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Abstract

The equity premium–risk-free rate puzzle in standard consumption-based asset pricing models disappears once we remove the government-imposed component from the consumption expenditure series. I calibrate this component based on the growth rates of two proxies for government intervention, which I also show to forecast the short- and long-term equity premiums between 1974 (or 1981) and 2017. In summary, investors require large premiums to hold stocks because stocks give poor returns when government intervention increases, thereby systematically reducing individuals' utility levels.

JEL Codes: G1, E1, H1

Keywords: Equity premium puzzle, intervention, regulation, risk.

1 Introduction and summary

Within a standard power utility consumption-based asset pricing model, consumption expenditure is not volatile enough to quantitatively explain the equity premium and risk-free rate for reasonable values of risk aversion. This, in summary, is the equity premium–risk-free rate puzzle in [Mehra and Prescott \(1985\)](#) and [Hansen and Jagannathan \(1991\)](#). My solution explores the idea that a fraction of expenditures is not freely chosen by the agents and that the puzzle arises as a consequence of ignoring this fact and calculating changes in marginal utilities directly from changes in expenditures.

Intuitively, this type of unwanted consumption can be related to fulfilling government regulations, as discussed by [Dawson and Seater \(2013\)](#), [Djankov et al. \(2002\)](#), or [Goff \(1996\)](#), for instance. As an anecdote, Andrew Birch, at the website *Greentech Media*, explains how the restrictions imposed by the U.S. government make installed solar panels in the United States cost \$3.25 per watt compared to \$1.34 in Australia.¹ Basically, the consumers are free to choose their consumption bundle in Australia, including additional hardware quality and services. In the United States, on the other hand, the government imposes permit and licensing restrictions for the installation companies, other layers of red tape, and requires the solar panels to be bundled with expensive incremental hardware and services that the consumers do not appear to value. If, for example, the typical consumption item passes through five sequential sectors as regulated as this one, then the fraction of expenditures that is not imposed by the government is only $(1.34/3.25)^5 \approx 1\%$.

The central idea of the paper is to “clean” consumption expenditure from its unwanted part and analyze only the voluntary consumption process. In particular, I assume that government-imposed consumption, X_t , provides no utility to the representative agent. I generate the consumption series,

$$c_t = k_t - X_t = k_t s_t, \tag{1}$$

¹Andrew Birch, “How to Halve the Cost of Residential Solar in the US,” *Greentech Media*, January 5, 2018, <https://www.greentechmedia.com/amp/article/how-to-halve-the-cost-of-residential-solar-in-the-us>.

multiplying the expenditure series, k_t , by the (modeled) surplus series, s_t , defined as the fraction of voluntary consumption in total expenditure. The definition of s_t resembles that of the surplus over an external habit level in [Campbell and Cochrane \(1999\)](#). However, instead of assuming non-standard preferences, as in [Campbell and Cochrane \(1999\)](#), what I obtain is an alternative measure of consumption which, in this sense, is closer to the procedures in [Kroencke \(2017\)](#) and [Savov \(2011\)](#), for example.

First, I demonstrate that the model generates any equilibrium equity premium and risk-free rate processes by assuming the desired surplus consumption process and correlation between surplus growth and the equity premium. In this step, the surplus series is not a function of any observable variable because otherwise it is not possible to guarantee that the corresponding consumption process is correlated with the equity premium, for example. This theoretical result is similar to the main proposition in [Constantinides and Duffie \(1996\)](#), in which assuming the desired cross-sectional variance of individual consumption growth achieves the same objective.

Next, I restrict surplus consumption to be a function of government intervention, for which I obtain two empirical proxies: The first, a simple counting measure inspired by [Dawson and Seater \(2013\)](#), is the number of pages in Title 3 of the Code of Federal Regulations (CFR). This Title concerns all presidential orders. The second is the number of economically significant rules (ESR) that underwent review by the Office of Information and Regulatory Affairs. Therefore, this (counting) measure also contains a qualitative component. In fact, both series can be interpreted as measures of government activity, more broadly. I accumulate these quantities over three years under the assumption that the initial effects of some government choices are delayed for that period.²

²The study of government-induced changes in risk premiums is also part of a growing literature on policy uncertainty. The standard theoretical framework in this literature, in [Pastor and Veronesi \(2013, 2012\)](#), is built on the supposition that governments (i) understand all trade-offs in the economy, (ii) are able to make optimal policy choices that maximize society's welfare, and (iii) are "quasi-benevolent", so that they tend to implement these policies. Therefore, the policy changes in this framework are typically positive. In contrast, optimal consumption is only achieved under free markets within the framework that I present. In the model, this happens because the government acts in its own self interest, which violates assumption (iii) above (but, in fact, violations of assumptions (i) or (ii) would have similar effects). The empirical proxies are also fundamentally different. For example, the index for policy uncertainty in [Baker et al. \(2016\)](#) include elections, wars, and national debt disputes. The proxies that I use, on the other hand, only include direct measures of

It is possible to assume a certain relation between the proxies and the level of regulation and estimate the intervention (and therefore surplus) *growth* rates from the proxies, but it is not possible to do the same for the baseline intervention *levels*. For example, as explained in Section 4.1, I assume that the relation between the surplus and the observable intervention proxy at time t , $r_{p,t}$, has the form

$$s_t = \exp\left(-\bar{\theta} \frac{r_{p,t}}{\bar{r}_{p,t}}\right), \quad (2)$$

where $\bar{r}_{p,t}$ is the proxy average and $\bar{\theta}$ is a constant that determines the average intervention level and implies a certain average surplus, $\bar{s} = e^{-\bar{\theta}}$. This value is important because it tells the relative scales for the proxies and expenditure growth rates to calculate consumption growth via Eq. (1).

I consider a grid for $\bar{s} = e^{-\bar{\theta}}$ and show that the Sharpe ratios and the subjective discount rate increase to very large numbers as the average intervention, $\bar{\theta}$, increases (and the surplus decreases). Hence, the question is not whether the model can generate the observed asset prices based on the proxies, but at which average surplus. I report several combinations of average surpluses, Sharpe ratios, subjective discount rates, and risk aversion parameters supported by the model and the proxies, showing that the model does explain the asset prices. However, it is difficult to interpret the value of \bar{s} because it is not possible to confirm the functional form of Eq. (2), or the possible determinants of $\bar{\theta}$ that I discuss in Section 4.1.

One example of relatively large Sharpe ratios (and low surplus) is based on the ESR proxy, a relative risk aversion of five, and 8% as the average surplus. In this case, the market Sharpe ratio is 0.5, the market price of risk is 1.5, and the difference between the continuously compounded risk-free and subjective discount rates is $r_{f,t} - \delta_t = -115\%$. For the CFR proxy, with the same risk aversion of five, and 16% as the average surplus, the market Sharpe ratio is 0.5, the market price of risk is 2.8, and the difference between the

government intervention, closer to the perspective in Dawson and Seater (2013). Finally, the results that I present are very different from the ones in Pastor and Veronesi (2017) who do not explain risk premiums.

risk-free and subjective discount rates is $r_{f,t} - \delta_t = -437\%$. The difference in these values arises due to the higher volatility of the CFR proxy compared to the ESR.

These examples highlight that the model implies large subjective discount rates, which, as I mention next, must also vary counter-cyclically to generate constant risk-free rates. This is unusual in the asset pricing literature because the typical calibrations rely on consumption expenditures to calculate changes in marginal utilities. The smooth series of expenditures suggests a very safe economy in which precautionary savings are negligible. Under this assumption, the subjective discount rates tend to be negative, instead. However, the literature on estimates of the subjective discount rate is actually inconclusive about its (likely positive) magnitude. The survey in [Frederick et al. \(2002\)](#) mentions a range of possible estimates going from slightly negative to infinity. They also point to evidence of counter-cyclical variation: Heroin addicts, for example, have higher subjective discount rates with respect to monetary payoffs in “bad times”, when they are craving the drug ([Giordano et al., 2002](#)).

The model also delivers counter-cyclical variation in the market price of risk based on both proxies without any further modeling assumption. I show this by calibrating the consumption process conditioned on the surplus being above its median (“good times”) or below (“bad times”): With the same parameters as above, the market prices of risk in bad and good times are, respectively, 1.69 and 1.23 based on the ESR, or 3.83 and 1.05 based on the CFR. The market Sharpe ratios also vary counter-cyclically for the CFR: 0.67 and 0.12. However, they seem pro-cyclical for the ESR: 0.44 and 0.55. This happens because the (typically difficult to estimate) point estimate of the correlation between the equity premium and calibrated consumption is higher in the “good states” for this proxy. The subjective discount rate also varies counter-cyclically: The difference between the risk-free and the subjective discount rates in bad and good times are, respectively, -143% and -95% for the ESR, or -764% and -99% for the CFR.³

³These variations in the subjective discount rates and Sharpe ratios seem large, especially for the CFR proxy. It is possible that the imprecise functional form chosen for Eq. (2) generates this effect. Still, all variations are counter-cyclical as expected, except for the market Sharpe ratio based on the ESR, which also becomes counter-cyclical if we either ignore the conditional correlation estimates or reduce the surplus further.

Finally, the model delivers short- and long-term predictability of the equity premium based on the two proxies. Therefore the variation in the market price of risk documented above happens at the “right” time: The two intervention proxies significantly forecast positive market premiums calculated at every horizon from one to five years (marginally for the 1-year market premium based on the ESR proxy). As originally observed by [Fama and French \(1989\)](#) for the expenditures process, the risk premiums are high in bad times and low in good times.

2 The economy

A representative agent lives in a continuous time economy with complete markets, and a unique and positive stochastic discount factor (SDF), $\zeta = \zeta(t)$, prices every asset. There are two goods with exogenous production and equal prices in every period: The *consumption good* and the *state good*. The government chooses the optimal amount of the state good, $X = (X_t)$, by controlling how much of the state good the agent must acquire bundled with the consumption good. This choice is such that it maximizes the government's own intertemporal objective function,

$$\max_{X=(X_t)} \mathbb{E} \left[\int_0^T e^{-\delta t} u_G(X) dt \right], \quad (3)$$

where \mathbb{E} is the expectation operator and $u_G(X)$ is the government's utility function.

