Risky Business:

Policy Uncertainty, Firm Evaluation, and Investment

(PRELIMINARY AND INCOMPLETE)

Giacomo Brusco* and Benjamin Glass†

October 5, 2018

LATEST VERSION OF THE PAPER AVAILABLE HERE

Abstract

Forecasts of the consequences of tax changes usually assume that economic actors expect these changes are permanent, despite the inevitable political uncertainty that could lead to future reversals or further changes. This reasoning extends to when a firm's tax burden is correlated to the success of its ventures. We show how a firm's belief about how government policy is correlated with the input's marginal product distorts its risk profile, leading it to change its input decision. Generally speaking, input use will be discouraged if the firm faces high taxes precisely when the input is more productive. We show that in a world of policy uncertainty this holds under an arbitrary tax system, and in particular it holds even if inputs can be deducted from the firm's taxable income. Whenever the covariance between policy and payoff is zero, our model replicates the classical result that the deductibility of input expenses leaves the decision undistorted. We use this theoretical relationship in an empirical model of asset pricing to infer what investors believe about how future government policy correlates with their risky investments in different firms in the stock market.

1 Introduction

Analyses of the effects of tax changes often assume that these changes are permanent, or that they will unfold in a deterministic way. While this does offers insight into policy recommendations, it poses a serious

*Economics, University of Michigan at Ann Arbor

†Economics, Pennsylvania State University at University Park

problem from a positive stand-point. Since firms can observe the political process, they form expectations about future policy, which will influence their present behavior. Indeed, tax uncertainty distorts firms' incentives by affecting both the timing of their investments and the risk profile they face. While previous work has been focused on the former, this paper is concerned with the latter.

While previous work about policy uncertainty was concerned with beliefs about the distribution of future taxes, this paper has a broader concern with the joint distribution of a firm's pre-tax returns and its tax obligation. We demonstrate that agents particularly care about the covariance of future taxes with future productivity. For instance, suppose a risk-neutral investor is considering an investment that costs \$3. The investment will either pay \$10 or \$0, each with equal probability. The government taxes the revenue from this investment at a rate of either 50% or 0%, each with equal probability. The investor's expected payoff clearly depends on when she will get taxed. If the investor believes that the tax kicks in only when the investment is successful, then her expected after-tax payoff will be $\frac{1}{2}10(1-0.5)+\frac{1}{2}0(1-0) = 2.5 < 3$, and she will not undertake the investment. If, on the other hand, the investor believes that the tax applies only when the investment is unsuccessful, then her expected after-tax payoff will be $\frac{1}{2}10(1-0)+\frac{1}{2}0(1-0.5) = 5 > 3$, and she will undertake the investment. Note that in either case the marginal distributions of pre-tax payoffs and tax rates are exactly the same; what pushes the investor to invest or not invest is her belief about their correlation.

As we note in our theoretical model, what ultimately matters to a firm is the covariance between its marginal tax rate and the marginal product of its inputs. Interestingly, the same mechanism can arise when there is no uncertainty about tax policy, but the tax schedule is not linear. This point goes far back in the literature on the effects of income taxation: Domar and Musgrave (1944) pointed out that when the government does not rebate taxes on corporate losses, this creates a piecewise linear tax schedule with a kink at zero: up to zero the marginal tax rate is zero, after zero there is a positive marginal tax rate. Since the government punishes profits more than it compensates losses, this disincentivizes investment[1]. Our model generalizes this point. Whenever the tax schedule is convex, this will automatically generate a positive covariance between the marginal tax rate and productivity, which has the effect of depressing investment. Further, the same effect can arise even if the tax schedule is linear, but firms are uncertain about what the marginal tax rate will be.

This paper investigates how policy uncertainty affects the risk profile faced by firms and how this affects their choices, both theoretically and empirically. In section 2, we enter into the details of the literature on tax changes, policy uncertainty, and investment, with an eye both on how people have thought about the

[1]While the main point of Domar and Musgrave's paper was how proportional income taxation affects risk-taking by individuals, they also had a number of other points relating to how taxation interacts with uncertain payoffs.

effects of policy uncertainty in the past, and the empirical evidence they have gathered. Section 3 lays out our full theoretical model. As we mentioned, this can be done using a simple model where decisions are taken statically, though facing uncertainty. Our model can accommodate any tax schedule, and allows for any aspect of said tax schedule to change stochastically. Then, we take our theoretical observations to data in section 4. We conclude in section 5.

2 Background

Public economists have long been thinking about how the prospect of tax changes affects economic choices in general, and investment in particular. We could separate these works in two branches: one concerned with "mean effects", and another concerned with "variance effects". The question in the first branch is: how does the future *expected* level of taxation affect a firm's investment decision? In this, one should include all models that assume perfect foresight. Auerbach and Hines (1988) is an early example of papers in this branch. In a perfect foresight model, they find that anticipated tax changes carry a lot of weight in explaining firm behavior, relative to a model of myopic expectations. Other examples include Poterba (1989) and Slemrod and Greimel (1999). The first paper shows how the yield spread between taxable and tax-exempt bonds responds to changes in expected individual income tax rates by performing event studies around the time of unexpected tax changes. The second goes a step further, and proxies changes in expectations with the odds of Steve Forbes winning the presidency in 1996[2], finding some evidence for a possible causal relationship. Rodrik (1991) also discusses how expectations of future policy interact with current decisions. He makes the point that in order for economic reform to have its desired impact, investors must believe it to be persistent. He models uncertainty as a probability of policy reversal, and shows that if previous policy and the reform are distant enough, even a small probability of reversal can act as a hefty tax on investment.

The second branch of this literature is concerned not only with the effects of changes in expectations, but also (and particularly) with the effects of uncertainty itself. While the common view on the topic is that policy uncertainty deters investment, early models of investment under uncertainty, such as Hartman (1972) and Abel (1983), show that, in fact, the optimal capital stock should actually increase in the face of uncertainty about output price. Pindyck (1988) makes the point that these results rely heavily on the assumption of *reversibility* of the investment. Hassett and Metcalf (1999) make a similar point in the context of uncertainty regarding investment tax credits: uncertainty affects the *timing* of investment. We may also include Skinner (1988), who notes that net-of-tax income may become less uncertain if the income tax rate is positively correlated with pre-tax income. In his model, unlike we do in ours, he is thinking about the

[2] Steve Forbes was an outspoken advocate of a "flat-tax" that would have erased the differential tax treatment.

welfare effects of income uncertainty for risk-averse agents.

More recent literature has found similar theoretical insights. When investment is (partially or fully) irreversible, uncertainty has the effect of delaying investment. Bloom (2009) makes this point in a model where firms face costly adjustments both for capital and labor decisions. He shows that if one assumes an (s, S) solution to the firm's optimal investment and hiring policy, a mean-preserving spread in the distribution of taxation results in an increased area of inactivity for the firm.

Whereas these two branches of the literature focus on the mean and variance of future policy, this paper focuses on the covariance between tax rates and productivity. We are unaware of any previous literature that considers the impact of this covariance. The paper that comes closest to discussing the mechanism we illustrate here may be Domar and Musgrave (1944). They discuss tax regimes that are non-linear functions of profit. We generalize their results in a way that allows us to consider cases where the tax schedule is itself uncertain, which they explicitly exclude.

To understand why it is so important to think about how policy uncertainty affects economic decisions, one should first realize that this represents a very concrete problem to all agents in an economy. To discipline thinking, let us try to think about *why* agents face uncertainty about policy. One reason might be that governments decide to condition their policies on uncertain states of the world. For instance, governments might decide to enact different policies during booms and recessions; if agents are uncertain about when booms and recessions will begin and end, then they will also be uncertain about economic policy. Further, this would automatically generate a non-zero covariance between uncertain fundamentals that affect firm profitability and policy. Another reason why policy uncertainty might arise is that the political processes can be inherently uncertain. In the absence of median-voter theorem type results, which fail, for example, whenever policy is more than one-dimensional, different candidates will run on different platforms. If all candidates are running to win, the outcome of the election will be inherently uncertain. Indeed, one could easily imagine a world where the ultimate outcome of the election depends on some underlying state of the world, unobservable to politicians, that also affects the productivity of firms; if people are more optimistic, say, they will consume more and increase firms profits, and vote for candidate A; if people are more pessimistic, they will consume less and decrease firm profits, and vote for candidate B.

At the root of this second source of policy uncertainty lies the inability of governments to commit. If governments could at any point tie the hands of all future governments to enact a certain policy, then the only possible source of uncertainty would arise from the government conditioning their policy on underlying fundamentals. But, as a matter of fact, governments have at best an imperfect ability to commit. Persson and Tabellini (1999) review many examples of political economy games where equilibria can change radically depending on whether the government has access to a commitment technology. Early analyses of optimal capital income taxation, such as Chamley (1986) and Judd (1985), all mention, almost offhand, that if lump-sum taxation were available, then the optimal policy would be to have a lump-sum levy on all wealth existing in period 0, leaving untouched the product of future investment. But such a policy would only be optimal in an environment where the government can credibly commit to never raising a capital levy again. Kehoe (1989) takes this a step further, and shows that in fact the ability of governments to commit to cooperating with other governments is not necessarily optimal for society, even in a world where all governments are benevolent. While in this paper we focus on the problem from the point of view of the firm, it would be complementary to our analysis to think about a government engaged in a game with firms might optimally decide to promise one thing and then do another when a certain state of the world is realized, or might decide to play a mixed strategy in equilibrium, leaving firms guessing as to the action it will actually take.

