Renewable Portfolio Standards and the value of cash

Abstract

The use of renewable energy to replace fossil fuels is at the core of transitioning to a greener economy, whereas how such a transition impacts the corporate sector is unclear. We employ the Renewable Portfolio Standards' (RPS) adoption in the United States as an exogenous shock to companies' energy portfolios and tackle the above question through the lens of the value of corporate cash holdings. We find RPS' adoption significantly increase companies' value of cash and such an effect is stronger for firms with greater financial constraints, weaker market power, lower internal capital mobility, higher growth opportunities, higher electricity intensity, or facing more stringent RPS compliance requirements. Cash holdings also increase significantly after the RPS' adoption. Our study demonstrates the precautionary motive plays a more significant role for companies' asset liquidity management under renewable energy policies.

JEL Classifications: Q54; G32; Q58

Keywords: renewable energy; climate change; Renewable Portfolio Standards (RPS); the value of cash holdings; financial policy; liquidity management

1.Introduction

Global warming and energy shortage have imposed unprecedented challenges on companies, the economy, and the society. Extreme weather events due to climate change are frequently reported around the world (e.g., wildfires in California, hurricane Ida in Louisiana, drought in South America, hottest summers on record in the U.K., and flood in Pakistan), causing billion-dollar of losses and thousands of lives. Energy sustainability related to carbon emission mitigation and military conflicts such as the Russia-Ukraine war emphasizes the importance of using renewable energy as a substitute for fossil fuels. During the past decades, much renewable energy policies had been implemented to address the challenges of climate change and energy shortages. However, what impacts do renewable energy and related policy have on companies, the economy, and society? To what extent are companies prepared for the changing landscape of energy provision? We aim to address these questions in this research.

We tackle the above questions through the lens of companies' asset liquidity management and examine how climate-related renewable energy policies impact the value of companies' cash holdings. Corporate cash holdings represent an essential asset category for companies and become increasingly important in an external environment full of uncertainties. Companies' cash-to-asset ratio has more than doubled in the last few decades, with firms in the U.S. alone holding trillions of dollars in cash and equivalents, which exceeds the amount of all companies' debt obligations (Bates, Kahle, and Stulz, 2009). Asset liquidity management becomes a paramount issue in companies' financial decisions, while the corporate sector is facing an era of unprecedented uncertainties underpinned by technological advances, geo-political conflicts, and environmental and social challenges. Cash holdings provide companies with financial flexibility and hedge risks (Froot, Scharfstein, and Stein, 1993; Acharya, Almeida, and Campello, 2007; Gao, Harford, and Li, 2013; Bates et al., 2009; Han and Qiu, 2007). Moreover, when companies face significant growth uncertainties, a healthy cash reserve enables companies to capture emerging growth opportunities thus enhance firm value (Almeida, Campello, and Weisbach, 2004). Therefore, cash holdings are pivotal in mitigating the impact of climate and energy uncertainties.

We set our study in the context of the staggered adoption of Renewable Portfolio Standards (RPS) and use it as an exogenous shock to companies' energy portfolio, energy cost, and energy uncertainty. RPS is a U.S. state-level policy that requires electricity providers to supply a required percentage of electricity using renewable resources, such as wind, solar thermal and photovoltaic, geothermal, biomass, and hydropower. It aims to promote the use of renewable energy and mitigate carbon emissions. By the end of 2021, 31 states and Washington DC have established a mandatory RPS program, and ten of these states (including California, Colorado, Hawaii, Maine, Nevada, New Mexico, New York, Oregon, Virginia, and Washington) and Washington DC have mandated 100% clean electricity supplied by zero-emission resources by 2050 or earlier. This policy is recognized as a primary contributor to reviving the renewable energy markets and an essential climate regulation (Greenstone and Nath, 2021).

As far as we are aware, little has been done to understand how RPS affects the corporate sector and how companies adapt to the renewed energy regime through revising their financial and investment decisions. Previous research has studied how RPS impact renewable energy generation and development (Menz and Vachon, 2006; Carley, 2009; Yin and Powers, 2010), carbon emissions (Greenstone and Nath, 2021; Sekar and Sohngen, 2014; Eastin, 2014), job market and economic development (Barbose, Wiser, Heeter, Mai, Bird, Bolinger, and Millstein, 2016). The scarcity of evidence on the corporate sector is a worrying omission considering that this sector is a primary contributor of Gross Domestic Product (GDP), tax income, employment, and economic growth. In this study, we aim to fill this gap by linking companies' value of cash and asset liquidity policies to RPS' adoption. Importantly, RPS significantly increased electricity prices (Palmer and Burtraw, 2005; Kydes, 2007; Greenstone and Nath, 2021; Upton and Snyder, 2017), which raised companies' energy input cost in the compliant states. Since RPS is introduced not at companies' discretion, it allows us to establish causality between renewable energy policies and company asset-liquidity decisions.

Following a method of Faulkender and Wang (2006), we investigate the value of cash by measuring how a dollar's worth increment of a company's cash holdings affect the company's market value of equity, before and after the RPS' adoption. In our baseline analysis, we find that the RPS' adoption significantly increases the value of cash holdings. The marginal value of cash is \$0.199 higher for those firms headquartered in an RPS-compliant state than for firms in non-compliant states. This finding is well in line with our expectation that the value of cash increases after the RPS's adoption. This is reasonable as follows. The RPS' adoption substantially raised electricity prices and increased companies' energy input costs (Greenstone and Nath, 2021). Ceteris paribus, raised energy costs reduce companies operating cash flow, which reduces companies' financial flexibility (Myers and Majluf, 1984) and presents the companies with the risk of having to pass valuable investment opportunities when they arise. On the other hand, raised energy costs also increase the financial distress risk indirectly through increased operating leverage when energy input contributes more to the fixed costs than variable costs. The increase operating leverage makes a company more vulnerable during economic downturns (Dang, Gao, and YU, 2022; Serfling, 2006). Therefore, the margin value of cash increases after the RPS's adoption, as cash holdings are usually used to overcome the above downside risks brought by the increase energy costs (e.g., Acharya et al, 2007; Bates et al., 2009; Froot et al., 1993; Gao et al., 2013; Han and Qiu, 2007; Keynes, 1936).

We conduct an array of checks to ensure the robustness of our baseline finding. First, we use propensity-score matching (PSM) and entropy balancing (EB) to ensure our treated and control samples are well balanced in their covariates. Second, we exclude from our control sample those firms headquartered in the same Independent System Operators (ISOs) or Regional Transmission Organizations (RTOs) as our treated firms, because ISOs and RTOs administer regional wholesale power markets (which could span multiple states) in which electricity prices tend to converge. Third, we follow the previous literature (Dang et al., 2022; Greenstone and Nath, 2021) to control the impact of several state-level policies to minimize the effect of confounding policies. Fourth, we use alternative ways to measure the change in cash (Faulkender and Wang, 2006) and alternative measures of excess stock return to ensure our baseline finding is not changed. Finally, we conduct the Impact Threshold for Confounding Variable (ITCV) test (Frank, 2000; Larcker and Rusticus, 2010), stacked regression estimator (Baker, Larcher, and Wang, 2022) and a placebo test to further rule out the concern that our baseline finding is biased by unobserved variables or treatment effect heterogeneity. Our baseline result is robust to these robustness analyses.

We also explore the cross-sectional heterogeneity of our baseline finding to corroborate our arguments. We find that the RPS' adoption increases the value of cash more dramatically when this policy is more relevant for firm decisions. Specifically, we find our baseline result more pronounced when firms use electricity more intensively and when they are headquartered in those states with greater policy stringency. Consistent with the precautionary motive of cash holdings, we also find our baseline result primarily driven by those companies with greater financial constraints, lower market power, lower internal capital mobility, or higher growth opportunities. Higher value of cash should incentivize companies to hold more cash after the RPS' adoption. Indeed, in an extended analysis, we find a significantly positive relationship between RPS' adoption and the level of cash holdings. Moreover, we identify the possible economic mechanisms that could drive our baseline findings. Specifically, we find that RPS policy could affect the value of cash holdings via decreasing firm's level of cash flow and increasing the cash flow volatility.

We contribute to two strands of literature. First, our study is an initiative aimed at understanding how the corporate sector adapts to the renewable energy policies instituted to address global warming and energy crises. Previous research mainly focus on how renewable policies influence renewable-energy generation (Yin and Powers, 2010; Hollingsworth and Rudik, 2019; Rader and Hempling, 2001), CO2 emissions (Greenstone and Nath, 2021; Upton and Snyder, 2017), electricity prices and demand (Greenstone and Nath, 2021; Upton and Snyder, 2017), employment and economic growth (Barbose et al., 2016). These studies are conducted at the state level, yet little is known how such policies impact company decisions and outcomes. We contribute to the literature by linking renewable energy policies to the value of corporate cash holdings and firms' asset liquidity policies. Since companies constitute a major part of GDP and are central to the global, national, and local economies, our research contributes to the literature by offering the first empirical evidence on RPS' financial effect on the corporate sector. Broadly, our study also relates to a nascent literature that examine how climate policies (including renewable energy policies) shift the balance of pros and cons in company decisions (e.g., Bartram, Hou and Kim, 2022; Dang et al., 2022).

Second, we extend the literature on corporate cash holdings by investigating the value of cash in the context of renewable energy policies. Cash reserves, asset liquidity and related debt capacity management have become a paramount issue in the last few decades (e.g., Acharya et al., 2007; Almeida et al., 2004; Bates et al., 2009; Faulkender and Wang, 2006; Froot et al., 1993; Gao et al., 2013; Han and Qiu, 2007; Opler, Pinkowitz, Stulz, and Williamson, 1999), especially in the context of increased costs and uncertainties underpinned by climate, social and political challenges and energy crises (Bates et al., 2009). The theory of precautionary cash holdings maintains that cash holdings offer financial flexibility, enable company growth, and hedge against financial risks (Almeida et al., 2004; Han and Qiu, 2007; Keynes, 1936). We find the value of cash increases significantly after the RPS' adoption, which is in line with the prediction of companies' precautionary motive to hold cash. Our findings demonstrate that transition risk related to renewable energy policies is a primary determinant of the value of cash and firms' asset liquidity decisions.

We proceed in the rest of this study as follows. Section 2 introduces the background of RPS policy, reviews the literature, and develops the hypothesis. Section 3 presents the sample, data, and methodology. Section 4 reports the empirical results of our empirical analysis. Section 5 reports the results of our robustness analysis. We conclude in Section 6.

2.Background, literature and hypothesis

2.1 Background of RPS policy

Renewable Portfolio Standards (RPS) is a state-level policy which is designed to incentivize renewable energy installation and generation in the United States. The RPS policy requires electricity providers or utilities to ensure a minimum percentage of renewable energy (including wind, solar thermal and photovoltaic, geothermal, biomass, and hydropower, or other renewable sources) incorporated in their states' portfolio of electric generating resources. The first RPS implementation could be dated back to 1983, when Iowa established Alternative Energy Law (revised in 1991), requiring its two investor-owned utilities (MidAmrican Energy and Alliant Energy Interstate Power and Light) to generate 105 megawatts (MW) clean energy from renewable energy resources. Currently, 31 states plus Washington DC have RPS requirements in place, with 10 of those have the target of 100% carbon-free by 2050 or earlier. One central component of an RPS is that RPS requirement is implemented through a system of tradable Renewable Energy Credits (RECs). RECs are created to facilitate compliance with RPS policy by allowing renewable energy credits to be bought and sold independently of the electricity to help electricity providers or utilities meet their RPS obligations. RECs have been developed to catalyze renewable energy generation by monetizing the environmental benefits inherent in such generation. The RECs system provides an additional stream of income for renewable energy developers and promotes the efficient allocation of renewable energy investment (Mack, Gianvecchio, Campopiano, and Logan, 2011).

However, on the one hand, several recent studies suggest that RPS's adoption has significantly increase retail electricity prices (Wiser, Barbose, Bird, Churchill, Deyette, and Holt, 2008; Greenstone and Nath, 2021; Upton and Snyder, 2017; Barbose, 2021; Palmer and Burtraw, 2005; Kydes, 2007). The higher electricity rate could be explained by the extra costs associated with the renewables in the following ways (Greenstone and Nath, 2021): First, higher electricity transmission and distribution costs (such as cost of land, utility poles, wires, substations, transformers, and other equipment) associated with delivering renewables from the most advantageous geographic location to centralized power supply area. Second, the costs associated with renewables' intermittency that requires dispatchable electricity sources (such as nuclear, gas, and coal) to fill in when the sun, wind, or water resources are unavailable. According to Energy Information Administration, the capacity factor[1] for solar plants, wind plants, and hydroelectric plants is about 25%, 34%, and 40%, respectively. Therefore, the installation of renewables should be paired constructed with the dispatchable electricity system to protect against their insufficient or excess supply. Third, the costs for displacement of current transmission infrastructure and compensation for those assets being stranded.

