Geopolitical risk, economic policy uncertainty and asset returns in Chinese financial markets

Thomas C. Chiang

Finance, Drexel University
Bennett S LeBow College of Business,
Philadelphia, Pennsylvania, USA

Abstract

Purpose – This paper investigates the impact of changes in economic policy uncertainty (ΔEPU_t) and geopolitical risk (|ΔGPR_t|) on asset returns in the Chinese market. 

Design/methodology/approach – The paper uses Engle’s (2009) dynamic conditional correlation (DCC) model and Chiang’s (1988) rolling correlation model to generate correlations of asset returns over time and analyzes their responses to (ΔEPU_t) and |ΔGPR_t|.

Findings – Evidence shows that stock-bond return correlations are negatively correlated to ΔEPU_t, whereas stock-gold return correlations are positively related to the |ΔGPR_t|, but negatively correlated with ΔEPU_t. This study finds evidence that stock returns are adversely related to the risk/uncertainty measured by downside risk, ΔEPU_t, and |ΔGPR_t|, whereas the bond return is positively related to a rise in ΔEPU_t; the gold return is positively correlated with a heightened |ΔGPR_t|.

Research limitations/implications – The findings are based entirely on the data for China’s asset markets; further research may expand this analysis to other emerging markets, depending on the availability of GPR indices.

Practical implications – Evidence suggests that the performance of the Chinese market differs from advanced markets. This study shows that gold is a safe haven and can be viewed as an asset to hedge against policy uncertainty and geopolitical risk in Chinese financial markets.

Social implications – This study identify the special role for the gold prices in response to the economic policy uncertainty and the geopolitical risk. Evidence shows that stock and bond return correlation is negatively related to the ΔEPU and support the flight-to-quality hypothesis. However, the stock-gold return correlation is positively related to |ΔGPR|, resulting from the income or wealth effect.

Originality/value – The presence of a dynamic correlations between stock-bond and stock-gold relations in response to ΔEPU_t and |ΔGPR_t| has not previously been tested in the literature. Moreover, this study finds evidence that bond-gold correlations are negatively correlated to both ΔEPU_t and |ΔGPR_t|.

Keywords Stock–bond return correlation, Stock-gold return correlation, Downside risk, Economic policy uncertainty, Geopolitical risk, Safe haven

Paper type Research paper

Abstract

Highlights

(1) This paper investigates the impact of changes in economic policy uncertainty (ΔEPU_t) and geopolitical risk (|ΔGPR_t|) on asset returns in the Chinese market.

(2) The dynamic correlation of stock and bond returns is negatively correlated to the ΔEPU_t, and bonds are a good instrument to avoid ΔEPU_t.

(3) Dynamic correlations of stock-gold returns are negatively correlated to ΔEPU_t but positively correlated with the |ΔGPR_t|.

JEL Classification — G10, G11, G14, G15

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Time-varying bond-gold return relations are negatively correlated with a rise in $\Delta \text{EPU}_t$ and $|\Delta \text{GPR}_t|$.

Both $\Delta \text{EPU}_t$ and $|\Delta \text{GPR}_t|$ create an adverse effect on stock returns.

Heightened $\Delta \text{EPU}_t$ correlates with a greater bond return, whereas a rise in $|\Delta \text{GPR}_t|$ gives rise to a higher return in gold. Gold is an effective instrument to hedge against $|\Delta \text{GPR}_t|$.

1. Introduction

Dynamic asset pricing models that highlight a risk-return tradeoff constitute the core of modern finance theory. Rational behavior implies that an economic agent constantly reacts to news due to external shocks or government policy innovations. This ongoing market adjustment phenomenon is cast in a dynamic approach, often giving rise to time-varying risk-return relations. In a system which operates under the stock-bond apparatus, investors attempt to make an efficient portfolio allocation that equalizes assets returns after adjusting for the features of different asset instruments. Should an external shock disrupt an equilibrium condition, asset holders would readjust portfolio combinations by moving funds from a lower return asset to an asset with a higher expected return in response to the return differentials. This “gross substituting” property (Tobin, 1969) would undoubtedly alter the existing correlation of stock-bond returns. However, if the shock is triggered by unexpected asset growth, the resulting wealth effect could drive higher demand for both stocks and bonds, this “wealth effect” leads to a positive correlation between the returns of these two asset categories. These market adjustments and an interaction between stocks and bonds have not incorporated the factors driven by the amount of risk/uncertainty appetite in the market.

The notion of positive correlation between stock-bond returns can be traced to the “Fed model” (Yardeni, 1997), which states that the P/E ratio derived from a stock investment should be approximately equal to the reciprocal of the bond’s yield to maturity, which leads to a positive correlation between the stock market’s E/P ratio and bond yields. Kwan (1996) observes that both required rates of stock returns and bond yields are considered as part of a discount factor for calculating the future income flows in a valuation model; it is, therefore, natural to form a positive correlation between stock and bond returns. Yet, an extreme market condition may drive investors to move their funds to a safe haven, generating a fly-to-quality phenomenon, where increase stock market volatility induces investors to sell off stocks in favor of bonds. Thus, the stock-bond returns would display a negative correlation. In examining the US market, Connolly et al. (2005) and Guidolin and Timmermann (2006) find evidence of negative spikes in stock-bond correlations at the sample period at the end of 1997 and the end of 1998. A similar finding is documented by Chiang et al. (2015) in the G7 markets. Recent studies by McMillan (2018), Pericoli (2018), Campbell et al. (2020) conclude that the relative equity and bond yield values and their relation are mainly driven by inflation rate, which causes negative correlations. However, Baele et al. (2010) report that macroeconomic fundamentals contribute little to explaining stock and bond return correlations, whereas the “variance premium” is critical in explaining stock return volatility.

Implicit in the above-mentioned literature is the notion that the portfolio composition is restricted to the two assets: stocks and bonds (Asness, 2003; Connolly et al., 2005; Baele et al., 2010; Chiang et al., 2015; McMillan, 2018). It also assumes that bonds are the only alternative asset to stocks as a way to avoid risk. This approach typically appears in empirical analyses of advanced markets. This premise may not hold true in Chinese society, since bond investment is not well developed and the instruments in bond trading are not generally understood by investors or households in the Chinese market; hence, bonds are not a popular asset used to hedge against uncertainty. Much more in line with traditional culture is the propensity of Chinese households to purchase gold in forms of coins, bars or pure gold
jewelry, which are favorably held as a way of storing value, facilitating future consumption, fostering a peaceful mind and providing a hedge against uncertainty while offering anonymity. Further, in times of national crisis, gold can provide both financial flexibility and investment options outside the home country. Among other reasons, China’s central bank can also use gold to maintain its exchange rate stability and to guard against national crisis during eras of uncertainty without worry about default risk [1]. Evidence, which shows that since 1900, all national currencies have been depreciated relative to gold (Clark, 2020), supports the claim that physical gold has been the best long-term vehicle for storing value. Although the international financial arrangement has departed from the Bretton Woods system, gold is still considered as a tangible asset to be held by the central bank for achieving portfolio diversification or providing a risk hedge. For these reasons, it is worth investigating the dynamic correlation between stock and gold returns in addition to the stock-bond return relation.

In analyzing the stock-bond correlation due to a shock from economic uncertainty, it has been the custom to use measures of market volatility, such as implied volatility of stock market (Whaley, 2009; Hakkio and Keeton, 2009; Connolly et al., 2005; Baele et al., 2010), implied volatility of bond market (Chiang et al., 2015) or inflation volatility (McMillan, 2018; Pericoli, 2018) to explain the stock-bond variations. No consideration is given to the impacts from ΔEPU and ΔGPR. Thus, the traditional definition of uncertainty/risk based on market volatility may not adequately encompass all information of uncertainty that sufficiently conveys investors’ fears and sentiments in decision making.

The recent literature finds that a change in economic policy uncertainty (ΔEPU) can cause further policy uncertainty in the future and hence increase stock market volatility (Caggiano et al., 2014; Bloom, 2014). Moreover, it has been seen that news of a change in geopolitical risk (ΔGPR) arising from an increase in uncertainty due to military tensions, political regime changes, terrorist threats, corruptions, etc. (Chan et al., 2019) can interrupt economic activity and households’ incomes. In fact, ΔGPR uncertainty could lead investors to take a more prudent approach on investments and postpone their decision-making because of an emotional dimension shaped by fear, pessimism and other negative reactions that cause investors to respond intensively to political events (Hillen et al., 2017). To cope with political uncertainty, investors are more likely to fly-to-gold instead of bonds, since hedging against uncertainty with gold is perceived as an acceptable means of storing value and could generally be converted to cash in global markets.

This paper contributes to the literature in the following aspects. First, in addition to the stock market risk, this study presents evidence by employing ΔEPU and ΔGPR to explain asset returns and their correlation variations. This treatment of model specification helps to reduce the bias of only using stock market risk as an argument due to its correlation with ΔEPU and ΔGPR [2]. Further, the selection of these two uncertainty variables differs from the traditional approach, which emphasizes an economic measure of stock return volatility. Both indices of EPU and GPR (Caldara and Iacoviello (2019) are news-based variables, which are obtained from the reading of local newspapers. As a result, the information is current and efficient and fairly delivered to the public without suffering from time delay and model biases.

Second, evidence shows a time-varying stock-bond correlation in the Chinese market, which is negatively correlated to the ΔEPU. The inverse relation also displays in the stock-gold return relation. The evidence of a negative response to a rise in the ΔEPU clearly presents a substitution effect for stock-bond and stock-gold relations and is also consistent with the decoupling phenomenon that occurs as uncertainty rises.