Our empirical work looks at how the stock market return on different firms, whose profitability is correlated in different ways with tax policy, varies upon a policy uncertainty shock. We decide to take this route rather than directly assessing the impact of policy uncertainty on investment for three reasons. First, as we explain in section 3, the mechanism linking the covariance of productivity and policy to the investment decision is exactly the same mechanism linking that covariance to firm profits. Third, our mechanism relates to policy and uncertainty shocks that are ex-ante uncertain to firms. In this sense we differ a lot from previous literature regarding productivity, which tends to treat it as an observable parameter, or at least a parameter known to firms or private individuals. As a result, we do not find it sufficient to look at how firms react to *realizations* of these uncertain parameters, because our theory has to do with their ex-ante *belief*, not with what will ultimately realize. Short of ripping people's heads open to observe their beliefs, the next best thing we can do is to look at scenarios, like stock markets, where expectations about future profitability are instantaneously incorporated into observable prices.

Our empirical strategy is indebted to papers that use stock market evaluations to infer the effects of policy, such as Cutler (1988), or Friedman (2009), besides the aforementioned Poterba (1989) and Slemrod and Greimel (1999). Baker, Bloom, and Davis (2016) develop an index of policy uncertainty based on newspaper coverage, the number of expiring tax provisions, and disagreement amongst forecasters, which will be prominent in the empirical investigations of this paper. They show that policy uncertainty tends to be correlated, among other things, to decreases in stock market returns. While Baker, Bloom and Davis (2016) take a more "reduced-form" approach, Handley and Limão (2017) have a more structural bend. In the context of trade policy, they develop a structural model, and estimate it around China's 2001 WTO accession, which drastically reduced uncertainty regarding trade policy between China and the U.S. This allows them to estimate key trade policy uncertainty parameters, which they then use to run counter-factuals. While this is an interesting approach to consider for the literature going forward, we preferred to use Baker, Bloom, and Davis's index, which seemed more related to the sort of mechanism we have in mind, and which gave us more freedom in choosing how to empirically illustrate our theoretical insight.

3 Framework

Expectations about future policy will influence decisions of firms in the present by distorting the distribution of their after-tax returns. As we have seen in section 2, this can happen in several ways: through changes in the first moment of policy, through changes in the second moment of policy, or through changes in the mixed moment between policy and other stochastic determinants of profitability. In this section we focus on this last mechanism. The model presented here, however, can also be interpreted to study first-moment effects, and we are actively working on extensions that would allow us to incorporate second-moment effects, by adding adjustment costs. Having a fuller picture might help us to see how all these different ways in which policy uncertainty affects firm profits act, both in isolation and in concert with each other.

We start with a model of uncertainty in a simple cash-flow tax. A firm has to decide on its scale of operations, facing a certain rate of deduction today, but an uncertain tax rate on tomorrow's revenue, as well as uncertain revenue. This example is particularly informative because it shows how our mechanism can arise from policy uncertainty in an environment that would otherwise leave the firm's decision undistorted. However, we want to stress that this point holds very broadly, and under several definitions of policy uncertainty. Similarly to the set-up in Rodrik (1991), one can effectively think of "tax collected" as any policy provision that reduces (or enhances) the profitability of investment, as long as government policy depends in any way on an (uncertain) final output. As we show later in this section, our point holds under a largely arbitrary tax system, and the flexibility in our definition of what constitutes a "tax" is reflected in the flexibility of our theoretical framework.

Suppose that an agent had to pick how much to invest, x, in a risky project, which will produce an uncertain amount $\epsilon f(x)$, where $f(x)$ is a known, strictly increasing, and strictly concave function, while ϵ is stochastic. The agents fortunes unfold in two periods: in the first period, the agent decides how much to invest, and gets to deduct expenses, x, against the current tax rate, τ_0; in the second period, the agent's revenue is realized, $\epsilon f(x)$, and it is taxed at rate τ_1. Assuming for simplicity that all prices are equal to unity, and that the agent values equally profits in both periods, we can write down her problem as:

$$max_x \mathbb{E}\Big[(1-\tau_1)\epsilon f(x) - (1-\tau_0)x\Big]. \tag{1}$$

Let us start with the case where τ_0 and τ_1 are both known. Letting x^* be the argmax to the problem in equation 1, the firm's expected profits are:

$$\begin{aligned}\bar{\Pi} &= \mathbb{E}\Big[(1-\tau_1)\epsilon f(x^*) - (1-\tau_0)x^*\Big] \\ &= (1-\tau_1)\bar{\epsilon}f(x^*) - (1-\tau_0)x^* \\ &\equiv \Pi(\tau_0, \tau_1, \bar{\epsilon}, x^*) \end{aligned} \tag{2}$$

where $\bar{\epsilon} = \mathbb{E}[\epsilon]$. Thus, in a world were tax policy is known ex-ante, the two tax rates τ_0 and τ_1 simply reduce (or increase) the firm's costs and revenue, respectively. If $\tau_0 = \tau_1 = \tau$, then an increase in the tax rate simply scales down expected profits proportionally. Note that in this last case the firm's choice of inputs remains undistorted relative to the case of no taxes. In general, the firm's optimal choice of investment will be

$$x^* = \frac{1-\tau_0}{(1-\tau_1)\bar{\epsilon}}.$$

If $\tau_0 = \tau_1$, then the firm will pick $x^* = 1/\bar{\epsilon}$, or the efficient choice it would have made had all tax rates been identically zero.

Now let us suppose that while τ_0, the current tax rate, is known, τ_1, the future tax rate, is not. The key insight here is that now the firm will care not about the marginal distributions of ϵ and τ_1 respectively, but about their *joint* distributions. Expected profits are now:

$$\begin{aligned}\bar{\Pi} &= \mathbb{E}\Big[(1-\tau_1)\epsilon f(x^*) - (1-\tau_0)x^*\Big] \\ &= \mathbb{E}[(1-\tau_1)\epsilon]f(x^*)(1-\tau_0)x^* \\ &= \Pi(\tau_0, \bar{\tau}_1, \bar{\epsilon}, x^*) - f(x^*)\rho\sigma_{\tau_1}\sigma_\epsilon, \end{aligned} \tag{3}$$

where $\bar{\tau}_1 = \mathbb{E}[\tau_1]$, $\rho = corr(\tau_1, \epsilon)$, $\sigma_{\tau_1} = \sqrt{Var(\tau_1)}$, and $\sigma_\epsilon = \sqrt{Var(\epsilon)}$. As we can see, the tax still has the same proportional effect on expected revenues and costs as in 2, but with the addition of a new term involving the covariance between tomorrow's tax rate and productivity. For given expected tax rate $\bar{\tau}_1$, an increase in the variance $\sigma^2_{\tau_1}$ will reduce profits when ρ is positive, and will increase them when ρ is negative.

More formally, by the Envelope Theorem, since the derivative of expected profit with respect to investment is zero, we have that if we marginally change σ_{τ_1} holding $(\tau_0, \bar{\tau}_1, \bar{\epsilon}, \rho, \sigma_\epsilon)$ constant,[3] we obtain:

$$\frac{\partial \bar{\Pi}}{\partial \sigma_\tau} = -f(x^*)\rho\sigma_\epsilon \tag{4}$$

Thus, when ρ is positive (negative), we should see that higher policy uncertainty, in the form of a higher σ_{τ_1}, decreases (increases) expected profits. This reasoning lies at the foundation of our empirical work. If the firm's stock market evaluation is given by its expected future stream of profits, it follows that unexpected increases in policy uncertainty should be associated with an increased evaluation if $\rho < 0$, and a decreased evaluation if $\rho > 0$.

This same mechanism is reflected in the choice of investment. Under a stochastic second-period tax rate, the optimal choice of investment is:

$$x^* = (f')^{-1}\left(\frac{1-\tau_0}{\bar{\epsilon}(1-\bar{\tau}_1) - \rho\sigma_{\tau_1}\sigma_\epsilon}\right). \tag{5}$$

If the tax rate and productivity were independent, so that $\rho = 0$, then one could induce the same efficient choice that the firm would make when all taxes are identically zero by setting $\tau_0 = \bar{\tau}_1$, similarly as in the case where all taxes are known ex-ante. However, if $\rho \neq 0$, then one should adjust the rate of first-period input deductibility to reflect this fact: $\tau_0 = \bar{\tau}_1 + \rho\sigma_{\tau_1}\sigma_\epsilon/\bar{\epsilon}$. Thus, if the tax rate is positively correlated with productivity, the firm will need to be compensated for input expenses *more* than the expected tax rate it will face on revenues. If instead the tax rate is negatively correlated with productivity the opposite will be true, since the firm knows that the tax rate will tend to be lower than average in states of the world where the investment reveals to be more productive. When the covariance is positive (negative), the firm will face a lower (higher) expected profit, the covariance acts as a tax (subsidy), and so the firm is less (more) willing to invest.

As noted in the introduction, this reasoning extends beyond political uncertainty about future policy. Whenever a tax system is progressive,[4] marginal tax rates will automatically increase whenever a business venture is more successful, thereby inducing positive correlation between the tax rate and the productivity of inputs. In this case, an equal increase of tax rates at all corporate income levels would discourage input use. Conversely, if the tax system was regressive, an equal increase of tax rates at all corporate income levels

[3] It might be unclear what we mean by changing a standard deviation while holding other parameters of the joint distribution constant. More formally, one can write $\tau_1 = \bar{\tau}_1 + z$, where z is a random variable with mean zero and variance σ_τ^2. Then we could perform a transformation by scaling z by some constant $c > 0$, $\tau = \bar{\tau} + cz$, which would increase the variance of τ and the covariance of τ and ϵ while leaving the mean tax and the correlation coefficient the same. In that case, equation 4 states the partial derivative of expected profit with respect to c when $\sigma_\tau = 1$.

[4] As, e.g., the federal corporate tax system used to be in the U.S. before the Tax Cuts and Jobs Act of December 2017, and as it currently is in many U.S. states.

would encourage input use.[5] To clarify ideas, let us consider a more general model.

