
-2.020 **			3.378 ***	0.050 ***	-0.284	0.094 **	0.073 ***	0.013	0.042	12,579
-2.04			*6.41*	*3.03*	*-1.21*	*2.17*	*4.22*	*0.70*		
X=Overall capital restrictions index										
-1.677 *	1.120 ***	-0.218 *			-0.476 **	0.120 ***	0.057 ***	0.001	0.043	13,797
-1.80	*4.24*	*-1.87*			*-2.10*	*2.79*	*4.70*	*0.05*		
-0.728			3.659 ***	-0.221 *	-0.262	0.084 **	0.056 ***	0.001	0.042	13,797
-0.85			*7.02*	*-1.87*	*-1.29*	*2.14*	*4.63*	*0.04*		

Table 7. Cross-sectional regressions of global tail risk: U.S. versus non-U.S.

For each stock i, the measures of tail risk of month t are estimated using the daily returns over the past six months. CTR_I^{D} is a co-tail risk which is computed as a semi-covariance of stock return and local market return, conditional on downside stock return, as specified in Eq. (4). CTR_I^{US} is a co-tail risk which is computed as a semi-covariance of stock return and U.S. market return, conditional on downside stock return, as specified in Eq. (8). Non-local & non-US global tail risk, $CTR\_I^{(G-D)-US}$, is a co-tail risk which is computed as a semi-covariance of stock return and non-local & non-US global market return, conditional on downside stock return, as specified in Eq. (9). Non-local & non-US global returns are obtained by orthogonalizing global market returns against the local market returns and U.S. market return. Both local and global market returns are obtained from the Datastream. Cross-sectional regressions with country dummies are performed for each month over all the sample countries (panel A), developed countries (panel B), and emerging markets (panel C). The table shows the averages of the estimated coefficients together with the *t*-values in italics. BETA is the market beta, obtained from the regression of daily stock returns on local market return over the past one year. SIZE is the log of the previous year-end market capitalization in U.S. dollars, and BM is the book-to-market ratio at the end of the previous year. ILLIQ is the Amihud illiquidity measure, absolute return over the currency value of trading volume, averaged over the past one year and multiplied by 10^3. Adj.R^2 and N are the averages of adjusted R^2s and the number of stocks used in regressions, respectively. Asterisks of ***, **, and * denote significance at 1%, 5%, and 10% level, respectively.

Intercept	Local CTR_I^{D}	US CTR_I^{US}	Non-local & non-US $CTR\_I^{(G-D)-US}$	BETA	SIZE	BM	ILLIQ	Adj. R^2	N
Panel A. All countries									
0.655	0.496 ***	1.168 ***	3.796 ***					0.178	16,453
0.63	*3.82*	*6.21*	*7.67*						
-0.486	0.888 ***	1.036 ***	3.443 ***	-0.552 ***	0.062 **	0.053 ***	0.000 **	0.192	14,283
-0.37	*7.65*	*5.46*	*7.75*	*-3.80*	*2.21*	*7.52*	*2.48*		
Panel B. Developed countries (excluding U.S.)									
0.416	1.021 ***	0.861 ***	4.631 ***					0.096	9,388
1.20	*5.38*	*3.58*	*6.91*						
-1.137	1.370 ***	0.754 ***	3.646 ***	-0.705 ***	0.099 ***	0.052 ***	0.001 ***	0.120	8,508
-1.49	*8.06*	*3.68*	*6.87*	*-3.48*	*2.83*	*4.59*	*3.10*		
Panel C. Emerging markets									
0.449	0.154	1.010 ***	3.091 ***					0.258	7,065
0.42	*0.96*	*4.67*	*6.47*						
0.313	0.588 ***	1.074 ***	2.786 ***	-0.551 ***	0.011	0.066 ***	0.000	0.272	5,775
0.24	*4.25*	*4.17*	*5.50*	*-2.98*	*0.34*	*7.11*	*0.96*		

Table 8. Cross-sectional regressions of tail risk measures with alternative tail sizes.

