Stock-Bond Return Dynamics and the Expected Country Stock Returns*

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ABSTRACT

Stock and bond prices move together with greater country-specific risk. Bonds hedge global growth expectation risk with low country-specific risk, resulting in a negative stock-bond correlation. However, as country-specific risk increases, bonds do not effectively hedge stocks because higher local growth expectation tends to lower inflation, leading to higher stock and bond prices. Consequently, countries with greater country-specific risk exhibit a higher stock-bond correlation. Investments in countries with a positive stock-bond relationship outperform those with a negative relationship by 7–11%. The superior performance is not driven by investments in a fixed set of countries.

Keywords: Stock-bond correlation, country stock market, country-specific risk

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Stock and bond prices move together with greater country-specific risk. Bonds hedge global growth expectation risk with low country-specific risk, resulting in a negative stock-bond correlation. However, as country-specific risk increases, bonds do not effectively hedge stocks because higher local growth expectation tends to lower inflation, leading to higher stock and bond prices. Consequently, countries with greater country-specific risk exhibit a higher stock-bond correlation. Investments in countries with a positive stock-bond relationship outperform those with a negative relationship by 7–11%. The superior performance is not driven by investments in a fixed set of countries.

I. Introduction

Recent developments in international exchange-traded funds (ETFs) have led to increased interest in macroeconomic investments focusing on global market cycles. These strategies rely on understanding how regional and global risk factors impact the returns of bonds and stocks, the two major financial asset classes. As a result, the dynamics of the prices of these asset classes should have implications on the risk premium of stocks at the country level.

While there have been advancements in comprehending the determinants of the correlation between stock and bond returns (SB correlation), whether a positive or negative correlation implies more risk for investors remains unclear. For example, one explanation, referred to as flight-to-quality, suggests that investors shift from risky (stocks) to safer (bonds) assets when there is increased uncertainty. This explanation implies that equity investments are riskiest when stocks and bonds are negatively related.[1] On the other hand, a negative SB correlation may indicate that bonds hedge against the risk of equity investments. Equity investments may be safer when hedging is more straightforward.

This paper investigates this hypothesis from an international standpoint and demonstrates that countries with positive SB relationships have higher country-specific risk, which requires greater risk compensation. When country-specific risk is low, bonds effectively hedge against global growth expectation risk. However, as country-specific risk increases, bonds lose their hedging ability since domestic inflation shocks negatively impact the economy's future growth. Therefore, stock and bond prices move together with greater country-specific risk, resulting in equity investors requiring a higher risk premium. Empirically, countries with positive SB relationships outperform those with negative SB relationships by 6.8 – 10.8%.

[1]Recent papers provide alternative channels of the driver of the correlation. Hasseltoft (2012), Chernov, Lochstoer, and Song (2021), Kozak (2022), and Jones and Pyun (2023) all imply that a negative SB correlation should yield a higher risk premium. The effect of a negative SB correlation on equity risk premium is either small or insignificant for inflation-based explanations.(e.g., David and Veronesi 2013, Song 2017, Campbell, Pflueger, and Viceira 2020).

A long-run risk-based model (Bansal and Yaron 2004) is provided in which global and country-specific risk affect consumption growth, dividend growth, inflation, and long-run risk processes. The model relies on three empirical observations: (i) the consistently negative correlation between inflation and real growth shocks in terms of country-specific risk, (ii) the relatively persistent nature of global growth and less persistent country-specific growth expectations, and (iii) the high susceptibility of the dividend growth process to global growth expectations. These observations lead to the conclusion that countries with greater country-specific risk have a higher SB correlation.

Domestic inflation and real growth relative to the world are negatively related if, for example, domestically and internationally produced goods are imperfect substitutes. In the model of Romer (1993), he notes that an expansion of domestic output should reduce the relative price of the domestic non-substitutable good. Rogoff (1985) also suggests that an expansionary monetary policy of a country can increase the relative price and unemployment rate of the country, thus lowering production. In the model of the present paper, the global inflation-real growth relationship affects the worldwide SB correlation through the mechanism proposed by Song (2017) and Campbell, Pflueger, and Viceira (2020). The additional negative country-specific inflation-real growth relationship in the model implies that an increase in country-specific volatility should increase the country's SB correlation relative to the world.

The second assumption that the country-specific growth expectation is relatively less persistent than the global process is shown by Kose, Otrok, and Whiteman (2003) and is supported by Bakshi, Carr, and Wu (2008) and Nakamura, Sergeyev, and Steinsson (2017). This assumption reinforces the model mechanism, particularly when the SB correlation is measured using longer-term bonds. Shocks to a less persistent variable are relatively short-lived, and longer-term bonds will not be as responsive to these shocks. Therefore, long-term bond yields are less responsive to country-specific and more to global growth expectation shocks. As global expectation shocks drive stock and bond prices in opposite directions, while country-specific inflation shocks move them in the same direction, higher country-specific volatility should increase the SB correlation.

The previous assumption implies that bonds will be exposed relatively more to global rather than to country-specific growth expectation shocks, while the third assumption implies that stock returns are heavily exposed to global expected growth risk. This may be the case in an open economy if firms export their products to the global market. Therefore, when global news is prevalent in the market, stocks and bonds will tend to move in opposite directions. Combined with the second assumption, they are more likely to move in the same direction with more country-specific news. The model directly incorporates this assumption in the dividend growth process, similar to Colacito and Croce (2011). This assumption is also consistent with the empirical observation that cross-country stock return correlations are higher than those of macro-variables.

The data confirms the consistent negative country-specific inflation-real growth relationship. Using the World Economic Outlook (WEO) data from the International Monetary Fund (IMF), forecast revisions of inflation and Gross Domestic Product (GDP) growth expectations are estimated. The analysis reveals that for global variables, the relationship between inflation and real growth changes from negative to positive, as also documented by Song (2017) and Campbell, Pflueger, and Viceira (2020), consistent with the SB correlation switching from positive to negative around the same time for most advanced economies reported by Li (2002). However, the relationship is consistently negative throughout the sample period for the country-specific components.

The evidence supports the model's predictions that both bond yields and stock prices react positively to global growth expectation shocks. However, country-specific growth expectation shocks have a smaller effect on stock returns than global shocks. The yields of 10-year maturity bonds show no response to country-specific growth shocks, and after controlling for global shocks, the effect is negative.

The analysis confirms that the time-varying relationship between stocks and bonds is determined by the level of country-specific volatility relative to global volatility, as measured in various ways. Specifically, I use two different measures to estimate the level of volatility: (1) the country-specific and global volatility estimated from quarterly consumption data and (2) the residual volatility estimated from the international capital asset pricing model (ICAPM Adler and Dumas 1983). The panel analyses show that for both measures considered, more country-specific risk results in a higher SB correlation.

The most notable aspect of the empirical analysis is its ability to forecast the relative cross-country performance of stock returns. Countries with the highest SB beta, those requiring the highest amount of bonds to hedge equity risk, outperform those with the lowest SB beta. The result is robust, controlling for variation in global bond yields and risk-adjusting returns by the ICAPM. The significance is not driven by the stock market's exposure to sovereign credit risk. Also, the SB betas strongly predict future stock market returns, even after controlling for standard macroeconomic variables, measures of illiquidity, and standard return predictors of international stock market returns. Moreover, countries' relative rankings of the SB beta change over time, meaning investments in a fixed set of countries do not drive superior performance.

This paper is connected to two distinct fields within the macro-finance asset pricing literature. The first pertains to the drivers of the international stock market risk premium. Related studies often emphasize global factors as the primary determinant of the international stock market risk premium.[2] Harvey (1995) and Bali and Cakici (2010) are notable exceptions. Harvey (1995) shows that emerging market country stock returns are higher. Bali and Cakici (2010) note that equity markets with diversifiable risk underperform. The findings align with these two articles, but this paper emphasizes the role of time-varying country characteristics.

[2]This includes seminal works such as Adler and Dumas (1983), Dumas and Solnik (1995), de Santis and Gerard (1997), Hjalmarsson (2010), Bollerslev, Marrone, Xu, and Zhou (2014) Cenedese, Payne, Sarno, and Valente (2016), Andersen, Fusari, and Todorov (2020), and Londono and Xu (2021), among others, all focus on the importance of global factors as main drivers of the risk premium.

The second is on the drivers of the correlation between stock and bond returns. This paper provides several new results. Extant literature often arrives at the opposite result that uncertainty leads to a negative SB correlation. For instance, Connolly, Stivers, and Sun (2005) report a positive predictive relationship between stock market volatility and the SB relationship, whereas Bekaert, Engstrom, and Xing (2009) show that stocks and bonds should move in opposite directions following a macro uncertainty shock. This paper shows that only global volatility contributes to the flight-to-quality effect, whereas higher country-specific volatility moves stock and bond prices in the same direction.

Recently, two new theories have emerged to explain the time-variation of the SB correlation. The first is that the relationship between real and inflation shocks is a crucial driver, as Song (2017) and Campbell, Pflueger, and Viceira (2020) suggest. Other studies, e.g., Chernov, Lochstoer, and Song (2021), Kozak (2022), Duffee (2022), and Jones and Pyun (2023), among others, propose that real factors are critical factors that move stocks and bonds together. This paper implies that these two explanations may be deeply interrelated.

The remainder of the paper is organized as follows: The next section describes the model and is followed by the data section in Section III. Section IV empirically shows the main drivers of stock and bond returns. Section V provides the cross-country return predictability results. A discussion of the relationship between the SB correlation and globalization is provided in Section VI, which is followed by a conclusion in Section VII.

II. The model

This section proposes a consumption-based model that builds on the long-run risk framework of Bansal and Yaron (2004).

1. Consumption and inflation dynamics

Consider an open economy with one large country and multiple small countries. The large country is referred to as "world" or "global," and the small country as "local." In this paper, a local country is affected by global and country-specific shocks, which are orthogonal to each other. The object is to compare the SB correlation and the equity risk premium for two or more small countries. Each country has a stochastic discount factor (SDF), represented by recursive preference, as considered by Epstein and Zin (1991), with a risk aversion coefficient of γ and an intertemporal elasticity of substitution coefficient of ψ. Following the convention, I let $\theta = \frac{1-\gamma}{1-1/\psi}$. Stocks, bonds, and currency assets are priced by the log of the SDF, which is defined as

$$m^i_{t+1} = \theta \log \beta - \frac{\theta}{\psi} \Delta c^i_{t+1} + (\theta - 1) R^i_{TW,t+1}, \tag{1}$$

where β is the time discount factor, and Δc^i_{t+1} and $R^i_{TW,t+1}$ are the consumption growth and the log returns on the wealth portfolio, respectively, for country i denominated in the local currency. The same preference parameters represent the global investor's SDF, except that the global variables with superscript * replace the country-specific variables denoted by superscript i. Superscripts for parameters or variables that are identical across all countries are omitted.

The consumption growth of country i follows a linear process where the shocks can either be country-specific or global. The dynamics are given by

$$\begin{aligned} \Delta c^i_{t+1} &= \mu + x^*_t + x^i_t + \sqrt{v^i_t} \epsilon^i_{c,t+1} + \sqrt{v^*_t} \epsilon^*_{c,t+1} && (2) \\ x^i_{t+1} &= \xi_l x^i_t + \sigma_{xl} \sqrt{v^i_t} \epsilon^i_{x,t} \\ v^i_{t+1} &= \omega_{l0} + \omega_{l1} v^i_t + \sigma_l \sqrt{v^i_t} \epsilon^i_{v,t+1}, && (3) \end{aligned}$$

where ϵ^i_c, ϵ^i_x, and ϵ^i_v are standardized error terms assumed uncorrelated.

Global consumption growth, expected growth, and variance are assumed to follow a similar linear process:

$$\Delta c^*_{t+1} = \mu + x^*_t + \sqrt{v^*_t}\epsilon^*_{c,t+1} \tag{4}$$
$$x^*_{t+1} = \xi_g x^*_t + \sigma_{xg}\sqrt{v^*_t}\epsilon^*_{x,t+1}$$
$$v^*_{t+1} = \omega_{g0} + \omega_{g1} v^*_t + \sigma_g\sqrt{v^*_t}\epsilon^*_{v,t+1},$$

where ϵ^*_c, ϵ^*_x, and ϵ^*_v are standardized error terms assumed uncorrelated with each other and with the corresponding country-specific shocks.

The dynamics imply that the consumption growth variance of country i is the sum of the variance of the country-specific (v^i_t) and global (v^*_t) components. Therefore, local consumption growth and variance shocks are both correlated to their global counterparts. Moreover, under the assumed dynamics, global consumption growth should equal the cross-sectional average of local consumption growth taken over many small countries.

In addition, I also assume the country i's inflation process to follow:

$$\pi^i_{t+1} = p_0 + p_1\pi^i_t + \sigma_{pl}\sqrt{v^i_t}\epsilon^i_{\pi,t+1} + \sigma_{pg}\sqrt{v^*_t}\epsilon^*_{\pi,t+1}, \tag{5}$$

where $\epsilon^i_{\pi,t+1}$ and $\epsilon^*_{\pi,t+1}$ are independently distributed standard normal error terms.

In line with the literature, this study accounts for the possibility of consumption growth and expectation shocks being correlated with inflation shocks. To this end, the correlation (ρ_l) between inflation shocks ($\epsilon^i_{\pi,t+1}$) and real shocks ($\epsilon^i_{x,t+1}$) is included at the country level. The global inflation-real growth correlation (ρ_g) is similarly defined. For simplicity, the country-specific and global correlation between inflation expectations and current growth is assumed to be equal to the corresponding correlation between inflation and growth expectations.

2. Bond yields and the uncovered interest rate parity

The yield of a one-period sovereign bond is purely a function of the moments of the local SDF and the expected inflation rate. The one-period yield for country i ($y^i_{1,t}$) is determined by:

$$y^i_{1,t} = -E_t[m^i_{n,t+1}] - 0.5Var_t[m^i_{n,t+1}], \tag{6}$$

where $m^i_{n,t+1}$ is the difference between the real SDF and the inflation rate of country i. The yields can be expressed as a linear function of the five state variables: $x^i_t, x^*_t, v^i_t, v^*_t$, and π^i_t. The appendix describes the detail, the derivation of the 10-year bond yield using iterations as in Jones and Pyun (2023).

International investments are realized in the currency of the country one invests in and should be converted to a common currency for a cross-country comparison. If the market is complete, the log of the currency returns (Δq^i_t) is represented by the difference between the local and the global SDF (e.g., Backus, Foresi, and Telmer 2001) expressed in nominal terms, which results in

$$\Delta q^i_{t+1} = m^i_{n,t+1} - m^*_{n,t+1}, \tag{7}$$

where a higher q^i implies a currency appreciation for country i.

The dynamics assumed for the global consumption process in Equation (4) imply that the uncovered interest rate parity (UIRP) holds, and there is no currency risk premium. This simplifies the cross-country comparison of equity market returns as it eliminates the need to convert returns into a common currency. According to the UIRP, the expected currency return on global investments is directly proportional to the interest rate differential. Hence, the difference in equity risk premium between countries measured in their respective local currencies is equivalent to the difference in expected excess returns between countries measured using a common currency. A detailed explanation of this derivation can be found in the appendix.

3. Dividend dynamics and stock returns

I assume that the growth rate of dividends (Δd^i) of the stock market in country i is described by the linear process:

$$\Delta d^i_{t+1} = \mu_d + \phi_d(\lambda_d x^i_t + (1-\lambda_d)x^*_t) + \sigma_{dg}\epsilon^*_{d,t+1} + \sigma_{dl}\epsilon^i_{d,t+1}, \tag{8}$$

where ϕ_d is the standard leverage parameter in long-run risk models, $\epsilon^*_{d,t+1}$ and $\epsilon^i_{d,t+1}$ are assumed to be independent of each other but are correlated with $\epsilon^*_{c,t+1}$ and $\epsilon^i_{c,t+1}$, respectively, with a common fixed correlation coefficient $\rho_{cd} > 0$.

Dividend growth shocks are assumed to be correlated with inflation shocks, with the exact correlation that governs the inflation-consumption growth correlation. This assumption applies to both the country-specific and the global components. The appendix shows the derivation of stock returns using Campbell and Shiller (1988) decomposition, which is standard.

4. Model calibration

Panel A of Table I lists the parameter specifications. The parameters are matched to the moments of world consumption, dividend, and the WEO GDP growth and inflation forecasts for the sample period of 1990-2022. Consumption, inflation, and dividend parameters are calibrated to match the moments of the corresponding series in the data. The relative contribution of global shocks to local shocks to these processes (the ratios between σ_{dg} and σ_{dl}, σ_{pg} and σ_{pl}, and the average of local and global consumption variance) are determined to match the empirical cross-country correlation of the variables. The persistence parameters of consumption variance (ω_{g1} and ω_{l1}) and the volatility-of-volatility multipliers (σ_g and σ_l) are inferred from the estimated model described in the appendix. The reported model implications are not sensitive to these parameter assumptions.

The long-run risk processes are calibrated to match the long-run GDP growth forecasts of the WEO. I first estimate the parameters for the global process using the cross-country average of the growth forecasts. Then, I take the residual of each country's growth forecast. The parameters for the country-specific component are estimated using these residuals. The global long-run risk component is set to be more persistent (0.989) than the country-specific component (0.930). These estimates are slightly lower than Nakamura, Sergeyev, and Steinsson (2017). From a model, they estimate a persistence level of 0.993 for the global and 0.954 for the country-specific long-run risk. However, their estimation confirms a relatively less persistent country-specific long-run risk process.