A firm has to decide how much to invest, x, on a risky project. Pre-tax profits are:

$$\pi(x,\epsilon) = \epsilon f(x) - x,$$

where ϵ is an ex-ante uncertain Hicks-neutral productivity shock. The firm faces a tax $T(\epsilon f(x), x, \epsilon)$, and can vary depending on realized revenue $\epsilon f(x)$, as well as input costs x, and the underlying productivity realization ϵ. The firm takes the decision before ϵ is realized, to maximize expected after-tax profits:

$$max_x \mathbb{E}[\pi(x,\epsilon) - T(\epsilon f(x), x, \epsilon)]. \tag{6}$$

Again letting x^* denote the optimal choice of investment, and then taking a first-order Taylor expansion of $T(\cdot)$ in its first argument, we obtain that expected profits are now:

$$\bar{\Pi} \approx \pi(x^*, \bar{\epsilon}) - \bar{T}(x^*) - f(x^*)C(x^*), \tag{7}$$

where $\bar{T}(x) = \mathbb{E}[T(\bar{\epsilon} f(x), x, \epsilon)]$, and $C(x) = cov(T_1(\epsilon f(x), x, \epsilon), \epsilon)$. For the sake of clarity, let us specify that we use subscripts on $T(\cdot)$ to indicate the argument with respect to which we are taking partial derivatives; thus T_1 indicates the partial derivative of $T(\cdot)$ with respect to its first argument. Again, we see a similar reasoning as in equation 3.

Once again, we have similar implications for investment. Taking the FOC of the problem in equation 6 gives us:

$$f'(x)\left[\bar{\epsilon} - \bar{T}_1(x)\bar{\epsilon} - C(x)\right] = 1 + \bar{T}_2(x)$$

Where $\bar{T}_1(x) = \mathbb{E}[T_1(\epsilon f(x), x, \epsilon)]$ is the expected marginal tax (or subsidy) on revenue, and $\bar{T}_2 = \mathbb{E}[T_2(\epsilon f(x), x, \epsilon)]$ is the expected marginal tax discount (or penalty) given for input use. All expectations are, of course, taken conditional on investment, as that is the control variable in the firm's problem. The firm's optimal choice of investment is now:

$$x^* = (f')^{-1}\left(\frac{1 + \bar{T}_2(x^*)}{\bar{\epsilon}(1 - \bar{T}_1(x^*)) - C(x^*))}\right). \tag{8}$$

[5] While this point is a natural implication of our model, the observation originates in Domar and Musgrave (1944). However, they do not consider uncertain tax rates.

Note that when there is no productivity uncertainty, or if productivity uncertainty is uncorrelated with the marginal tax rate, then $C(x) = 0$ for any choice of x, so that equation 8 yields $x^* = f'^{-1}(1+\bar{T}_2(x)/\bar{\epsilon}(1-\bar{T}_1(x)))$. Again, we have that firms are allowed to deduct expenses at the same marginal rate as they are taxed on revenue (that is, $T_1(\epsilon f(x), x, \epsilon) = -T_2(\epsilon f(x), x, \epsilon)$ for all (x, ϵ)), the firm will make the efficient choice that it would make in the absence of taxation. This echoes the long standing result that taxing profits does not distort firm decisions. However, in our case, as the covariance between the marginal tax rate and the productivity of investment becomes larger, since $f'^{-1}(\cdot)$ is a decreasing function, optimal investment declines.

There are two noteworthy cases in which the covariance of marginal tax rates and productivity distorts investment. The first, more well known case is where the tax revenue function $T(\cdot)$ is known ex-ante, so that it does not depend on ϵ conditional on realized profit, $T(\epsilon f(x), x, \epsilon) = T(\pi(x, \epsilon))$. In this case, the covariance may be non-zero because the tax revenue function T is non-linear, and so the marginal tax rate is not constant. This relates to a classic point originally made by Domar and Musgrave in 1944. When the government has a constant tax rate on positive firm profits, but does not remit payment to firms that realize net negative profit, then it is discouraging investment whenever firms fear they could make negative profit upon a sufficiently poor productivity realization. More generally, if $T(\cdot)$ is a convex function of profits, and if there is any uncertainty in ϵ, then $cov(T'(\pi(x, \epsilon))\epsilon)$ must be positive for any positive value of x.[6]

The less studied case where the covariance of the firm's marginal tax rate and its productivity comes into play is one where the tax rate is both uncertain and correlated with productivity. This is precisely the sort of case we consider at the beginning of the section. That example, although it presents an unrealistic tax system, gives us two important insights. First, policy uncertainty might affect firms in a way that we haven't really contemplated in the past, by distorting the risk profile they face with their investments. Even though there is no "timing" of the decision to speak of, as all decisions in the model are taken *before* the uncertainty is realized, firms change their decisions in the face of policy uncertainty whenever they believe that policy correlates with the pre-tax productivity of their investment. It should be noted, however, that by adopting a static model we are implicitly assuming complete irreversibility of investment. "Partial" irreversibility can be obtained by adding adjustment costs, say $\frac{1}{2}\xi(x - x(\tau, \epsilon))^2$ for some $\xi > 0$, which would preserve our main results[7]. Second, how firms react to uncertainty shocks in the tax depends on how their productivity is correlated with said tax. By observing how firms (or their expected profits) react to policy uncertainty shocks, then, we should be able to infer how their productivity is correlated to policy. This observation is at the foundation of our empirical application, which we dive into next.

[6] To be more precise, $C(x) \geq 0$, with strict equality assured if $T(\pi)$ is strictly convex.
[7] More formal results on this on their way.

4 Empirics: a CAPM Approach to Policy Uncertainty

As we mention in section 3 our empirical methodology looks at stock market prices, which are tied to the expected profitability of a firm. As we have seen in our theoretical model, the expected profits of a firm will react differently to policy uncertainty shocks depending on how they are correlated with firm productivity. While all of our work so far has presumed a neutral attitude to risk, the distortion of the risk profile of investment will affect risk-loving or risk-averse agents, too. As the foundation of our empirical strategy is a capital asset pricing model that presumes agents are averse to risk, we formally develop a finance model in section 4.1. Section 4.2 takes a more practical look at the data and methodology we use. Finally, we present preliminary results and discuss future work in section 4.3.

4.1 An ICAPM Model of Policy Uncertainty

Consider the problem of $h = 1, \ldots, H$ infinitely lived agents who, every period, have to decide how much of their wealth W_{ht} to consume, c_{ht}, which gives them utility $u_h(c_{ht})$, and what share of their saved wealth to invest, $\pi_{ht} = [\pi_{h1t}, \ldots, \pi_{hNt}]$, on N assets. Investment opportunities depend on market risk, as well as policy risk, denoted by state variable P_t. Here we are going to treat P_t as a scalar representing the variance of a policy variable, but one could easily obtain the same results thinking of P_t as a vector of moments for the same variable. P_t is assumed to move according to a first-order Markov process. The Bellman equation for an individual agent is:

$$V_{ht}(P_t, W_{ht}) = max_{c_{ht},\pi_{ht}} \Big[u_h(c_{ht}) + \delta_h \mathbb{E}_t[V_{h,t+1}(P_{t+1}, (W_{ht} - c_{ht})\pi'_{ht} R_{t+1})] \Big| \mathbf{1}'\pi_{ht} = 1 \Big], \tag{9}$$

where subscript t indicates expectations taken conditional on information available at time t, for some discount factor $\delta_h \in (0, 1)$. As in Back (2010) (p. 194-195), the envelope condition and the fact that the ratio of marginal utilities is a one-period Stochastic Discount Factor, we have that

$$Z_{h,t+1} = \delta_h \frac{\partial V_{h,t+1}(P_{t+1}, W_{h,t+1})/\partial W_{h,t+1}}{\partial V_{h,t}(P_t, W_{h,t})/\partial W_{h,t}} \tag{10}$$

$$\equiv \frac{\delta_h V_{hw}(P_{t+1}, W_{h,t+1})}{V_{hw}(P_t, W_{h,t})} \tag{11}$$

Since $Z_{h,t+1}$ is a one-period SDF, we have that, by definition, for any pair (i, t):

$$\mathbb{E}_t[Z_{h,t+1}R_{i,t+1}] = 1. \tag{12}$$

When appropriately manipulated, this produces the relation

$$\mathbb{E}_t[R_{i,t+1}] = \frac{1}{\mathbb{E}_t[Z_{h,t+1}]} - \frac{1}{\mathbb{E}_t[Z_{h,t+1}]} cov_t(R_{i,t+1}, Z_{h,t+1}). \tag{13}$$

Taking a first order Taylor approximation of $V_{hw}(P_{t+1}, W_{h,t+1})$ around $(P_t, W_{h,t})$, and adding over all households, we obtain our (approximate) CAPM equation:

$$\mathbb{E}_t[R_{i,t+1}] \approx \zeta_t + \alpha_t cov_t(\Delta W_{t+1}, R_{i,t+1}) + \eta_t cov_t(\Delta P_{t+1}, R_{i,t+1}), \tag{14}$$

where,

$$\zeta_t = \alpha_t \sum_h \frac{-V_{hw}}{\delta_h V_{hww}}, \tag{15}$$

$$\eta_t = \alpha_t \sum_h \frac{V_{hwp}}{V_{hww}}, \tag{16}$$

$$\begin{aligned} \alpha_t &= \mathbb{E}_t\left[\sum_h \frac{-V_{hw}(P_{t+1}, W_{h,t+1})}{V_{hww}}\right]^{-1} \\ &\approx \sum_h \frac{V_{hw}}{V_{hww}}, \end{aligned} \tag{17}$$

where the argument of $V(\cdot)$ is $(P_t, W_{h,t})$ unless otherwise noted, and the last approximate equality holds as long as $\mathbb{E}_t[\Delta W_{t+1}] \approx 0$ and $\mathbb{E}_t[\Delta P_{t+1}] \approx 0$.

