Equity-Risk Premium: Fiscal Interventions in the '08 Recession

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Replication

Replication data and scripts for the analyses presented in this paper are publicly available with the Harvard Dataverse: https://doi.org/10.7910/DVN/ENDZPF.

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Abstract

The authors examine the Equity-Risk Premium by analyzing inflation-adjusted S&P 500 closing prices and aggregated monthly U.S. Treasury bond sales from January 2003 to December 2013. Applying the Hodrick-Prescott filter, the authors find that while S&P 500 prices remain relatively stable over the study period, bond sales rise sharply from 2007 to 2009 and remain elevated, reflecting a shift towards safer assets; this conclusion is robust to the smoothing parameter chosen. The study investigates whether U.S. fiscal interventions during the 2008 recession significantly increased treasury bond investment. A DiD analysis, using France as a control, indicates that these interventions caused a significant increase in monthly inflation-adjusted U.S. treasury bond sales, contributing to an acceleration of the Equity-Risk Premium. The authors caution, however, that the DiD estimates may be biased upwards due to omitted variables or endogeneity. The paper concludes by proposing directions for future research.

Keywords: Equity-Risk Premium, Expected Utility, General Equilibrium, Prospect Theory, 2008 Recession, Hodrick-Prescott Filter, Differences-in-Differences (DiD), Causal Inference, Natural Experiment, Quasi-Experiment

Introduction

The Equity-Risk Premium refers to the persistent tendency of stocks to surpass their anticipated returns. This phenomenon was first studied by Mehra and Prescott (1985) who noted that the returns on the Standard & Poor's (S&P) 500 Index substantially outpaced the expected return based on its market-valued pricing and, simultaneously, that U.S. treasury bonds, generally regarded as virtually risk-free debt, are substantially overpriced for their returns. This indicates that investors are consistently undervaluing equity and, conversely, overvaluing risk-free debt.

Theoretical Explanations

Reitz (1988) attempted the first explanation for the puzzle we could identify, adjusting the asset pricing model to include a "low-probability, depression-like... state". Reitz asserted that by refining the parameters of his pricing model to show "plausibly severe" yet "not too improbable" crashes, the discrepancy between the market valuation of equity and its actual returns could be entirely resolved (1988). We reject this explanation; while the addition of a third state to the pricing model is reasonable, Reitz's estimation approach is problematic. His methodology numerically hacks away the observed effects, distributing them over multiple overfitted coefficients, and then dismisses the residual effects as general variance. Explaining the Equity-Risk Premium requires more than claiming it does not exist. It is imperative to scrutinize the assumptions present theory is based upon.

Von Neumann and Morgenstern (1947) posit that the rational market participant values risk and reward directly, through expected utility. That is:

$$U = \sum u(x_k)p_k \tag{1}$$

where p_k is the probability of outcome k with outcome, either positive or negative, x_k. The utility function, u, shows a diminishing marginal utility. The first derivative of this function, $u'(x_k)$, measures the marginal utility of the participant; the range of this first derivative exists in $\mathbb{R}$. The second derivative of this function, $u''(x_k)$, is a concave which represents the

curvature of u. The range of this second derivative exists in $(-\infty, 0)$. These derivatives can directly measure the participant's risk aversion using the Arrow-Pratt model (Pratt, 1964):

$$A(x) = -\frac{u''(x)}{u'(x)} \tag{2}$$

$A(x)$ exists in $(0, \infty)$, where higher values indicate a greater risk aversion. This utility model has served as a foundation for several advancements in general equilibrium theory, but is imperfect.

Expected utility relies upon the assumption of participant rationality which cannot always be trusted, as seen here. Kahneman and Tversky (1979) demonstrate several instances in which market participants deviate from expected utility calculations, leading to what they term Prospect Theory, an alternative explanation for investor decision-making. Prospect Theory posits a human bias for risk aversion which precedes logical calculations (Kahneman & Tversky, 1979). Market participants under this theory "hate losing" more than they "love winning," reflecting a tendency to avoid losses more strongly than to seek gains. This concept has been applied to a number of economic problems involving risk and loss, ranging from educator incentives (Fryer *et al.*, 2012) to prize-linked savings accounts (Tufano *et al.*, 2008).

Thus, we present a complete explanation for the Premium: a rational differential in the utility of market participants coupled with an irrational risk aversion among investors. This explains why the Premium exists, however, the Premium is not static; we observe a recent acceleration in the phenomenon which we validate and attempt to explain in this paper.