Third, with respect to the reaction to ΔGPR uncertainty, there is no clear direction for the stock-bond return correlation; however, evidence suggests that stock-gold return correlations are positively correlated to the ΔGPR, displaying a dominance of income effect.
Fourth, testing of the uncertainty effects on individual asset returns produces evidence, which is consistent with the finding of Jones and Sackley (2016) in US and Europe markets and suggests that stock and gold returns are negatively correlated with ΔEPU; however, the bond return is positively correlated with ΔEPU, indicating that bonds are a good instrument for hedging against a rise in ΔEPU. On the other hand, evidence concludes that both stock and bond returns are negatively correlated to a rise in |ΔGPR|, yet, the gold return displays a positive sign, implying that gold is a good instrument to hedge against the |ΔGPR|. Clearly, Chinese investors are able to identify the difference and make a clear choose among different instruments to hedge against uncertainty whether it arises from economic policy or from geopolitical policy.

Fifth, this study also analyzes the time-varying correlations between bond and gold returns. Evidence indicates that the bond-gold return relation is negatively correlated to a heightened ΔEPU, and |ΔGPR|, respectively. This study thus provides a thorough analysis of the triangular relations of stock-bond, stock-gold and bond-gold return variations.

The remainder of this paper is organized as follows. Section 2 provides a brief literature review that leads to the specification of the asset-return correlation models. Section 3 presents an econometric model pertinent to empirical analysis. Section 4 describes the data and variable construction for the study's empirical analysis. Section 5 presents empirical evidence for dynamic correlations in relation to ΔEPU, and |ΔGPR|. Section 6 reports estimated results of ΔEPU, and |ΔGPR| on returns in different asset markets. Section 7 concludes the empirical findings.

2. Literature review

Correlations of asset returns are rather complex. In addition to the common time trend and individual time series correlations, return variables commonly react to economic news, changes in inflation rate, the business cycle and policy innovations on the one hand. On the other hand, there are common cross-correlations with each other or with some unobservable variables (Stock and Watson, 1988), which create spurious correlations. Thus, the effect of stock returns and bond yields on the discount factor may not be a unique channel that explains correlations of stock-bond return relations. Although the relative values of stocks and bonds are normally driven by the return disparities, an upward shift in the wealth effect and an enthusiastic high-tech boom that induced investors to hold both stocks and bonds simultaneously in the late 1990s in the US market may also be responsible for this behavior (d’Addona and Kind, 2006). In fact, economic fundamentals could be the key to boost asset returns. Andersson et al. (2008) report that inflation and economic growth expectations are significant in interpreting the time-varying correlation between stock and bond returns in US and German markets. McMillan (2018) and Campbell et al. (2020) explain that higher inflation lowers real bond returns and higher output raises stock returns, causing bond and stock returns to present a negative correlation. Similarly, Yang et al. (2009) investigate markets in the US and the UK and find that the correlation of stock–bond returns is related to the business cycle. However, Baele et al. (2010) cannot find that variables such as interest rates, inflation, the output gap and cash flow growth make a strong contribution in explaining stock-bond return correlations in the U.S. data.

During a period in which a stock market experiences a severe downturn, it is generally observed that stock-bond returns reveal a negative correlation. This is essentially due to the risk adverse behavior of investors who tend to sell off stocks and replace them with bonds as volatility increases. This shift triggers a “flight-to-quality” phenomenon (Baur and Lucey, 2009; Lucey, 2009; Chiang et al., 2015). But as economic prospects turn more optimistic, risk adverse investors opt to re-enter the stock market, leading to a “flight-from-quality” phenomenon. Thus, the result is a negative correlation for stock-bond returns. Evidence documented by Gulko (2002), Connolly et al. (2005), Baur and Lucey (2009), Lucey (2009) and Chiang et al. (2015)
confirms this hypothesis and finds that stock–bond returns are negatively correlated with stock market uncertainty as measured by the implied volatility of the S&P 500 index.

Despite the contributions of the above empirical analyses, the premise in previous empirical analyses is restricted to a two-asset model, which is applicable to advanced markets and may not be relevant to emerging market where the bond market is relatively thin. Thus, several studies hypothesize gold, instead of bonds, should be considered as a safe haven for investors. To test whether gold acts as a safe haven, which is defined as a security that is uncorrelated with stocks and bonds in a market crash, Baur and Lucey (2010) examine the US, UK and German markets and find that gold is a hedge against stocks on average and a safe haven in extreme stock market conditions. A portfolio analysis further shows that the safe haven property is short-lived. O'Connor et al. (2015) apply a Markov-Switching model to assess whether two distinct states exist between gold’s return with the stock return. The evidence provided by their study based on the UK and US markets indicates that gold is consistently a hedge, but no distinct safe haven state exists between gold and stock markets. Tripathy (2016) investigates the India market and finds that the gold price and stock market price are co-integrated, indicating a long-run equilibrium relationship between them. However, no causal relationship exists between the gold price and stock market price in the short run.

In spite of the evidence that gold acts as an instrument for hedging risk, analyses are limited to time periods when stock market conditions are extreme, or the inflation rate is high. In practice, investors are continually monitoring their portfolio performance and maintain a consistent watch on the parametric effect of uncertainty. In fact, the scope of the shocks, which occur and are revealed in daily newspapers, indicates that the origin of uncertainty is by no means limited in the times of significant financial shocks. For this reason, this study examines the impact of news-based changes in economic policy uncertainty (ΔEPU) and geopolitical risk (ΔGPR) on asset returns and their dynamic correlations. In facing a rise of ΔGPR uncertainty, gold is an instrument universally acceptable as a means of storing value, whereas a perceived limitation of bonds is that their value is often subject to validation of a political regime and they are often constrained by their marketability in global markets. However, holding gold versus securities entails opportunity costs that become readily apparent when the economy recovers. In this climate, the costs continue to grow as the economy booms; thus, the property of gold as a safe haven is expected to be short-lived. This study provides an empirical study on the dynamic correlations between stock-bond and stock-gold relations in Chinese markets [3]. Further, this study extends the analysis to the time-varying bond-gold return variations. The evidence from this paper, therefore, undoubtedly provides more insight on investors’ portfolio behavior that goes beyond the traditional approach taken in analyzing asset correlations, which typically is limited to financial volatility and economic shocks.

3. A dynamic conditional correlation model
To estimate the dynamic conditional correlation (DCC) path between asset returns, it is convenient to follow Engle’s (2009) model, which has been widely used to investigate the time-varying coefficient property in the literature (Chiang et al., 2007; Antonakakis et al., 2013; Allard et al., 2020, among others). This model is appealing because of its ability to capture multivariate return correlations and has a capacity for dealing with the volatility clustering phenomenon that alleviates the heteroscedasticity problem.

Let us consider a bivariate return series, \( \{ R_t \} \), which can be expressed as:

\[
R_t = \delta_t + u_t
\]

(1)

where \( R_t = [R_{t,i}, R_{t,j}]' \), which can be simplified as a 2 × 1 vector for asset returns i and j; \( \delta_t \) is the mean values of assets \( R_{t,i} \) and \( R_{t,j} \), which has the conditional expectation of multivariate
time series properties \([5]\); \(u_t \mid F_{t-1} = [u_{t,1}, u_{t,2}] \sim N(0, H_t)\), \(F_{t-1}\) is the information set up for time \(t-1\). In the multivariate DCC-GARCH apparatus, \(\text{Engle (2009)}\) sets up the conditional variance-covariance matrix \(H_t\) as:

\[
H_t = D_t P_t D_t^{-1}
\]  

(2)

where \(D_t = \text{diag}\{H_t^{-1/2}\}\) is the diagonal matrix of time-varying standard deviations from the model; \(P_t\) is the time-varying conditional correlation matrix, which is obtained from the following transformation:

\[
P_t = \text{diag}\{Q_t\}^{-1/2} Q_t \text{diag}\{Q_t\}^{-1/2}
\]  

(3)

The expression of \(P_t\) matrix in equation (3) is satisfied by ones on the diagonal and off-diagonal elements that have an absolute value less than one. Since finance theory suggests that the impact of a negative shock may have a more profound effect on the volatility than that of an equivalent positive shock, there is an extra impact on the dynamic correlations. This notion leads to an asymmetric DCC model. In expressing it, we write \([6]\):

\[
Q_t = \Omega + a \varepsilon_{t-1} \varepsilon_{t-1}' + \gamma \eta_{t-1} \eta_{t-1}' + \beta Q_{t-1},
\]

(4)

where the \(Q_t\) is a positive definite and \(\eta_t = \min[\varepsilon_t, 0]\).

The product of \(\eta_{t,i} \eta_{t,j}\) will be non-zero only if these two variables are negative. The coefficient of \(\gamma\) captures the notion that the correlation increases more in response to negative shocks than positive shocks. The estimation of \(\Omega\) is given by:

\[
\hat{\Omega} = (1 - \alpha - \beta) \bar{Q} - \gamma \bar{N},
\]

(5)

where \(Q_t = (Q_{t,i})\) is assumed to be the \(2 \times 2\) time-varying covariance matrix of \(\varepsilon_t\), \(\bar{Q} = E[\varepsilon_t \varepsilon_t']\) is the \(2 \times 2\) unconditional variance matrix of \(\varepsilon_t\) (where \(\varepsilon_{t,i} = u_{t,i} / \sqrt{h_{t,i}}\)), \(\bar{N} = E[\eta_t \eta_t']\) is the \(2 \times 2\) unconditional variance matrix of \(\eta_t\), \(a, \beta\) and \(\gamma\) are non-negative scalar parameters satisfying \((1 - \alpha - \beta - \gamma) > 0\). The substitution of equation (5) for (4) yields:

\[
\rho_{q,t} = \frac{Q_{q,t}}{\sqrt{Q_{i,i}Q_{j,j}}},
\]

(6)

which can be used to calculate the correlations for the two assets. As proposed by \(\text{Engle (2009)}\), the ADCC model can be estimated by using a two-stage approach to maximize the log-likelihood function.

