Flights to safety

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Flights to Safety*

Lieven Baele[1] Geert Bekaert[2] Koen Inghelbrecht[3]

Min Wei[4]

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Abstract

Despite a large and growing theoretical literature on flights to safety, there does not appear to exist an empirical characterization of flight-to-safety (FTS) episodes. Using only data on bond and stock returns, we identify and characterize flight to safety episodes for 23 countries. On average, FTS episodes comprise less than 5% of the sample, and bond returns exceed equity returns 2 to 3%. The majority of FTS events are country-specific not global. FTS episodes coincide with increases in the VIX, decreases in consumer sentiment indicators in the US, Germany and the OECD and appreciations of the yen and the Swiss franc. The financial, basic materials and industrial industries under-perform in FTS episodes, but the telecom industry outperforms. Both money market instruments and corporate bonds face abnormal negative returns in FTS episodes. Most commodity prices decrease sharply during FTS episodes, whereas the gold price measured in dollars increases slightly. Both economic growth and inflation decline right after and up to a year following a FTS spell.

JEL Classification: G11, G12, G14, E43, E44

Keywords: Stock-Bond Return Correlation, Liquidity, Flight-to-Safety.

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[1] CentER, Netspar, Tilburg University. E-mail: Lieven.Baele@uvt.nl

[2] Graduate School of Business, Columbia University, and NBER. E-mail: gb241@columbia.edu

[3] Department Financial Economics, Ghent University, and Finance Department, University College Ghent. E-mail: Koen.Inghelbrecht@hogent.be

[4] Federal Reserve Board of Governors, Division of Monetary Affairs,Washington. Email: min.wei@frb.gov

1 Introduction

In periods of market stress, the financial press interprets extreme and inverse market movements in the bond and equity markets often as "flights to safety" or "flights to quality." In particular, between August 2004 and June 2012, a period marred by a global financial crisis, the Financial Times referred 805 times to "Flight(s)-to-Quality" and 533 times to "Flight(s)-to-Safety."

There is an active theoretical academic literature studying such phenomena. In Vayanos (2004)'s model, risk averse investment managers fear redemptions during high volatility periods and therefore an increase in volatility may lead to a "flight-to-liquidity." At the same time, their risk aversion also increases, leading to a "flight-to-safety," meaning that they require higher risk premiums, which in turn drives down the prices of risky assets (a flight to quality). In Caballero and Krishnamurthy (2008), Knightian uncertainty may lead agents to shed risky assets in favor of uncontingent and safe claims when aggregate liquidity is low thereby provoking a flight to quality or safety. Brunnermeier and Pedersen (2009) study a model in which speculators, who provide market liquidity, have margin requirements increasing in volatility. They show how margin requirements can help cause a liquidity spiral following a bad shock, where liquidity deteriorates in all markets, but also a flight to quality, which they define as a sharp drop in liquidity provision for the high margin, more volatile assets. One agent models can also generate "flights-to-safety." In the consumption based asset pricing literature (e.g. Barsky (1989); Bekaert et al. (2009)) a flight to safety is typically defined as the joint occurrence of higher economic uncertainty (viewed as exogenous) with lower equity prices (through a cash flow or risk premium effect) and low real rates (through a precautionary savings effect).

These articles seem to treat flights to quality, safety and/or liquidity as Justice Potter treated porn: we know it when we see it. However, to be able to test and refute a diverse set of theoretical models, an empirical characterization of flight to safety episodes would appear essential. The goal of our paper is to define, detect and characterize flight-to-safety episodes for 23 countries. In doing so, we only use high frequency data on the prototypical risky asset (a well-diversified equity index) and the prototypical safe and liquid asset (the benchmark Treasury bond). Beber et al. (2009) use the Euro-area government bond market to show that in times of market stress, investors demand liquidity rather than credit quality. Longstaff (2004), focusing on the US Treasury market, shows that the liquidity premium in Treasury bonds can represent up to 15% of their value. In other words, flights to safety may be as much or more about flights to liquidity than about flights to quality.

It is therefore important to focus on a liquid bond benchmark in our work.

To define a flight to safety, we use the simple observation that it happens during periods of market stress (high equity market volatility), entails a large and positive bond return, a large and negative equity return, and negative high-frequency correlations between bond and stock returns (which are typically otherwise positively correlated as both represent high duration assets). We use a plethora of econometric techniques to transform these features into an identification scheme for flight to safety episodes, which we detail in Section 2. In Section 3, we then analyze the identified flight to safety episodes in 23 countries in more detail. We find that FTS episodes comprise less than 5% of the sample on average, and bond returns exceed equity returns 2 to 3% on FTS days. Only a minority of FTS events can be characterized as global (less than 30% for most countries). FTS episodes coincide with increases in the VIX, decreases in consumer sentiment indicators in the US, Germany and the OECD and appreciations of the yen and the Swiss franc. Finally, in section 4, we characterize the dynamic cross-correlations between flights to safety and the financial and economic environment. As just one example, we compute flight to safety betas for various equity portfolios, and a large variety of asset classes. The financial, basic materials and industrial industries under-perform in FTS episodes, but the telecom industry outperforms. Large cap stocks outperform small cap stocks. All these returns control for systematic exposure. For the bond market, we find that both money market instruments and corporate bonds face abnormal negative returns in FTS episodes. Most commodity prices decrease sharply during FTS episodes, whereas the gold price measured in dollars increases slightly. We also investigate the link with the real economy. Both economic growth and inflation decline right after and up to a year following a FTS spell.

There are, of course, a number of empirical papers that bear some indirect relationship to what we attempt to accomplish. Baele et al. (2010) show that a dynamic factor model with standard fundamental factors fails to provide a satisfactory fit for stock and bond return comovements. The ability of the model to capture episodes of negative stock-bond return correlations only improves when stock-bond illiquidity factors (potentially capturing "flight-to-liquidity") and the VIX (potentially capturing "flight-to-safety") are included. Connolly et al. (2005) and Bansal et al. (2010) show that high stock market uncertainty is associated with low correlations between between stock and bond returns, and higher bond returns at high frequencies. Goyenko and Sarkissian (2008) define a flight to liquidity and/or quality using illiquidity in short-term (non-benchmark) US Treasuries and show that it affects future stock returns around the globe. Baur and Lucey (2009) define a flight to quality as a period in which stock and bond returns decrease in a falling stock market and differentiate it from contagion, where asset markets move in the same direction. They define the 1997 Asian crisis and the 1998 Russian crisis as flight to safety episodes. The recent financial crisis also sparked a literature on indicators of financial instability and systemic risk which are indirectly related to our flight to safety indictor. The majority of those articles use data from the financial sector only (see e.g. Acharya et al. (2011); Adrian and Brunnermeier (2011); Allen et al. (2012); Brownlees and Engle (2010)), but Hollo et al. (2012) use a wider set of stress indicators and we revisit their methodology in Section 2.2.2.

2 Identifying Flight-to-Safety Episodes

2.1 Data and Overview

Our dataset consists of daily stock and 10-year government bond returns for 23 countries over the period January 1980 till January 2012. Our sample includes two countries from North-America (US, Canada), 18 European countries (Austria, Belgium, Czech Republic, Denmark, France, Finland, Germany, Greece, Ireland, Italy, Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland, UK), as well as Australia, Japan, and New-Zealand. We use Datastream International's total market indices to calculate daily total returns denominated in local currency, and their 10-year benchmark bond indices to calculate government bond returns. For the countries in the euro zone, we use returns denominated in their original currencies (rather than in synthetic euros). For these countries, we take the returns on German Government bonds as benchmark, wheareas for the other European countries, we use the return on their own government bonds. More details as well as summary statistics can be found in the Appendix.

2.2 Measures of Flights to Safety

Our goal is to use only these bond and stock return data to identify a flight-to-safety (FTS henceforth) episode. From the theoretical literature the symptoms of a flight to safety are rather easy to describe: market stress (high equity and perhaps bond return volatility), a simultaneous high bond and low equity return, low (negative) correlation between bond and equity returns. We use 4 different indicators. The first two are simple indicator variables that turn the incidence of (a subset of) the symptoms into a [0,1] indicator, with 1 indicating a sure FTS episode, and 0 indicating with certainty that no FTS took place. The last two use a regime switching model to identify the probability of a flight to safety based on its symptoms. In the following sub-section, we detail these various approaches, whereas section 2.3 discusses how to aggregate the measures into one FTS indicator.

2.2.1 A Flight-to-Safety Dummy

Our simplest measure identifies a flight-to-safety event as a day with both an (extreme) negative stock return and an (extreme) positive bond return. The flight-to-safety indicator FTS for country i at time t is calculated as:

$$FTS_{i,t} = I\left\{r^b_{i,t} > z_{i,b}\right\} \times I\left\{r^s_{i,t} < z_{i,s}\right\} \tag{2.1}$$

where I is an indicator function, and $r^b_{i,t}$ and $r^s_{i,t}$ the time t returns in country i for respectively its benchmark government bond and equity market. We allow for different values for the country-specific thresholds $z_{i,b}$ and $z_{i,s}$. As a starting point, we assume both of them to be zero, $z_{i,b} = z_{i,s} = 0$. Alternatively, because flights-to-safety are typically associated with large drops (increases) in equity (bond) prices, we use thresholds:

$$z_{i,b} = \kappa \times \sigma_{i,b} \qquad\qquad z_{i,s} = -\kappa \times \sigma_{i,s} \tag{2.2}$$

where $\sigma_{i,b}$ and $\sigma_{i,s}$ are the full-sample country-specific return volatilities for bond and stock returns, respectively. Consequently, equity (bond) returns must be κ standard deviations below (above) zero before we identify a day to be a FTS day.

Table 1 reports the incidence of FTS under the simple indicator model for different threshold levels κ. We focus on the fractional number of instances (as a percent of the (country-specific) total number of observations) because the number of observations across countries varies. The number of FTS instances decreases rapidly with the threshold level, from about 1/4th of the sample for $\kappa = 0$ to mostly less than 3 percent for $\kappa = 1$. Less than half a percent of days experience bond and stock returns that are simultaneously 2 standard deviations above/below zero, respectively. To benchmark these numbers we conducted a small simulation experiment. Imagine that bond and stock returns are normally distributed with their means, standard deviations and correlations equal to the ensemble averages over the full sample of 23 countries[1]. In such a world, we would expect flights to safety to be quite rare compared to the real world with fat tails, negative skewness and time-varying correlations. The last line in the table reports FTS numbers for the simulated data. It

[1] The equally-weighted unconditional annualized equity and bond return means (volatilities) in percent are 10.78 (19.5) and 7.39 (5.83) respectively. To annualize, we assume there are 252 trading days per year. The unconditional correlation is -0.09.

is reasonable to expect that extreme FTS events are more common in the data than predicted by the unconditional multivariate normal distribution. However, until $\kappa = 1$, the percentage of FTS instances in the data is actually lower than predicted by the normal model. This suggests to use a $\kappa > 1$ for our definition of a FTS.

To get a sense of what happens on such extreme days, Table 2 reports the average difference between bond and equity returns on flight to safety days. The return differential increases from 1.20 percent for $\kappa = 0$ to over 3.19 percent for $\kappa = 1$ to more than 5 percent for $\kappa = 2$. On extreme FTS days, when $\kappa = 4$, the return impact increases to 9.28 percent on average, exceeding more than 12 percent in the Czech Republic, the UK, New Zealand, and Ireland.

2.2.2 Ordinal FTS Index

Here we quantify the various FTS symptoms extracted from bond and equity returns, and use the joint information about their severity to create a composite FTS index. We use 6 individual indicators, either positively (+) or negatively (-) related to FTS incidence:

- The difference between the bond and stock return (+)
- The difference between the difference between the bond return and its 250 moving average and the equity return minus its 250 days moving average (+)
- The short-term stock-bond return correlation (-)
- The difference between the short and long-term stock-bond return correlation (-)
- The short-term equity return volatility (+)
- The difference between the short and long-term equity return volatility (+)

Most of these indicators are self explanatory. Because the macro-economic environment may affect returns and correlations, we also consider return and correlation measures relative to time-varying historical benchmarks (250 day moving averages).

To estimate the short and long-term volatilities and correlations, we use a simple kernel method. Given a sample from $t = 1, .., T$, the kernel method calculates stock and bond return variances and their pairwise covariance/correlation at any normalized point $\tau \in (0,1)$ as:

$$\begin{aligned} \sigma_{i,\tau}^2 &= \textstyle\sum_{t=1}^{T} K_h\left(t/T-\tau\right) r_{i,t}^2, \qquad i=s,b \\ \sigma_{s,b,\tau} &= \textstyle\sum_{t=1}^{T} K_h\left(t/T-\tau\right) r_{s,t} r_{b,t} \\ \rho_{s,b,\tau} &= \sigma_{s,b,\tau} \Big/ \sqrt{\sigma_{b,\tau}^2 \sigma_{s,\tau}^2} \end{aligned}$$

where $K_h(z) = K(z/h)/h$ is the kernel with bandwidth $h > 0$. The kernel determines how the different observations are weighted. We use a two-sided Gaussian kernel with bandwidths of respectively 5 (short-term) and 250 (long-term) days (expressed as a fraction of the total sample size T):

$$K(z) = \frac{1}{\sqrt{2\pi}} exp\left(\frac{z^2}{2}\right)$$

Thus, the bandwidth can be viewed as the standard deviation of the distribution, and determines how much weight is given to returns either in the distant past or future. For instance, for a bandwidth of 5 days, about 90% of the probability mass is allocated to observations ±6 days away from the current observation; for a bandwidth of 250 days, it takes ±320 days to cover 90% of the probability mass[2]. We use a two-sided symmetric kernel rather than a one-sided and/or non-symmetric kernel because, in general, the bias from two-sided symmetric kernels is lower than for one-sided filters (see e.g. Ang and Kristensen (2012)).