On the other hand, RECs price could be highly volatile and thus increase energy uncertainties since REC trading is fractured by state-specific regulations. The United States currently does not have a single, unified REC market. Instead, varying state-specific regulation have created a disparate REC trading regimes (Mack et al., 2011). Perhaps the most deleterious restriction on RPS policy to realize the full potential of RECs is the in-state generation requirements, which in part stem from states' self-interest in promoting renewable energy within their own borders and potentially violate the Interstate Commerce Clause of the US Constitution (Mack et al., 2011; Elefant and Holt, 2011). States only allow a utility to satisfy its full RPS compliance requirements with in-state RECs and preclude or limit the use of out-of-state RECs for protectionist reason (Elefant and Holt, 2011). Therefore, REC prices, and hence RPS compliance costs, can be quite volatile, with large swings from year to year, depending upon whether a given state or region is in surplus or deficit relative to its RPS obligations (Heeter et al., 2014; Chupka, 2003). All these increasing renewables costs would be passed to downstream electricity users and would induce a substantial increase in firms' electricity costs and unprecedented uncertainties, which potentially affects the value of cash holdings for treated firms in RPS-compliant states.

2.2 Literature review and hypothesis

2.2.1 Literature review

This paper is associated with a growing body of research on the value of cash holdings. A firm may hoard significant cash assets for a variety of motivations (Keynes, 1936; Opler et al.,

[1] The ratio of actual electrical energy output over a given period of time to the theoretical maximum electrical energy output over that period.

1999; Gao et al., 2013; Han and Qiu, 2007). The most recognized motive is the transaction motive, in the aim of reducing transactions costs by saving the cost of liquidating assets or selling securities to obtain cash to make the payments. Another motive for holding cash is precautionary motive, which enables the firm to protect themselves against adverse cash flow shocks that might force them to forgo valuable investment opportunities due to costly external financing. Given that the RPS implementation appears to have dealt a significant shock to firms' input cost structure, the precautionary motive constitutes the theoretical foundation of our current paper.

A strand of prior research highlights the precautionary benefits of cash holdings in the role of seizing valuable investment projects in the presence of greater financial constraints. Keynes (1936) documents that a major benefit of cash holdings is to capture promising investment opportunities whenever they arise, especially for firms with higher financial constraints. Modigliani and Miller's (1958) develop a theory of investment and suggest that cash only affects firm value when markets are not frictionless. Myers and Majluf (1984) posit that firms with sufficient financial slack could undertake positive-NPV investment that otherwise would bypass due to costly external financing. Analogously, Fazzari and Petersen (1993) emphasize the role of working capital on investment in the presence of finance constraints, suggesting the smoothing benefits of cash holdings. More recent studies provide a plenty of empirical evidence in supporting of those theories. Notably, Almeida et al. (2004) suggest that hoarding cash could facilitate future investment when firms have constrained access to external capital. Moreover, Faulkender and Wang (2006) posit that the marginal value of cash should be higher for firms that face greater financing constraints, especially those with value-enhancing investment opportunities. Furthermore, Denis and Sibilkov (2010) support the view that greater cash holdings of constrained firms are a value-increasing response to costly external financing. By contrast, unconstrained firms could raise external fund at any time without frictions and, therefore, have less precautionary demand for cash holdings (Gao and Mohamed, 2018). Overall, the literature supports the precautionary benefits of cash holdings in shielding investment capability when firms are financially constrained or dependent on external finance.

Another strand of literature addresses the precautionary value of cash reserves in the role of hedging against financial and operational risk when firms are financially constrained. Froot et al. (1993) argue that the hedging role of internally generated funds in reducing the variability in cash flows. Acharya et al. (2007) support that accumulating cash allows financially constrained firms to hedge against future cash shortfalls. A consensus on recent studies demonstrates that precautionary demand of firms for cash reserves is greater due to increasing levels of riskiness of cash. For example, Opler et al. (1999) suggests firms hold more liquid assets if their cash flow volatility is higher, particularly in financially constrained firms. Han and Qiu (2007) also show that a financially constrained firm increases its cash holdings in response to an increase in cash flow volatility. Similarly, Bates et al. (2009) document a sharp increase in corporate cash holdings and tie it to a parallel increase in cash flow volatility. Given that a large adverse cash flow shock results in a higher likelihood of financial distress (Itzkowitz, 2013), cash holdings provide financially constrained firms with financial flexibility and hedging against financial risks, and the value of cash holdings would be substantially increased accordingly. Recent works provide empirical evidence on this argument. Typically, Pinkowitz and Williamson (2007) point out that the value of cash holdings increases when firms are confronting higher cash flow volatility, particularly for firms with limited access to capital markets. Duchin (2010) also reveals that the adverse cash flow shocks would increase the marginal value of holding cash in financially constrained firms.

To our knowledge, previous literature largely studies on various firm-specific attributes that could possibly affect the value of cash holdings, such as firm diversification (Subramaniam, Tang, Yue, and Zhou, 2011; Tong, 2011), growth opportunities (Myers and Majluf, 1984; Pinkowitz and Williamson, 2002), product market competition (Alimov, 2014), financial constraints (Faulkender and Wang, 2006), investment uncertainty or cash flow volatility (Denis and Sibilkov, 2010; Pinkowitz and Williamson, 2007), etc., either through the channel of shielding valuable investment or the way of hedging against risk. However, much less is known about how firms benefit from cash reserves in the face of government climate policy. In this paper, we fill in this gap by presenting that how RPS policy affects the value of cash holdings under the precautionary motive.

2.2.2 Hypothesis

Previous literature demonstrates that RPS causes a substantial exogenous increase in firms' electricity costs and energy uncertainties (e.g., Wiser et al., 2008; Greenstone and Nath, 2021; Upton and Snyder, 2017; Barbose, 2021; Palmer and Burtraw, 2005; Kydes, 2007; Heeter et al., 2014; Chupka, 2003). We posit that such an exogenous shock significantly increases firms' reliance on internal liquidity to grab any transient growth opportunities or hedge financial and operational risks.

Based on Keynes (1936) and Almeida et al. (2004), financially constrained firms without sufficient internal liquidity reserves often forgo valuable investment opportunities. The high cost of external capital, owing to transaction costs and information asymmetry, often makes otherwise profitable projects appearing unattractive (e.g., Faulkender and Wang, 2006; Heaton, 2002). Because of the lost investment opportunities, these firms would have suboptimal firm value ex ante (Minton and Schrand, 1999; Opler et al., 1999; Faulkender and Wang, 2006). Recent research provides empirical evidence that the average retail electricity prices are 11% higher than they otherwise would be in the 7th year after RPS adoption, and 17% higher at 12 years after RPS passage (Greenstone and Nath, 2021). The significantly higher electricity costs after RPS' adoption increase the likelihood of a firms' internal cash flow shortfalls and undermine a firm's ability to make value-increasing investments (Campbell, Goldman, and Li, 2021). In addition, higher REC price volatility would be passed to downstream electricity users as well and potentially increase firm's cash flow volatility. Firms with greater cash flow volatility face greater costs of external finance, thereby making it less likely to undertake positive-NPV (net present value) projects (Denis and Sibilkov, 2010; Pinkowitz and Williamson, 2007). The RPS-affected firms, therefore, can enhance firm value through reserving more cash internally to enhance their investment capability and increase firm value ex ante (Myers and Majluf, 1984; Almeida et al., 2004; Gao and Jia, 2016). This constitutes the first reason that the value of cash increases after RPS's adoption.

The RPS' adoption also increases firms' financial and operational risks. Increased electricity cost after RPS lowers firms' internal cash flows and increases the frequency of cash shortfalls. Firms, therefore, should find it more difficult to meet their payment commitment to suppliers or meet their debt obligations towards creditors. The default risk and even bankruptcy should increase for the compliant firms after the RPS, accordingly (Smith and Warner, 1979; Anderson, Mansi, and Reeb, 2003; Hackbarth, Miao, and Morellec, 2006; Brogaard, Li, and Xia, 2017). Moreover, the RPS' implementation could increase the probability of firms' distress risk through increasing operating leverage. Specifically, Dang et al. (2022) suggest that increased electricity price adds more to firms' fixed cost than to variable costs, thus increasing their operating leverage and reduces firms' operating flexibility. The increased operating leverage make companies particularly vulnerable under uncertainties because they must cover more fixed costs, regardless of the external conditions. Indeed, previous evidence shows higher operating leverage makes financial distress more likely (Mandelker and Rhee, 1984; Mauer and Triantis, 1994; Serfling, 2016; Kahl, Lunn, and Nilsson, 2019). Since increased financial distress risk makes it more difficult for firms to access external finances (Denis and Sibilkov, 2010; Faulkender and Wang, 2006; Pinkowitz and Williamson, 2007), we argue that, post RPS, firms find it more valuable to hold cash precautionarily to hedge risks (Keynes, 1936; Han and Qiu, 2007).

Collectively, our discussions above lead to the hypothesis that cash holdings become more valuable after RPS' adoption. The increased value of cash holdings would allow firms to incur a lower cost when they make investments using internal funds without having to access costly external capital markets. With increased value of cash, the financial burden for companies would also become lighter when they rely on the presence of asset liquidity to weather through periods of uncertainties and reduce cost of financial distress or even bankruptcy. We expect the enhanced value of cash to have a fundamental impact on the liquidity composition of firms' balance sheet and related financing and investment strategies.

3. Sample, data, and methodology

3.1 Sample and data

Referring to existing RPS studies (Greenstone and Nath, 2021; Upton and Snyder, 2017; Eastin, 2014), we collect the RPS legislation year from a combination information disclosed by National Conference of State Legislatures, U.S. Renewables Portfolio Standards 2021 Status Update of Lawrence Berkeley National Laboratory, U.S. Energy Information Administration, and NC Clean Energy Technology Center. Details of RPS legislation year are presented in Appendix 1. We follow recent studies and match RPS legislation year to the state where each firm is headquartered (Matsa, 2010; Agrawal and Matsa, 2013; Acharya, Baghai, and Subramanian, 2014; Dougal, Parsons, and Titman, 2015), which is also typically where major plants and operations are located (Henderson and Ono, 2008). Hence, using the headquarter states could capture a large proportion of RPS effect. We obtain the headquarter information from Comphist in Wharton Research Date Services (WRDS) which reports firms' historical data on headquarters. A limitation of Comphist is that this database only provides the latest headquarters locations from year of 2007. Therefore, we supplement Comphist headquarter data in two ways. First, for firm-years that during year 2004−2006, we extract the actual state of headquarters from SEC EDGAR filings. Second, for firm-years prior to year of 2004, we refer to the headquarter data provided by Bai, Fairhurst, and Serfling (2020)[2]. We collect financial data from CRSP/Compustat Merged in WRDS over the years of 1971−2020, with no missing values for the main variables of interest. We follow Faulkender and Wang (2006) and exclude financial firms (SIC codes from 6000 to 6999) and utility firms (SIC codes from 4900 to 4999). Our final sample consists of 143264 firm-year observations from 31 RPS-compliant states (plus Washington DC) and 19 non-RPS-compliant states. One benefit of our setting is that the RPS legislation year are staggered over time, which allows a firm headquartered in RPS-compliant states to be in both the treatment and the control group. Thus, the staggered RPS policy signifies that the control group is not restricted to firms headquartered in states that never adopt RPS policy (Appel, 2019; Bai et al., 2020; Bertrand and Mullainathan, 2003). As common practice, all continuous variables in our sample are winsorized at the 1% on both tails.