Evidence of Accelaration

We source monthly S&P 500 close prices from Google Finance ranging from January, 2003, to December, 2013, and monthly CPI data over the same time period from the U.S. Bureau of Labor Statistics (n.d.). We adjust the CPI data to a base month of January, 2000, and then deflate the S&P data accordingly. We apply Hodrick and Prescott's (1997) time

series filter to the deflated S&P data for trend analysis[1]. There is a reasonable degree of disagreement over the smoothing parameter, λ, which should be applied to monthly data in this method. Hodrick and Prescott (1997) advise using $\lambda = 14,400$ for monthly data, whereas Ravn and Uhlig (2002) advise $\lambda = 123,600$. Thus, we apply two versions of the filter, the first under Hodrick and Prescott's (1997) value [λ = 14,400], and the second under Ravn and Uhlig's (2002) recommendation [λ = 123,600]. All three series of the S&P 500 over this time period—the data and both filtered versions—are visualized in Figure 1. The conclusion is robust to the smoothing parameter applied: over the study period, the S&P 500 has remained relatively static in its deflated trend price, indicating a stable market valuation of equity in the U.S..

Next, we source monthly auction data of U.S. treasury bonds from the U.S. Department of the Treasury over the same time period and analyze it in the same manner. The data ranges from January, 2003, to December, 2013, and is deflating using the same monthly U.S. CPI data, adjusting to the January, 2000 base month. We apply the same filtering algorithms to this series, applying Hodrick and Prescott's (1997) $\lambda = 14,400$ recommendation in the first instance and Ravn and Uhlig's (2002) $\lambda = 123,600$ recommendation in the second. All three series of U.S. treasury issuance—the data and both filtered versions—are visualized in Figure 2. We find that prior to 2007, treasury bond sales are relatively static, excepting cyclical patterns, but that they climb in the period from late 2007 to early 2009, and remain at this higher level through the end of the study period.

These findings are interesting separately, but discordant together, under general equilibrium assumptions. A static valuation of the S&P 500 signals that investors believe traditional equities are fairly priced for their potential risks and rewards. However, the simultaneous acceleration in the real issuance of treasury bonds indicates an increased desire for risk-free assets among investors. This increased desire is not inexplicable for an intra-recession period, but it is unusual for this heightened risk aversion to persist long after the recession period. Therefore, this paper aims explain what events within the 2008

[1]This process is implemented using the `mFilter` package (Balcilar, 2019) and the R Language for Statistical Computing (R Core Team, 2024).

recession permanently altered investors' perceptions of risk in the markets for equity.

Fiscal Interventions

In 2008, the U.S. Government mobilized in several previously unprecedented ways in attempt to stabilize the financial markets. In July, Congress passed the Housing and Economic Recovery Act amid the subprime mortgage crisis (U.S. Congress, 2008). In September, the Federal Housing Finance Agency (FHFA) took housing GSEs Fannie Mae and Freddie Mac under conservatorship (FHFA, 2008). In October, the Federal Deposit Insurance Commission (FDIC) established the Temporary Liquidity Guarantee Program to ease public fears around floundering banks (FDIC, 2008) and, later that same month, then Treasury Secretary Henry Paulson implemented the Troubled Asset Relief Program (TARP), aiming to buy and insure $700 Billion in toxic assets (U.S. Department of the Treasury, 2008).

The efficacy or necessity of these extensive measures can be argued over, but that is not central to this inquiry. Whether warranted or not, these measures introduced a climate of uncertainty among investors. Wary of the potential for further intervention, equity markets became seen as unpredictable and arbitrary, making investors more risk averse. This heightened risk aversion led investors to shift their portfolios towards safer investments. Bonds became increasingly attractive for their stability and government-backing, unlike the volatile equity markets which were now viewed as highly subject to regulatory influence. As a result, bonds became further overvalued and stocks became further undervalued, widening the existing gap between asset classes and accelerating the Equity-Risk Premium. The remainder of this paper tests this explanation of acceleration in the Equity-Risk Premium.

Methods

We source treasury auction data from January, 2003, until December, 2013, for both the United States and France from the U.S. Department of the Treasury (n.d.) and the Agence France Trésor (n.d.), respectively. We prepare this data and perform a Differences-in-Differences (DiD) analysis.