We aggregate the individual FTS indicators into one composite FTS indicator using the "ordinal" approach developed in Hollo et al. (2012) who propose a composite measure of systemic stress in the financial system. As a first step, we rank the indicators that increase with FTS (bond minus stock returns, short-term equity market volatility, and the difference between short and long-term equity market volatility) from low to high, and those that decrease with the likelihood of FTS (short-term stock-bond correlation, difference between short and long-term stock bond correlation) from high to low. Next, we replace each observation for indicator i by its ranking number $\zeta_{i,t}$ divided by the total number of observations T, i.e. $\psi_{i,t} = \zeta_{i,t}/T$, so that values close to one (zero) are associated with a larger (lower) likelihood of FTS. For instance, a value of 0.95 at time t_0 for say short-term equity return volatility would mean that only 5 percent of observations over the full sample have a short-term equity volatility that is larger or equal than the time t_0 value. Consequently, we take at each point in time the average of the ordinal numbers for

[2]To ensure that the weights sum to one in a finite sample, we divide by their sum.

each of the six indicators[3].

The ordinal approach yields a number for each indicator that can be interpreted as a cumulative density function probability, but it does not tell us necessarily the probability of a flight to safety. For example, numbers very close to 1 such as 0.99 and 0.98 are likely both flights to safety, but whether a number of say 0.80 is a FTS or not is not immediately clear. Despite the imperfect correlation between the different indicators, the maximum ordinal numbers for the composite index are quite close to 1 for all 23 countries varying between 0.9775 and 0.9996. To benchmark our numbers, we first collect the ordinal numbers of the days that satisfy all the "mild" FTS –symptoms. In particular, these are days featuring:

1. A positive bond-stock return difference
2. A positive difference between the bond return minus its 250 day moving average and the stock return minus its 250 day moving average
3. A negative short-term stock-bond return correlation
4. A negative difference between the short and long-term stock-bond return correlation
5. A value for short-term equity return volatility that is more than one standard deviation above its unconditional average (that is, larger than double its unconditional average)
6. A positive difference between the short and long-term equity return volatility.

We view the minimum of this set of ordinal indicator values as a threshold. All observations with an ordinal number below this threshold get a FTS Ordinal Indicator equal to zero. It would appear unlikely that such days can be characterized as flights to safety. For observations with an ordinal number above the threshold, we set the FTS Ordinal Indicator equal to one minus the percentage of "false positives", calculated as the percentage of observations with an ordinal number above the observed ordinal number that are not matching our FTS criteria. The number of false positives will be substantial for observations with relatively low ordinal numbers (but still above the minimum threshold) but close to zero for observations with ordinal numbers close to 1.

[3]We also considered taking into account the correlation between the various indicators as suggested by Hollo et al. (2012), where higher time series correlations between the indicators increase the stress indicator's value. However, our inference regarding FTS episodes was not materially affected by this change.

The left panel of Figure 1 plots the FTS Ordinal Indicators and corresponding threshold levels for the US, Germany, and the UK; the right panel shows the derived FTS probabilities. Values with a probability larger than 50% are depicted in black, values below 50% in light grey. The percentage of days that have an ordinal indicator value above the threshold ranges from 6% of the total sample for Germany to 9% for the UK. Of those observations, about 65% have a FTS probability larger than 50% in the UK, compared to about 75% in the US. In Germany, this proportion even exceeds 98%.

We further characterize FTS incidence with the ordinal indicator in Table 3. The threshold levels show a tight range across countries with a minimum of 0.65 and a maximum of 0.80. The mean is 0.72. The percentage of sample observations above the threshold equals 10.5% with an interquartile range of 9.3%-11.4%. The raw ordinal indicators seem to display consistent behavior across countries. Our indicator is also influenced by the number of false positives above the threshold value. Therefore, the third column shows the percentage of observations above the threshold that have a FTS ordinal indicator larger than 50%. The mean is 52.9% and the interquartile range is 39.1%-64.9%. Germany proved to be an outlier with 98.7% and the minimum value of 18.59% is observed for the Czech Republic. The final column assesses how rare FTS episodes are according to this indicator. The percentage of observations with an FTS ordinal indicator larger than 50% as a percentage of total sample is 5.2% on average, with an interquartile range of 4.6%-6.3%. The range is quite tight across countries (minimum of 2.7%, maximum of 7.9%).

2.2.3 A Univariate Regime-Switching FTS Model

Define $y_{i,t} = r^b_{i,t} - r^s_{i,t}$, with $r^s_{i,t}$ the stock return for country i and $r^b_{i,t}$ the return on the benchmark government bond for that country. We model $y_{i,t}$ as a three-state regime-switching model. We need two regimes to model low and high volatility that are typically identified in RS models for equity returns (see Ang and Bekaert (2002) and Perez-Quiros and Timmermann (2001)). The third regime then functions as the FTS regime. The regime variable follows a Markov Chain with constant transition probabilities. Let the current regime be indexed by v.

$$y_{i,t} = \mu_{i,v} + \sigma_{i,v}\epsilon_{i,t} \tag{2.3}$$

with $\epsilon_{i,t} \sim N(0,1)$. The means and volatilities can take on 3 values. Of course, in a FTS, $y_{i,t}$ should be high. To identify regime 3 as the flight-to-safety regime, we impose its mean to be positive and higher than the means in the other two regimes, i.e. $\mu_{i,3} > 0, \mu_{i,3} > \mu_{i,1}, \mu_{i,3} > \mu_{i,2}$. The transition probability matrix, Φ_i, is 3×3, where each probability p_{kj} represents $P\left[S_{i,t} = k \middle| S_{i,t-1} = j\right]$, with $k, j \in \{1, 2, 3\}$:

$$\Phi_i = \begin{pmatrix} p_{11}^i & p_{21}^i & (1 - p_{11}^i - p_{21}^i) \\ p_{12}^i & p_{22}^i & (1 - p_{12}^i - p_{22}^i) \\ (1 - p_{23}^i - p_{33}^i) & p_{23}^i & p_{33}^i \end{pmatrix} \tag{2.4}$$

Panel A of Table 4 reports the estimation results. The first column reports detailed estimation results for the US, followed by the average estimate and interquartile range across all 23 countries. Regime 1 is characterized by low volatility, and a significantly negative bond-stock return difference for all countries. This is in line with the expectation that equities outperform bonds in tranquil times. Regime 2 corresponds to the intermediate volatility regime, and also features a mostly negative bond-stock return difference, yet typically of a smaller magnitude than in regime 1 and often not statistically significant. Annualized volatility is about double as high in regime 2 than in regime 1 (20.1% versus 10.5%).

Average volatility in regime 3, the FTS regime, is on average more than 47%, which is more than 2.35 (4.5) times higher than in regime 2 (1). Looking at the interquartile range, the bottom volatility quartile of the FTS regime is nearly double as high as the top volatility quartile of regime 2. The mean bond-stock return difference amounts to about a quarter of a percent on average (significantly different from zero at the 5% (10%) level in 11 (16) of the 23 countries), with an interquartile range of [0.198%; 0.271%]. While this is a relatively small number, the effect is substantially higher on days that the FTS jumps to the "on" state (1.09% on average, with an interquartile range of 0.73%-1.33%).

The FTS regime is the least persistent regime (with an average probability of staying of 94.7% versus 98.1% for regime 1 and 96.7% for regime 2). The average FTS spell lasts 26.4 days. The large interquartile range (35.2 versus 17.2 days) reflect the substantial cross-sectional dispersion in the average FTS regime durations across countries. There are an average of 26 FTS spells in the sample. This number is somewhat hard to interpret as the sample period varies between 23 years and less than 13 years across different countries. Yet, most of the spells occur in the second half of the sample, and the number is useful to compare across models.

2.2.4 A Bivariate Regime-Switching FTS Model

The univariate RS FTS model uses minimal information to identify FTS episodes, namely days of relatively high differences between bond and stock returns. While for most countries, the FTS regime means were quite substantially above zero, it is still possible that such a high difference occurs on days when both bonds and equities decrease in value, but the equity market, the more volatile market, declines by more. To make such cases less likely, and to incorporate more identifying information, we estimate the following bivariate model for stock and bond returns in each country (we remove the country subscript i for ease of notation):

$$
\begin{aligned}
r_{s,t} &= \alpha_0 + \alpha_1 J_{s,t}^{lh} + \alpha_2 J_{s,t}^{hl} + \alpha_3 \left(J_t^{FTS} + v S_t^{FTS} \right) + \varepsilon_{s,t}, && (2.5)\\
& \quad \varepsilon_{s,t} \sim N\left(0, h_s\left(S_t^s\right)\right) && (2.6)\\
r_{b,t} &= \beta_0 + \beta_1 J_{b,t}^{lh} + \beta_2 J_{b,t}^{hl} + \beta_3 \left(J_t^{FTS} + v S_t^{FTS} \right) + \\
& \quad \left(\beta_4 + \beta_5 S_t^{FTS}\right) r_{s,t} + \varepsilon_{b,t},\ \varepsilon_{b,t} \sim N\left(0, \theta_{t-1} h_b\left(S_t^b\right)\right) && (2.7)
\end{aligned}
$$

The variance of the stock return shock follows a two-state regime-switching model with latent regime variable S_t^s. The variance of the bond return shock has two components, one due to a spillover from the equity market, and a bond-specific part. The latter follows a two-state regime-switching square-root model with latent regime variable S_t^b; θ_{t-1} is the lagged bond yield[4]. $J_{s,t}^{lh}$ and $J_{s,t}^{hl}$ are equal to 1 when the equity return shock variance switches regimes (from low to high or high to low), and zero otherwise. We expect α_1 to be negative and α_2 to be positive. $J_{b,t}^{lh}$ and $J_{b,t}^{hl}$ are defined in a similar way (but depend on the bond return shock variance). Without the jump terms, regime switching models such as the one described above often identify negative means in the high volatility regime. However, we would expect that there is a negative return when the regime jumps from low to high volatility but that the higher volatility regime features expected returns higher not lower than the low volatility regime. The jump terms have this implication with $\alpha_1 < 0$ and $\alpha_2 > 0$. There is a mostly unexpected negative (positive) return when the regime switches from the low (high) volatility to the high (low) volatility regime. Within the high volatility regime, there is some expectation that a positive jump will occur driving the mean higher than in the low volatility regime where there is a chance of a jump to a high volatility regime. This intuition was first explored and analyzed in Mayfield (2004).

The structure so far describes a fairly standard regime switching model for bond and stock returns, but would not allow us to identify flights to safety. Our identification for the flight to safety regime uses information on the means of bonds versus

[4]By making the bond return shock variance a function of the (lagged) interest rate level, we avoid that the high volatility regime is only observed in the first years of sample, as the early 1980s is a period of high interest rates.

equities, on equity return volatility and on the correlation between bond and stock returns. Let S_t^{FTS} be a latent regime variable that equals 1 on FTS days and zero otherwise. We impose $\alpha_3 < 0$ (stock markets drop during FTS episodes), $\beta_3 > 0$ (bond prices increase during FTS), and $\beta_5 < 0$ (the covariance between stocks and bonds decreases during FTS episodes). It is conceivable that a flight to safety lasts a while, but it is unlikely that the returns will continue to be as extreme as on the first day. Therefore we introduce the J_t^{FTS} variable, which is 1 on the first day of a FTS-regime and zero otherwise, and the $\upsilon-$parameter. The $\alpha_3$and β_3 effects are only experienced "in full" on the first day but with υ restricted to be in $(0,1)$,the negative (positive) flight-to-safety effect on equity (bond) returns is allowed to decline after the first day. We assume S_t^b and S_t^{FTS} to be independent Markov chain processes. For S_t^s, we assume that the equity volatility regime is always in the high volatility state, given that we experience a FTS episode:

$$\Pr\left(S_t^s = 1 |\, S_{t-1}^s, S_t^{FTS} = 1\right) = 1 \tag{2.8}$$

Panel B of Table 4 summarizes the estimation results. The jump terms have the expected signs for the equity market (and are mostly significant) but for bond returns, the results are more mixed. We clearly identify a high and low volatility regime for both the bond and the stock market, with volatilities typically about twice as high in the high volatility regime. In terms of the parameters governing the FTS regime, we find that α_3 is -7.863% in the US, and -5.03% on average, with a substantial interquartile range ([-7.42%, -1.29%]). Not surprisingly, the υ-scaling parameter is mostly rather small (interquartile range of [0.015,0.062]), indicating that a FTS mostly only induces one day of heavy losses[5]. For bond returns, β_3 is 0.72% on average, but it is also often drawn to the lower boundary of zero. Finally, we do find that β_5 is statistically significantly negative, indicating that a FTS induces a negative covariance between bond and stock returns (or at least one lower than the covariance in non-FTS regimes). As reflected by the average and interquantile values for β_4, the average stock-bond correlation in 'normal' times is relatively close to zero in our sample.

We do find that the bivariate model predicts FTS spells to last substantially longer than in the univariate model, namely an average of 89.9 days in the US and 86.6 days on average in all countries (but with a substantial interquartile range of [58-101]). The number of FTS spells is on average even smaller than for the univariate model, but there are more spells in the US (24) relative to the univariate

[5]The average value for ν (0.156) is higher than the value for the top quartile because a small number of countries have a value of ν close to one (but also a low absolute value for α_3).

model (18).

