Do the Fama-French Factors proxy Geopolitical Risks?

Abstract

This paper investigates whether geopolitical risk measures have some statistical significance for 20 advanced country equity portfolios in the presence of the Fama-French factors. Baseline results indicated that some Fama-French factors appear to be significant for some country and regional equity portfolios. The coefficient of the general geopolitical risk index emerged with a negative sign suggesting a decline in these countries' equity portfolios but not always as statistically significant. Furthermore, when using the two components of the main risk index, geopolitical threats and acts, it was found that these risk components either marginally added statistical significance or not at all beyond what the main risk index provided. Additional results using panel specification and the Fama-MacBeth methodology corroborated the above findings. The main findings imply that geopolitical risks may not always be statistically relevant to general equity portfolios in the presence of the market factor.

Keywords: Fama-French factors, geopolitical risk, Fama-MacBeth methodology, panel analysis, country equity portfolios
JEL classifications: G15, G39

1. Introduction

Investors generally face a multitude of local and foreign risks which are embedded in various financial and economic magnitudes and are systematic in nature. When forming global financial asset portfolios, investors typically employ well-known risk factors such as those proposed by Fama and French (1993, 2015, 2017). In fact, there is a vast literature on the significance and predictability of the Fama-French risk factors on stock returns. Their original 3-factor model – which used the market risk premium, the size, and value factors – proved highly significant. The addition of two more risk factors – profitability and investment – also provided additional explanatory power to the cross-section of stock returns. Further additions or modifications to these risk factors came from Carhart (1997), who suggested the momentum factor (originally identified by Jagadeesh and Titman, 1993, 2001), and the return on assets factor (along with the Fama-French market and investment factors), put forth by Chen, Novy-Marx and Zhang (2011). Further developments in risk factors Durant et al. (2011) entailed the use of the volatility index as their risk measure.

More general risk factors which were employed in the financial empirical literature were the economic policy uncertainty index, the volatility index and political uncertainty, among many others (Xu et al., 2021, Yang et al., 2021, Durant et al., 2011, and Kelly et al., 2016, respectively, to name just a few). Some studies have also documented the significant effects of other geopolitical events, such as wars (Glick and Taylor, 2010) and nuclear tests and missile launches (Jung et al., 2021) on several aspects of a national economy. Other researchers have studied the reaction of the stock market to specific geopolitical events, often providing conflicting results thereby rendering unique factors to any specific geopolitical occurrence far from conclusive. For example, Baur and Smales (2020) examined the relationship between geopolitical risk and several financial assets and precious metals and showed that the response of precious metals to geopolitical risk differs considerably from that of assets such as stocks and bonds and that precious metals are hedges of geopolitical risk and geopolitical threats (as opposed to acts) in particular. Szafranek, Rubaszek and Uddin (2023) examined the relationship between three most popular uncertainty measures – the volatility index (VIX), geopolitical risk and economic policy uncertainty (EPU) – and found that all three measures to be highly connected during major economic turmoil and hostile events.

Recently, Laopodis (2023) investigated the significance of the five Fama-French risk factors along with a number of risk factors constructed out of fundamental macroeconomic variables (in the spirit of Chen et al., 1986) and reported that the Fama-French factors (FF, henceforth) did not always surface as significant for industries across decades (since the 1960s) thus yielding some explanatory power to selected macro factors. Das et al. (2019) investigated the effects of several global risk measures such as economic policy uncertainty, financial stress and geopolitical risk on emerging economies' stock markets and reported that the first risk measure had more profound effects compared to the other two risk measures.

Despite the abundance of financial and geopolitical risk factors in explaining stock returns, both nationally and internationally, no work exists on the combination of geopolitical risk factors with the FF factors. To the best of our knowledge, there is no formal study which examined the impact of specific geopolitical risk components on country equity portfolios alongside the FF factors. A Thesis by McCallen (2018) is the only work that has examined the FF factors with geopolitical risk and applied to US stock portfolios.[1] Investors use the FF factors to build diversified portfolios that can help alleviate systematic risks. Geopolitical risks can introduce additional diversification needs, as certain events can have an uneven impact on specific financial assets and/or industries. That said, we understand that geopolitical events tend to impact on financial markets by elevating market volatility and uncertainty. By combining the FF factors with geopolitical risks, we seek to capture the (long-term) factors that explain returns over longer periods.

Hence, this paper is novel in the following aspects. First, we examine the power of geopolitical risk (measures) in explaining country equity portfolios across a sample of developed countries, within the context of the Fama and French (1993, 2015) 5-factor asset pricing model. We test this proposition using equity portfolios at the country (aggregate) level, from four regions of the world, instead of just using individual equity portfolios. Specifically, we seek to determine if the now-common measure of geopolitical risk index (GPR) of Caldara and Iacoviello (C&I, 2022) provides additional explanatory power over the 5 FF factors in the case of twenty country equity portfolios spanning four geographical regions (Europe, Asia-Pacific excluding Japan, Japan and North America excluding US). C&I constructed a monthly GPR, starting as far back as the mid1980s, via the combination of several varieties that rely on counting the appearance of several keywords in major global newspapers. The authors tested their index on the reaction of several industries in the U.S. to the nine largest movements in the index and found that some industries (such as Defense) experienced short-term positive excess returns over the S&P500, but most industries experienced short-term negative excess returns, with all effects dissipating within three months.

A related question we will examine is whether presence of significant geopolitical risk events such as the 9/11/2000 terrorist attacks in the United States or the 2020 Ukraine-Russia war capture most of the variability in country equity portfolios relative to other geopolitical events. In other

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[1] *https://doi.org/10.17615/ypjq-rv78*

words, if we isolate these specific events would we still see the same pattern in importance of geopolitical risk across countries and in the presence of FF factors?

Second, we wish to examine if the two components of the GPR index – geopolitical *Threats* and geopolitical *Acts* – somehow proxy the FF factors in explaining country equity portfolio returns or if the factors take away explanatory power from thee two components of geopolitical risk. Specifically, the *Threats* risk component of the index includes war, military buildups, and terror threats among others that may adversely impact the aggregate equity markets. In setting up our investigation, we believe that threats may be more significant than actions because the former elevate uncertainty, whereas the latter can be eventually contained and faster embedded in the expectations of market agents. Furthermore, it is a fact that investors do not seem to be concerned with large geopolitical risks, such as the possibility of nuclear war, because the costs would be very high in order to make significant portfolio adjustments. In addition to the above, we test if the main risk index itself (and/or its components) can contribute to the explanatory power of conventional measures of risk such as the VIX and EPU. This also serves the purpose of establishing (or not) comparability with previous studies.

The third contribution of this paper is to determine the price of risk of the main index and its two components. To this end, we employ the Fama-MacBeth (1973) regression methodology – at the aggregate (panel) country equity portfolio level - to geopolitical risk measures that pertain to each region so as to pinpoint the relevance and significance of these risk factors in all regions' country equity portfolios. If the geopolitical risk factors are not priced, then it may be inferred that the country equity portfolios (1) either ignore such risks because they are short-lived or because they may affect some sectors but in the aggregate these impacts are smoothed out or (2) that they have already been discounted by these financial portfolios.

The significance of the study rests on economic and financial grounds. We argue that geopolitical risk can significantly affect a country's economy via several channels and thus this study has important implications for all market agents and markets. First, in the wake of serious geopolitical tensions such as military events and conflicts, global firms may postpone their foreign direct as well as financial investments in these countries. The same can be said for the country in general where its citizens feel that their personal freedom and security are at jeopardy. Second, consumers and other households may feel the need to reduce their major purchases and withdraw funds (or reduce capital flows) resulting in reduced supply of credit and a higher cost of financing, which, in turn, hurts all market agents. And finally, a country's financial market will be severely constrained from these outside, global threats and become ineffective either via reduction in risk appetites or by further restraining extension of credit to the economy.

The remainder of the paper obeys the following order. Section 2 contains the data sources, their construction and the methodological design of the study. Section 3 presents some preliminary statistics on the country portfolios and the baseline empirical results. Section 4 presents further evidence using country-specific risk indices, the results from the Fama and MacBeth approach and panel analysis. Some general discussion is included also. Section 5 contains some robustness checks. Finally, Section 6 summarizes and concludes the study.

2. Data and Methodology

2.1 Data, sources and variable construction

We examine twenty (20) countries from four geographic regions, from 1985:01 to 2022:12. Specifically, the countries are: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Singapore, Spain, Sweden, Switzerland, Hong-Kong, and the UK. We add the United States' (US) equity portfolio (proxied by the NYSE index), since there is no country portfolio for the US, for comparison purposes. The four regions we consider are Europe, North America (excluding the US), Asia-Pacific (excluding Japan) and Japan. As far as the FF factors are concerned, we are careful to select those that pertain to the same regions. All above data (for the country portfolios and FF factors) were collected from K. French's data library, are monthly in frequency, and all in US dollar terms.[2]

The portfolios employed, in this stage of the analysis, are the high-portfolios built on the B/M ratio.[3] Following French's description, all portfolios were constructed at the end of December each year by sorting on one of the four ratios and then compute value-weighted returns for the following 12 months.[4] The value portfolios (High) contain firms in the top 30% of a ratio and the growth portfolios (Low) contain firms in the bottom 30%. There are two sets of portfolios. In one, firms are included only if we have data on all four ratios. In the other, a firm is included in a sort variable's portfolios if we have data for that variable. The market return is the value weighted average of the returns for only firms with all four ratios.