4. Data

This study employs monthly stock data for the sample period of January 2000 through May 2020, including the total stock market index (TTMK), Shanghai A-share index (SHA), Shanghai B-share index (SHB), Shenzhen A-share index (SZA) and Shenzhen B-share index (SZB). The stock indices are downloaded from \textit{Datastream International}.

The indices of EPU and GPR data were downloaded from economic policy uncertainty website, which is available at: \texttt{https://www.policyuncertainty.com/all_country_data.html}. The original data of EPU were constructed by \textit{Baker et al. (2013)} and updated from time to time. The EPU Index for China (\textit{Davis et al., 2019}) is obtained from monthly counts of articles that contain at least one term in each of three words sets: Economics, Policy and Uncertainty. The newspaper-based uncertainty data for China were obtained from two Chinese newspapers: the Renmin Daily and the Guangming Daily. The first step was to search for the words uncertain/uncertainty/not sure/hard to tell/unknowns/economy/business, etc. in

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each set based on Chinese characters and correspondingly, translations in English. The second step focuses on scaling the raw monthly EPU counts by the number of total articles for the same newspaper and month. Davis et al. (2019) show that the Chinese EPU index was elevated with the Global Financial Crisis of 2008–2009, and especially, rising trade policy tensions in 2017–2018.

Caldara and Iacoviello (2017) construct a monthly index of geopolitical risk (GPR) Index by counting the occurrence of words related to geopolitical tensions in 11 leading international newspapers. The search identifies articles containing references to the following words involving actual adverse geopolitical events: {military-related tensions, nuclear tensions, war threats, terrorist threats, terrorist acts or the beginning of a war}. Caldara and Iacoviello’s (2017) data set includes monthly country specific GPR indexes constructed for 18 emerging economies. This study utilizes the Chinese GPR index, which was downloaded from Caldara and Iacoviello (2019) and is available at https://www2.bc.edu/matteo-iacoviello/gpr.htm.

The daily stock index data are used to calculate the downside risk, which is the minimum value of daily returns of the past 22 trading days (Bali et al., 2009); the original $\text{VaR}_t$’s are multiplied by $-1$ before running regressions. The bond return is calculated based on the 30-year government bond. The stock returns are calculated by taking the first natural log-difference of price indices times 100.

5. **Empirical evidence**

5.1 **Time series paths of asset indices**

Figure 1 depicts the time series plots of various stock indices that measure the total market (TTMK), SHA, SHB, SZA, SZB, bond and gold price. The stock indices display a high degree of comovements as exhibited by some major turning points, which reflect they are subject to some common events or external shocks. Two special points are noteworthy. First, the TTMK index lies above the positions of SHA, SHB, SZA and SZB at different points of time, revealing the impact of dividend yields distributed to investors. The difference is also reflected in a higher value for the mean as reported in Table 1. Second, the time paths of TTMK show historical peaks at three different times; the first one occurred in October 2007 during a long bull market, which then turned to a bear market in October 2008 as a global financial crisis gripped markets across the world. The second time Chinese stock prices reached a new historical high was in May 2015 when the markets were driven by an easing in monetary policy, which eased margin financing and prompted an enthusiastic expansion by individual investors in speculative investment [7]. The bubble then burst and markets corrected. Starting early 2016, the market rebounded and reached a third peak in January 2018. Since then, the markets have reversed due to the impact of a Chinese-U.S. trade war [8].
Notice that during the global financial crisis and its post period, gold prices rose steadily. Additionally, the change in attitude of risk adverse investors, which was partly induced by the stimulus plan (Barboza, 2008), has caused the gold index to outperform other indices since October 2008. This performance reflects to some extent investors’ use of gold as a hedge against uncertainty after the global financial crisis and recent COVID-19’s spreads.

5.2 Summary of statistics of asset returns
Presented in Table 1 is the monthly returns for different assets along with aggregate markets. The mean value in Table 1 indicates that the TTMK stocks have the highest performance, while the SHA underperforms all other markets and is just slightly higher than the bond market return. The performance of gold return, which lies behind the TTMK and SZB markets, is reasonably good. Yet, the gold return variability is much lower than the stock returns as shown in the SD. With respect to the bond return, the mean value presents the lowest value and is accompanied by the smallest SD.

5.3 Dynamic conditional correlations of asset returns
Figure 2 depicts time series plots of dynamic conditional correlations for the monthly data between 30-year Chinese bond returns and stock returns for TTMK, SHA, SHB, SZA and SZB indices, respectively, based on equation (6) as given by \( \rho_t(R_i, R_j) = \frac{h_{ij,t}}{\sqrt{h_{ii,t}} \sqrt{h_{jj,t}}} \). The plots clearly indicate the correlations are time-varying and mostly lie in the positive regime and exhibit a stationary pattern, except for the SHB stock-bond correlation, which has spikes in periods of the late 2008 – early 2009, which may be influenced by the US stock market disturbances during the period of the financial crisis. However, the correlations between gold return and stock returns are somewhat different. As shown in Figure 3, the time-varying patterns for the pairwise correlations between stock and gold returns swing across different regimes. Nevertheless, the correlations of stock-gold relations for the SHB-share markets are more stable. The different time paths between Figures 2 and 3 demonstrate the different preferences that investors have toward gold and bonds, even though both of these two assets can alternatively be viewed as instruments for hedging against stock risk.

To provide a more concise analysis, we present summary statistics of pairwise correlated asset returns. Table 2 reports the correlations of stock-bond returns. The results indicate a positive relation for all correlation coefficients although negative figures are shown in the minimum values. The positive correlations may be attributable to the income effect that simultaneously drives stocks and bonds. This result is not consistent with the evidence in advanced market (Connolly et al., 2005; Chiang, 2020). For a comparison, the estimation is also provided in the last column, which shows a negative relation in the US market.

<table>
<thead>
<tr>
<th></th>
<th>( R_{TTMK,t} )</th>
<th>( R_{SHA,t} )</th>
<th>( R_{SHB,t} )</th>
<th>( R_{SZA,t} )</th>
<th>( R_{SZB,t} )</th>
<th>( R_b,t )</th>
<th>( R_{Gold,t} )</th>
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<tbody>
<tr>
<td>Mean</td>
<td>1.1254</td>
<td>0.3527</td>
<td>0.7436</td>
<td>0.6880</td>
<td>0.9699</td>
<td>0.3315</td>
<td>0.7800</td>
</tr>
<tr>
<td>Median</td>
<td>1.0564</td>
<td>0.6425</td>
<td>0.3200</td>
<td>1.0066</td>
<td>1.2993</td>
<td>0.3492</td>
<td>0.6332</td>
</tr>
<tr>
<td>Maximum</td>
<td>24.1840</td>
<td>24.3787</td>
<td>53.9978</td>
<td>25.6839</td>
<td>87.5985</td>
<td>0.5408</td>
<td>13.2127</td>
</tr>
<tr>
<td>Std. Dev</td>
<td>8.1147</td>
<td>7.5553</td>
<td>10.2115</td>
<td>8.6279</td>
<td>9.9221</td>
<td>0.0962</td>
<td>4.6330</td>
</tr>
<tr>
<td>Skewness</td>
<td>-0.3956</td>
<td>-0.5159</td>
<td>0.4504</td>
<td>-0.3716</td>
<td>2.3353</td>
<td>-0.1067</td>
<td>-0.0571</td>
</tr>
<tr>
<td>Jarque-Bera</td>
<td>20.1058</td>
<td>49.8427</td>
<td>20.3700</td>
<td>18.8497</td>
<td>56.7700</td>
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<td>245</td>
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<td>245</td>
<td>245</td>
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</tbody>
</table>

Table 1. Summary statistics of monthly stock market returns: 2000.01–2020.05
The correlations of stock-gold returns are reported in Table 3. The statistics show that the correlation coefficients between stocks and gold in the Chinese market are time-varying and positive as well. The Bai–Perron test indicates the breakup dates, and the Chow test demonstrates the rejection of absence of structural changes. These results of a positive correlation between stock and gold returns appear contrary to general observations in the US market whose coefficient is provided in the last column. Why does Chinese market performance follow a path contrary to conventional anticipation and instead displays a positive sign for the stock-gold relation? Obviously, the evidence suggests that gold does not seem to serve as an asset that can be substituted for stocks. It appears that both stock and gold work to complement each other due to either an income or wealth effect that arises from the high saving rate in China. The other possibility may stem from the country’s thin bond markets.