4.2 Data and Empirical Strategy

Our data comes from three different sources. First, we use Baker, Bloom and Davis's (2016) Economic Policy Uncertainty (EPU) index, which forms an index of policy uncertainty based on:

1. Newspaper coverage from 10 major newspapers containing policy-related words;

2. How many federal tax code provisions are set to expire in the next 10 years;

3. Dispersion in the forecasts of the CPI, federal expenditures, and state and local expenditures by individual forecasters in the Federal Reserve Bank of Philadelphia's Survey of Professional Forecasters.

The EPU index varies monthly and is available for over 30 years, from 1985 onwards. We might also be interested in data on government expenditure in proportion to GDP, which Baker, Bloom and Davis (2016) sometimes use in their regressions as a control for the first moment of government policy. Second, we use monthly returns from CRSP on the stock of publicly traded firms between 1985 and 2014. Third, we match these financial data with Compustat quarterly data about firm fundamentals, namely market capitalization, book value, sector, and foreign income. We restrict attention to firms for which data is available throughout our sample period, which runs from 1985 to 2014.

Conceptually, the data set consists of a set of monthly returns for $i = 1, \ldots, N$ assets over $t = 1, \ldots, T$ periods. Our method is heavily inspired by Fama and French (1993) and their (and others') subsequent work on empirical models of asset pricing. Our empirical model makes use of the Fama-French framework and adds another state variable, policy uncertainty. The idea here is that policy uncertainty poses a separate source of systemic risk which is not necessarily priced into the returns on the market portfolio. The idea here is that if we were looking at *all* savings opportunities of agents we would find a "naked" CAPM to hold, but since we are looking only at a subset of assets there will be other state variables of interest. We think of policy uncertainty as a state variable which in part governs what investment opportunities are available. We give a more formal derivation of an intertemporal-CAPM model in which policy uncertainty pops up as a state variable in a CAPM-style equation in section 4.1.

Our empirical model is:

$$\mathbb{E}[R_{it} - R_{ft}] = \beta_{im}\mathbb{E}[R_{mt} - R_{ft}] + \beta_{is}\mathbb{E}[SMB_t] + \beta_{ih}\mathbb{E}[HML_t] + \beta_{ip}\mathbb{E}[EPU_t], \tag{18}$$

where R_{it} is the return on portfolio i in period t; R_{ft} is the risk-free rate of return; SMB_t (Small Minus Big) and HML_t (High Minus Low) are the difference in returns between diversified portofolios of small and big firms (in terms of their market capitalization) and between diversified portfolios of high- and low-BE/ME ratio firms (Book Evaluation/Market Evaluation)[8]; EPU_t is the EPU index; and the β's are coefficients on the OLS regressions of $(R_{it} - R_{ft})$ on $(R_{mt} - R_{ft})$, SMB_t, HML_t, EPU_t. Because firm fundamentals like total assets (used to compute market value and book value) are only available quarterly, quarters are our basic time unit here. This prompts us to estimate the following equation:

[8]These factors are the ones used in Fama and French (1993) and many subsequent pieces that have been found to work particularly well.

$$R_{it} - R_{ft} = \alpha_i + \beta_{im}(R_{mt} - R_{ft}) + \beta_{is}SMB_t + \beta_{ih}HML_t + \beta_{ip}EPU_t + u_{it}, \tag{19}$$

where u_{it} is a mean-zero i.i.d. error term.

While our methodology is heavily inspired by the financial literature on empirical tests of CAPM models, our intent is not to re-invent the CAPM. As a result, we find it of interest to run a "naked" version of the CAPM without SMB or HML, as well. This allows us to get a slightly bigger sample size[9], as well as to run the regression monthly. Our second regression estimates:

$$R_{it} - R_{ft} = \alpha_i + \beta_{im}(R_{mt} - R_{ft}) + \beta_{ip}EPU_t + u_{it}. \tag{20}$$

What we are ultimately interested in are the coefficients on EPU_t, for two reasons. First, we are interested in documenting which kinds of firm returns tend to do better or worse when policy uncertainty increases. As showcased in section 3, this should tell us about how their own productivity is correlated with policy. To study this, we cut the sample according to three different classification: by sector, by multinational status[10], and size (as measured by market capitalization). Second, finding significant coefficients on EPU_t would be a weak test that our mechanism is at work. Of course, we cannot rule out other confounding factors that might be correlated with policy uncertainty. However, finding that all stocks do not vary at all with changes in EPU_t would tell us that our mechanism is *not* at work, which, perhaps, would be interesting in its own right.

4.2.1 Identifying Assumptions

It should be noted that we are making several assumptions here. First, we are assuming that there is one (correct) distribution of all economic and policy-related parameters, a belief shared by all agents in the economy. As a result of this, the changes in the volatility of policy shocks are assumed to be identical for savers operating in financial markets as they are for firm owners deciding on input use.

Second, we are effectively assuming that the correlation between policy and productivity does not change for any specific firm during the entire sample period. We see how this might be a problematic assumption that, as beliefs about the variance of policy are changing, beliefs about the correlation between policy and productivity are held constant. However, this might not be as crazy as it sounds if one buys that said

[9] Specifically, we use 690 firms rather than the 556 used in the Fama-French CAPM.

[10] More specifically, a dummy for whether the firm has positive foreign income.

Test	Naked CAPM	Fama-French CAPM
All sectors identical	< 0.001	< 0.001
Local = Multinational	0.1415	0.1565
Small = Big	0.9625	< 0.001
All sectors identical (oil)	0.0406	< 0.001
All sectors identical (health)	< 0.001	< 0.001
All sectors identical (reduced)	< 0.001	< 0.001

Table 1: Tests of the null hypothesis that all β's are equal to each other in several specifications.

correlation is determined by fundamental relations between the government and a given sector, whereas policy uncertainty is driven by more ephemeral swings in public opinion or current events.

One way we are thinking to address these concerns about this is to allow for ρ to change across different, say, three year periods. Of course, we are also holding other aspects of policy constant over the sample period. If, say, swings in policy uncertainty were to be correlated with swings in one particular direction of"mean" government policy, this would obfuscate our empirical results.

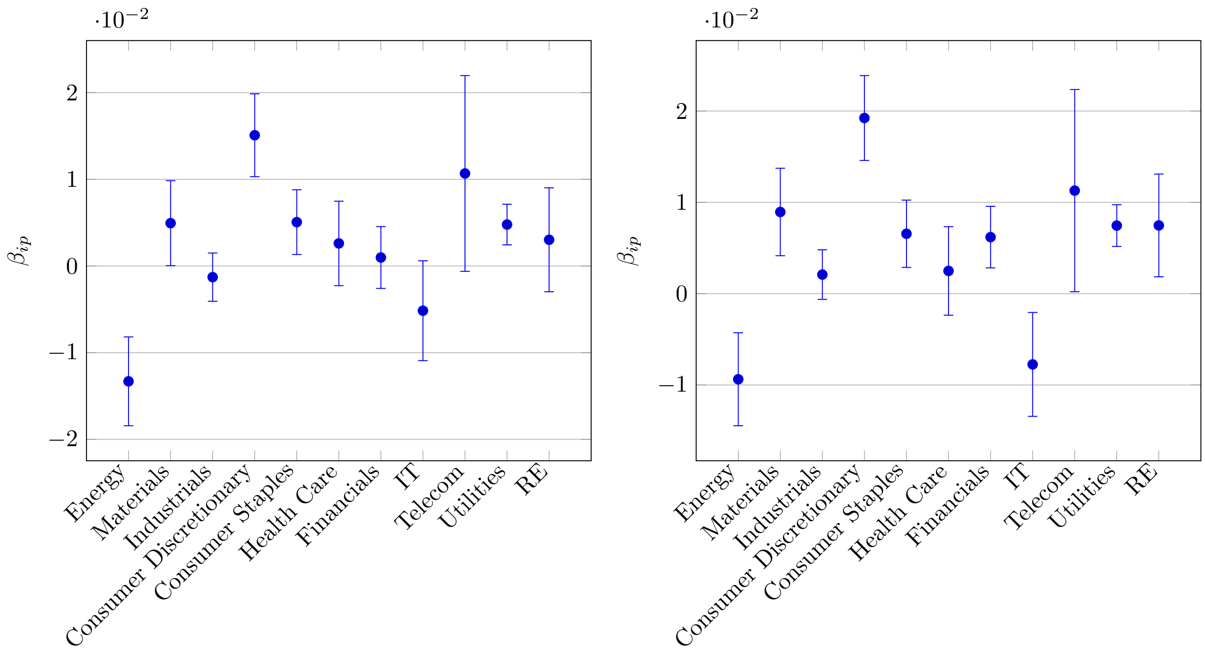
4.3 Results

As we mention in section 4.2, one of our main interests is in looking at how policy uncertainty β's vary by three classifications: by sector, by multinational status, and by size. In order to interpret these results, it might be useful to know that the standard deviation of EPU over our sample period was 32.6. Policy uncertainty jumps after big, unexpected events. For instance, after the 9/11 attacks the EPU index increased by 103.77[11]; after the 2016 election, it increased by 76.86[12]. Figure 10 in the data appendix graphs the EPU index during our sample period.

We can reject the null hypothesis that all individual firm β's are zero with more than 99.9% confidence. In all the categorizations below, we can also always reject the null hypothesis that all category-level β's are zero, again with confidence higher than 99.9%. We can also usually reject the null hypothesis that all β's are equal to each other. More details about this are provided in Table 1.

Figure 1 reports sector-level policy beta's for both models. Interestingly, it appears that three sectors in particular tend to have higher returns in periods of high policy uncertainty, indicating their productivity is negatively correlated with policies harming their profits: Consumer Discretionary, which includes products like cars, other durables, and services; Consumer Staples, which includes food, beverages and tobacco, and household products; and Utilities, which includes electric and gas utilities, as well as renewable electricity producers. On the other hand, the energy sector, composed mostly of oil and gas manufacturers, tends to

[11]From 84.29 in August 2001, to 188.06 in September 2001.
[12]From 92.52 in October 2016 to 169.39 in November 2016.