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[2] *https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html*

[3] We have also used the other classifications namely, earnings-price (E/P); cash earnings to price (CE/P); and dividend yield (D/P), but the results were similar.

[4] There are two general categories of portfolios, value and growth. We use the value category in the main analysis and save the growth category for the robustness tests.

The relevant five FF factors are the following. The first factor is the market risk premium, *MRP*, which should be positively related to portfolio returns. The next two FF factors are the one capturing the size premium (*SMB*) and the second reflecting the value-to-growth premium (*HML*) The size premium, where firms with lower market capitalizations generate higher risk-adjusted returns than firms with larger market capitalizations, was one of the first empirical irregularities documented in the literature (Banz, 1981). On the value factor, *value* stocks are those with a higher ratio of book value of equity to their market capitalization, while *growth* stocks are those with a lower ratio. The last two factors, that Fama and French added to their 3-factor model, were the *RMW*, or the difference between the returns on diversified portfolios of stocks with robust (high and steady) and weak (low) profitability, and *CMA*, derived from the difference between the returns on diversified portfolios of the stocks of low and high investment firms, which we call conservative and aggressive.

The geopolitical risk index (GPR) data were collected from C&I's webpage.[5] The authors created a measure of adverse geopolitical events and associated risks based on a count of major, global newspaper articles covering geopolitical tensions, and examine its evolution and economic effects since 1900. According to the authors, "The index values assume that higher geopolitical risk foreshadows lower investment, stock prices, and employment. Higher geopolitical risk is also associated with higher probability of economic disasters and with larger downside risks to the global economy." This index will be used in first-difference form (ΔGPR) in the ensuing econometric analysis.

Following C&I, the GPR index reflects automated text-search results of the electronic archives of 10 newspapers: Chicago Tribune, the Daily Telegraph, Financial Times, The Globe and Mail, The Guardian, the Los Angeles Times, The New York Times, USA Today, The Wall Street Journal, and The Washington Post. The authors calculated the index by counting the number of articles related to adverse geopolitical events in each newspaper for each month (as a share of the total number of news articles). The search is organized in eight categories: War Threats (Category 1), Peace Threats (Category 2), Military Buildups (Category 3), Nuclear Threats (Category 4), Terror Threats (Category 5), Beginning of War (Category 6), Escalation of War (Category 7), Terror Acts (Category 8). Based on the search groups above, the authors also constructed two sub-indexes. The Geopolitical Threats (GPRT) includes words belonging to categories 1 to 5 above. The Geopolitical Acts (GPRA) index includes words belonging to categories 6 to 8.

According to C&I, the materialization of adverse geopolitical events has often been the catalyst for heightened fears about future adverse events for example, terrorist attacks which may

[5] *https://www.matteoiacoviello.com/gpr.htm*

increase the threat of future attacks or of a war. The GPRT and GPRA indexes have a correlation 0.45 from 1990 onward suggesting that, despite some common spikes, there is some independent variation that is better highlighted when examining particular historical episodes.

2.2 Methodology

Given the established superiority of the 5-factor over the 3-factor model (Gibbons et al., 1989), we set up the specification of the FF 5-factor time-series regression with the general geopolitical risk index – the benchmark specification – which is specified as follows:

$$ERP_{it} = \alpha_i + b_1\, MRP_t + b_2\, SMB_t + b_3\, HML_t + b_4\, RMW_t + b_5\, CMA_t + b_6\, \Delta GPR + \varepsilon_{it} \qquad (1)$$

where

ERP_t is the country portfolio i's excess returns, $(R_{it} – R_f)$, at time t,

R_{it} is the realized excess return on equity portfolio i at time t,

R_f is the realized return on the risk-free asset at time t,

MRP_t is the difference between the market return and the risk-free rate, $(R_{mt} – R_f)$

R_{mt} is the realized excess return on the market portfolio at time t,

SMB_t is the realized return on the mimicking portfolio for the size factor at time t,

HML_t is the realized return on the mimicking portfolio for the book-to-market factor at time t,

RMW_t is the realized return on the mimicking portfolio for the profitability factor at time t,

CMA_t is the realized return on the mimicking portfolio for the investment factor at time t,

ΔGPR is the change in the general geopolitical risk index at time t

and α_i, $b_{1...5}$, are parameters to be estimated and ε_{it} is the error term.

The risk premium found by Fama and MacBeth on the market factor can be expanded to factor models, in general. The (expected) returns of a portfolio are determined by their sensitivity to a factor and the risk premium of that factor. Thus, the more sensitive a portfolio (or security) is to a factor, and the higher the risk premium of the factor, λ, the higher the expected return of the security, above the risk-free rate, r_f. Essentially, what this means is that if a risk-averse investor knows a factor that affects returns exists, then he/she expects higher returns for taking on a security that is sensitive to this factor (a positive risk premium).

The general version of this specification is shown below:

$$E[r_{i,t}] = r_{f,t} + \lambda_i\, \beta_i \qquad (2)$$

Obviously, this specification will be expanded with all FF factors and the geopolitical risk factors. However, the focus this procedure will be on the various geopolitical risk factors, which were mentioned earlier, not the FF factors themselves. The FF factors simply serve as control variables in this study.

The alternative methodology we will employ to find the risk premia of the factors is the Fama and MacBeth (1973) approach to find the risk factors' loadings. The Fama-MacBeth (FM, henceforth) approach involves two steps. In the first step, for each single time period a cross-sectional regression is performed (in the spirit of equation (1) or, more generally, equation (2) above), where the factors (F) are used as explanatory variables. So, for each country equity portfolio i (from 1 to N), we estimate the following linear regression model:

$$R_{it} = \alpha_i + \sum_{m=1}^{M} \beta_{mF}\, F_{m,t} + e_{it} \qquad \text{for } t = 1, \ldots, T \text{ and } m = 1, \ldots, M \tag{3}$$

where F_m is the m^{th} risk factor at time t and e is the error term. From this model, we obtain the estimated betas, $\hat{\beta}_{mF}$, which are the betas (β) associated with the m^{th} risk factor.

The second step runs time-series analysis of the final coefficient estimates as the average of the first step coefficient estimates, and involves estimating the following regression:

$$R_{it} = \gamma_{0t} + \sum_{m=1}^{M} \lambda_{it}\, \hat{\beta}_{mF} + \varepsilon_{it} \qquad \text{for } i = 1, \ldots, N \tag{4}$$

where $\hat{\beta}_{\mathrm{mF}}$ refer to the estimated betas for each risk factor and λ_{it} refer to the factors' loadings. We also hypothesize that the disturbances are independent of the common factors and that the disturbances are independent and identically distributed over time with mean zero and a nonsingular residual covariance matrix. If the portfolio' loadings with respect to the risk factors are important determinants of average returns, then the λ terms from the above regression should be significant (note that the λ terms represent the prices of risk for innovations in each state variable).

It is worth noting that only cross-sectional coefficient estimates in the first step are used to estimate the coefficients, but not their standard errors. As a result, any heteroscedasticity and residual-dependent issues in the first step will not influence the final results because the heteroscedasticity (and any residual dependencies) do not alter the unbiasedness of the coefficient in the OLS estimation. Further, the Newey-West correction will be applied to ensure that the model does not suffer from serial correlation either.

Finally, we use an unbalanced panel specification to determine if all FF factors' explanatory power proxy geopolitical risk over time. The basic framework for this discussion is a regression model of the form:

$$y_{it} = a + b\, x_{it} + e_{it} \tag{5}$$

where y is the dependent variable (the country portfolios), a is the intercept term, b is a $kx1$ vector of parameters to be estimated on the explanatory variables and x is a $1xk$ vector of observations on the X explanatory variables, $t = 1, \ldots, T$ and $i = 1, \ldots, K$. The simplest type of fixed effects models is to allow for an intercept in the regression model to differ cross-sectionally but not overtime, while all slope estimates are fixed both cross-sectionally and over time.