For each stock i, the measures of tail risk of month t are estimated using the daily returns over the past six months. CTR_I^D ($CTR\_I^{US}, CTR\_I^{(G-D)-US}$) is a co-tail risk which is computed as a semi-covariance of stock return and local (US, Non-local & non-US global) market return, conditional on downside stock return, as specified in Eq. (4) (Eq. (6)). We obtain local and global market return from Datastream. Tail risk measures for the 5%, 10%, 20%, 30%, 40%, and 50% tails are calculated using daily returns over the past six months. Cross-sectional regressions on three tail measures with control variables and country dummies are performed for each month over all the sample countries (panel A), developed countries (panel B), and emerging markets (panel C). The table shows the averages of the estimated coefficients together with the t-values in italics. BETA is the market beta, obtained from the regression of daily stock returns on local market return over the past one year. SIZE is the log of the previous year-end market capitalization in U.S. dollars, and BM is the book-to-market ratio at the end of the previous year. ILLIQ is the Amihud illiquidity measure, absolute return over the currency value of trading volume, averaged over the past one year and multiplied by 10^3. Adj.R^2 and N are the averages of adjusted R^2s and the number of stocks used in regressions, respectively. Asterisks of ***, **, and * denote significance at 1%, 5%, and 10% level, respectively. For brevity, results for the control variables are not reported.

	Tail size											
	5%		10%		20%		30%		40%		50%	
Panel A. All countries												
Local: $SCVI^{M}$	1.421	***	0.888	***	0.618	***	0.520	***	0.287	***	-0.301	***
	9.32		*7.65*		*6.40*		*5.86*		*3.03*		*-2.63*	
US: $SCVI^{US}$	1.267	***	1.036	***	0.784	***	0.692	***	0.518	***	-0.186	*
	5.74		*5.46*		*5.18*		*5.22*		*4.51*		*-1.80*	
Non-local & non-US Global: $SCVI^{(G-M)-US}$	3.194	***	3.443	***	3.276	***	3.412	***	2.922	***	-0.122	
	6.87		*7.75*		*8.46*		*9.51*		*9.19*		*-0.45*	
Panel B. Developed countries (excluding U.S.)												
Local: $SCVI^{M}$	1.908	***	1.370	***	1.100	***	1.000	***	0.742	***	-0.258	
	8.79		*8.06*		*7.61*		*8.10*		*5.85*		*-1.59*	
US: $SCVI^{US}$	0.855	***	0.754	***	0.565	***	0.447	***	0.329	**	-0.138	
	3.08		*3.68*		*3.28*		*3.01*		*2.45*		*-1.14*	
Non-local & non-US Global: $SCVI^{(G-M)-US}$	3.611	***	3.646	***	3.398	***	3.629	***	3.349	***	-0.077	
	6.35		*6.87*		*7.18*		*8.28*		*8.39*		*-0.22*	

Panel C. Emerging markets												
Local: $SCVI^{M}$	0.975	***	0.588	***	0.365	***	0.286	**	0.086		-0.254	**
	5.16		*4.25*		*3.09*		*2.57*		*0.77*		*-2.22*	
US: $SCVI^{US}$	1.478	***	1.074	***	0.886	***	0.950	***	0.734	***	-0.142	
	4.44		*4.17*		*4.21*		*5.01*		*4.23*		*-0.98*	
Non-local & non-US Global: $SCVI^{(G-M)-US}$	2.283	***	2.786	***	2.874	***	3.016	***	2.499	***	-0.144	
	3.52		*5.50*		*6.51*		*7.64*		*6.64*		*-0.39*	

Table 9. Cross-sectional regressions of alternative tail risk measures.