Given the restriction imposed by the government, the representative agent then chooses the amount of the consumption good (or simply "consumption"), c , that maximizes his time-separable expected utility,

$$\max_{c=(c_t)} \mathbb{E} \left[\int_0^T e^{-\delta t} \frac{1}{1-\gamma} c^{1-\gamma} dt \right], \quad (4)$$

subject to the budget constraint

$$\mathbb{E} \left[\int_0^T \zeta_t c_t dt \right] + \mathbb{E} \left[\int_0^T \zeta_t X_t dt \right] \leq \mathbb{E} \left[\int_0^T \zeta_t e_t dt \right], \quad (5)$$

where the right-hand side is the expected present value of the endowment process, $e = (e_t)$, and the left-hand side is the expected present value of the expenditures on (i) the consumption good, c , and (ii) the state good, X . This optimization induces the SDF

$$\zeta_t = e^{-\delta t} \left(\frac{c_t}{c_0} \right)^{-\gamma}. \quad (6)$$

The optimal consumption process: Let consumption expenditure, $k_t = c_t + X_t$, defined in Eq. (1), follow the diffusion process

$$dk_t = k_t [\mu_{k,t} dt + \sigma_{k,t} dz_{1,t}], \quad (7)$$

and let surplus consumption, s_t , defined in Eq. (2), follow the diffusion process

$$ds_t = s_t [\mu_{s,t} dt + \sigma_{s,t} dz_{2,t}], \quad (8)$$

where $dz_{1,t}$ and $dz_{2,t}$ are independent one-dimensional standard Brownian motions, and μ_t and σ_t are stochastic processes in both equations. An application of Itô's Lemma based on the definition of s_t and the two diffusions above gives the diffusion process for consumption,

$$dc_t = c_t [\mu_{c,t} dt + \sigma_{c,t}^\top dz_t], \quad (9)$$

$$\mu_{c,t} = \mu_{k,t} + \mu_{s,t}, \quad (10)$$

$$\sigma_{c,t} = \begin{pmatrix} \sigma_{k,t} \\ \sigma_{s,t} \end{pmatrix}, \quad (11)$$

where $^\top$ is the transposition sign and dz_t is a two-dimensional standard Brownian motion.

The SDF dynamics and equilibrium returns: A second application of Itô's Lemma based on Eq. (6) and the consumption process in Eq. (9) gives the standard consumption-based SDF dynamics

$$d\zeta_t = -\zeta_t \left[\left(\delta + \gamma \mu_{c,t} - \frac{1}{2} \gamma (1 + \gamma) \|\sigma_{c,t}\|^2 \right) dt + \gamma \sigma_{c,t}^\top dz_t \right], \quad (12)$$

where $\|\cdot\|$ is the Euclidean norm. The drift term corresponds to the continuously compounded risk-free interest rate, $r_{f,t}$, and the volatility term gives the market price of risk, $\lambda_t = \gamma \sigma_{c,t}$.

The Sharpe ratio of asset i , which pays no dividends and has price following

$$dP_{i,t} = P_{i,t} [\mu_{i,t} dt + \sigma_{i,t}^\top dz_t], \quad (13)$$

is given by

$$SR_i \equiv \frac{\mu_{i,t} - r_{f,t}}{\|\sigma_{i,t}\|} = \rho_{ic,t} \gamma \|\sigma_{c,t}\|, \quad (14)$$

where $\rho_{ic,t}$ is the correlation between the risk premium of asset i and consumption growth. More specifically, Eq. (14) gives the market Sharpe ratio with $\rho_{ic,t} = \rho_{mc,t}$ or the market price of risk, $\|\lambda_t\|$, for $\rho_{ic,t} = 1$.

2.1 Freely choosing the surplus consumption parameters

Let us assume that \bar{S}_t is the market Sharpe ratio that we would like to generate. Substituting Eq. (11) in Eq. (14), we obtain

$$\sigma_{s,t} = \sqrt{\left(\frac{\bar{S}_t}{\gamma \rho_{mc,t}}\right)^2 - \sigma_{k,t}^2}, \quad (15)$$

for which the solution is a real number for any standard set of parameters and given that $\rho_{mc,t} \neq 0$. This condition highlights that a large $\sigma_{s,t}$ in Eq. (15) is usually not enough to generate the desired Sharpe ratio because the correlation could approach zero if s_t is uncorrelated with the market premium. If the surplus consumption is heteroskedastic, even if aggregate expenditure is homoskedastic, the model generates time-varying Sharpe ratios that also vary counter-cyclically if the surplus volatility, $\sigma_{s,t}$, decreases with the surplus consumption level.

Under the same assumption of $\rho_{mc,t} \neq 0$, the model also jointly generates any choice of risk-free rate: The restriction of a positive subjective discount rate, $\delta > 0$, on the drift term in Eq. (12), together with Eq. (10) and Eq. (15) gives

$$\mu_{s,t} < \frac{r_{f,t}}{\gamma} - \mu_{k,t} + \frac{1}{2}(1 + \gamma) \left(\frac{\bar{S}_t}{\gamma \rho_{mc,t}}\right)^2, \quad (16)$$

which, again, has a solution in the real numbers for any standard set of parameters. The risk-free rate can be made constant with an assumption similar to the one in [Campbell and Cochrane \(1999\)](#), explicitly connecting the drift, $\mu_{s,t}$, to the volatility of the surplus process indicated in Eq. (15), or directly connecting it to the market Sharpe ratio, \bar{S}_t in Eq. (16).

In summary, the framework provides directions to “reverse-engineer any asset pricing results”, which is what [Cochrane \(2017\)](#) describes as one of the main contributions of [Constantinides and Duffie \(1996\)](#), for example.⁴ However, this also means that the model can be too flexible unless we can relate the surplus consumption to the data, as I do next.

⁴In [Constantinides and Duffie \(1996\)](#), this is achieved by assuming the desired cross-sectional variance in consumption. I achieve the same by choosing the desired surplus consumption process in Eq. (8), instead.

2.2 Surplus as a function of government intervention

The economy has Q sectors/stages, indexed by $q = \{1, \dots, Q\}$, through which the consumption good must pass before it can be consumed.⁵ The government imposes the same (time-varying) restrictions, r_t , on all sectors: Each sector processes the goods for one period by continuously adding r_t units of the state good to each unit of the total being processed before passing everything to the next sector. Hence, the cost of regulation accumulates as the good passes through the production chain.

The state good and the consumption good have a price of one, so the total cost of the goods that reach sector Q at time t (expenditures) is

$$k_t = c_t e^{\sum_{q=1}^Q r_{q,t}} = c_t e^{\theta_t}, \quad (17)$$

where $r_{q,t}$ is the prevailing rate of state goods production in each sector when the goods were (previously) processed in sector q ; c_t is the value of the consumption goods; and $\theta_t = Q\bar{r}_t$ can be interpreted as the product between the average rate of the state goods production in the previous sectors at time t , \bar{r}_t , and the number of sectors, Q . This implies that surplus consumption is

$$s_t = e^{-\theta_t}. \quad (18)$$

The fraction of expenditure from which the agent derives utility, s_t , decreases with the production rate of the state good, \bar{r}_t , which is magnified by the existence of multiple Q sectors. It is important to have this multiplicative effect in mind when later analyzing the magnitudes of the average surpluses obtained in the calibration exercise. In addition, Eq. (17) suggests that lagged intervention levels are relevant to describe s_t : The choices of r_t that were in place when the goods were previously processed in each sector q , $r_{q,t}$, still affect the relation between consumption and expenditure at time t .

⁵Intuitively, these sectors/stages could correspond to natural resource extraction, manufacturer, distributor, retailer, and consumer, for example.

3 Data and proxy construction

3.1 Market and consumption data

All returns are continuously compounded. I calculate the market premium (MP) and the nominal risk-free rate from the data on Kenneth French's website. The inflation rate from December to December is from the annual CPI (all urban consumers) in the FRED database.

Consumption expenditure growth, k_g , follows the end of year convention and uses the data in NIPA Table 7.1 from the Bureau of Economic Analysis. I use the GDP deflator (from lines 1 and 10) to obtain the real per capita expenditures on nondurables (line 8) and services (line 9). The sum of these two numbers gives real per capita consumption expenditure, k_t , from which I calculate growth as

$$k_{g,t} = \ln\left(\frac{k_t}{k_{t-1}}\right). \quad (19)$$

3.2 The two proxies for government intervention

The main empirical issue related to realistically calibrating and evaluating the model is to obtain measures of the restrictions placed by the government on the individual consumption choices. Early on, in a different but related context, [Friedman and Friedman \(1980\)](#) use the number of pages in the Federal Register to measure the growth of regulation. More recently, [Dawson and Seater \(2013\)](#) provide a comprehensive discussion about the total number of pages in the Code of Federal Regulation as a measure of federal regulation. [Dawson and Seater \(2013\)](#) discuss its issues and how it compares favorably with other measures and, more importantly, they show that increases in this measure are associated with reduced output growth because regulations force the firms to use suboptimal combinations of inputs.

I use the number of pages in Title 3 of the Code of Federal Regulations (CFR), which concerns all presidential orders, as one of the proxies for government intervention. There are two main reasons to consider only Title 3: The first is that it reflects the posture of the

federal government regarding intervention more directly. The underlying assumption is that a more active government makes more choices and leaves less alternatives available for the individuals. Hence, government activity in general is detrimental to the individual.⁶ The second reason is one of timing: The regulations (subsequently) created by the federal agencies also appear in the remaining chapters of the Code. These regulations tend to arise from previous government choices, not necessarily from the ones currently being made.

I obtain the number of pages in the CFR for the (yearly) editions between 1975 and 2017. The data regarding the editions until 2016 are from the Regulatory Studies Center, Columbian College of Arts and Sciences, George Washington University and I hand collect the data for 2017 from the U.S. Government Publishing Office.⁷ Title 3 of the CFR is published every January 1; therefore, these data correspond to the years between 1974 and 2016, in fact.

One of the issues with the CFR is that it is purely a counting measure, so “two identical values may comprise regulations of different types and, even within a given type, may represent regulations of different stringency” (Dawson and Seater, 2013). Therefore, I consider the number of **economically significant rules** (ESR) that underwent review by the Office of Information and Regulatory Affairs each year as a second measure containing a qualitative component. I hand collect these yearly data from their website as of December 31, between 1981 and 2017.⁸

3.2.1 Lagged measures of government intervention?

As explained before and shown in Eq. (17), the assumption of multiple economic sectors implies that the restrictions in place in previous periods (when the goods were processed

⁶This contrasts, for example, with the assumptions in standard models of political uncertainty, such as Pastor and Veronesi (2013, 2012), in which government intervention can increase individual welfare.

⁷These data can be found at, respectively, <https://regulatorystudies.columbian.gwu.edu/reg-stats> and <https://www.gpo.gov>.

⁸A regulatory action is determined to be “economically significant” by the Office of Information and Regulatory Affairs “if it is likely to have an annual effect on the economy of \$100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or tribal governments or communities.” More information about the Office at <https://www.reginfo.gov/>.

in a given sector q) also affect the surplus consumption at time t . This suggests that some lagged measures of government intervention can be relevant. In addition, as also explained, several regulatory choices give federal agencies the power to further regulate the economy at a later point in time. Hence, in most of the analysis I consider three-year accumulated proxies, $ESR_{3y,t}$ or $CFR_{3y,t}$, which are the sum of the regulation proxies in year t , $r_{p,t} = ESR_t$ or $r_{p,t} = CFR_t$, and their two lags, as

$$r_{3y,t} = \sum_{l=0}^2 r_{p,t-l}. \quad (20)$$

3.2.2 Statistical description

Figure 1 shows the histogram of the ESR and CFR proxies, both in individual years and accumulated over three years. The number of ESR (in individual years or accumulated over three years) tends to be more evenly distributed than the number of pages in the CFR, especially in individual years. On the other hand, in relation to the mean of the respective proxy, the first five columns of Table 1 show that the CFR is more volatile than the ESR (accumulated or not), and the accumulated proxies are less volatile in general. The proxy's volatility is important because it connects to the volatility of the calibrated consumption process later on.