5.4 Determinants of time-varying asset return correlations
Although portfolio theory claims that risk adverse investors tend to allocate their assets following the mean-variance approach (Tobin, 1969) by moving funds from assets with low returns to instruments with higher returns during periods of relatively low volatility and reversing the course during periods of relatively high volatility (Gulko, 2002), this approach can be viewed as restrained from financial perspective. In practice, investors often promptly react to policy uncertainty as well as the fear for geopolitical risk. As noted in the recent literature, heightened EPU can impede economic activity, causing a potential deterioration in future cash flows that would depress stock prices (Bloom, 2009, 2014; Davis et al., 2019;
Table 2. Summary statistics of monthly correlations between stock and bond returns: 2002.06–2019.03
Table 3. Summary statistics of monthly correlations between stock and gold returns: 2002.06–2019.03

<table>
<thead>
<tr>
<th></th>
<th>$\rho_i(R_{TTMK}, R_G)$</th>
<th>$\rho_j(R_{SHA}, R_G)$</th>
<th>$\rho_i(R_{SHJ}, R_G)$</th>
<th>$\rho_i(R_{SZA}, R_G)$</th>
<th>$\rho_i(R_{SZB}, R_G)$</th>
<th>$\rho_j(R^{US}_{TTMK}, R^{US}_G)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>0.0989</td>
<td>0.2210</td>
<td>0.0843</td>
<td>0.1742</td>
<td>0.1507</td>
<td>-0.0624</td>
</tr>
<tr>
<td>Median</td>
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<td>0.2071</td>
<td>0.1223</td>
<td>0.1594</td>
<td>0.1455</td>
<td>-0.0685</td>
</tr>
<tr>
<td>Maximum</td>
<td>0.6381</td>
<td>0.8335</td>
<td>0.2491</td>
<td>0.7147</td>
<td>0.5336</td>
<td>0.2766</td>
</tr>
<tr>
<td>Minimum</td>
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<td>-0.3661</td>
<td>-0.6476</td>
<td>-0.3110</td>
<td>-0.4875</td>
<td>-0.3677</td>
</tr>
<tr>
<td>Std. Dev</td>
<td>0.1957</td>
<td>0.2436</td>
<td>0.1426</td>
<td>0.2262</td>
<td>0.2999</td>
<td>0.1317</td>
</tr>
<tr>
<td>Skewness</td>
<td>0.2440</td>
<td>0.1570</td>
<td>-2.8062</td>
<td>0.1272</td>
<td>-0.2480</td>
<td>0.4217</td>
</tr>
<tr>
<td>Kurtosis</td>
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<td>2.4874</td>
<td>12.4159</td>
<td>2.1637</td>
<td>2.0632</td>
<td>2.6110</td>
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<tr>
<td>Jarque-Bera</td>
<td>4.3520</td>
<td>3.6731</td>
<td>1226.6120</td>
<td>7.7685</td>
<td>11.4699</td>
<td>8.2672</td>
</tr>
<tr>
<td>Chow test $\chi^2_1$</td>
<td>15.02</td>
<td>35.78</td>
<td>58.34</td>
<td>42.80</td>
<td>35.36</td>
<td>13.24</td>
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<tr>
<td>Observations</td>
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<td>245</td>
<td>245</td>
<td>245</td>
<td>245</td>
<td>245</td>
</tr>
</tbody>
</table>

**Note(s):** Bai–Perron test is used to locate the breakpoint, Chow test with $\chi^2_1$ distribution rejects the null hypothesis regarding the absence of structural changes $\rho_i(R_i, R_j)$ denotes a correlation between asset returns $i$ and $j$. 

$\rho_t(R_i, R_j)$ denotes a correlation between asset returns $i$ and $j$.
Likewise, a rise in GPR variability ($|\Delta \text{GPR}_t|$) would lead to market instability and cause delays in business investment decisions, which would result in low economic activity and pessimistic economic forecasts that would depress advances in the stock market (Pastor and Veronesi, 2013; Liu et al., 2017; Caldara and Iacoviello, 2019). Incorporating these qualitative elements into an analytical framework yields:

$$
(1 - \phi_p L^p) \hat{\rho}_t^* = b_0 + b_1 \Delta \text{EPU}_t + b_2 |\Delta \text{GPR}_t| + \epsilon_t
$$

(7)

where $\hat{\rho}_t^*$ is a Fisher transformation of the asset return correlation coefficient, that is, $\hat{\rho}_t^* = \frac{1}{2} \ln \left( \frac{1 + \hat{\rho}_t}{1 - \hat{\rho}_t} \right)$, since the original $\hat{\rho}_t$ contains negative value (Chiang et al., 2007). The $(1 - \phi_p L^p) \hat{\rho}_t^*$ term takes care of the $\hat{\rho}_t^*$ series, which may entail the $p$th orders of autoregressions. To explain the time-varying nature of the coefficients, the arguments of a change in economic policy uncertainty, $\Delta \text{EPU}_t$, and uncertainty from change in geopolitical risk, $|\Delta \text{GPR}_t|$, are included.

The literature has demonstrated that a sudden rise in $\Delta \text{EPU}_t$ or $|\Delta \text{GPR}_t|$ would interrupt the flow of business operations, causing income uncertainty, which would tamp down liquidity and lead to a decline in demand for assets [9]. This phenomenon may be called the income uncertainty effect (Tobin, 1969; Bloom, 2009, 2014). Conversely, as $\Delta \text{EPU}_t$ or $|\Delta \text{GPR}_t|$ lessens, investors are likely induced to increase their demand for assets, which would drive a positive correlation between asset returns (Hong et al., 2014).

On the other hand, the movement in investments could undergo a phenomenon, known as a substitution effect, which sees risky assets (stocks) and safe haven assets (bonds and gold) moving in opposite directions as uncertainty rises. Under this scenario, investors sell off their riskier assets (stocks) and move their funds into safer assets (bonds and gold) as uncertainty rises [10]. This shift results in a negative relation between stocks and bonds (gold) returns. As uncertainty declines, however, investors then switch from lower return assets to higher return assets, resulting in a negative correlation between risky and safe assets (Hong et al., 2014; Li et al., 2015a, b). The ultimate impact on the correlations of these assets depends on the relative influence from the income effect and substitution effect as well as the investors’ preference toward assets.

Estimates of equation (7) use a GED-GARCH procedure (Nelson, 1991; Bollerslev et al., 1992; Li et al., 2005) and control for the autocorrelations. Estimates of stock-bond correlations, which are reported in Table 4, indicate that coefficients for $\Delta \text{EPU}_t$ display negative signs and are statistically significant. The evidence suggests that investors governed by a risk adverse attitude are inclined to move funds from stocks to bonds as uncertainty escalates. This decoupling behavior is apparent as $\Delta \text{EPU}_t$ rises. This result is consistent with the flight-to-quality phenomenon in the US market as stock market volatility increases. The evidence is documented by Connolly et al. (2005), d’Addona and Kind (2006), Li et al. (2015a, b), Fang et al. (2017) and Arouri et al. (2016).

The coefficients of $|\Delta \text{GPR}_t|$ however, exhibit mixed results. For the SZA and SZB markets, the coefficients continue to display negative signs, indicating that investors in these markets do not treat the impacts of $\Delta \text{EPU}_t$ and $|\Delta \text{GPR}_t|$ differently in terms of attitude toward risk/uncertainty. However, the same is not true for the SHA and SHB and TTM where investors react differently to an escalation of uncertainty from $\Delta \text{EPU}_t$ vs. $|\Delta \text{GPR}_t|$. These results appear to demonstrate positive coefficients, which imply that income effect dominates that of substitution effect (Hong et al., 2014; Li et al., 2015a, b) between stocks and bonds for SHA and SHB investors as they confront a rise in $|\Delta \text{GPR}_t|$.

The statistics in Table 5 report the parametric effects on stock-gold return correlations in response to uncertainty. The results are more uniform, and the $R$-squares are higher than
Table 4. Time-varying correlations of stock-bond returns that are explained by a change in economic policy uncertainty and absolute value of change in geopolitical risk.

| Correlation                  | $C$  | $\Delta\text{EPU}_t$ | $|\Delta\text{GPR}_t|$ | AR(1) | AR(2) | AR(3) | $\omega$ | $\sigma^2_{t-1}$ | $\sigma^2_{t-1}$ | $R^2$ |
|------------------------------|------|----------------------|-------------------------|-------|-------|-------|---------|----------------|----------------|------|
| $\hat{\rho}_t^*(R_{TTMK}, R_b)$ | 0.1405 | -0.0003           | 0.0005                  | 0.5309 | 0.0968 | 0.1286 | 0.0245 | 0.2959           | 0.2436           | 0.45 |
|                              | 32.49 | -6.13              | 3.92                    | 22.72  | 5.19   | 8.02   | 0.74    | 0.38             | 0.17             |      |
| $\hat{\rho}_t^*(R_{SHA}, R_b)$  | 0.0518 | -0.000065       | 0.0002                  | 0.9380 | -0.0909 | -0.0000 | 0.0000          | 0.0665   | 0.9705           | 0.77             |      |
|                              | 11.31 | -3.81              | 7.63                    | 34.68  | -4.13  | -0.16  | -0.16     | 0.2116                | 0.2284           | 0.08 |
| $\hat{\rho}_t^*(R_{SHB}, R_b)$  | 0.1393 | -0.0004           | 0.0013                  | 0.1856 | -0.0892 | -0.0892 | 0.3027          | 0.2916                | 0.2284           | 0.06 |
|                              | 15.76 | -5.75              | 2.30                    | 12.40  | -5.21  | -5.21  | 0.20    | 0.22             | 0.06             |      |
| $\hat{\rho}_t^*(R_{SZA}, R_b)$  | 0.0531 | -0.0003           | -0.0005                 | 0.2240 | 0.1553 | 0.0227 | 0.0227          | 0.0313                | 0.7003           | 0.09 |
|                              | 29.52 | -9.71              | -5.02                   | 29.88  | 8.57   | 0.21   | 0.21    | 0.03             | 0.48             |      |
| $\hat{\rho}_t^*(R_{SZB}, R_b)$  | 0.1385 | -0.0001           | -0.0007                 | -0.0541 | 0.0896 | 0.0589 | 0.0589          | 0.5174                | 0.8587           | 0.02 |
|                              | 44.66 | -5.95              | -7.31                   | -17.90 | 13.06  | 0.33   | 0.12    | 1.89             |                  |      |