For each stock *i*, the measures of tail risk of month *t* are estimated using the daily returns over the past one year. CTR_I^{D} ($CTR\_I^{US}, CTR\_I^{(G-D)-US}$) is a co-tail risk which is computed as a semi-covariance of stock return and local (US, Non-local & non-US global) market return,, conditional on downside stock return, as specified in Eq. (4) (Eq. (6)). We obtain local and global market return from Datastream. Tail risk measures for the 5%, 10%, 20%, 30%, 40%, and 50% tails are calculated using daily returns over the past one year. Cross-sectional regressions on three tail measures with control variables and country dummies are performed for each month over all the sample countries (panel A), developed countries (panel B), and emerging markets (panel C). The table shows the averages of the estimated coefficients together with the *t*-values in italics. BETA is the market beta, obtained from the regression of daily stock returns on local market return over the past one year. SIZE is the log of the previous year-end market capitalization in U.S. dollars, and BM is the book-to-market ratio at the end of the previous year. ILLIQ is the Amihud illiquidity measure, absolute return over the currency value of trading volume, averaged over the past one year and multiplied by 10^3. Adj.R^2 and N are the averages of adjusted R^2s and the number of stocks used in regressions, respectively. Asterisks of ***, **, and * denote significance at 1%, 5%, and 10% level, respectively. For brevity, results for the control variables are not reported.

	Tail size											
	5%		10%		20%		30%		40%		50%	
Panel A. All countries												
Local: CTR_I^{D}	0.619	***	0.461	***	0.267	***	0.215	***	0.088		-0.245	***
	8.14		*7.16*		*4.73*		*3.91*		*1.48*		*-3.40*	
US: CTR_I^{US}	0.789	***	0.664	***	0.550	***	0.502	***	0.391	***	-0.159	**
	5.80		*5.79*		*5.63*		*5.95*		*5.21*		*-2.19*	
Non-local & non-US Global: $CTR\_I^{(G-D)-US}$	1.758	***	2.067	***	1.914	***	2.049	***	1.839	***	-0.200	
	5.92		*7.49*		*7.95*		*8.92*		*8.85*		*-1.11*	
Panel B. Developed countries (excluding U.S.)												
Local: CTR_I^{D}	0.940	***	0.757	***	0.525	***	0.494	***	0.353	***	-0.287	***
	7.73		*7.20*		*5.99*		*6.38*		*4.41*		*-2.66*	
US: CTR_I^{US}	0.526	***	0.465	***	0.422	***	0.361	***	0.284	***	-0.125	
	3.33		*3.44*		*3.57*		*3.52*		*3.10*		*-1.45*	
Non-local & non-US Global: $CTR\_I^{(G-D)-US}$	1.982	***	1.977	***	1.822	***	2.084	***	2.076	***	-0.210	
	5.38		*5.97*		*6.24*		*7.71*		*8.29*		*-0.87*	

Panel C. Emerging markets												
Local: CTR_I^{D}	0.467	***	0.340	***	0.168	**	0.106		-0.008		-0.201	***
	4.88		*4.12*		*2.36*		*1.56*		*-0.12*		*-2.90*	
US: CTR_I^{US}	0.689	***	0.693	***	0.636	***	0.640	***	0.506	***	-0.099	
	3.57		*4.31*		*4.63*		*5.18*		*4.46*		*-1.01*	
Non-local & non-US Global: $CTR\_I^{(G-D)-US}$	1.479	***	1.953	***	1.788	***	1.865	***	1.533	***	-0.200	
	4.62		*6.83*		*7.16*		*7.71*		*6.40*		*-0.88*	

Table 10. Cross-sectional regressions of tail risk measures with additional control variables.