The last four columns also show that the measures are positively correlated, but not by much. In particular, the two main variables in the analysis, $ESR_{3y,t}$ and $CFR_{3y,t}$, have correlations of only 0.5 and seem to capture partially different aspects of government intervention. Regarding stationarity, the results of the Augmented Dickey-Fuller tests reported in Table 2 reject the hypotheses of unit roots, based on the number of lags (one for all series) suggested by the correlograms in Figure 2.

3.3 Regulation growth rates and the market premium

The relatively low volatility of consumption expenditure growth is at the heart of the equity premium puzzle as we infer from Hansen and Jagannathan (1991). Therefore, the ability of government intervention to quantitatively explain the observed equity premium also depends on how volatile the growth rate in intervention is. Figure 3 shows that the volatility in regulation growth (considering either CFR_{3y} or ESR_{3y}) is of the same order of magnitude as the market premium volatility, while consumption expenditure growth varies considerably less. There also seems to be a negative correlation between intervention growth and the equity premium. This is important because it suggests positive comovement between (voluntary) consumption growth and risk premiums, as we would expect.

Columns 2, 4, and 5 in Table 3 provide more details: For example, Column 2 shows that regulation growth measured as $CFR_{g,3y}$ has almost the same volatility as the market premium, MP . The volatility of regulation growth measured as $ESR_{g,3y}$ is lower but still one order of magnitude larger than the volatility of consumption expenditure growth, k_g . In addition, the last six columns in row 5 show that these two proxies are more correlated with the market premium than consumption expenditure is. The relation between the two proxies and expenditure is different: The correlation is negative for $ESR_{g,3y}$ and essentially zero for $CFR_{g,3y}$, even though the two proxies are positively correlated with each other.⁹ For the individual year proxies, ESR_g or CFR_g , the volatilities are considerably larger, but the correlations with the market premium (and expenditure growth) are lower.

⁹Note that the periods are different because the $ESR_{g,3y}$ sample is shorter.

4 Model calibration: The equity premium–risk-free rate puzzle

In this section, I calibrate the consumption process in Eq. (9) based on the observed time series of consumption expenditure and proxies for intervention. The calibrated parameters result in different average levels of intervention and I report the results for a range of these values. Next, I obtain the respective Sharpe ratios and risk-free rate for a few relative risk aversion coefficients: $\gamma \in \{1, 2, 3, 4, 5\}$. The risk-free rate is a function of the estimates of $\mu_{c,t}$ and $\sigma_{c,t}$ and is given by the drift of the SDF process in Eq. (12). The Sharpe ratio is a function of $\sigma_{c,t}$ (and the correlation term) in Eq. (14). I report unconditional and conditional estimates of these quantities.

4.1 Calibrating the consumption process, $c = c(t)$

Let us assume that government intervention fluctuates over time around a certain exogenous value, \bar{r} , and that the fluctuation happens in proportion to the value of the proxy at time t , $r_{p,t} = ESR_{3y,t}$ or $r_{p,t} = CFR_{3y,t}$, as

$$\bar{r}_t = \bar{r} \left(\frac{r_{p,t}}{\bar{r}_p} \right), \quad (21)$$

where \bar{r}_p is the proxy average. In addition, define the (proportional) intervention growth as

$$r_{g,t} = \frac{r_{p,t} - r_{p,t-1}}{\bar{r}_p}. \quad (22)$$

Substituting Eq. (21) in $\theta_t = Q\bar{r}_t$, we can rewrite Eq. (18) as a function of each proxy to obtain Eq. (2),

$$s_t = \exp\left(-\bar{\theta} \frac{r_{p,t}}{\bar{r}_p}\right), \quad (23)$$

where $\bar{\theta} = Q\bar{r}$, and obtain consumption growth as

$$c_{g,t} \equiv \frac{c_t}{c_{t-1}} = \exp\left(k_{g,t} - \bar{\theta} r_{g,t}\right), \quad (24)$$

where c_t is defined in Eq. (1), $k_{g,t}$ is defined in Eq. (19), and $r_{g,t}$ is defined in Eq. (22). Consumption growth now becomes a function of the – observable – values of consumption expenditure and the intervention growth, given $\bar{\theta}$. This equation shows that the choice of $\bar{\theta}$ is crucial because it controls the weights on the growth rates in expenditure and regulation that are used to calculate consumption growth.

However, there are two main issues related to determining $\bar{\theta} = Q\bar{r}$ empirically. The first, as discussed before, is that explicit measures of government intervention do not exist (Dawson and Seater, 2013), so it is not possible to obtain an estimate for \bar{r} . In addition to that, it is not clear how to obtain an estimate for the number of separate sectors involved

in the production of the typical good in the economy, Q . So instead of selecting a value, I investigate a range of possibilities for $\bar{\theta}$: I consider values from zero to $\bar{\theta}_{max} = 2.5$, which corresponds to average surpluses from 100% to around 8%, in most of the analysis.

4.2 The original (unconditional) equity premium puzzle

Under the assumption that consumption expenditure, k_t , is equivalent to the optimal consumption that solves, for example, the standard problem in Mehra and Prescott (1985), c_t , the puzzle arises from the impossibility of finding a reasonably low value for the coefficient of relative risk aversion, $\gamma \leq 5$, that generates a market Sharpe ratio similar to what has been historically observed (for example, between 0.2 and 0.5) and also generates a small or negative difference between the risk-free and subjective discount rates, $r_{f,t} - \delta$, which is the case for a positive subjective discount rate.

Figure 4 and Figure 5 (respectively with ESR_{3y} or CFR_{3y} as the proxies for intervention) show that there is no puzzle for several calibrated values of government intervention according to the framework that I present. The graphs display the market prices of risk on the top row, the market Sharpe ratios in the middle, and the difference between the risk-free and the subjective discount rates, $r_{f,t} - \delta$, at the bottom. From left to right, the coefficient of relative risk aversion that generates the graphs increases: $\gamma \in \{1, 2, 3, 4, 5\}$. All of these values vary (via $\bar{\theta}$) with the average consumption surplus that appears on the horizontal axis in each graph.

The graphs confirm that consumption expenditure alone, which corresponds to a surplus of 100%, is unable to generate either reasonable Sharpe ratios or positive values for the subjective discount rate. However, they also show that the puzzles eventually disappear as the average surplus decreases based on both proxies: The two figures contain graphs that show a region in which the market Sharpe ratio is between 0.2 and 0.5 or the market price of risk is between 0.8 and 2, for example. In these regions, the difference between the risk-free rate and the subjective discount rate tends to be very negative, $r_{f,t} - \delta \ll 0$. Given an estimate for the risk-free rate of $r_{f,t} \approx 1\%$, the subjective discount rate, δ , is

positive but often much larger than the usual assumption in previous calibrations of asset pricing models. This is especially the case because the previous models tend to imply negative subjective discount rates. However, [Frederick et al. \(2002\)](#) also mention very large estimates for the subjective discount rate. Although typically positive, the estimates range from slightly negative to infinity in their survey of the literature.

A comparison of the two proxies reveals that the consumption growth series created from the more volatile CFR_{3y} proxy (Table 3) generates higher Sharpe ratios for a given level of government intervention. On the other hand, the correlation between the market premium and consumption growth calculated from ESR_{3y} is larger (as shown in the graphs on the left-hand side of Figure 8). This implies that the ESR -based series generates larger and often reasonable market Sharpe ratios even with lower market prices of risk.

4.3 Counter-cyclical variation in the market price of risk

A second question is whether the **conditional** equity premium is still a puzzle. [Cochrane \(2011\)](#), among others, documents that risk premiums vary counter-cyclically over time, which means that the SDF volatility must vary over time. The problem is that under the hypothesis that consumption expenditure, k_t , is equivalent to optimal consumption, most consumption-based asset pricing models imply that the SDF volatility is constant because k_t is homoskedastic. Even some advanced models that generate time variation in the market price of risk, such as [Campbell and Cochrane \(1999\)](#), can only achieve this by assumption.¹⁰

I answer this question based on conditional estimates of the parameters in the model that I present. In particular, I condition the set of parameter estimates on whether, at the beginning of the period, the proxy for government intervention, $r_{p,t} = ESR_{3y,t}$ or $r_{p,t} = CFR_{3y,t}$, is above or below its respective median. Therefore, I analyze the predictions of the model based on two sets of parameters: One estimated when government intervention is high (bad times), $(\hat{\mu}_{c,t}^h, \hat{\sigma}_{c,t}^h, \hat{\rho}_{mc,t}^h)$, and another one found when intervention is low (good

¹⁰[Campbell and Cochrane \(1999\)](#) explicitly assume that their “sensitivity function” is such that the volatility of surplus consumption (as they define it, over an external habit level) increases when the surplus declines, which generates the counter-cyclical variation in the market price of risk that they document.

times), $(\hat{\mu}_{c,t}^l, \hat{\sigma}_{c,t}^l, \hat{\rho}_{mc,t}^l)$. As given by Eq. (14), the model delivers counter-cyclical variation in risk premiums if the volatility of the surplus consumption increases when the surplus declines (given that expenditures are homoskedastic). However, instead of assuming that this happens, as in [Campbell and Cochrane \(1999\)](#), I check whether we observe this in the data.

The plots in Figure 6 (based on ESR_{3y}) and Figure 7 (based on CFR_{3y}) show the same quantities as Figure 4 and Figure 5, but conditioned on the level of intervention. For a given average surplus on the horizontal axis, the red solid lines in the graphs correspond to the periods in which the intervention level is above its median (“bad times” and low consumption surplus). The navy dashed lines correspond to the remaining periods (“good times”).

The market prices of risk increase in bad times based on both proxies (top rows in Figure 6 and Figure 7), meaning that the model also delivers a counter-cyclical market price of risk despite the constant volatility of consumption expenditure and without any model assumption driving this result. The calibration based on CFR_{3y} , in Figure 7, also delivers the conditional equity premium (the graphs in the second row), but the one based on ESR_{3y} , in Figure 6, seems to imply pro-cyclical market Sharpe ratios, instead. The graphs on the right-hand side in Figure 8 show why this happens: The correlation between the market premium and consumption growth seems to be smaller in bad times for the ESR_{3y} . However, ignoring these conditional estimates generates counter-cyclical market Sharpe ratios based on this proxy, too. And, in fact, correlations are particularly difficult to measure ([Campbell and Cochrane, 1999](#)), so the solution makes sense especially in such a small sample. Another alternative is to assume even lower values of average surplus (not shown in the graph) because they also generate counter-cyclical market Sharpe ratios.