The inflation-real growth correlations roughly align with the estimated correlation between the GDP growth and inflation forecasts, as detailed in the next section. Model 1, the main specification, takes values similar to those estimated from the data, but for illustrative purposes, takes the country-specific inflation-real growth correlation to be equal to the world correlation coefficient. The observed relationship between country-specific volatility and SB relationship is more pronounced if the country-specific inflation-real growth correlation is lower than that of the global, as data suggests. Two additional specifications are considered to examine how the level of SB correlations are affected by the inflation-real growth correlation: Model 2, designed to fit the post-1998 sample, and Model 3, to match the 1990-1998 period.

Dividend growth is calculated by taking the difference between the total and price index returns for the sample starting from 1999. The asymmetry parameter (λ_d) in the process quantifies the reliance of dividend growth on country-specific expectation shocks compared to global growth expectation shocks. This parameter, estimated from the data, is 0.2, but the choice is somewhat arbitrary. For example, Colacito and Croce (2011) argue that this parameter should be close to zero. Therefore, alternative values of this parameter will also be considered in the analysis. This specification aligns with the higher equity return correlation over cross-country correlation in macro variables.

In Panel B, the model-implied asset moments are calculated and compared to those computed from the data. The data-based moments are obtained either from (i) the US data only or (ii) the world mean and median. The median of the values computed between the US and other countries is used for the cross-country correlations in the US data. The model-based moments are calculated by averaging 1000 independent simulations. In each simulation, the consumption and dividend series for two countries are drawn for 500 months, with the first 100 months dropped. The cross-country consumption and dividend growth correlations are then computed based on the simulations.

Overall, the moments and correlations of the model represent the data well, given the relatively simple dynamics assumed. Compared to earlier research, the cross-country correlation between consumption growth is higher than Backus, Kehoe, and Kydland (1992) and Nakamura, Sergeyev, and Steinsson (2017) in this sample. On the other hand, the correlation between inflation expectations is lower than that of Wang and Wen (2007), among others, mainly due to the different sample used for calibration. Nonetheless, the lower cross-country inflation expectation correlation using a more recent sample is consistent with the findings of Bekaert and Ermolov (2023).

5. SB correlation/beta and country-specific volatility

In standard frameworks such as Bansal and Yaron (2004), shocks to the two state variables – variance and expected consumption growth – have opposing effects on stock and bond prices. A positive shock to expected growth increases stock prices by boosting dividend growth expectations and the price-dividend ratio. However, the interest rate also rises with the shock as the demand for money increases. As bond yields and prices move in the opposite direction, bond returns are negative with such shocks.

An increase in consumption growth volatility also affects stock and bond prices in the opposite direction. Specifically, higher consumption volatility indicates greater risk for equity investors, which raises the risk premium of equity investment, leading to lower stock prices. For bonds, precautionary savings result in lower yields and higher prices. Since cash flow shocks do not significantly impact bond prices, the correlation between stocks and bond returns is negative. Therefore, in the standard model, stock and real bond prices always move in opposite directions.

However, as Li (2002) describes, the correlation is not always negative in the data, switching from positive for much of the 20^{th} century to negative after 2000 for most developed countries. Prior studies, e.g. Song (2017) and Campbell, Pflueger, and Viceira (2020) impose a non-zero correlation between inflation and real growth shocks to account for the positive SB correlation observed in the pre-1999 sample. In line with these studies, the present model also describes an additional inflation process that is correlated with shocks to country-specific and global real variables. In the model, stocks and bonds can move in the same or opposite directions depending on the volatility process and chosen values of correlations.

This section first presents the main implication of the model, that the SB correlation/beta is positively affected by country-specific volatility under reasonable parameter values. Then, this section further delves into the model's mechanism, which is based on three assumptions drawn from previous research and is in line with empirical observations.

Figure 1 displays the associations between country-specific volatility and the SB correlation (Panel a), country-specific volatility and the SB beta (Panel b), and country-specific volatility and the equity risk premium (Panel c) based on the Model 1 specification. Each Panel shows the relationship for different values of λ_d, holding the global consumption volatility constant at its average level. The solid line depicts the relationship with $\lambda_d = 0.2$, while vertical lines show the two standard deviation confidence intervals of the country-specific volatility.

The first two panels reveal a positive association between the SB correlation and country-specific volatility. The relationship also holds when the SB beta is used instead. In magnitude, for countries in the 2.5 bottom percentile of country-specific volatility, SB correlation is about

-0.21, which increases to 0.08 for countries in the 2.5 top percentile. The last Panel shows that countries with a positive SB correlation tend to offer higher compensation to equity investors for country-specific volatility. Compared to countries in the 2.5 percentile, countries in the 97.5 percentile with a positive SB correlation are expected to outperform by 3% annually.

The patterns observed for the baseline are also observed using the two alternative specifications considered, which are presented in Figure 2. As shown in Panels (a) and (b), the inflation-real growth correlation in Model 2 matches the post-1998 period. Model 3, shown in Panels (c) and (d), matches the earlier sample and fits the SB correlation between 1990 and 1998.

In Model 2, the global inflation-real growth correlation is positive. Panels (a) and (b) show that the average SB correlation/beta is negative for most countries. Despite variations in parameter values, the relationship between country-specific volatility and the SB correlation/beta remains the same. Countries with higher country-specific risk have a higher SB correlation/beta, while countries with lower country-specific risk have a lower SB correlation/beta.

In Model 3, both global and country-specific inflation-real growth correlations are more negative than the baseline. Panel (c) and (d) show that the SB correlation and the beta is now positive for most countries. Nevertheless, a positive relationship between country-specific volatility and SB correlation/beta is still observed. Moreover, the relationship between country-specific volatility and SB correlation/beta is more pronounced when dividend growth is highly exposed to global growth risk, while it is weaker if the exposure to local risk is relatively higher.

To summarize, for all specifications, the SB correlation/beta tends to be higher for countries with greater country-specific volatility. In the following section, I outline three model assumptions that explain the underlying reasons for the positive link between SB correlation/beta and country-specific volatility.

6. Drivers of stock-bond return dynamics

6.1. Negative relation between country-specific growth expectations and inflation

The correlation between shocks to expected growth and inflation is an essential driver of the time-varying SB relationship, as is the underlying idea of David and Veronesi (2013), among others. With inflation, bond yields tend to rise, leading to negative returns for bonds. If there is a negative correlation between inflation and real growth, then stock returns are also likely to be negative since higher inflation can lead to lower expected dividend growth. This results in a positive SB correlation.

As described in the empirical section, before 1998, many countries exhibited a negative correlation between inflation and real growth, implying a positive correlation between stocks and bonds. However, in later years, the correlation between inflation and real growth became positive, which led to a negative correlation between stocks and bonds. These observations are consistent with prior research.

In the current model, the relationship between stocks and bonds is influenced by both global and country-specific factors. While the global inflation-real growth correlation is a significant driver of the overall global variation in SB correlations, the country-specific correlation uniquely contributes to the variation across countries.

While the three model specifications considered above assume varying global inflation-real growth correlations, the country-specific inflation-growth correlation is assumed to be consistently negative across model specifications. These correlations are calibrated to match the available data. Model 2 is calibrated to match the later sample period of 1999-2022, and Model 3 is set to be similar to the earlier sample of 1990-1998.

The negative country-specific correlation assumption implies that the SB correlation should be higher for countries with relatively more country-specific risk. This is because positive country-specific inflation expectations shocks lower bond prices directly and stock prices indirectly as economic growth is expected to be lower. This is in addition to the varying global inflation-real growth correlation, which should explain why the world SB correlation changed its sign in the late 1990s, as earlier studies argue.

Certain parameter values may imply a reverse relationship. This condition could arise when the global inflation-growth relationship is highly negative, or the country-specific correlation is highly positive. To further investigate these possible conditions, I compare the slope of the relationship under different combinations of global and country-specific inflation-growth correlations. Specifically, for each inflation-growth correlation pair, I calculate the model-implied SB correlation when country-specific volatility is two standard deviations from the mean while keeping the global volatility set to its average value, similar to Figure 1. Then, I compute the slope of the relationship.

Figure 3 presents a contour plot depicting the slope calculated using the approach outlined above. Lighter shades on the plot indicate a positive slope, while darker shades indicate a more negative slope. The plot highlights that, for instance, in Model 1, where the country-specific inflation-real growth correlation is -0.15, the global correlation must be lower than -0.45 to yield a negative relationship. Likewise, for a global correlation of -0.15, the country-specific correlation should be as high as 0.2 for the SB correlation to have a positive relationship with country-specific volatility.

6.2. Persistent global and less persistent country-specific shocks

Time-varying levels of persistence of macroeconomic shocks are another driver of the SB correlation, as demonstrated by Jones and Pyun (2023), among others. In their model, a high level of consumption growth persistence leads to a negative SB correlation because both bond yields and stock prices are positively affected by growth expectation shocks. Since positive cash flow shocks increase stock price, a positive correlation between cash flow and expectation shocks leads to a further negative comovement between stocks and bonds. When expectation and current cash flow shocks are negatively related (i.e., shocks are less persistent), stock and bond returns are positively related.

The model in this section features different levels of persistence for the global growth expectation, country-specific growth expectation, and inflation processes. The global growth expectation process is assumed to have the highest level of persistence, and the country-specific growth expectation process has the lowest level of persistence. The lower persistence of country-specific growth is consistent with Kose, Otrok, and Whiteman (2003) and Nakamura, Sergeyev, and Steinsson (2017).

A variable with a low level of persistence indicates that shocks to the variable are less likely to have prolonged effects. Therefore, in this framework, longer-term bonds such as 10-year bonds are less likely to be affected by country-specific growth expectation shocks than they would be by global growth expectation shocks.

Panel (a) of Figure 4 displays the response of short-term (1-year) and long-term (10-year) bonds to global and country-specific growth expectation shocks implied by the model. The panel shows how bonds yield with different maturities respond to a single standard deviation shock to country-specific and global growth expectations. The results indicate that a one standard deviation shock in country-specific growth expectations increases the one-year bond yield by approximately 10 basis points, while the response to global growth expectations is only 1.8 basis points. In contrast, while the response of 10-year yields to a one standard deviation global growth expectation shock is similar to that of 1-year yields, the reaction to a one standard deviation country-specific expectation shock is merely 1.1 basis points, which is only about one-ninth of the response to one-year bond yields.

Depending on the parametrization, the first two assumptions made in this paper – the negative inflation-real growth correlation and the lower persistence for country-specific risk – can lead to the possibility that bond yields react negatively to positive expectation shocks. Panels

(b) and (c) of Figure 4 depict the response of 10-year bond yields to a single standard deviation country-specific and global growth expectation shock for different levels of inflation-real growth correlation. The panels demonstrate that bond yields may respond negatively to country-specific growth shocks even at a relatively moderate inflation-real growth correlation (-0.35) of country-specific risk. In comparison, the global component requires a lower correlation (-0.5) to generate a negative response.

In short, shocks to global growth expectations generate a strong negative comovement between stocks and bonds regardless of the maturity used for bonds. However, the lower level of persistence of the country-specific growth expectation process implies that country-specific growth shocks will have minimal influence on the negative comovement between stock and bond prices, particularly for longer-term bonds.

6.3. Dividend's asymmetric exposure to global growth expectation shocks

The third contributing force to the positive relationship between country-specific volatility and the SB correlation is the high exposure of dividend growth to the global growth expectation process ($\lambda_d < 0.5$). In an open economy where firms engage in international trade, with inputs sourced from abroad and processed goods sold overseas, it is reasonable to expect a low value of λ_d. This assumption is also consistent with the high cross-country equity return correlation observed in the market, which has prompted research on international contagion.

Since the dividend process is highly sensitive to global growth expectations, stock prices will respond strongly to global growth expectation and less to country-specific growth expectation shocks. This asymmetry amplifies the previously mentioned mechanism, as stock prices and bond yields both move intensely in the same direction for a unit of global growth shock, resulting in a strong negative SB comovement. The effect is weaker for country-specific growth shocks by comparison.

The last two panels of Figure 4 compare how stock returns and 10-year bond yields are affected by a single standard deviation shock to country-specific/global growth and inflation. Specifically, Panel (d) shows that stock returns are highest for a given positive global growth expectation shock and much lower for country-specific growth expectation shocks. In addition, they are negatively affected by inflation shocks. Panel (e) shows that 10-year bonds respond least to country-specific growth expectation shocks and most to country-specific inflation shocks.

To summarize, when expectation shocks occur, the negative comovement of stock and bond returns is more pronounced, especially if the shocks are global in nature. In contrast, when inflation shocks occur, the positive comovement of stock and bond returns is more significant, particularly if the shocks are country-specific. As a result, countries with higher levels of country-specific volatility tend to have a more positive and higher SB correlation.

III. Data

This section describes the data and the sample used in this paper. The appendix further describes the data source, the estimation methodology of the models used, and the construction of control variables.

The countries covered in the empirical analysis pertain to 30 countries until the end of 2022, selected based on the total stock market capitalization, representativeness within the economic region, and data availability. Fourteen countries (Austria, Belgium, Finland, France, Germany, Italy, Netherlands, Norway, Russia, Spain, Sweden, Switzerland, Turkey, and the United Kingdom) are in Europe, nine (China, India, Indonesia, Japan, Korea, Malaysia, Philippines, Singapore, and Thailand) are from Asia, four (Brazil, Canada, Mexico, and the United States) from America, two (Australia and New Zealand) are from Oceania, and one is from Africa (South Africa). Two G20 countries (Argentina and Saudi Arabia) are excluded from the sample due to the insufficient availability of bond yield data at the daily level. Among the top

20 stock market exchanges, only Iran and Taiwan Stock Exchange are omitted for the same reason. Russia is removed in 2022 due to the possible disintegration from the global market.

The MSCI index is used to proxy stock returns, and 10-year bond yields are used to compute the stock-bond relationship. The availability of the bond yield data often restricts the sample period. Therefore, 10-year maturity for bonds is a natural choice since yields of that maturity are available for the longest sample period. For stock returns, I consider both the net total returns index and the price index returns denominated in local currency. The main difference is the inclusion of dividends in computing stock returns. While using total returns accurately compares the stock market performance, the sample for most countries only begins in 1999. The price index is available for a longer sample period, and the returns are highly correlated with total returns.

In the empirical analysis, I combine the stock and bond data with the WEO database available from the IMF, which includes Gross Domestic Product (GDP) and inflation forecasts, GDP both on a total and per capita basis, the quarterly consumption data obtained from the OECD, and the CDS database obtained from Intercontinental Exchange. Fewer countries are covered in some of the analyses if the database does not cover them.

Although the SB correlation is typically used in prior studies to assess the SB relationship, I rely on the SB beta for cross-country return comparison. This is because the SB beta represents the number of bonds required to hedge equity holdings (in the case of a negative beta) or the amount of risk introduced by holding one unit of bond (for a positive beta). Specifically, the SB beta is the slope of the regression

$$R^i_{m,t+1} = \alpha^i + \beta^i(-\Delta y^i_{t+1}) + \epsilon^i_{t+1}, \tag{9}$$

where $R^i_{m,t+1}$ is the log stock return of a country equity index denominated in local currency and Δy^i_{t+1} is the first-difference of the ten-year Treasury bond yield of country i, also in local currency. The negative sign is included to align the interpretation of the result with the correlation between returns. Similarly, the SB correlation is calculated as the negative correlation between stock returns and first-order differences in 10-year bond yields, estimated using the entire available sample of price returns.

Table II summarizes the sample of this paper. The second column of Panel A describes the first year the country is entered into the sample. There are only seven countries at the beginning of the price index sample, which subsequently increases to 21 by 1999. The total return sample has 21 countries at the beginning of 1999. Panel A further summarizes the average and standard deviations of the countries' stock index returns, bond yields, the SB beta, the SB correlation, and the beta of the international CAPM of Adler and Dumas (1983).

However, a direct cross-country comparison of the stock returns, bond yields, currency returns, and the SB correlation/beta is not straightforward since the sample covered for each country is not the same. Considering this limitation, we can observe that emerging markets such as China, India, Indonesia, Mexico, South Africa, and Thailand exhibit higher returns than typically classified developed markets like EU countries or Japan. This observation aligns with the common belief that bond yields and their volatility are generally higher in emerging markets.

Panel B presents the unconditional cross-sectional correlation coefficients across the 40 countries in the sample. The results indicate a weak unconditional relationship between stock returns and the SB beta/correlation. Additionally, the SB correlation and SB betas are negatively correlated with the CAPM beta and positively correlated with stock return volatility.

IV. Determinants of stock-bond joint dynamics

In this section, I study the relationship between inflation and real growth for the global and country-specific components separately. Specifically, I test the model assumption that country-specific inflation and growth rate are negatively correlated. Then, I provide empirical evidence that suggests that the stock-bond correlation is positively related to country-specific or local volatility.

1. The relationship between growth and inflation

The WEO provides economic forecasts for individual countries, regions, the advanced economy in aggregate, and the world. The reports with future GDP forecasts and inflation for each country are provided biannually, in April and October. The surveys begin three months before the reports are published, generally from January for April and July for October reports. While GDP growth (data) and consumption growth (model) may not be perfectly aligned, the interpretation of this analysis implicitly assumes they are not substantially different.

Shocks to inflation and growth projections or expectations are measured biannually for each country at the release of the report for the current and each of the next two years. Revisions to the current-year projections are designed to capture revisions to the same-year projections in the next half-year. The October revision of year t is measured as the difference between the same year (t) projection made in October and the previous April. For April year t, the revision is the difference between the year $t-1$ estimate made in April and the projection made in the preceding October of year $t-1$. Since these shocks are errors to the same-year projections, I follow Duffee (2023) and call them the "nowcast" error of the economy.

Shocks to the next year's forecast ("the one-year-ahead forecast revision") are measured similarly with a one-year lead from the nowcast. For October of year t, the forecast error is the difference between the one-year-ahead ($t+1$) forecasts between October and April of the same year t. For April of year t, it is the difference between the year t forecast of April and the one-year-ahead forecast of the prior October. The two-year-ahead forecast revision in October is the difference between the two-year-ahead forecasts between October and April. For April, it is the year $t+1$ forecast minus the two-year-ahead forecast made in October of year $t-1$.