2.3 Aggregate FTS Incidence

At this point, we have transformed data on bond and stock returns and simple information about the "symptoms" of a FTS into 4 noisy indicators on the presence of a FTS regime. All 4 indicators are between 0 and 1 and can be interpreted as a measure of the probability of being in a FTS regime. For the FTS dummy approach, we select $\kappa = 1.5$ as the preferred method, because it gives an incidence of FTS regimes somewhat similar to the Ordinal FTS index, and to make FTS episodes suitably rare relative to what we expect from a normal distribution (see Section 2.2.1). In general, these two methods yield a relatively low incidence of FTS regimes, whereas the regime-switching approach delivers relatively persistent FTS regimes and classify more periods into the FTS regime. Table 5 (right hand side columns) reports the average number of days classified as FTS regimes for the 4 approaches. For most countries, the proportion of time spent in an FTS-episode increases monotonically moving from the threshold index (0.96% on average) to the ordinal index (4%), then to the univariate regime switching model (9.76%) and finally the bivariate model (14.83%). Within each method, the interquartile ranges are quite tight, ranging from 0.74%-1.16% for the threshold index to 2.6%-5.3% for the ordinal index to 8%-11.9% and 13%-17.7% for the univariate and bivariate RS models, respectively.

To infer whether a particular day suffered a flight to safety episode, we must use the imperfect information given in the indicators to come up with a binary classification. There is of course a large literature on classification that suggests that the optimal rule (in the sense that it minimizes misclassification) is to classify the population based on the relative probability. Given that there are two regimes, a probability of a flight to safety higher than 0.5 would lead to the conclusion that there is a flight to safety. Unfortunately, this literature assumes that we do observe the true regime for at least a sub-set of the population which we do not (see e.g. Gilbert (1968)).

To aggregate the information in the 4 indicators, we use two methods. A first naïve aggregator is simply to average the probabilities at each point of time and then to use that average to infer whether there is a flight to safety or not. A second method, which leans more on the extant literature on regime classification based on qualitative variables, recognizes that if three of the 4 variables indicate a flight to safety, we should be rather confident a flight to safety indeed occurred. Using the probabilities of the 4 indicators, we therefore classify a day as a FTS, if the joint probability that at least 3 out of 4 FTS indicators are 1 is higher than 0.5[6]. We also record that joint probability as a measure of the strength of our confidence.

Given these two aggregation methods, we record the proportion of time spent in a FTS episode in Table 5 (left columns). The average proportion is 4.7% (interquartile range of 3.2%-6.4%) using the average measure and 2.36% (interquartile range of 1.8%-3.0%) using the joint probability measure. In Table 6, we report the "return impact" (bond return minus equity return) both on FTS and non-FTS days. The rarer nature of FTS episodes under the joint probability measure translates into a higher return impact of 2.91% on FTS days versus 1.76% for the average measure. The interquartile range for the return impact measure is relatively tight for both measures. As expected, on non-FTS days, the return impact measure is slightly negative (-0.08%), reflecting the on average higher return on stocks than on bonds in tranquil times.

Figure 2 plots the aggegrate FTS indicators for the US. The top panel plots the average FTS indicator together with the corresponding FTS dummy (one when the average indicator $>$ 0.5, and zero otherwise). The middle and bottom panel plot the joint measure and the corresponding joint FTS probability. Both measures largely select the same periods as FTS episodes, and are highly correlated at 84.8%. The main difference between both measures is that FTS episodes are slightly longer lasting for the average measure than for the more demanding joint measure. Generally, the joint probability measures on FTS dates are rather close to one. Table 7 shows that this correlation is near the top of the range among our different countries. On average, the correlation is 67.8% with an interquartile range of 60.5%-75.3%. On average, the "average" measure is most highly correlated with the FTS indicator derived from the univariate RS model, whereas the joint probability measure is most highly correlated with the ordinal measure. In Panel B, we report correlations using weekly data. The weekly FTS indicators are dummies with a value equal to one if at least one day within that week is a FTS day according to that specific indicator, and zero otherwise. Weekly correlations are quite a bit higher than daily correlations, suggesting that the different indicators do tend to select similar FTS spells, with small timing and persistence differences. We further characterize FTS in Section 3.

[6]We assume that the FTS indicators are independent for this computation.

3 Characterizing FTS Episodes

To characterize the nature of FTS episodes, we investigate returns before, on and after FTS episodes; examine their comovement across countries and how they correlate with alternative indicators of market stress, uncertainty and risk aversion. Figure 3 plots returns in the equity and bond market as well as the difference between the bond and equity return, averaged over the 23 countries, ranging from 30 days before to 30 days after a FTS event. In the graphs on the left, FTS is identified using the average measure, in the graphs on the right the joint probability FTS measure is used. The solid lines take all FTS days into account, even if the previous day was also a FTS day. The dotted lines show returns and return impact around the first day of a FTS spell only. The solid lines indicate that the FTS events are characterized by very sudden simultaneous drops in the equity market and increases in the bond market, as expected. For the average (joint probability) measure, the average equity return is -1.49% (-2.44%) and the average bond return is +0.28% (0.47%). These FTS-events do seem to occur in periods when equity returns are already slightly negative and bond returns slightly positive. Somewhat oddly, just before the start of an FTS episode, we see somewhat substantial positive equity returns and negative bond returns (see the dotted line).

Figure 4 plots the percentage of countries experiencing a FTS at each point in time. The FTS indicators clearly select well known global crises as global FTS events, including the October 1987 crash, the 1997 Asian crisis, the Russian crisis and LTCM debacle in 1998, the Lehman Brothers collapse and several spells during the European sovereign debt crisis. Defining a global FTS as one where at least two third of our countries experience a FTS, there are a total of 109 days of global FTS according to the average measure, but only 39 days according to the joint probability measure. In Table 8, we report the proportion of FTS spells that are global in nature. The cross-country average of local FTS spells that are global in nature amounts to 32.5% for the average indicator and 23.7% for the joint measure. The interquartile ranges are 21%-30.8% and 13.3%-22.2%, respectively. Large developed countries such as the US, the UK and Germany (reported separately) feature a relatively low proportion of global spells, suggesting they are more subject to idiosyncratic flights to safety. While the interquartile ranges are relatively tight, a number of small countries, such as Norway, the Czech Republic and Poland have unduly high proportions of global FTS episodes (more than 70% under the average measure).

Our FTS indicators require minimal data inputs and provide a high frequency reading of flight to safety episodes. Of course, there are other financial indicators that may allow identification of a flight to safety episode. In Table 9, we investigate the comovement between our FTS indicators and three types of alternative stress indicators. First, we investigate the well-known US VIX index, the option - implied volatility on the S&P500 which is generally considered to be a fear index. We use daily changes in the index as the dependent variable in a regression on our FTS indicators. Second, we investigate a series of sentiment/confidence indicators. The sentiment variables include the Baker-Wurgler sentiment indicator (purged of business cycle fluctuations) and the Michigan consumer sentiment index which measure sentiment in the US; the Ifo Business Climate indicator (which measures sentiment in Germany) and the OECD consumer confidence indicator (seasonally-adjusted). We use changes in these indices as the dependent variable. Because these sentiment variables are only available on a monthly basis, we regress them on the fraction of days of FTS instances within the month (expressed in %). Finally, we regress the percentage change in value of two safe haven currency values (i.e. the Swiss Franc, the Japanese Yen and an equally-weighted portfolio of the two) on the FTS indicator using daily data. Note that the currencies are expressed in domestic currency units per unit of the safe currency and positive values indicate an appreciation of the safe currency.

Panel A of Table 9 shows the results for average FTS measure, Panel B for the joint probability FTS measure. We show slope parameter estimates for the US, Germany and the UK, as well as the average, standard deviation and top/bottom quartile parameter estimates across all 23 countries. The last column shows the number of countries for which the parameter estimates are significant. We focus the discussion on Panel A. The VIX, despite being a risk-based measure, increases significantly during FTS episodes for all countries (in the Netherlands the coefficient is only significant at the 10% level). There is clear evidence of a significant decline in consumer and business sentiment during FTS episodes. The Baker-Wurgler sentiment indicator and the Michigan consumer sentiment decrease significantly when there is FTS in the US. The Michigan index also reacts significantly to flight to safety instances in Germany and the UK, despite these countries witnessing only a limited number of global flights to safety (see Table 8). There are another 6 countries, whose FTS episodes have a significant effect on the Michigan index, but only 4 significant coefficients for the regression involving the Baker-Wurgler index. The Ifo business climate indicator declines significantly in times of FTS for all but one country. This is somewhat surprising as this indicator measures the German business climate. A FTS negatively affects OECD consumer confidence in 19 countries, as measured by the country-specific OECD indicator of consumer sentiment. The OECD consumer confidence indicator also reacts negatively to FTS events in 19 out of 23 countries. The 4 countries for which the FTS coefficient is not significant are Australia, New Zealand, Ireland and Spain. Thus, the latter two measures seem to somehow be linked to FTS events across the globe.

There is also strong evidence of a flight to safe haven currencies in times of a FTS. On average, during a FTS day, the Swiss Franc and the Japanese Yen appreciate respectively by 0.22% and 0.43%. The effect is statistically significant for most countries, but for the US, we only find the appreciation of the Japanese Yen to be statistically significant on FTS days. The results in Panel B for the joint probability measure are largely consistent with the results in Panel A, both qualitatively and even quantitatively.

4 FTS and the Economic and Financial Environment

In this section, we examine the comovement of FTS spells and financial returns on the one hand and indicators of the real economy on the other hand. Our goal is again to document comovements rather than to explain or look for causality. Before we begin, we provide one other indicator of the importance of FTS. It is to be expected that bond and stock returns, the two major asset classes, are positively correlated as they both represent long duration assets. Over our sample period, which starts fairly late in 1980, this correlation is nonetheless negative for 19 out of 23 countries. It is conceivable that this negative correlation is mainly caused by the relatively high incidence of FTS in the last 30 years. If such a “FTS-heavy” era is not likely to occur again in the near future, investors may want to re-assess the computation of the bond-stock return correlation. To assess the importance of FTS events for this important statistic, we eliminated FTS events in each country from the sample and recomputed the stock-bond return correlation. The stock-bond return correlation is 4.25% on average in “normal” periods (interquartile range of [-0.6%,5.2%]) and -9.12% overall (interquartile range of [-13.1%,-5.3%]).

4.1 FTS and Stock Portfolios

To assess the FTS “beta” of different stock portfolios, we regress the daily returns on various stock portfolios onto the FTS indicator, but also on two controls for “standard” systematic risk, the world market return and the local stock market return, both measured in local currency units. As a consequence, the FTS beta must be interpreted as the abnormal return earned during FTS episodes, controlling for normal beta risk. Importantly, it does not indicate which portfolios perform best or worst during FTS spells, as portfolios with positive (negative) FTS betas may have also high (low) market betas, making them perform overall relatively well (poorly) during an FTS spell. We also tried a specification with interactions between the FTS indicator and the benchmark returns, but this specification often runs into multi-collinearity problems and the results are therefore omitted.

Table 10 reports the FTS betas for 10 industry portfolios (using the Datastream industry classification) and the MSCI style portfolios (large caps, mid caps, small caps, value and growth). The style portfolios also include a SMB portfolio (i.e. the return of the small cap portfolio minus the return on the large cap portfolio) and a HML portfolio (i.e. the return of the value portfolio minus return on the growth portfolio). All regressions use daily returns. Panel A shows the results for average FTS measure, Panel B for the joint probability FTS measure, both described in Section 2.3. We show the estimates for the US, Germany and UK, as well as the average, standard deviation and top/bottom quartile parameter estimates across all 23 countries. We focus the discussion on Panel A but the results in Panel B are very similar.

For the industry portfolios, there are industries which show globally significant out- or underperformance during a FTS, even controlling for their "normal" betas. The three under-performing industries are financials, basic materials and industrials. The inter-quartile range is negative for these industries and the FTS beta statistically significant in more than half the countries. The only "defensive" industry is telecom, which increases by 22 bps on a FTS-day, controlling for its normal beta. Other industries show strong but country-specific results. For instance, the technology sector significantly outperforms in the US, but underperforms in Germany and the UK. In terms of style portfolios, large cap portfolios have positive FTS betas, whereas small cap portfolios have negative FTS betas. Value portfolios tend to have negative FTS betas and growth portfolios positive ones, but the betas are small and the results are statistically weaker than for the size portfolios. This is naturally confirmed when we look at spread portfolios, where the SMB portfolio is significantly negative in 20 out of 23 countries, but the HML portfolio is only significantly negative in 6 countries.

4.2 FTS and Bond Portfolios

For bond returns, we follow a similar procedure as for equity returns, controlling for the normal exposure to the long-term benchmark bond in each regression. When we investigate corporate bond returns we also control for the local stock market return. Table 11 reports the FTS betas for the bond portfolios. The bond portfolios include JP Morgan cash indices (1, 2, 3, 6 and 12 months), benchmark Datastream government bond indices (2, 5, 7, 10, 20 and 30 year) and BOFA ML coporate bond indices (with respectively AAA, AA, A and BBB ratings). The corporate bond indices are only available for the US, Japan, Canada, Australia and the Eurozone as a whole. We use the Eurozone corporate bond index for regressions with FTS indicators of European countries and the corporate bond index of Australia for the regression with the FTS indicator of New Zealand. Further, we consider two spread portfolios, the 10 year bond return minus the 2 year bond return and the return on the BBB portfolio minus the return on the AAA portfolio. Thus, the first portfolio primarily reacts to changes in the term spread, and the second to changes in default risk. All returns are daily and denominated in local currency.