3.2 Empirical methodology

We exploit the staggered state-level RPS adoption and use a difference-in-difference approach to study the impact of RPS on the value of cash and firms' liquidity policy. The difference in-difference approach is widely used in the literature to establish causality between firm outcomes and their determinants (e.g., Serfling, 2016; Klasa, Ortiz-Molina, Serfling, and Srinivasan, 2018; Shang, 2020; Correa and Lel, 2016; Nguyen, Phan, and Sun, 2018; Chowdhury, Doukas, and Park, 2021). Our baseline specification builds on the model proposed by Faulkender and Wang (2006):

$$\begin{aligned} r_{i,t} - R_{i,t} = \beta_0 &+ \beta_1 \Delta C_{i,t} \times RPS_{i,t} + \beta_2 \Delta C_{i,t} + \beta_3 RPS_{i,t} + \beta_4 \Delta E_{i,t} + \beta_5 \Delta NA_{i,t} + \beta_6 \Delta R\&D_{i,t} \\ &+ \beta_7 \Delta I_{i,t} + \beta_8 \Delta D_{i,t} + \beta_9 C_{i,t-1} + \beta_{10} ML_{i,t} + \beta_{11} NF_{i,t} + \beta_{12} C_{i,t-1} \times \Delta C_{i,t} \\ &+ \beta_{13} ML_{i,t} \\ &\times \Delta C_{i,t} + Year\ fixed\ effects + Firm\ fixed\ effects + \varepsilon_{i,t} \qquad (1) \end{aligned}$$

The dependent variable is the excess stock return equals to $r_{i,t} - R_{i,t}$, where $r_{i,t}$ is the cumulated monthly stock return over the fiscal year of firm *i* in year *t* and $R_{i,t}$ is stock *i*'s benchmark portfolio return in year *t* (Louis, Sun, and Urcan, 2012; Tong, 2011; Rapp, Schmid, and Urban, 2014). The benchmark portfolios are Fama-French 25 size and book-to-market value-

[2] We thank Professor John Bai in Northeastern University for generously providing the headquarter data with the link: https://sites.google.com/site/johnbaijianqiu/data?authuser=0

weighted portfolios (Fama and French, 1993). The independent variable of our interest is the interaction term of $\Delta C_{i,t} \times RPS_{i,t}$, where $RPS_{i,t}$ is an indicator variable that equals to 1 at the year of RPS legislation and afterwards, and 0 otherwise, for firms in 31 RPS-compliant states (plus Washington DC). For those in 19 non-RPS-compliant states, we set the RPS indicator equal to 0 in every year (Klasa et al., 2018). If the passage of RPS policy has a positive effect on the value of corporate cash holdings, we expect the coefficient of $\Delta C_{i,t} \times RPS_{i,t}$ is positive, that is β_1>0, and statistically significant at conventional levels. By contrast, if the adoption of RPS policy reduces the value of cash, β_1 should be negative and statistically significant. Since the macroeconomic factors may also affect the precautionary motive of cash holdings, we control year dummies in our regression model. We further control for firm-fixed effects to rule out the concern that unobservable time-invariant firm characteristics may bias our results. Further, we cluster standard errors by state of headquarters because RPS is a state-level policy (Klasa, Maxwell, and Ortiz-Molina, 2009; Serfling, 2016).

Following existing literature, we include a series of control variables (Harford, Klasa, and Maxwell, 2014; Kim and Bettis, 2014; Duchin, 2010; Klasa et al., 2009; Tong, 2011; Chowdhury et al., 2021; Faulkender and Wang, 2006; Drobetz, Grüninger, and Hirschvogl, 2010; Haushalter, Klasa, and Maxwell, 2007; Gao and Jia, 2016; Denis and Sibilkov, 2010). $\triangle C_{i,t}$ indicates one-year change in the cash and short-term investment of firm *i* from year *t*-1 to year *t* $\triangle E_{i,t}$ represents one-year change in earnings before interest and taxes of firm i from year $t-1$ to year *t*. $\triangle NA_{i,t}$ denotes one-year change in total assets minus cash and short-term investments of firm *i* from year $t-1$ to year *t*. $\triangle RD_{i,t}$is one-year change in research and development expense of firm *i* from year $t-1$ to year *t*, which is set to 0 if the data is missing. $\triangle I_{i,t}$ is one-year change in total interest expense of firm *i* from year $t-1$ to year *t*, which is set to 0 if the data is missing. $\triangle D_{i,t}$ is one-year change in dividends of firm *i* from year $t-1$ to year *t*. $C_{i,t-1}$ is the cash and short-term investments of firm *i* in year $t-1$. $ML_{i,t}$ is the market leverage, defined as total debt over the sum of total debt and market value of equity of firm *i* at the end of fiscal year *t*. $NF_{i,t}$ is the net financing of firm *i* during the fiscal year *t*. All explanatory variables except market leverage are standardized by lagged market value of equity. The definition of all the variables is shown in Appendix 2.

To understand the pre-period and the post-period effect of RPS adoption, we further scrutinize the corresponding dynamic RPS effect. Referring to Greenstone and Nath (2021), we establish a mean-shift effect model over a three-year time span to examine dynamic coefficient trends. To do so, we firstly define a time trend variable τ, which is normalized to equal 0 in the year the policy adopted. Specifically, if a firm is 3 years prior to the adoption of RPS in a state, we set τ equals to -3. If a firm has adopted RPS for 3 years, we set τ equals to 3. We then define an indicator $D_{i,a\leq\tau<b}$ for each time period relative to the passage of the RPS policy. For instance, $D_{i,-3\leq\tau<0}$ is a dummy variable that equals one if firm i is in the period of 1−3 years prior to the RPS adoption, and 0 otherwise. $D_{i,0<\tau\leq 3}$ is a dummy variable that equals one if firm i is in the period of 1−3 years after RPS adoption, and 0 otherwise. For states that never adopt the RPS policy, The indicator is set equal to 0. As non-adopters, they do not play a role in the estimation of the coefficients, but they aid in the estimation of the year-fixed effects, as well as the constant (Greenstone and Nath, 2021). We estimate the model as follows:

$$\begin{aligned} r_{i,t} - R_{i,t} = \beta_0 &+ \beta_1 \Delta C_{i,t} \times D_{i,-6\leq\tau<-3} + \beta_2 \Delta C_{i,t} \times D_{i,-3\leq\tau<0} + \beta_3 \Delta C_{i,t} \times D_{i,0\leq\tau\leq 3} \\ &+ \beta_4 \Delta C_{i,t} \times D_{i,3<\tau\leq 6} + \beta_5 \Delta C_{i,t} \times D_{i,\tau>6} + \beta_6 D_{i,-6\leq\tau<-3} + \beta_7 D_{i,-3\leq\tau<0} \\ &+ \beta_8 D_{i,0\leq\tau\leq 3} + \beta_9 D_{i,3<\tau\leq 6} + \beta_{10} D_{i,\tau>6} + Controls_{i,t} \\ &+ Year\ fixed\ effects + Firm\ fixed\ effects + \varepsilon_{i,t} \qquad (2) \end{aligned}$$

The coefficients of our interest β_{1-5} report the mean value of cash holdings over each time period, relative to the benchmark that exceeds 6 years prior to the adoption of RPS in a state, after adjusting for year- and firm-fixed effect. If the adoption of RPS policy is truly exogenous and is not drive by ex-ante increases in the value of cash, then β_1 and β_2 (before the adoption of RPS policy) should be insignificant.

4. Empirical results

4.1 Summary statistic and correlation analysis

Summary statistics for the full sample are presented in Table 1. The average excess stock return is 0.7%, with the median value of −8.7%, which is consistent with prior research that return distribution are skewed to the right (Louis et al., 2012; Faulkender and Wang, 2006). The average change in cash holdings is positive, accounting for 1.2% of their total market value of equity, which is consistent with the notion that, on average, firms have been increasing their cash holdings over time (Bates et al., 2009; Itzkowitz, 2013). Moreover, earnings and net assets have increased

2.2% and 7.3% over time, respectively, whereas R&D expense, interest expense, and dividend payments seem to be relatively stable (Louis et al., 2012). The statistics of other control variables could be comparable to existing literature (Faulkender and Wang, 2006; Louis et al., 2012).

<Insert Table 1 here>

To eliminate potential multicollinearity concerns, we illustrate the pairwise correlation coefficients of variables based on the sample. As shown in Table 2, excess stock return is significantly and negatively related to interest expense and market leverage, and statistically positive with other control variables, which are in line with Faulkender and Wang (2006). All correlation coefficients range from 0.001 to 0.469, which are well below 0.6, suggesting that multicollinearity issue is not a concern in our regression estimations. Additionally, the variance inflation factors (hereafter VIFs) are well below the threshold of 10 initiated by Neter, Kutner, Nachtsheim, and Wasserman (1996), which further rule out the multicollinearity concern in our study. Results for VIFs are not presented for brevity.

<Insert Table 2 here>

4.2 Baseline regression results

The results of RPS's impact on the value of cash holdings obtained from the estimation of our baseline regression model (1) are presented in Table 3. The coefficient measures the dollar change in shareholder value resulting from a one dollar change in the amount of cash held by the firm (Faulkender and Wang, 2006). In Column (1), the initial coefficient estimate corresponding to the change in cash holdings suggests that an extra dollar of cash is only valued by shareholders at \$0.808, after adjusting for year- and firm-fixed effect. This value changes dramatically when we incorporate interaction terms in Column (2), with the estimated marginal value of cash for a firm increasing to \$1.239. Importantly, the coefficient of $\triangle C_{i,t} \times RPS_{i,t}$ is 0.199, with 1% level of statistical significance, suggesting that the marginal value of cash is significantly higher (\$0.199) in firms with the passage of RPS relative to those without, providing support to our hypothesis that RPS policy will increase the value of cash holdings. We refer to Chowdhury et al. (2021) and further assess the economic significance of the RPS policy. Ceteris paribus, for the mean firm with cash holdings equivalent to 18.6% relative to the market value of equity and an average leverage ratio of 25.7% at the beginning of the fiscal year (the mean value of $C_{i,t-1}$ and $ML_{i,t}$ is 0.186 and 0.257 as shown in summary statistics), the marginal value of cash before the adoption of RPS is \$0.949 (\$1.239− \$0.331×18.6%− \$0.888×25.7%). After the adoption of RPS, the value of cash increases to \$1.148 (\$1.239+ \$0.199 − \$0.331×18.6%− \$0.888×25.7%). These figures show that relative to the value of cash holdings in control states, the estimated value of \$1 cash holdings in treatment states increases by about 21% ((\$1.148−\$0.949)/ \$0.949) after the adoption of RPS. Those findings suggest that on average the marginal value of cash holdings increases significantly, both statistically and economically, after the passage of RPS policy. To exclude any other policy effect specific to various states in a year, we further control for state-year fixed effect (Serfling, 2016; Ni and Yin, 2018) in our staggered DID regressions in Column (3−4), with the RPS dummy being subsumed. We display similar results as shown in Column (1−2), which provides further evidence that having RPS policy significantly and economically increases the value of a dollar of cash holding.

We also find that the coefficient for RPS is significantly negative with the excess stock return, suggesting that returns decrease by 2.2% after the RPS adoption, which is in line with the notion that RPS imposes greater financial and operational risks arising from higher electricity costs for firms and thus negatively affect the market reaction. As for control variables, earnings, net assets, R&D expense, dividend payments, lagged cash holdings, and net financing are significantly positive related to excess stock return, whereas interest expense and market leverage are statistically negative, which are consistent with Faulkender and Wang (2006).

<Insert Table 3 here>

To explore the dynamic effect of RPS implementation on the value of cash holdings, we establish a mean-shift effect model (Greenstone and Nath, 2021) and plot the corresponding dynamic coefficient trends over a three-year time span, relative to the benchmark that exceeds 6 years prior to the adoption of RPS in a state, incorporating year- and firm-fixed effect. Figure 1 plots the coefficient estimates of the interaction term $\triangle C_{i,t} \times RPS_{i,t}$ before and after RPS adoption, with 95% confidence intervals, after adjusting for state-level clustering. We find the 95% confidence interval include zero in the period of 4-6 years prior to the passages of RPS, suggesting that no statistically significant result is found during that period, which is consistent with our expectation. However, the graph shows a statistically significant increase in the period of 1−3 years prior to the RPS adoption, a trend that continues after the establishment of RPS policy. The pre-trend of RPS effect suggests that the market could respond to the RPS policy even at the initial embryonic stage of RPS Senate Bill legislative process. This argument is supported by anticipation effect of the policy proposed by Malani and Reif (2015).

US state Senate Bill legislative process can be extremely complicated and time-consuming[3]. The process generally is composed of proposing and drafting bills, holding hearings for debating or amending by the committee of both the Senate and House of Representatives, voting by the members of Senate and House of Representatives, reaching consensus by a conference committee made of Senate and House members, and finally being signed or vetoed by the governor. Similar process is applied to RPS policy, which is heatedly debated in public years prior to their adoption and thus the anticipation effect could well explain our results. We take the RPS policy adopted in New York state as an example. “Renewable Portfolio Standards” by New York state is first defined in 2001 and then the background and feasibility analysis are further refined in 2002 (The 2002 State Energy Plan required that the New York State Energy Research and Development Authority examine and report on the feasibility of establishing the RPS policy.). Finally, the policy is officially proposed by Public Service Commission in 2003 (On February 19, 2003, the Public Service Commission instituted a proceeding to develop and implement a RPS for electric energy retailed in New York state to address increasing concerns with the climate effects of, and over-dependence on, fossil-fired generation.) Following with another year and a half of public hearings and participation by over 150 parties, the “Order Approving Renewable Portfolio Standard Policy” was eventually issued on Sep 24, 2004.