The two-year-ahead forecast is a pure measure of expectation shock because both revised and original values are based on future forecasts.

The relationship between global inflation and real shocks is calculated by taking the simple correlation coefficient between the nowcast errors, one-year-ahead forecast revisions, and two-year-ahead forecast revisions. The global variables forecast shocks are measured in two ways. One takes the simple cross-sectional mean of the shocks measured for each country in the sample, and the second takes the value of the "advanced economies."[3]

The country-specific inflation-real relationship is measured by the partial correlation coefficient. I compute the partial correlation coefficient between inflation and growth shocks controlling for global variables, where global is measured by either the cross-sectional average or the value of the advanced economies. I also consider a third specification to differentiate regional from country-specific correlations, where the continent average of the shocks is used as a control.

Table III summarizes the simple and partial correlation coefficients for the entire sample period and the 1990-1998 and 1999-2022 periods separately. Panel A shows the results for the nowcast errors, Panel B is for the one-year-ahead, and Panel C is for the two-year-ahead forecast revisions. For country-specific correlations, the numbers reported are the average of partial correlation coefficients measured for each country. Therefore, the standard errors measure the cross-country variation in the correlations.

There are two noteworthy observations to consider. Firstly, in all panels, the overall average global correlation is small. However, as reported by Campbell, Pflueger, and Viceira (2020), there is a significant difference between the two sample periods, 1990-1998 and 1999-2022. The global inflation-real growth correlation varies considerably from negative to positive, implying

[3]The WEO provides the value of the "world." However, the value for the inflation forecast begins in 1996, making it inappropriate to calculate the correlation for the sample of 1990-1998, where worldwide SB correlation is positive. In the next section, where subsample analysis is unnecessary, I replace the value with the value computed from the "world."

that the global correlation could be the primary factor driving the switch in the stock-bond correlation commonly observed across many countries.

The second observation is that the country-specific inflation-growth correlation is consistently negative and is statistically significant. The estimates from the two subsamples indicate that the time variation in the country-specific component is not very high. These observations support the model's assumption that the global nominal-real correlation is highly time varying while the country-specific correlation remains relatively consistently negative.

2. Stock and bond market response to growth and inflation shocks

The analysis above affirms the negative country-specific correlation between inflation and real growth. This section examines the response of stock prices and bond yields to these shocks separately.

Duffee (2023) finds that stocks generally elicit a positive response from expected growth shocks. However, contrary to standard theory, bond yields tend to respond negatively to these growth shocks. Similar to standard models, the proposed model also predicts both stocks and real bond yields to react positively to growth expectation shocks. However, the model additionally suggests that yields should respond more positively to global growth shocks, while country-specific shocks should have a relatively minor impact. In addition, if the country-specific inflation-real growth correlation is negative, nominal bond yields may respond negatively to a positive country-specific growth expectation shock.

One challenge in further studying the hypothesis is the uncertainty regarding the timing mismatch between forecast and financial data. As mentioned, forecasts are made between January and March (July-September) and released in April (October). If investors possess the same level of knowledge as forecasters, the April forecast should be matched with a timeframe between January and March. However, if forecasters outperform investors in their economic forecasts and the stock market responds to the release of the forecasts, the end of April financial data may be more appropriate for matching.

I match the forecast data to the end of March and September financial data. However, to minimize the error arising from the mismatch, forecasts, stock returns, and yield shocks are measured at a one-year horizon. Also, since subsample estimation is not performed, I use the "world" forecasts instead of the advanced economy forecasts because it is more directly linked to the model.

The response to stock price and bond yields is estimated using a panel regression where annual stock returns and yearly changes in bond yields are regressed on revisions to the two-year-ahead forecast of expected growth and inflation. Both global and country-specific forecast revisions are used as explanatory variables. Since the goal is to understand the response to the shocks for an average country, country-fixed effects are added to all regressions.

The panel regression results are presented in Table IV. Panel A displays the results using annual stock returns as the dependent variable. The first column of the panel shows that stock returns are positively related to revisions to the future growth forecasts. The regression, including revisions to inflation expectation, reported in the second column, further suggests that inflation shocks are negatively related to stock returns, but this effect is statistically insignificant. In the third and fourth columns, only global variables, measured by the cross-country average or the world forecast, are added to the regression. The results suggest that stock returns respond positively to revisions to growth expectations. For revisions to inflation expectations, the result is mixed depending on how global inflation is measured. Finally, when both local and global variables are included together in the regression, global growth expectation shocks have a greater effect on stock prices, which is consistent with the model's implication.

Panel B shows the relationship, where changes in 10-year bond yields are used as the dependent variable. The panel regression results indicate that local growth forecast revisions do not significantly affect 10-year bond yields. When including both growth and inflation expectation shocks in the regression, only inflation shocks have a significant positive impact on bond yields, while growth expectation shocks have an insignificant effect. This finding aligns with the model's prediction that local growth shocks have a minimal impact on bond yields, but the sign of the coefficient is negative. This result is consistent with Duffee (2023), but the lack of significance suggests limited support in the international setting.

When both global and local shocks are used in the regression, the regression results indicate that local growth expectation shocks have a negative effect on bond yields, while global growth shocks have a significant positive effect. Similar to the response to stock returns, the effect of inflation shocks on bond yields is mixed. Country-specific inflation shocks positively affect bond yields controlling for shocks to the cross-country average inflation forecasts. However, when the world forecast is used, bond yields are affected more by global inflation shocks.

The negative coefficient on the local growth expectation is somewhat puzzling, as also pointed out by Duffee (2023). One likely scenario is the influence of cross-country flows on bond yields, which is beyond the model of this paper. For instance, positive news about an economy may attract more investment, increasing demand for sovereign bonds. This higher demand for bonds may decrease interest rates relative to the global economy, ultimately reducing bond yields.

3. Country-specific volatility and the SB correlation

This section tests whether higher country-specific volatility is associated with a more positive SB correlation. According to the model, global growth shocks have a significant positive impact on stocks and a negative impact on bonds, whereas global inflation shocks have an ambiguous effect on SB correlations. Therefore, the SB relationship should be strongly negative when most local shocks are global.

Country-specific shocks tend to move stock and bond prices in the same direction because country-specific inflation shocks negatively affect both stock and bond prices. While country-specific growth expectation shocks increase stock prices and decreases long-term bond prices, the latter effect is relatively small. As a result, higher country-specific volatility leads to a positive SB relationship.

Two different measures are used to estimate the country-specific volatility for robustness. As a first approach, I estimate the volatility of country-specific consumption growth. The estimation is performed by defining local consumption growth as a linear function of world average consumption growth and estimating the volatility of the residual component. Finally, the volatility is estimated through a stochastic volatility model using a Markov-chain Monte Carlo method, which is explained in detail in the appendix.

The second approach uses the volatility of stock market returns that are orthogonal to the global value-weighted stock index returns and the currency returns relative to USD. In the model, the financial market's volatility is determined by two volatility processes. Therefore, for each country, the dynamics of the volatility of stock returns is a linear function of these two volatility processes. To capture country-specific volatility, I leverage the residual volatility of a country's stock market obtained from the international CAPM. By controlling for the overall stock market volatility, the residual component of volatility can serve as a proxy for country-specific volatility.

Table V summarizes the quarterly panel regression results, where the two country-specific volatility measures are regressed on the SB correlation and SB beta. The SB beta is estimated using equation (2), and the beta and the correlation are estimated using daily data over a non-overlapping three-month period. Panel A and B correspond to each of the aforementioned volatility measures. For each panel, the left side shows the results for the SB correlation, while the right side displays the results for the SB beta.

The panels in Table V provide strong evidence in support of the hypothesis that the SB relationship is positive when there is more country-specific volatility. Panel A, in particular, shows that the SB correlation is positively related to country-specific volatility regardless of the types of fixed effects used as control.

The impact of global volatility on the SB correlation is negative. This implies that increased volatility over time leads to a lower SB correlation, as has been explained by flight-to-quality. This result shows that the flight-to-quality is primarily global. After accounting for global volatility, country-specific volatility is found to have a positive effect on the SB relationship instead of the negative effect previously observed.

In the model, stock prices are more sensitive to global growth shocks relative to bond yields, particularly when accounting for the impact of inflation. This suggests that stock return volatility may better indicate global volatility than bond yield volatility. Consequently, higher stock return volatility should lead to a negative SB relationship when both bond and stock volatility are included in the regression. In comparison, higher bond yield volatility should lead to a positive SB relationship.

The results of the test are presented in Panel C. The first two regressions show the impact of bond or stock volatility as the sole explanatory variable. The results in the first two columns suggest that countries with higher stock and bond volatility tend to have a positive SB correlation after controlling for time-fixed effects. These time-fixed effects control for global variations in the SB relationship.

However, when bond and stock volatility are added together in the regression, a higher bond yield volatility leads to a positive SB relationship, while the opposite is observed for stock return volatility. This finding, again, confirms that the SB relationship is more positive when there is more country-specific risk.

V. The cross-section of country stock returns

The analysis above suggests that stocks and bond prices are more likely to move in the same direction when there is more country-specific volatility. This implies that countries with a positive SB relationship are riskier investments and, therefore, should have a higher risk premium. The analysis in this section aims to demonstrate that countries with a positive SB relationship tend to perform better than those with a negative relationship.

A positive SB relationship is riskier for the investors for two related reasons. Firstly, a positive SB relationship is associated with more country-specific risk. Secondly, in the presence of greater country-specific risk, bonds do not provide a hedge against global growth risk, to which stocks are highly exposed. Thus, the positive SB relationship indicates that the hedging potential of investing in both bonds and stocks is reduced, making the investment riskier. As a result, investors are likely to demand a higher risk premium to compensate for this increased risk.

Following this interpretation, to understand the link between the SB relationship and stock market performance, I measure the SB relationship using a rolling window SB beta because the beta measures the unit of bonds required to hedge stocks.

1. Main empirical result

I estimate the regression slope β^i of (9) using daily and weekly returns and 10-year yields. The total return index and the price index are used for stock returns, and the results are reported separately. While the total return-based index sample is more accurate as the returns include dividends, the sample period for the price index-based sample is slightly longer.

I rely on a rolling-window of 12 months for daily betas as the estimation period. For weekly betas, I rely on a rolling-window of 52 weeks. Since stock returns and bond yields are denominated in local currency in the SB beta estimation, they are not affected by asynchronous trading hours and can be estimated using daily data. Therefore, I use daily betas as the primary specification but use betas estimated using weekly data only when there is a need to control global variables.

At the end of each month, daily and weekly betas are estimated for each country, and countries are then sorted by the estimates. After that, five index portfolios are formed based on their rankings, and returns for the subsequent month are evaluated. Portfolio 1 contains countries with the most negative SB relationship, and Portfolio 5 includes those with the most positive relationship. Returns are expressed in USD, computed as the sum of the returns in local currency (Returns in local) and currency returns (Currency). The returns reported in USD are also risk-adjusted using the international CAPM as described in the data appendix.

Panel A of Table VI lists the results based on the net total index returns, whereas values reported in Panel B are based on the price index returns. For each panel, The results using daily (left side) and weekly estimates (right side) are provided separately for each panel. For all specifications considered, strong evidence suggests countries with a positive SB beta perform well. Focusing on the second column of each side and panel, in which USD-based returns are presented, investments in countries with a relatively positive SB relationship generate 0.57%–0.90% (6.8%–10.8%) higher subsequent returns compared to those with a negative relationship.

The difference in returns remains high and statistically significant across all specifications after risk-adjusting returns by the international CAPM or even when returns are presented in local currency. In further decomposing the performance of each portfolio into currency return and local currency denominated components, the panels show that the results are entirely driven by local currency denominated returns. Currency returns tend to be higher for Portfolio 1, which consists of countries with negative SB beta or with little risk. However, most of the specifications reveal that the difference is statistically insignificant.

In estimating the SB betas, the beta may be capturing stock returns' sensitivity to global bond yield changes. Yield changes are highly correlated across countries (e.g., Jotikasthira, Le, and Lundblad 2015, Colacito and Croce 2011). Hence, a high cross-country correlation between yield shocks implies that yield betas may capture the stock market's reaction to particular global shocks.

Therefore, I consider an additional specification where the global yield innovations (and global stock returns in addition to yields) are controlled. The specification is given by

$$R^i_{m,t+1} = \gamma^i_0 + \gamma^i_y(-\Delta y^i_{t+1}) + \gamma^i_g \sum_{\forall j}(-\Delta y^j_{t+1}) + \gamma^i_{gs} R^*_{m,t+1} + \epsilon^i_{t+1}, \tag{10}$$

where weekly data is used to estimate the regression. Similarly to the main specification, note the negative signs in the yield changes.

The results of this alternative specification are reported in Panel A of Table VII. The left side of the panel describes the results when γ^i_{gs} is set to zero, and the bottom part uses the full model. Overall, the results are similar to Table VI. The return difference based on both controls is slightly lower at 0.41%–0.55% per month but remains statistically significant. A weaker result is also natural if local and global yield shocks are highly correlated.

Figure 5 presents the time-series performance of the quintile portfolios formed based on lagged SB betas. The figure shows that investing one dollar in the positive beta portfolio in 1999 would have resulted in a final value of 7.53 USD by the end of 2022, compared to only 1.69 USD for the negative beta portfolio. The higher return of the positive beta portfolio is likely due to higher risk compensation, as indicated by its greater volatility and is consistent with the hypothesis of this paper.

2. Default risk

Treasury bonds are subject to sovereign default risk. Moreover, as reported by Pan and Singleton (2008) and Longstaff, Pan, Pedersen, and Singleton (2011), sovereign default risk and the associated risk premium are primarily determined by highly time-varying global factors. I examine whether this paper's main return predictability result is due to stock returns reacting to sovereign default risk.

Mathematically, in the absence of any liquidity premium, inflation risk, and double default, it is well known that bond yield can be decomposed as the sum of the risk-free rate and the CDS spread. Any variation in bond yields that is not driven by the default compensation component must hence be due to changes in the risk-free rate. The changes in the bond yield can be represented by

$$\Delta y^i_{t+1} \approx \Delta CDS^i_{t+1} + \Delta RF^i_{t+1}, \tag{11}$$

where CDS^i_{t+1} is the CDS rate and RF^i_{t+1} is the risk-free yield.[4]

Then, I estimate the beta of these two components using the regression

$$R^i_{m,t+1} = \delta^i_0 + \delta^i_1(-\Delta RF^i_{t+1}) + \delta^I_2(-\Delta CDS^i_{t+1}) + \epsilon^i_{t+1}, \tag{12}$$

where $R^i_{m,t+1}$ is the stock return of country i in local currency, and sort the countries by the two beta estimates separately. The negative signs are to match the interpretation to the main specification, namely the SB beta. Thereafter, portfolios are formed for each of these estimates separately, and returns are evaluated for the subsequent month as in the previous analysis.

[4] The approximation comes from assuming that

$$\Delta CDS^i_{t+1} \times \Delta RF^i_{t+1} \approx 0.$$

Panel B of Table VII summarizes the stock returns expressed in USD, the CAPM risk-adjusted returns, the stock returns expressed in the local currency, and the currency returns of the portfolios. This analysis is based on daily data, and the result for the estimates using weekly data is unreported but very similar.

If default risk is priced in the stock market, stock prices that react most negatively to increased CDS spread (Portfolio 5) should generate higher returns. However, the tabulated findings suggest no evidence thereof – the signs are the opposite of this premise, although the difference is statistically insignificant. In contrast, investments in countries whose stock returns react most negatively to a positive shock in the risk-free bond yield beta (Portfolio 5) have higher returns for the subsequent month, consistent with the main explanation of this paper.

In sum, these findings suggest that default risk is unlikely to be the source of the main results. When global risk factors are the main drivers of sovereign credit risk, and the SB beta reflects information on country-specific risk, the results reported are a natural outcome.

3. Cross-sectional regressions

Table VI indicates that the SB beta strongly predicts the relative performance of country-level stock returns. This finding contrasts the insignificant unconditional relationship between SB betas and average stock market returns in Panel B of Table II.

There are two objectives of this section. The first is to fill the gap described above and confirm that the SB betas contain information about the time-varying characteristic of the country-specific equity risk premia. The second objective is to investigate whether the predictive power of SB betas is due to them being simple proxies of standard macroeconomic variables or other predictors that are known to predict stock returns in the international setting.

A cross-sectional regression is conducted for these purposes. First, for each month, the leading month country stock index returns are regressed on the SB beta estimates and control variables. Then, the time-series mean of the regression coefficients and the Fama-MacBeth standard errors are calculated.

3.1. Time-varying cross-country predictability

To investigate whether the cross-sectional difference in stock market performance can be explained by country-fixed or highly persistent variables (such as geographical location and the degree of economic development), I include the time-series average of the beta estimates as a control variable. This control variable is forward looking but represents a reasonable way to capture fixed characteristics.

Panel A of Table VIII summarizes the test results of this first hypothesis using price returns. The first specification shows the regression without any control, and the significance is consistent with the main empirical result reported in Table VI. The subsequent regressions control for the time-series average. The coefficient on the time-varying component remains positive and statistically significant, whereas the time-series average coefficient is negative. This second piece of evidence strongly suggests that the return predictability of the SB beta is driven by the time-varying rather than the time-constant component.

In addition, I investigate whether the outperformance of certain countries is due to them being emerging markets or having higher growth potential.I include several macroeconomic variables as controls in the regression analysis to test this possibility. These variables include per capita GDP, which represents whether the country is in a developed or emerging market economy; total GDP, which reflects the size of the country; the country's long-run inflation forecast from the WEO; and the country's GDP growth forecast also from the WEO.