4.3.1 Stability of the risk-free rate

The bottom graphs in Figure 6 and Figure 7 suggest that there are big differences in the risk-free rate parameters estimated in good and bad times for the average surplus values

that generate reasonable Sharpe ratios. More specifically, Table 4 shows conditional and unconditional market Sharpe ratios, market prices of risk, and differences between the risk-free and subjective discount rates, $r_{f,t} - \delta_t$, for selected average surplus levels, \bar{s}_t . These choices are such that, for each proxy, the market Sharpe ratio is close to 0.2 or 0.5, or the market price of risk is close to 0.8 or 2.

What these graphs and Table 4 imply is that the subjective discount rate, δ_t , must vary counter-cyclically (unless the parameters in the model are not well estimated), given that the risk-free rate does not change much. Under this assumption, the changes in $r_{f,t} - \delta_t$ observed in the last columns of Table 4 are almost entirely due to changes in δ_t . This type of preference shock means that the agents become more impatient in bad times, $\delta^h > \delta^l$. And, indeed, there is evidence that this happens. For example, the mechanism could be similar to what makes heroin addicts discount both drugs and money more steeply when they are craving the drug (“bad times”) than when they are not (“good times”) (Giordano et al., 2002).

Finally, although not necessarily puzzling, one potential issue is that, in some cases, the magnitude of this change must be substantial. For example, based on the ESR_{3y} , the subjective discount rate would need to increase close to 25% on average in bad times, and reduce close to 17% on average in good times for the average surplus values reported in Table 4. For the estimates based on the CFR_{3y} , these numbers would change to 51% and 54%, respectively.

5 The predictability puzzle

A final aspect of the equity premium is that we suspect, at least since [Fama and French \(1988\)](#), that the variation in the equity premium is predictable, especially at longer horizons ([Cochrane, 2011](#)). The conditional results in the previous section show that, within the framework that I present, the market price of risk increases with regulation. Hence, the proxies for intervention should ideally forecast the equity premium, which is the question that I address in this section.

Figure 9 gives an overview of the predictive relation between each intervention proxy and the market premium at 1- to 5-year horizons. The scatter plots show the market premiums at different horizons going forward from time t on the vertical axis and the proxies at time t on the horizontal axis. They suggest that there is, indeed, a clear, positive relation between intervention and risk premiums. Table 5 confirms the results suggested by Figure 9 and reports the estimated slope coefficients, β_{rh} , in predictive regressions of the form

$$MP_{t+h} = \alpha_{rh} + \beta_{rh}r_{p,t} + \epsilon_{t+h}, \quad (25)$$

where $r_{p,t} = ESR_{3y,t}$ or $r_{p,t} = CFR_{3y,t}$ is the proxy for intervention at time t and MP_{t+h} is the market premium compounded over h years, $h \in \{1, 2, 3, 4, 5\}$, starting at time t . The slope coefficients, β_{rh} , are significantly positive for every horizon and for both proxies, even if only being marginally significant for the 1-year horizon based on ESR_{3y} .

Intuitively, the consumer surplus decreases (economic conditions deteriorate) and risk premiums increase with government intervention. This is similar to the conclusion in [Fama and French \(1989\)](#) based on consumer expenditure. In summary, it shows that the framework that I present also delivers predictability of the equity premium.

5.1 The individual yearly components in the three-year proxies

As a robustness check, I investigate the forecasting properties of the individual yearly values that are accumulated to build the proxy for government intervention. Eq. (20) shows that the series CFR_{3y} and ESR_{3y} correspond to the values of each proxy in a given year, t , added to their values in the two previous years. In this section, I run predictive regressions of the market premium based on each of these three components individually. The regressions, similar to the ones in Eq. (25) and for the same horizons, h , have the form

$$MP_{t+h} = \alpha_{hl} + \beta_{hl}r_{p,t-l} + \epsilon_{l,t+h}, \quad (26)$$

where, now, the proxies for intervention at time t are $r_{p,t} = ESR_{y,t}$ or $r_{p,t} = CFR_{y,t}$, which are, respectively, the number of economically significant rules (ESR) or pages in Title 3 of the Code of Federal Regulations (CFR) in each **individual** year, t . I consider these values at time $t - l$, where $l \in \{0, 1, 2\}$ indicates the number of lags (and translates to one of the three components of the accumulated proxy, as described in Eq. (20)).

Table 6 and Table 7 show that each of the three components of both proxies significantly forecasts the market premium for at least two of the five different horizons. In line with the previous literature on equity premium predictability, the proxies tend to have better forecasting power at longer horizons. However, this seems to be negatively related to the number of lags: None of the proxies measured with two lags forecasts the 5-year market premium. On the other hand, both proxies forecast the 4- and 5-year market premiums when the proxies are measured without lags, while failing to forecast the 1-year premium. Finally, lagged values of CFR_y seem to forecast the market premium better than lagged values of ESR_y , and the opposite seems to happen for their values at time t .

Intuitively and in line with the model, the delayed effect of intervention on the market premium is consistent with the existence of several consecutive sectors in the economy and the assumption that the regulation costs are accumulated as the goods pass from one sector to the next.

6 Summary

In this paper we learn that the equity premium puzzle seems to arise because we use changes in consumption expenditure to calculate changes in the marginal utility of consumption. By failing to remove the part of consumption expenditure that is imposed by the government, we miscalculate utility levels and changes in marginal utility.

We also learn how to “clean” the expenditure series from this type of consumption, based on two observable proxies for government intervention. For several of the calibrated series using this method, there are no puzzling aspects associated with the equity premium or risk-free rate. The framework also explains the predictability puzzle and the counter-cyclical variation in risk premiums that we observe in the data. Finally, we learn that the subjective discount rates vary counter-cyclically and are a lot larger than previously assumed in the asset pricing literature. Still, this is supported by the empirical evidence on subjective discount rates.

The paper also provides an intuitive explanation for the large observed equity premium: People avoid stocks because stocks tend to give bad returns exactly when the government decides to increase intervention in the economy. When intervention increases, the consumers become “hungry” because they must consume more of what the government wants and, as a consequence, less of what they actually want. This makes stocks undesirable for everyone in the economy and reduces their demand, driving the price of stocks down and inevitably increasing their expected returns.

7 Figures

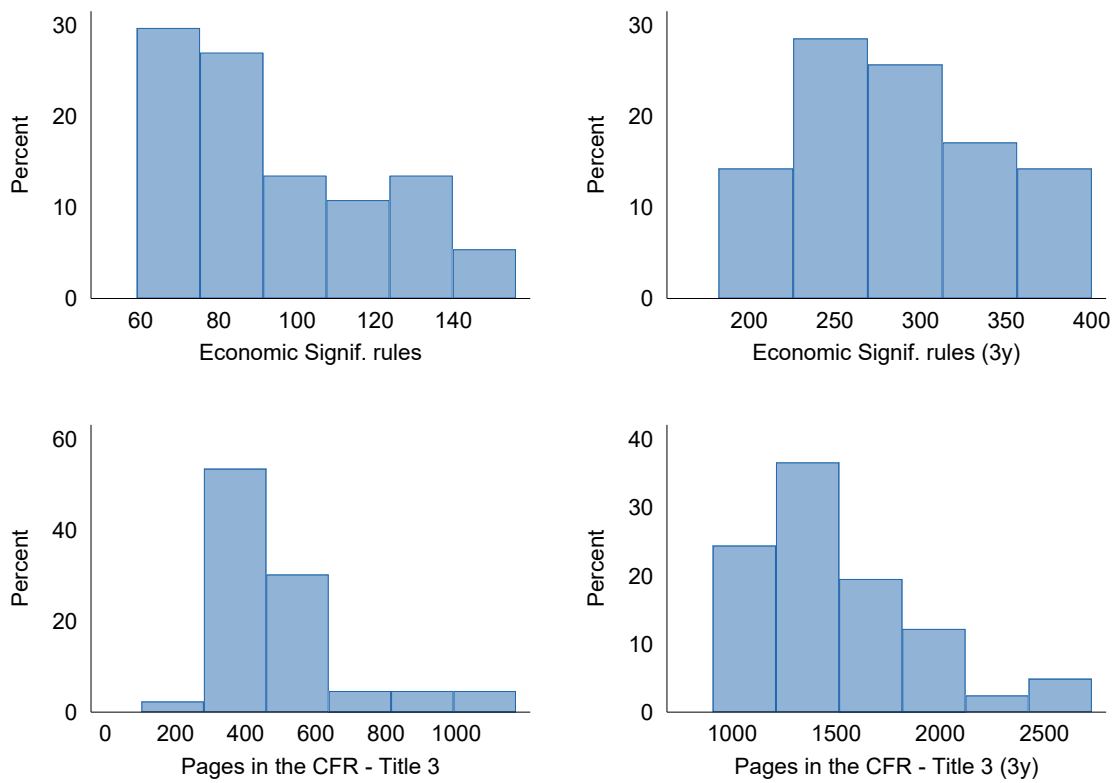


Figure 1: Two measures of government intervention. The top two graphs show the number of economically significant rules passed by the federal government each year (on the left) and the totals accumulated over three years (on the right). The lower graphs show equivalent measures for the number of pages in Title 3 of the Code of Federal Regulations (concerning presidential orders).