For each stock i, the measures of tail risk of month t are estimated using the daily returns over the past six months. CTR_I^{D} is a co-tail risk which is computed as a semi-covariance of stock return and local market return, conditional on downside stock return, as specified in Eq. (4). Non-local global tail risk, CTR_I^{G-D}, is a co-tail risk which is computed as a semi-covariance of stock return and non-local global market return, conditional on downside stock return, as specified in Eq. (7). Non-local global market returns are obtained by orthogonalizing global market returns against the local market returns. Both local and global market returns are obtained from the Datastream. Cross-sectional regressions with country dummies are performed for each month over all the sample countries (panel A), developed countries (panel B), emerging markets (panel C), and the U.S. (panel D). The table shows the averages of the estimated coefficients together with *t*-values in italics. BETA is the market beta, obtained from the regression of daily stock returns on local market return over the past one year. SIZE is the log of the previous year-end market capitalization in U.S. dollars, and BM is the book-to-market ratio at the end of the previous year. ILLIQ is the Amihud illiquidity measure, absolute return over the currency value of trading volume, averaged over the past one year and multiplied by 10^3. DBETA is the downside beta, obtained from the regression of daily stock returns on local market return over the past one year, conditioning on the market excess returns below its average. MOM is the 6-month cumulative return from t-7 to t-2. COSKEW is the coskewness of daily returns over the past one year. IVOL is the idiosyncratic volatility, obtained from the standard deviation of daily residuals estimated by the Fama-French three factor model over the past month. MAX is the maximum daily return within the past month. Adj.R^2 and N are the averages of adjusted R^2s and the number of stocks used in regressions, respectively. Asterisks of ***, **, and * denote significance at 1%, 5%, and 10% level, respectively.

Intercept	Local CTR_I^D	Non-local global CTR_I^G-D	BETA	SIZE	BM	ILLIQ	DBETA	MOM	COSKEW	IVOL	MAX	Adj.R^2	N
Panel A. All countries													
-0.651	1.005 ***	2.822 ***	-0.382 **	0.038	0.055 ***	0.000 *	-0.059					0.175	16,812
-0.48	*8.81*	*10.12*	*-2.16*	*1.28*	*7.24*	*1.94*	*-0.83*						
-0.700	0.939 ***	2.791 ***	-0.432 **	0.041	0.055 ***	0.000 *		0.345 ***				0.176	16,812
-0.51	*8.37*	*9.87*	*-2.12*	*1.35*	*7.18*	*1.89*		*3.67*					
-0.667	0.908 ***	2.921 ***	-0.405 **	0.040	0.054 ***	0.000 *			-0.347 **			0.175	16,812
-0.49	*8.25*	*10.15*	*-2.15*	*1.33*	*7.14*	*1.92*			*-2.59*				
0.878	0.648 ***	1.998 ***	-0.319 *	-0.015	0.053 ***	0.001 ***				-0.231 ***		0.178	16,736
0.65	*6.09*	*8.18*	*-1.80*	*-0.54*	*7.09*	*3.92*				*-10.73*			
0.546	0.740 ***	2.205 ***	-0.319 *	-0.004	0.054 ***	0.000 ***					-7.277 ***	0.178	16,748
0.41	*6.80*	*8.35*	*-1.76*	*-0.14*	*7.19*	*3.53*					*-13.19*		
0.715	0.635 ***	1.974 ***	-0.257	-0.010	0.054 ***	0.000 ***	-0.070	0.346 ***	-0.383 ***	-0.082 ***	-5.237 ***	0.182	16,736
0.54	*6.08*	*8.61*	*-1.34*	*-0.34*	*7.27*	*3.72*	*-1.33*	*3.93*	*-3.19*	*-2.97*	*-7.99*		
Panel B. Developed countries (ex. US)													
-0.076	1.044 ***	1.845 ***	-0.576 ***	0.045	0.047 ***	0.001 ***	-0.056	0.515 ***	-0.360 **	-0.081 ***	-5.965 ***	0.128	8,501
-0.10	*7.21*	*6.46*	*-2.82*	*1.33*	*4.41*	*6.06*	*-1.11*	*4.49*	*-2.06*	*-2.73*	*-7.25*		
Panel C. Emerging countries													
1.412	0.417 ***	1.324 ***	-0.432 *	-0.029	0.068 ***	0.000 **	-0.056	0.301 ***	-0.254 *	-0.132 ***	-6.874 ***	0.279	5,764
1.08	*3.37*	*4.76*	*-1.95*	*-0.88*	*7.22*	*2.41*	*-0.73*	*2.71*	*-1.82*	*-3.39*	*-6.27*		
Panel D. US													
3.565 ***	-0.202	0.642	0.484	-0.122 **	0.058	1.053	-0.367 *	0.491	-0.912 **	-0.071	-2.032	0.077	2,471
2.96	*-0.59*	*1.10*	*1.24*	*-2.15*	*0.61*	*0.76*	*-1.77*	*1.57*	*-1.99*	*-1.22*	*-1.56*		