Panel A shows the results for average FTS measure, Panel B for the joint probability FTS measure. We show slope parameter estimates for the US, Germany and UK, as well as the average, standard deviation and top/bottom quartile parameter estimates across all 23 countries. For the US, there is a very pronounced term structure shift in FTS episodes, with short term bonds underperforming and long term bonds (the 20-30 year bonds) outperforming. When looking across all countries, the result that remains pervasive is the under-performance of money market instruments relative to the benchmark bond by an average of 5 to 6 basis points. However, the very long term bonds do not necessarily outperform relative to the benchmark bond, probably reflecting the liquidity advantages of the benchmark bond. The spread's portfolio outperformance in the US and UK does not generally extend to other countries. Corporate bonds underperform controlling for their usual exposures to the stock market and the bond market, with the underperformance becoming larger and more significant for lower rated bonds, although the FTS betas of A and BBB-rated bonds are quite similar. Note that the betas of corporate bonds to the long-term bonds are around 0.4 and slightly decreasing for lower ratings whereas the equity betas are minuscule. Hence, corporate bonds almost surely outperform equities during FTS-episodes. The "default spread" portfolio has a significantly negative FTS beta in all 23 countries.

4.3 FTS and Commodities

In Table 12, we report regression coefficients from a regression of the S&P GSCI benchmark commodity index returns on the FTS indicator. These returns reflect the returns on commodity futures contracts worldwide. We consider broad indices (Commodity Total, Energy, Industrial Metals, Precious Metals, Agriculture, Livestock) and subindices (Crude Oil, Brent Crude Oil and Gold). As before, we investigate daily returns, but there is no natural risk correction for normal times, so the slope coefficient now simply measures the differential return on FTS days relative to normal days. The table has the exact same structure as the previous tables for bonds and equities. We note that commodity prices generally decline on FTS days and using the average measure the returns are significantly negative with averages ranging from an average across countries of minus 20 basis points for Livestock to minus 97 basis points for Brent Crude Oil. Using the joint probability measure, the returns are larger in absolute magnitude. They are mostly statistically significant for *all* countries. There is one, not entirely surprising, exception: precious metals and its main component gold. There are significantly positive gold futures returns measured in dollars, but this significance extends only to 4 countries (or 11 using the joint probability measure). Of course, the dollar measurement is the most relevant as for other countries the gold futures return reflects both changes in the gold price and changes in the dollar's value relative to the local currency.

4.4 FTS Episodes and the Real Economy

In Table 13, we investigate the comtemporenous comovement between FTS episodes and the real economy. We regress a number of real economy variables on the fraction of days of FTS instances within the month (expressed in decimals). We investigate the following variables: inflation, industrial production growth (IP), the unemployment rate and the OECD leading indicator (available monthly); GDP growth and investment/GDP (available quarterly). For inflation, IP growth, GDP growth, the unemployment rate and investment growth, we also have survey forecasts and we use both the mean and the standard deviation of individual forecasts (available monthly, in %). The growth variables are computed as the next quarter value relative to the current value (in %). The unemployment rate (in %), the OECD leading indicator, investment/GDP (in %) and the survey forecast variables are computed as absolute differences between the next quarter value and the current value. Panel A shows the results for the average FTS measure, Panel B for the joint probability FTS measure. We focus the discussion on Panel A but the results in Panel B are analogous. GDP growth and IP growth decrease significantly immediately following FTS episodes for respectively 20 and 8 countries. The average growth and the interquartile range across countries are strictly negative. Inflation is significantly lower right after FTS episodes for most countries. Unemployment increases significantly for 16 out of 23 countries. The mean survey forecasts reveal a significant and negative effect for the real growth variables and inflation and a significant and positive effect for unemployment and this is true for most countries (although forecasts data is not available for all countries/variables). Forecast uncertainly (as measured by the standard deviation of individual forecasts) does not change significantly during FTS episodes.

In Table 14, we investigate whether FTS predicts future economic performance. We regress the cumulative one year growth or increase in the economic variables on the fraction of days of FTS instances within the month (expressed in decimals). The cumulative one year growth in GDP, industrial production and CPI (inflation) is computed as the next year value relative to the current value (in %). The increase in the unemployment rate (in %), the OECD leading indicator, investment/GDP (in %) and private credit to business/GDP (in %) is computed as the absolute difference between the next year value and the current value. FTS predicts negative one-year growth in industrial production and GDP for all countries. The effect is significant for most countries. Unemployment is expected to increase substantially after the year following a FTS spell. Inflation also declines significantly for most countries. Note that the economic magnitudes are very large. For example, GDP growth would be predicted to be 4.2% lower if all days within a month were categorized as a FTS (FTS incidence = 100%). Of course, such a month is never observed as the maximum FTS incidence is 67.2%. The two last results are perhaps initially counterintuitive. High FTS incidence predicts an increase in the OECD leading indicator one year from now. Of course, recall that the contemporaneous (one quarter ahead) response of the OECD indicator to a FTS spell was negative. As the OECD aims to predict the business cycle with a 6 to 9 months lead, this suggests that the economy is expected to rebound within two years. However, while significant in the US, UK and Germany, we do not observe it for all countries. The private credit to GDP variable also yields mixed results, but on average private credit to GDP *increases* after a FTS spell. This may simply mean that GDP falls faster than the extension of credit.

5 Conclusions

We define a flight to safety event as a day where bond returns are positive, equity returns are negative, the stock bond return correlation is negative and there is market stress as reflected in a relatively large equity return volatility. Using only data on equity and bond returns, we identify FTs episodes in 23 countries. On average, FTS episodes comprise less than 5% of the sample, and bond returns exceed equity returns 2 to 3%. FTS events are mostly country-specific and less than 30% can be characterized as global. Nevertheless, our methodology easily identifies major market crashes, such as October 1987, the Russia crisis in 1998 and the Lehman bankruptcy as FTs episodes. FTS episodes coincide with increases in the VIX, decreases in consumer sentiment indicators in the US, Germany and the OECD and appreciations of the yen and the Swiss franc. The financial, basic materials and industrial industries under-perform in FTS episodes, but the telecom industry outperforms. Money market securities and corporate bonds have negative "FTS-beta". Most commodity prices decrease sharply during FTS episodes, whereas the gold price measured in dollars increases slightly. Both economic growth and inflation decrease immediately following a FTS spell, and this decrease extends to at least one year after the spell.

We hope that our results will provide useful input to theorists positing theories regarding the origin and dynamics of flights to safety, or to asset pricers attempting to uncover major tail events that may drive differences in expected returns across different stocks and/or asset classes. They could also inspire portfolio and risk managers to look for portfolio strategies that may help insure against FTS-events.

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Table 1: Flights-to-Safety Dummy

This table reports the number of FTS days as a percentage of total observations. For a given threshold level κ, we identify a Flight-to-Safey episode as a day when the bond return is κ standard deviations above zero while at the same time the equity return for that country is κ standard deviations below zero. The standard deviations for bond and stock returns are country-specific and calculated over the full sample. We allow κ to vary from 0 to 4.

	Percentage # FTS Instances, $\kappa = 1, .., 4$								
	0	0.5	1	1.5	2	2.5	3	3.5	4
US	21.82	6.70	2.41	0.90	0.42	0.22	0.12	0.07	0.04
Germany	24.20	7.02	3.20	1.19	0.45	0.27	0.12	0.06	0.04
UK	23.44	6.45	1.97	0.63	0.25	0.11	0.05	0.04	0.02
Switzerland	31.25	6.24	2.02	0.74	0.30	0.20	0.12	0.06	0.01
Japan	29.01	8.23	2.21	0.61	0.18	0.04	0.03	0.00	0.00
Canada	24.00	6.75	2.19	0.69	0.28	0.18	0.08	0.03	0.03
Sweden	26.08	8.00	2.12	0.58	0.13	0.08	0.05	0.00	0.00
Australia	25.32	7.64	2.35	0.88	0.35	0.12	0.03	0.02	0.02
Denmark	25.56	7.55	2.15	0.67	0.32	0.12	0.02	0.02	0.00
France	26.73	8.13	3.07	1.31	0.43	0.23	0.08	0.06	0.01
Belgium	26.13	7.17	2.82	1.06	0.37	0.23	0.10	0.06	0.05
Italy	28.01	8.55	2.90	1.28	0.44	0.26	0.13	0.02	0.02
New Zealand	26.16	8.26	2.37	0.72	0.20	0.15	0.07	0.02	0.02
Netherlands	26.60	7.80	3.14	1.23	0.38	0.22	0.11	0.05	0.04
Ireland	26.64	7.17	2.64	1.08	0.37	0.18	0.08	0.05	0.04
Spain	27.00	9.07	3.55	1.46	0.54	0.29	0.15	0.06	0.05
Austria	24.98	6.53	2.58	1.16	0.44	0.22	0.11	0.05	0.04
Czech Republic	27.48	8.30	2.67	0.84	0.27	0.17	0.04	0.02	0.02
Finland	27.52	9.30	3.31	1.12	0.27	0.14	0.06	0.02	0.02
Greece	28.44	8.88	2.76	0.87	0.29	0.16	0.07	0.02	0.00
Norway	26.34	7.62	2.34	0.74	0.40	0.24	0.12	0.04	0.02
Poland	28.54	9.43	3.01	0.94	0.32	0.15	0.06	0.02	0.00
Portugal	27.91	8.59	3.49	1.27	0.43	0.24	0.14	0.07	0.03
Average	26.49	7.80	2.66	0.96	0.34	0.18	0.08	0.04	0.02
Simulation	27.31	11.16	3.27	0.66	0.09	<0.01	<0.001	<0.001	<0.001

Table 2: Return Impact on FTS Days

This table reports the average impact, measured as the difference between the daily bond and stock return, on FTS days, for different threshold levels κ.

	Return Impact on FTS days, in %								
	0	0.5	1	1.5	2	2.5	3	3.5	4
US	1.25	2.35	3.50	4.63	6.11	6.73	7.92	7.94	8.89
Germany	1.14	2.24	3.00	3.95	4.76	5.43	6.18	6.69	6.77
UK	1.10	2.06	3.18	4.41	5.75	7.08	8.81	9.99	12.09
Switzerland	0.87	1.92	2.90	3.80	4.99	5.46	5.97	5.65	5.94
Japan	1.12	2.01	3.02	3.83	4.79	5.64	5.86	-	-
Canada	1.06	2.02	3.00	4.30	5.82	6.26	7.28	8.89	8.89
Sweden	1.44	2.44	3.55	4.77	6.47	7.33	7.16	-	-
Australia	1.13	2.01	3.01	4.08	5.00	5.46	6.13	6.59	6.59
Denmark	1.08	1.90	2.82	3.69	4.15	4.99	5.23	5.23	-
France	1.18	2.14	3.12	3.84	4.83	5.74	7.01	6.83	9.48
Belgium	0.98	1.96	2.77	3.63	4.67	5.47	6.49	7.37	7.35
Italy	1.29	2.28	3.48	4.32	5.27	5.87	6.64	8.87	8.87
New Zealand	0.90	1.52	2.24	3.17	4.80	5.53	6.91	13.97	13.97
Netherlands	1.13	2.15	3.11	3.99	5.12	6.15	7.25	8.74	9.72
Ireland	1.13	2.21	3.28	4.33	5.63	7.31	9.47	12.32	13.96
Spain	1.26	2.23	3.21	4.11	5.29	6.23	7.03	8.46	8.62
Austria	0.98	2.05	2.97	3.77	4.45	5.44	6.32	7.89	8.44
Czech Republic	1.31	2.34	3.48	4.60	5.54	6.46	9.11	12.02	12.02
Finland	1.65	2.81	3.88	4.93	6.11	6.73	7.46	9.14	9.14
Greece	1.48	2.56	3.72	4.92	6.04	6.82	7.35	8.98	-
Norway	1.38	2.37	3.54	4.89	5.84	6.72	8.14	9.04	7.86
Poland	1.64	2.75	3.86	5.02	6.00	6.76	7.28	7.74	-
Portugal	1.03	1.95	2.75	3.70	4.61	5.71	5.99	7.00	8.51
Average	1.20	2.19	3.19	4.20	5.31	6.15	7.09	8.54	9.28

Table 3: The Ordinal FTS Indicator

This table reports summary statistics for the Ordinal FTS Indicator discussed in Section 2.2.2. The first column reports summary statistics for the threshold level, calculated as the minimum of the ordinal numbers on days that satisfy a set of "mild" FTS conditions. Column 2 reports the percentage of observations that have an ordinal number above this threshold. Column 3 reports how much of those observations have an ordinal indicator larger than 50 percent (calculated as 1 minus the percentage of false positives, i.e. the percentage of observations with an ordinal number above the threshold that are not meeting our FTS criteria). Column 4 shows the percentage of observations in the full sample that have an ordinal FTS indicator larger than 50%.

	Threshold Level	% observation > Threshold	% (obs > threshold) with indicator > 0.5	% obs with indicator > 0.5
US	0.772	6.9%	75.4%	5.2%
Germany	0.781	6.5%	98.7%	6.4%
UK	0.728	9.0%	65.3%	5.9%
Mean	0.723	10.5%	52.9%	5.2%
Median	0.723	10.3%	57.0%	5.1%
Min	0.650	4.8%	18.6%	2.7%
Max	0.804	19.3%	98.7%	7.9%
Interquartile	0.710	9.3%	39.1%	4.6%
Range	0.728	11.4%	64.9%	6.3%

Table 4: Estimation Results Regime-Switching FTS models

Panel A presents the estimation results for the Univariate 3-state Regime-Switching model described in Section 2.2.3. Panel B reports estimation results for the Bivariate Regime-Switching FTS model with jump terms as described in Section 2.2.4. We show detailed estimation results for the US, as well as the average and top/bottom quartile parameter estimates across all 23 countries. ***, **, and * represent statistical significance at the 1 and 5 percent level, respectively. FTS duration is expressed in days.