3. Empirical results

3.1 Preliminary statistical investigation

We begin with the 20-country value portfolios' descriptive statistics (for the full sample, 1990:01-2022:12). Some general comments can be made. First, most portfolios have different means with Sweden and New Zealand displaying the highest values (1.3836 and 0.5486, respectively). The lowest mean (0.2238) was displayed by the US's portfolio. Second, Ireland and Norway exhibited the highest volatility (10.224 and 9.246, respectively), whereas the UK and Belgium displayed the lowest volatility (5.972 and 6.147, respectively). The US's portfolio volatility (1.8653) was the lowest. Third, almost half of the country portfolios showed negative skewness, which implies frequent high and negative returns over time, compared the remaining portfolios which showed positive skewness values. Fourth, all country equity portfolios had kurtosis values greater than 3 (the normal distribution's value) relative to the remaining portfolios which had very high kurtosis values (Singapore's value was the highest). Only the US portfolio's kurtosis was less than 3. Since high kurtosis means that there have been many price fluctuations in the past (positive or negative) around the average returns, investors might face what we call kurtosis risk.

Finally, we computed the coefficient of variation (CV), as the ratio of the standard deviation to the mean, which indicates the extent of variability in relation to the mean of the sample. The higher the CV, the greater the dispersion. We notice that New Zealand and Italy have the highest values (13.996 and 13.824, respectively), whereas Belgium, Demark and Sweden have the lowest values (5.551, 5.613 and 5.617, respectively). So, even though Ireland and Norway had the highest variability in their equity portfolio returns, the New Zealand's and Italy's returns surface as the riskiest of all. For comparison, the US portfolio's CV was 8.3327, somewhere in the middle among these country portfolios.

Table 2, in two panels, depicts the static correlations among the five FF factors (CMA, HML, SMB, RMW and MRKT) for the 20 country-specific regions and the main geopolitical risk index, from 1990:1 to 2022:12. The prefixes before each factor are *AP*, for the Asia-Pacific region, *E*, for the European region, *J* for Japan and *NA* for the North American region. Looking at Panel A, we observe very low correlations for the first four factors among the E, J and NA factors with the AP factors, whereas moderate correlations between the European and North American CMA and HML factors, but negligible correlations for the Japanese region with the North American region for the SMB and

RMW factors. One may argue that the low correlations among these factors implies that they contain information which could be useful for predicting country portfolio returns. Finally, the correlations among all regions' market factors ranged from moderate (0.4672) to high (0.8193).

Inspecting Panel B of the table, we report very low correlations between the geopolitical risk index and each of the region-specific FF factors. Hence, it may be inferred that these factors and the index have nothing in common which could permit each of them to reveal potential useful information for the country portfolios. In addition, two results that are consistent across these regional factors are first, that the correlations between the risk index and the market factors were negative, and second, that those between the index and SMB were positive.

Next, we examine the descriptive statistics of the geopolitical risk index (GPR) and its components, the Geopolitical Threats (GPRT) and the Geopolitical Acts (GPRA) indices (1985-2019=100). The results are shown in Table 3. First, we observe that the mean of the *Threats* index is higher than that of the *Acts*, suggesting that the general geopolitical space was dominated by more threats than acts during the period of investigation. Second, the geopolitical *Acts* index has the smallest variance, followed by the main geopolitical risk index. Third, the very high positive skewness values signify a very large number of small (negligible) positive events (or word mentions), while increasingly few events are very significant. Finally, the high kurtosis values (leptokurtic distribution) for all risk measures imply that there have been occasional instances of abnormally extreme events on either side of the mean. In conjunction with positive skewness, we say that there are higher odds of positive outliers (in events on word mentions). The histograms of the three indices, shown in Figure 1, corroborate the three indices' excess skewness and kurtosis values (highly skewed distributions) or significant departures from normality, in general. Finally, the correlations between the main index and *Acts* and *Threats* are 0.9156 and 0.8353, respectively, while that between the *Acts* and *Threats* is 0.5484.

Figure 2 shows the three indices since 1985. As is clearly evident, the geopolitical acts index (GRPA) is more pronounced during some years such as the early 1990s, 2000s as well as the early 2020s. The geopolitical threats (GRPT) index follows that of the Acts index but is much less pronounced. Finally, the main (aggregate) index (GRP) is somewhere in-between -rather flat for many periods- with some exceptions as noted above, where it is shown to spike. The three largest spikes in that index were recorded during the Gulf War (early 1990s), after the 9/11 terrorist attacks (early 2000s), and in 2022 (Ukraine-Russia war). In between, there were some more smaller spikes including the Paris terrorist attacks (mid-2015), the 2017-18 North Korean crisis and the 2020 COVID-19 health pandemic. These spikes corroborate the global nature of the GPR measures.

In the ensuing empirical analysis, we intend to investigate if geopolitical risk is only priced when there is a large geopolitical event. Specifically, if we separate the aforementioned major geopolitical events would we still see the same pattern in importance of geopolitical risk across countries' equity portfolios in the presence of the FF factors? This sub-sample analysis might help tell a story about whether geopolitical risk is already captured by the FF factors or if there just aren't enough significant geopolitical events in the data in order to make the geopolitical risk measure stand out when compared with FF factors in a long time series.

3.2 Benchmark model empirical results

We begin with the estimation of equation (1) – the benchmark model – where all five FF factors are included along with the main, aggregate geopolitical risk index (in 1st difference form). The empirical results for each country are shown in Table 4. All regressions were run with heteroscedasticity and serial correlation corrections. As a result, the regressions' standard errors were always very small and the Durbin-Watson values (for the serial correlation check) hovered around 2. The asterisks *, **, and *** denote statistical significance at the 5%, 10% and 1% levels, respectively.

From the results we see that the market return is highly statistically significant for all country portfolios, as generally expected.[6] Some other FF factors appear to be significant for some country portfolios. The most statistically significant factor is HML, which emerged as such for fourteen country portfolios, followed by the SMB factor. However, the focus of these results is also on the geopolitical risk index (used in first-difference form), which did not emerge as significant for most of the country portfolios despite being negative for about half of them. In addition, the CMA and RMW factors seem to have been the least relevant to most country portfolios and almost suggesting their redundancy in the presence of the other two factors. Specifically, these two factors did not appear to be relevant for thirteen country portfolios during the period under examination. The adjusted R-square values were 70%, on average (except for the US's, which was much higher). Finally, regarding the US's equity portfolio, we observed that all FF factors surfaced as statistically significant, as expected, but the geopolitical risk index did not emerge as statistically significant.

[6] He et al. (2015) using similar equity portfolios also reported a strong impact (judged by the size of the coefficient) of the stock market in similar regressions and same regions.

Instead of using the main geopolitical risk index in first-difference form, we derived the residuals from an ARMA(1,1) specification and labeled them as 'shock'.[7] Then, we first ran simple regression analyses with each country portfolio without the FF factors. The results are shown in Panel A of Table 5. From the table we see that in all cases the shocks emerged with a negative sign suggesting a depression of these countries' equity portfolios. Second, in eight out of the twenty cases the shock was statistically significant (at the 5% and 1% levels). The constant terms in all but one equation were statistically significant signifying absence of potential explanatory power from the shock magnitude. The R-square values were always very low, thus validating the above conclusion. For the US's case, we observed that the geopolitical shock was statistically significant and with a negative sign. In addition, when comparing these results with those using the difference in the geopolitical index (Table 4), we note that the shock variable is more often statistically significant than the former variable. Hence, unexpected geopolitical events seem to bear greater significance to these country equity portfolios and the countries themselves, by extension.

In Panel B of the table, we show the regression results when the four FF factors (except for the market, which was always found statistically significant) are included with the shock factor. One important conclusion is that the HML factor, followed by CMA, retained their statistical significance more often than the other two factors in the presence of the shock variable. The same conclusion applies to the US equity portfolio. The second notable conclusion is that the shock variable was negative for fourteen country portfolios (plus the US's), and statistically significant for the same portfolios (including the US's) as reported in Panel A of the table. A final observation for these results is that, in all cases, the magnitude (size) of the shock's coefficient was much smaller (in absolute terms) than those in Panel A of the table. This suggests that the four FF factors absorbed some of the extent of the impact of geopolitical risk without necessarily taking away its statistical significance. Hence, one could infer that there is some kind of interplay among these factors and geopolitical risk.

3.3 Using the components of the main geopolitical risk index

Recall that the two components of the GPR index are the geopolitical threats (GPRT) and the geopolitical acts (GPRA) indexes. The GPRT index searches articles for phrases related to threats and military buildups, while the GPRA index searches words and phrases referring to the realization or the escalation of adverse events. We ran the full regressions (with all five regional-specific FF factors)

[7] Caldara and Iacoviello (2022) also derived the residuals from the index, and called them GPRSHOCK but we found an ARMA(1,1) specification to be optimal, based on the use of the Schwartz information criterion. Results are not reported but are available upon request.

with each component for each country and the entire period. Instead of reporting all the results, we decided to report only the geopolitical risk components' coefficients, their standard errors and the adjusted R-squares (see Table 6).[8] Both indices were used in first-difference form ($\Delta GPRA$ and $\Delta GPRT$) to make them stationary.