Table 11. Factor model regressions of tail risk.

In each month t, a stock is ranked into deciles in a given country on the basis of co-tail risk (CTR_I), which is estimated using daily returns over the past six months. Subsequently, stocks with the same rank are combined to form ten equally-weighted portfolios across countries in the regions specified in the table. Each portfolio return (in US dollars) in excess of the risk-free rate is regressed on Global one, three, and five factor models as specified in Eqs. (10)-(12). CTR_I^{G} is a co-tail risk which is computed as a semi-covariance of stock return and global market return, conditional on downside stock return, as specified in Eq. (6). CTR_I^{US} is a co-tail risk which is computed as a semi-covariance of stock return and U.S. market return, conditional on downside stock return. $CTR\_I^{(G-D)-US}$, is a co-tail risk which is computed as a semi-covariance of stock return and non-local & non-US global market return, conditional on downside stock return, as specified in Eq. (9). Non-local & non-US global returns are obtained by orthogonalizing global market returns against the local market returns and U.S. market return. Both local and global market returns are obtained from the Datastream. The SMB (small cap minus big), HML (high book-to-market minus low), RMW (robust operating profitability minus weak), and CMA (conservative investment minus aggressive) are obtained from K. French's website. The table shows the estimated alphas with the t-values in italics from the regression of each of the ten portfolios that are formed based on global tail risk (panel A), co-tail risk with respect to the U.S. market return (panel B), and non-local & non-US global tail risk (panel C). The U.S. stocks are dropped from the sample. Rows labeled ''Global one-factor alpha'', ''Global three-factor alpha'', and ''Global five-factor alpha'' indicate the intercepts from the models in Eqs. (10)-(12), respectively. The last column of the table (labeled ''High–Low'') shows the difference in the estimated intercepts that are obtained from the regressions of the portfolios with the highest co-tail risk (p=High) and of those with the lowest co-tail risk (p=Low). Asterisks of ***, **, and * denote significance at 1%, 5%, and 10% level, respectively.