The above results suggest that these characteristics are not likely to have a significant impact as they are unlikely to vary much over three decades. Panel A confirms that neither economic growth rate, size of the economy, inflation, nor growth perspective drives the cross-country predictability.

In the appendix, I repeat the analysis with net total returns. As noted earlier, the sample is mostly shorter but includes dividends. The results are qualitatively similar to the price index return-based results, but the coefficients of the cross-sectional regressions are lower. The difference mainly stems from using a shorter sample period.

3.2. Global market illiquidity

One of the well-known predictors of international stock returns is the exposure to the global liquidity factor (Bekaert, Harvey, and Lundblad 2007). Goyenko and Sarkissian (2014) find that exposure to US Treasury illiquidity is a significant driver of international stock returns. Given the significant findings in this literature, it is reasonable to consider global illiquidity variables as control variables in this study. The construction of these monthly measures follows Goyenko and Sarkissian (2014) and is described in the appendix in more detail.

The regression analysis involves regressing stock index returns on each of the four illiquidity measures' residuals in addition to the global value-weighted portfolio returns using a rolling window of 60 months. Panel B of Table VIII describes the results of this cross-sectional regression. The results show that the SB beta continues to be a significant predictor of the cross-section of country stock returns. Specifically, three out of four illiquidity measures – the Treasury illiquidity, the fraction of zero returns, and the fraction of zero volume stocks – negatively predict future stock market returns, as expected. However, the coefficient on the SB beta remains positive and statistically significant.

3.3. The relationship to other return predictors

The subsequent analysis investigates the relationship between SB betas and other standard predictors used in the international stock return predictability literature. To answer this question, I consider the return predictors that Cenedese, Payne, Sarno, and Valente (2016) and Hjalmarsson (2010) examine. They show that country-level dividend yields, term spread, and cross-country momentum strongly predict international stock returns.

Following the same methodology described earlier, I conduct a cross-sectional analysis with these additional predictors as controls. As previous studies do, the dividend yield of each country is estimated annually as the difference between the net total returns and the price returns of the corresponding MSCI index. The term spread is the difference between 10-year and 1-year yields, and momentum is the average return preceding the measurement time by 2 to 12 months. The term spread and momentum are estimated monthly on the last trading day. Since dividend yields are only available from 1999 onwards, I limit this analysis to the post-1999 sample.

Panel C of Table VIII summarizes the results of this analysis. Overall, the SB beta remains positive and statistically significant for all predictors considered. Strong evidence shows that the SB beta outperforms dividend yield, term spread, or momentum. Overall, the coefficient on the SB beta is smaller than those results reported in Models 1-3. The main reason is that estimating dividend yields requires the total returns index data. Since the total return index sample begins in 1999, the economic magnitudes are rather comparable to Panel A of the table based on total returns provided in the appendix.

VI. Globalization and SB correlation

Recent articles studying the time-variation in the SB correlation using US data have focused on the late 1990s due to a significant sign switch in the correlation during this period. Theories explaining the switch include the inflation-based explanation and the real economy-led explanation. However, the late 1990s can be analyzed from multiple perspectives. For instance, asset correlations across countries have risen over time, and international trade increased significantly during that period. In their study, Eiling and Gerard (2015) demonstrate an increasing trend in asset correlation. This section investigates whether globalization contributed to the overall decline in the SB correlation.

Figure 6 presents tentative evidence indicating that globalization might contribute to the fluctuation in the SB correlation over time. Panel (a) compares the SB correlation with the correlation between the MSCI USA Price Index returns and the MSCI World Ex-USA Price Index returns, estimated using monthly data. The correlation between the USA and Ex-USA returns is considerably higher, particularly starting from the time when the SB correlation is lower. Additionally, a clear inverse relationship between the two correlations is apparent. When the SB correlation is below its median trend, the US-World correlation appears to be higher than its historical trend.

For a substantial portion of the sample, the MSCI World Ex-USA Price Index data is available only on a monthly basis. This limited data frequency poses a constraint to further analysis of the relationship. Therefore, the daily MSCI World Price Index returns are used instead in Panel (b). The negative association between the SB and US-world stock correlations is not as evident in this panel. This weak result may be because the US market's large fraction of market capitalization drives up the general level of the US-world stock return correlation. Therefore, in Panel (c), the US-World stock return correlation is detrended by subtracting the 36-month lag. The panel reveals a more precise negative relationship with the SB correlation.

I further test the significance of the relationship between the SB correlation and the US-World stock return correlation through several methods. Firstly, I compute the simple correlation coefficient between the US-World Price Index returns for two different periods separately: 1972-1998 and 1999-2022. The results, summarized in Panel A of Table IX, suggest that the US-World stock return correlation is higher and the SB correlation is lower in the later sample period, consistent with what Figure 6 describes. Hence, the analysis confirms the negative relationship between the SB correlation and the US-World return correlation between the two sample periods.

A common structural break could be one possible driver of this negative relationship between the two series. That is, there may be other factors that drive the structural break in both of the time series. This possibility is investigated through a time-series regression, where the estimated US-World return correlation is regressed on the contemporaneous SB correlation, a dummy variable for the post-1998 period, and their interaction. A monthly regression is employed where correlations are estimated using daily observations with a one-month window to mitigate spurious relationships that may arise from using non-overlapping observations.

Panel B of the same table describes the results. If the shared variation is due to the structural break, the coefficient on the interactive variable should be significant. On the other hand, if the variation is due to fluctuation unrelated to the structural break, the simple coefficient on SB correlation should be significant. The regression result shows that the negative relationship between the SB correlation and the US-World return correlation is unexplained primarily by the structural break.

The sample is then further split into two periods: before and after the beginning of 1999. A simple regression is estimated separately for each of the subsamples. The negative relationship is observed, and the coefficient on the SB correlation is negative in both subsamples. These findings suggest that the negative relationship between the two correlations is not solely due to a common structural break that happened around this time.

For robustness, I further test the hypothesis using an alternative method. Monthly US stock returns are regressed on world stock returns, interacting with the SB correlation. If there is a common variation between the US-World stock correlation and the SB correlation, the coefficient on the interactive term should be negative. The first column of Panel C shows that the coefficient is indeed negative and statistically significant, supporting the hypothesis.

I employ another approach further to investigate the possibility of a common structural break. I introduce an indicator variable that takes a value of 1 for the post-1998 period and an interaction of the indicator variable with the SB correlation and monthly world returns. Using US returns as the dependent variable, this triple-interaction term should capture any potential comovement that could be attributed to the common structural break around that time. The second column of Panel C presents the results, which indicate that the structural break does not drive the comovement in the correlation.

VII. Conclusion

This paper demonstrates that the dynamics between stock and bond returns contain information about the expected excess returns of the equity market relative to the rest of the world. Stock and bond prices tend to move in the same direction when countries or regions have higher country-specific risk. Conversely, stocks and bonds move in opposite directions for countries or regions with lower country-specific risk, hedging against each other. Bonds can offset global growth expectation risk in such countries, making stock investments less risky. As a result, the equity investment in these countries requires less compensation. This article provides empirical support for these hypotheses.

The presented model in this paper offers a new explanation for the time-varying correlation between stock returns and bond yields. The conventional flight-to-quality hypothesis suggests that during periods of heightened volatility, investors shift towards less risky investments such as bonds. However, this paper's findings reveal that flight-to-quality is actually influenced by the global component rather than local volatility. In countries with high local volatility, stock and bond prices move together, contradicting the standard theory.

This paper establishes a connection between two previously distinct theories on the stock-bond correlation. The first theory posits that the correlation is driven by the relationship between inflation and real growth, while the second theory emphasizes the role of shock persistence. Our analysis suggests that both theories are linked to the increasing integration of the world.

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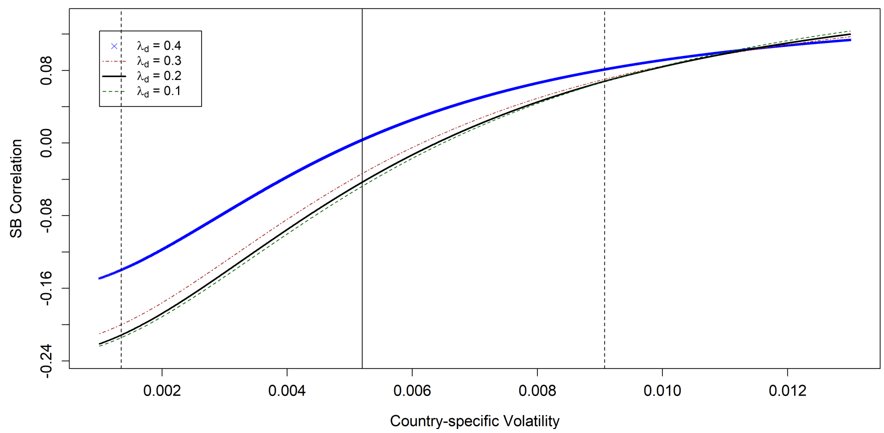
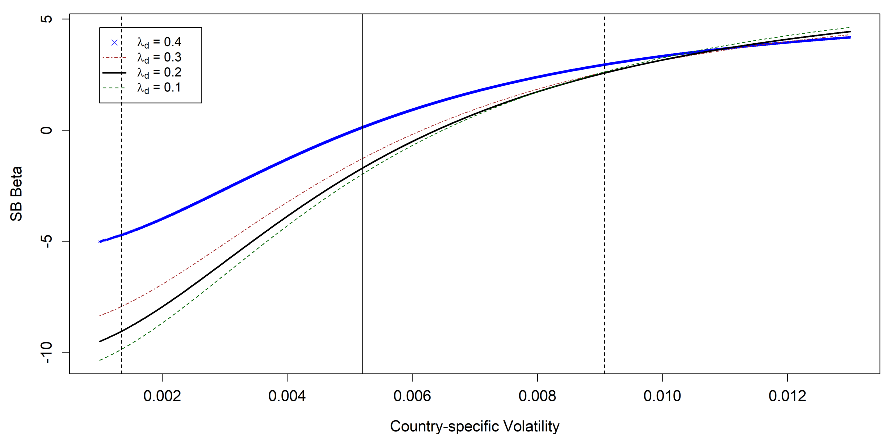
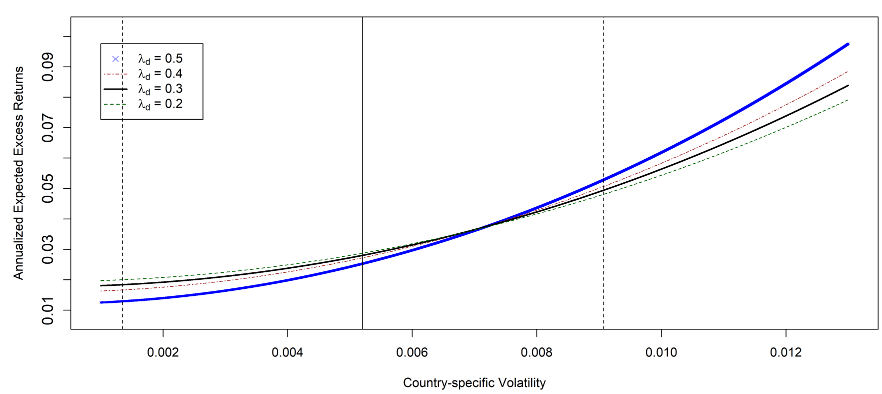


(a) SB correlation



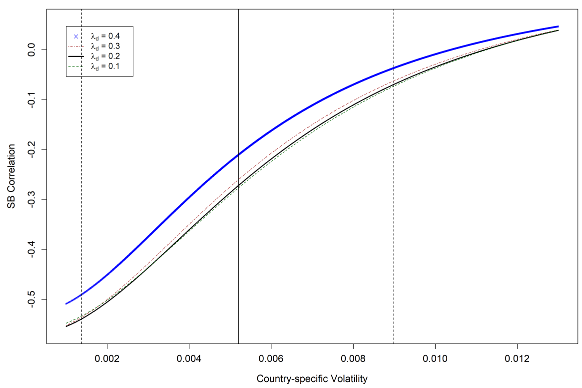
(b) SB beta



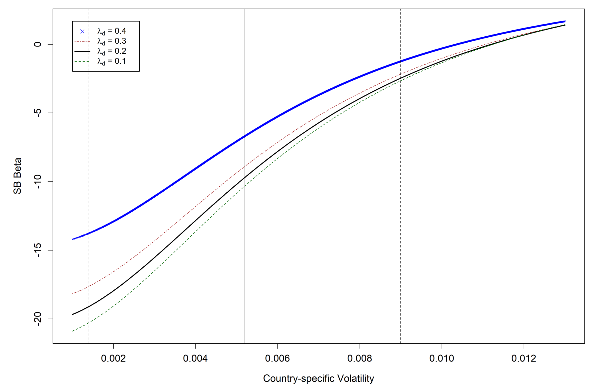
(c) Expected stock returns

Figure 1. SB beta and the expected stock returns

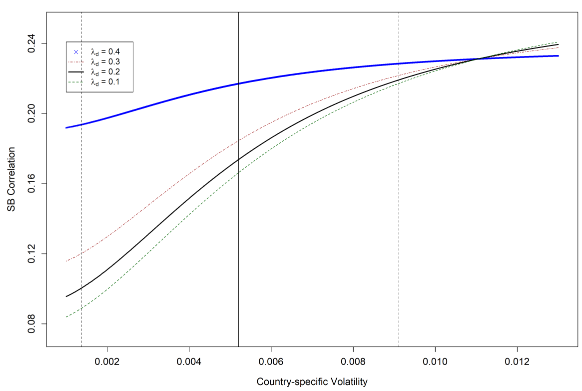
This figure displays the model-implied variation in the SB correlation (Panel a), the SB beta (Panel b), and the expected excess market returns (Panel c) for various levels of country-specific volatility. The global volatility is set at the average value specified by the model. The SB correlation represents the negative correlation between unexpected changes in log stock prices and 10-year nominal bond yields, while the SB beta represents the negative of the covariance divided by the variance of the unexpected changes in 10-year nominal bond yields. The mean of the country-specific volatility is shown as a solid vertical line, and the 95% confidence interval is represented by dotted lines. This figure is generated using the parameters specified as Model 1 in Table I and is expressed in monthly terms except for the expected excess returns, which is annualized.



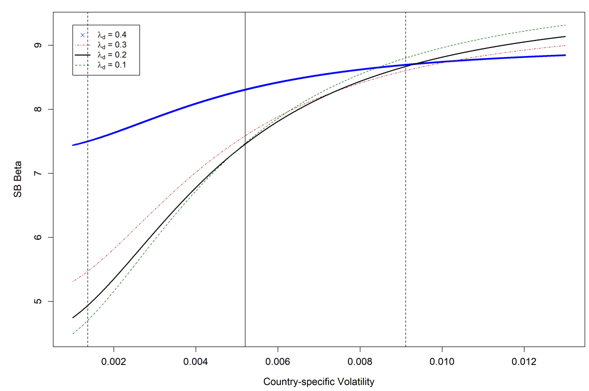
(a) Negative SB correlation



(b) Negative SB beta



(c) Positive SB correlation



(d) Positive SB beta

Figure 2. SB beta and country-specific volatility under alternative specifications

Panels (a) and (c) represent the relationship between country-specific volatility and SB correlations under different correlation values between inflation and real growth. Panels (b) and (d) show the relationship using SB betas instead of correlations. Parameters specified as Model 2 are used to generate Panels (a) and (b), and parameters of Model 3 are used to generate Panels (c) and (d). The global volatility is assumed to be at the average value in all four panels. The average country-specific volatility is shown as a solid vertical line, and dotted lines represent the 95