From the results in Panel A, we observe that the relevant *Acts* coefficients are both positive and negative. Four of them are statistically significant namely, for France, Germany, Ireland and New Zealand. Even more discouraging results are shown in Panel B, when the *Threats* risk index was used, where its coefficient surfaced as significant in the case of Switzerland only. Furthermore, it appears that the sizes of the *Threats'* coefficients are larger than those of the *Acts*. Another difference was that the *Threats*' coefficients had fewer negative signs than those with the *Acts* risk index. Finally, although not reported in the table, an interesting result is that the FF factors for both components of the risk index emerged as statistically significant exactly the same way as they appeared in the regressions with the main geopolitical risk index (reported in Table 4). The same conclusions apply to the US equity portfolio. Thus, it can be concluded that the two risk index components do not add anything beyond what the main risk index contains and that the five FF factors capture these two types of risk quit well.

The above results are in line with those using the main aggregate index. For example, McCallen (2018) noted that these risk components did not add anything to various US equity portfolios even when applying different econometric methodologies. It is plausible to assume that the market agents may have discounted an armed conflict – and embedded elsewhere such as the stock market or bond yields – and that is why this is not showing up in the regression coefficients. Moreover, as C&I (2018) admit, the *Acts* component may be of lesser importance because agents expect armed conflicts to resolve the uncertainty around a particular set of events soon (and also because coordinated international actions reduce the expectation of more serious financial and other consequences), while the *Threats* component may have a stronger effect as it elevates uncertainty and the probability of future adverse events. Finally, it is also reasonable to state that geopolitical risks affect more the volatility of the stock market rather than its mean (returns, as we have used here). For example, Yuni et al. (2022) found that geopolitical acts and threats have different impacts on the real estate markets in North American, Asia-Pacific and European regions, with the acts being less significant than the threats. Finally, some studies documenting similar results are those by Gkillas et al., (2018), Balcilar et al., (2018), Salisu et al., (2022) and ElSayed and Helmi (2021) supporting this assertion.

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[8] Full results are available upon request.

At this point, it would be instructive to repeat the above empirical analysis without each country's market factor – but with the other four regional FF factors – in an effort to see if the market indeed absorbs much of the risk contained in the two geopolitical risk components. We will not report the full results but only those that are worthy of mention. First, when using the *Acts* index in contemporaneous form it emerged as statistically significant in the cases of Canada, Italy, Norway (marginally significant, at the 10% level) and Switzerland, with a negative sign. In the case of the *Threats* index, France's, Germany's, Japan's, Norway's and Switzerland's coefficients were negative and statistically significant (but marginally in Japan and Norway). The same results applied to the US portfolio. Second, when adding these indices in one-month lag form, the *Acts* coefficients were positive and statistically significant for Austria, Australia, Belgium, Hong Kong, the Netherlands, New Zealand and Sweden, but the *Threats* index coefficient was only significant (and positive) in the case of Belgium. Hence, judging from these results one could infer that the equity market may be mostly responsible for absorbing (capturing) most of the information contained in these risk components. The remaining four FF factors did not show much of statistical significance in these regressions.

3.4 Sub-sample analyses

In this sub-section, we re-estimate the baseline model with dummy variables for each of the three main global risk episodes, namely the 1990-91 Gulf war, the 2027-18 North Korean crisis and the 2022 Ukraine-Russian war. As mentioned earlier, these events were shown with the largest spikes in the main geopolitical risk index (see Figure 2). We seek to determine if these global political and military events – to be proxied by a dummy variable – are significant and strong enough to price geopolitical risk in the presence of the five FF factors. The three dummy variables were constructed as follows. The value of 1 was given to these periods: 1990:08 – 1991:03, representing the Gulf war (*Gulf*), 2017:07 – 2018:05, capturing the North Korean military crisis (*NK*), and 2022:01 – 2022:12, to reflect to Ukraine-Russian war (*UR*). In all other dates, the value 0 zero was assigned. We will not report the full results from each of the three regressions per country portfolio but only the coefficients of the three dummy variables. These are displayed in Table 7.

From the results, it is quite evident that these specific geopolitical events did not affect these countries' equity portfolios, with some exceptions. Specifically, New Zealand's equity portfolio was seen to be positively and strongly affected by the recent (and ongoing) Ukraine-Russian war, whereas those of Norway and Spain by the Gulf war, in a negative and positive manner, respectively. Another notable result is that the Ukraine-Russian war appears to have impacted all countries equity portfolios much greater (judging from the size of the coefficients) than the Gulf war or the North

Korean missile crisis and its impact was either negative or positive, depending on the country. A final observation is that the coefficient of the North Korean threat was negative for those countries belonging to the Asia-Pacific region because of their proximity with North Korea.

4. Further analysis

In this section, we conduct additional regressions on the impact of geopolitical risk and the FF factors on country portfolios using *country-specific* measures of that risk. Then, we carry out panel analysis to see the combined impact of these magnitudes on country portfolios. Finally, we employ the Fama-MacBeth econometric methodology to see if additional insights of the impact of geopolitical risk are present.

4.1 Using country-specific measures of geopolitical risk

This section reports the results on the use of country-specific risk measures for most of the countries (for Austria, Ireland, New Zealand and Singapore, there were none). C&I constructed these measures of geopolitical risk by counting the joint occurrences in news relevant to a country's capital city. Such news received less weight in the main (aggregate) risk index. According to C&I, the resulting indexes were created using three U.S. newspapers that captured the U.S. perspective on risks posed by, or involving, the country in question.

The results from the regressions (with the five FF factors) are displayed in Table 8. Again, we only report the relevant coefficients, standard errors and adjusted R-square values but not the factors. The results suggest that these country-specific measures are not relevant in explaining a country's equity portfolio. Given that these (or most) countries shared exposure to common geopolitical events, it is not surprising to see these insignificant results for all countries. Perhaps, the heterogeneity of these countries' financial and economic characteristics (including geographic location) may be a factor explaining why these weak results. Or, it could be that the country's equity market was mostly responsible for taking away these country-specific risk measures' explanatory power.

4.2 Panel analysis

In this section, we estimate an unbalanced panel specification for all country portfolios, all five FF factors and the main index of geopolitical risk. Two notes are needed. First, the five FF factors are not country-specific, as in the previous section, but general, covering all the regions we examined above. Hence, they are common to all country equity portfolios. Second, the sample begins in January 1990 due to the availability of these FF factors from that year on. We estimated two panel specifications, fixed and random effects, but the Hausman specification test indicated the fixed-effects version to be the appropriate one.

The fixed-effects model assumes that the levels of the independent variables are fixed (i.e., constant), and only the dependent variable changes in response to the levels of independent variables. Fixed-effects models explore the relationship between predictor and outcome variables within an entity (country, here) where each entity has its own individual characteristics that may or may not influence the predictor variables. Fixed-effects models remove the effect of the time-invariant characteristics so we can assess the net effect of the predictors on the outcome variable. This implies that those time-invariant characteristics are unique to the country and should not be correlated with other country characteristics. Each country is different and thus, its error term and the constant (which captures country-specific characteristics) should not be correlated with the others.

The results from the estimation of the fixed-effects model is shown in Table 9. Some additional metrics (adjusted R-square, F-statistic and the log-likelihood values are included at the bottom of the table). The value of the *rho* metric (0.00183) means that the fraction of the variance due to the errors terms is very small. From the results, we can see that the market is highly statistically and economically significant. The remaining four, common FF factors did not show up as statistically significant. By contrast, the (change in) the geopolitical risk index did emerge as negative but statistically insignificant.[9] This finding may be interpreted as that these countries' portfolios, in general, may be indeed affected by such a risk measure, which is very general and comprises of catchy words, but not in a statistically significant manner. By contrast, geopolitics have non-negligible effects on major global commodities and general economic activities. We can only begin understanding the information transmission mechanism from GPR to the global financial market (Liu et al., 2021). Finally, it may also be that the common FF factors (beyond the relevant equity market) do not offer any additional explanatory power to the general geopolitical risk index.

4.3 Using the Fama-MacBeth approach

The results from the FM panel regressions, with the Newey-West serial correlation correction, are reported in Panels A and B of Table 10. Looking at Panel A, where the results with the general geopolitical risk index are reported, and as with the earlier results, only the market factor is highly statistically significant while all other FF factors are not. The geopolitical risk index (ΔGPR)

[9] We had also substituted this variable with the measure of a geopolitical shock, as defined earlier, but it too did not emerge as statistically significant but still negative.

did show up as negative but statistically insignificant, at the 5% level, albeit (marginally) significant at the 10% level. Further, its coefficient emerged as sizable which means that its effect may be important for these country equity portfolios. It is worth mentioning (although not reported) that when the FM regression was run without the geopolitical risk index, all but the market risk factors were also statistically insignificant. With the inclusion of the GPR, the regressions' statistics (average and adjusted R^2) were both much higher (from 0.4070 and 0.2890, respectively), as seen in the panel. In addition, the CMA factor changed sign from positive (in the regression without the GPR index) to negative but with much larger in size. Finally, we used the geopolitical risk shock variable in place of the change in GPR but the results were essentially the same.