<Insert Figure 1 here>

We report the RPS dynamic effect on the value of cash holdings estimated from the mean-shift regression model (2) in Table 4. Referring to Bertrand and Mullainathan (2003), we replace the RPS dummy with 5 dummy variables: *Year (−6, −4)* is a dummy variable equals one if the

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[3] Each state’s legislative process could be found here: https://www.statescape.com/resources/legislative/legislative-process/.

time is 4–6 years before the RPS' adoption in a state and zero otherwise. *Year* $(-3, -1)$ is a dummy variable equals one if the time is 1–3 years before the RPS' adoption in a state and zero otherwise. *Year (0, 3)* is a dummy variable equals one if the time is 0–3 years after the RPS' adoption in a state and zero otherwise. *Year (4, 6)* is a dummy variable equals one if the time is 4–6 years after the RPS' adoption in a state and zero otherwise. *Year (6+)* is a dummy variable equals one if the time is six years or more after the RPS' adoption in a state and zero otherwise. The interaction term allows us to assess whether any RPS effect can be found prior to the introduction of the RPS policy.

In Column (1), we find that the coefficient on $\triangle C_{i,t} \times Year\ (-6, -4)$ is statistically insignificant, however the coefficient on $\triangle C_{i,t} \times Year\ (-3, -1)$ is positive and statistically significant, indicating that our finding is consistent with the anticipation effect of RPS policy. The pre-trend of RPS effect suggests that the market responds to the RPS policy at the initial embryonic stage of RPS Senate Bill legislative process. The pre-trend has significant implications for understanding a full picture of RPS effect. Without identifying anticipation effects with the same sign as post-adoption effects will underestimate the full treatment effect of RPS policy. The coefficients corresponding to $\triangle C_{i,t} \times Year\ (0, 3)$, $\triangle C_{i,t} \times Year\ (4, 6)$, *and* $\triangle C_{i,t} \times Year\ (6+)$ remain positive at 1% level of statistical significance, suggesting a profound and sustainable effect of RPS on the value of cash holdings for the RPS-compliant firms. In Column (2), we further include a variable *Trend* for the varying time trend in each period in our regression model. Specifically, *Trend* is an indicator for each year t relative to the RPS's adoption year (i.e., year 0). For states that never adopt an RPS program, *Trend* is set to zero. We find the dynamic coefficients of RPS on the value of cash are generally similar in magnitude to the results presented in Column (1). Overall, our findings suggest that anticipation effect matters greatly when estimating policy treatment effect.

<Insert Table 4 here>

4.3 Cross-sectional analysis

We further perform cross-sectional analysis to understand the heterogeneity of the treatment effect (e.g., financial constraint, market power, internal capital mobility, growth opportunities, electricity intensity). We use cross-sectional subsamples rather than triple interaction in our analysis since significant structural breaks between the subsamples are identified, with all the p-values of Chow test being zero.

4.3.1 Financial constraint subsample

Our previous evidence supports that post-RPS electricity price shock leads firms to have a stronger precautionary motive for holding cash. We assume that such result could be strengthened when firms experience greater financial constraints. Financially constrained firms face more downside risk (Goldstain, Ozdenoren, and Yuan, 2013) and are more likely to experience increased costs of external financing (Hennessy and Whited, 2007). An extra precautionary dollar of internal funds enables RPS-compliant firms to avoid the higher costs of external capital, thereby, rendering internal funds relatively more valuable than firms that can easily raise cash. In this section, we examine the effect of RPS policy on the value of cash holdings by subdividing our sample with different degree of firm's financial constraint. We expect the positive RPS effect on the value of cash would be stronger in financial constraint subsample.

Following existing literature (Hadlock and Pierce, 2010), we use *HP index*[4] as a proxy for financial constraint. We follow Hodlock and Pierce (2010) and construct the *HP Index* as $-0.737 \times Ln\ (AT) + 0.043 \times Ln\ (AT) \times Ln\ (AT) - 0.040 \times AGE$, where AT is the total assets. AGE is the firm age, which is calculated as the number of years since the firm's IPO. Firms are classified as constrained if *HP index* is above the industry median value (three-digit SIC code). Column (1-2) of Table 5 illustrates the findings for financial constraint subsamples. The coefficient of interaction term $\triangle C_{i,t} \times RPS_{i,t}$ for constrained firms as shown in Column (1) is 0.226 at 1% level of statistical significance, whereas the coefficient for unconstrained firms is 0.131 as presented in Column (2). We then follow Cleary (1999) and employ Fisher's permutation test (Fisher, 1935; Pitman, 1937; Pitman, 1938) to examine the difference in coefficients' magnitudes between subsamples. The empirical p-value of Fisher's test (1000 simulations) is reported close to the bottom of the table with the value of 0.000, indicating that the difference is statistically significant. The analysis suggests that constrained firms are exposed to a stronger RPS impact on the value of cash relative to unconstrained firms.

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[4] We also employ *Payout Ratio* (Chen and Chen, 2012), *Credit Rating* (Farre-Mensa and Ljungqvist, 2016), and *Composite Indicator* (Bartram, Hou, and Kim, 2022) as alternative measurements for financial constraints. All the findings are consistent with *HP Index*. Results for these measurements are not presented for brevity.

4.3.2 Market power subsample

We argue that market (monopoly) power plays a moderating role on the relationship between RPS and the value of cash. Economic theory indicates that firms possessing market power may be able to use this power to raise profits above levels that would otherwise exist in a more competitive environment (Moyer and Chatfield, 1983). Thus, firms with higher market power have more pricing power that enables them to pass on post-RPS electricity cost shock to consumers through higher prices (Abdoh and Varela, 2017), given that customers have fewer substitutes to escape price increase (Gaspar and Massa, 2006). Hence, firms with higher market power have less precautionary motive for reserving cash to hedge against RPS cost shock. Consequently, we suppose the impact of RPS on the value of cash would be less pronounced for firms with higher market power.

Referring to Giroud and Mueller (2010), we use *sales-based Herfindahl-Hirschman Index*[5] (*HHI*) as our proxy for market power. We define *HHI* as the sum of squared market shares of all firms in an industry (three-digit SIC code), computed as $HHI_{jt} = \sum_{i=1}^{N_j} SALES_{i,j,t}{}^2$, where *SALES* is the firm's net sales as a proportion of all firms' total sales in the same industry. To address the issue of sales volatility, we use a three-year moving average *HHI* as suggested by Giroud and Mueller (2010). We classify a firm as having higher market power if its industry *HHI* falls in the highest quintile across the industries in the sample. Column (3-4) of Table 5 presents support for our cross-sectional predictions. We find that the RPS policy has no significant effect on the value of cash holdings for firms with higher market power (Column (3)), however the coefficient of $\triangle C_{i,t} \times RPS_{i,t}$ remains positive with the statistical significance level of 1% for firms with lower market power (Column (4)). The empirical p-value of Fisher's test (1000 simulations) is below 0.01, indicating that the difference in the marginal value of cash is significant at better than 1%. The results validate that higher market power could alleviate the effect of RPS on the value of cash.

4.3.3 Internal capital mobility subsample

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[5] We use asset-based Herfindahl-Hirschman Index (*HHI*) (Giroud and Mueller, 2010) and the number of firms in the industry (Stigler, 1964; Stigler, 1983; Jiang, Kim, Nofsinger, Zhu, 2015) as alternative measurements of market power. We find similar results as sales-based *HHI*.

A large amount of prior study validates the effectiveness of internal capital markets of conglomerate firms, highlighting their efficient allocation of firms' capital resources (Shin and Stulz, 1998; Lamont, 1997; Khanna and Tice, 2001). Conglomerate firms could fund profitable projects that would otherwise be forgone due to costly external financing (Stulz, 1990) and could function as a natural hedge against financing and predation risk (Subramaniam et al., 2011), by creating a larger internal capital market. We assume the diversified structure in conglomerate firms would relieve post-RPS energy cost shock, because the diversified firm structure in itself may act as a substitute for cash reserves (Subramaniam et al., 2011). By contrast, standalone firms might face a stronger effect of RPS on the value of cash, since the lack of internally funds would increase their precautionary motive for holding cash to adapt to the RPS cost shock.

Following Comment and Jarrell (1995), we use business-segment data in Compustat and distinguish conglomerate firms from the number of segments reported by management. Referring to Cohen and Lou (2012), we define conglomerate firms that operate in more than one segment[6] and whose aggregate assets from all reported segments account for more than 80% of the total assets of the firm. The latter condition is to ensure that the sum of all segments of a conglomerate firm in our sample is a fair representation of the entirety of the firm. Column (5-6) of Table 5 present the findings for firm structure subsamples. We find that the coefficient of the interaction term $\triangle C_{i,t} \times RPS_{i,t}$ is only 0.095 in conglomerate firms (Column (5)), while the coefficient of the interaction term is 0.206 in standalone firms, with the statistical significance level of 1% (Column (6)). Following Cleary (1999), we use simulation evidence to determine the significance of the observed differences in coefficient estimates. We find the coefficient in conglomerate firms is significantly smaller in magnitude compared to standalone firms, with p-values of Fisher's permutation test < 0.01 (1000 simulations). The findings are supportive of the assumption that internal capital market could mitigate the effect of RPS cost shock in conglomerate firms.

4.3.4 Growth opportunity subsample

Myers and Majluf (1984) and Jensen (1986) argue that the valuation of liquidity would be most affected by the growth opportunities of the firm. We therefore explore the cross-sectional variation related to the firm's growth opportunity on the effect of RPS on the value of cash. Firms

[6] We also use distinguish standalone firms and conglomerate firms based on the number of reported four-digit SIC codes (Comment and Jarrell, 1995), and our finding is qualitatively robust.

with higher growth opportunity face a greater threat of losing the investment opportunity, and thus they have higher demand for precautionary cash to enhance their resilience to the RPS-induced cost shock. Holding a cushion of liquid assets clearly preserve value by protecting management's ability to carry out its strategic plan and shielding firms' investment opportunity (Pinkowitz and Williamson, 2007; Pinkowitz and Williamson, 2002). Therefore, in response to the RPS cost shock, investors may effectively assign a greater value on firms' marginal dollar of cash in higher-growth firms than those with fewer growth opportunities.

We divide our sample into higher- and lower-growth subsamples using *Tobin's Q*[7] as the proxy variable of growth opportunity (Denis and Osobov, 2008). *Tobin's Q* is measured as the ratio of the market value of total capital (book value of total assets − book value of equity + market value of equity) to the book value of total assets. A firm is coded as high-growth company if its measured growth opportunity is above its industry median value (three-digit SIC code). Column (7-8) of Table 5 present the RPS' effect on the value of cash holdings for firms with higher- and lower- growth opportunities, respectively. We find that the coefficient on $\triangle C_{i,t} \times RPS_{i,t}$ is significantly positive and larger (0.334 in Column (7)) in magnitude for higher-growth firms, compared to that in firms with lower growth opportunity (0.128 in Column (8)). The magnitude of the values assigned to cash differ significantly, with p-value of 0.000 under Fisher's permutation test (1000 simulations), suggesting that firms increase the value of cash more dramatically for those with higher growth opportunity when facing the electricity price shock.

<Insert Table 5 here>

4.3.5 Electricity intensity subsample

Our findings suggest that the RPS-induced electricity price shock leads to a higher value of cash. A natural question to ask is whether more electricity-intensive firms would be more exposed to this policy. To explore the heterogeneity in the RPS effect for firms with various degrees of electricity intensity, we calculate firm-level electricity intensity by using business-segment data (the business-segment data is available since 1976, and each segment is assigned with a four-digit SIC code), weighted by the percent of sales in each segment of firm based on

[7] Similar findings when we use sales growth (Klapper and Love, 2004) and assets growth (Titman and Wessels, 1988) as the proxies for growth opportunity.

industry electricity intensity data. We follow Dang et al. (2022) and define industry electricity intensity measure as the ratio of the quantity of purchased electricity (measured in trillions of British thermal units) to the value of total shipments (measured in billions of dollars). The data is obtained from the Supplement Tables of Annual Energy Outlook Products of the U.S. EIA for both manufacturing industry (including refining, food, paper, bulk chemical, glass, cement, iron and steel, aluminum, fabricated metal product, machinery, computers, transportation equipment, electrical equipment, wood products, plastics, and balance of manufacturing) and non-manufacturing industry (including only agriculture, construction, and mining)[8]. We classify a firm as having higher electricity intensity if its electricity intensity is above the median value in a year. Since RPS influences corporate financial decisions via an increase in electricity prices, we expect the treatment effect should be stronger for firms with higher electricity intensity.