Panel A: Univariate 3-state RS FTs Model

	US	**Average**	**6th**	**17th**
Regime-dependent Intercepts (expressed in daily %)				
μ_1	-0.046***	-0.057	-0.079	-0.039
μ_2	-0.014	-0.020	-0.050	-0.007
μ_3	0.218*	0.249	0.198	0.271
Annualized Volatility Estimates				
σ_1	0.097***	0.105	0.087	0.122
σ_2	0.195***	0.201	0.166	0.217
σ_3	0.465***	0.473	0.408	0.498
FTS duration	36.3	26.7	17.2	35.3
# spells	18	26.4	17	31

Panel B: Bivariate RS FTs Model

	US	**Average**	**6th**	**17th**
Equity: Intercept + Jump Terms (expressed in daily %)				
α_0	0,076***	0.069	0.050	0.085
α_1	-1.275**	-2.359	-2.053	-0.246
α_2	1,732***	3.020	1.257	1.989
Bond: Intercept + Jump Terms (expressed in daily %)				
β_0	0,02***	0.030	0.029	0.033
β_1	-0.360	-0.775	-0.923	-0.327
β_2	-0.691***	-0.242	-0.578	0.068
FTS Estimates (expressed in daily %)				
α_3	-7,863***	-5.0286	-7.4159	-1.2872
β_3	0.0001	0.7237	0.0179	0.6736
ν	0,012***	0.1561	0.0146	0.0615
Beta Estimates				
β_4	0,178***	0.0307	-0.0055	0.0382
β_5	-0,344***	-0.1667	-0.1974	-0.1114
Annualized Volatility Estimates				
$h_s\left(S_t^s=1\right)$	0,104***	0.1100	0.0930	0.1316
$h_s\left(S_t^s=2\right)$	0,255***	0.2860	0.2464	0.3245
$h_s\left(S_t^b=1\right)$	0,021***	0.0157	0.0132	0.0180
$h_s\left(S_t^b=2\right)$	0,048***	0.0357	0.0314	0.0382
FTS duration	89.9	86.6	58.0	101.3
# spells	24	16.0	10.0	18.5

Table 5: Percentage Number of FTS Instances

This table reports the percentage number of days that a FTS is observed according to our two aggregate measures (columns 1 and 2) and four individual measures (columns 3 to 6).

	Aggregate Measures		Individual Measures			
Country	Average	Joint Prob.	Threshold	Ordinal	Univ RS	Bivar RS
US	3.91	2.84	0.90	5.17	7.98	21.74
Germany	4.95	3.92	1.19	6.37	11.31	26.77
UK	5.22	3.51	0.63	5.86	9.40	23.17
Switzerland	3.02	2.17	0.74	5.68	7.05	6.95
Japan	1.34	0.50	0.61	3.07	5.49	12.96
Canada	4.36	2.52	0.69	4.74	8.56	19.26
Sweden	6.41	4.03	0.58	6.66	14.59	28.24
Australia	3.21	1.03	0.88	1.80	3.72	17.71
Denmark	6.55	2.30	0.67	2.42	12.00	17.74
France	4.59	3.02	1.31	6.34	7.85	17.32
Belgium	7.11	3.51	1.06	4.34	8.83	16.66
Italy	4.42	2.34	1.28	3.28	8.17	10.16
New Zealand	0.81	0.33	0.72	1.82	1.99	1.78
Netherlands	9.60	4.40	1.23	5.29	12.18	17.26
Ireland	6.38	2.53	1.08	3.69	8.89	14.29
Spain	7.87	4.23	1.46	5.67	12.09	23.73
Austria	6.15	2.56	1.16	3.08	11.91	14.50
Czech Republic	1.53	0.57	0.84	2.59	2.96	5.55
Finland	7.73	2.75	1.12	4.76	19.20	14.80
Greece	5.33	1.80	0.87	2.52	19.75	13.08
Norway	0.58	0.08	0.74	0.16	10.83	0.12
Poland	1.45	0.53	0.94	2.07	10.88	3.46
Portugal	5.52	2.79	1.27	4.65	8.85	13.75
Average	4.70	2.36	0.96	4.00	9.76	14.83
Median	4.82	2.53	0.92	4.17	9.14	14.81
Min	0.58	0.08	0.58	0.16	1.99	0.12
Max	9.60	4.40	1.46	6.66	19.75	28.24
Interquartile	3.21	1.80	0.74	2.59	7.98	12.96
Range	6.38	3.02	1.16	5.29	11.91	17.74

Table 6: Return Impact on FTS Days

This table reports the return impact - the difference between the bond and stock return - on FTS days as identified by the two aggregate (columns 1 and 2) where we also record the return impact on non-FTS days, and four individual measures (columns 3 to 6).

	Average measure		Joint Prob. Measure		Individual Measures			
	FTS	non-FTS	FTS	non-FTS	Threshold	Ordinal	Univ RS	Bivar RS
US	2.53%	-0.12%	2.86%	-0.10%	4.63%	2.33%	0.18%	0.14%
Germany	2.46%	-0.14%	2.63%	-0.12%	3.95%	2.24%	0.30%	0.12%
UK	1.99%	-0.12%	2.43%	-0.10%	4.41%	2.04%	0.17%	0.08%
Switzerland	2.34%	-0.09%	2.53%	-0.08%	3.80%	1.98%	0.33%	0.33%
Japan	3.20%	-0.04%	3.81%	-0.01%	3.83%	2.52%	0.22%	0.17%
Canada	2.13%	-0.10%	2.86%	-0.08%	4.30%	2.16%	0.20%	0.15%
Sweden	2.37%	-0.18%	2.80%	-0.13%	4.77%	2.53%	0.11%	0.15%
Australia	1.13%	-0.04%	3.58%	-0.04%	4.08%	2.35%	0.54%	0.11%
Denmark	0.65%	-0.06%	1.68%	-0.05%	3.69%	1.52%	0.23%	0.16%
France	2.25%	-0.13%	2.67%	-0.11%	3.84%	2.27%	0.36%	0.16%
Belgium	0.51%	-0.06%	1.37%	-0.07%	3.63%	1.17%	0.23%	0.16%
Italy	0.89%	-0.07%	2.24%	-0.08%	4.32%	2.02%	0.30%	0.23%
New Zealand	2.07%	-0.02%	4.03%	-0.01%	3.17%	1.51%	0.47%	0.75%
Netherlands	0.42%	-0.07%	1.57%	-0.09%	3.99%	1.42%	0.28%	0.18%
Ireland	0.78%	-0.08%	2.58%	-0.09%	4.33%	1.73%	0.36%	0.24%
Spain	0.64%	-0.07%	1.71%	-0.09%	4.11%	1.50%	0.26%	0.13%
Austria	0.80%	-0.07%	2.30%	-0.07%	3.77%	1.90%	0.20%	0.13%
Czech Republic	2.73%	-0.07%	4.55%	-0.05%	4.60%	2.34%	0.18%	0.29%
Finland	0.55%	-0.07%	2.39%	-0.09%	4.93%	1.99%	0.08%	0.16%
Greece	0.86%	-0.06%	3.09%	-0.07%	4.92%	2.52%	-0.04%	0.16%
Norway	5.27%	-0.06%	6.19%	-0.03%	4.89%	4.37%	0.33%	0.83%
Poland	3.09%	-0.05%	5.05%	-0.03%	5.02%	3.76%	0.29%	0.30%
Portugal	0.93%	-0.05%	1.94%	-0.05%	3.70%	1.52%	0.38%	0.32%
Average	1.76%	-0.08%	2.91%	-0.07%	4.20%	2.16%	0.26%	0.24%
Min	0.42%	-0.18%	1.37%	-0.13%	3.17%	1.17%	-0.04%	0.08%
Max	5.27%	-0.02%	6.19%	-0.01%	5.02%	4.37%	0.54%	0.83%
Interquartile	0.80%	-0.09%	2.30%	-0.09%	3.83%	1.73%	0.20%	0.15%
Range	2.37%	-0.06%	3.09%	-0.05%	4.60%	2.34%	0.33%	0.24%

Table 7: Correlations between FTS Indicators

This table reports unconditional correlations between the different aggregate and individual FTS indicators. Panel A contains correlations between the daily FTS measures, Panel B correlations between weekly FTS measures. The weekly FTS indicators are dummies with a value equal to one if at least one day within that week is a FTS day according to that specific indicator, and zero otherwise.

Panel A: Daily data

CORR OF		Average Measure				Joint Prob. Measure			
WITH	Joint Prob.	Treshold	Ordinal	Univ	Bivar	Treshold	Ordinal	Univ	Bivar
US	84.8%	43.2%	74.4%	59.4%	38.3%	43.4%	72.3%	56.8%	32.5%
Germany	88.5%	45.7%	84.8%	57.6%	37.4%	46.5%	76.7%	56.0%	33.4%
UK	81.3%	33.3%	77.1%	67.0%	42.5%	39.4%	75.3%	58.6%	34.7%
Average	67.8%	42.8%	58.7%	62.4%	49.7%	47.0%	67.4%	45.2%	35.6%
Min	37.0%	27.4%	19.5%	21.9%	26.6%	32.8%	35.3%	8.1%	15.6%
Max	88.5%	79.2%	84.8%	86.9%	71.1%	60.0%	90.3%	60.9%	51.8%
Interquartile	60.5%	35.1%	53.2%	57.6%	41.6%	44.1%	61.6%	40.5%	32.7%
Range	75.3%	46.9%	65.1%	70.7%	59.2%	50.8%	76.7%	56.0%	39.1%

Panel B: Weekly data

CORR OF		Average Measure				Joint Prob. Measure			
WITH	Joint Prob.	Treshold	Ordinal	Univ	Bivar	Treshold	Ordinal	Univ	Bivar
US	92.3%	50.7%	81.0%	81.1%	48.7%	51.5%	77.0%	78.2%	42.0%
Germany	93.4%	59.4%	89.6%	70.9%	45.0%	59.0%	82.5%	69.8%	40.7%
UK	90.3%	42.2%	85.3%	80.5%	47.3%	46.0%	82.1%	75.2%	40.9%
Average	82.2%	55.6%	69.6%	73.3%	55.9%	55.3%	73.9%	59.9%	45.5%
Min	63.3%	38.1%	27.3%	37.8%	38.2%	41.4%	37.6%	12.7%	24.6%
Max	93.4%	79.6%	89.6%	91.2%	72.2%	70.7%	96.3%	78.6%	69.3%
Interquartile	76.5%	50.7%	64.0%	70.9%	50.3%	51.6%	67.4%	57.5%	40.7%
Range	89.2%	60.1%	77.4%	82.3%	61.8%	59.1%	85.1%	70.5%	48.4%

Table 8: The Incidence of Global FTS

This table reports how many of the local FTS days are global in nature. At the left, FTS instances are identified using the average measure, at the right using the joint measure. We define a FTS event global when at least 2/3rds of all countries experience FTS on that same day. We report country-specific statistics for the US, Germany, and the UK, and summary statistics (average, min, max, interquartile range) for our full sample of 23 countries.

	Average Measure			Joint Prob. Measure		
	# FTS	# global	% global	# FTS	# global	% global
US	327	84	25.7%	238	31	13.0%
Germany	414	99	23.9%	328	39	11.9%
UK	437	103	23.6%	294	39	13.3%
Average	341.3	82.7	32.5%	174.8	28.9	23.7%
Min	29	22	13.4%	4	2	5.4%
Max	804	108	75.9%	368	39	75.0%
Interquartile	209	66	21.0%	67	19	13.3%
Range	437	101	30.8%	243	39	22.2%

Table 9: FTS Indicators and Alternative Stress Indicators

This table reports regression coefficients from a regression of changes in the VIX, sentiment variables and safe have currency values on the FTS indicator (instances). The VIX and safe haven currency values (i.e. the Swiss Franc, the Japanese Yen and an equally-weigthed portfolio of the two) are available on a daily basis and are regressed on the FTS dummy. The sentiment variables are available on a monthly basis and are regressed on the fraction of days of FTS instances within the month (expressed in %). The VIX and sentiment variables are expressed in absolute changes. The currency values are expressed in percentage changes in value (country currency per unit of safe currency). The sentiment variables include the Baker-Wurgler sentiment indicator (purged of business cycle fluctuations) and the Michigan consumer sentiment index which measure sentiment in the US, the Ifo Business Climate indicator (sentiment in Germany) and the OECD consumer confidence indicator (seasonally-adjusted). Panel A shows the results for the average FTS measure, Panel B for the joint probability FTS measure, both described in Section 2.3. We show slope parameter estimates for the US, Germany and UK, as well as the average, standard deviation and top/bottom quartile parameter estimates across all 23 countries. The last column shows the number of countries for which the parameters estimates are significant at the 5% level. ***, **, and * represent statistical significance at the 1, 5 and 10 percent level, respectively.