(a) Naked CAPM

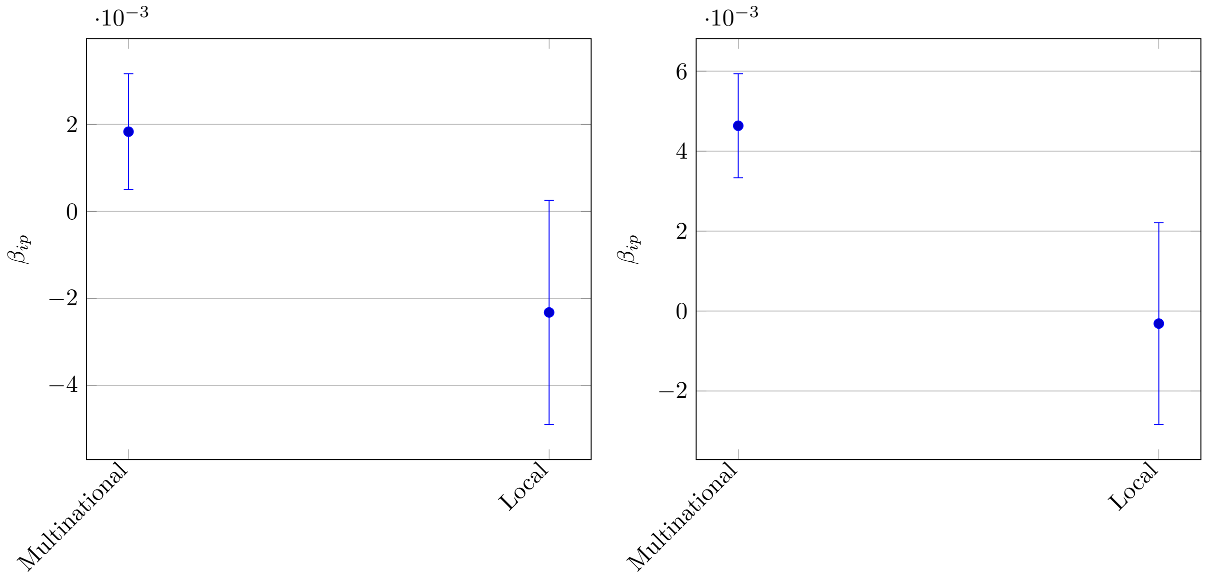
(b) Fama-French CAPM

Figure 1: Mean β_{ip}'s by sector (95% CI)

have lower returns in periods of high policy uncertainty, indicating that policies that decrease their profits tend to be implemented during periods that would otherwise be very advantageous for them.

Figure 2 illustrates results for the classification by multinational status. For both the naked and the Fama-French CAPM we cannot reject the null that the effect is the same for multinational and domestic companies. For the naked CAPM, the p-value for the test that the effect is the same is 0.1415, while for the Fama-French CAPM it is 0.1565. It should be noted that firms classified as "multinationals" here are the ones that had any foreign income in a given year. Given the heavy selection of "successfull" firms into our sample, the vast majority of our observations – over 90% – is constituted by multinational companies. While our estimates here are mostly statistically insignificant, they do go in the direction that one would expect, with policy uncertainty in the U.S. being generally worse for companies that earn all of their income domestically.

Finally, figure 3 represents mean beta's for small and big firms. "Small" here means a firm was in the smallest quintile of market capitalizations for a given year, while "big" means they were in the highest quintile. While we can reject the null hypothesis that EPU is uncorrelated with firms of all sizes with very high confidence ($> 99.9\%$), we cannot always reject the hypothesis that the result is identical for small and big firms. While in the naked CAPM the p-value for the test that small and big firms have the same average β's is 0.9625, we can reject the null with very high confidence in the Fama-French model. This makes sense



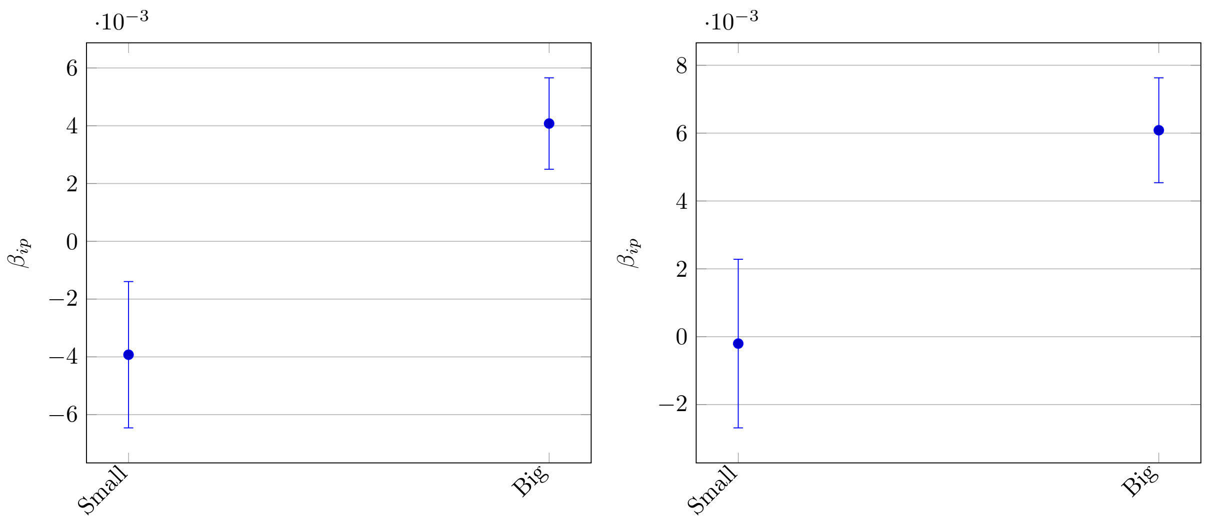
(a) Naked CAPM

(b) Fama-French CAPM

Figure 2: Mean β_{ip}'s by multinational status (95% CI). A company is classified as a "multinational" whenever it has positive foreign income.

given that in the Fama-French CAPM equation we are already accounting for other common risk factors that arise from size differences, which might be confounding results in the naked CAPM. In the Fama-French specification, we can see that the returns of big firms tend to benefit from policy uncertainty, whereas the returns of small firms tend to suffer. This is consistent with our prior that big firms can pull more weight politically to obtain a policy environment that is more favourable to them.

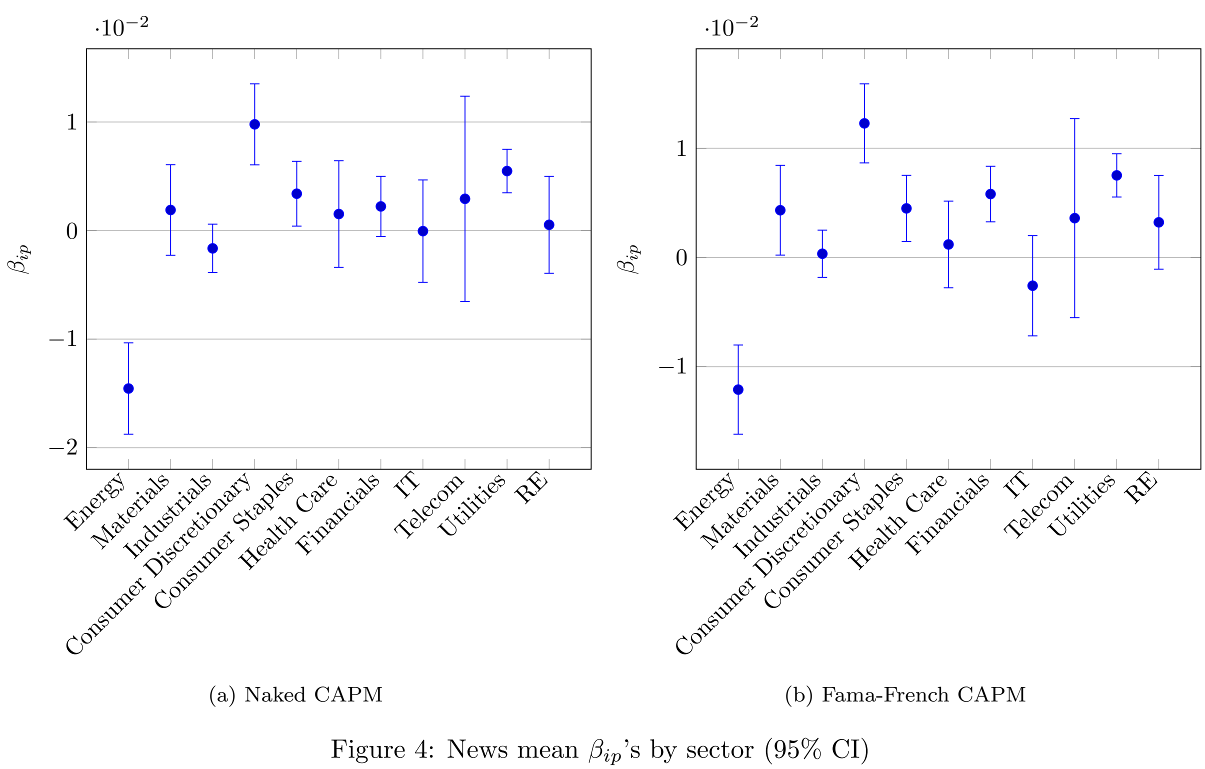
Figure 2 illustrates results for the classification by multinational status. For both the naked and the Fama-French CAPM we cannot reject the null that the effect is the same for multinational and domestic companies. For the naked CAPM, the p-value for the test that the effect is the same is 0.1415, while for the Fama-French CAPM it is 0.1565. It should be noted that firms classified as "multinationals" here are the ones that had any foreign income in a given year. Given the heavy selection of "successfull" firms into our sample, the vast majority of our observations – over 90% – is constituted by multinational companies. While our estimates here are mostly statistically insignificant, they do go in the direction that one would expect, with policy uncertainty in the U.S. being generally worse for companies that earn all of their income domestically.