Panel B of the table, reports the results with the geopolitical risk threats (GPRT) and acts (GPRA), both in first-difference form. The GPRA's values from the FM regressions are in parentheses. Again, the market risk premium surfaced highly statistically significant (with the correct sign) in both cases, whereas all other FF factors did not. Although the geopolitical risk *Threats* index's coefficient showed up as negative and marginally (at the 10% level of significance) statistically significant (but not economically, due to its small size), the *Acts* index's did not. Perhaps, these disaggregated risk indices do not matter for country (or aggregate) equity portfolios and it is possible (although this cannot be inferred from these results) that some sectors – presumably geopolitically-sensitive ones – could be affected but not others. So, these 'hidden' findings are smoothed out when aggregating all sectors' equity portfolios to arrive at the country equity portfolio level. Nonetheless, the negative sign of the *Threats* index suggests that there could be some cost to these financial assets when hostile threats are announced but this cost is typically short-lived and is absorbed (discounted) by market agents. This finding is in line with the one we found when we used sub-samples to examine the impact of specific geopolitical events (acts and threats) on these country equity portfolios.

4.4 General discussion

Overall, it can be surmised that the geopolitical risk index and its components may not be (economically and statistically) relevant to aggregate equity country portfolios but very significant to narrower equity portfolios such as equity market indices or constructed portfolios. In addition, the fact that each country's equity market portfolio always surfaced as highly statistically significant, while the remaining four FF factors did not, may suggest that geopolitical risks are embedded in the market portfolio. This is a startling result which has not been adequately documented in the empirical literature within this context. Given that the market is a forward-looking indicator and gets updated on a daily basis, whereas each FF factor is narrower in scope and content, this inference makes sense. If that was not the case, then probably geopolitical risk could have been explicitly priced in these equity portfolios, both in the presence and absence of the market's portfolio. Hence, the stock market may be a first indicator of geopolitical risk because, as we have found in this paper, it was always statistically significant even in the presence of the geopolitical risk index or its components.

In addition, the finding that country-specific geopolitical risk indices were not found to be statistically significant suggests that they may be more relevant to other countries such as emerging countries and may impact more the volatility of stock returns. The heterogeneous character of these countries' financial and economic features may rationalize our weak results of the insignificance of country-specific risk factors on country equity portfolios. It is more realistic to assume that market agents around the globe may be more sensitive to geopolitical threats than acts since the former, as mentioned earlier, can be unpredictable and more severe if proof of that (such as an act) is not present. Investor expectations and sentiment may play a more important role than when currently observing an act of aggression, which may be expected to end soon. Recent work by Hoque and Zaidi (2020) reveals that country-specific geopolitical risk factors surfaced as significant in fragile emerging economies (Brazil, India, Indonesia, South Africa, and Turkey).

Overall, the general and consistent finding that the equity market for each country can capture both aggregate and specific risks, whether they refer to global acts and threats or country-specific, is a very important result with several implications. Threats are unrelated to traditional equity risk factors. C&I corroborated this assertion since they found that shocks to geopolitical actions seemed to have a slightly positive but statistically insignificant relationship with stock market index returns. In other words, investors are not very forward-looking in forming their expectations of geopolitical risk especially when threats remain as such and do not convert into acts. Tying the above to the other findings from our analyses, we could infer that investor sentiment may be embedded in the equity market (as well as other financial markets) much more than in other financial factors (examined here). Hence, as a general conclusion we may state that the stock market surfaces as a powerful factor reflecting general and specific geopolitical risks in many of the countries examined in this paper.

5. Robustness checks

In this section, we will do a number of robustness tests. First, we will use the actual stock market indices of each country instead of country equity portfolios along with the usual factors and geopolitical risk index. Second, we include a well-known fear factor – the volatility index (VIX) – along with the geopolitical risk index and the five FF factors to see if the geopolitical risk index retains or loses its information content. This analysis will be contrasted with the benchmark model results reported in Table 4. Durand et al. (2011) have examined the role of the VIX with the presence of the three FF factors (plus the momentum factor) and found that changes in the VIX impact the factors as well as the stock expected returns. Finally, we will make use of the other type of country equity portfolios – the growth – to detect any significant differences between the value, on which the main analysis was conducted, and the growth portfolios.

We begin with the estimation of simple regressions with the main geopolitical risk shock with and without the five FF factors. The results are shown in Table 11, in two panels. In Panel A, we see the results from the regressions without the factors. In comparison with Panel A of Table 5, we do not see many differences in the statistical significance of the geopolitical risk shock magnitude. The common result, however, is that the preponderance of the signs of the shock variable is negative. One notable difference is the statistical significance of Australia's, Austria's, and Italy's shock variable coefficients and the loss of statistical significance of Ireland's coefficient. Looking at Panel B, where the four factors (except for the market) are included, although we do not see any significant and fundamental changes in terms of the signs and sizes of the estimated shock coefficients with Panel B of Table 5, we do observe many differences in the FF factors. Specifically, two of them, the CMA and HML factors, and for many countries have reversed their statistical significance either from statistical significance (*) to no statistical significance (---) or vice versa.

The second robustness check entails the inclusion of the (change in the) volatility index (ΔVIX) in the reference regression with all five FF factors and the change in the geopolitical risk index (ΔGPR).[10] The results are shown in Table 12 and are reported in a concise manner. Then, they will be compared to the results in Table 4. From the results, it can be seen that the statistical significance or not (for some countries) of the main geopolitical risk index stands in the presence of the fear gauge, the VIX. There was no significant difference in the results for the FF factors as well as the geopolitical risk factor. The VIX was found statistically significant for Australia, Finland, Japan, Netherlands, New Zealand, Switzerland and the UK. Hence, it can be concluded that the benchmark results are once again corroborated.

The final robustness test deals with the use of the growth type of the country equity portfolios. We reran the benchmark regressions (with all FF factors and the change in the geopolitical risk index) but did not see any statistically significant changes in any of the coefficients of interest.

[10] We also used the economic policy uncertainty (EPU) index but the results were basically the same as with the VIX.

These results were much closer to the benchmark ones obtained with the value equity portfolios. Thus, once more the main results remained robust to these alternative checks.[11]

6. Conclusions and implications

In this paper, we examined whether geopolitical risk measures have some statistical significance for 20 advanced country equity portfolios (plus the US equity portfolio, proxied by the NYSE index) with and without the presence of the five FF factors (market, SMB, HML, CMA and RMW). The analysis was conducted using monthly data from 1985 to 2022. A summary of our findings follows.

First, with the exception of the market portfolio, some FF factors appeared to be significant for some country portfolios in a regression with the factors and the main, general geopolitical risk index. Second, using the general geopolitical risk shocks (as opposed to the differences in the risk index), it was found that its coefficients emerged with negative signs (but not always statistically significant) suggesting a depression of these countries' equity portfolios. Third, when using the two components of the main risk index, geopolitical threats and acts in regressions for each country, it was found that these two risk index components did not add anything beyond what the main risk index contained. Hence, the results suggest that these country-specific risk measures are not relevant to explaining the country equity portfolios. Given that these (or most) countries shared exposure to common geopolitical events, it is not surprising to see these insignificant results for all countries. However, in all cases the equity market was always statistically significant.

Finally, when estimating a panel specification or using the Fama-MacBeth regression methodology, with common FF factors (as opposed to region-specific FF factors), it was found that, again, although the market was highly statistically and economically significant, as it has always been in other regressions, the remaining four FF factors did not show up as statistically significant. By contrast, although the coefficient of the geopolitical risk index had a negative sign it was statistically insignificant or marginally significant in the results from the Fama-MacBeth regressions. These findings may be interpreted as that these countries' equity portfolios, in general, are not (statistically) affected by such a risk measure, which is very general and comprises only of catchy words.

These findings have important implications for investors, portfolio managers and policy-makers alike. Multi-factor or mixed models (with factors and variables) that pass robustness tests can be used for investment design but not blindly applied across all countries (and, possibly, all financial asset portfolios). A portfolio manager needs to understand the specifics of a country before

[11] The results not reported here but are available upon request.

designing an investment strategy via multi-factor modelling. To that end, the country's equity market may be the first magnitude that needs to be investigated for its ability to be efficient and forward-looking. Further, if portfolio managers apply style investment strategies associated with macro risk factors, then if clients' future claims depend on macroeconomic factors analogous strategies can be beneficial to clients and managers alike. Finally, policy-makers should be aware of the potential impact of geopolitical risks on the economy and well as the financial sector.