We prepare this data using a three-step process. First, we clean datasets separately,

retaining only relevant columns for each dataset, reformatting the data to be consistent across groups, and aggregating the issuance up to the country-month-year[2]. Second, we perform data adjustments, deflating the total issuance[3] and converting all French data from Euros to USD[4]. Third, we join all data into a single dataframe and convert to a long format in which there are three dummy variables: the period, the group, and the interaction between the first two variables[5].

To perform the DiD, we regress the inflation- and currency-adjusted monthly bond issuance onto all three dummy variables simultaneously. In this model, the United States is the intervention group, and France is the control group. The pre-intervention period ranges from January 2003 to December 2006, and the post-intervention period ranges from January 2010 to December 2013. We omit the intervening period because we are only interested in pre- and post-recession behavior, rather than the volatile intra-recession period. This analysis tests the hypothesis that United States fiscal interventions in 2008 caused a significant increase in inflation-adjusted U.S. treasury bond sales.

Results

The DiD analysis is modeled by the following regression:

$$Y_{it} = \beta_0 + \beta_1 T_i + \beta_2 D_t + \beta_3 (T_i \cdot D_t) + \varepsilon_{it} \tag{3}$$

where Y_{it} represents the total issuance variable for observation i at time t, T_i is the group (nation) variable, D_t is the period (time period) variable, and $(T_i \cdot D_t)$ is the interaction between group and time period. β_0, β_1, β_2, and β_3 estimate the intercept and the effects of

[2]This process is implemented using the `dplyr` package (Wickham *et al.*, 2023) and the R Language for Statistical Computing (R Core Team, 2024).

[3]We source monthly CPI data for both the United States and France from the U.S. Bureau of Labor Statistics (n.d.) and the Organisation for Economic Cooperation and Development (n.d.), respectively. We process the CPI data such that January, 2000, is the base cycle and use this as a deflation multiplier.

[4]We utilize monthly-level Euro-to-USD conversion data over the study period from the U.S. Federal Reserve (n.d.).

[5]In this long format, the period indicates the time period of the observation (`1` for post-recession and `0` for pre-recession), the group indicates the country of the observation (`1` for the United States and `0` for France), and the interaction indicates the interaction of the prior two dummies (`1` for post-recession United States and `0` for all else).

group, time, and the group-time interaction, respectively. The model estimates are shown in Table 1.

The key parameter of interest, β_3, captures the average intervention effect of United States policy in the 2008 recession on monthly treasury bond sales[6]. The results indicate that this policy intervention caused a statistically significant increase of approximately \$68,312.045 Million in the inflation-adjusted monthly issuance of treasury bonds (Table 1). This aligns with our hypothesis, which posited that fiscal interventions during the recession stimulated treasury bond sales and accelerated the Equity-Risk Premium.

The DiD model accounts for approximately 93.905% of the variance in the total currency- and inflation-adjusted issuance [$R^2 = .939$] (Table 1). While this suggests a strong explanatory power, caution is warranted, as endogeneity or omitted variables may bias these estimates upwards. For instance, concurrent monetary policy measures or global economic shocks, not accounted for in the model, could have also influenced bond issuance during the recessionary period.

Discussion

Our analysis provides compelling evidence that fiscal interventions during the 2008 recession significantly increased the sales of U.S. treasury bonds. Our DiD model accounts for a substantial amount of variance in the data, suggesting that our concept—fiscal intervention causing investor uncertainty—is a major explanatory factor in the Equity-Risk Premium.

However, several limitations should be considered to lend context to our findings. Omitted variable bias and endogeneity may inflate the estimates in our model. Factors such as international monetary policies or other macroeconomic variables not included in our model might also influence treasury issuance, potentially overstating effects of recession interventions. Additionally, the exclusion of the volatile intervention period from our analysis, while methodologically justified, may overlook intra-recession insights, potentially warranting separate investigation.

Future research could enhance the validity of our conclusions by incorporating

[6]This term is also known as the "DiD Estimator" or the interaction term.

additional data and exploring alternative methodologies. Expanding the dataset to include more control nations would improve the robustness of baseline estimates. Further, segmenting auction data by investor classes or financial assets could enable more nuanced research questions that were beyond the scope of this study. Methodologically, Instrumental Variable (IV) estimation (e.g. Wright, 1928; Reisterøl, 1941), Structural Vector Autoregression (SVAR) (e.g. Sims, 1980), or other causal inference techniques could provide additional support for our findings. Investigating the Equity-Risk Premium using parallel methodologies may also address concerns about omitted variable bias and endogeneity, yielding more reliable estimates of the effects of fiscal interventions on U.S. treasury bond issuance. Continued research in this area is encouraged, as convergent findings would strengthen the conclusions drawn from this study.