(a) Naked CAPM

(b) Fama-French CAPM

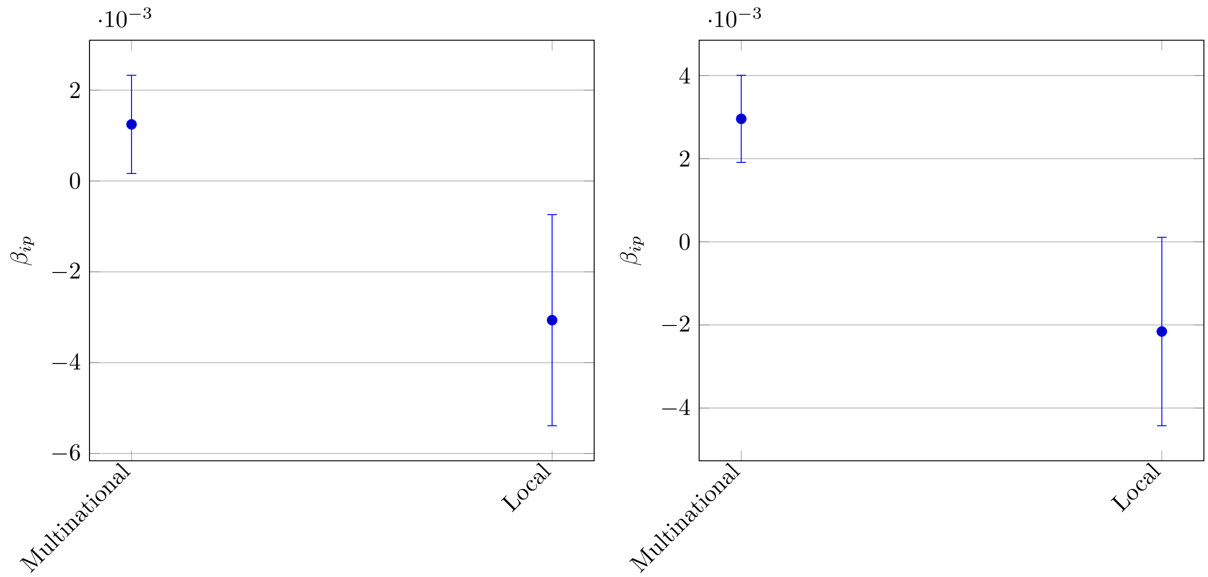
Figure 3: Mean β_{ip}'s by size (95% CI). "Small" means in the lowest quintile of market cap, "big" means in the highest quintile.



(a) Naked CAPM

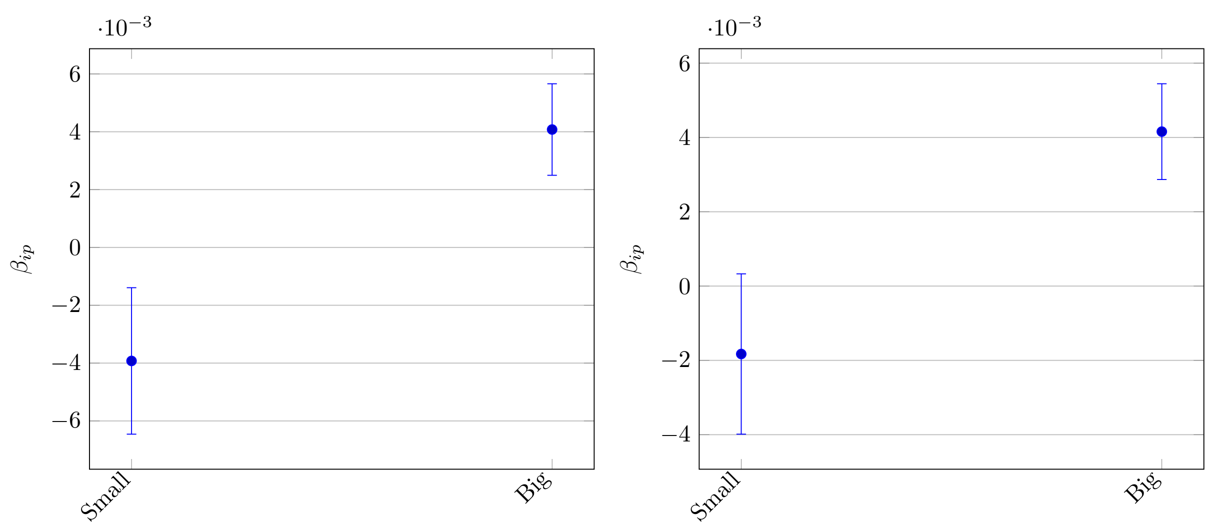
(b) Fama-French CAPM

Figure 4: News mean β_{ip}'s by sector (95% CI)



(a) Naked CAPM (b) Fama-French CAPM

Figure 5: News mean β_{ip}'s by multinational status (95% CI). A company is classified as a "multinational" whenever it has positive foreign income.



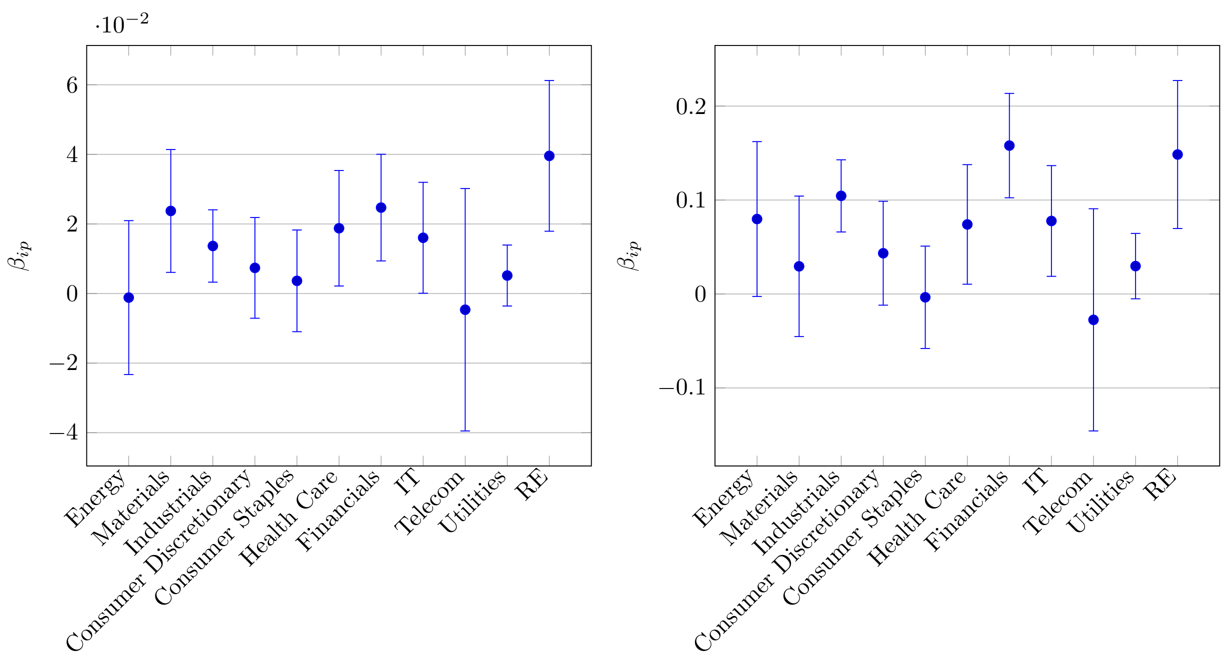
(a) Naked CAPM (b) Fama-French CAPM

Figure 6: News mean β_{ip}'s by size (95% CI). "Small" means in the lowest quintile of market cap, "big" means in the highest quintile.

4.4 Alternative Measures

Because of concerns over how confounding factors might be weakening our analysis, we are thinking about new measures of policy uncertainty that might not present the same problems. One possibility is to use "Google Trends" data on search intensity for particular keywords. The idea is that this would allow us to get more specific measures of uncertainty in policy relevant to certain sectors. We attempt a first pass at this approach by looking at Google searches for "oil drilling" and "healthcare". Figures 11 and 11 depict graphical representations of these variables in the data appendix. Searches for oil drilling spike once in 2008, when the Bush administration lifted a ban on offshore drilling, and again during the summer of 2010, during the oil spill in the Gulf of Mexico; searches for healthcare tend to be high throughout the Obamacare debate.