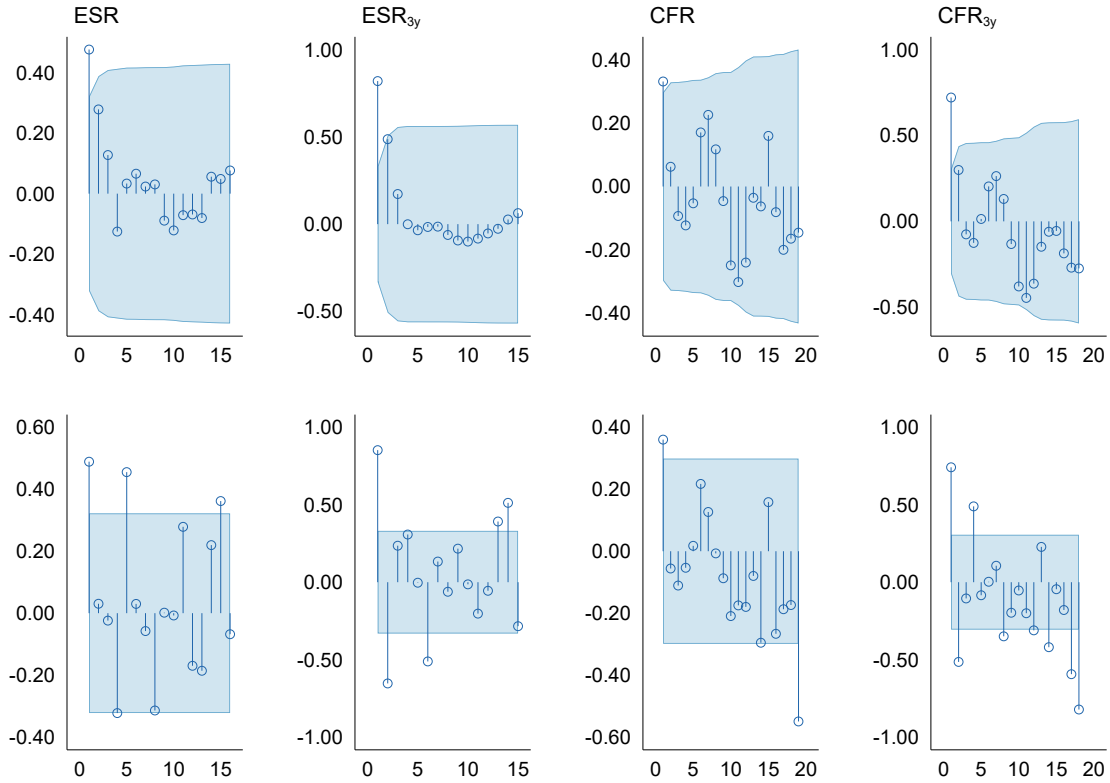


Figure 2: Correlograms for the number of economically significant rules and number of pages in the Code of Federal Regulation. The top graphs display the autocorrelation plots; the lower graphs display the partial autocorrelation plots. The columns correspond to the number of economically significant rules in (i) a given year (ESR) or in (ii) the preceding three years (ESR_{3y}), and to the number of pages in Title 3 of the Code of Federal Regulations in (iii) a given year (CFR), or in (iv) the preceding three years (CFR_{3y}). The shaded blue areas correspond to the 95% confidence interval.

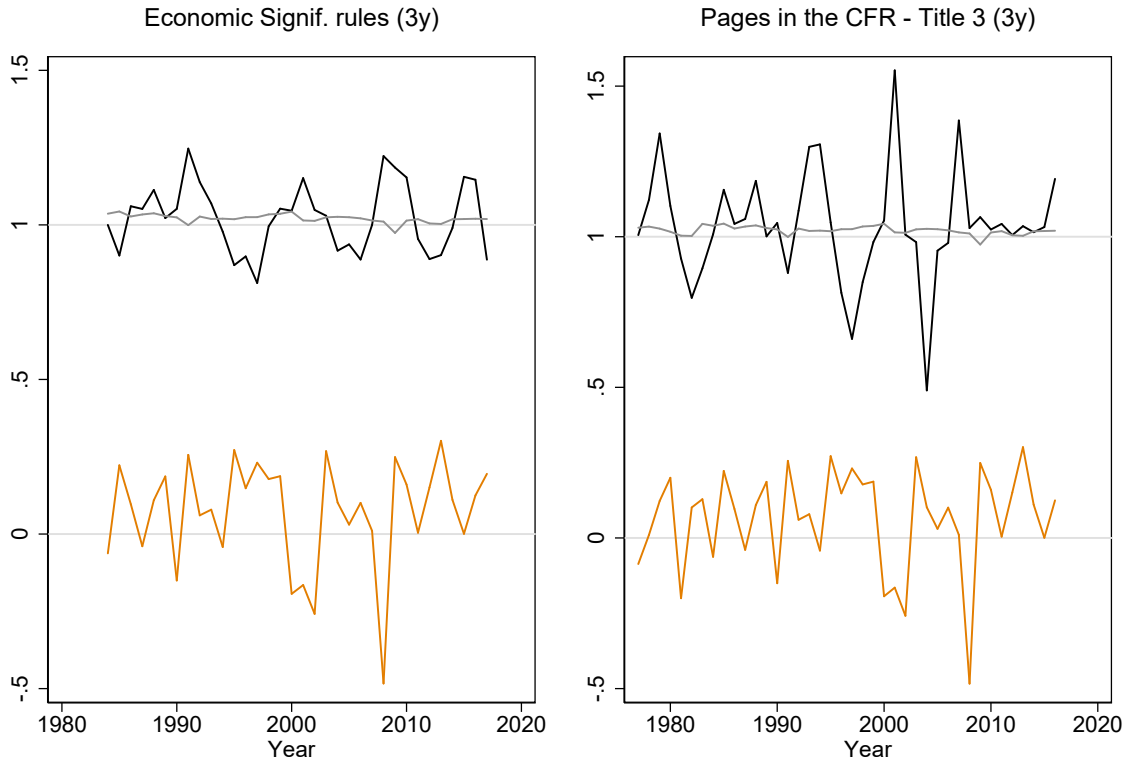


Figure 3: Yearly intervention growth, expenditure growth, and equity premium. In both graphs, the orange line at the bottom shows the equity premium and the gray line at the top shows consumption expenditure growth. For the graph on the left, the black line at the top shows the yearly growth in the number of economically significant rules passed by the federal government in the three years preceding year t (compared to the total in the three years preceding year $t - 1$). The graph on the right shows an equivalent measure for the number of pages in Title 3 of the Code of Federal Regulations.

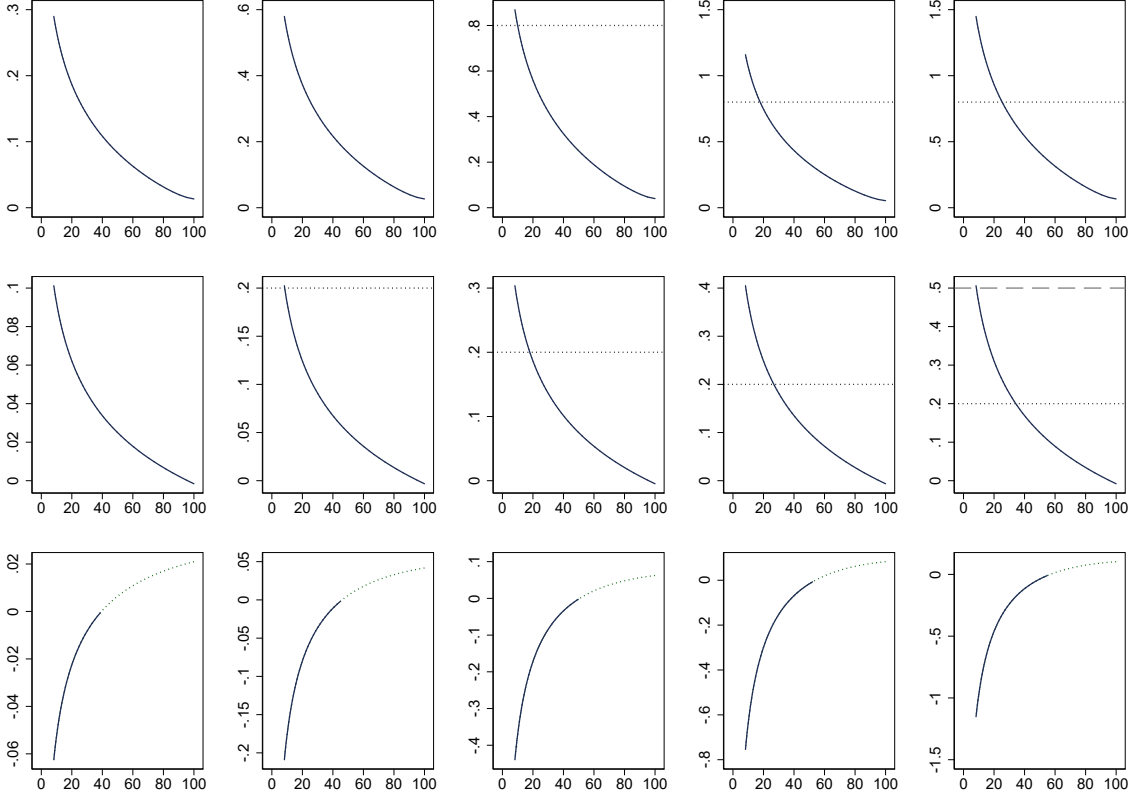


Figure 4: *ESR*-based unconditional market prices of risk (top), market Sharpe ratios (middle), and subjective discount rate subtracted from the risk-free rate (bottom). Consumption growth is calibrated as

$$c_{g,t} = \exp(k_{g,t} - \bar{\theta} r_{g,t}), \quad r_{g,t} = \frac{ESR_{3y,t} - ESR_{3y,t-1}}{\overline{ESR}_{3y}},$$

where $k_{g,t}$ is expenditure growth, $ESR_{3y,t}$ is the intervention proxy at time t (the number of economically significant rules passed in the preceding three years), \overline{ESR}_{3y} is its average, and $\bar{s}_t = e^{-\bar{\theta}}$ is the assumed average surplus appearing in the horizontal axis in every graph. The graphs from left to right are each obtained under the assumption of a different value for the relative risk aversion parameter, $\gamma = 1, \dots, 5$. On the vertical axis, the top graphs display the market prices of risk, the middle ones display the market Sharpe ratios, and the lower ones show the subjective discount rate subtracted from the risk-free rate, $r_{f,t} - \delta$, with a solid line exclusively for $r_{f,t} - \delta \leq 0$. The reference dotted lines in the top graphs correspond to 0.8. The dotted (dashed) lines in the middle graphs correspond to 0.2 (0.5).

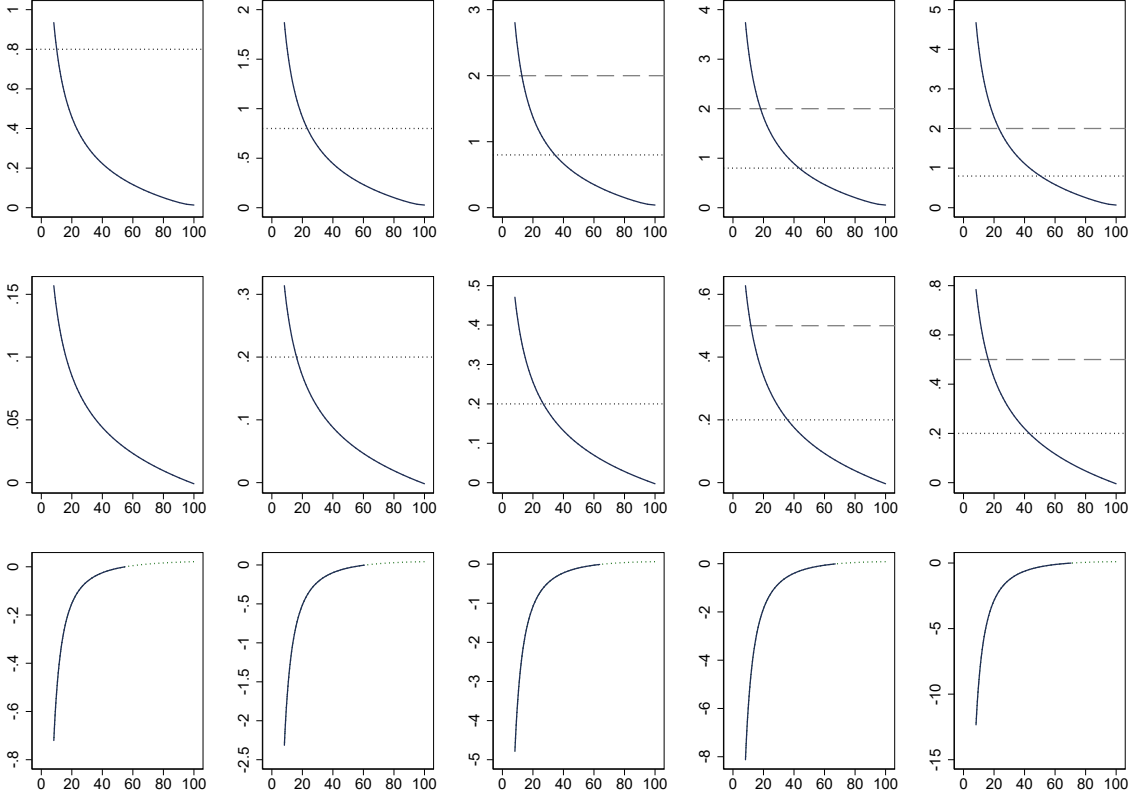


Figure 5: *CFR*-based unconditional market prices of risk (top), market Sharpe ratios (middle), and subjective discount rate subtracted from the risk-free rate (bottom). Consumption growth is calibrated as