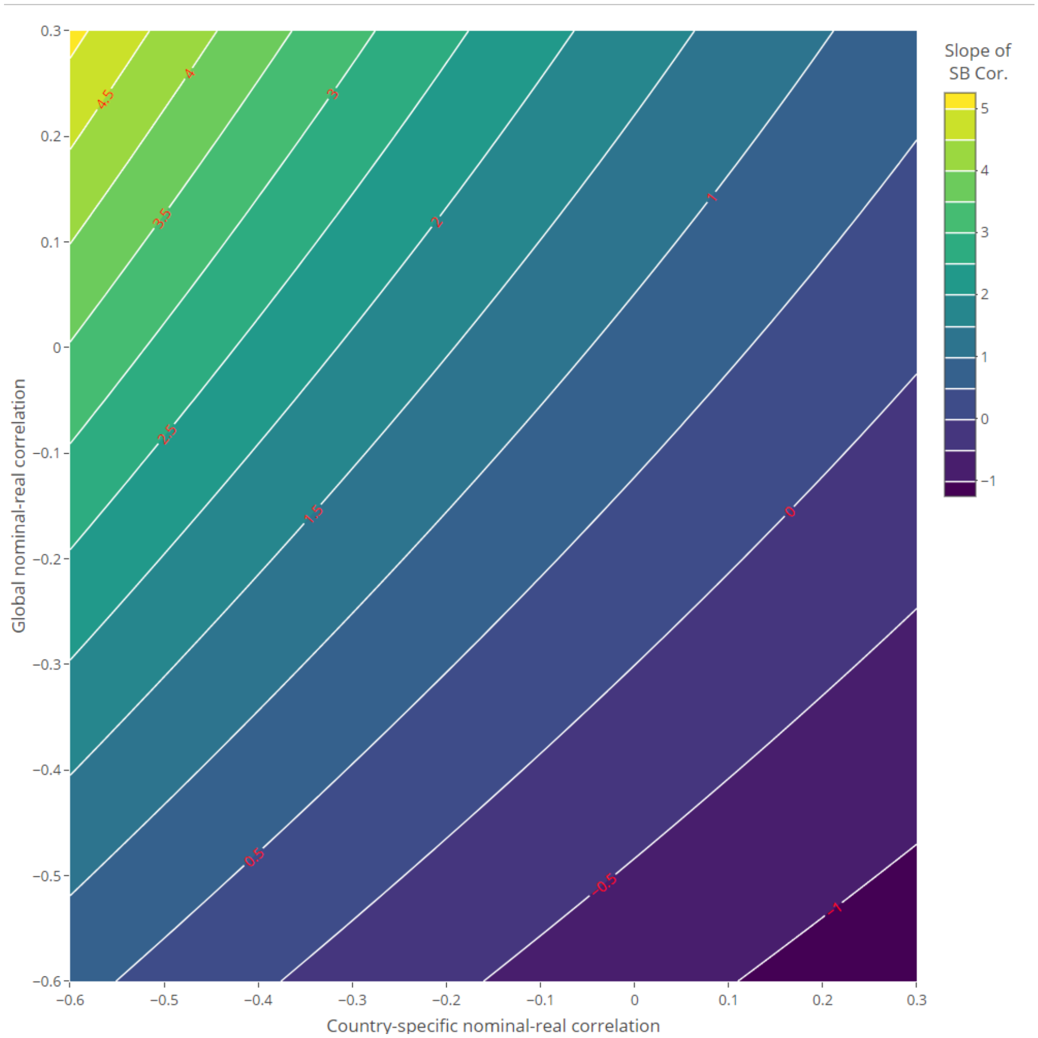
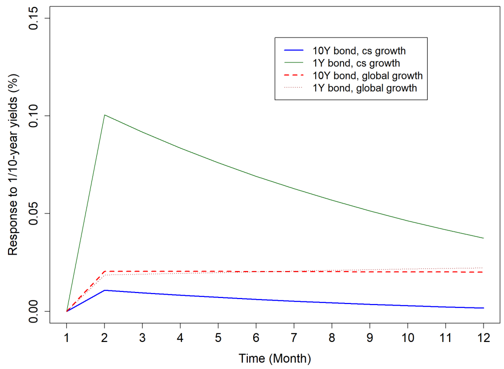
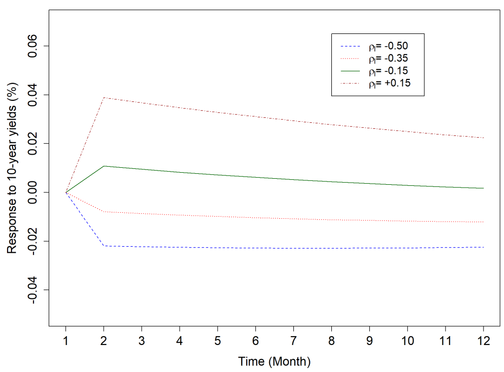


Figure 3. The slope of SB correlation on country-specific volatility

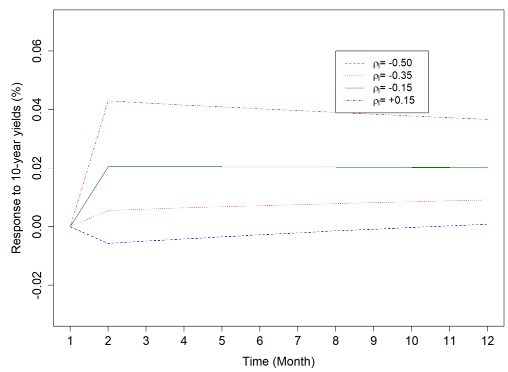
This plot displays a two-dimensional view of the relationship between the slope of the SB correlation and the country-specific volatility while controlling for different levels of the growth-inflation correlation implied by the model. The plot uses a contour map, where darker regions indicate a lower slope of the SB correlation on country-specific volatility. The parameters specified as Model 1 in Table I generate this figure.



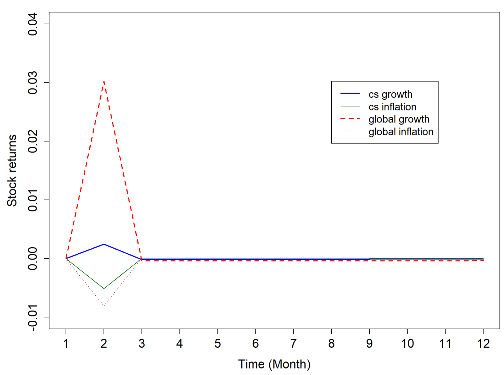
(a) Response to 1- vs 10-year bond yields



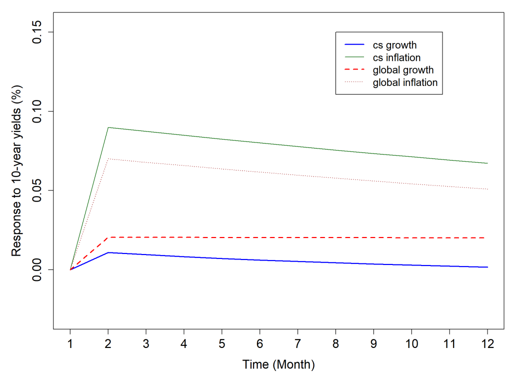
(b) Response to country-specific growth expectation shock



(c) Response to global growth expectation shock



(d) Response to stock returns



(e) Response to 10-year bond yields

Figure 4. Drivers of the stock-bond yield dynamics

This figure illustrates the response of 1-year and 10-year bond yields and stock returns to one standard deviation shock in country-specific and global growth and inflation expectations. Panel (a) displays the response of 1-year and 10-year bond yields to growth shocks. Next, panels (b) and (c) show the response of 10-year bond yields to country-specific and global growth shocks for various values of inflation-real growth correlation. Finally, Panels (d) and (e) demonstrate the reactions of stock returns and 10-year bond yields to growth expectations and inflation shocks. The parameters specified as Model 1 in Table I generate this figure.

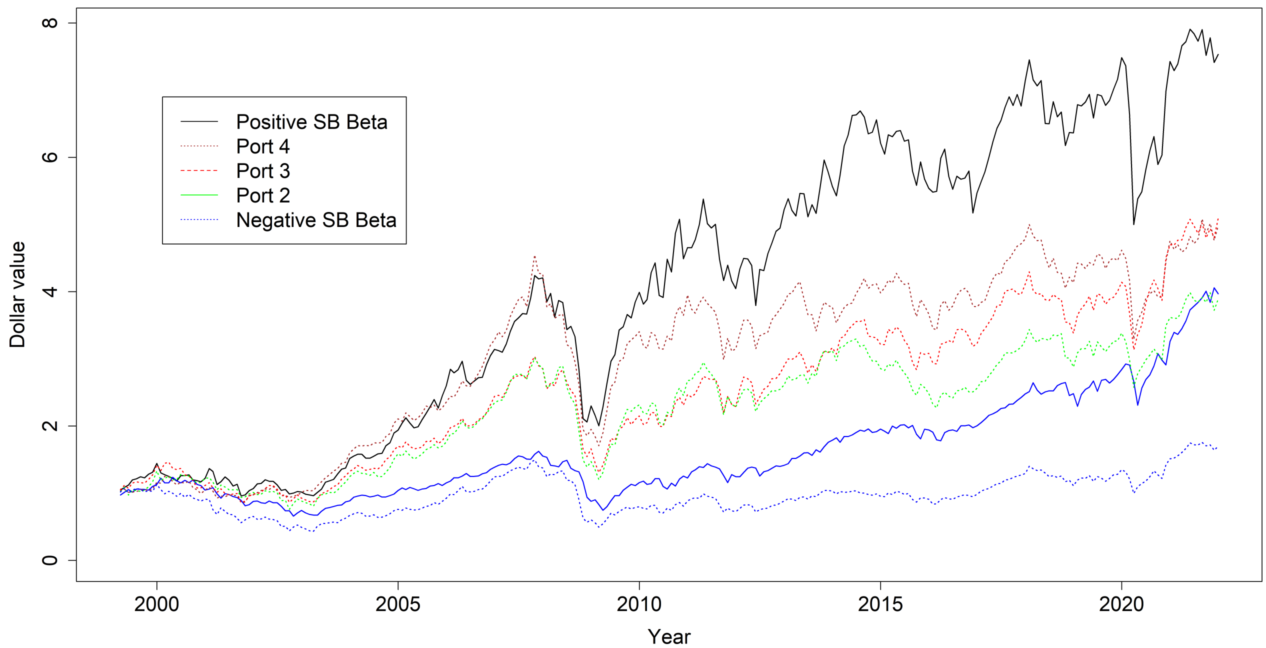
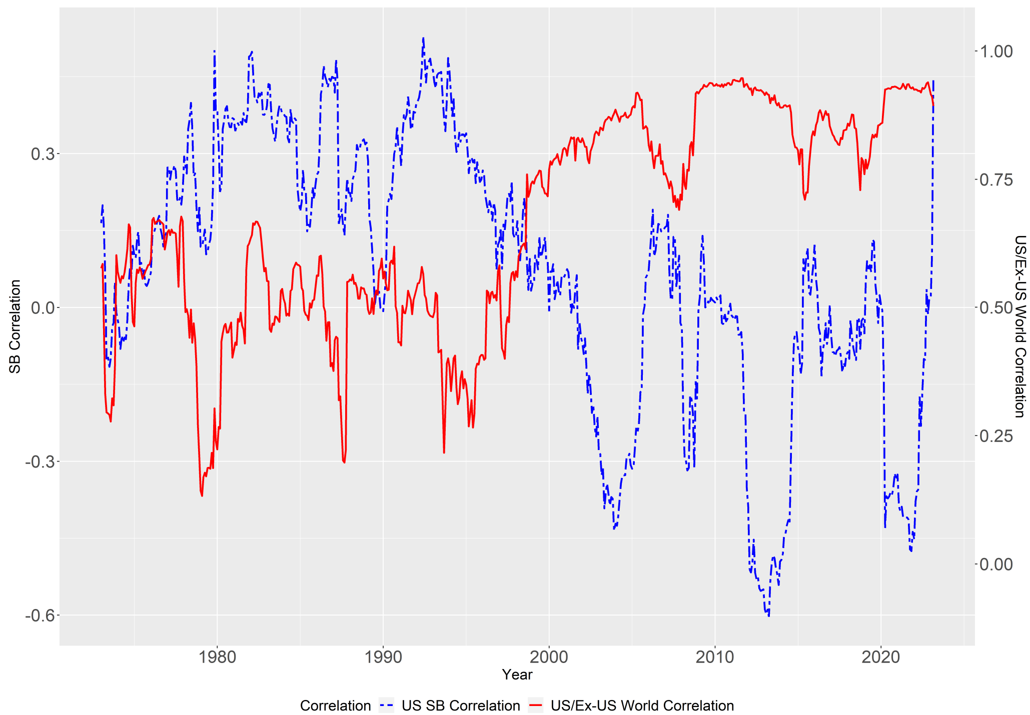
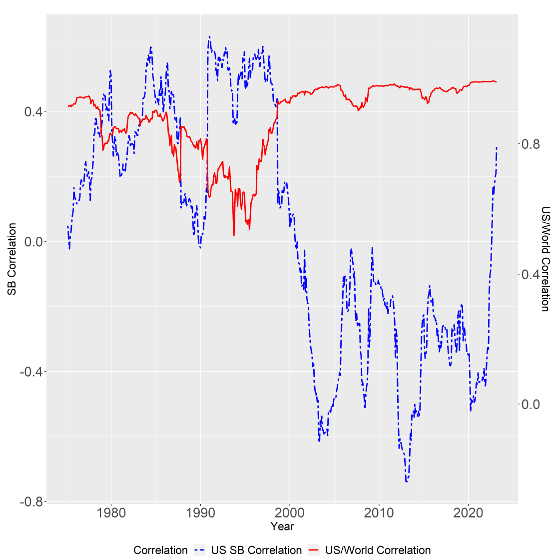


Figure 5. International stock market performance

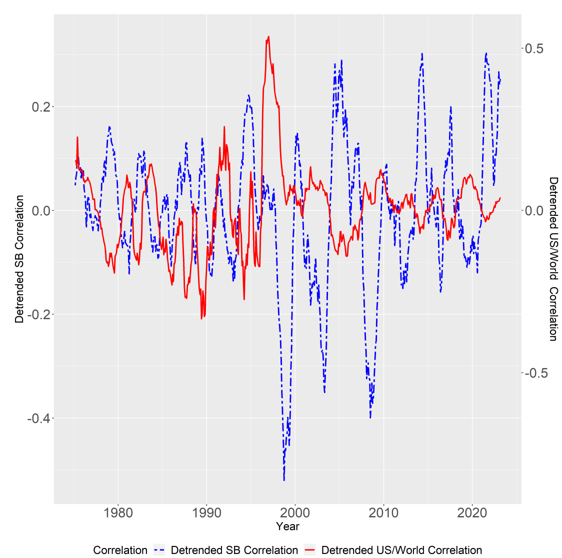
This figure shows the relative performance of quintile country equity portfolios formed after sorting by their SB beta. The SB beta is the negative beta of local stock market returns regressed on changes in ten-year sovereign bond yields. The top quintile represents countries with the highest SB beta values, while the bottom quintile represents countries with the lowest SB beta values. The graph shows the performance of the portfolios over time. The x-axis represents the year, and the y-axis represents the dollar value of the asset assuming a $1 investment in 1999.



(a) US-ExUS world stock correlation and SB correlation



(b) US-world stock correlation and SB correlation



(c) Detrended US-world stock correlation and SB correlation

Figure 6. The time series of the US-World equity correlation

This figure displays the association between the SB correlation of the US and the correlation between the US and global stock index returns (US-world correlation) in three different panels. Panel (a) displays the relationship between the SB correlation and the US-world correlation estimated using 36 monthly observations, where the global stock returns are measured using the MSCI World Ex-USA Index returns. Panel (b) represents the same relationship, using MSCI World Index returns for world returns. Finally, Panel (c) presents the relationship between the US SB correlation and the US-World correlation estimated using one year of daily data using MSCI World Index returns and detrended by subtracting the 36-month rolling window average.

Table I
Model Calibration

Panel A of this table outlines the primary parameter specifications of the model, while Panel B presents the model-implied asset pricing moments based on simulation. The moments estimated from 1990 to 2022 are provided for comparison purposes. The parameters in Panel A are in monthly terms, while the values in Panel B are annualized. Δc^i and Δd^i denote the consumption and dividend growth of country i. Δy^i is the unexpected changes in nominal 10-year yields of country i, π^i is the one-period (year in the data) ahead inflation forecast, and R_m^i is the nominal stock return of country i in denominated in local currency. ρ_{SB} is the SB correlation, and β_{SB} is the negative covariance between R_m^i and Δy^i divided by the variance of Δy^i. The model-based cross-country correlations are calculated by averaging the values of 1,000 simulations. Each simulation involves generating 500 months of consumption and dividend growth for the country and dropping the first 100. I use net total returns beginning in 1999 to estimate the mean of stock returns and use price returns that begin in 1990 to estimate the volatility, ρ_{SB}, and β_{SB}.

Panel A. Parameter specification

Preference parameters		Inflation parameters			
γ	7.5	p_1	0.970		
ψ	2	$\bar{\pi}$	0.002		
β	0.9987	σ_{pg}	0.085		
		σ_{pl}	0.057		
Consumption parameters		**Dividend Parameters**		**Variance parameters**	
μ	0.0018	μ_d	0.0019	ω_{g1}	0.961
ξ_g	0.989	ϕ_d	5.0	ω_{l1}	0.986
ξ_l	0.930	λ_g	0.2	$\sqrt{\bar{v}_t{}^i}$	0.0052
σ_{xg}	0.034	σ_{dg}	9.0	$\sqrt{\bar{v}_t{}^*}$	0.0028
σ_{xl}	0.067	σ_{dl}	6.5	σ_g	0.00089
				σ_l	0.00087

Correlations

	Model 1	Model 2	Model 3
ρ_{cd}	0.55	0.55	0.55
ρ_l	−0.15	−0.15	−0.25
ρ_g	−0.15	0.15	−0.35

Panel B. Consumption, dividend, inflation, and asset pricing moments

	Model			Data		
	Model 1	Model 2	Model 3	US (Median)	Global Mean	Global Median
μ		2.16%		2.38%	2.59%	2.11%
σ		2.05%		1.54%	2.13%	1.77%
$\text{Cor}(\Delta c^i, \Delta c^j)$		0.346		0.368	0.350	0.371
$\text{Cor}(\Delta d^i, \Delta d^j)$		0.490		0.494	0.380	0.418
$\text{Cor}(\Delta \pi^i, \Delta \pi^j)$		0.389		0.639	0.352	0.352
Nominal yields (10Y)	4.79%	4.67%	4.85%	4.26%	5.18%	4.22%
Stock returns	7.88%	7.99%	7.80%	7.16%	7.14%	6.78%
Stock market volatility	18.42%	18.59%	18.30%	15.22%	20.76%	20.66%
$\text{Cor}(\Delta y^i, \Delta y^j)$	0.503	0.602	0.426	0.593	0.464	0.578
$\text{Cor}(R_m^i, R_m^j)$	0.595	0.602	0.591	0.697	0.584	0.667
ρ_{SB}	−0.043	−0.272	0.173	−0.089	0.007	−0.046
1990-1998				0.300	0.212	0.217
1999-2022				−0.333	−0.047	−0.095
β_{SB}	−1.714	−9.69	7.45	−1.693	−1.041	−1.234
1990-1998				3.913	7.667	3.930
1999-2022				−7.030	−2.677	−2.700

Table II
Summary statistics

This table provides a summary of the data used in this paper. Panel A displays summary statistics for daily MSCI net total and price returns, 10-year sovereign bond yields, SB beta ($\hat{\beta_{SB}}$), SB correlation ($\hat{\rho_{SB}}$), and the international CAPM beta. The sample for price returns begins in the year specified in the second column, while the sample for total returns begins in the year specified or 1999, whichever is later. Panel B describes the unconditional cross-sectional correlations between measures of SB relationship and other variables of interest, including the average price and total returns, currency returns, CAPM beta, stock market volatility, and bond yield volatility. All standard deviations and betas are estimated using daily data from the entire sample. The p-values are reported in parentheses.