	Low	P2	P3	P4	P5	P6	P7	P8	P9	High	High-Low
Panel A. Portfolios sorted on CTR_I^{G}											
All countries (excluding US)											
Global one-factor alpha	-1.850***	-1.248***	-0.949***	-0.808***	-0.683***	-0.668***	-0.544***	-0.512***	-0.432**	-0.601***	1.257***
	-8.11	*-5.73*	*-4.42*	*-3.92*	*-3.41*	*-3.34*	*-2.79*	*-2.62*	*-2.22*	*-3.07*	*10.97*
Global three-factor alpha	-1.977***	-1.424***	-1.131***	-0.977***	-0.862***	-0.852***	-0.739***	-0.713***	-0.633***	-0.794***	1.187***
	-10.28	*-7.68*	*-6.15*	*-5.55*	*-5.05*	*-4.99*	*-4.45*	*-4.23*	*-3.81*	*-4.70*	*11.11*
Global five-factor alpha	-1.949***	-1.448***	-1.167***	-1.013***	-0.941***	-0.913***	-0.813***	-0.797***	-0.709***	-0.864***	1.087***
	-9.70	*-7.54*	*-6.09*	*-5.54*	*-5.27*	*-5.20*	*-4.73*	*-4.60*	*-4.13*	*-4.97*	*9.57*
Developed countries (excluding US)											
Global one-factor alpha	-2.366***	-1.538***	-1.122***	-0.838***	-0.712***	-0.592***	-0.424**	-0.393**	-0.319*	-0.628***	1.738***
	-9.72	*-7.17*	*-5.69*	*-4.34*	*-3.96*	*-3.36*	*-2.46*	*-2.36*	*-1.88*	*-3.60*	*10.73*
Global three-factor alpha	-2.482***	-1.737***	-1.313***	-1.036***	-0.919***	-0.807***	-0.651***	-0.632***	-0.563***	-0.853***	1.630***
	-12.24	*-10.16*	*-8.32*	*-6.78*	*-6.49*	*-5.82*	*-4.84*	*-4.83*	*-4.19*	*-5.98*	*11.09*
Global five-factor alpha	-2.403***	-1.775***	-1.348***	-1.119***	-1.015***	-0.916***	-0.781***	-0.769***	-0.689***	-0.965***	1.438***
	-11.27	*-9.93*	*-8.08*	*-6.99*	*-6.93*	*-6.35*	*-5.62*	*-5.79*	*-4.99*	*-6.52*	*9.34*
Emerging countries											
Global one-factor alpha	-1.407***	-1.004***	-0.808***	-0.789***	-0.667**	-0.742***	-0.656**	-0.623**	-0.538**	-0.585**	0.836***
	-5.34	*-3.75*	*-2.96*	*-3.03*	*-2.58*	*-2.84*	*-2.56*	*-2.39*	*-2.09*	*-2.31*	*7.05*
Global three-factor alpha	-1.544***	-1.161***	-0.982***	-0.934***	-0.821***	-0.900***	-0.823***	-0.791***	-0.701***	-0.750***	0.801***
	-6.42	*-4.64*	*-3.87*	*-3.85*	*-3.41*	*-3.70*	*-3.46*	*-3.25*	*-2.94*	*-3.20*	*6.72*