$$c_{g,t} = \exp(k_{g,t} - \bar{\theta} r_{g,t}), \quad r_{g,t} = \frac{CFR_{3y,t} - CFR_{3y,t-1}}{\overline{CFR}_{3y}},$$

where $k_{g,t}$ is expenditure growth, $CFR_{3y,t}$ is the intervention proxy at time t (the number of pages in Title 3 of the Code of Federal Regulations in the preceding three years), \overline{CFR}_{3y} is its average, and $\bar{s}_t = e^{-\bar{\theta}}$ is the assumed average surplus appearing in the horizontal axis in every graph. The graphs from left to right are each obtained under the assumption of a different value for the relative risk aversion parameter, $\gamma = 1, \dots, 5$. On the vertical axis, the top graphs display the market prices of risk, the middle ones display the market Sharpe ratios, and the lower ones show the subjective discount rate subtracted from the risk-free rate, $r_{f,t} - \delta$, with a solid line exclusively for $r_{f,t} - \delta \leq 0$. The reference dotted (dashed) lines in the top graphs correspond to 0.8 (2) and they correspond to 0.2 (0.5) in the middle graphs.

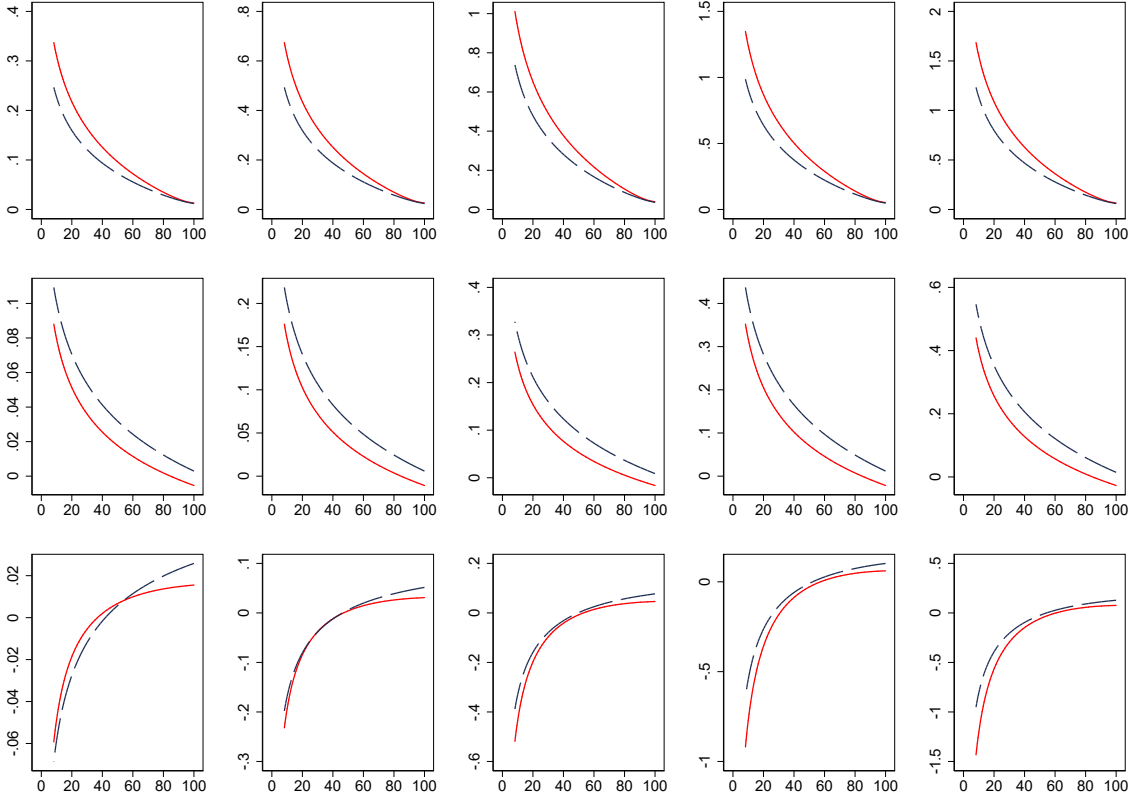


Figure 6: *ESR*-based conditional market prices of risk (top), market Sharpe ratios (middle), and subjective discount rate subtracted from the risk-free rate (bottom). Consumption growth is calibrated as

$$c_{g,t} = \exp(k_{g,t} - \bar{\theta} r_{g,t}), \quad r_{g,t} = \frac{ESR_{3y,t} - ESR_{3y,t-1}}{\overline{ESR}_{3y}},$$

where $k_{g,t}$ is expenditure growth, $ESR_{3y,t}$ is the intervention proxy at time t (the number of economically significant rules passed in the preceding three years), \overline{ESR}_{3y} is its average, and $\bar{s}_t = e^{-\bar{\theta}}$ is the assumed average surplus appearing in the horizontal axis in every graph. The graphs from left to right are each obtained under the assumption of a different value for the relative risk aversion parameter, $\gamma = 1, \dots, 5$. On the vertical axis, the top graphs display the market prices of risk, the middle ones display the market Sharpe ratios, and the lower ones show the subjective discount rate subtracted from the risk-free rate, $r_{f,t} - \delta$, with a solid line exclusively for $r_{f,t} - \delta \leq 0$. The red solid lines correspond to the periods in which the number of economically significant rules (over the previous 3 years) is above its median. The navy dashed line corresponds to the remaining periods.

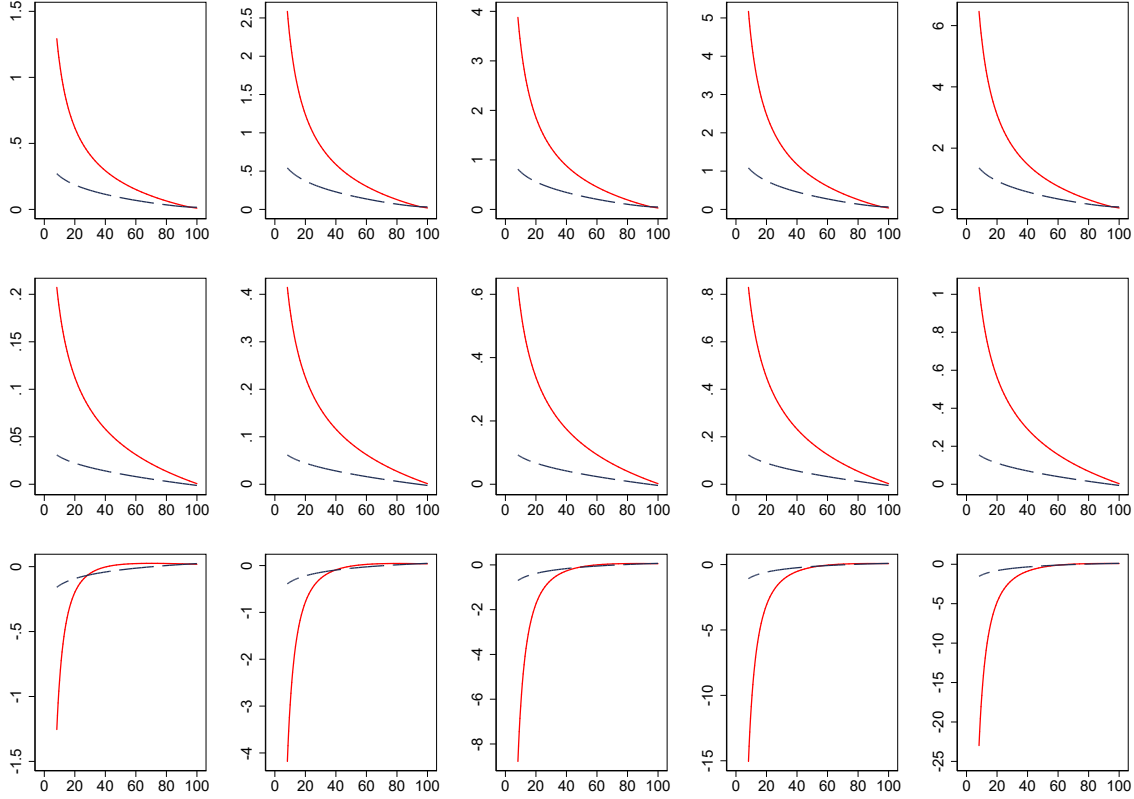


Figure 7: CFR-based conditional market prices of risk (top), market Sharpe ratios (middle), and subjective discount rate subtracted from the risk-free rate (bottom). Consumption growth is calibrated as

$$c_{g,t} = \exp\left(k_{g,t} - \bar{\theta} r_{g,t}\right), \quad r_{g,t} = \frac{CFR_{3y,t} - CFR_{3y,t-1}}{\overline{CFR}_{3y}},$$

where $k_{g,t}$ is expenditure growth, \bar{r} is the assumed average level of government intervention, $CFR_{3y,t}$ is the intervention proxy at time t (the number of pages in Title 3 of the Code of Federal Regulations in the preceding three years), \overline{CFR}_{3y} is its average, and $\bar{s}_t = e^{-\bar{\theta}}$ is the assumed average surplus appearing in the horizontal axis in every graph. The graphs from left to right are each obtained under the assumption of a different value for the relative risk aversion parameter, $\gamma = 1, \dots, 5$. On the vertical axis, the top graphs display the market prices of risk, the middle ones display the market Sharpe ratios, and the lower ones show the subjective discount rate subtracted from the risk-free rate, $r_{f,t} - \delta$, with a solid line exclusively for $r_{f,t} - \delta \leq 0$. The red solid lines correspond to the periods in which the number of pages in Title 3 of the Code of Federal Regulations (over the previous three years) is above its median. The navy dashed line corresponds to the remaining periods.