Panel A. Summary statistics

Country	Yr–	Price returns		Total returns		Bond yields		$\hat{\beta}_{SB}$	$\hat{\rho}_{SB}$	CAPM
		Mean	Std.	Mean	Std.	Mean	Std.			beta
Australia	1990	0.046	0.138	0.076	0.134	0.055	0.096	−0.776	−0.053	0.811
Austria	1993	0.023	0.232	0.046	0.244	0.034	0.078	−5.824	−0.164	0.911
Belgium	1993	0.027	0.188	0.014	0.201	0.036	0.080	−2.137	−0.074	0.857
Brazil	2010	−0.020	0.329	0.073	0.213	0.108	0.074	7.364	0.497	0.824
Canada	1990	0.059	0.146	0.074	0.146	0.045	0.091	−2.037	−0.104	0.776
China	2006	0.056	0.252	0.079	0.251	0.035	0.017	−2.325	−0.038	0.852
Finland	1996	0.069	0.282	0.045	0.279	0.030	0.073	−8.538	−0.194	1.219
France	1990	0.049	0.167	0.052	0.175	0.040	0.092	−4.314	−0.140	1.072
Germany	1990	0.044	0.193	0.044	0.208	0.036	0.090	−8.599	−0.263	1.121
India	1999	0.130	0.243	0.137	0.242	0.078	0.054	2.566	0.103	0.544
Indonesia	2004	0.130	0.223	0.152	0.223	0.088	0.081	3.202	0.277	0.420
Italy	1993	0.014	0.207	0.012	0.203	0.042	0.088	5.284	0.238	0.973
Japan	1990	−0.007	0.192	0.038	0.176	0.018	0.063	−4.528	−0.122	0.784
Korea	2001	0.094	0.211	0.108	0.211	0.039	0.057	−2.491	−0.092	0.643
Malaysia	1999	0.041	0.172	0.062	0.138	0.041	0.028	1.300	0.072	0.405
Mexico	2002	0.077	0.227	0.126	0.155	0.074	0.050	0.852	0.106	0.850
Netherlands	1991	0.058	0.169	0.064	0.180	0.037	0.087	−6.533	−0.206	1.030
Norway	1996	0.054	0.204	0.083	0.199	0.040	0.072	−4.609	−0.154	0.738
NZ	1998	0.019	0.165	0.063	0.148	0.056	0.085	0.880	0.046	0.438
Philippines	1998	−0.003	0.232	0.047	0.210	0.093	0.189	0.654	0.102	0.444
Russia	2001	0.030	0.328	0.090	0.285	0.055	0.094	6.609	0.288	0.940
Singapore	2000	0.038	0.209	0.063	0.200	0.027	0.034	−3.249	−0.122	0.615
S. Africa	1997	0.086	0.193	0.131	0.175	0.099	0.085	3.244	0.250	0.699
Spain	1993	0.044	0.206	0.029	0.205	0.045	0.098	3.353	0.141	1.011
Sweden	1991	0.081	0.219	0.082	0.208	0.043	0.117	−0.697	−0.028	0.787
Switzerland	1995	0.055	0.145	0.046	0.133	0.019	0.057	−6.120	−0.192	0.680
Thailand	2001	0.067	0.233	0.096	0.233	0.036	0.045	−0.080	−0.003	0.612
Turkey	2011	0.069	0.234	0.095	0.233	0.115	0.124	2.077	0.329	0.592
UK	1990	0.034	0.141	0.044	0.138	0.046	0.099	−1.692	−0.089	0.817
USA	1990	0.085	0.147	0.072	0.152	0.043	0.071	−4.059	−0.208	0.987
World	1990	0.048	0.155	0.052	0.158					

Panel B. Unconditional correlations

	Net ret.	Price ret.	Currency ret.	CAPM beta	Stock vol.	Bond vol.
$\hat{\beta}_{SB}$	0.034	−0.285	−0.207	−0.384	0.415	0.151
	(0.859)	(0.127)	(0.273)	(0.036)	(0.023)	(0.425)
$\hat{\rho}_{SB}$	−0.058	−0.399	−0.323	−0.349	0.549	0.194
	(0.760)	(0.029)	(0.082)	(0.058)	(0.002)	(0.303)

Table III
Expected inflation and expected growth

This table presents the simple correlation coefficients between shocks to global GDP growth forecast/estimates and shocks to global inflation forecast/estimates and the cross-country average partial correlation between shocks to the forecasts/estimates controlling for global variables, along with their t-statistics. Panel A describes the correlation coefficients for the nowcast error, Panel B summarizes those values for the one-year-ahead forecast revision, and Panel C shows the estimates for the two-year-ahead forecast revision. The left side of the panels summarizes the simple correlation coefficient between shocks to global variables. The right of the panels reports the partial correlation coefficient between shocks to local variables. The correlations estimated for the entire sample first and then after splitting the sample into two periods. $\Delta\hat{x}_{t,t}$ ($\Delta\hat{\pi}_{t,t}$) denotes GDP growth (inflation) nowcast error. In April of year t, it is the difference between the estimate for the past year ($t-1$) and the concurrent-year estimate for the previous October. $\Delta\hat{x}_{t,t+1}$ in April year t is the one-year-ahead forecast, which is the difference between the current year t estimate and the year t of October previous year. $\Delta\hat{x}_{t,t+2}$ in April year t is the difference between the $t+1$ forecast and the two-year-ahead forecast of the previous October. In October of year t, they are measured as the difference between year t, $t+1$, and $t+2$ estimates/forecasts of October and April, respectively.

Panel A. Contemporaneous estimation error

	$\text{Cor}(\Delta\hat{x}^g_{t,t}, \Delta\hat{\pi}^g_{t,t})$				$\text{Cor}(\Delta\hat{x}^i_{t,t}, \Delta\hat{\pi}^i_{t,t} \mid \Delta\hat{x}^g_{t,t}, \Delta\hat{\pi}^g_{t,t})$			
Global measured by:	1990-2022	1990-1998	1999-2022	Diff.	1990-2022	1990-1998	1999-2022	Diff.
World average	−0.059	−0.315	0.198	0.513	−0.208	−0.247	−0.207	0.040
	(−0.46)	(−1.29)	(1.38)		(−4.36)	(−3.75)	(−4.60)	(0.14)
World & continent					−0.122	−0.105	−0.081	0.024
average					(−2.33)	(−1.28)	(−1.77)	(0.58)
Advanced economy	0.325	−0.141	0.339	0.480	−0.168	−0.106	−0.122	−0.016
	(2.71)	(−0.53)	(2.47)		(−2.64)	(−1.46)	(−2.47)	(−0.25)

Panel B. One-year ahead forecast error

	$\text{Cor}(\Delta\hat{x}^g_{t,t+1}, \Delta\hat{\pi}^g_{t,t+1})$				$\text{Cor}(\Delta\hat{x}^i_{t,t+1}, \Delta\hat{\pi}^i_{t,t+1} \mid \Delta\hat{x}^g_{t,t+1}, \Delta\hat{\pi}^g_{t,t+1})$			
Global measured by:	1990-2022	1990-1998	1999-2022	Diff.	1990-2022	1990-1998	1999-2022	Diff.
World average	−0.123	−0.470	0.005	0.475	−0.194	−0.232	−0.220	0.012
	(−0.98)	(−2.06)	(0.03)		(−4.36)	(−3.14)	(−6.99)	(0.14)
World & continent					−0.198	−0.211	−0.162	0.049
average					(−4.33)	(−2.74)	(−4.52)	(0.58)
Advanced economy	0.154	0.086	0.163	0.077	−0.124	−0.158	−0.105	0.052
	(1.23)	(0.32)	(1.13)		(−2.64)	(−2.24)	(−2.68)	(0.73)

Panel B. Shocks to two-year ahead forecast

	$\text{Cor}(\Delta\hat{x}^g_{t,t+2}, \Delta\hat{\pi}^g_{t,t+2})$				$\text{Cor}(\Delta\hat{x}^i_{t,t+2}, \Delta\hat{\pi}^i_{t,t+2} \mid \Delta\hat{x}^g_{t,t+2}, \Delta\hat{\pi}^g_{t,t+2})$			
Global measured by:	1990-2022	1990-1998	1999-2022	Diff.	1990-2022	1990-1998	1999-2022	Diff.
World average	−0.150	−0.661	−0.095	0.566	−0.217	−0.194	−0.273	−0.079
	(−1.19)	(−3.41)	(−0.65)		(−4.95)	(−2.67)	(−6.55)	(−0.89)
World & continent					−0.187	−0.129	−0.173	−0.044
average					(−4.29)	(−1.71)	(−4.22)	(−0.08)
Advanced economy	0.172	−0.343	0.209	0.552	−0.192	−0.189	−0.138	0.051
	(1.37)	(−1.37)	(1.47)		(−3.83)	(−2.64)	(−3.22)	(0.70)

Table IV
Stock and bond market response to local and global shocks

This table summarizes the results of the panel regression where annual stock returns (Panel A) and yearly changes in 10-year bond yields (Panel B) are regressed on the two-year forecast revision of inflation ($\Delta\hat{\pi}_{t,t+2}$) and GDP growth ($\Delta\hat{x}_{t,t+2}$). The two-year forecast revisions in year t are measured as the difference between the year $t+1$ forecasts and the two-year-ahead forecasts made in year $t-1$. Stock prices and bond yields at the end of March is matched to the April forecasts, and values at the end of September are matched to the October forecasts. Superscript i denotes individual country forecast, a is the cross-country average, and w is "world" value. The t-statistics with time-cluster-robust standard errors are reported.

Panel A. Panel regression of stock returns

	Stock returns ($R_{m,t}$)					
$\Delta\hat{x}^i_{t,t+2}$	8.454	8.413			4.183	3.711
	(3.03)	(3.01)			(3.80)	(2.04)
$\Delta\hat{\pi}^i_{t,t+2}$		−0.219			−0.274	−0.126
		(−0.87)			(−1.23)	(−0.46)
$\Delta\hat{x}^a_{t,t+2}$			5.259		8.430	
			(3.01)		(1.90)	
$\Delta\hat{\pi}^a_{t,t+2}$			0.348		0.527	
			(1.05)		(2.72)	
$\Delta\hat{x}^w_{t,t+2}$				6.569		9.721
				(3.09)		(2.52)
$\Delta\hat{\pi}^w_{t,t+2}$				−3.444		−1.401
				(−1.44)		(−0.59)
Country FE	Y	Y	Y	Y	Y	Y
R^2	0.151	0.152	0.176	0.236	0.194	0.188
N	1674	1674	1674	1474	1674	1474

Panel B. Panel regression of bond yields

	First-difference in bond yields (Δy_t)					
$\Delta\hat{x}^i_{t,t+2}$	−0.081	−0.068			−0.451	−0.354
	(−0.63)	(−0.54)			(−3.38)	(−2.35)
$\Delta\hat{\pi}^i_{t,t+2}$		0.067			0.072	0.010
		(2.49)			(2.45)	(0.27)
$\Delta\hat{x}^g_{t,t+2}$			0.302		0.733	
			(1.30)		(2.95)	
$\Delta\hat{\pi}^g_{t,t+2}$			−0.091		−0.091	
			(−3.18)		(−3.22)	
$\Delta\hat{x}^w_{t,t+2}$				0.182		0.544
				(0.58)		(1.66)
$\Delta\hat{\pi}^w_{t,t+2}$				0.586		0.572
				(2.20)		(2.08)
Country FE	Y	Y	Y	Y	Y	Y
R^2	0.234	0.267	0.246	0.275	0.257	0.281
N	1674	1674	1674	1474	1674	1474

Table V
The stock-bond relationship and local volatility

This table summarizes the results of the panel regressions, where SB correlations ($\hat{\rho}_{SBd}$, left) and SB betas ($\hat{\beta}_{SBd}$, right) are regressed on various measures of local and global volatility. In Panel A, global volatility is measured from a stochastic volatility (SV) model using the cross-country average of quarterly consumption growth. The country-specific (CS) volatility is also measured from an SV model after specifying local consumption growth as a linear function of global consumption growth. Country-specific stock market volatility is the volatility of the residual of the international version of the CAPM. Stock and bond volatility is measured quarterly using daily observations over the past rolling 12-month window. The SB correlations and betas are measured quarterly using non-overlapping daily observations. The t-statistics computed using time-cluster-robust standard errors are reported in parentheses.

Panel A. Global and local volatility and the SB relationship (N=2208)

	$\hat{\rho}_{SBd,i}$				$\hat{\beta}_{SBd,i}$			
CS volatility	14.156	13.929	8.941	2.730	309.739	304.346	197.330	54.080
	(2.75)	(2.76)	(4.08)	(1.76)	(2.53)	(2.52)	(2.75)	(1.82)
Global volatility		−38.390	−3.650	−27.515		−909.675	−145.030	−675.810
		(−1.59)	(−2.55)	(−1.58)		(−1.62)	(−3.31)	(−1.87)
Country FE	N	N	Y	Y	N	N	Y	Y
Time FE	Y	Y	N	Y	Y	Y	N	Y
R^2	0.515	0.519	0.218	0.708	0.422	0.424	0.209	0.608

Panel B. Country-specific stock market volatility and the SB relationship (N=2842)

	$\hat{\rho}_{SBd,i}$				$\hat{\beta}_{SBd,i}$			
CS stock vol.	1.162	2.045	0.775	0.451	26.279	61.235	22.449	20.405
	(6.17)	(8.39)	(4.46)	(1.83)	(5.75)	(6.33)	(3.71)	(1.85)
Stock market vol.		−0.966	−0.845	−0.606		−38.254	−28.231	−29.844
		(−5.22)	(−5.94)	(−3.20)		(−4.26)	(−5.30)	(−3.04)
Country FE	N	N	Y	Y	N	N	Y	Y
Time FE	Y	Y	N	Y	Y	Y	N	Y
R^2	0.291	0.308	0.372	0.559	0.213	0.235	0.331	0.493

Panel C. Stock/bond volatility and the SB relationship (N=2842)

	$\hat{\rho}_{SBd,i}$				$\hat{\beta}_{SBd,i}$			
Bond yield vol.	3.958		2.305	1.824	101.086		44.201	27.663
	(4.80)		(4.60)	(3.55)	(4.30)		(3.98)	(2.18)
Stock market vol.		0.610	−0.321	−0.198		6.902	−14.945	−14.325
		(4.86)	(−3.75)	(−1.97)		(1.66)	(−3.63)	(−3.12)
Country FE	N	N	Y	Y	N	N	Y	Y
Time FE	Y	Y	N	Y	Y	Y	N	Y
R^2	0.261	0.228	0.371	0.563	0.195	0.177	0.332	0.493

Table VI
SB betas and international stock market performance (I)

The table reports the average and Newey-West t-statistics of the leading month country stock returns in USD and local currency, USD-denominated returns adjusted by the ICAPM, and currency returns of the SB beta sorted quintile portfolios. The portfolios are formed by sorting the countries based on their lagged SB betas, estimated using daily or weekly data over a rolling 12-month or 52-week window. Panel A reports the results using MSCI net total returns as a proxy for country stock returns, while Panel B uses price index returns. Portfolio 5 consists of countries that have a positive and high relationship between stock and bond returns. The t-statistics are calculated using Newey-West standard errors with 6 lags.

Panel A. Returns based on total returns (1999-2022)

	Daily SB beta estimation					Weekly SB beta estimation				
	USD ret.	α_{CAPM}	Local ret.	Currency	$\hat{\beta}_{SBd}$	USD ret.	α_{CAPM}	Local ret.	Currency	$\hat{\beta}_{SBw}$
Port 1	0.45	−0.15	0.32	0.12	−13.48	0.50	−0.16	0.38	0.10	−13.42
	(1.26)	(−1.35)	(1.01)	(0.85)		(1.42)	(−1.49)	(1.26)	(0.75)	
Port 2	0.58	−0.02	0.56	0.00	−7.83	0.59	0.14	0.47	0.10	−6.41
	(1.63)	(−0.17)	(1.90)	(−0.00)		(1.67)	(0.66)	(1.63)	(0.68)	
Port 3	0.81	0.47	0.77	0.01	−3.76	0.75	0.31	0.75	−0.03	−2.48
	(2.32)	(2.55)	(2.82)	(0.08)		(2.15)	(2.60)	(2.79)	(−0.25)	
Port 4	0.90	0.34	0.85	0.02	0.72	0.81	0.47	0.89	−0.11	1.69
	(2.71)	(2.37)	(3.21)	(0.18)		(2.29)	(3.27)	(3.13)	(−0.90)	
Port 5	1.03	0.72	1.17	−0.18	5.74	1.13	0.63	1.17	−0.07	7.57
	(2.69)	(3.96)	(3.69)	(−1.72)		(3.03)	(3.26)	(3.74)	(−0.72)	
H–L	0.57**	0.88***	0.84***	−0.30**	19.22	0.63***	0.79***	0.78***	−0.17	20.99
	(2.49)	(4.65)	(3.67)	(−2.54)		(2.77)	(4.11)	(3.55)	(−1.58)	

Panel B. Returns based on price returns (1990-2022)

	Daily SB beta estimation					Weekly SB beta estimation				
	USD ret.	α_{CAPM}	Local ret.	Currency	$\hat{\beta}_{SBd}$	USD ret.	α_{CAPM}	Local ret.	Currency	$\hat{\beta}_{SBw}$
Port 1	0.09	−0.41	0.03	0.05	−10.16	0.26	−0.23	0.21	0.04	−10.36
	(0.32)	(−2.60)	(0.12)	(0.48)		(0.89)	(−1.42)	(0.82)	(0.37)	
Port 2	0.41	−0.04	0.42	−0.03	−4.98	0.43	−0.02	0.37	0.04	−3.83
	(1.43)	(−0.24)	(1.75)	(−0.29)		(1.54)	(−0.13)	(1.60)	(0.36)	
Port 3	0.84	0.31	0.78	0.03	−1.67	0.65	0.21	0.61	0.02	−0.51
	(2.90)	(2.00)	(3.26)	(0.31)		(2.24)	(1.30)	(2.52)	(0.21)	
Port 4	0.92	0.42	0.82	0.08	2.17	0.78	0.28	0.79	−0.04	3.29
	(3.17)	(2.25)	(3.35)	(0.72)		(2.62)	(1.63)	(3.16)	(−0.36)	
Port 5	0.94	0.32	1.02	−0.12	7.45	1.16	0.46	1.23	−0.07	9.20
	(2.61)	(1.45)	(3.26)	(−1.18)		(3.42)	(2.11)	(3.97)	(−0.62)	
H–L	0.85***	0.73***	0.99***	−0.17	17.61	0.90***	0.69***	1.02***	−0.11	19.56
	(3.31)	(2.93)	(4.15)	(−1.44)		(3.62)	(2.72)	(4.33)	(−0.86)	

Table VII
SB betas and international stock market performance (II)

The table reports the average and Newey-West t-statistics of the leading month country stock returns in USD and local currency, USD-denominated returns adjusted by the ICAPM, and currency returns of the SB beta sorted quintile portfolios. The portfolios are formed by sorting the countries based on their lagged SB betas, estimated using daily or weekly data over a rolling 12-month or 52-week window. Panel A presents the results of a regression where the betas are estimated by regressing stock returns on negative contemporaneous changes in bond yields while controlling for changes in global bond yields, measured as the cross-country average. The right side of the panel shows the results when the global value-weighted stock returns denominated in USD are included as an additional control variable in the regression. Panel B reports the results of a regression where stock returns are regressed on the two components of the yield changes: the risk-free component and the credit risk component. The left side is for the sovereign credit default risk component, while the right is for the risk-free component.