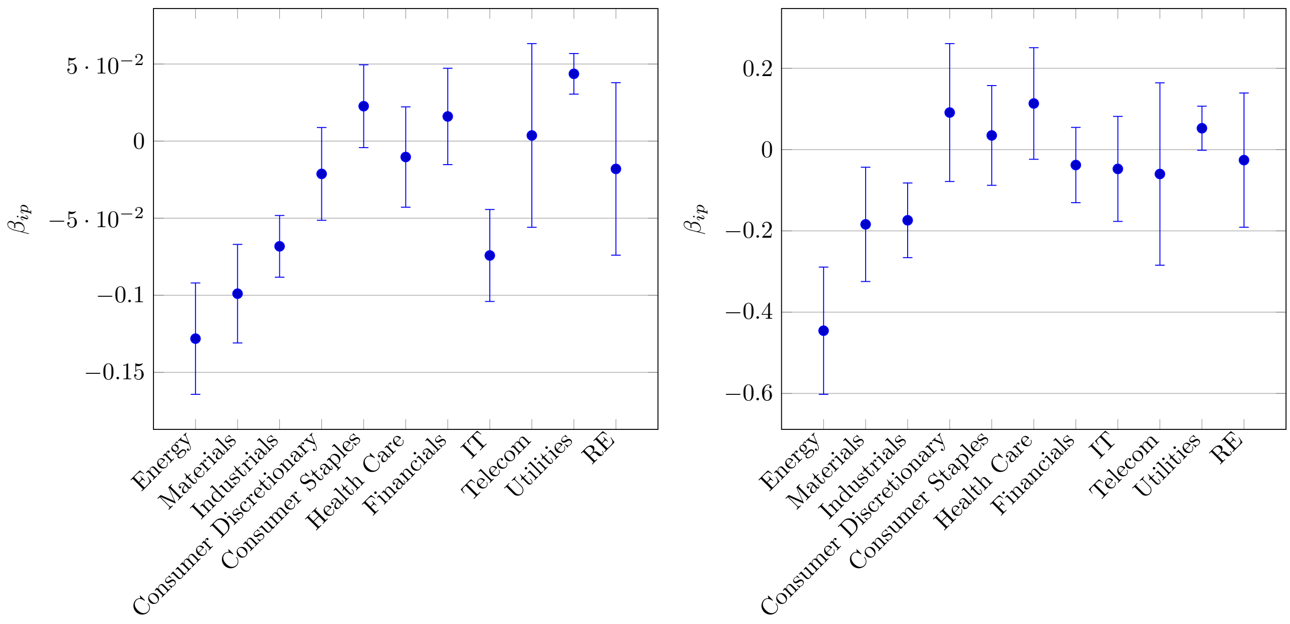
Results are presented by sector in figures 7 and 8. What we'd expect to see here is that these two measures will be relevant for two particular sectors (respectively, Energy and Health Care), and that they preserve the sign of the coefficient found on EPU. Instead, we find quite the opposite. In both cases, the sector of interest seems to be insensitive to its associated measure of uncertainty. We believe this might be due to the fact that these measures are even more sensitive to confounding factors. The Gulf spill in 2010 certainly did not represent a "mean preserving spread" in the distribution of oil-drilling regulation.



(a) Naked CAPM

(b) Fama-French CAPM

Figure 7: Google Trends: "oil drilling". Mean β_{ip}'s by sector (95% CI)



(a) Naked CAPM

(b) Fama-French CAPM

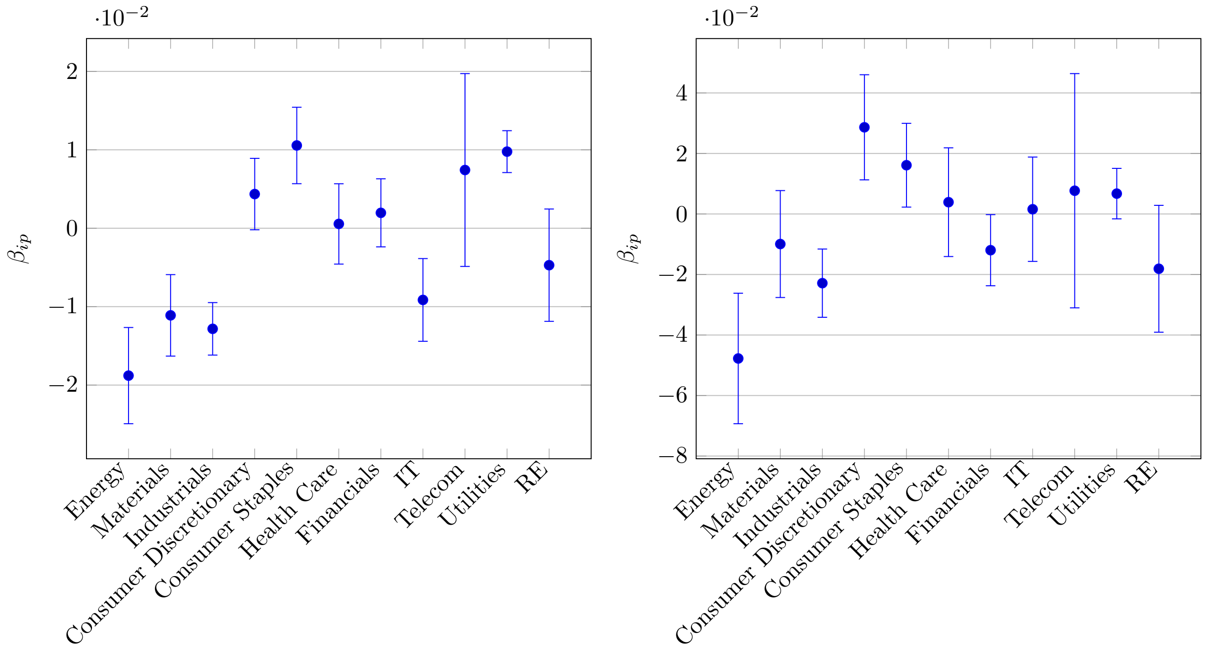
Figure 8: Google Trends: "healthcare". Mean β_{ip}'s by sector (95% CI)

Another thing that might be affecting results is that Google Trends are only available starting in 2004, so the new analysis are effectibely using a different sample. To address this concern, we run the specification with EPU on the reduced sample. As we can see in figure 9, our results do not drastically change in the shorter sample.

While we believe there is more work to be done with Google Trends data, we are also looking at other sources of data that might help us construct robustness tests of our empirical analysis. For one thing, Baker, Bloom and Davis (2016) offer more "categorical" measures of policy uncertainty, such as specifically for Health Care or National Security, taxes or spending, which we could use in lieu of Google Trends data. Further, it'd be interesting to see how our estimates change with each individual component of the EPU index.[13]

Another great source of data for us might be surveys of CFO's. The Duke CFO Global Business Outlook, for example, asks "During the past quarter, which items have been the most pressing concerns for your company's top management team?". In the last quarter available, the second quarter of 2018, 30.7% of responses included the concern "Government policies", and 28.9% included "Regulatory requirements". We could use variation in responses to this question and others as measures of policy uncertainty.

[13]News, expiring tax provisions, and forecast dispersion.



(a) Naked CAPM

(b) Fama-French CAPM

Figure 9: GT reduced sample with EPU. Mean β_{ip}'s by sector (95% CI)

5 Conclusion

The question of how policy uncertainty affects investment has been raised in economics long ago. In this paper, we show how the classical result that the deductibility of expenses leaves the choice of input undistorted is not valid whenever tax policy is correlated with other uncertain determinants of input productivity. Such a correlation might be induced by the tax system itself, or might arise due to how the political process reacts to changes in productivity.

Our theoretical model considers an arbitrary tax system and shows that whenever there is a covariance between the determinants of the firm pre-tax productivity and its marginal tax rate, this will act as an implicit tax on investment. This tax can discourage investment, if the covariance is positive; but it can also encourage investment (i.e., act as a subsidy), if the covariance is negative. The intuitive mechanism at work here is strikingly simple, and really can be boiled down to the numerical example we provided in the introduction: it is bad for expected profits if taxes are high precisely when times are bountiful.

In our empirical work, we use stock market data to see how returns on different firms react to jumps in policy uncertainty, and then use this relationship to infer the sign of the correlation between their productivity and tax policy. We do this not only to give suggestive evidence that our mechanism is at work, but also to document how different correlations are related to other firm characteristics.

We find that firms in the energy sector tend to be harmed by policy uncertainty, while firms in consumer-related activities tend to benefit from it. This is suggestive evidence that government policy tends to crack down on companies when times are good in the former, and when times are bad in the latter. One possible explanation for this could be that technological discoveries that make oil and gas companies more productive (like, say, fracking) tend to be accompanied by crackdowns on drilling regulations. Empirical work is still in its early stages, and we plan to expand it in several ways, including thinking about other categorizations and other measures of policy uncertainty.

In conclusion, this paper studies how a firm behaves when it faces uncertainty regarding both its tax bill and the productivity of its inputs. Given our preliminary results, we have reason to believe that this carries significant consequences for a number of classical results in the economics of business taxation.

References

Andrew B Abel. Optimal investment under uncertainty. *The American Economic Review*, 73(1):228–233, 1983.

Alan J. Auerbach and James R. Hines. Investment tax incentives and frequent tax reform. *American Economic Review Papers and Proceedings*, 78(2), 1988.

Kerry E. Back. *Asset Pricing and Portfolio Choice Theory*. Oxford University Press, 2010.

Scott R. Baker, Nicholas Bloom, and Steven J. Davis. Measuring economic policy uncertainty. *The Quarterly Journal of Economics*, 131(4):1593–1636, 2016.

Nicholas Bloom. The impact of uncertainty shocks. *Econometrica*, 77(3):623–685, 2009.

Christophe Chamley. Optimal taxation of capital income in general equilibrium with infinite lives. *Econometrica*, pages 607–622, 1986.

David M Cutler. Tax reform and the stock market: An asset price approach. *The American Economic Review*, 78(5):1107–1117, 1988.

Evsey Domar and Richard Musgrave. Proportional income taxation and risk-taking. *The Quarterly Journal of Economics*, 58(3):388–422, 1944.

Eugene F Fama and Kenneth R French. Common risk factors in the returns on stocks and bonds. *Journal of financial economics*, 33(1):3–56, 1993.

John N Friedman. The incidence of the medicare prescription drug benefit: using asset prices to assess its impact on drug makers. *Working Paper*, 2009. URL http://www.brown.edu/Departments/Economics/Faculty/John_Friedman/partd.pdf.

Kyle Handley and Nuno Limão. Policy uncertainty, trade, and welfare: theory and evidence for china and the united states. *American Economic Review*, 107(9):2731–83, 2017.

Richard Hartman. The effects of price and cost uncertainty on investment. *Journal of economic theory*, 5 (2):258–266, 1972.