Panel A: Average Measure

	US	**Germany**	**UK**	**Mean**	**Std**	**6th**	**17th**	**Sign.**
Volatility								
VIX	2.881***	1.704***	1.482***	1.261	0.964	0.387	1.975	22
Sentiment								
Baker-Wurgler	-0.011**	-0.004	-0.005	-0.007	0.010	-0.011	-0.001	4
Michigan	-0.038**	-0.045***	-0.037***	-0.032	0.029	-0.038	-0.017	8
Ifo Business	-0.026***	-0.028***	-0.022***	-0.030	0.031	-0.028	-0.016	22
OECD	-0.004***	-0.003***	-0.002***	-0.003	0.002	-0.003	-0.002	19
Currencies								
Swiss Franc	0.044	0.167***	0.213***	0.219	0.299	0.042	0.290	19
Japanese Yen	0.169***	0.298***	0.386***	0.430	0.485	0.158	0.443	21
EW	0.107***	0.233***	0.299***	0.325	0.388	0.102	0.366	22

Panel B: Joint Probability Measure

	US	**Germany**	**UK**	**Mean**	**Std**	**6th**	**17th**	**Sign.**
Volatility								
VIX	3.283***	1.832***	1.524***	1.900	1.146	1.240	1.832	23
Sentiment								
Baker-Wurgler	-0.011**	-0.002	-0.006	-0.017	0.034	-0.011	0.000	5
Michigan	-0.032	-0.044***	-0.049***	-0.069	0.129	-0.044	-0.021	5
Ifo Business	-0.030***	-0.029***	-0.032***	-0.049	0.044	-0.043	-0.028	20
OECD	-0.004***	-0.004***	-0.003***	-0.004	0.004	-0.006	-0.002	18
Currencies								
Swiss Franc	0.060	0.162***	0.259***	0.452	0.613	0.119	0.333	21
Japanese Yen	0.200***	0.306***	0.495***	0.895	1.034	0.330	0.715	22
EW	0.130***	0.234***	0.377***	0.673	0.800	0.234	0.522	23

Table 10: FTS and Equity Portfolios

This table reports regression coefficients from a regression of stock portfolio returns on the FTS indicator. The stock portfolios include Datastream industry portfolios (10 industry classification) and MSCI style portfolios (large caps, mid caps, small caps, value and growth). The style portfolios also include a SMB portfolio (i.e. return of small cap portfolio minus return of large cap portfolio) and a HML portfolio (i.e. return of value portfolio minus return of growth portfolio). The portfolio returns are expressed in percentages on a daily basis and are denominated in their original currencies. In the regressions, we control for beta risk by adding a global factor (world market return) and a local factor (local stock market return). Panel A shows the results for average FTS measure, Panel B for the joint probability FTS measure, both described in Section 2.3. We show slope parameter estimates for the US, Germany and UK, as well as the average, standard deviation and top/bottom quartile parameter estimates across all 23 countries. The last column shows the number of countries for which the parameters estimates are significant at the 5 percent level. ***, **, and * represent statistical significance at the 1, 5 and 10 percent level, respectively.

Panel A: Average Measure

	US	**Germany**	**UK**	**Mean**	**Std**	**6th**	**17th**	**Sign**
Industry Portfolios								
Oil & Gas	-0.079	-0.470**	-0.014	-0.075	0.316	-0.141	0.076	9
Basic Materials	-0.221***	-0.031	-0.245***	-0.125	0.265	-0.216	-0.053	13
Industrials	-0.093***	-0.069**	-0.031	-0.120	0.191	-0.213	-0.027	12
Consumer Goods	0.133***	0.002	0.072	-0.118	0.281	-0.214	0.025	7
Health Care	0.250***	0.038	0.185***	0.016	0.320	-0.065	0.185	12
Consumer Services	0.141***	-0.023	0.003	-0.142	0.377	-0.209	0.066	13
Telecom	0.249***	0.322***	0.271***	0.224	0.347	0.082	0.271	16
Utilities	-0.025	-0.037	0.044	0.009	0.272	-0.113	0.095	7
Financials	-0.275***	-0.219***	-0.195***	-0.180	0.226	-0.269	-0.040	15
Technology	0.108**	-0.132*	-0.348***	-0.187	0.324	-0.348	0.031	10
Style Portfolios								
Large Cap	0.021***	-0.083***	0.047***	0.123	0.218	0.012	0.105	17
Mid Cap	-0.125***	-0.369***	-0.161***	-0.139	0.173	-0.161	-0.040	14
Small Cap	-0.129***	-0.255***	-0.239***	-0.208	0.141	-0.315	-0.124	19
Value	-0.047**	-0.209***	0.041**	-0.017	0.077	-0.068	0.041	6
Growth	0.062***	0.027	0.027	0.069	0.098	0.012	0.076	12
SMB	-0.148***	-0.172***	-0.287***	-0.339	0.296	-0.375	-0.167	20
HML	-0.110*	-0.236***	0.014	-0.086	0.143	-0.174	0.021	6

Panel B: Joint Probability Measure

	US	**Germany**	**UK**	**Mean**	**Std**	**6th**	**17th**	**Sign**
Industry Portfolios								
Oil & Gas	-0.095	-0.274	0.088*	-0.148	0.593	-0.375	0.098	11
Basic Materials	-0.312***	-0.054	-0.311***	-0.225	0.455	-0.365	-0.076	14
Industrials	-0.103***	-0.038	-0.026	-0.211	0.351	-0.407	-0.050	13
Consumer Goods	0.225***	-0.109*	0.085	-0.189	0.496	-0.297	0.110	11
Health Care	0.218***	0.016	0.162***	-0.117	0.701	-0.204	0.162	11
Consumer Services	0.158***	0.002	0.025	-0.122	0.418	-0.234	0.107	12
Telecom	0.279***	0.424***	0.312***	0.355	0.420	0.231	0.460	17
Utilities	-0.108**	-0.089**	0.044	-0.147	0.596	-0.259	0.055	10
Financials	-0.357***	-0.246***	-0.275***	-0.385	0.632	-0.449	-0.208	17
Technology	0.142**	-0.080	-0.476***	-0.077	0.339	-0.286	0.152	8
Style Portfolios								
Large Cap	0.029***	-0.148***	0.047***	0.145	0.336	-0.021	0.157	12
Mid Cap	-0.140***	-0.338***	-0.215***	-0.281	0.495	-0.321	-0.069	13
Small Cap	-0.191***	-0.156***	-0.256***	-0.346	0.387	-0.441	-0.156	19
Value	-0.062**	-0.300***	0.053**	-0.057	0.148	-0.134	-0.004	9
Growth	0.067***	0.015	0.014	0.102	0.194	0.002	0.163	11
SMB	-0.219***	-0.008	-0.304***	-0.502	0.608	-0.741	-0.205	19
HML	-0.129***	-0.315***	0.039	-0.159	0.282	-0.404	0.039	13

Table 11: FTS and Bond Portfolios

This table reports regression coefficients from a regression of bond portfolio returns on the FTS indicator. The bond portfolios include JP Morgan cash indices (1, 2, 3, 6 and 12 months), benchmark Datastream government bond indices (2, 5, 7, 10, 20 and 30 year) and BOFA ML coporate bond indices (with respectively AAA, AA, A and BBB ratings). The corporate bond indices are only available for the US, Japan, Canada, Australia and the Eurozone as a whole. We use the Eurozone corporate bond index for regressions with FTS indicators of European countries and the corporate bond index of Australia for the regression with the FTS indicator of New Zealand. Further, we consider two spread portfolios, the 10 year bond return minus the 2 year bond return and the return on the BBB portfolio minus the return on the AAA portfolio. Thus, the first portfolio primarily reacts to changes in the term spread, and the second to changes in default risk. All returns are daily and denominated in local currency. In each regression, we control for the 10 year benchmark government bond return. In the regressions for the corporate bonds, we also control for the local stock market return. Panel A shows the results for average FTS measure, Panel B for the joint probability FTS measure, both described in Section 2.3. We show slope parameter estimates for the US, Germany and UK, as well as the average, standard deviation and top/bottom quartile parameter estimates across all 23 countries. The last 2 columns show respectively the number of countries for which the parameters estimates are significant at the 5 percent level and the number of countries for which data is available. ***, **, and * represent statistical significance at the 1, 5 and 10 percent level, respectively.

Panel A: Average Measure

	US	**Germany**	**UK**	**Mean**	**Std**	**6th**	**17th**	**Sign**	**Obs**
Cash									
1 Month	-0.008***	-0.004***	-0.009***	-0.006	0.003	-0.009	-0.004	11	12
2 Month	-0.007***	-0.004***	-0.009***	-0.006	0.003	-0.009	-0.004	10	12
3 Month	-0.008***	-0.004***	-0.009***	-0.006	0.004	-0.009	-0.004	9	12
6 Month	-0.009***	-0.003***	-0.009***	-0.005	0.005	-0.009	-0.002	8	12
12 Month	-0.013***	-0.001	-0.009***	-0.005	0.005	-0.010	-0.001	4	11
Goverment									
2 Year	-0.019***	0.010***	-0.007	0.001	0.018	-0.015	0.010	9	15
3 Year	-0.022***	0.021***	0.002	0.008	0.021	-0.011	0.021	10	16
5 Year	-0.003	0.035***	0.015	0.017	0.032	-0.003	0.031	8	16
7 Year	0.003	0.042***	0.029**	0.008	0.043	-0.010	0.021	6	17
10 Year	-	-	-	-	-	-	-	-	23
20 Year	-	-0.014*	0.091***	0.017	0.040	-0.022	0.043	3	9
30 Year	0.147***	-0.003	0.141***	0.014	0.073	-0.033	0.012	6	12
30Y - 2Y	0.166***	-0.020	0.148***	-0.002	0.070	-0.041	-0.001	8	17
Corporate									
AAA	-0.016	-0.001	-0.013*	0.004	0.112	-0.028	-0.009	10	23
AA	-0.033***	-0.039***	-0.044***	-0.023	0.128	-0.050	-0.025	21	23
A	-0.057***	-0.077***	-0.075***	-0.071	0.144	-0.095	-0.059	23	23
BBB	-0.060***	-0.077***	-0.075***	-0.062	0.142	-0.092	-0.054	20	23
BBB - AAA	-0.040***	-0.075***	-0.062***	-0.066	0.055	-0.075	-0.041	19	23

Panel B: Joint Probability Measure

	US	**Germany**	**UK**	**Mean**	**Std**	**6th**	**17th**	**Sign**	**Obs**
Cash									
1 Month	-0.007***	-0.005***	-0.009***	-0.007	0.003	-0.009	-0.005	10	12
2 Month	-0.007***	-0.005***	-0.009***	-0.007	0.003	-0.009	-0.005	9	12
3 Month	-0.007***	-0.004***	-0.009***	-0.007	0.004	-0.009	-0.005	10	12
6 Month	-0.007***	-0.003***	-0.010***	-0.007	0.006	-0.011	-0.003	9	12
12 Month	-0.010***	-0.001	-0.009**	-0.008	0.007	-0.013	-0.008	5	11
Goverment									
2 Year	-0.021***	0.010**	-0.005	-0.008	0.029	-0.022	0.008	8	15
3 Year	-0.025***	0.022***	0.007	0.011	0.040	-0.013	0.024	10	16
5 Year	-0.004	0.035***	0.023*	0.038	0.061	-0.003	0.072	8	16
7 Year	0.001	0.043***	0.041***	0.016	0.085	-0.015	0.057	10	17
10 Year	-	-	-	-	-	-	-	-	23
20 Year	-	-0.020**	0.127***	0.020	0.062	-0.020	0.070	4	9
30 Year	0.177***	-0.013	0.201***	0.045	0.081	-0.013	0.049	7	12
30Y - 2Y	0.198***	-0.030*	0.205***	0.014	0.107	-0.045	0.062	10	17
Corporate									
AAA	-0.026**	-0.008	-0.022**	0.027	0.343	-0.044	-0.017	15	23
AA	-0.058***	-0.046***	-0.053***	-0.002	0.348	-0.066	-0.040	22	23
A	-0.081***	-0.079***	-0.093***	-0.062	0.360	-0.139	-0.081	23	23
BBB	-0.082***	-0.068***	-0.087***	-0.056	0.367	-0.138	-0.082	23	23
BBB - AAA	-0.052***	-0.061***	-0.065***	-0.083	0.059	-0.116	-0.055	20	23

Table 12: FTS and Commodity Prices

This table reports regression coefficients from a regression of the S&P GSCI benchmark commodity index returns on the FTS indicator. We consider broad indices (Commodity Total,Energy,Industrial Metals,Precious Metals,Agriculture,Livestock) and subindices (Crude Oil,Brent Crude Oil andGold). The returns are expressed in percentages on a daily basis and are denominated in local currency. Panel A shows the results for average FTS measure, Panel B for the joint FTS measure, both described in Section 2.3. We show slope parameter estimates for the US, Germany and UK, as well as the average, standard deviation and top/bottom quartile parameter estimates across all 23 countries. The last column shows the number of countries for which the parameters estimates are significant at the 5 percent level. ***, **, and * represent statistical significance at the 1, 5 and 10 percent level, respectively.