Panel A. Controlling for global variables using total returns (1999-2022)

	Control for global yields				Control for global yields and stock returns			
	USD ret.	α_{CAPM}	Local ret.	Currency	USD ret.	α_{CAPM}	Local ret.	Currency
Port 1	0.62	−0.13	0.52	0.10	0.63	−0.03	0.60	0.02
	(1.74)	(−1.16)	(1.65)	(0.67)	(1.84)	(−0.27)	(1.98)	(0.13)
Port 2	0.71	0.08	0.63	0.06	0.70	0.05	0.55	0.13
	(2.08)	(0.85)	(2.21)	(0.42)	(2.06)	(0.53)	(2.02)	(0.95)
Port 3	0.67	0.18	0.58	0.05	0.74	0.46	0.71	0.00
	(1.97)	(1.65)	(2.24)	(0.39)	(2.16)	(2.26)	(2.63)	(0.02)
Port 4	0.77	0.67	0.85	−0.11	0.55	0.24	0.64	−0.11
	(2.12)	(2.91)	(2.94)	(−0.95)	(1.57)	(2.09)	(2.30)	(−0.89)
Port 5	1.03	0.56	1.11	−0.12	1.17	0.62	1.20	−0.06
	(2.70)	(2.91)	(3.51)	(−1.15)	(3.00)	(4.03)	(3.66)	(−0.54)
H–L	0.41*	0.69***	0.59***	−0.21*	0.55**	0.66***	0.59***	−0.08
	(1.83)	(3.52)	(2.69)	(−1.91)	(2.51)	(3.98)	(2.85)	(−0.83)

Panel B. Decomposition of bond yields into credit risk and risk-free components (1999-2019)

	Beta to the CDS component				Beta to the risk-free component			
	USD ret.	α_{CAPM}	Local ret.	Currency	USD ret.	α_{CAPM}	Local ret.	Currency
Port 1	0.69	−0.10	0.64	0.02	0.54	−0.27	0.52	0.00
	(1.66)	(−0.79)	(1.84)	(0.15)	(1.34)	(−2.30)	(1.52)	(−0.01)
Port 2	0.75	−0.01	0.71	0.01	0.80	0.06	0.78	−0.01
	(1.87)	(−0.04)	(2.28)	(0.03)	(1.90)	(0.53)	(2.36)	(−0.08)
Port 3	0.66	0.21	0.69	−0.07	0.80	0.11	0.76	0.01
	(1.61)	(1.58)	(2.21)	(−0.50)	(1.99)	(0.76)	(2.48)	(0.04)
Port 4	0.86	0.19	0.88	−0.06	0.80	0.26	0.85	−0.08
	(2.18)	(1.11)	(2.89)	(−0.45)	(2.07)	(1.54)	(2.84)	(−0.60)
Port 5	0.96	0.26	0.95	−0.04	0.94	0.41	0.96	−0.07
	(2.16)	(1.10)	(2.54)	(−0.33)	(2.12)	(1.68)	(2.55)	(−0.65)
H–L	0.27	0.39*	0.31	−0.06	0.40*	0.68***	0.45*	−0.07
	(1.22)	(1.84)	(1.39)	(−0.51)	(1.74)	(3.00)	(1.89)	(−0.56)

Table VIII
Cross-sectional regressions - Price index returns (1990-2022)

This table summarizes the average and the t-statistics of the cross-sectional regressions, where the leading USD-denominated monthly price index country stock returns are regressed on the daily SB beta ($\hat{\beta_{SBd}}$) and control variables. Control variables include the time-series average of the SB beta, total GDP, GDP per capita, GDP growth forecast, inflation forecast (Panel A), the dividend yields, term spread, and momentum (Panel B), the exposure to innovations in three different US illiquidity measures as described in the main text (Panel C). R^2 reports the average of the R^2s of the cross-sectional regressions.

Panel A. Baseline specification and control for macroeconomic variables

	Model 1	Model 2	Model 3	Model 4	Model 5
$\hat{\beta}_{SBd,t}$	0.060***	0.090***	0.059***	0.058**	0.077***
	(2.94)	(3.94)	(2.81)	(2.57)	(3.27)
$\overline{\hat{\beta}_{SBd,t}}$		−0.063***			
		(−2.99)			
Inflation Forecast			−6.41		−7.96
			(−0.98)		(−1.15)
Total GDP				0.00	0.01
				(0.09)	(0.18)
GDP per cap				−0.30	−0.39
				(−1.02)	(−1.19)
GDP Forecast				−8.79	−15.44
				(−1.13)	(−1.36)
R^2	0.111	0.134	0.197	0.347	0.402

Panel B. Control for return predictors

	Model 1	Model 2	Model 3	Model 4
$\hat{\beta}^i_{d,t}$	0.027**	0.030**	0.030*	0.034**
	(2.17)	(2.28)	(1.75)	(2.08)
Dividend Yield	−0.98			−4.51
	(−0.12)			(−0.65)
Term Spread		−0.03		−0.04
		(−0.40)		(−0.57)
Momentum			0.36	0.47
			(0.57)	(0.71)
R^2	0.149	0.163	0.191	0.319

Panel C. Control for liquidity factors

	Model 1	Model 2	Model 3	Model 4	Model 5
$\hat{\beta}^i_{SBd,t}$	0.067***	0.057***	0.059**	0.069***	0.098**
	(2.82)	(2.98)	(2.58)	(3.02)	(2.18)
Zero trading volume	−0.11				0.57
	(−0.83)				(0.77)
Treasury illiquidity		0.00			0.00
		(−0.50)			(0.85)
Zero return			−0.259*		−0.63
			(−1.66)		(−0.73)
Amihud	−0.11			60.92	−203.57
	(−0.83)			(0.69)	(−0.90)
R^2	0.205	0.204	0.206	0.206	0.423

Table IX
SB correlations and globalization

This table examines the relationship between the SB correlation ($\hat{\beta_{SBd}}$) and the correlation of US (R_{US}) and world (R_W) stock returns. Panel A presents the correlations between SB returns and US-world stock returns separately for two sample periods: 1972-1998 and 1999-2022. Panel B reports the results of a time-series regression with monthly observations, where the correlation of US-world stock returns is regressed on the SB correlation, a dummy variable that takes a value of 1 only for the post-1998 period, and their interaction. Panel C shows the results of a monthly regression, where US monthly returns are regressed on world returns, the SB correlation, the post-1998 dummy, and their interaction. The t-statistics are computed with a Newey-West adjustment with a lag of 12.

Panel A. Summary statistics

	$\text{Cor}(R_{US,t}, R_{W,t})$	$\hat{\rho}_{SBd}$
1972-1998	0.739	0.233
1999-2022	0.912	−0.333

Panel B. Time-series regression using US-World correlations

	$\text{Cor}(R_{US,t}, R_{W,t})$			
	All sample		1972-1998	1999-2022
$\hat{\rho}_{SBd,t}$	−0.16	−0.13	−0.12	−0.04
	(−5.70)	(−2.76)	(−2.79)	(−2.05)
$1_{\text{post},t}$		0.11		
		(3.58)		
$\hat{\rho}_{SBd,t} \times 1_{\text{post},t}$		0.08		
		(1.67)		
R^2	0.158	0.217	0.026	0.042
N	612	612	324	288

Panel C. Time-series regression using stock returns and SB correlation

	$R_{US,t}$			
	All sample		1972-1998	1999-2022
$R_{W,t}$	0.71	0.73	0.69	0.77
	(41.76)	(33.88)	(17.64)	(46.57)
$R_{W,t} \times \hat{\rho}_{SBd,t}$	−0.16	−0.20	−0.15	−0.05
	(−4.73)	(−3.12)	(−1.77)	(−1.89)
$\hat{\rho}_{SBd,t}$	0.08	0.15	0.67	−0.38
	(0.41)	(0.76)	(1.66)	(−2.76)
$R_{W,t} \times \hat{\rho}_{SBd,t} \times 1_{\text{post},t}$		0.09		
		(1.13)		
$1_{\text{post},t}$		0.09		
		(0.39)		
R^2	0.748	0.748	0.639	0.914
N	612	612	324	288

A. Data appendix

1. Data sources

The dataset consists of the international stock index and bond yield data from Bloomberg. The Morgan Stanley Capital International (MSCI) net total returns index represents the aggregate country-level equity prices. One limitation of the net total returns index is its relatively short sample, which begins in 1999 for most countries. Therefore, the analysis is supplemented by the price index, available earlier at the daily frequency. I use the indices denominated in local currency to compute daily, weekly, and monthly stock returns. When evaluating the performance of investment strategies, I convert local returns to USD using the exchange rates sourced from Bloomberg. Since the SB correlation is estimated using local currency returns and the performance is evaluated monthly, the asynchronous trading hours worldwide are irrelevant to the conversion. In addition to the country-level stock returns, I also obtain the stock returns of the global value-weighted portfolio. The MSCI value-weighted index returns proxy global stock returns when calculating the international capital asset pricing model (CAPM) beta, as described below.

Bond yields are represented by ten-year sovereign bonds, all of which are denominated in their respective local currency. Ten-year yields are available for the longest period at the daily interval, which is critical since the availability of bond yield data mainly restricts the sample. The second reason is that the model implies that the relationship between country-specific volatility and the SB correlation should be stronger using longer-term bond yields.

I use the sovereign credit default swap (CDS) spread to decompose bond yields into sovereign default spread and the risk-free component. The CDS data is obtained from the intercontinental exchange, whereby the last quoted mid-price of the week and month is chosen to compute the implied default spread in the sovereign bonds. The data covers 2004-2021.

One of the main assumptions in the model relies on the relationship between growth expectations and inflation expectations. The data comes from the World Economic Outlook provided by the International Monetary Fund and spans the year sample period 1990-2022. The forecasts of advanced economies begin in 1991, and those of the world begins in 1996.

Several country-level macroeconomic variables are used as control variables in the empirical analyses. Global and country-level inflation rates are obtained from the World Bank, and country-level total gross domestic product (GDP), and GDP per capita are denominated in USD and sourced from the International Monetary Fund database.

2. Estimation of the international CAPM

The ICAPM beta is estimated using the following equation:

$$R_{m,t+1}^{i,USD} = b_0^i + b_g^i R_{\text{MSCI},t+1}^{USD} + b_1^i \Delta q_{t+1}^i + \epsilon_{t+1}^i, \tag{13}$$

where $R_{m,t+1}^{i,USD}$ is the log return of the country i's stock index converted to USD, $R_{\text{MSCI},t+1}^{USD}$ denotes the log returns of the MSCI World Index in USD, and q_{t+1}^i is the log price of country i's currency relative to USD. Then, risk-adjusted returns are computed as:

$$R_{m,t}^{i,USD} - \hat{b}_g^i R_{\text{MSCI},t}^{USD} - \hat{b}_q^i \Delta q_t^i.$$

When risk-adjusting the price index (net total) returns, the beta from the ICAPM using price (net total) index returns are used.

3. Variance estimation

In the empirical section, the relationship between the volatility of country-specific consumption growth and the stock-bond correlation is tested. Quarterly real final consumption expenditure data is obtained from the Organization for Economic Co-operation and Development (OECD) website. For each quarter, I measure the log consumption growth for each country. Global consumption is defined as the cross-country average consumption growth.

Global and country-specific consumption growth is estimated from a stochastic volatility (SV) model, where the log of volatility has constant variance. The stochastic volatility model is estimated using the Markov Chain Monte Carlo (MCMC) method and is given by:

$$\Delta c^i_{t+1} = \mu^i_c + \gamma^i_c \Delta c^*_{m,t+1} + \exp(h^i_t/2)\eta^i_{1,t+1} \tag{14}$$

$$h^i_{t+1} = \mu^i_h + \nu^i_h(h^i_t - \mu^i_h) + \sigma^i_h \eta^i_{2,t+1}, \tag{15}$$

where $\eta^i_{1,t+1}$ and $\eta^i_{2,t+1}$ are standard normal errors, Δc^i_{t+1} is the quarterly real consumption growth for country i, $\Delta c^* t + 1$ is the average world consumption growth. For the global consumption volatility, I estimate the model

$$\Delta c^*_{t+1} = \mu^*_c + \exp(h^*_t/2)\eta^*_{1,t+1} \tag{16}$$

$$h^*_{t+1} = \mu^*_h + \nu^i_h(h^*_t - \mu^*_h) + \sigma^*_h \eta^*_{2,t+1}, \tag{17}$$

where $\eta^i_{1,t+1}$ and $\eta^i_{2,t+1}$ are standard normal errors. I use the MCMC scheme developed by Hosszejni and Kastner (2021) once using the entire sample.

4. Measurement of illiquidity

Exposures to global illiquidity (Bekaert, Harvey, and Lundblad 2007) and illiquidity of Treasury bonds (Goyenko and Sarkissian 2014) are variables that are known to predict the cross-sectional difference in international stock returns. I follow Goyenko and Sarkissian (2014) to construct a measure of Treasury illiquidity. First, I compute the average percentage quoted bid-ask spread of off-the-run US T-bills maturity with less than one year available from the Center for Research in Security Prices (CRSP) daily Treasury Quotes file. Then, for each month, I take the average spread for each security and the equally-weighted average across assets. Since this measure is persistent, I follow Goyenko and Sarkissian (2014) and take the residual of an autoregressive model of order 2. Each country's exposure to this residual is estimated after controlling for the global stock market index.

I follow a similar approach to estimate measures of zero returns and zero trading volume. First, I use US data to calculate the fraction of days that have zero returns or zero trading volume for each stock and month. Then, for each month, I take the average of these fractions to construct a monthly measure of US illiquidity. To account for global differences in liquidity, I estimate the exposure of each country to this measure of US illiquidity after controlling for the global stock market index returns.