Table 6 reports the RPS's effect on the value of cash holdings for the subsamples of varying level of electricity intensity. Column (1-2) reports the RPS' effect on the value of cash holdings using firms in both manufacturing and non-manufacturing industry. We find that the coefficient on $\triangle C_{i,t} \times RPS_{i,t}$ is 0.302 for firms with higher electricity intensity (Column (1)), which is larger than 0.182 for firms with lower electricity intensity (Column (2)). We also present robustness checks by using firms in manufacturing industry only in Column (3-4), the results of which show a similar pattern. We continue to find that the firms with higher electricity intensity are most affected by RPS energy cost shock, with the coefficient appears 0.331 in Column (3) and 0.242 in Column (4). We follow Cleary (1999) and use Fisher's test (1000 simulations) to examine the difference in the magnitudes between the subsamples. The significant empirical p-value further verifies that the coefficient is statistically larger in electricity-intensive firms, supporting our conjecture that the effect of RPS policy on the value of cash is indeed more pronounced for firms with higher electricity intensity.

<Insert Table 6 here>

[8] To match the EIA data with our Compustat sample, we use SIC code for the following manufacturing and non-manufacturing industries: manufacturing industry includes refining (29), food (20), paper (26), bulk chemical (28), glass (321-323), cement (324-329), iron and steel (331-332), aluminum (333-339), fabricated metal product (34), machinery (351-356, 358-359), computers (357), transportation equipment (37), electrical equipment (36), wood products (24-25), plastics (30), balance of manufacturing, while non-manufacturing industry includes agriculture (01-09), construction (15-17), mining (10-14).

Above, we examine the possible cross-sectional heterogeneity in the RPS's effects on the value of cash holdings. We find that firms with higher financial constraint, lower market power, lower internal capital mobility, higher growth opportunities, or higher electricity intensity, would adjust their value of cash more dramatically in response to the RPS-induced electricity price shock. Our results provide useful insight and guidance on firms' adaption strategies to climate challenges and transition to clean energy, as well as contribute to building firms' resilience to climate change risks of increasingly stringent environmental regulations.

4.4 RPS stringency

As reported in 2nd, Feb, 2023, the Biden administration sets out an ambitious target of 80% renewable energy generation by 2030 and 100% carbon-free electricity by 2035. To achieve this goal, RPS policy requires an increasing percentage of energy generated from renewables, leading to an increased RPS stringency over time (Greenstone and Nath, 2021). We further consider the potential impact of RPS stringency (instead of RPS indicator) on the value of cash in the regression as additional evidence to support our findings. We employ the RPS net requirement to proxy the RPS stringency, calculated as the difference between statutory requirements and qualified pre-existing renewable generation. Higher RPS stringency indicates a higher amount of new renewable generation required to comply with the policy, and thus leads to a relatively higher energy cost for firms. Firms with higher RPS stringency would have a stronger precautionary motive to hold cash in case of grabbing any transient growth opportunities or hedging potential financial risks. Therefore, we expect the value of cash will substantially increase as the RPS policy is getting more stringent.

We employ two measurements for *RPS Stringency*. First, we measure *RPS Stringency* as the ratio of net requirement to total electricity consumption, computed as (RPS requirements at year *t* / total electricity consumption at year *t* − RPS achievement at year *t*-1 / total electricity consumption at year *t*-1. Second, we use the ratio of net requirement to total RPS requirements, calculated as (RPS requirements at year *t* − RPS achievement at year *t*-1) / RPS requirements at year *t*. Data is collected from Lawrence Berkeley National Laboratory (LBNL) and Energy Information Administration (EIA). We set *RPS Stringency* to zero if the firms are not in RPS-compliant states. Table 7 reports the result of the impact of RPS stringency on the value of cash holdings. Consistent with our expectation, we find a statistically significant increase in the market value of a change in cash holding. The result holds for both of the *RPS Stringency* measurements as reported in Column (1) and Column (2). The effect of *RPS Stringency* is also economically large. Ceteris paribus, one-standard-deviation increase in the *RPS Stringency* is associated with an increase of 4.8% and 7.9%[9] of the sample mean value of excess stock return, respectively. The findings show that the effect of RPS stringency on the value of cash is both economically substantial and statistically significant. The results support our assumption that the RPS stringency increases the value of cash holdings.

<Insert Table 7 here>

4.5 The level of cash holdings

Apart from analyzing the value of cash holdings, we also examine whether firms indeed increase their cash holdings after RPS' adoption. Given the marginal return to reserve cash increases, we assume the level of firm cash holdings to increase until it reaches a new level where the renewed marginal return of holding cash equals its marginal cost. Moreover, since RPS policy is an exogenous shock, firms experience no corporate governance issue, and thus agency problem is not a big concern of our assumption. Consequently, the higher marginal return of cash holdings than the cost would naturally lead firms to increase their level of cash holdings. To test this auxiliary hypothesis, we again use a staggered difference-in-difference approach and control for the determinants of cash holdings suggested by Harford, Mansi, and Maxwell (2008) as follows:

$$\begin{aligned} CashHolding_{i,t} &= \beta_0 + \beta_1 RPS_{i,t} + \beta_2 Size_{i,t-1} + \beta_3 Leverage_{i,t-1} + \beta_4 Tobin's\ Q_{i,t-1} \\ &+ \beta_5 Cash\ Flow_{i,t-1} + \beta_6 CF\ Volatility_{i,t-1} + \beta_7 Working\ Capital_{i,t-1} \\ &+ \beta_8 R\&D_{i,t-1} + \beta_9 Capex_{i,t-1} \\ &+ \beta_{10} Acquisition_{i,t-1} + Year\ fixed\ effects + Firm\ fixed\ effects \\ &+ \varepsilon_{i,t} \qquad (3) \end{aligned}$$

We define *CashHolding* as the cash and short-term investment held by the firm. RPS is a dummy variable that equals to 1 at the year of RPS legislation and afterwards, and 0 otherwise. Following Harford et al. (2008), the control variables for the cash regression include the natural

[9] Calculated as the standard deviation of *RPS Stringency* multiply the coefficient of $\triangle C\times$ *RPS Stringency* multiply the mean value of $\triangle C$, divided by the mean value of *Return*.

logarithm of firm size (*Size*), firm leverage (*Leverage*), ratio of the market value to book value of assets (*Tobin's Q*), cash flow (*CF*), standard deviation of cash flows for the past 5 years (*CF Volatility*), net working capital (*Working Capital*), research and development (*R&D*), capital expenditures (*Capex*), and acquisitions (*Acquisition*). We include year- and firm-fixed effect in the model, with the standard errors clustered by state. We also control additional indicator variables for firms that pay dividends (*Payout Ratio*) and for firms with long-term S&P, Moody's, Fitch, or Duff & Phelps ratings (*Bond Rating*) for robustness check (Harford et al., 2008). All variable definitions are presented in Appendix 2.

Table 8 displays the effect of RPS policy on the level of cash holdings. In Column (1), we find the coefficient on RPS is positive with 1% level of statistical significance, indicating that the level of cash holdings increases significantly after the passage of RPS policy. We find similar results after including *Payout Ratio* and *Bond Rating* in the regression in Column (2), suggesting the result of a significant and positive treatment effect is quite robust. In terms of economic magnitude, after the adoption of the RPS, we find the cash holdings increase by 6.0%[10] relative to the sample mean for both models. Taken together, the findings suggest that the positive effect of the RPS policy on cash holdings is statistically and economically significant. The result is consistent with our prediction that the adoption of RPS indeed increases firms' level of cash holdings.

<Insert Table 8 here>

5. Robustness checks

5.1 Propensity score matching

To address the endogeneity problems on self-selection bias by observable firm characteristics, in this section, we re-examine the effect of RPS policy on the value of cash holdings by employing propensity score matching approach to ensure that the treatment and control groups have similar financial characteristics before the onset of RPS adoption. To construct the PSM sample, we use a logit model to estimate the likelihood that a firm is in a state that has adopted the RPS, where the propensity score of RPS adoption is modeled as a function of all the control variables included in the baseline value-of-cash model (Table 3) together with industry- (three-

[10] Calculated as the coefficient on RPS divided by the mean value of cash holdings.

digit SIC code) and year-fixed effects. For each treatment firm we select a control firm, from all firms in those states that never adopt the RPS in our sample period, whose propensity score in year $t-1$ is the closest to that of the treated firm, without replacement and with a maximum radius of 0.01.

Table 9 presents the RPS's impact on the value of cash holdings, estimated using the PSM firm-year observations. Consistent with earlier findings, the coefficient on $\triangle C_{i,t} \times RPS_{i,t}$ continues to load positive and significant in Panel A, suggesting that the observed positive effect is not driven by observable difference in firm financial characteristics. We tabulate the mean value of all the matching variables for treatment and control groups in Panel B, as well as their mean difference. The p-value from t-tests indicates that the mean difference between these two groups is statistically insignificant at 10% significance level, which verifies a successful matching based on propensity scores. Overall, the results show that the treatment effect remains qualitatively the same as our baseline results using the PSM sample.

<Insert Table 9 here>

5.2 Entropy balancing

Entropy balancing (EB), proposed by Hainmueller (2012), is a preprocessing procedure that create balanced samples for the subsequent estimation of the treatment effect. In contrast to PSM, EB involves a reweighting scheme that assign a scalar weight to each sample unit, so that the reweighted data could further balance out the covariates with prespecified moments. Follow Hainmueller and Xu (2013), we apply the STATA package called EBALANCE to adjust the sample including the means, variance, and skewness of all the covariates, as well as their first order interactions. The covariate balance is significantly improved compared to the unbalancing data between treated and control groups. Table 10 reports the causal effects of RPS on the value of cash by using EB sample. We regress the outcome on the RPS in the reweighted data and continue to observe the RPS has a significant and positive effect on the value of cash holdings. Overall, we conclude that our main inference is robust to the EB analysis.

<Insert Table 10 here>

5.3 Excluding the effect of ISOs and RTOs

An Independent System Operator (ISO) or Regional Transmission Organization (RTO) in the United States is an electric power transmission system operator that coordinates, controls, and monitors a multi-state electric grid. The establishment year and state members of ISO or RTO are presented in Appendix 3. ISOs or RTOs administer regional wholesale electricity markets and ensure fair electricity prices, to promote economic efficiency, reliability, and non-discriminatory practices. Therefore, the electricity prices in the same ISO or RTO converges. To obtain a cleaner control sample for our DID model, we exclude firms located in the non-RPS states that share the same ISO or RTO with the RPS states. Table 11 reports the impact of RPS policy on the value of cash holdings excluding the confounding effect of ISOs or RTOs. The coefficient on the interaction term $\triangle C_{i,t} \times RPS_{i,t}$ keep positive and significant, suggesting the effect of RPS policy on the value of cash is persistent. Overall, we argue that the positive effect of RPS policy on the value of cash could barely be changed after considering the potential effect of ISOs or RTOs.

<Insert Table 11 here>

5.4 Controlling for confounding policies

Another endogeneity concern about our analysis is the presence of several energy industry regulations other than RPS that may impact electricity consumption and pricing and hence confound our empirical findings. We then introduce potential confounding policies, namely, *EERS, GPP, GHGRP*, and *NBP* program, to further address the concern that our empirical findings might be confounded by these regulations (Greenstone and Nath, 2021; Dang et al., 2022). Specifically, *EERS* is the Energy Efficiency Resource Standards, under which the utilities must procure a percentage of their future electricity and natural gas needs using energy efficiency measures. *GPP* is EPA's Green Power Partnership program that encourages organizations to buy green power to reduce the environmental impacts of their electricity use. *GHGRP* is the Greenhouse Gas Reporting Program, which requires certain facilities to report their emissions of greenhouse gases, in the aim to recognize the sources of emissions to guide development of policies to reduce emissions. *NBP* is NOx Budget Trading Program, a regional cap-and-trade program aimed at mitigating the NOx emissions in the United States. Details on the legislative year of each state are illustrated in Appendix 4. Table 12 presents the impact of RPS policy on the value of cash after controlling for these confounding policies. The coefficients on the interaction term $\triangle C_{i,t} \times RPS_{i,t}$ shown in Column (1−4) remain positive and significant at 1% level of statistical significance in each model. In Column (5), the result persists after we control for all policies in the same specification. Overall, the analysis suggests that our statistical inferences are not affected by these confounding polices.