Note(s): $\hat{\rho}_t^*(R_i, R_j)$ denotes a correlation between asset returns $i$ (stock) and $j$ (bond). $\hat{\rho}_t^*$ is the Fisher transformation of the original correlation coefficient. $\Delta\text{EPU}_t$ is a change in economic policy uncertainty. $|\Delta\text{GPR}_t|$ measures the uncertainty of the geopolitical policy risk. For each model, the first row reports the estimated coefficients, the second row is the estimated $t$-statistics. The critical values of $t$-distribution at the 1%, 5% and 10% levels of significance are 2.63, 1.98 and 1.66, respectively.
### Table 5

| Correlation | $C$ | $\Delta EPU_t$ | $|\Delta GPR_t|$ | AR(1) | AR(2) | $\omega$ | $\epsilon^2_{t-1}$ | $\sigma^2_{t-1}$ | $R^2$ |
|-------------|-----|----------------|-----------------|------|-------|--------|----------------|----------------|------|
| $\hat{\rho}_i^*(R_{TTMK}, R_G)$ | 0.2967 | -0.0001 | 0.0003 | 0.9626 | 0.0016 | 0.4551 | 0.6303 | 0.87 |
| | 6.64 | -4.08 | 6.39 | 164.80 | 1.00 | 0.95 | 2.27 |
| $\hat{\rho}_i^*(R_{SHA}, R_G)$ | 1.6121 | -0.0001 | 0.0004 | 0.8751 | 0.1212 | 0.0004 | 0.1460 | 0.9018 | 0.92 |
| | 0.61 | -10.71 | 5.79 | 32.78 | 4.26 | 0.70 | 0.70 | 8.32 |
| $\hat{\rho}_i^*(R_{SHB}, R_G)$ | -1.3145 | -0.00002 | 0.0000 | 0.8330 | 0.1723 | 0.0001 | -0.0191 | 0.8720 | 0.96 |
| | -1.33 | -3.97 | 3.54 | 69.31 | 14.39 | 1.33 | -0.39 | 7.55 |
| $\hat{\rho}_i^*(R_{SZA}, R_G)$ | 2.9296 | -0.00005 | 0.0011 | 0.1705 | 0.8266 | 0.0078 | 7.6465 | 0.0583 | 0.90 |
| | 0.30 | -6.62 | 19.18 | 6.41 | 30.35 | 1.30 | 1.27 | 0.31 |
| $\hat{\rho}_i^*(R_{SXB}, R_G)$ | 2.5096 | -0.00002 | 0.0005 | 0.6087 | 0.3883 | 0.0019 | 2.988 | 0.070 | 0.96 |
| | 1.47 | -5.97 | 33.50 | 22.18 | 14.00 | 2.58 | 1.91 | 1.69 |

**Note(s)**: $\hat{\rho}_i^*(R_i, R_j)$ denotes correlation between asset returns $i$ (stock) and $j$ (gold). $\hat{\rho}_i^*$ is the Fisher transformation of the original correlation coefficient. $\Delta EPU_t$ is a change in economic policy uncertainty. $|\Delta GPR_t|$ measures the geopolitical policy risk uncertainty. For each model, the first row reports the estimated coefficients, the second row is the estimated $t$-statistics. The critical values of $t$-distribution at the 1%, 5% and 10% levels of significance are 2.63, 1.98 and 1.66, respectively.
those stock-bond return correlations. First, the coefficients of $\Delta EPU_t$ for various stock-gold correlations exhibit negative signs and are highly significant. The negative stock-gold relation indicates that investors are inclined to switch from stocks to gold as $\Delta EPU_t$ increases. This trend could stem from a traditional view toward gold in Chinese society that is seen as a better and universal instrument to hedge against uncertainty. Second, evidence reveals that the estimated slope of $|\Delta GPR_t|$ is positive for stock-gold correlations and the estimated t-statistics are highly significant. The comovements of stock and gold returns in response to $|\Delta GPR_t|$ may be attributable to an increase in volatility for $\Delta GPR$ (Balcilar et al., 2018). An increase in volatility generates fear that would delay investment and consumption decisions. This results in an income effect, causing a decline in demand for both stocks and gold. Note that heightened $\Delta GPR$ uncertainty could produce a substitution effect, as investors replace stocks with gold in their portfolio to hedge against geopolitical risk. The positive sign of the correlation for stock-gold relation implies the income effect outweighs the substitution effect. In addition, low government bond yields, as observed by Spratt et al. (2020), would induce investors searching for alternative assets to consider rising stock and gold prices as an option to the recent $\Delta GPR$. Third, the different signs for the coefficients of $\Delta EPU_t$ and $|\Delta GPR_t|$ imply that investors are able to discriminate between the potential impact arising from economic uncertainty vs. political tension uncertainty. In summary, the evidence clearly indicates that market participants are more likely to move their funds from stocks to bonds or gold as EPU increases; however, when the $|\Delta GPR|$ escalates, it would raise stock market volatility (Balcilar et al., 2018), causing noise trades to sell off; however, the rational traders would long stocks (Sentana and Wadhwani, 1992), leading to an increase in demanding for stocks and gold [11]. The demand rise for stocks is due to an anticipation of higher risk premium, while the demand upward shift for gold is to hedge risk. These two forces drive a positive correlation between stock-gold returns [12]. (Hong et al., 2014).

5.5 Dynamic correlations based on rolling sample approach
Although the DCC models have been predominantly employed to derive the time-varying correlations, some researchers prefer to use the rolling sample approach because of its simplicity. Studies by Chiang (1988), Connelly et al. (2005) and McMillian (2018) are examples. Thus, employing the rolling sample approach to generate the time-varying correlation is worthy of examination. In this context, 36 observations are used as a fixed window length, and the sample period is rolled ahead one month at a time to estimate the dynamic correlation between stock and bond (gold) return relations. This approach provides a means of testing market participant reactions to $\Delta EPU_t$ and $|\Delta GPR_t|$ as news releases. Table 6 reports the rolling correlations between stock-bond returns and Table 7 reports the rolling correlations between stock-gold return that are explained by $\Delta EPU_t$ and $|\Delta GPR_t|$. In these tables, the time-varying correlations are denoted by $\text{Cor}(\cdot)$, which are used to distinct from the DCC estimators, $\rho_t(\cdot)$. As before, the estimations in Tables 6 and 7 controls for autocorrelations.

Evidence in Tables 6 and 7 suggests that the estimated results are qualitatively comparable. First, coefficients of $\Delta EPU_t$ for stock-bond return relations in Table 6 consistently show negative signs and are statistically significant. The outcomes hold true for the stock-gold relations in Table 7, which displays a decoupling phenomenon and suggests that a rise in $\Delta EPU_t$ will cause flight-to-qualities in bonds and gold. Second, the coefficients of $|\Delta GPR_t|$ are positive and t-statistics are significant at the 5%. The testing results, which support the positive comovements of stock and gold returns in response to a heightened $|\Delta GPR_t|$, may result from a volatility-fear-income channel as noted by Hong et al. (2014) and Balcilar et al. (2018). The evidence thus concludes that the estimated results are robust across different methods in generating the time-varying correlation between asset returns [13].
| Correlation          | $C$   | $\Delta\text{EPU}_t$ | $|\Delta\text{GPR}_t|$ | AR(1) | AR(2) | AR(3) | AR(12) | $\omega$ | $\epsilon^2_{t-1}$ | $\sigma^2_{t-1}$ | $R^2$ |
|----------------------|-------|----------------------|--------------------------|-------|-------|-------|-------|--------|----------------|----------------|-----|
| $\text{Cor}(R_{\text{TMMK}}, R_b)$ | -9.1795 | -0.0105 | 0.0090 | 0.9058 | -0.1620 | 0.0953 | 26.8253 | 1.8487 | 0.3898 | 0.83 |
|                     | -36.71 | -4.04    | 7.22  | 152.06 | -14.21 | 11.39 | 0.79 | 0.83 | 0.70 |
| $\text{Cor}(R_{\text{SHA}}, R_b)$ | -41.5881 | -0.0061 | 0.0116 | 0.9866 | -0.0063 | 43.1650 | 0.6695 | 0.4717 | 0.92 |
|                     | -296   | -2.06    | 1.29  | 191.02 | -6.15 | 1.45 | 1.56 | 2.23 |
| $\text{Cor}(R_{\text{SHB}}, R_b)$ | -16.7906 | -0.0076 | 0.0140 | 1.2018 | -0.2721 | 0.0188 | 156.2918 | 1.2258 | 0.3883 | 0.89 |
|                     | -8.35  | -2.82    | 2.36  | 211.10 | -20.04 | 2.17 | 1.23 | 1.18 | 1.23 |
| $\text{Cor}(R_{\text{SZA}}, R_b)$ | -41.5920 | -0.0815 | -0.0453 | 0.9770 | -20.04 | 2.17 | 156.2918 | 1.2258 | 0.3883 | 0.89 |
|                     | -1.04  | -2.68    | -0.99 | 64.58  | 3.04 | 1.35 | 1.23 | 1.23 |
| $\text{Cor}(R_{\text{SZB}}, R_b)$ | -5.7458 | -0.0605 | -0.0415 | 0.8614 | 0.118 | -0.1751 | 0.9660 | 0.3089 | 0.0699 | 0.90 |
|                     | -3.85  | -6.69    | -3.80 | 45.92  | 6.47 | -11.96 | 1.67 | 1.52 | 0.05 |

**Note(s):** $\text{Cor}(R_i, R_b)$ denotes correlation coefficient between stock returns $i$ (stock) and $b$ (bond) derived from rolling estimations with 36 months as a fixed window. $\Delta\text{EPU}_t$ is a change in economic policy uncertainty. $|\Delta\text{GPR}_t|$ measures the uncertainty of the geopolitical policy risk. For each model, the first row reports the estimated coefficients, the second row is the estimated $t$-statistics. The critical values of $t$-distribution at the 1%, 5% and 10% levels of significance are 2.63, 1.98 and 1.66, respectively.
Table 7: Rolling regression correlation coefficients of stock-gold returns that are explained by changes in economic policy uncertainty and absolute value of geopolitical risk uncertainty.