B. Technical appendix

1. Consumption dynamics and the wealth portfolio

Denote the state vector as

$$\vec{\Sigma}_t^i = \begin{bmatrix} \Delta c_t^i & \Delta d_t^i & x_t^* & x_t^i & v_t^* & v_t^i & \pi_t^i \end{bmatrix}'$$

We can write the conditional mean as

$$\mathrm{E}_t\left[\vec{\Sigma}_{t+1}^i\right] = \Lambda_0 + \Lambda_1 \vec{\Sigma}_t^i,$$

where

$$\Lambda_0 = \begin{bmatrix} \mu & \mu_d & 0 & 0 & \omega_{g0} & \omega_{l0} & p_0 \end{bmatrix}'$$

and

$$\Lambda_1 = \begin{bmatrix} 0 & 0 & 1 & 1 & 0 & 0 & 0 \\ 0 & 0 & \phi_d(1-\lambda_d) & \phi_d\lambda_d & 0 & 0 & 0 \\ 0 & 0 & \xi_g & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \xi_l & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \omega_{g1} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & \omega_{l1} & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & p_1 \end{bmatrix}$$

The conditional covariance matrix is

$$\text{Cov}_t\left(\vec{\Sigma^i}_{t+1}, \vec{\Sigma^i}'_{t+1}\right) = V_G v_t^* + V_L v_t^i,$$

where

$$V_G = \begin{bmatrix} 1 & \rho_{cd}\sigma_{dg} & 0 & 0 & 0 & 0 & \rho_g\sigma_{pg} \\ \rho_{cd}\sigma_{dg} & \sigma_{dg}^2 & 0 & 0 & 0 & 0 & \rho_g\sigma_{pg}\sigma_{dg} \\ 0 & 0 & (1-\lambda_d)^2\phi_d^2\sigma_{xg}^2 & 0 & 0 & 0 & \rho_g(1-\lambda_d)\phi_d\sigma_{pg}\sigma_{xg} \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \sigma_g^2 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ \rho_g\sigma_{pg} & \rho_g\sigma_{pg}\sigma_{dg} & \rho_g(1-\lambda_d)\phi_d\sigma_{pg}\sigma_{xg} & 0 & 0 & 0 & \sigma_{pg}^2 \end{bmatrix}$$

and

$$V_L = \begin{bmatrix} 1 & \rho_{cd}\sigma_{dl} & 0 & 0 & 0 & 0 & \rho_l\sigma_{pl} \\ \rho_{cd}\sigma_{dl} & \sigma_{dl}^2 & 0 & 0 & 0 & 0 & \rho_l\sigma_{pl}\sigma_{dl} \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \lambda_d^2\phi_d^2\sigma_{xl}^2 & 0 & 0 & \rho_l\lambda_d\phi_d\sigma_{xl}\sigma_{pl} \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & \sigma_l^2 & 0 \\ \rho_l\sigma_{pl} & \rho_l\sigma_{pl}\sigma_{dl} & 0 & \rho_l\lambda_d\phi_d\sigma_{xl}\sigma_{pl} & 0 & 0 & \sigma_{pl}^2 \end{bmatrix}$$

The SDF of country i can be represented by

$$m_{t+1}^i = m_0 + M'\vec{\Sigma}_{t+1}^i - (\theta - 1)\vec{A}'\vec{\Sigma}_t^i$$

with

$$m_0 = \theta \log \beta + (\theta - 1)\left(\kappa_0 + A_0(\kappa_1 - 1)\right),$$

$$M = \begin{bmatrix} -\gamma & 0 & (\theta-1)\kappa_1 A_{xg} & (\theta-1)\kappa_1 A_x & (\theta-1)\kappa_1 A_g & (\theta-1)\kappa_1 A_l & 0 \end{bmatrix}'$$

$$A = \begin{bmatrix} 0 & 0 & A_{xg} & A_x & A_g & A_l & 0 \end{bmatrix}'.$$

The values for $A.$ are solved by using the method of undetermined coefficients from the Euler equation. $m_{t+1}^i + R_{TW,t+1}^i$ can be represented by:

$$e_{w,0} + E_{w,2}'\vec{\Sigma}_{t+1}^i - E_{w,1}'\vec{\Sigma}_t^i,$$

where $e_{w,0} = m_0 + \left(\kappa_0 + A_0(\kappa_1 - 1)\right)$. Therefore, we need the following conditions:

$$\begin{aligned}
&A_{xg} = A_x = \frac{1 - \frac{1}{\psi}}{1 - \kappa_1 \xi_g} \\
&\theta(\kappa_1 v_{g1} - 1)A_g + 0.5E_{w,2}'V_G E_{w,2} = 0 \\
&\theta(\kappa_1 v_{l1} - 1)A_l + 0.5E_{w,2}'V_L E_{w,2} = 0 \\
&e_{w,0} + E_{w,2}'\Lambda_0 = 0,
\end{aligned}$$

where the first equation follows from $\xi_g = \xi_l$ and

$$E_{w,2} = \begin{bmatrix} 1-\gamma & 0 & \theta\kappa_1 A_{xg} & \theta\kappa_1 A_x & \theta\kappa_1 A_g & \theta\kappa_1 A_l & 0 \end{bmatrix}'$$

The formula for A_g and A_l are solved from a quadratic equation, but only one of the values has a reasonable value. If values of the components of A are known, we can derive the formula for a one-period as well as a 10-year bond.

2. Multi-period bond yields

The nominal pricing kernel is

$$m^i_{n,t+1} = m^i_{t+1} - \pi_{t+1},$$

where π^i_t is the one-period expected inflation rate of country i at time t.

Define the matrix M_n as

$$M_n = \begin{bmatrix} -\gamma & 0 & (\theta-1)\kappa_1 A_{xg} & (\theta-1)\kappa_1 A_x & (\theta-1)\kappa_1 A_g & (\theta-1)\kappa_1 A_l & -1 \end{bmatrix}'$$

The log price of a riskless one-period bond ($B_{1,t}$) is derived by

$$\begin{aligned} B^i_{1,t} =& \mathrm{E}_t\left[m^i_{n,t+1}\right] + 0.5\mathrm{Var}_t\left(m^i_{n,t+1}\right) \\ =& m_0 + M_n'\Lambda_0 + \left(M_n'\Lambda_1 - (\theta-1)A'\right)\vec{\Sigma}^i_t + 0.5M_n'V_G M_n v^*_t + 0.5M_n'V_L M_n v^i_t \\ =& m_0 + M_n'\Lambda_0 + \left(M_n'\Lambda_1 - (\theta-1)A' + 0.5\Psi'\right)\vec{\Sigma}^i_t, \end{aligned}$$

where

$$\Psi' = \begin{bmatrix} 0 & 0 & 0 & 0 & M_n'V_G M_n & M_n'V_L M_n & 0 \end{bmatrix}'.$$

Therefore, the yield of a one-period nominal bond is represented by

$$y^i_t = (-m_0 - M_n'\Lambda_0) + \left(-M_n'\Lambda_1 + (\theta-1)A' - 0.5\Psi'\right)\vec{\Sigma}^i_t.$$

Now suppose that the k-period bond has a log price

$$B^i_{k,t} = D_{k,0} + D'_k \vec{\Sigma}^i_t.$$

Then the $(k+1)$-period bond has a price that is equal to the conditional expectation of

$$\mathrm{E}_t\left[m^i_{n,t+1} + B^i_{k,t+1}\right] + 0.5\mathrm{Var}_t\left(m^i_{n,t+1} + B^i_{k,t+1}\right),$$

where

$$m^i_{n,t+1} + B^i_{k,t+1} = m_0 + D_{k,0} + (M' + D_k)'\vec{\Sigma}^i_{t+1} - (\theta-1)A'\vec{\Sigma}^i_t.$$

The log price of the bond can be solved as

$$\begin{aligned} B^i_{k,t+1} =& m_0 + D_{k,0} + (M_n + D_k)'(\Lambda_0 + \Lambda_1 \vec{\Sigma^i}_t) - (\theta-1)A'\vec{\Sigma^i}_t + 0.5(M_n + D_k)'\mathrm{Cov}_t\left(\vec{\Sigma^i}_{t+1}, \vec{\Sigma^i}'_{t+1}\right)(M_n + D_k) \\ =& m_0 + D_{k,0} + (M_n + D_k)'\Lambda_0 + \left((M + D_k)'\Lambda_1 - (\theta-1)A'\right)\vec{\Sigma^i}_t + 0.5\Psi'_k\vec{\Sigma^i}_t, \end{aligned}$$

where

$$\Psi_k = \begin{bmatrix} 0 & 0 & 0 & 0 & (M_n + D_k)'V_G(M_n + D_k) & (M_n + D_k)'V_L(M_n + D_k) & 0 \end{bmatrix}'$$

The log of $(k+1)-$period bond price is, therefore

$$B^i_{k+1,t} = D_{k+1,0} + D'_{k+1}\vec{\Sigma}^i_t,$$

where

$$D_{k+1,0} = m_0 + D_{k,0} + (M_n + D_k)'\Lambda_0$$

and

$$D_{k+1} = \Lambda'_1(M_n + D_k) - (\theta-1)A + \frac{1}{2}\Psi_k.$$

The $(k+1)-$period yield is derived as

$$y^i_{k+1,t} = Y_{k+1,0} + Y_{k+1}\vec{\Sigma}^i_t,$$

where $Y_{k+1,0} = -D_{k+1,0}$ and $Y_{k+1} = -D_{k+1}$.

3. Dividend dynamics and stock returns

The price-dividend ratio ($z^i_{m,t}$) of country i's stock market is conjectured to be a linear function of the local and global state variables. Following the logic above, let the price/dividend ratio can be represented by $z^i_{m,t} = D'\vec{\Sigma}^i_t$, where

$$D = \begin{bmatrix} 0 & 0 & D_{xg} & D_x & D_g & D_l & 0 \end{bmatrix}'.$$

The solutions for the coefficients can be solved using the Euler equation

$$\mathrm{E}_t[m^i_{t+1} + R^i_{m,t+1}] + 0.5\mathrm{Var}_t[m^i_{t+1} + R^i_{m,t+1}] = 0.$$

$m^i_{t+1} + R^i_{m,t+1}$ can be represented by:

$$e_0 + E_2'\vec{\Sigma}^i_{t+1} - E_1'\vec{\Sigma}^i_t,$$

where

$$e_0 = m_0 + (\kappa_{m,0} + D_0(\kappa_{m,1} - 1))$$

$$E_2 = \begin{bmatrix} -\gamma & 1 & (\theta-1)\kappa_1 A_{xg} + \kappa_{m,1}D_{xg} & (\theta-1)\kappa_1 A_x + \kappa_{m,1}D_x & (\theta-1)\kappa_1 A_g + \kappa_{m,1}D_g & (\theta-1)\kappa_1 A_l + \kappa_{m,1}D_l & 0 \end{bmatrix}'$$

and some E_1, which need not be specified to describe the final formula. One can verify that the coefficients in matrix B solves equations:

$$\begin{aligned}
&D_{xg} = \frac{(1-\lambda_d)\phi - \frac{1}{\psi}}{1-\kappa_1\xi_g} \\
&D_x = \frac{\lambda_d\phi - \frac{1}{\psi}}{1-\kappa_1\xi_l} \\
&((\theta-1)A_g + D_g)(\kappa_1 v_{g1} - 1) + 0.5E_2' V_G E_2 = 0 \\
&((\theta-1)A_l + D_l)(\kappa_1 v_{l1} - 1) + 0.5E_2' V_L E_2 = 0 \\
&e_0 + E_2'\Lambda_0 = 0,
\end{aligned}$$

where similar to the above, the variance terms solve a quadratic equation, only one of the two gives a reasonable value. Then, market returns are defined as $\Delta d^i_{t+1} + \kappa_{m,0} + \kappa_{m,1} z^i_{m,t+1} - z^i_{m,t}$, which takes the form of

$$S_0 + S'\vec{\Sigma}^i_t,$$

where S is defined as

$$S = \begin{bmatrix} 0 & 1 & \kappa_{m,1}D_{xg} & \kappa_{m,1}D_x & \kappa_{m,1}D_g & \kappa_{m,1}D_l & 1 \end{bmatrix}'.$$

Given the formula for stock returns and bond yields, deriving the second moments and the covariance between stock returns and innovation in 10-year bond yields is straightforward.

4. International stock market risk premium

As shown in the main paper, it is sufficient to derive the risk premium of stock investment implied by the local investor in local currency. To better understand this assertion, the expected excess return of the stock market investment in country i for the global investor is

$$E[R^i_{m,t+1} + \Delta q^i_{t+1}] - y^*_t,$$

where y^*_t is the hypothetical yield of the global investor. Applying the UIRP relationship ($E_t[\Delta q^i_{t+1}] = y^*_t - y^i_t$), one can see that the above becomes

$$E[R^i_{m,t+1}] - y^i_t.$$

The UIRP relationship holds since

$$\begin{aligned} E_t[\Delta q^i_{t+1}] + 0.5Var_t[\Delta q^i_{t+1}] &= E_t[m^i_{n,t+1}] + 0.5Var_t[m^i_{n,t+1}] - E_t[m^*_{n,t+1}] - 0.5Var_t[m^*_{n,t+1}] \\ &= y^*_t - y^i_t, \end{aligned} \tag{18}$$

and the currency risk premium for the global investor is

$$Cov_t(-m^*_{n,t+1}, m^i_{n,t+1} - m^*_{n,t+1}) = 0,$$

where both of these relationships hold since all countries are homogeneous. Therefore,

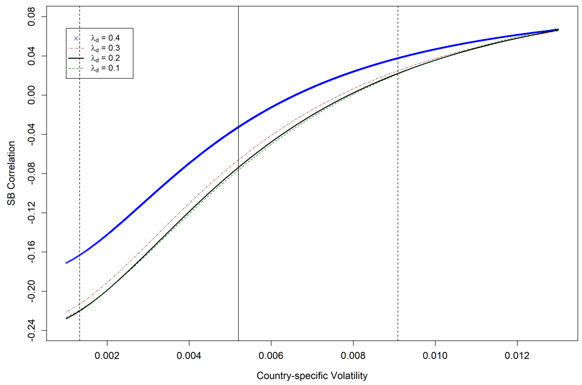
$$Cov_t(m^i_{n,t+1}, m^*_{n,t+1}) = Var_t(m^*_{n,t+1}).$$

The risk premium can be derived as

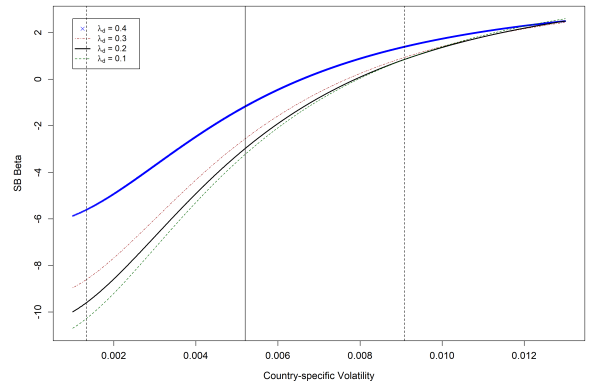
$$E_t[R^i_{m,t+1}] + 0.5Var_t[R^i_{m,t+1}] + E_t[m^i_{n,t+1}] + 0.5Var_t[m^i_{n,t+1}] = Cov(-m^i_{n,t+1}, R^i_{m,t+1})$$
$$= -S'V_G M_n v^*_t + -S'V_L M_n v^i_t.$$

C. Additional cross-sectional regressions

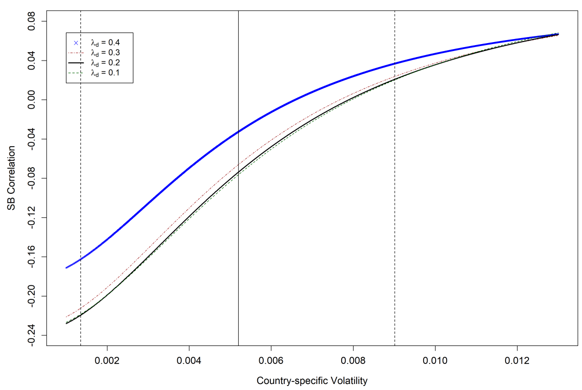
Table A1 shows the results using total returns instead of price returns. The sample for this analysis is shorter; therefore, many of the coefficients have lower t-statistics. However, the results remain robust and confirm the findings of the price index return-based results.



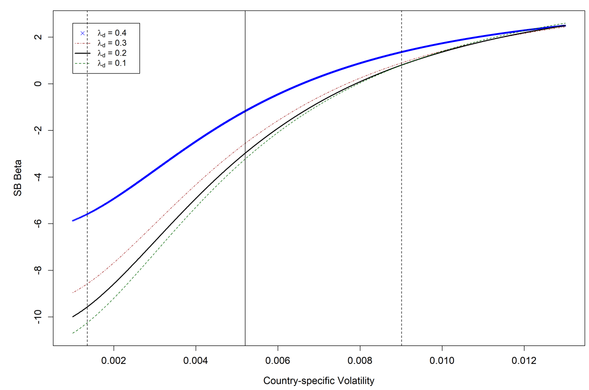
(a) SB correlation with $\gamma = 10$



(b) SB beta with $\gamma = 10$



(c) SB correlation with $\psi = 1.5$



(d) SB beta with $\psi = 1.5$

Figure A1. SB beta and correlation under alternative specifications

This figure plots the variation in the SB correlations (a and c) and SB betas (b and d) under alternative values of risk-aversion and elasticity of substitution parameterizations.

Table A1
Cross-sectional regressions - Total returns (1999-2022)

This table summarizes the average and the t-statistics of the cross-sectional regression using leading monthly total index country stock returns in USD as the dependent variable and daily SB beta and other controls as independent variables. Control variables include the time-series average of the SB beta, total GDP, GDP per capita, GDP growth forecast, inflation forecast (Panel A), the dividend yields, term spread, and momentum (Panel B), and the exposure to innovations in three different US illiquidity measures as described in the main text (Panel C).

Panel A. Baseline specification and control for macroeconomic variables

	Model 1	Model 2	Model 3	Model 4	Model 5
$\hat{\beta}_{SBd,t}$	0.027∗∗	0.048∗∗∗	0.024∗∗	0.024∗	0.026∗∗
	(2.58)	(3.11)	(2.16)	(1.96)	(2.15)
$\overline{\hat{\beta}_{SBd,t}}$		−0.03			
		(−1.61)			
Inflation Forecast			1.24		2.57
			(0.20)		(0.38)
Total GDP				−0.03	−0.04
				(−0.93)	(−1.11)
GDP per cap				−0.08	−0.02
				(−0.65)	(−0.15)
GDP Forecast				0.30	−0.37
				(0.04)	(−0.05)
R^2	0.070	0.131	0.145	0.259	0.303

Panel B. Control for return predictors

	Model 1	Model 2	Model 3	Model 4
$\hat{\beta}^i_{SBd,t}$	0.02	0.026∗∗	0.02	0.02∗
	(1.60)	(2.14)	(1.60)	(1.65)
Dividend Yield	12.783∗			8.91
	(1.92)			(1.37)
Term Spread		0.034		0.04
		(0.43)		(0.47)
Momentum			0.18	0.12
			(0.31)	(0.19)
R^2	0.133	0.155	0.177	0.298

Panel C. Control for liquidity factors

	Model 1	Model 2	Model 3	Model 4	Model 5
$\hat{\beta}^i_{SBd,t}$	0.014∗	0.019∗∗	0.018∗	0.02	0.013∗
	(1.67)	(1.99)	(1.89)	(1.63)	(1.65)
Zero trading volume	0.03				0.04
	(0.54)				(0.66)
Treasury illiquidity		0.00			0.00
		(−0.57)			(−0.95)
Zero return			0.02		0.02
			(0.31)		(0.30)
Amihud				23.94	35.61
				(0.53)	(0.69)
R^2	0.131	0.138	0.138	0.141	0.315