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Table 1 **Country portfolios' descriptive statistics**

Country	Mean	Variance	St. Dev.	Skewness	Kurtosis	CV
Austria	1.0780	56.0131	7.4845	0.2435	6.4681	6.9491
Australia	1.0379	47.4031	6.8867	-0.6974	7.4964	6.6351
Belgium	1.1075	46.1681	6.1479	-0.1407	4.9833	5.5519
Canada	0.9382	43.0488	6.5610	-0.3042	5.9021	6.9930
Denmark	1.1712	43.3471	6.5711	-0.2702	5.8720	5.6136
Finland	1.2456	58.9459	7.6776	0.7117	6.2651	6.1601
France	0.8903	51.4288	7.1713	-0.1498	5.4838	8.0540
Germany	1.0959	46.7049	6.8327	-0.4567	4.6656	6.2340
HongKong	1.1672	75.6259	8.6965	0.5951	7.5209	7.4509
Ireland	1.0859	104.537	10.224	0.4986	4.2345	9.4154
Italy	0.6221	74.4921	8.6035	0.1994	4.1794	13.829
Japan	0.7550	43.8387	6.6217	0.7658	5.5509	8.7747
Netherlands	1.1758	58.7811	7.6668	-0.5873	6.1123	6.5216
N. Zealand	0.5486	58.9644	7.6794	-0.0498	4.6887	13.996
Norway	1.0365	85.4912	9.2461	-0.2645	4.6134	8.9207
Singapore	1.2597	69.7026	8.3494	1.1717	12.136	6.6205
Spain	1.0535	56.9141	7.5445	0.2512	6.4781	7.1614
Sweden	1.3836	61.5720	7.8471	0.3241	5.0922	5.6179
Switzerland	0.8901	43.0427	6.5601	-0.3598	5.6352	7.3797
UK	0.7329	35.6626	5.9721	-0.0981	6.1252	8.1489
US	0.2238	3.4793	1.8653	-0.9128	2.8367	8.3327

Notes: High portfolios built on B/M ratio; dates from 1985:1-2022:12; CV is the coefficient of variation (st. deviation/mean).

Table 2 Correlations among the Fama-French factors and geopolitical risk index

Panel A: correlations among the region-specific Fama-French factors

	APCMA	**ECMA**	**JCMA**
ECMA	0.3622		
JCMA	0.2664	0.3885	
NACMA	0.3425	0.5777	0.2471

	APHML	**EHML**	**JHML**
EHML	0.2899		
JHML	0.2265	0.4275	
NAHML	0.2660	0.6555	0.4813

	APSMB	**ESMB**	**JSMB**
ESMB	0.4519		
JSMB	0.1455	0.2996	
NASMB	0.2223	0.3324	0.0701

	APRMW	**ERMW**	**JRMW**
ERMW	0.1252		
JRMW	0.0966	0.1509	
NARMW	0.1946	0.2507	0.0095

	APMRKT	**EMRKT**	**JMRKT**
EMRKT	0.7642		
JMRKT	0.4997	0.5435	
NAMRKT	0.7434	0.8193	0.4672

Panel B: correlations between geopolitical risk and region-specific Fama-French factors

	APCMA	APSMB	APMRKT	APHML	APRMW	ECMA	ESMB	EMRKT	EHML	ERMW
GPR	-0.0227	0.0216	-0.0116	-0.0041	0.0413	-0.0208	0.0056	-0.0579	0.0087	-0.0329

	JCMA	JSMB	JMRKT	JHML	JRMW	NACMA	NASMB	NAMRKT	NAHML	NARMW
GPR	0.0193	0.0535	-0.0194	-0.0193	-0.0064	-0.0250	0.0662	-0.0498	-0.0423	-0.0355

Notes: CMA, HML, SMB, RMW and MRKT are the five Fama-French factors; AP is Asia-Pacific; E is Europe; J is Japan and NA is North America region; sample period 1985:1 – 2022:12.

Table 3 Descriptive statistics of the geopolitical risk index and components

	Mean	St. Deviation	Skewness	Kurtosis	Max	Min
GPR	100.531	48.1029	4.3923	30.8766	512.52	39.04
GPRA	98.151	74.8491	5.9058	51.4263	854.07	28.45
GPRT	102.760	44.5678	3.0681	16.9625	413.31	36.68

Correlations: GPR-GPRA: 0.9156 GPR-GPRT: 0.8353 GPRA-GPRT: 0.5484

Note: indices were examined in levels.

Table 4 Benchmark regression model results

Country	Fama-French factors							
	Constant	MRKT	CMA	HML	RMW	SMB	ΔGPR	Adj-R^2
Austria	0.409**	1.068***	-0.137	0.077	-0.335*	-0.062	-0.003	0.797
Australia	0.668*	0.645***	-0.265	0.039	0.163	0.031	0.001	0.367
Belgium	0.445*	0.831***	-0.506*	0.642*	-0.122	0.238*	-0.005	0.719
Canada	-0.027	1.034***	0.214	-0.155	0.077	0.015	0.003	0.756
Denmark	0.002	0.956***	-0.345*	0.663*	0.144	0.186*	0.008	0.731
Finland	0.087	0.687***	-0.076	1.067*	0.308	0.634*	-0.000	0.603
France	-0.000	1.067***	-0.376*	0.845***	-0.312*	0.058	-0.006*	0.914
Germany	0.188	1.034***	0.176	0.173	0.432*	0.065	-0.008	0.876
HongKong	-0.038	1.054***	-0.178	0.476*	-0.167	0.125	-0.001	0.882
Ireland	-0.267	1.027***	-0.796*	1.245*	0.812*	0.325	-0.013**	0.597
Italy	0.036	1.097***	0.054	0.452*	-0.567*	0.069	-0.007**	0.897
Japan	0.244*	1.097***	0.015	0.632***	-0.068	0.312*	0.000	0.896
Netherlands	0.145	1.079***	-0.812*	0.832***	-0.289	0.186*	0.003	0.765
N. Zealand	-0.398	1.000***	0.007	0.243	0.226	0.167	-0.024*	0.634
Norway	0.167	1.078***	-0.289	0.298	-0.491	0.312*	-0.011**	0.742
Singapore	0.069	1.088***	-0.004	0.554*	-0.004	0.176*	0.006	0.855
Spain	0.140	0.976***	0.034	0.671*	0.107	0.134	0.001	0.834
Sweden	0.145	1.027***	0.469*	0.499*	-0.062	0.224*	0.001	0.812
Switzerland	0.078	1.078***	-0.642*	0.437*	-0.698*	0.165*	-0.014*	0.786
UK	0.094	1.067***	0.013	0.312*	-0.423*	-0.024	-0.000	0.867
US	-0.092**	0.422***	0.029**	0.090***	0.039***	-0.034***	-0.003	0.941

Notes: *, **, *** denote significance at the 5%, 10% and 1% levels, respectively.

Table 5 **Regressions on the main geopolitical risk index shock using country portfolios**

Panel A: without the Fama-French factors

	Constant	Shock	R^2		Constant	Shock	R^2
Austria	1.1412*	-0.0139	0.003	Italy	0.9691*	-0.0366*	0.018
Australia	1.2151*	-0.0041	0.000	Japan	1.0978*	-0.0051	0.000
Belgium	1.4856*	-0.0165	0.005	Netherlands	1.3689*	-0.0135	0.003
Canada	0.9448*	-0.0038	0.000	N. Zealand	0.3661	-0.0365*	0.021
Denmark	1.2000*	-0.0035	0.000	Norway	1.1616*	-0.0410*	0.018
Finland	1.2978*	-0.0135	0.000	Singapore	1.3860*	-0.0234	0.006
France	1.2333*	-0.0287*	0.014	Spain	1.2456*	-0.0142	0.003
Germany	1.3867*	-0.0297*	0.018	Sweden	1.5998*	-0.0107	0.001
Hong-Kong	1.3156*	-0.0227*	0.010	Switzerland	1.0798*	-0.0302*	0.022
Ireland	1.0667*	-0.0291*	0.008	UK	0.9987*	-0.0125	0.004
US	0.2219*	-0.0058**	0.012				

Panel B: with the Fama-French factors

	Shock	CMA	HML	RMW	SMB		Shock	CMA	HML	RMW	SMB
Austria	0.0013	---	---	*	---	Italy	-0.0096*	---	*	*	---
Australia	-0.0041	---	---	---	---	Japan	-0.0031	---	*	---	*
Belgium	-0.0065	*	*	---	*	Netherlands	-0.0109	*	*	---	*
Canada	0.0038	---	---	---	---	N. Zealand	-0.0225*	---	---	---	---
Denmark	0.0035	*	*	---	---	Norway	-0.0130*	---	---	---	*
Finland	-0.0065	---	*	---	*	Singapore	-0.0084	*	*	---	---
France	-0.0067*	*	*	*	---	Spain	0.0022	---	*	---	---
Germany	-0.0097*	---	*	---	---	Sweden	0.0107	*	*	---	*
Hong-Kong	-0.0047**	---	*	---	---	Switzerland	-0.0152*	*	*	*	*
Ireland	-0.0141*	*	*	*	---	UK	0.0012	---	*	*	---
US	-0.0047**	***	***	***	---						

Notes: the *shock* is the residuals from an ARMA(1,1) specification of the ΔGPR index; *, **, *** denote significance at the 5%, 10% and 1% levels, respectively; --- means that the factor is not statistically significant.