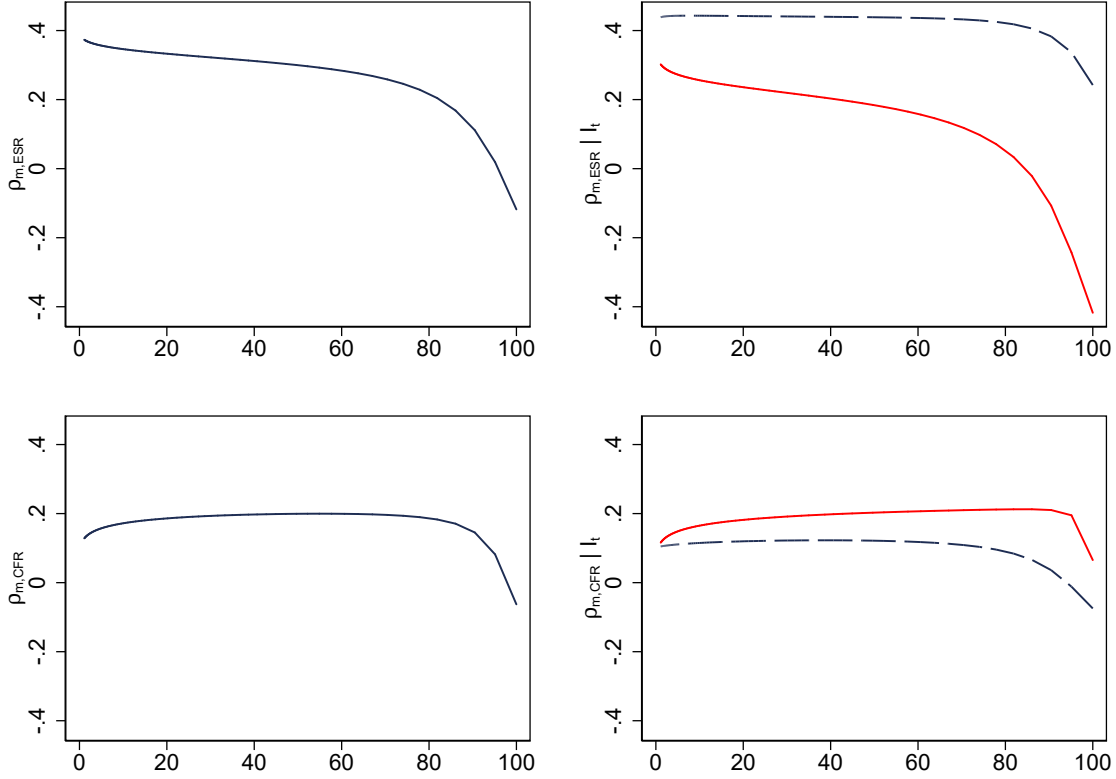


Figure 8: Conditional (right) and unconditional (left) estimates of the yearly correlation between the equity premium and consumption growth. Consumption growth is calibrated as

$$c_{g,t} = \exp(k_{g,t} - \bar{\theta} r_{g,t}), \quad r_{g,t} = \frac{r_{p,t} - r_{p,t-1}}{\bar{r}_p},$$

where $k_{g,t}$ is expenditure growth, $r_{p,t}$ is the proxy value at time t , \bar{r}_p is its average, and $\bar{s}_t = e^{-\bar{\theta}}$ is the assumed average surplus appearing in the horizontal axis in every graph. The proxies are the number of economically significant rules in the preceding three years (resulting in $\rho_{m,ESR}$ in the top graphs), or the number of pages in Title 3 of the Code of Federal Regulations in the preceding three years (resulting in $\rho_{m,CFR}$ in the bottom graphs). The solid red lines in the graphs on the right display the correlation conditioned on $r_{p,t-1}$ being above its respective median (the dashed navy lines display it otherwise).

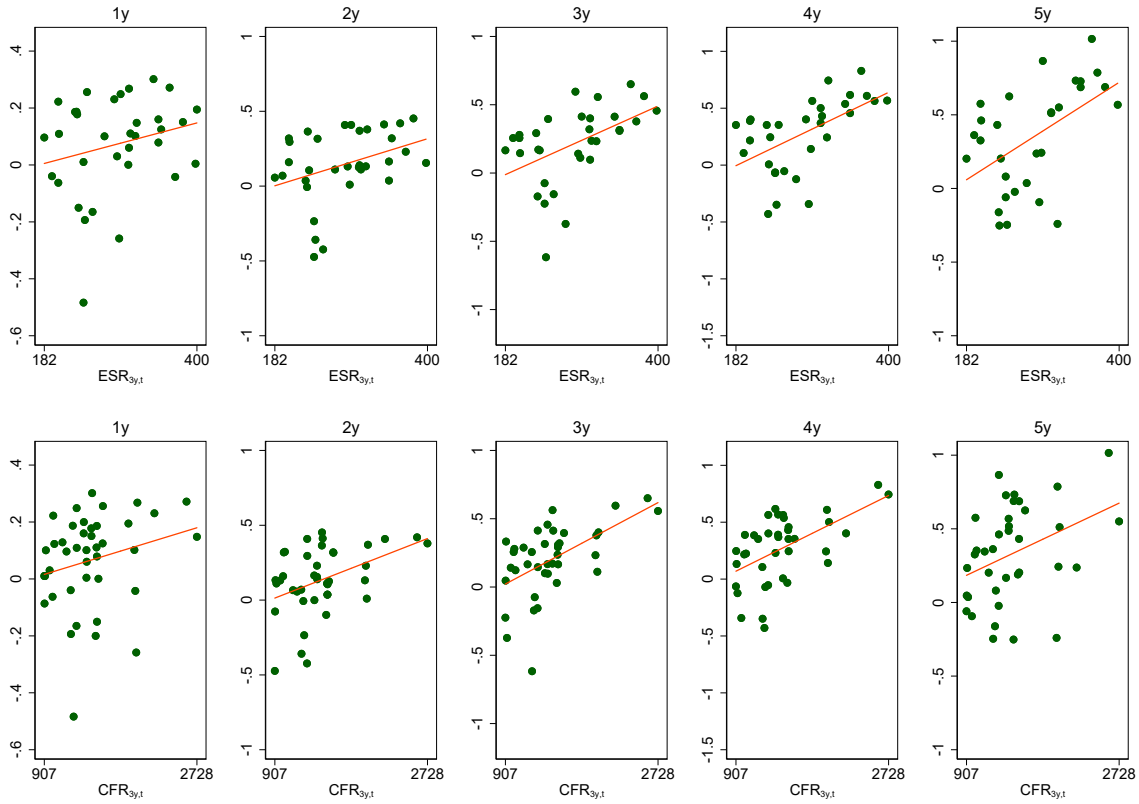


Figure 9: Illustration of the predictive relation between the market premium and government intervention. The graphs plot pairs of the form MP_{t+h} vs. $r_{p,t}$, where the proxy for intervention, $r_{p,t}$, is either the number of economically significant rules in the preceding three years, ESR_{3y} (at the top), or the number of pages in Title 3 of the Code of Federal Regulations in the preceding three years, CFR_{3y} (at the bottom), and MP_{t+h} is the market premium compounded over h years starting at time t , $h \in \{1, 2, 3, 4, 5\}$ (from left to right). The OLS fitted regression line in each case is in red.

8 Tables

Table 1: Descriptive statistics of the proxies for government intervention. The first five columns show the mean (μ), standard-deviation (σ), number of years (Obs), minimum (Min), and maximum values (Max), of the variables. The next columns show their pairwise correlations. The variables are the number of economically significant rules each year (*ESR*) or accumulated in the three years preceding that year (*ESR*_{3y}), and the number of pages in Title 3 of the Code of Federal Regulations each year (*CFR*) or accumulated in the three years preceding that year (*CFR*_{3y}).

	μ	σ	Obs	Min	Max	<i>ESR</i>	<i>ESR</i> _{3y}	<i>CFR</i>	<i>CFR</i> _{3y}
<i>ESR</i>	95	26	37	59	156	1.00	0.75	0.49	0.33
<i>ESR</i> _{3y}	286	62	35	182	400	0.75	1.00	0.44	0.50
<i>CFR</i>	490	206	43	103	1170	0.49	0.44	1.00	0.67
<i>CFR</i> _{3y}	1465	432	41	907	2728	0.33	0.50	0.67	1.00

Table 2: Augmented Dickey-Fuller unit-root tests. The table shows the number of lags used in the test (Lags), number of years (Obs), the test statistics (Z_t), and the MacKinnon approximate p-value for Z_t , (p). The variables are the number of economically significant rules each year (*ESR*) or accumulated in the three years preceding that year (*ESR*_{3y}), and the number of pages in Title 3 of the Code of Federal Regulations each year (*CFR*) or accumulated in the three years preceding that year (*CFR*_{3y}).

	Lags	Obs	Z_t	p
<i>ESR</i>	1	35	-2.78	0.061
<i>ESR</i> _{3y}	1	33	-3.44	0.010
<i>CFR</i>	1	41	-3.61	0.006
<i>CFR</i> _{3y}	1	39	-3.88	0.002

Table 3: Descriptive statistics of the yearly growth rates in government intervention, consumption expenditure, and the market premium. The first five columns show the mean (μ), standard-deviation (σ), number of years (Obs), minimum (Min), and maximum values (Max), of the variables. The next columns show their pairwise correlations. The variables are the market premium (MP), the growth in consumption expenditure ($K_g = \frac{k_t}{k_{t-1}}$), the growth in the number of economically significant rules each year (ESR_g), and the growth in the number of pages in Title 3 of the Code of Federal Regulations each year (CFR_g). The last two measures have 3-year cumulative counterparts: The growth in the number of rules (pages in the CFR) accumulated in the three years preceding year t compared to the total in the three years preceding year $t - 1$ ($ESR_{g,3y}$ and $CFR_{g,3y}$).