Panel A: Average Measure

	US	**Germany**	**UK**	**Mean**	**Std**	**6th**	**17th**	**Sign**
Commodity Total	-0.739***	-0.654***	-0.675***	-0.647	0.470	-0.739	-0.372	23
Energy	-0.866***	-0.746***	-0.777***	-0.740	0.549	-0.823	-0.427	23
Industrial Metals	-0.813***	-0.934***	-0.876***	-0.770	0.460	-0.934	-0.426	23
Precious Metals	0.070	-0.026	-0.069	-0.015	0.110	-0.069	0.024	3
Agriculture	-0.431***	-0.443***	-0.402***	-0.417	0.312	-0.443	-0.208	23
Livestock	-0.232***	-0.261***	-0.237***	-0.201	0.101	-0.261	-0.131	21
Crude Oil	-1.038***	-0.851***	-0.902***	-0.813	0.595	-0.907	-0.472	23
Brent Crude Oil	-1.204***	-0.962***	-0.985***	-0.965	0.651	-1.204	-0.592	23
Gold	0.119**	0.042	-0.002	0.042	0.102	-0.020	0.075	4

Panel B: Joint Probability Measure

	US	**Germany**	**UK**	**Mean**	**Std**	**6th**	**17th**	**Sign**
Commodity Total	-0.854***	-0.675***	-0.786***	-1.052	0.632	-1.260	-0.675	23
Energy	-0.978***	-0.775***	-0.866***	-1.177	0.703	-1.537	-0.777	23
Industrial Metals	-0.942***	-0.933***	-1.078***	-1.289	0.712	-1.287	-0.952	23
Precious Metals	0.074	0.049	-0.064	0.035	0.418	-0.101	0.084	6
Agriculture	-0.563***	-0.437***	-0.563***	-0.703	0.501	-0.743	-0.437	22
Livestock	-0.276***	-0.261***	-0.331***	-0.321	0.170	-0.331	-0.228	21
Crude Oil	-1.170***	-0.891***	-0.991***	-1.294	0.740	-1.649	-0.891	23
Brent Crude Oil	-1.389***	-0.996***	-1.109***	-1.531	0.882	-1.806	-0.999	23
Gold	0.146**	0.116**	0.020	0.125	0.409	0.000	0.158	11

Table 13: FTS and the Real Economy

This table reports regression coefficients from a regression of the real economy variables on the fraction of days of FTS instances within the month (expressed in decimals). The real economy variables include inflation, industrial production growth (IP), the unemployment rate and the OECD leading indicator (available monthly); GDP growth and investment/GDP (available quarterly). For inflation, IP growth, GDP growth, unemployment rate and investment growth, we also use the mean of survey forecasts and the standard deviation of the individual forecasts (available monthly, in %). The growth variables are computed as the next quarter value relative to the current value (in %). The unemployment rate (in %), the OECD leading indicator, investment/GDP (in %) and the forecast variables are computed as absolute differences between the next quarter value and the current value. Panel A shows the results for average FTS measure, Panel B for the joint probability FTS measure, both described in Section 2.3. We show slope parameter estimates for the US, Germany and UK, as well as the average, standard deviation and top/bottom quartile parameter estimates across all 23 countries. The next to column shows the number of countries for which the parameters estimates are significant at the 5 percent level. The last column shows the number of countries for which the real economy is available. ***, **, and * represent statistical significance at the 1, 5 and 10 percent level, respectively.

Panel A: Average Measure

	US	**Germany**	**UK**	**Mean**	**Std**	**6th**	**17th**	**Sign**	**Obs**
Inflation	-1.270***	-0.908***	-0.801***	-0.848	0.748	-1.111	-0.427	19	23
Inflation Forecast Mean	-1.336***	-0.486***	-0.937***	-0.836	1.067	-0.937	-0.354	17	21
Inflation Forecast St. Dev.	0.093	0.023	0.084	0.023	0.090	-0.018	0.037	0	12
IP Growth	-3.161***	-4.279***	-1.947**	-5.304	6.138	-4.279	-2.083	8	14
IP Growth Forecast Mean	-3.703***	-3.081***	-1.609**	-3.919	5.103	-3.627	-1.609	17	19
IP Growth Forecast St. Dev.	0.402**	0.258*	0.075	0.539	0.671	0.075	0.462	4	12
GDP Growth	-2.038***	-2.781**	-1.364***	-3.349	4.084	-3.638	-1.364	20	23
GDP Growth Forecast Mean	-1.804***	-1.519***	-0.945***	-1.591	1.936	-1.519	-0.863	20	21
GDP Growth Forecast St. Dev.	0.101*	0.091*	-0.001	0.117	0.143	0.027	0.091	1	12
Unemployment	0.954***	0.233**	0.163*	0.528	0.422	0.188	0.887	16	23
Unemployment Forecast Mean	0.826***	0.216	0.438***	0.463	0.229	0.216	0.542	6	7
Unemployment Forecast St. Dev.	0.071*	-0.012	0.059	0.046	0.073	-0.012	0.064	3	7
Investment/GDP	-0.744***	-0.305	-0.292	-6.834	26.139	-1.106	-0.139	4	20
Investment Growth Forecast Mean	-5.611***	-3.973***	-1.522*	-6.495	8.496	-9.884	-2.613	11	12
Investment Growth Forecast St. Dev.	0.851**	-0.055	-0.043	0.780	1.769	-0.043	0.467	3	12
OECD Leading Indicator	-0.944***	-0.714***	-0.351**	-0.843	1.073	-0.944	-0.356	17	23

Panel B: Joint Probability Measure

	US	Germany	UK	Mean	Std	6th	17th	Sign	Obs
Inflation	-1.353***	-0.952***	-1.058***	-1.493	2.048	-1.409	-0.807	16	23
Inflation Forecast Mean	-1.630***	-0.559***	-1.297***	-1.475	2.498	-1.483	-0.389	17	21
Inflation Forecast St. Dev.	0.119*	0.007	0.113	0.099	0.166	-0.021	0.113	0	12
IP Growth	-3.255***	-4.557***	-2.567**	-10.453	20.280	-5.659	-3.161	8	14
IP Growth Forecast Mean	-3.751***	-3.811***	-1.898**	-5.207	9.228	-3.751	-1.879	14	19
IP Growth Forecast St. Dev.	0.430**	0.237	-0.041	0.809	1.296	0.000	0.478	2	12
GDP Growth	-2.399***	-3.044**	-1.899***	-7.654	14.418	-6.567	-1.969	19	23
GDP Growth Forecast Mean	-1.738***	-1.801***	-1.142***	-2.285	3.900	-1.873	-1.044	18	21
GDP Growth Forecast St. Dev.	0.111	0.077	-0.020	-0.019	0.385	-0.001	0.111	1	12
Unemployment	1.079***	0.354***	0.199*	0.754	0.748	0.216	1.324	13	23
Unemployment Forecast Mean	0.906***	0.289*	0.525***	0.590	0.303	0.301	0.623	5	7
Unemployment Forecast St. Dev.	0.077*	-0.030	0.059	0.061	0.104	-0.030	0.077	1	7
Investment/GDP	-0.977***	-0.344	-0.338	2.420	22.953	-2.156	-0.132	3	20
Investment Growth Forecast Mean	-5.595***	-4.860***	-2.323**	-10.202	18.679	-12.388	-2.491	11	12
Investment Growth Forecast St. Dev.	0.987**	-0.164	-0.185	1.804	5.131	-0.159	0.987	2	12
OECD Leading Indicator	-0.990***	-0.677**	-0.578**	-1.221	1.595	-1.139	-0.665	17	23

Table 14: FTS and the Future Real Economy

This table reports regression coefficients from a regression of the cumulative one year growth or increase in the real economy variables on the percentage days of FTS instances within the month (expressed in decimals). The real economy variables include inflation, industrial production growth (IP), the unemployment rate and the OECD leading indicator (available monthly); GDP growth and investment/GDP (available quarterly); private credit/GDP (available annually). The cumulative one year growth in GDP, industrial production and CPI (inflation) is computed as the next year value relative to the current value (in %). The cumulative one year increase in the unemployment rate (in %), the OECD leading indicator, investment/GDP (in %) and private credit/GDP (in %) is computed as the absolute difference between the next year value and the current value. Panel A shows the results for average FTS measure, Panel B for the joint FTS measure, both described in Section 2.3. We show slope parameter estimates for the US, Germany and UK, as well as the average, standard deviation and top/bottom quartile parameter estimates across all 23 countries. The next to column shows the number of countries for which the parameters estimates are significant at the 5 percent level. The last column shows the number of countries for which the real economy is available. ***, **, and * represent statistical significance at the 1, 5 and 10 percent level, respectively.

Panel A: Average Measure

	US	**Germany**	**UK**	**Mean**	**Std**	**6th**	**17th**	**Sign**	**Obs**
Inflation	-3.565***	-3.109***	-2.880***	-2.575	1.690	-3.565	-1.350	18	23
IP Growth	-9.301***	-5.241***	-4.959***	-11.232	14.598	-9.553	-4.539	12	14
GDP Growth	-4.218**	-6.693**	-4.531***	-8.874	11.323	-8.955	-3.132	19	23
Unemployment	2.651***	0.277	0.605*	1.986	1.902	0.538	2.651	17	23
Investment/GDP	-2.060**	-0.495	-1.709***	-44.348	182.555	-4.651	-0.562	11	20
OECD Leading Indicator	1.691**	2.237***	0.917*	0.685	1.810	-0.914	1.691	13	23
Private Credit/GDP	35.317*	-11.569*	-12.467	16.311	59.974	-6.030	14.481	5	23

Panel B: Joint Probability Measure

	US	**Germany**	**UK**	**Mean**	**Std**	**6th**	**17th**	**Sign**	**Obs**
Inflation	-3.825***	-3.167***	-3.668***	-3.896	3.077	-4.535	-2.659	17	23
IP Growth	-9.625***	-4.152**	-5.959***	-18.363	30.070	-10.907	-4.412	11	14
GDP Growth	-4.775**	-6.717**	-5.670***	-16.466	24.349	-14.928	-4.460	16	23
Unemployment	2.962***	0.502	0.707*	3.015	3.902	0.817	2.962	14	23
Investment/GDP	-2.310**	-0.412	-2.405***	-28.755	101.813	-10.561	-0.657	7	20
OECD Leading Indicator	2.290**	3.186***	1.173*	1.511	3.487	-0.507	2.290	7	23
Private Credit/GDP	47.157*	-13.773*	-17.227	27.101	97.326	-13.773	39.922	4	22

Figure 1: Ordinal Indicator: US, Germany, and UK

The left panels plot the ordinal FTS Indicators for the US, Germany, and UK together with the minimum threshold level, calculated as the minimum of all ordinal values for which the minimal FTS conditions hold . The right panels plot the derived probability measures. Values with a value above 0.5 are depicted in black, values below 0.5 in light grey.

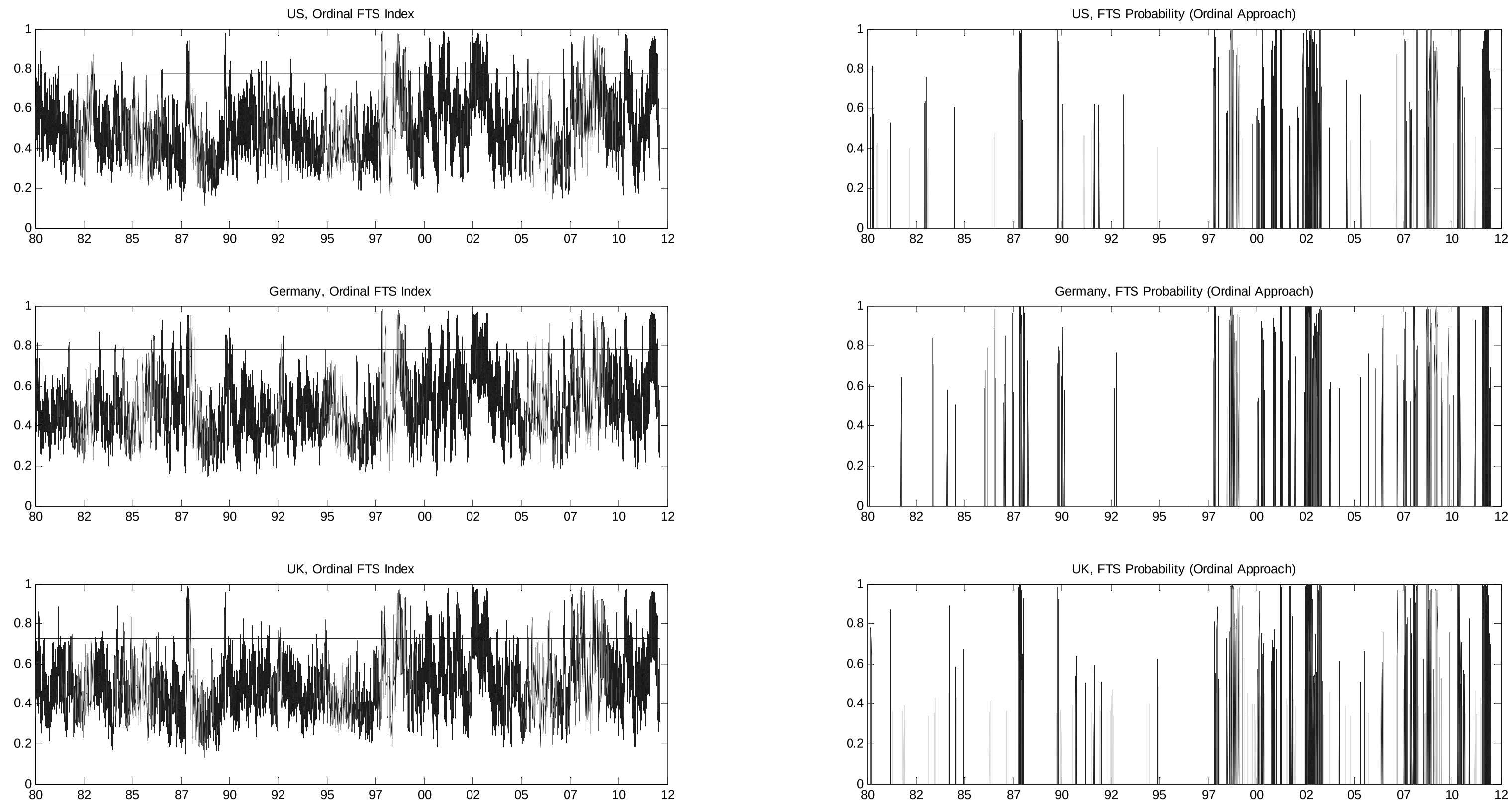


Figure 2: Aggregate FTS Indicators, US

The top panel of this figure plots the average FTS indicator together with the corresponding FTS dummy for the US. The dummy is equal to one when the average indicator is larger than 50%, and zero otherwise. The middle panel plots the joint probility measure, which equals one when at least three of the four individual indicators signal FTS. The bottom panel plots the corresponding FTS probability, which is a measure of the strength or confidence in our indicator.