Table 6 Full-model regressions with the geopolitical acts and threats indices

Panel A: GPRA index							
	Coefficient	St. Error	adj-R^2		Coefficient	St. Error	adj-R^2
Austria	-0.0002	0.0031	0.793	Italy	-0.0042	0.0021	0.892
Australia	-0.0041	0.0041	0.367	Japan	-0.0009	0.0016	0.880
Belgium	-0.0036	0.0025	0.715	Netherlands	0.0022	0.0019	0.764
Canada	0.0026	0.0017	0.750	N. Zealand	-0.0176*	0.0036	0.631
Denmark	0.0054	0.0025	0.731	Norway	-0.0051	0.0041	0748
Finland	-0.0011	0.0031	0.601	Singapore	0.0041	0.0040	0.856
France	-0.0043*	0.0012	0.914	Spain	0.0008	0.0012	0.833
Germany	-0.0051**	0.0031	0.871	Sweden	0.0010	0.0011	0.816
Hong-Kong	-0.0021	0.0019	0.882	Switzerland	-0.0082	0.0030	0.782
Ireland	-0.0097**	0.0051	0.598	UK	-0.0004	0.0003	0.864
US	0.0006	0.0005	0.945				
Panel B: GPRT index							
	Coefficient	St. Error	adj-R^2		Coefficient	St. Error	adj-R^2
Austria	-0.0031	0.0053	0.793	Italy	-0.0062	0.0051	0.891
Australia	0.0071	0.0041	0.367	Japan	0.0031	0.0033	0.889
Belgium	-0.0048	0.0035	0.715	Netherlands	0.0041	0.0035	0.765
Canada	0.0009	0.0041	0.750	N. Zealand	-0.0176	0.0101	0.626
Denmark	0.0073	0.0065	0.730	Norway	-0.0111	0.0061	0.742
Finland	0.0029	0.0025	0.607	Singapore	0.0021	0.0061	0.854
France	-0.0054	0.0041	0.912	Spain	0.0021	0.0021	0.838
Germany	-0.0056	0.0050	0.873	Sweden	0.0000	0.0001	0.816
Hong-Kong	0.0015	0.0009	0.881	Switzerland	-0.0136*	0.0062*	0.780
Ireland	-0.0096	0.0081	0.597	UK	-0.0009	0.0011	0.863
US	-0.0003	0.0003	0.941				

Notes: GPRA is the geopolitical risk Acts index and GPRT is the geopolitical risk Threats index; models were estimated with the five Fama-French factors; *, ** denote statistical significance at the 5% and 10% levels, respectively; adj-R^2 is the adjusted R-square from each regression.

Table 7 **Sub-sample analysis of geopolitical risks**

Dummies	Country portfolios										
	Austria	Australia	Belgium	Canada	Denmark	Finland	France	Germany	Hong Kong	Ireland	Italy
Gulf	0.847	-0.787	1.480	-0.569	0.170	0.424	0.488	0.581	-0.589	-3.548	0.292
NK	0.656	-0.647	0.729	-1.227	-0.759	1.566	-0.950	-0.090	-0.103	0.213	0.208
UR	-0.559	2.517	-0.320	-0.445	4.546	1.714	0.655	0.472	0.535	-0.692	1.421

	Japan	Netherlands	N. Zealand	Norway	Singapore	Spain	Sweden	Switzerland	UK	US
Gulf	0.032	0.223	-0.320	-2.935**	0.593	2.017*	1.181	-0.176	0.072	0.675
NK	-0.304	-0.677	-0.334	-1.358	-0.378	-0.431	-0.727	0.261	0.430	0.035
UR	-2.334	3.088	3.106***	0.365	2.967	0.393	-4.365	-0.499	-0.443	0.876

Notes: The Gulf dummy refers to the 1990 Gulf war; the NK dummy reflects the North Korean missile crisis of the 2017-8 period; the UR dummy refers to the 2021 Ukraine-Russian war; *, **, *** denote statistical significance at the 5%, 10% and 1% levels, respectively.

Table 8 **Regressions with country-specific risk measures**

	Coefficient	St. Error	adj-R^2		Coefficient	St. Error	adj-R^2
Australia	1.7271	1.1141	0.367	Italy	-2.0423	1.7951	0.892
Belgium	-0.5477	0.5315	0.718	Japan	-1.1811	0.8933	0.890
Canada	1.9619	1.7741	0.750	Netherlands	1.8321	2.0015	0.764
Denmark	3.0933	3.1165	0.729	Norway	2.0741	2.1131	0.741
Finland	-4.7329	3.8125	0.607	Spain	-0.5811	1.6821	0.838
France	0.3034	0.2941	0.911	Sweden	-3.4670	4.1101	0.817
Germany	-0.6426	0.6650	0.872	Switzerland	-1.4034	2.1332	0.775
Hong-Kong	0.9965	0.9991	0.882	UK	0.3569	0.2811	0.863

Note: models were estimated with the five Fama-French factors.

Table 9 Panel regression results

Variable	Coefficient	Std. Error	t-Statistic	Probability
Market	0.8233	0.0118	69.319	0.0000
CMA	0.0940	0.0660	1.423	0.1545
HML	0.0586	0.0538	1.089	0.2761
RMW	0.0959	0.0775	1.237	0.2158
SMB	-0.0368	0.0464	-0.793	0.4274
ΔGPR	-0.0009	0.0018	-0.417	0.6229
Constant	0.2632	0.0607	4.336	0.0000

Adj-R^2 = 0.6719 F-stat = 571.155 (0.000) Log-L = -22660.89 rho = 0.0018

Note: the fixed-effects model specification's results are shown.

Table 10 Fama-MacBeth regression results

Panel A: *GPR index*

Variable	Coefficient	Std. Error	t-Statistic	Probability
Market	0.8561***	0.0225	37.920	0.000
CMA	-1.8962	1.5067	-1.264	0.466
HML	-2.0800	3.0438	-0.680	0.495
RMW	1.9757	4.0589	0.491	0.627
SMB	-1.0206**	0.5814	-1.741	0.738
ΔGPR	-9.2364**	5.3547	-1.761	0.079
Constant	0.0507	0.3675	0.141	0.890

Average R^2 = 0.5224 Adj. R^2 = 0.3007 F-stat (6, 400) = 242.73 (0.000)

Panel B: Threats (*GPRT*) and Acts (*GRPA*)

Variable	Coefficient	Std. Error	t-Statistic	Probability
Market	0.830***(0.301)***	0.022 (0.024)	36.95 (36.96)	0.000 (0.000)
CMA	0.005 (-0.026)	0.048 (0.050)	0.110 (-0.510)	0.920 (0.607)
HML	0.060 (0.063)	0.047 (0.049)	1.280 (1.281)	0.201 (0.203)
RMW	0.006 (-0.023)	0.047 (0.053)	0.141 (-0.441)	0.802 (0.658)
SMB	-0.063 (-0.028)	0.058 (0.059)	-1.090 (-0.471)	0.276 (0.636)
ΔGPRT (ΔGPRA)	-0.103** (0.013)	0.054 (0.021)	-1.902 (0.601)	0.072 (0.547)
Constant	0.030 (-0.001)	0.049 (0.021)	0.060 (-0.03)	0.951 (0.978)

Average R^2 = 0.4830 (0.4780) Adj. R^2 = 0.2370 (0.237) F-stat (6, 400) = 194.23 (194.24)

Notes: the coefficients, standard errors, t-statistics and probabilities of *Acts* are in parentheses in Panel B; **, *** denote statistical significance at the 10% and 1% levels, respectively; regressions were run with the Newey-West correction with 2 lags.