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Table 1: DiD regression model. U.S. fiscal interventions in 2008 caused a significant increase in monthly bond issuance.

DV: U.S. Monthly Bond Issuance (Millions USD)	
Intercept (β_0)	18917.779***
	(5367.767)
Group (β_1)	247977.222***
	(7591.169)
Period (β_2)	17732.230**
	(7591.169)
Interaction (β_3)	68312.045***
	(10735.535)
Observations	192
R^2	.939
$R^2_{\text{adj.}}$	.938
Residual SE	37188.983
Residual DF	188

*Signif. Codes: *: .1, **: .05, ***: .01*

Figure 1: Filtered time series of real S&P 500 monthly close prices. Valuation remains static over the study period.

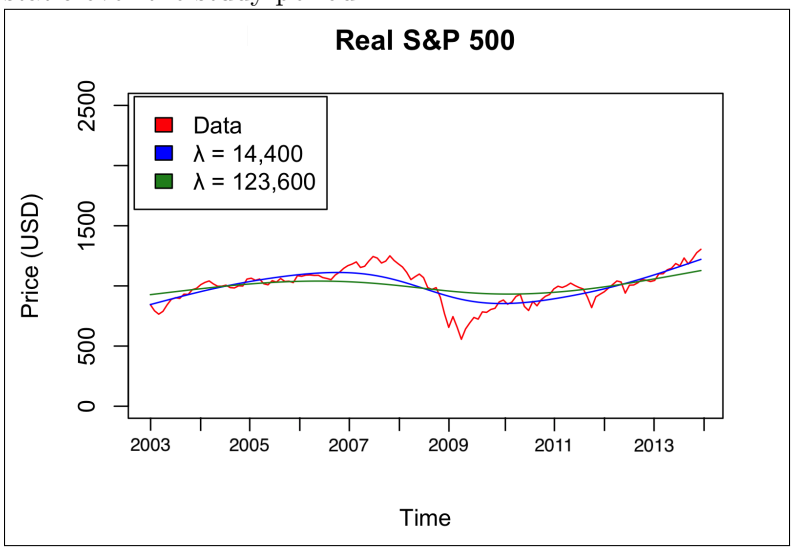
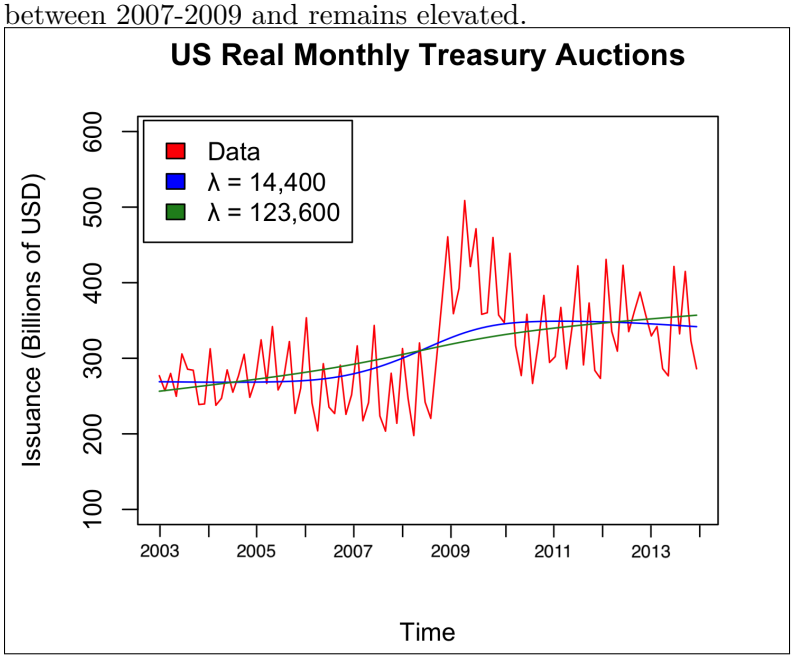
Figure 2: Filtered time series of real monthly U.S. treasury bond auctions. Issuance climbs between 2007-2009 and remains elevated.