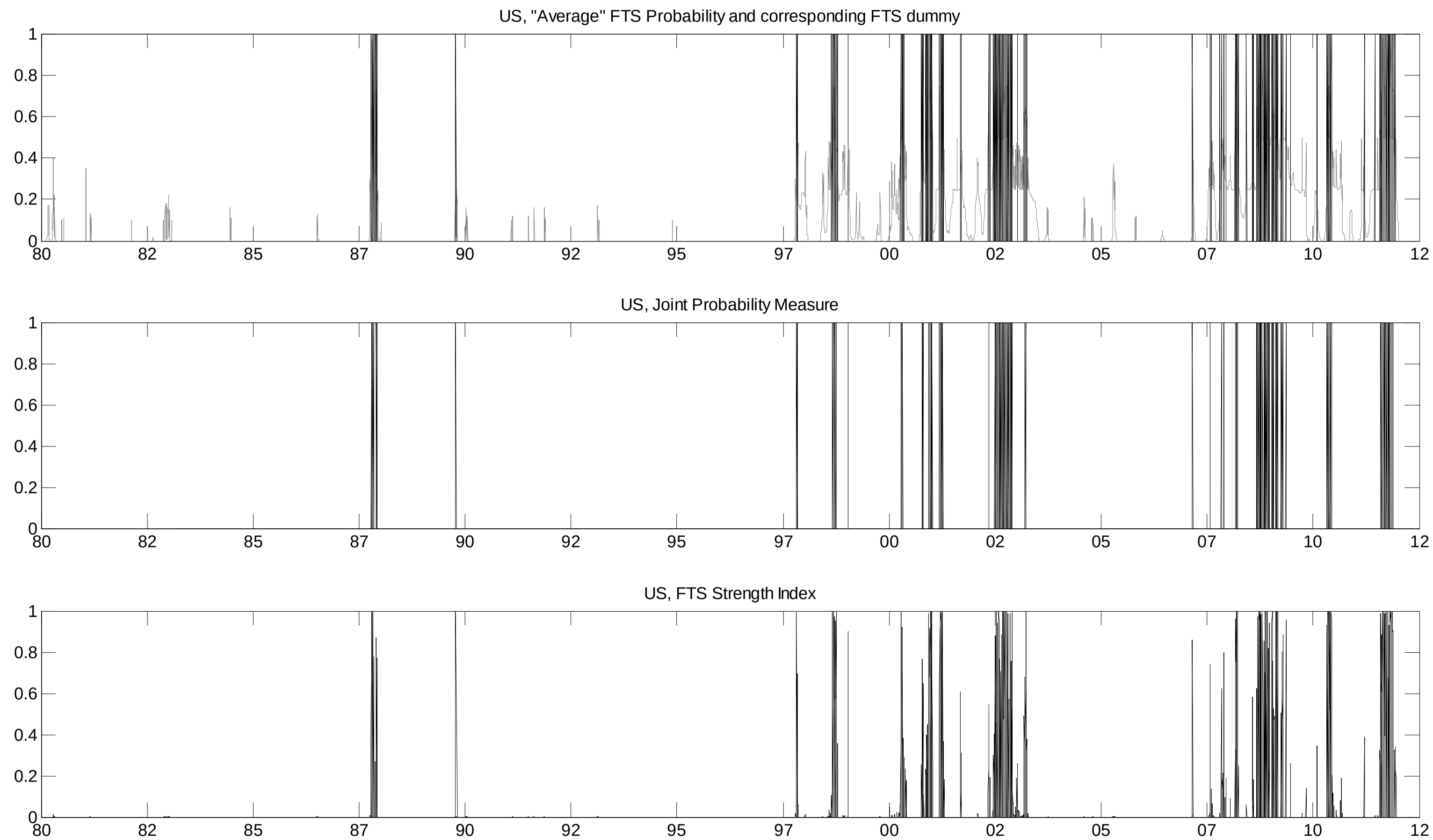


Figure 3: Return Impact before/on/after FTS days

This figure plots returns (in percent) in the equity and bond market as well as the difference between the bond and equity return, averaged over the 23 countries, ranging from 30 days before to 30 days after a FTS event. In the graphs on the left, FTS is identified using the average measure, in the graphs on the right the joint probability FTS measure is used. The solid lines take all FTS days into account, the dotted lines show returns and return impact around the first day of a FTS spell only.

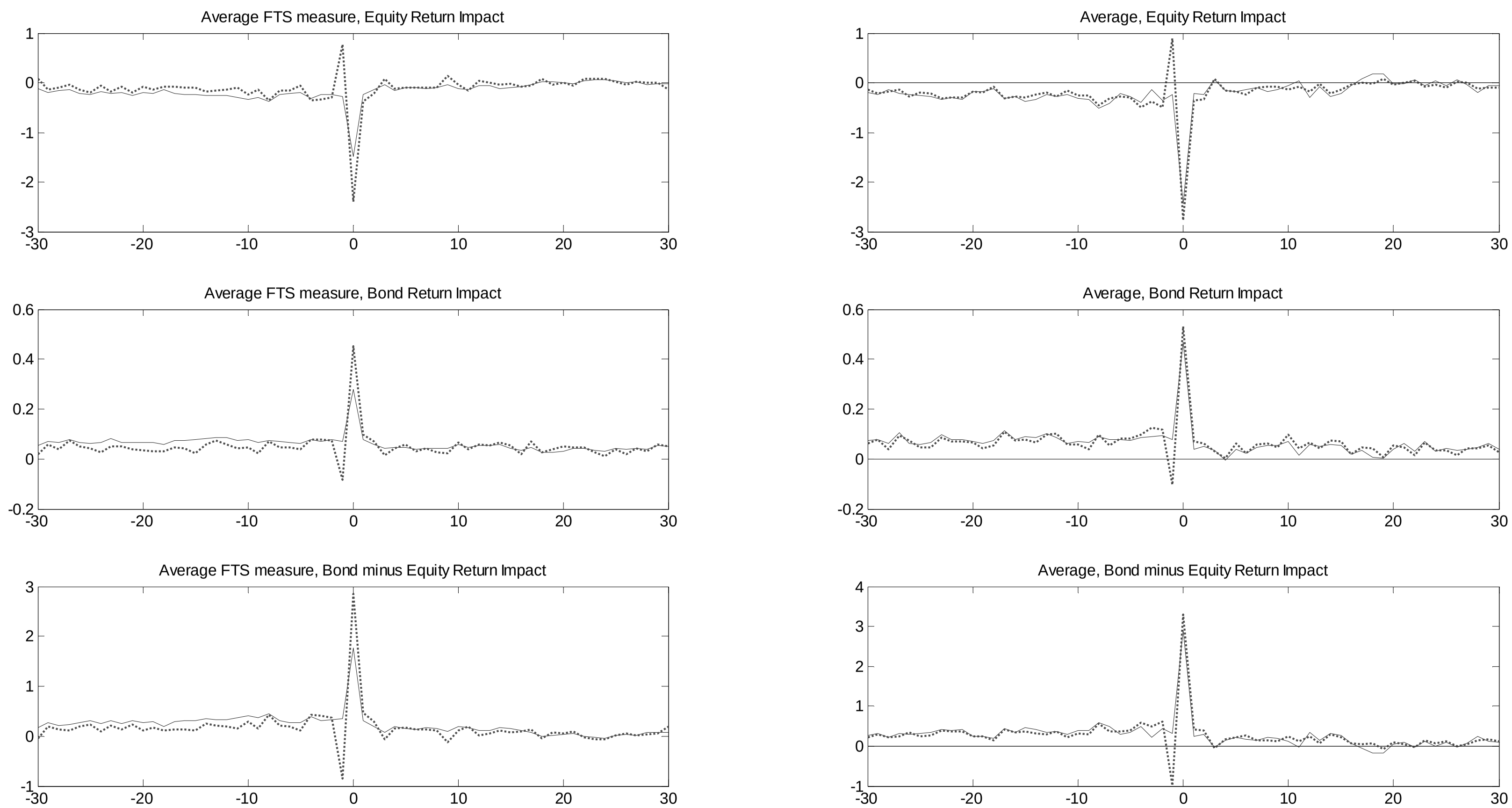
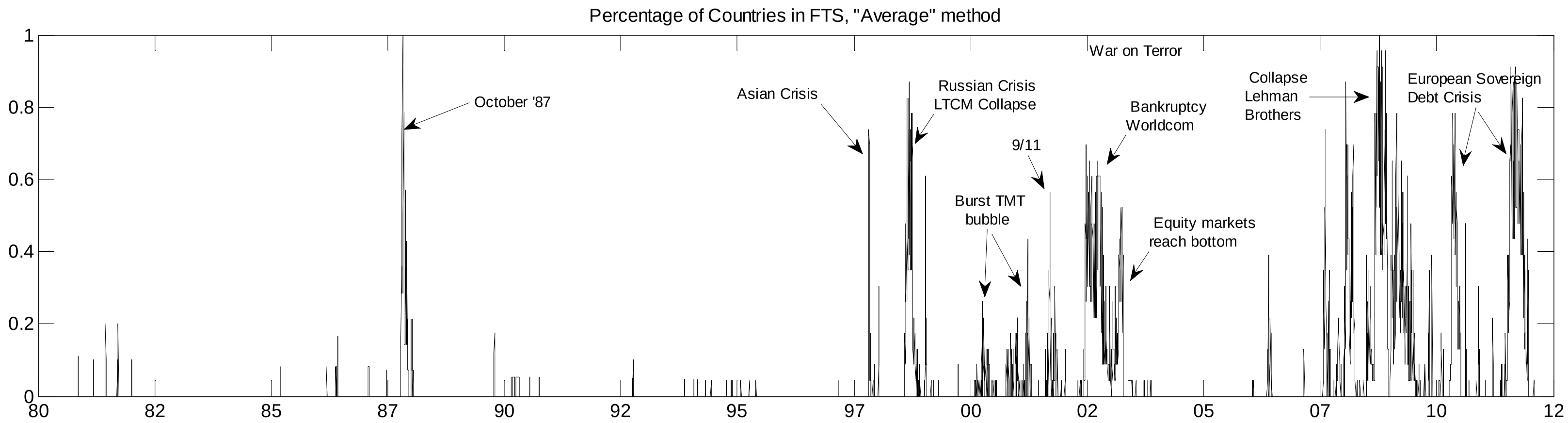
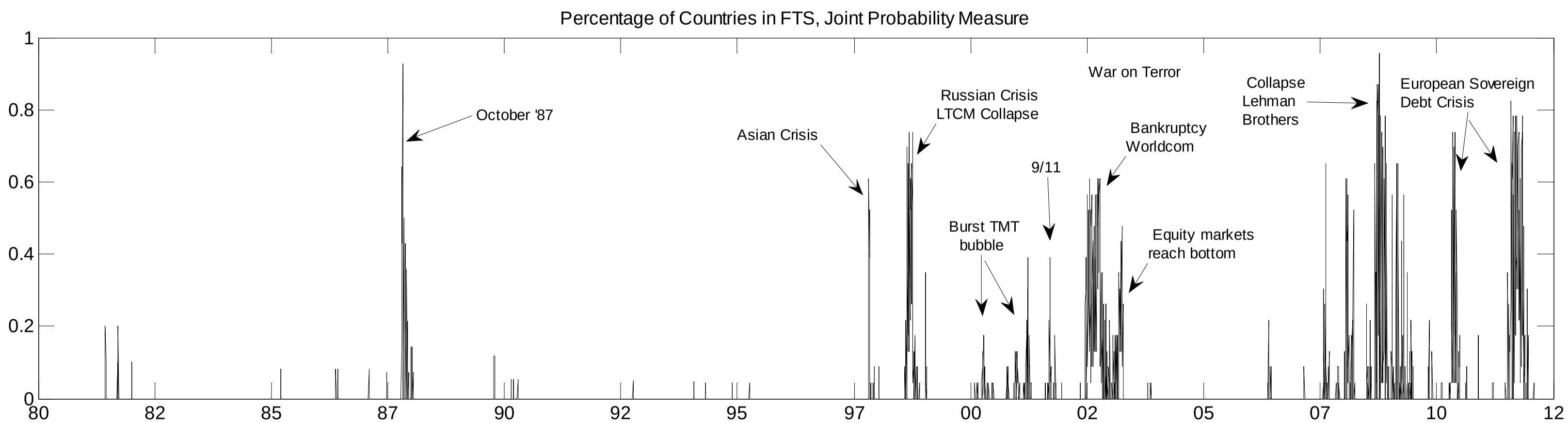


Figure 4: Percentage of Countries in FTS

This Figure plots the equally-weighted percentage of countries experiencing a FTS at each point in time. In the top panel, FTS is identified using the average measure, while in the bottom panel the joint probability measure is used.





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Editor

Jan Smets
Member of the Board of directors of the National Bank of Belgium

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