| Correlation       | C     | ΔEPU<sub>t</sub> | |ΔGPR<sub>t</sub>| | AR(1)  | AR(2)  | AR(12) | ω     | σ<sup>2</sup> | σ<sup>2</sup> | R<sup>2</sup> |
|-------------------|-------|------------------|---------|---------|--------|--------|--------|-------|--------|--------|--------|
| Cor(R<sub>TDMK</sub>, R<sub>G</sub>) | 0.5519 | -0.0001 | 0.0001 | 0.9380 | 0.0312 | 0.0011 | 0.3750 | 0.8094 | 0.91   |
|                   | 16.42 | -11.09 | 2.29   | 92.53  | 3.39   | 0.52   | 0.97   | 3.88   |
| Cor(R<sub>SHA</sub>, R<sub>G</sub>) | 0.2014 | -0.0016 | 0.0011 | 0.2502 | 0.5962 | -0.1905 | 7.7797 | 20.9832 | -0.8411 | 0.73   |
|                   | 27.87 | -14.96 | 5.09   | 13.15  | 19.44  | -14.21 | 1.05   | 0.18   | -1.48  |
| Cor(R<sub>SHB</sub>, R<sub>G</sub>) | 0.3388 | -0.0012 | 0.0005 | 0.7933 | 0.2288 | -0.0601 | 0.0594 | 4.8104 | 0.56   | 0.93   |
|                   | 9.36  | -26.06 | 4.46   | 43.51  | 14.00  | -12.22 | 0.34   | 0.37   | 0.58   |
| Cor(R<sub>SZA</sub>, R<sub>G</sub>) | -0.0135 | -0.0001 | 0.0006 | 0.9133 |        |        |        | 0.0701 | 0.4315 | -0.2302 | 0.87   |
|                   | -0.34 | -2.45  | 8.90   | 139.13 |        |        |        | 0.18   | 0.07   | -0.04   |
| Cor(R<sub>SZB</sub>, R<sub>G</sub>) | 0.2506 | -0.0003 | 0.0006 | 0.9423 |        |        |        | 0.0378 | 5.3456 | -0.0091 | 0.92   |
|                   | 15.41 | -13.10 | 21.31  | 246.91 |        |        |        | 1.68   | 0.78   | -0.59   |

Note(s): Cor(R<sub>i</sub>, R<sub>G</sub>) denotes correlation coefficient between stock returns (stock) and G (gold) derived from rolling estimations with 36 months as a fixed window. ΔEPU<sub>t</sub> is a change in economic policy uncertainty. |ΔGPR<sub>t</sub>| measures the geopolitical policy risk uncertainty. For each model, the first row reports the estimated coefficients, the second row is the estimated t-statistics. The critical values of t-distribution at the 1%, 5% and 10% levels of significance are 2.63, 1.98 and 1.66, respectively.
Having demonstrated the correlations of stock-bond and stock-gold returns, it is natural to extend the analysis to the bond-gold return correlation, especially the latter has received less attention in the literature. Two thoughts factor into establishing the correlations between returns of bond and gold. The first is the return forgone by holding gold, the opportunity. For example, a higher interest rate would induce asset holders to switch from gold to bond holding. In contrast, a low or negative interest rate would lead to a demand for gold. The second is an investor’s risk adverse attitude to uncertainty as EPU and GPR change. It is conceivable that bond yield is more sensitive to economic policy changes, such as a central bank’s monetary policy or a change in a government’s fiscal policy since interest rate changes would accompany these policy changes. However, gold tends retain its value not only in hedging against financial crisis, but also in storing value as geopolitical uncertainty heightens. This is especially the case as a local currency loses value.

Table 8 reports the dynamic correlations for bond-gold return. This table contains both DCC and rolling correlation estimates that are explained by $\Delta$EPU$^j$ and $\Delta$GPR$^j$ uncertainty. The upper panel is based on $\Delta$GPR$^j$ squared; the lower panel is measured by the absolute $\Delta$GPR$^j$. The estimates clearly conclude that the coefficients of bond-gold return correlations are negatively related to the $\Delta$EPU$^j$ and $|\Delta$GPR$^j|$, (or $\Delta$GPR$^j$)$^2$, respectively. The evidence appears to be consistent with the opportunity cost hypothesis and with different reactions to the $\Delta$EPU$^j$ vis-à-vis to $|\Delta$GPR$^j|$ or ($\Delta$GPR$^j$)$^2$, which becomes much clearer in the following section, which examines the individual asset returns in response to the $\Delta$EPU$^j$ and $|\Delta$GPR$^j|$, respectively.

### 6. Evidence on individual asset returns

In the previous section, we examined the correlations of two asset returns, which revealed no information on the reaction of an individual asset return in response to uncertainty or shock changes. Since uncertainty changes have affected investors’ sentiments, aversion to uncertainty may cause bonds, gold, and stocks to load with different signs. More concrete empirical evidence on individual asset returns will provide evidence to justify the directions of correlation.

This section examines the impact of the key factors, $\Delta$EPU$^j$ and $|\Delta$GPR$^j|$, on asset returns controlling for $\Delta$VaR$^j$ and autocorrelations. The regression model is given below as:

$$
(1 - \phi p L^p) R_{i,t} = c_0 + c_1 \Delta$VaR$^j + c_2 \Delta$EPU$^j + c_3 |\Delta$GPR$^j| + \epsilon_t
$$

where $R_{i,t}$: $\{R_{TTMK,t}, R_{SHA,t}, R_{SHB,t}, R_{SZA,t}, R_{SZB,t}, R_{h,t}, R_{G,t}\}$ denotes returns from total market stock, Shanghai A-shares, Shanghai B-shares, Shenzhen A-shares, Shenzhen B-shares, Chinese 30-year bonds and gold market returns. The expression $(1 - \phi p L^p)$ represents the current and lagged parameter operator applied to asset return $i$ at time $t$, which is included for controlling the autocorrelations up to order $p$. $\Delta$VaR$^j$ is the change in the Value-At-Risk to be used to measure the downside risk, which is obtained from the minimum value of the last 22 daily stock returns (Bali et al., 2009). The $\Delta$VaR$^j$ series is multiplied by $(-1)$ before running the regression [14]. Definitions of the other variables were defined earlier in the paper.

The rationale to include the downside risk is due to its significant information content, which captures the financial market volatility and the higher moments of stock returns implied in the Cornish–Fisher expansion (1937) as noted by Bali et al. (2009) and Chen et al. (2018). Inclusion of $\Delta$VaR$^j$ in the test equation helps to control for the influence that arises from spurious correlation with $\Delta$EPU$^j$ and $|\Delta$GPR$^j|$ in the test equation.

As argued by Bloom (2009, 2014), a rise in $\Delta$EPU$^j$ will create uncertainty among economic agents who will likely delay corporate investment and households’ consumption, which in turn would impede economic activity and future cash flow. For this reason, the stock return
### Table 8. Rolling regression correlation coefficients of bond-gold return correlation by using both DCC and rolling methods and test their movements that are explained by change in economic policy uncertainty and GPR.

<table>
<thead>
<tr>
<th>Correlation</th>
<th>C</th>
<th>ΔEPU</th>
<th>ΔGPR</th>
<th>AR(1)</th>
<th>ω</th>
<th>$\epsilon^2_{t-1}$</th>
<th>$\sigma^2_{t-1}$</th>
<th>$\bar{R}^2$</th>
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<tbody>
<tr>
<td>$\tilde{\rho}_{t}(R_b, R_G)$</td>
<td>-0.0387</td>
<td>-0.0004</td>
<td>-0.0001</td>
<td>0.5211</td>
<td>0.0041</td>
<td>0.2750</td>
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<td>0.34</td>
</tr>
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<td>-38.86</td>
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<td>-12.06</td>
<td>32.30</td>
<td>0.19</td>
<td>0.22</td>
<td>0.10</td>
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<tr>
<td>Cor($R_b R_G$)</td>
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<td>0.9565</td>
<td>50.8001</td>
<td>0.9402</td>
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<table>
<thead>
<tr>
<th>Correlation</th>
<th>C</th>
<th>ΔEPU</th>
<th>ΔGPR</th>
<th>AR(1)</th>
<th>ω</th>
<th>$\epsilon^2_{t-1}$</th>
<th>$\sigma^2_{t-1}$</th>
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</thead>
<tbody>
<tr>
<td>$\tilde{\rho}_{t}(R_b, R_G)$</td>
<td>-0.0512</td>
<td>-0.0001</td>
<td>-0.0002</td>
<td>0.5655</td>
<td>0.0053</td>
<td>0.1533</td>
<td>0.0341</td>
<td>0.33</td>
</tr>
<tr>
<td></td>
<td>-30.17</td>
<td>-6.76</td>
<td>-7.01</td>
<td>58.96</td>
<td>0.21</td>
<td>0.13</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>Cor($R_b R_G$)</td>
<td>-11.903</td>
<td>-0.0039</td>
<td>-0.0479</td>
<td>0.9447</td>
<td>90.1315</td>
<td>0.9754</td>
<td>0.0745</td>
<td>0.85</td>
</tr>
<tr>
<td></td>
<td>-7.00</td>
<td>-4.24</td>
<td>-15.13</td>
<td>253.86</td>
<td>1.61</td>
<td>1.06</td>
<td>0.22</td>
<td></td>
</tr>
</tbody>
</table>

**Note(s):** $\tilde{\rho}_{t}(R_b, R_G)$ denotes correlation between bond return and gold return using DCC method, Cor($R_b, R_G$) denotes correlation coefficient between bond return and gold return using rolling correlation method. ΔEPU is a change in economic policy uncertainty, ΔGPR and $|\Delta GPR|_i$ measure the geopolitical policy risk uncertainty, respectively. For each model, the first row reports the estimated coefficients, the second row is the estimated t-statistics. The critical values of t-distribution at the 1%, 5% and 10% levels of significance are 2.63, 1.98 and 1.66, respectively.
and $\Delta \text{EPU}_t$ are expected to be negatively correlated. Evidence provided by Antonakakis et al. (2013), Li et al. (2015b), Chen et al. (2017), Li (2017), Chan et al. (2019), Chiang (2019) and Chen and Chiang (2020) confirms this expectation.