Kevin A Hassett and Gilbert E Metcalf. Investment with uncertain tax policy: Does random tax policy discourage investment. *The Economic Journal*, 109(457):372–393, 1999.

Kenneth L Judd. Redistributive taxation in a simple perfect foresight model. *Journal of Public Economics*, 28(1):59–83, 1985.

Patrick J Kehoe. Policy cooperation among benevolent governments may be undesirable. *The Review of Economic Studies*, 56(2):289–296, 1989.

Torsten Persson and Guido Tabellini. Chapter 22 political economics and macroeconomic policy. *Handbook of Macroeconomics*, 1/C:1397–1482, 1999.

Robert S Pindyck. Irreversible investment, capacity choice, and the value of the firm. *American Economic Review*, 78:969–85, 1988.

James M Poterba. Tax reform and the market for tax-exempt debt. *NBER Working Paper No. 2900*, 1989.

Dani Rodrik. Policy uncertainty and private investment in developing countries. *Journal of Development Economics*, 36(2):229–242, 1991.

Jonathan Skinner. The welfare cost of uncertain tax policy. *Journal of Public Economics*, 37(2):129–145, 1988.

Joel Slemrod and Timothy Greimel. Did steve forbes scare the us municipal bond market? *Journal of Public Economics*, 74(1):81–96, 1999.

A Adjustment Costs Example

For simplicity, we consider a tax on revenue in this section. An investment x yields return $\epsilon f(x)$, where $f(x) = 2\sqrt{x}$. Suppose that with probability one $\epsilon = 1$. In addition, $\tau = \frac{1}{2}$ with probability one. Then the firm optimally sets $x = \frac{1}{2}$. It never needs to adjust investments thereafter because τ and ϵ are known with probability one.

However, suppose instead that with probability p it turns out that $\epsilon = 1/p$, and with probability $1-p$ it turns out that $\epsilon = 0$. In addition, we let $\tau = 1$ if $\epsilon = 0$, while $\tau = 0$ otherwise. Thus, there is now a negative covariance between τ and ϵ, whereas before there was no covariance. Finally, after the realizations of τ and ϵ, there is a fixed cost F of adjusting capital.

In this new hypothetical, so long as $p < 0.5$, the firm will never choose $x = (1/p)^2$. That option is dominated by $x = 0$, as this option makes the likelihood of adjusting and paying the fixed adjustment cost F not as likely. The other possibility is that the firm chooses $x = 1$ and does not adjust at all.[14] The firm's expected profit from the strategy of not adjusting is 1, whereas the expected profit from choosing $x = 0$ and adjusting to $(1/p)^2$ if $\epsilon = 1/p$ is $(1/p)^2 - F$. So long as $p < \min\{\frac{1}{F+1}, 0.5\}$, the firm optimizes by choosing $x = 0$. Thus, with adjustment costs, decreasing the covariance between taxes and productivity can decrease investment.

B Data Appendix

In this section we provide details about the data used in our empirical analysis. Figures 10, 11, and 12 plot the evolution of our main measures of policy uncertainty over the respective sample periods. Table 2 refers summary statistics about the two samples underlying the naked CAPM and the Fama-French CAPM models estimated in our empirical analysis. Table 3 shows correlations between our different measures of policy uncertainty.

[14] If the firm does not adjust, then it maximizes $p * \frac{2\sqrt{x}}{p} - x$.

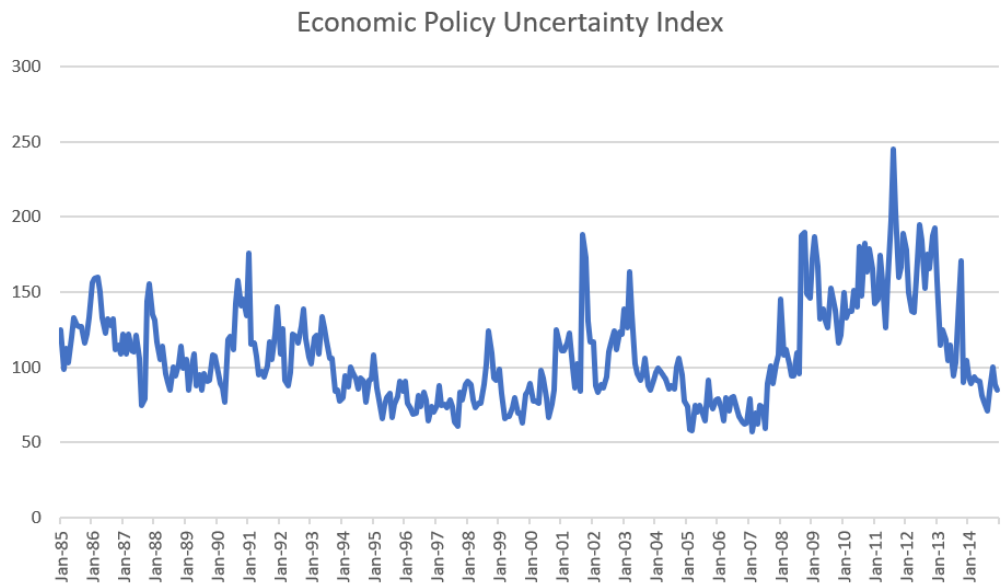


Figure 10: Economic Policy Uncertainty Index from Baker, Bloom and Davis (2016).

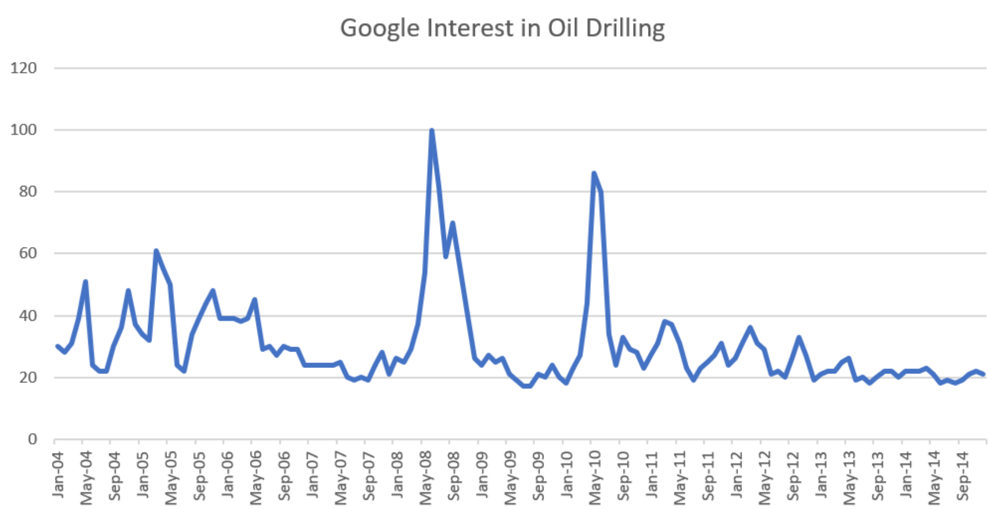


Figure 11: Google search interest in “oil drilling”.

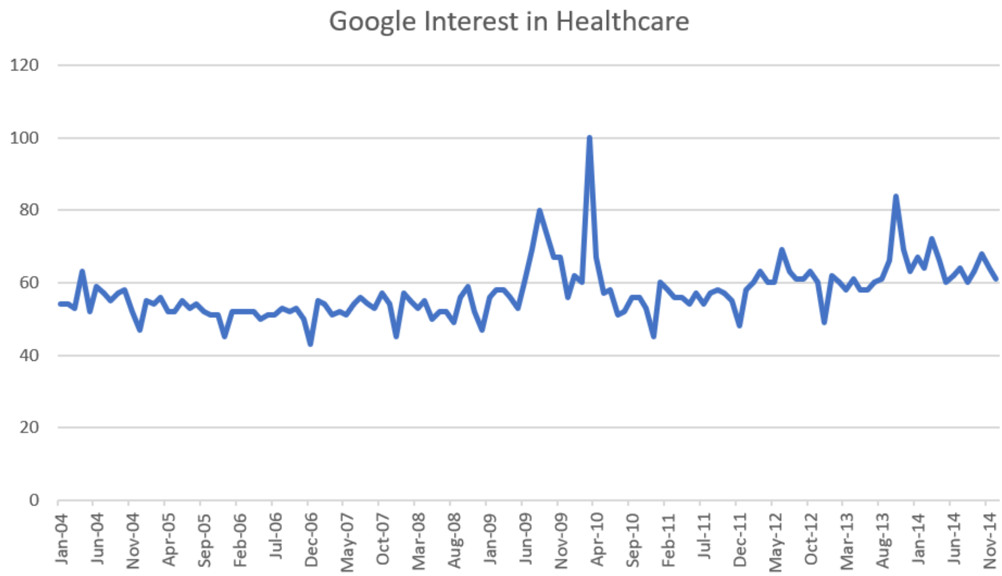


Figure 12: Google search interest in "healthcare".

	Naked	Fama-French
Number of firms	690	556
Number of periods	360	120
Market value in \$1000's	7310.31 (25393.46)	8442.63 (27846.81)
Multinational	0.928	0.927
Energy	0.068	0.065
Materials	0.078	0.070
Industrials	0.235	0.239
Consumer disc	0.125	0.128
Consumer staples	0.067	0.064
Health	0.070	0.077
Finance	0.109	0.088
IT	0.117	0.121
Telecom	0.007	0.009
Utilities	0.088	0.098
Real Estate	0.036	0.040

Table 2: Summary Statistics for the two samples corresponding to the two specifications of interest.

	oil drilling	healthcare	EPU
oil drilling	1.000		
healthcare	−0.2672	1.000	
EPU	−0.0623	0.2336	1.000

Table 3: Correlations between measures of policy uncertainty.