	μ	σ	Obs	Min	Max	ESR_g	$ESR_{g,3y}$	CFR_g	$CFR_{g,3y}$	MP	K_g
ESR_g	1.03	0.25	36	0.44	1.73	1.00	0.58	0.12	0.12	-0.24	-0.21
$ESR_{g,3y}$	1.02	0.11	34	0.81	1.25	0.58	1.00	0.11	0.35	-0.35	-0.27
CFR_g	1.13	0.55	42	0.23	3.65	0.12	0.11	1.00	0.42	-0.07	0.05
$CFR_{g,3y}$	1.04	0.19	40	0.49	1.55	0.12	0.35	0.42	1.00	-0.21	-0.02
MP	0.06	0.20	91	-0.60	0.45	-0.24	-0.35	-0.07	-0.21	1.00	0.20
K_g	1.02	0.02	88	0.92	1.08	-0.21	-0.27	0.05	-0.02	0.20	1.00

Table 4: Calibration using selected average surplus levels. Calibrated consumption is

$$c_{g,t} = \exp(k_{g,t} - \bar{\theta} r_{g,t}), \quad r_{g,t} = \frac{r_{p,t} - r_{p,t-1}}{\bar{r}_p},$$

where $r_{p,t}$ is the proxy value at time t , and \bar{r}_p is its average. The average surplus, in the second column, is $\bar{s}_t = e^{-\bar{\theta}}$. The proxies are the number of economically significant rules accumulated for three years ($r_{p,t} = ESR_{3y,t}$), or the number of pages in Title 3 of the Code of Federal Regulations accumulated for three years ($r_{p,t} = CFR_{3y,t}$) and appear in the first column. The other results follow from that: SR is the market portfolio Sharpe ratio, λ is the market price of risk, and $r_f - \delta$ is the difference between the continuously compounded risk-free and subjective discount rates, all obtained unconditionally. The superscripts indicate their equivalents conditioned on the (previous period) level of government intervention, in which the proxies are above (h) or below (l) their medians. All values, except the Sharpe ratios and the market prices of risk, are in percentage terms. The choices of average surplus correspond to SR around 0.2 or 0.5, or λ around 0.8 or 2.

	\bar{s}_t	SR	SR^h	SR^l	λ	λ^h	λ^l	$r_f - \delta$	$r_f^h - \delta^h$	$r_f^l - \delta^l$
ESR_{3y}	33	0.21	0.16	0.24	0.65	0.75	0.56	-19	-24	-16
ESR_{3y}	8	0.51	0.44	0.55	1.45	1.69	1.23	-115	-143	-95
ESR_{3y}	25	0.27	0.22	0.31	0.82	0.95	0.70	-34	-42	-29
ESR_{3y}	3	0.73	0.66	0.76	2.03	2.35	1.73	-225	-282	-182
CFR_{3y}	43	0.20	0.27	0.07	1.02	1.34	0.54	-51	-70	-30
CFR_{3y}	16	0.51	0.67	0.12	2.81	3.83	1.05	-437	-764	-99
CFR_{3y}	50	0.16	0.22	0.05	0.82	1.07	0.45	-30	-38	-21
CFR_{3y}	22	0.39	0.52	0.11	2.08	2.80	0.88	-233	-386	-73

Table 5: Predictive regressions of the market premium based on accumulated intervention. The predictive regressions have the form

$$MP_{t+h} = \alpha_{rh} + \beta_{rh}r_{p,t} + \epsilon_{t+h},$$

where the proxy for intervention ($r_{p,t}$) is either the number of economically significant rules accumulated for three years ($r_{p,t} = ESR_{3y,t}$), or the number of pages in Title 3 of the Code of Federal Regulations accumulated for three years ($r_{p,t} = CFR_{3y,t}$). MP_{t+h} is the market premium (in %) compounded over h years, $h \in \{1, 2, 3, 4, 5\}$, starting at time t . The table reports the estimated β_{rh} coefficients of the intervention proxy in each case (next to the respective proxy, in thousands), the number of years (Obs.), and the coefficient of determination (R^2). The t statistics in parentheses has OLS standard errors and the one in brackets has Newey-West standard errors with h lags. The significance is given by the latter: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

	MP_{t+1}	MP_{t+2}	MP_{t+3}	MP_{t+4}	MP_{t+5}
$ESR_{3y,t}$	65.3 (1.37) [1.72]	144.2* (2.13) [2.23]	230.3* (3.00) [2.60]	295.7* (3.51) [2.48]	303.5* (3.14) [2.25]
Obs.	34	33	32	31	30
R^2	0.026	0.100	0.205	0.274	0.234
$CFR_{3y,t}$	9.0* (1.50) [2.53]	21.8*** (2.81) [3.89]	32.7*** (3.98) [4.47]	36.5*** (3.86) [5.30]	26.9** (2.31) [3.52]
Obs.	41	40	39	38	37
R^2	0.031	0.150	0.281	0.274	0.108

Table 6: Predictive regressions of the market premium based on the yearly number of economically significant rules, ESR, at different lags. The predictive regressions have the form

$$MP_{t+h} = \alpha_{hl} + \beta_{hl}ESR_{y,t-l} + \epsilon_{l,t+h},$$

where the proxy for intervention is the number of economically significant rules (ESR_y) in the (individual) year $t-l$, with $l \in \{0, 1, 2\}$. MP_{t+h} is the market premium (in %) compounded over h years, $h \in \{1, 2, 3, 4, 5\}$, starting in year t . The table reports the estimated β_{hl} coefficients of the proxy (in thousands) for each lag (l), the number of years (Obs.), and the coefficient of determination (R^2). The t statistics in parentheses has OLS standard errors and the one in brackets has Newey-West standard errors with h lags. The significance is given by the latter: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

	MP_{t+1}	MP_{t+2}	MP_{t+3}	MP_{t+4}	MP_{t+5}
$ESR_{y,t}$	60.1 (0.56) [0.80]	172.5 (1.07) [1.32]	335.3* (1.75) [2.17]	517.8* (2.43) [2.67]	645.7* (2.78) [2.61]
Obs.	36	35	34	33	32
R^2	-0.020	0.004	0.059	0.132	0.179
$ESR_{y,t-1}$	137.8 (1.17) [1.50]	308.6* (1.88) [2.16]	482.3** (2.57) [2.99]	612.8** (2.93) [2.96]	651.2** (2.77) [2.81]
Obs.	35	34	33	32	31
R^2	0.011	0.072	0.149	0.196	0.182
$ESR_{y,t-2}$	184.6 (1.52) [1.96]	361.7** (2.19) [2.88]	486.1** (2.54) [2.86]	522.2* (2.36) [2.54]	431.9 (1.65) [1.84]
Obs.	34	33	32	31	30
R^2	0.038	0.106	0.150	0.132	0.056

Table 7: Predictive regressions of the market premium based on the number of pages in Title 3 of the Code of Federal Regulations, CFR, at different lags. The predictive regressions have the form

$$MP_{t+h} = \alpha_{hl} + \beta_{hl}CFR_{y,t-l} + \epsilon_{l,t+h},$$

where the proxy for intervention is the number of pages in Title 3 of the Code of Federal Regulations (CFR_y) in the (individual) year $t - l$, with $l \in \{0, 1, 2\}$. MP_{t+h} is the market premium (in %) compounded over h years, $h \in \{1, 2, 3, 4, 5\}$, starting in year t . The table reports the estimated β_{hl} coefficients of the proxy (in thousands) for each lag (l), the number of years (Obs.), and the coefficient of determination (R^2). The t statistics in parentheses has OLS standard errors, and the one in brackets has Newey-West standard errors with h lags. The significance is given by the latter: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

	MP_{t+1}	MP_{t+2}	MP_{t+3}	MP_{t+4}	MP_{t+5}
$CFR_{y,t}$	0.7 (0.05) [0.04]	8.5 (0.48) [0.57]	31.8 (1.62) [1.82]	57.9* (2.76) [2.60]	59.4* (2.51) [2.31]
Obs.	43	42	41	40	39
R^2	-0.024	-0.019	0.039	0.145	0.122
$CFR_{y,t-1}$	10.5 (0.81) [1.04]	34.0** (2.02) [3.46]	60.0*** (3.36) [3.85]	61.7** (2.95) [3.53]	50.0** (2.04) [3.58]
Obs.	42	41	40	39	38
R^2	-0.008	0.072	0.209	0.168	0.079
$CFR_{y,t-2}$	24.2** (1.93) [3.27]	50.3** (3.15) [2.81]	51.7*** (2.75) [3.62]	40.1*** (1.77) [3.92]	4.5 (0.17) [0.23]
Obs.	41	40	39	38	37
R^2	0.064	0.186	0.147	0.054	-0.028

References

- Baker, Scott R., Nicholas Bloom, and Steven J. Davis, 2016, Measuring economic policy uncertainty, *Quarterly Journal of Economics* 131, 1593–1636.
- Campbell, John Y., and John H. Cochrane, 1999, By force of habit: A consumption-based explanation of aggregate stock market behavior, *Journal of Political Economy* 107, 205–251.
- Cochrane, John H., 2011, Presidential Address: Discount rates, *Journal of Finance* 66, 1047–1108.
- Cochrane, John H., 2017, Macro-finance, *Review of Finance* 21, 945–985.
- Constantinides, George M., and Darrell Duffie, 1996, Asset pricing with heterogeneous consumers, *Journal of Political Economy* 104, 219–240.
- Dawson, John W., and John J. Seater, 2013, Federal regulation and aggregate economic growth, *Journal of Economic Growth* 18, 137–177.
- Djankov, Simeon, Rafael La Porta, Florencio Lopez-de Silanes, and Andrei Shleifer, 2002, The regulation of entry, *Quarterly Journal of Economics* 117, 1–37.
- Fama, Eugene F., and Kenneth R. French, 1988, Dividend yields and expected stock returns, *Journal of Financial Economics* 22, 3–25.
- Fama, Eugene F., and Kenneth R. French, 1989, Business conditions and expected returns on stocks and bonds, *Journal of Financial Economics* 25, 23–49.
- Frederick, Shane, George Loewenstein, and Ted O’Donoghue, 2002, Time discounting and time preference: A critical review, *Journal of Economic Literature* 40, 351–401.
- Friedman, Milton, and Rose D. Friedman, 1980, *Free to choose* (London: Secker and Warburg).

- Giordano, Louis A., Warren K. Bickel, George Loewenstein, Eric A. Jacobs, Lisa Marsch, and Gary J. Badger, 2002, Mild opioid deprivation increases the degree that opioid-dependent outpatients discount delayed heroin and money, *Psychopharmacology* 163, 174–182.
- Goff, Brian, 1996, *Regulation and macroeconomic performance*, volume 21 (Springer Science & Business Media).
- Hansen, Lars P, and Ravi Jagannathan, 1991, Implications of security market data for models of dynamic economies, *Journal of Political Economy* 99, 225–262.
- Kroencke, Tim A., 2017, Asset pricing without garbage, *Journal of Finance* 72, 47–98.
- Mehra, Rajnish, and Edward C. Prescott, 1985, The equity premium: A puzzle, *Journal of Monetary Economics* 15, 145–161.
- Pastor, Lubos, and Pietro Veronesi, 2012, Uncertainty about government policy and stock prices, *Journal of Finance* 67, 1219–1264.
- Pastor, Lubos, and Pietro Veronesi, 2013, Political uncertainty and risk premia, *Journal of Financial Economics* 110, 520–545.
- Pastor, Lubos, and Pietro Veronesi, 2017, Political cycles and stock returns, Working Paper 23184, National Bureau of Economic Research.
- Savoy, Alexi, 2011, Asset pricing with garbage, *Journal of Finance* 66, 177–201.