The effect of $\Delta \text{EPU}_t$ on the bond yield is mainly conveyed through the term structure relation. Leippold and Matthys (2015) find that increased government policy uncertainty leads to a decline in bond yields. Bordo et al. (2015) find that policy uncertainty has a significant negative effect on bank credit growth. When facing the dampening effect of $\Delta \text{EPU}_t$ on the economy, a monetary authority usually would lower the short rate, which through the term structure relation further affects long-term interest rates. Of course, an expected increase in money supply could generate a higher inflation expectation and induce a heightened long-term interest rate.

When the economy is under extreme stress or experiencing political turbulence, gold is perceived as a favorable instrument to hedge against uncertainty and becomes a safe haven (Jones and Sackley, 2016; Baur and Lucey, 2010; Qin et al., 2020). In addition, gold has been held as part of a central bank’s international reserve as an instrument to safeguard the value of its national currencies (Baur and McDermott, 2010) and to avoid default risk or political risk. From this perspective, the price of gold should respond positively to an increase in $\Delta \text{EPU}_t$. Bilgin et al. (2018) report that a rise in EPU leads to increases in the price of gold. However, they find that gold prices are less likely to decline when economic policy conditions improve. Jones and Sackley (2016) find that increases in EPU contribute to increases in the price of gold. Similarly, by using the nonparametric causality-in-quantiles, Raza et al. (2018) show that change EPU causes gold prices to increase.

An escalation of $\Delta \text{GPR}$ uncertainty ($\Delta \text{GPR}^2_t$ or $|\Delta \text{GPR}_t|$) has a similar effect on asset returns (Brogaard et al., 2020). As documented by Caldera and Iacoviello (2019), an aggravation in GPR tends to weaken economic activity and, in turn, stock returns. This is essentially due to fact that $\Delta \text{GPR}$ can have an adverse effect on production and consumptions, which is triggered by delays in investment as well as the postponement of household spending on durable goods (Wade, 2019). This weakening in demand would undoubtedly threaten potential profits and hence depress stock prices. A heightened level of $\Delta \text{GPR}$ can also create greater volatility in financial markets as evidenced by Balcilar et al. (2018), causing a flight-to-quality and an increase in demand for bonds (Fang et al., 2017) or gold (Baur and Lucey, 2010). Thus, it is anticipated that a rise in $\Delta \text{GPR}$ or its volatility would give rise to higher demand for gold, causing a decoupling phenomenon. However, as mentioned earlier, there is an income/wealth effect, making stock and gold complementary.

Estimates based on the use of the GED-GARCH procedure (Nelson, 1991) are reported in Tables 9 and 10, which reveal several interesting findings. Focusing first on the stock returns, we find that all of the estimated coefficients from uncertainty measures (Table 9), including $\Delta \text{VaR}_t$, $\Delta \text{EPU}_t$ and $\Delta \text{GPR}^2_t$, display negative signs and are significant at the 1% level. The robustness test in Table 10, which replaces $\Delta \text{GPR}^2_t$ with $|\Delta \text{GPR}_t|$, achieves the same qualitative results. The evidence strongly suggests that risk or uncertainty would produce an adverse effect on stocks regardless of whether the risk is from a stock market per se ($\Delta \text{VaR}_t$), economic policy uncertainty ($\Delta \text{EPU}_t$), or geopolitical risk ($\Delta \text{GPR}^2_t$ or $|\Delta \text{GPR}_t|$).

Second, in response to the risk, investors intend to “fly to quality”, which can be seen in the movement of the funds from stocks to bonds with a rise in policy uncertainty. This shift is indicated by negative coefficients of stock returns along with positive coefficients of bond returns with respect to $\Delta \text{EPU}_t$ as shown in both Tables 9 and 10. The evidence is consistent with the notion illustrated by Gulko (2002) and evidence documented by Jones and Sackley (2016) and Lucey (2009).

Third, the evidence also indicates investors would “fly-to-gold”, which is seen in the coefficients of gold returns that are positive with a heightened level of $\Delta \text{GPR}^2_t$ as shown in
Table 9. Estimates of downside risk, economic policy uncertainty and geopolitical risk on aggregate stock returns

<table>
<thead>
<tr>
<th>Market return</th>
<th>$C$</th>
<th>$\Delta \text{VaR}_t$</th>
<th>$\Delta \text{EPU}_t$</th>
<th>$\Delta \text{GPR2}_t$</th>
<th>AR(1)</th>
<th>AR(11)</th>
<th>$\omega$</th>
<th>$\epsilon^2_{t-1}$</th>
<th>$\sigma^2_{t-1}$</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_{\text{TTMK},t}$</td>
<td>0.992</td>
<td>-0.032</td>
<td>-0.042</td>
<td>-0.0001</td>
<td>41.574</td>
<td>11.584</td>
<td>0.843</td>
<td>0.06</td>
<td>3.11</td>
<td>0.06</td>
</tr>
<tr>
<td></td>
<td>21.96</td>
<td>-31.69</td>
<td>-30.96</td>
<td>-3.17</td>
<td>0.07</td>
<td>0.61</td>
<td>3.11</td>
<td>0.06</td>
<td>3.11</td>
<td>0.06</td>
</tr>
<tr>
<td>$R_{\text{SHA},t}$</td>
<td>0.576</td>
<td>-0.025</td>
<td>-0.023</td>
<td>-0.0003</td>
<td>34.194</td>
<td>0.988</td>
<td>0.645</td>
<td>0.06</td>
<td>1.78</td>
<td>0.06</td>
</tr>
<tr>
<td></td>
<td>7.77</td>
<td>-18.42</td>
<td>-6.48</td>
<td>-5.64</td>
<td>0.63</td>
<td>0.77</td>
<td>1.78</td>
<td>0.06</td>
<td>1.78</td>
<td>0.06</td>
</tr>
<tr>
<td>$R_{\text{SHB},t}$</td>
<td>0.919</td>
<td>-0.019</td>
<td>-0.043</td>
<td>-0.001</td>
<td>48.018</td>
<td>0.651</td>
<td>0.647</td>
<td>0.03</td>
<td>1.86</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td>9.37</td>
<td>-10.53</td>
<td>-5.63</td>
<td>-13.77</td>
<td>0.69</td>
<td>0.83</td>
<td>1.86</td>
<td>0.03</td>
<td>1.86</td>
<td>0.03</td>
</tr>
<tr>
<td>$R_{\text{SZA},t}$</td>
<td>0.568</td>
<td>-0.032</td>
<td>-0.040</td>
<td>-0.0003</td>
<td>47.974</td>
<td>0.798</td>
<td>0.629</td>
<td>0.05</td>
<td>1.41</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>4.82</td>
<td>-14.54</td>
<td>-16.73</td>
<td>-4.37</td>
<td>0.59</td>
<td>0.70</td>
<td>1.41</td>
<td>0.05</td>
<td>1.41</td>
<td>0.05</td>
</tr>
<tr>
<td>$R_{\text{SZB},t}$</td>
<td>1.072</td>
<td>-0.029</td>
<td>-0.047</td>
<td>-0.001</td>
<td>45.047</td>
<td>0.390</td>
<td>0.668</td>
<td>0.05</td>
<td>1.77</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>11.45</td>
<td>-47.45</td>
<td>-37.07</td>
<td>-14.74</td>
<td>0.71</td>
<td>0.61</td>
<td>1.77</td>
<td>0.05</td>
<td>1.77</td>
<td>0.05</td>
</tr>
<tr>
<td>$R_{b,t}$</td>
<td>0.352</td>
<td>-0.000003</td>
<td>0.00002</td>
<td>-0.000003</td>
<td>0.972</td>
<td>0.001</td>
<td>-0.017</td>
<td>0.97</td>
<td>0.02</td>
<td>0.97</td>
</tr>
<tr>
<td></td>
<td>34.21</td>
<td>-0.90</td>
<td>8.45</td>
<td>-15.40</td>
<td>334.48</td>
<td>0.80</td>
<td>0.66</td>
<td>0.02</td>
<td>0.66</td>
<td>0.02</td>
</tr>
<tr>
<td>$R_{G,t}$</td>
<td>0.553</td>
<td>-0.002</td>
<td>-0.007</td>
<td>0.00004</td>
<td>0.108</td>
<td>5.452</td>
<td>0.776</td>
<td>0.04</td>
<td>2.92</td>
<td>0.04</td>
</tr>
<tr>
<td></td>
<td>15.62</td>
<td>-2.69</td>
<td>-12.73</td>
<td>2.56</td>
<td>9.48</td>
<td>0.47</td>
<td>0.70</td>
<td>2.92</td>
<td>0.70</td>
<td>2.92</td>
</tr>
</tbody>
</table>