<Insert Table 12 here>

5.5 Alternative measures of change in cash

Up to now, we apply the change in cash and short-term investment in our econometric specifications. Following Faulkender and Wang (2006), we conduct robustness checks by using three alternative measures of change in cash over the fiscal year. The first alternative measure is portfolio-adjusted change in cash, which is calculated by the change in cash and short-term investment net the average change in cash in the benchmark portfolios during the corresponding fiscal year. The benchmark portfolios are Fama-French 25 size and book-to-market value-weighted portfolios. For the other two measures, we employ the unexpected change in cash, which is obtained from the residuals of the change in cash models proposed by Almeida et al. (2004) (a parsimonious model in Page 1787 and an augmented model in Page 1788). The first parsimonious model specification we use is as follows:

$$\triangle C_{i,t} = \beta_0 + \beta_1 Cash\ Flow_{i,t} + \beta_2 Tobin's\ Q_{i,t} + \beta_3 Size_{i,t} + \varepsilon_{i,t} \qquad (4)$$

where the *Cash Flow* is income before extraordinary items plus depreciation and amortization, *Tobin's Q* is the market value divided by the book value of assets, and *Size* is the natural logarithm of firm size. The second model is the extension of the first model referring to Almeida et al. (2004), which includes four additional variables, namely, $Expenditures$ (capital expenditures), $Acquisitions$ (acquisitions), $\triangle NWC$ (change in noncash working capital), and $\triangle Short\ Debt$ (change in short-term debt). The second augmented model is specified as follows:

$$\begin{aligned}\triangle C_{i,t} = \beta_0 + \beta_1 Cash\ Flow_{i,t} + \beta_2 Tobin's\ Q_{i,t} + \beta_3 Size_{i,t} + \beta_4 Expenditures_{i,t} \\ + \beta_5 Acquisitions_{i,t} + \beta_6 \triangle NWC_{i,t} \\ + \beta_7 \triangle Short\ Debt_{i,t} + \varepsilon_{i,t} \qquad (5)\end{aligned}$$

The results using these three alternative measures of change in cash appear in Column (1−3), respectively, of Table 13. We explicitly include year- and firm-fixed effect to control for possible unobservable individual heterogeneity. All the estimated coefficients of $\triangle C_{i,t} \times RPS_{i,t}$ are similar in magnitude with the statistical significance level of 1%. The unpresented results for dynamic effects are consistent with previous results. The stability of these findings demonstrates that using alternative measures change of cash would not affect our assumptions.

<Insert Table 13 here>

5.6 Alternative measures of excess stock return

Furthermore, we also employ unexpected stock returns, which is captured by the value of the residual terms from Fama and French three-factor model (Fama and French, 1993), Carhart four-factor model (Carhart, 1997), and Fama and French five-factor model (Fama and French, 2015), as the alternative measures of excess stock return. The model specifications we use are as follows:

$$R_{i,t} - R_{f,t} = \beta_0 + \beta_1(R_{m,t} - R_{f,t}) + \beta_2 SMB_t + \beta_3 HML_t + \varepsilon_{i,t} \qquad (6)$$

$$R_{i,t} - R_{f,t} = \beta_0 + \beta_1(R_{m,t} - R_{f,t}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 Mom_t + \varepsilon_{i,t} \qquad (7)$$

$$R_{i,t} - R_{f,t} = \beta_0 + \beta_1(R_{m,t} - R_{f,t}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 RMW_t + \beta_4 CMA_t + \varepsilon_{i,t} \qquad (8)$$

where $R_{i,t}$ is the annual stock return on individual security in year *t*, $R_{f,t}$ is the risk-free return in year *t*, $R_{m,t}$ is the return on the value-weight market portfolio in year *t*, SMB_t is the difference between the returns on a diversified portfolios of small and big stocks in year *t*, HML_t is the difference between the returns on diversified portfolios of high and low B/M stocks in year *t*, RMW_t is the difference between the returns on diversified portfolios of stocks with robust and weak profitability in year *t*, and CMA_t is the difference between the returns on diversified portfolios of stocks of low and high investment firms in year *t* (Fama and French, 1993; Fama and French, 2015). Mom_t is one-year momentum in stock returns in year *t* (Carhart, 1997).

If an asset pricing model completely captures expected return, the individual firm residuals would be the unexpected return (excess stock return) that are unexplained by exposures to the current factors. We analyze the models using annual stock returns and calculate the residuals as the difference between realized return and model-fitted return. Table 15 shows the robustness checks using the value of residuals as the alternative measures of excess stock return. We find the significant relationship between the RPS and the value of cash is persistent as shown in Column (1-3). Moreover, the unreported dynamic effects remain qualitatively unchanged, which provides solid robust evidence to our hypothesis.

<Insert Table 14 here>

5.7 The impact threshold for confounding variable (ITCV) test

To further exclude that our regression results might be driven by the potentially confounding, omitted variables, we conduct the impact threshold for confounding variables (ITCV) following Larcker and Rusticus (2010, p.202) and Frank (2000) to address this endogeneity concern. Omitted-variable bias is induced by the omitted variable's correlation with the independent variable of interest and its correlation with the dependent variable. The product of these two correlations would reflect the extent of the omitted-variable bias (Dai, Fu, Kang, and Lee, 2016). We assess this bias by computing the value of ITCV, beyond which our findings might be biased or even invalidated if such a confounding variable is incorporated in our model. Following Frank (2000), we calculate ITCV as the lowest product of the raw (partial) correlations between the confounding variable and the independent variable and between the confounding variable and dependent variable. The greater the magnitude of ITCV is, relative to the raw (partial) impact of the control variables, the less likely that our results of the baseline regressions are subject to the confounding-, omitted-variable bias. Table 15 demonstrates the ITCV estimates of our baseline model. As is shown in the Column (3) and Column (6), we find the value of ITCV is 0.0086, implying that a raw (partial) impact of the potentially confounding, omitted variable needs to exceed 0.0086 to overturn our main results. Clearly, our result indicates that no confounding, omitted variable has a raw or partial impact with a greater magnitude than 0.0086 as shown in Column (3) and Column (6) for each control variable. This table thereby provides assurance that our baseline regression estimates are immune from this confounding-variable endogeneity issue.

<Insert Table 15 here>

5.8 Stacked regression estimator

Baker, Larcker, and Wang (2022) argues that staggered DID regressions are susceptible to biases introduced by treatment effect heterogeneity. They document that the impact of policy changes that rely on staggered treatment timing can result in Type-I and Type-II errors. Moreover, Sun and Abraham (2021) shows that even dynamic treatment effect would be a problematic. They argue that in the presence of staggered treatment timing and treatment effect heterogeneity, the dynamic effect estimates for one relative-time period is contaminated by the causal effects of other relative-time periods in the estimation sample. Thus, the important challenge we have identified in the chosen methodology is that staggered DID estimates could likely be biased. An approach developed for circumventing the above issue is a "stacked regression" (Baker et al., 2022; Cengiz et al., 2019). The idea is to create event-specific "clean 2*2" datasets (each involving the comparison between a treated and an effective control group in a window before and after the treated group receives treatment), including the outcome variable and controls for the treated observations and all other observations that are "clean" controls. For each clean 2*2 dataset, the researcher generates a dataset-specific identifying variable. These event-specific data sets are then stacked together, and a DID regression is estimated on the stacked dataset, with dataset-specific unit- and time-fixed effects. Thus, we intend to use stacked regression estimator as robustness check to solve the problems introduced by staggered treatment timing and treatment effect heterogeneity. Table 16 reports estimates using the stacked regression estimator and suggests strong evidence of a statistically significantly positive impact of RPS on the value of cash, either when we consider the RPS treatment effect (Column (1)) or the dynamic effect (Column (2)).

<Insert Table 16 here>

5.9 The placebo tests

DID estimation could over-reject the null hypothesis when long time series are used, since the dependent observations within each firm are serially correlated because of that (Bertrand, Duflo, and Mullainathan, 2004). To alleviate this issue, we follow Guo and Masulis (2015) and conduct placebo test by randomly assigning the RPS status to each firm. Specifically, we firstly select exactly 32 states at random and designate them as RPS pseudo state, and then we randomly assigned each pseudo state a pseudo year. We create pseudo RPS policy by interacting pseudo state and pseudo year. To increase the identification power of placebo test, we repeat the data generation process and run the DID regression 1000 times. Figure 2 shows the distribution of estimated t-statistics of the interaction term of $\triangle C_{i,t} \times RPS_{i,t}$ from 1000 simulations of pseudo RPS shock to the value of cash holdings. To be comparable, we also plot the original t-statistics on $\triangle C_{i,t} \times RPS_{i,t}$ in our baseline model (7.71 in Column (2) of Table 3) with vertical dashed pink line. We find the vertical dashed pink line are located outside the distribution of estimated *t*-statistics from the simulations. The placebo test provides further evidence that the increased value of cash holdings is caused by the RPS shock other than other unobservable or unmeasurable shocks.

<Insert Figure 2 here>

5.10 Mechanism of the RPS policy

In this section, we identify the possible economic mechanisms that could drive our baseline findings. We assume that the RPS policy could affect the value of cash holdings via decreasing firm's level of cash flow and increasing the cash flow volatility. To validate these mechanisms, we estimate the staggered DID regressions presented in Table 17, with the level of cash flow and cash flow volatility as the main dependent variables. The choice and measures of the control variables follow Ang, Hodrick, Xing, and Zhang (2009) and Bernile, Bhagwat, and Yonker (2018), along with year and firm fixed effects in the specifications.

We first study the RPS's effect on firm's level of cash flow. We hypothesize that the RPS adoption reduces the level of cash flow for the treatment firms in RPS-compliant states. Given that the RPS policy imposes additional costs on electricity users via increased electricity prices (Greenstone and Nath, 2021), firms' cost of goods sold would be increased and thus the level of cash flow would be decreased. To test this prediction, in Column (1) of Table 17, we examine the effect of RPS on firms' portfolio-adjusted cash flow. We follow Minton and Schrand (1999) and define cash flow as sales less cost of goods sold less selling, general and administrative expense less the change in working capital. The result is consistent with our assumption that the degree of cash flow decreased post-RPS. The RPS's impact on cash flow is statistically significant and economically relevant. Specifically, firms' cash flow reduced by 40%[11] after RPS adoption. Additionally, we provide extra evidence in Column (2) by employing portfolio-adjusted Tobin' Q as the proxy for investment opportunity. Since a firm's cash flow shortfall could impair a firm's ability to grasp the investment opportunity when they emerge (Campbell et al., 2021), we conjecture that RPS policy would reduce investment opportunity as well. The finding is in line with our prediction, lending additional support that RPS implementation would reduce firms' level of cash flow.

[11] Calculated as the coefficient on RPS divided by the mean value of portfolio-adjusted cash flow.

Second, we examine how the RPS adoption would affect firm's cash flow volatility. We hypothesize that RPS adoption increases the cash flow volatility for the treatment firms in RPS-compliant states. Since the RECs price volatility would add costs to the utility firms, the higher costs would be passed to downstream electricity users in a higher electricity price, and the price volatility will be passed to downstream as well, leading to greater energy uncertainties and thereby increasing firms' cash flow volatility. Based on the Sheikh (2022) and Kim and Sorensen (1986), we measure cash-flow volatility as the standard deviation of cash flow scaled by the absolute value of the mean of cash flow over the trailing five years window. Column (3) of Table 17 presents the regression estimates of RPS's effect on firms' cash flow volatility. The result shows a significant and positive treatment effect, which is consistent with our cash flow volatility channel. In terms of economic magnitude, after RPS adoption, cash flow volatility increased by 13.8%[12]. We present extra test by applying stock-price volatility as additional evidence in Column (4). Since stock-price volatility reflects the degree of cash-flow uncertainty because stock prices tend to fluctuate more when cash flows are unpredictable (Chay and Suh, 2009), we predict that stock-price volatility would be increased as well post-RPS. We follow Kang and Liu (2008) and compute the stock-price volatility as the annualized standard deviation of stock returns using the past five years of monthly stock return data. We find similar results as in Column (3), suggesting that the RPS policy would indeed increase firms' cash flow volatility.

<Insert Table 17 here>

6. Conclusion

To mainstream the decarbonization of the world economy and reach net zero emissions by 2050, ambitious climate policies are implementing in both emerging and developing countries to accelerate the net-zero commitment over the next three decades. However, existing literature provides limited evidence on how climate policy shock influences corporate liquidity management. Our study fills this gap by identifying exogenous RPS policy shock to firms' most important liquidity assets: cash holdings. Our evidence supports that higher electricity prices post-RPS substantially and significantly increases the value of a dollar of cash, suggesting that firms in RPS-compliant states have a stronger precautionary motive for holding cash in case of grabbing any

[12] Calculated as the coefficient on RPS divided by the mean value of cash flow volatility.

transient growth opportunities or hedging potential financial risks. Interestingly, we uncover a full picture of the treatment effect of RPS policy by discovering a significant increase three-year window prior to the RPS adoption, revealing that RPS policy could be responded by the market even at the initial embryonic stage of RPS Senate Bill legislative process.

Our further cross-sectional analysis shows that firms exhibited heterogeneous response to the RPS implementation. Consistent with previous theories, firms increase the value of cash more dramatically for those with higher financial constraint, lower market power, lower internal capital mobility, higher growth opportunities, or higher electricity intensity, suggesting their multifaceted response to the RPS policy. Additional analysis on the effect of RPS stringency provides further evidence in supportive our findings. Supplementary analysis on the RPS effect on the level of cash holdings shows an expected positive relationship between those two, implying that firms indeed increase their cash holdings to adapt to the changing landscape of energy provision. We also provide additional evidence of the economic mechanisms driving our finding, that is, the level of cash flow and the cash flow volatility channels. Our study survives an array of robustness check, including employing PSM and EB approach, considering the effect of ISOs or RTOs, controlling for confounding polices (*EERS, GPP, GHGRP*, and *NBP*), using alternative measures of change in cash and alternative excess stock return, conducting ITCV test, applying stacked regression estimator as well as placebo tests.