Table 11 Regressions on the risk index shock using equity portfolios

Panel A: without the Fama-French factors

	Constant	Shock	R^2		Constant	Shock	R^2
Austria	0.2628	-0.0223*	0.013	Italy	-0.0171	0.0086	0.001
Australia	0.1513	-0.0111*	0.000	Japan	-0.0871	-0.0071	0.001
Belgium	-0.2606	-0.0095	0.005	Netherlands	0.1189*	-0.0105	0.004
Canada	0.4468*	-0.0068	0.002	N. Zealand	0.2612	-0.0265*	0.020
Denmark	0.7540*	-0.0085	0.003	Norway	0.0612	-0.0340*	0.011
Finland	0.1978*	-0.0115	0.001	Singapore	0.1740	-0.0224**	0.019
France	0.1233*	-0.0217*	0.019	Spain	0.1414*	-0.0112	0.004
Germany	0.5387	-0.0297*	0.028	Sweden	1.2193*	0.0117	0.004
Hong-Kong	2.5256*	-0.0367*	0.050	Switzerland	0.4798*	-0.0182*	0.021
Ireland	0.3667	-0.0131	0.006	UK	0.6887*	-0.0145	0.005

Panel B: with the Fama-French factors

	Shock	CMA	HML	RMW	SMB		Shock	CMA	HML	RMW	SMB
Austria	-0.0059	*	*	---	---	Italy	0.0863	---	---	---	---
Australia	-0.0181*	*	*	---	---	Japan	-0.0061	*	*	*	---
Belgium	-0.0075	*	---	*	---	Netherlands	-0.0105*	*	*	---	*
Canada	-0.0038	---	---	---	*	N. Zealand	-0.0201*	---	*	---	---
Denmark	-0.0035*	*	*	*	---	Norway	-0.0141*	---	*	---	*
Finland	-0.0045	*	*	---	*	Singapore	-0.0214*	*	*	---	---
France	-0.0047*	*	*	*	---	Spain	0.0131	---	*	---	---
Germany	-0.0303**	*	*	---	*	Sweden	0.0122	---	---	---	---
Hong-Kong	-0.0447	*	*	*	---	Switzerland	-0.0182*	*	*	*	*
Ireland	-0.0091	*	*	---	*	UK	0.0011	---	*	*	---

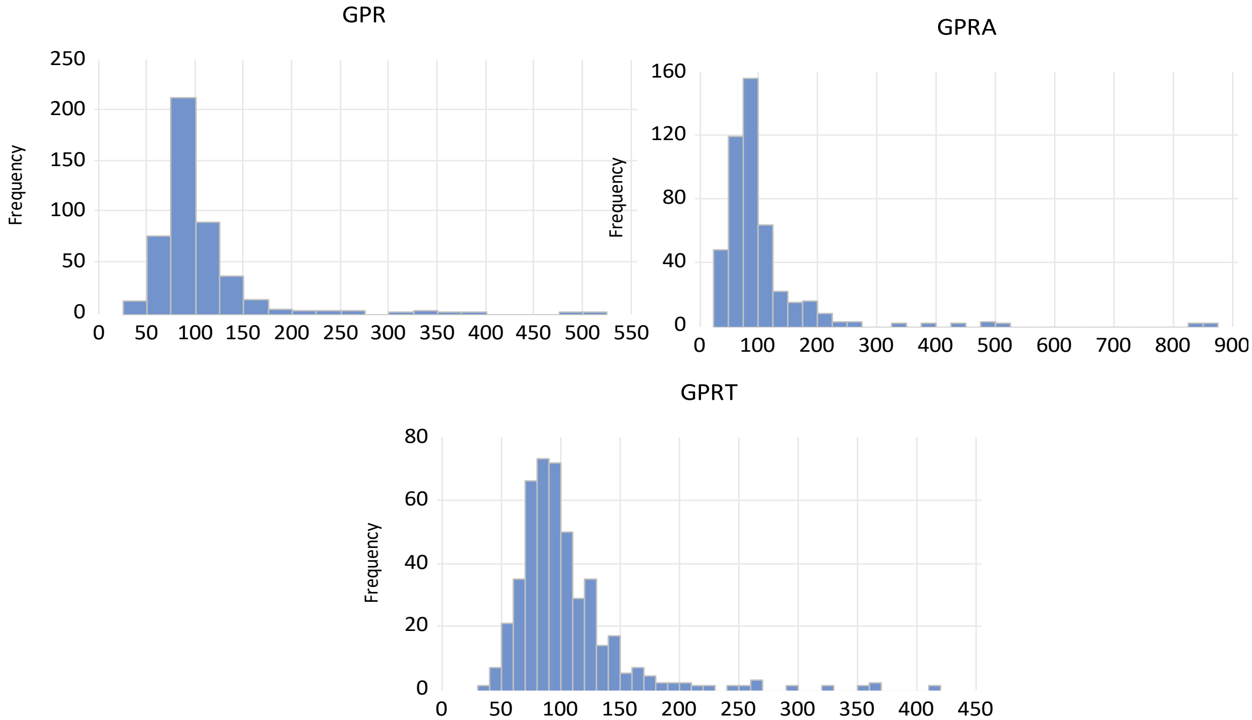
Notes: the *shock* is the residuals from an ARMA(1,1) specification of the ΔGPR index; *, ** denote significance at the 5% and 10% levels, respectively; --- means that the factor is and is not statistically significant.

Table 12 Regression results with the 5 Fama-French factors, GPR and VIX

Country	ΔGPR	ΔVIX	Adj-R^2		ΔGPR	ΔVIX	Adj-R^2
Austria	-0.0021	0.0591	0.797	Italy	-0.0071**	0.0266	0.897
Australia	0.0052	-0.5380**	0.487	Japan	0.0012	-0.0486*	0.890
Belgium	-0.0055	0.0208	0.719	Netherlands	0.0044	-0.1994***	0.775
Canada	0.0031	-0.0115	0.750	N. Zealand	-0.0241*	-0.1102*	0.638
Denmark	0.0081	-0.0112	0.731	Norway	-0.0114**	-0.0245	0.742
Finland	0.0007	-0.1879*	0.603	Singapore	0.0069	-0.0538	0.856
France	-0.0064*	-0.0308	0.912	Spain	0.0015	0.0156	0.838
Germany	-0.0085*	0.0205	0.877	Sweden	0.0086	0.0472	0.817
HongKong	-0.0023	0.0116	0.882	Switzerland	-0.0134***	-0.1011*	0.786
Ireland	-0.0147	-0.1265	0.599	UK	-0.0013	0.0808*	0.865
US	-0.051*	-0.2346*	0.768				

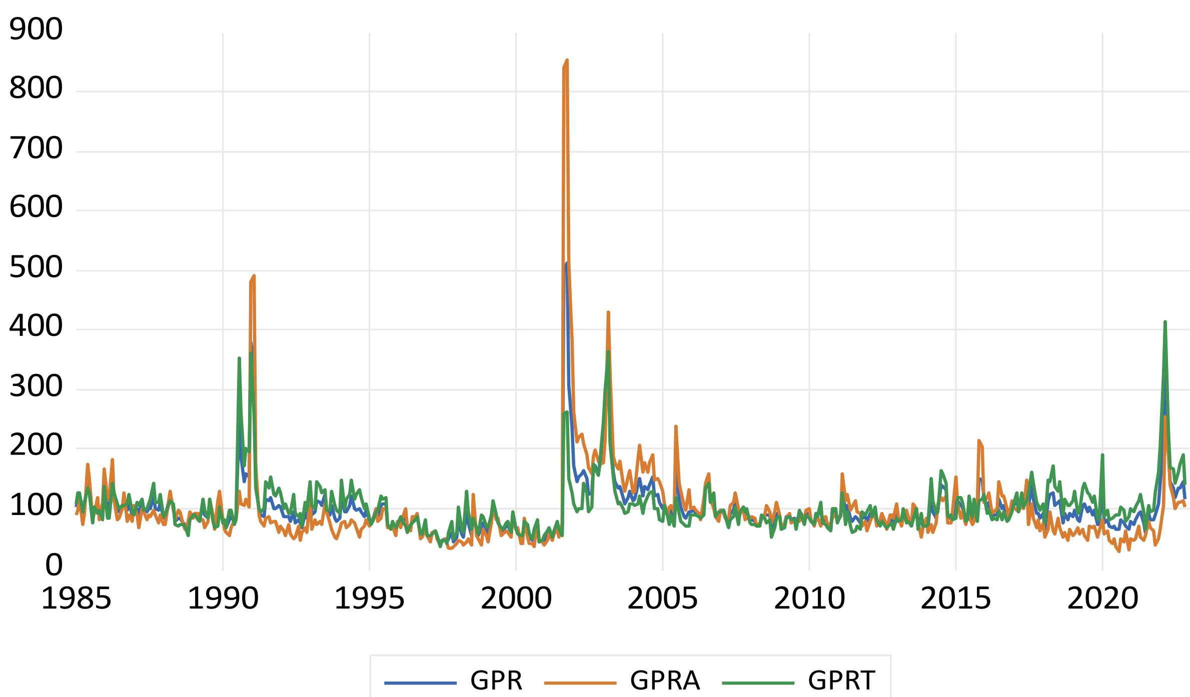
Notes: *, **, *** denote significance at the 5%, 10% and 1% levels, respectively; ΔGPR and ΔVIX are the changes in the general geopolitical risk index and the VIX, respectively.

Figure 1 Histograms of the three geopolitical risk indices



Notes: GPR, GPRA and GPRT are the main index, the Acts index and the Threats index, respectively.

Figure 2 Geopolitical risk indices, 1985-2022



Note: GPR is the main index, GPRA is the Acts index and GPRT is the Threats index.