Note(s): This table presents evidence of asset returns, $R_t$ on $\Delta \text{VaR}_t$, $\Delta \text{EPU}_t$, and $\Delta \text{GPR2}_t$ using a GED-GARCH(1,1) procedure. The asset returns are: TTMK (Total stock market index), SHA (Shanghai A-share index), SHB (Shanghai B-share index), SZA (Shenzhen A-share index), SZB (Shenzhen B-share index), $R_{b,t}$ (bond return) and $R_{G,t}$ (gold return). The independent variables are changes in downside risk ($\Delta \text{VaR}_t$), economic policy uncertainty ($\Delta \text{EPU}_t$) and geopolitical policy risk uncertainty ($\Delta \text{GPR2}_t$). AR($p$) denotes autocorrelation with $p$th orders. The statistics of $\omega$, $\epsilon^2_{t-1}$ and $\sigma^2_{t-1}$ in the variance equation are constant parameters. For each model, the first row reports the estimated coefficients, the second row contains the estimated $t$-statistics. The critical values of $t$-distribution at the 1%, 5% and 10% levels of significance are 2.63, 1.98 and 1.66, respectively. $R^2$ is the coefficient of determination.
Note(s): This table presents evidence of asset returns, $R_t$ on $\Delta \text{VaR}_t$, $\Delta \text{EPU}_t$, and $|\Delta \text{GPR}_j|$ using a GED-GARCH(1,1) procedure. The asset returns are: TTMK (Total stock market index), SHA (Shanghai A-share index), SHB (Shanghai B-share index), SZA (Shenzhen A-share index), SZB (Shenzhen B-share index), $R_b$ (bond return) and $R_G$ (gold return). The independent variables are changes in downside risk ($\Delta \text{VaR}_t$), economic policy uncertainty ($\Delta \text{EPU}_t$) and geopolitical policy risk uncertainty ($|\Delta \text{GPR}_j|$). $\text{AR}(p)$ denotes autocorrelation with $p$th orders. The statistics of $\omega$, $\epsilon_t^2$ and $\sigma_t^2$ in the variance equation are constant parameters. For each model, the first row reports the estimated coefficients, the second row contains the estimated $t$-statistics. The critical values of $t$-distribution at the 1%, 5% and 10% levels of significance are 2.63, 1.98 and 1.66, respectively. $R^2$ is the coefficient of determination.
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Table 9 and $|\Delta GPR|_t$ as shown in Table 10 while the coefficients with stock returns are negative. Thus, the evidence appears to have a clear substitution effect. However, the statistics in Tables 9 and 10 do not contain the income effect or the wealth effect. Apparently, the movement of funds depends on the nature and the source of risk/uncertainty along with the substitution effect and income/wealth effect. For Chinese investors, gold is likely viewed as a favorable instrument to hedge against $\Delta GPR$ uncertainty given the fact that bond market is thin in the country. In addition, gold is known to be an asset to be portable and is a flexible instrument to be converted into cash for fulfilling future investments or consumption.

Fourth, the evidence is consistent with the negative correlation between bond and gold returns as evidenced by these asset returns, which display opposite reactions to the $\Delta GPR_t$ and $|\Delta GPR|_t$ (or $\Delta GPR^2_t$). Evidence suggests that estimated results are robust with different methods to be used to derive the time-varying correlations of stock-bond returns.

7. Conclusions
A substantial number of empirical studies have been done by focusing on stock market risk and economic policy uncertainty (EPU) as main arguments to explain equity market behavior; however, attention to geopolitical risk is relatively limited. This study highlights the role of $|\Delta GPR|_t$, along with $\Delta EPU_t$, in explaining the impact of investors’ behavior on asset returns. By focusing on Chinese financial markets, this study achieves several important empirical findings. First, evidence indicates that the stock-bond relations are negatively related with the $\Delta EPU_t$, indicating a flight-to-quality behavior. The evidence of a negative correlation is consistent with Gulko (2002), Connolly et al. (2005), Baur and Lucey (2009), Lucey (2009) and Li et al. (2015b) in US market. However, with respect to the uncertainty from $\Delta GPR$, only SZA and SZB markets display negative signs, this is consistent with the notion that investors in these markets tend to move funds from stocks to bonds as $\Delta GPR$ rises.

Second, the evidence on the stock-gold return correlation in the Chinese market consistently displays a positive relation, which differs from the finding in US market. In particular, the stock-gold return correlation is positively correlated with escalating $|\Delta GPR|_t$ or $\Delta GPR^2_t$. This evidence concerning the Chinese market is consistent with the fact that the income/wealth effect outweighs the substitution effect or the behavior that the rational traders tend to purchase stocks and gold in facing a rise of $|\Delta GPR|_t$ in anticipating higher prices in these assets. While testing the stock-gold return correlation in response to the $\Delta EPU_t$, the evidence uniformly shows a negative relation, indicating the presence of a flight-to-quality phenomenon; but in this case the quality asset is gold.

Third, extending the analysis of asset return correlation, this study presents new evidence on the time-varying correlations for bond-gold return relations. Interestingly, the results consistently conclude that the coefficients of bond-gold return correlations are negatively correlated with $\Delta EPU_t$ and $|\Delta GPR|_t$, (or $\Delta GPR^2_t$), respectively. Evidence suggests that Chinese market participants tend to use bond instruments to hedge against EPU; however, in facing the geopolitical uncertainty, the behavior is more consistent with holding gold to hedge the risk.

Fourth, by testing the impacts of $\Delta VaR_t$, $\Delta EPU_t$ and $|\Delta GPR|_t$ ($\Delta GPR^2_t$) on each stock returns, this study finds that all stock returns are negatively correlated with the uncertainty measures, including changes in stock market downside risk, $\Delta EPU_t$, and $|\Delta GPR|_t$. This holds true for the stocks in the aggregate market and markets in A-share and B-share stocks.

Fifth, the evidence consistently shows that the bond return is positively correlated with a rise in $\Delta EPU_t$, rather than $\Delta VaR_t$ and $|\Delta GPR|_t$ (or $\Delta GPR^2_t$); while the gold return is positively correlated with $|\Delta GPR|_t$ (or $\Delta GPR^2_t$) not the risk from $\Delta VaR_t$ and $\Delta EPU_t$, indicating that investors are extremely willing to move funds into the gold market with an increase in uncertainty of $\Delta GPR$ as measured by $|\Delta GPR|_t$ or $\Delta GPR^2_t$. This result is consistent...
with the notion of a flight-to-gold phenomenon. The preference toward gold in Chinese society has a long tradition. This preference along with a high saving rate would also induce households to increase their demand for gold as political uncertainty hits the market, since gold is a more generally acceptable and universally recognized instrument to store value, which can be easily converted to a local currency for facilitating future consumptions. From this perspective, funds do not necessarily flow from the sale of stocks, which limits investors by the asset constraint as described in the Tobin’s general equilibrium framework. Instead, funds that could satisfy the demand for gold could come from savings due to a rapid growth in Chinese GDP, promoting the income/wealth effect and moderating the substitution effect.

ORCID iDs
Thomas C. Chiang http://orcid.org/0000-0002-1586-3437

Notes
1. A survey conducted on the demand of global Central Banks for gold reserves indicates an increase in 2020 due to low interest rates. The responses to the factors that influence the decision of holding gold are rather informative. It is reported that 79% of respondents believe that gold stores long-term value; 79% of respondents view gold’s performance during times of crisis as a valuable instrument; 74% of respondents see gold as having no default risk; 64% of respondents think gold has an advantage in effectively diversifying portfolios, and 63% think gold lacks political risk (Goldhub, 2020). Thus, holding gold has unique merits.
2. The correlation between Chinese stock market volatility and EPU is 0.57 ($t = 10.52$) and the correlation of VaR and EPU is 0.24 ($t = 3.75$). However, the correlations of stock return volatility and VaR with GPR are low and statistically insignificant.
3. This study focuses on the Chinese stock market as it becomes the second largest in the world market capitalization. As of 2019, the total value in China was: 8515.5 billion U.S. dollars. https://www.theglobaleconomy.com/rankings/stock_market_capitalization_dollars/. The recent stock connect programs (Shanghai-Hong Kong and the Shenzhen-Hong Kong Stock Connects) have provided important financial gateways for both institutional and investors (Borst, 2017).
4. Some research uses a rolling regression method to generate the time-varying correlations (Chiang, 1988; Connolly et al., 2005). The analysis will be discussed in the due time.
5. Some researchers prefer to estimate the asset return on domestic macroeconomic factors, such as the inflation rate, interest rate and other state variables first and use the resulting residual to examine the correlations of asset return relation. (Yang et al., 2009; Pericoli, 2018).
6. This section follows closely to Engle (2009, pp. 45–49).
7. A big wave of new accounts occurred from late 2014 through early 2015. A little more than 40 million accounts were opened for the period of June 2014 ~ May 2015.
8. Hu et al. (2018) provide a good review on the Chinese capital market.
9. Using $\Delta GPR_t^2$ or $|\Delta GPR_t|$ to serve as uncertainty measure of GPR is based on the notion provided by Ding et al. (1993) in their study of stock return properties.
10. A heightened GPR would more likely induce investors to move their funds into the gold market rather than to the bond market, since the latter is subject to political risk as well. This statement holds true without having government’s interference in the gold market.
11. Sentana and Wadhwani (1992) use the term of positive feedback trader as the noise trader and negative feedback trader as the rational trader.
12. In re-estimating equation (7) by replacing $|\Delta GPR_t|$ with $\Delta GPR_t^2$, the results are comparable to those reported in Tables 5 and 6 Since $\Delta GPR_t^2$ tends to produce a smaller coefficient, the measure of $|\Delta GPR_t|$ makes more sense.
13. It should be noted that the rolling sample correlations tend to generate the serial correlation, which could inflate the \( t \)-statistics. In addition, the estimated coefficients are subject to the choice of fixed window length. However, our attempt sufficiently demonstrates the robustness of the model.

14. Frank Knight makes a distinction between risk and uncertainty based on the measurability. Knight (1921) notes that only quantifiable uncertainty is defined as risk. The news-based uncertainty indices constructed by Baker et al. (2013) and Davis (2016) provide a measurability of EPU.

References


Further reading


Corresponding author

Thomas C. Chiang can be contacted at: chiangtc@drexel.edu

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