Our research generates significant implications and impact on policies related to climate change and renewable technology. Two big announcements in European climate policy came on March 30, 2023. The European Union reached a provisional deal to increase its renewable energy targets, an important pillar of the bloc's plans to fight climate change and end dependence on Russian fossil fuels. And the United Kingdom released its long-awaited climate strategy, promising "an energy revolution" and setting out a pathway for the nation to reach net zero. However, these European governments had not adequately set out the specific rules or regulations on how it intended to reach net zero. The green energy policy, Renewable Portfolio Standards (RPS) in U.S., has set a constructive and insightful model by advancing renewable energy resources as the alternatives to coal, petroleum, and nuclear energy, for other countries. Our research findings highlight the expected or unexpected consequences on the corporate sector of such policies and feedback to the policy making process and inform sound policy making.

Our study also highlights the importance of understanding the implications of corporate adaption strategies and decisions related to climate policy. In the presence of unprecedented uncertainties due to climate and political uncertainty, renewable-energy policies like RPS play a crucial role in ensuring energy supply, mitigating climate challenges, and supporting economic and social development. Our findings help companies to understand the transition risks they face due to the adoption of renewable energy policy and enable them to optimize their responses to such challenges in the transition to renewable energy sources. Overall, our research facilitates a smooth transition to a greener and more sustainable economy and society around the world. Our research also lays the ground for further research on company risks in the context of green transition, company responses, decisions, and strategies to the climate policies and net-zero commitments, the economic and social externalities of company decisions in relation to the green transition, such as economic development, employment market and public health, among others.

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Table 1: Summary Statistics

Variable	Mean	1st Quartile	Median	3rd Quartile	Std
$Return_{i,t}$	0.007	−0.358	−0.087	0.213	0.625
$\triangle C_{i,t}$	0.012	−0.033	0.002	0.043	0.158
$RPS_{i,t}$	0.281	0.000	0.000	1.000	0.449
$\triangle E_{i,t}$	0.022	−0.030	0.010	0.054	0.195
$\triangle NA_{i,t}$	0.073	−0.034	0.047	0.193	0.528
$\triangle RD_{i,t}$	0.001	0.000	0.000	0.000	0.023
$\triangle I_{i,t}$	0.003	−0.002	0.000	0.006	0.034
$\triangle D_{i,t}$	0.000	0.000	0.000	0.001	0.014
$C_{i,t-1}$	0.186	0.038	0.101	0.227	0.251
$ML_{i,t}$	0.257	0.036	0.192	0.417	0.246
$NF_{i,t}$	0.046	−0.036	0.001	0.085	0.284
N			143264		

Note: This table presents the summary statistics of the sample during 1971–2020. Appendix 2 provides all variable definitions.

Table 2: Correlation Analysis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
$Return_{i,t}$	1.000										
$\triangle C_{i,t}$	0.207***	1.000									
$RPS_{i,t}$	0.009***	−0.014***	1.000								
$\triangle E_{i,t}$	0.277***	0.124***	−0.024***	1.000							
$\triangle NA_{i,t}$	0.133***	−0.033***	−0.059***	0.119***	1.000						
$\triangle RD_{i,t}$	0.025***	0.037***	−0.035***	−0.143***	0.130***	1.000					
$\triangle I_{i,t}$	−0.047***	−0.002	−0.029***	−0.017***	0.398***	0.039***	1.000				
$\triangle D_{i,t}$	0.059***	0.023***	−0.019***	0.050***	0.108***	0.012***	0.020***	1.000			
$C_{i,t-1}$	0.089***	−0.197***	0.052***	0.108***	−0.080***	−0.093***	−0.066***	−0.016***	1.000		
$ML_{i,t}$	−0.178***	−0.029***	−0.148***	−0.010***	−0.024***	−0.043***	0.154***	−0.045***	0.091***	1.000	
$NF_{i,t}$	0.057***	0.195***	−0.009***	0.001	0.469***	0.043***	0.326***	0.058***	−0.053***	0.060***	1.000

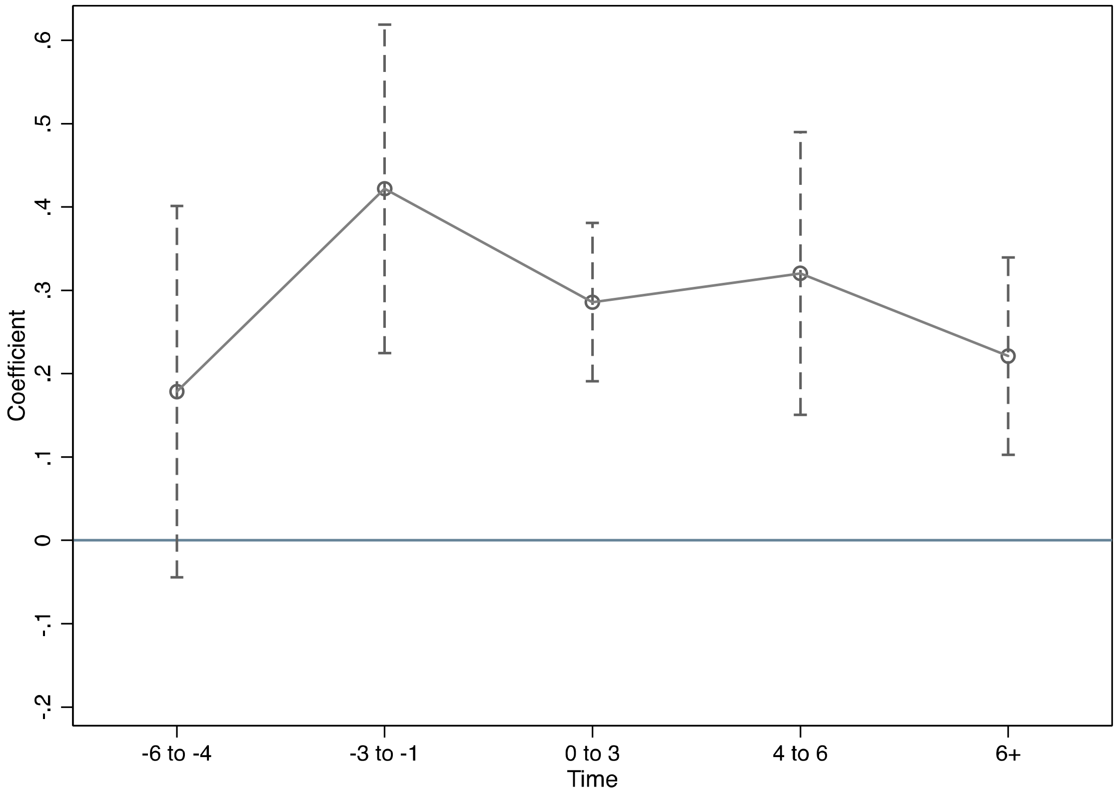
Note: This table reports the pairwise correlation coefficients of variables based on the sample during 1971−2020. Appendix 2 provides all variable definitions. *, **, *** represent the statistical significance at the 10%, 5% and 1% levels.

Table 3: The RPS' Impact on the Value of Cash Holdings

	(1)	(2)	(3)	(4)
	$Return_{i,t}$	$Return_{i,t}$	$Return_{i,t}$	$Return_{i,t}$
$\triangle C_{i,t} \times RPS_{i,t}$		0.199^{***}		0.200^{***}
		[7.71]		[7.92]
$\triangle C_{i,t}$	0.808^{***}	1.239^{***}	0.798^{***}	1.222^{***}
	[17.74]	[23.60]	[17.64]	[23.75]
$RPS_{i,t}$		-0.022^{**}		
		[−2.34]		
$\triangle E_{i,t}$	0.669^{***}	0.667^{***}	0.665^{***}	0.663^{***}
	[24.46]	[25.78]	[23.87]	[25.15]
$\triangle NA_{i,t}$	0.131^{***}	0.136^{***}	0.131^{***}	0.136^{***}
	[19.26]	[19.33]	[19.27]	[19.18]
$\triangle RD_{i,t}$	0.906^{***}	0.861^{***}	0.904^{***}	0.862^{***}
	[8.03]	[7.23]	[8.31]	[7.46]
$\triangle I_{i,t}$	-0.707^{***}	-0.653^{***}	-0.697^{***}	-0.646^{***}
	[−9.30]	[−8.18]	[−9.27]	[−8.20]
$\triangle D_{i,t}$	0.869^{***}	0.864^{***}	0.882^{***}	0.877^{***}
	[5.98]	[5.85]	[5.86]	[5.73]
$C_{i,t-1}$	0.607^{***}	0.595^{***}	0.601^{***}	0.589^{***}
	[17.23]	[16.74]	[17.51]	[17.01]
$ML_{i,t}$	-0.864^{***}	-0.850^{***}	-0.854^{***}	-0.840^{***}
	[−37.50]	[−36.18]	[−41.38]	[−40.27]
$NF_{i,t}$	0.030^{*}	0.007	0.029^{*}	0.007
	[1.71]	[0.46]	[1.72]	[0.48]
$C_{i,t-1} \times \triangle C_{i,t}$		-0.331^{***}		-0.322^{***}
		[−6.40]		[−6.26]
$ML_{i,t} \times \triangle C_{i,t}$		-0.888^{***}		-0.887^{***}
		[−14.65]		[−15.16]
Year fixed effects	Yes	Yes	No	No
State-year fixed effects	No	No	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
Intercept	0.081^{***}	0.081^{***}	0.080^{***}	0.073^{***}
	[11.67]	[14.26]	[12.02]	[11.10]
Adj. R^2	0.218	0.227	0.228	0.237
N	143264	143264	143264	143264

Note: This table reports the RPS' impact on the value of cash holdings based on the sample during 1971−2020. $Return_{i,t}$ is the excess stock return, i.e., $r_{i,t} - R_{i,t}$, where $r_{i,t}$ is the cumulated monthly stock return over the fiscal year of firm *i* in year *t* and $R_{i,t}$ is stock *i*'s benchmark portfolio return in year *t* (Louis, Sun, and Urcan, 2012; Tong, 2011; Rapp et al., 2014). The benchmark portfolios are Fama-French 25 size and book-to-market value-weighted portfolios (Fama and French, 1993). Appendix 2 provides all variable definitions. *t* statistics are reported in the brackets. *, **, *** represent the statistical significance at the 10%, 5% and 1% levels, respectively.

Figure 1: Coefficients Plot of the RPS' Dynamic Effect



Note: We plot the coefficients, reported in Table 4, on the interaction terms between $\triangle C$ and time dummy variables. The horizon axis plots time, and the vertical axis plots the magnitude of the coefficients. The dashed lines indicate the 95% confidence intervals of the coefficients.