Global five-factor alpha	-1.564 ***	-1.175 ***	-1.019 ***	-0.931 ***	-0.885 ***	-0.921 ***	-0.850 ***	-0.829 ***	-0.735 ***	-0.785 ***	0.782 ***
	-6.17	*-4.48*	*-3.85*	*-3.67*	*-3.47*	*-3.64*	*-3.41*	*-3.25*	*-2.94*	*-3.22*	*6.12*
Panel B. Portfolios sorted on CTR_I^{US}											
All countries (excluding US)											
Global three-factor alpha	-1.972 ***	-1.458 ***	-1.173 ***	-1.113 ***	-0.880 ***	-0.792 ***	-0.753 ***	-0.663 ***	-0.592 ***	-0.685 ***	1.288 ***
	-9.97	*-7.80*	*-6.22*	*-6.36*	*-5.05*	*-4.78*	*-4.53*	*-3.94*	*-3.60*	*-4.19*	*11.68*
Global five-factor alpha	-1.937 ***	-1.483 ***	-1.196 ***	-1.171 ***	-0.957 ***	-0.868 ***	-0.843 ***	-0.734 ***	-0.675 ***	-0.735 ***	1.199 ***
	-9.43	*-7.62*	*-6.13*	*-6.52*	*-5.26*	*-5.08*	*-4.92*	*-4.21*	*-3.96*	*-4.32*	*10.25*
Developed countries (excluding US)											
Global three-factor alpha	-2.502 ***	-1.743 ***	-1.343 ***	-1.159 ***	-0.900 ***	-0.821 ***	-0.700 ***	-0.559 ***	-0.572 ***	-0.681 ***	1.821 ***
	-11.91	*-10.12*	*-8.23*	*-7.87*	*-6.16*	*-5.92*	*-5.14*	*-4.34*	*-4.34*	*-4.84*	*11.55*
Global five-factor alpha	-2.418 ***	-1.767 ***	-1.372 ***	-1.225 ***	-1.000 ***	-0.933 ***	-0.856 ***	-0.696 ***	-0.716 ***	-0.789 ***	1.629 ***
	-11.00	*-9.75*	*-8.04*	*-8.03*	*-6.55*	*-6.49*	*-6.17*	*-5.26*	*-5.28*	*-5.35*	*9.90*
Emerging countries											
Global three-factor alpha	-1.519 ***	-1.221 ***	-1.036 ***	-1.083 ***	-0.871 ***	-0.775 ***	-0.806 ***	-0.762 ***	-0.615 ***	-0.696 ***	0.824 ***
	-6.13	*-4.87*	*-4.03*	*-4.37*	*-3.58*	*-3.32*	*-3.39*	*-3.13*	*-2.61*	*-3.06*	*7.13*
Global five-factor alpha	-1.529 ***	-1.246 ***	-1.053 ***	-1.134 ***	-0.928 ***	-0.820 ***	-0.839 ***	-0.776 ***	-0.646 ***	-0.697 ***	0.826 ***
	-5.88	*-4.74*	*-3.93*	*-4.40*	*-3.62*	*-3.37*	*-3.37*	*-3.04*	*-2.61*	*-2.93*	*6.63*
Panel C: Portfolios sorted on $CTR\_I^{(G-D)-US}$											
All countries (excluding US)											
Global three-factor alpha	-2.103 ***	-1.448 ***	-1.181 ***	-1.135 ***	-0.884 ***	-0.833 ***	-0.734 ***	-0.697 ***	-0.567 ***	-0.525 ***	1.579 ***
	-10.39	*-7.70*	*-6.35*	*-6.35*	*-4.94*	*-4.87*	*-4.45*	*-4.24*	*-3.52*	*-3.40*	*14.00*
Global five-factor alpha	-2.067 ***	-1.437 ***	-1.211 ***	-1.178 ***	-0.939 ***	-0.896 ***	-0.816 ***	-0.797 ***	-0.664 ***	-0.614 ***	1.455 ***
	-9.78	*-7.35*	*-6.27*	*-6.35*	*-5.07*	*-5.02*	*-4.81*	*-4.72*	*-4.02*	*-3.85*	*12.23*
Developed countries (excluding US)											
Global three-factor alpha	-2.543 ***	-1.736 ***	-1.428 ***	-1.223 ***	-0.993 ***	-0.840 ***	-0.690 ***	-0.580 ***	-0.486 ***	-0.483 ***	2.060 ***
	-12.16	*-10.02*	*-9.00*	*-8.20*	*-6.74*	*-5.99*	*-5.07*	*-4.38*	*-3.72*	*-3.63*	*12.82*
Global five-factor alpha	-2.450 ***	-1.698 ***	-1.460 ***	-1.303 ***	-1.083 ***	-0.971 ***	-0.822 ***	-0.722 ***	-0.651 ***	-0.633 ***	1.817 ***
	-11.12	*-9.31*	*-8.74*	*-8.34*	*-7.13*	*-6.66*	*-5.94*	*-5.32*	*-4.93*	*-4.63*	*10.89*
Emerging countries											
Global three-factor alpha	-1.729 ***	-1.207 ***	-0.974 ***	-1.066 ***	-0.798 ***	-0.835 ***	-0.779 ***	-0.809 ***	-0.646 ***	-0.569 ***	1.161 ***
	-6.73	*-4.75*	*-3.80*	*-4.24*	*-3.19*	*-3.43*	*-3.34*	*-3.47*	*-2.80*	*-2.61*	*9.76*
Global five-factor alpha	-1.744 ***	-1.220 ***	-1.004 ***	-1.078 ***	-0.825 ***	-0.840 ***	-0.819 ***	-0.872 ***	-0.683 ***	-0.605 ***	1.142 ***
	-6.46	*-4.58*	*-3.74*	*-4.10*	*-3.14*	*-3.29*	*-3.34*	*-3.59*	*-2.84*	*-2.65*	*8.92*