Table 4: The Dynamic Effect

	(1) $Return_{i,t}$	(2) $Return_{i,t}$
$\triangle C_{i,t} \times Year\ (-6, -4)$	0.178	0.177
	[1.61]	[1.61]
$\triangle C_{i,t} \times Year\ (-3, -1)$	0.422***	0.418***
	[4.30]	[4.43]
$\triangle C_{i,t} \times Year\ (0, 3)$	0.286***	0.285***
	[6.03]	[6.03]
$\triangle C_{i,t} \times Year\ (4, 6)$	0.320***	0.323***
	[3.79]	[3.82]
$\triangle C_{i,t} \times Year\ (6+)$	0.221***	0.221***
	[3.75]	[3.74]
$\triangle C_{i,t}$	1.173***	1.173***
	[23.60]	[23.69]
$Year\ (-6, -4)$	−0.010	−0.020
	[−0.75]	[−0.28]
$Year\ (-3, -1)$	0.014	−0.102
	[1.06]	[−1.57]
$Year\ (0, 3)$	−0.012	−0.030*
	[−0.88]	[−1.93]
$Year\ (4, 6)$	−0.023	−0.100
	[−1.14]	[−1.55]
$Year\ (6+)$	−0.019	−0.029
	[−1.23]	[−0.89]
$\triangle E_{i,t}$	0.670***	0.669***
	[25.87]	[25.82]
$\triangle NA_{i,t}$	0.136***	0.136***
	[19.15]	[19.10]
$\triangle RD_{i,t}$	0.860***	0.862***
	[7.07]	[7.08]
$\triangle I_{i,t}$	−0.643***	−0.643***
	[−8.14]	[−8.08]
$\triangle D_{i,t}$	0.862***	0.862***
	[5.83]	[5.82]
$C_{i,t-1}$	0.596***	0.596***
	[16.74]	[16.85]
$ML_{i,t}$	−0.851***	−0.850***
	[−36.23]	[−36.72]
$NF_{i,t}$	0.006	0.006
	[0.40]	[0.40]
$C_{i,t-1} \times \triangle C_{i,t}$	−0.336***	−0.336***
	[−6.40]	[−6.40]
$ML_{i,t} \times \triangle C_{i,t}$	−0.834***	−0.833***
	[−14.90]	[−15.02]
$Trend\ (-6, -4)$		−0.002
		[−0.12]
$Trend\ (-3, -1)$		−0.056*

		[−1.76]
Trend (0, 3)		0.010*
		[1.86]
Trend (4, 6)		0.015
		[1.07]
Trend (6+)		0.001
		[0.36]
Year fixed effects	Yes	Yes
Firm fixed effects	Yes	Yes
Intercept	0.079***	0.080***
	[15.35]	[13.60]
Adj. R^2	0.227	0.228
N	143264	143264

Note: This table reports the RPS's dynamic effect on the value of cash holdings. The time dummy variables are defined for every three years: *Year (−6, −4)* is a dummy variable equals one if the time is 4–6 years before the RPS' adoption in a state and zero otherwise. *Year (−3, −1)* is a dummy variable equals one if the time is 1–3 years before the RPS' adoption in a state and zero otherwise. *Year (0, 3)* is a dummy variable equals one if the time is 0–3 years after the RPS' adoption in a state and zero otherwise. *Year (4, 6)* is a dummy variable equals one if the time is 4–6 years after the RPS' adoption in a state and zero otherwise. *Year (6+)* is a dummy variable equals one if the time is six years or more after the RPS' adoption in a state and zero otherwise. In Column (1), we include year- and firm-fixed effects, with the standard errors clustered by state. In Column (2), we further include a variable *Trend* for the varying time trend in each period. Specifically, *Trend* is an indicator for each year *t* relative to the RPS's adoption year (i.e., year 0). For states that never adopt an RPS program, *Trend* is set to zero. Appendix 2 provides all variable definitions. *t* statistics are reported in the brackets. *, **, *** represent the statistical significance at the 10%, 5% and 1% levels, respectively.

Table 5: Subsample Analysis of the RPS effect

	$Financial\ Constraint_{i,t}$		$Market\ Power_{i,t}$		$Internal\ Capital\ Mobility_{i,t}$		$Growth\ Opportunity_{i,t}$	
	HP Index		*Sales-based HHI*		*Number of segments*		*Tobin's Q*	
	Constrained	Unconstrained	Higher market power	Lower market power	Conglomerate	Standalone	Higher growth	Lower growth
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$Return_{i,t}$	$Return_{i,t}$	$Return_{i,t}$	$Return_{i,t}$	$Return_{i,t}$	$Return_{i,t}$	$Return_{i,t}$	$Return_{i,t}$
$\triangle C_{i,t} \times RPS_{i,t}$	0.226***	0.131**	0.147	0.209***	0.095	0.206***	0.334***	0.128**
	[6.05]	[2.43]	[1.31]	[7.68]	[1.55]	[5.39]	[3.15]	[2.30]
$\triangle C_{i,t}$	1.265***	1.227***	0.994***	1.288***	1.058***	1.331***	1.648***	0.802***
	[25.40]	[14.01]	[9.87]	[24.02]	[12.89]	[24.45]	[18.41]	[19.76]
$RPS_{i,t}$	−0.004	−0.029**	−0.037**	−0.013	−0.035**	−0.029**	−0.037**	−0.003
	[−0.26]	[−2.67]	[−2.48]	[−1.30]	[−2.34]	[−2.26]	[−2.01]	[−0.24]
$\triangle E_{i,t}$	0.628***	0.704***	0.739***	0.661***	0.682***	0.678***	0.724***	0.568***
	[24.88]	[22.34]	[18.72]	[22.99]	[20.47]	[19.35]	[18.23]	[31.64]
$\triangle NA_{i,t}$	0.149***	0.124***	0.133***	0.135***	0.118***	0.148***	0.198***	0.113***
	[15.84]	[16.00]	[11.21]	[17.18]	[9.42]	[11.64]	[13.68]	[14.42]
$\triangle RD_{i,t}$	0.912***	0.684***	1.076***	0.691***	0.215	1.048***	0.660***	0.408***
	[5.60]	[3.32]	[3.46]	[5.78]	[0.78]	[7.71]	[3.08]	[3.44]
$\triangle I_{i,t}$	−0.492***	−0.749***	−0.627***	−0.598***	−0.722***	−0.722***	−0.551***	−0.665***
	[−4.23]	[−6.04]	[−5.05]	[−5.93]	[−4.15]	[−6.29]	[−3.01]	[−6.32]
$\triangle D_{i,t}$	0.970***	0.781***	0.987***	0.811***	0.530***	0.803***	0.789***	1.045***
	[4.89]	[4.20]	[3.42]	[5.07]	[2.71]	[3.75]	[3.16]	[6.89]
$C_{i,t-1}$	0.697***	0.528***	0.551***	0.621***	0.629***	0.669***	1.112***	0.514***
	[19.86]	[14.34]	[10.98]	[18.75]	[17.64]	[16.55]	[15.65]	[20.50]
$ML_{i,t}$	−0.949***	−0.810***	−0.836***	−0.895***	−0.888***	−0.912***	−0.982***	−0.542***
	[−37.87]	[−19.77]	[−26.79]	[−31.73]	[−25.56]	[−48.78]	[−27.30]	[−26.62]
$NF_{i,t}$	0.025	−0.023	−0.050*	0.011	−0.049**	0.035	0.038	−0.071***
	[1.24]	[−1.62]	[−1.88]	[0.71]	[−2.21]	[1.45]	[1.43]	[−9.41]
$C_{i,t-1} \times \triangle C_{i,t}$	−0.353***	−0.299***	−0.290***	−0.356***	−0.282***	−0.381***	−0.503***	−0.205***
	[−5.28]	[−4.32]	[−3.91]	[−5.89]	[−2.82]	[−6.13]	[−4.22]	[−3.93]
$ML_{i,t} \times \triangle C_{i,t}$	−0.887***	−0.896***	−0.673***	−0.911***	−0.606***	−0.955***	−1.232***	−0.319***
	[−9.40]	[−6.81]	[−5.83]	[−13.39]	[−4.92]	[−13.40]	[−10.56]	[−5.99]
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	0.049***	0.111***	0.118***	0.084***	0.154***	0.039***	0.108***	−0.075***
	[4.94]	[13.03]	[10.83]	[12.74]	[14.27]	[5.15]	[10.15]	[−8.96]

p-value (Chow test)	0.000		0.000		0.000		0.000	
p-value (Fisher's Permutation test)	0.006		0.001		0.000		0.000	
Adj. R^2	0.216	0.239	0.228	0.233	0.242	0.222	0.264	0.247
N	67815	73972	27097	111917	36961	86693	66876	73356

Note: This table reports cross-sectional analysis to better understand the heterogeneity of the RPS effect. Columns (1) and (2) report the RPS's effect on the value of cash holdings for the subsamples of varying level of financial constraint. We follow Hadlock and Pierce (2010) and employ *HP Index* as a proxy to measure the degree of financial constraint. *HP Index* is constructed as −0.737×Ln(AT)+ 0.043×Ln(AT) ×Ln(AT) −0.040×AGE. A firm is classified as financially constrained if its *HP Index* is above the industry median (three-digit SIC code). Column (3) and (4) show the findings for the subsamples of varying level of market power. We measure market power using a three-year moving average *sales-based Herfindahl-Hirschman Index* (*HHI*) for a firm's three-digit SIC code industry, computed as $HHI_{jt} = \sum_{i=1}^{N_j} SALES_{i,j,t}{}^2$, where *SALES* is the firm's net sales as a proportion of all firms' total sales in the same industry (Giroud and Mueller, 2010). We classify a firm as having high market power if its industry *HHI* falls in the highest quintile across the industries in the sample. Columns (5) and (6) report the RPS' effect on the value of cash holdings for conglomerate and standalone firms, from a perspective of internal capital market. We use Compustat business-segment data to distinguish between conglomerate and standalone firms, based on the number of reported segments (Comment and Jarrell, 1995). Conglomerate firms are those that operate in more than one segments with the aggregation of reported segment assets contributing more than 80% of their total assets. The condition of 80% is to ensure that a firm's reported segments is a fair representation of the firm (Cohen and Lou, 2012). Standalone firms are those operate in only one segment. The business-segment data is available from 1976 to 2020. Column (7) and (8) present the RPS' effect on the value of cash holdings for firms with varying level of growth opportunities. We employ *Tobin's Q* to proxy for growth opportunities (Denis and Osobov, 2008), which is measured as the ratio of the market value of total capital (book value of total assets − book value of equity + market value of equity) to the book value of total assets. A firm is a higher-growth company if its measured growth opportunity is above its industry median value (three-digit SIC code). The empirical *p*-values of Chow tests are presented close to the bottom of the table, indicating that the structural break between subsamples is identified. The structure change justifies the use of subsamples than triple interaction. Following Cleary (1999), we employ the Fisher's permutation test (Fisher, 1935; Pitman, 1937; Pitman, 1938) to examine the difference in coefficients between subsamples. The empirical *p*-values of Fisher's permutation tests (1000 simulations) are reported close to the bottom of the table. Appendix 2 provides all variable definitions. *t* statistics are reported in the brackets. *, **, *** represent the statistical significance at the 10%, 5% and 1% levels, respectively.

Table 6: Subsample Analysis Based on Electricity Intensity

	Electricity intensity (Manufacturing and non-manufacturing)		*Electricity intensity (Manufacturing only)*	
	Higher	*Lower*	*Higher*	*Lower*
	(1)	(2)	(3)	(4)
	$Return_{i,t}$	$Return_{i,t}$	$Return_{i,t}$	$Return_{i,t}$
$\triangle C_{i,t} \times RPS_{i,t}$	0.302***	0.182***	0.331***	0.242***
	[5.54]	[3.10]	[4.71]	[3.34]
$\triangle C_{i,t}$	1.266***	1.280***	1.295***	1.239***
	[20.02]	[16.48]	[16.02]	[16.60]
$RPS_{i,t}$	−0.033*	−0.041**	−0.040***	−0.039*
	[−1.69]	[−2.15]	[−2.78]	[−1.78]
$\triangle E_{i,t}$	0.589***	0.735***	0.740***	0.784***
	[10.46]	[26.11]	[20.05]	[26.06]
$\triangle NA_{i,t}$	0.128***	0.156***	0.136***	0.189***
	[10.75]	[11.90]	[8.90]	[14.83]
$\triangle RD_{i,t}$	0.538**	0.897***	0.810***	0.785***
	[2.39]	[5.68]	[3.15]	[4.66]
$\triangle I_{i,t}$	−0.412**	−0.853***	−0.526**	−0.940***
	[−2.30]	[−7.14]	[−2.64]	[−6.77]
$\triangle D_{i,t}$	0.606*	0.723***	0.458	0.512**
	[1.82]	[3.26]	[1.00]	[2.26]
$C_{i,t-1}$	0.680***	0.638***	0.712***	0.662***
	[11.13]	[15.35]	[10.38]	[14.63]
$ML_{i,t}$	−0.961***	−0.832***	−0.904***	−0.798***
	[−31.17]	[−24.70]	[−22.82]	[−20.51]
$NF_{i,t}$	0.058**	−0.023	0.048	−0.041
	[2.20]	[−0.91]	[1.53]	[−1.29]
$C_{i,t-1} \times \triangle C_{i,t}$	−0.304***	−0.486***	−0.345***	−0.474***
	[−2.70]	[−5.24]	[−2.98]	[−4.21]
$ML_{i,t} \times \triangle C_{i,t}$	−0.892***	−0.871***	−0.965***	−0.787***
	[−7.46]	[−9.16]	[−6.24]	[−8.31]
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
Intercept	0.089***	0.049***	0.067***	0.027***
	[10.92]	[6.23]	[6.72]	[3.29]
p-value (Chow test)	0.000		0.000	
p-value (Fisher's Permutation test)	0.002		0.046	
Adj. R^2	0.243	0.226	0.252	0.229
N	37484	45098	28180	36945

Note: This table reports the RPS's effect on the value of cash holdings for the subsamples of varying level of electricity intensity. We calculate firm-level electricity intensity by using business-segment data (the business-segment data is available since 1976, and each segment is assigned with a four-digit SIC code), weighted by the percent of sales in each segment of firm based on industry electricity intensity data. We follow Dang et al. (2022) and define industry electricity intensity measure as the ratio of the quantity of purchased electricity (measured in trillions of British thermal units) to the value of total shipments (measured in billions of dollars). The data is obtained from the Supplement Tables of Annual Energy Outlook Products of the U.S. EIA for both manufacturing industry (including refining, food, paper, bulk chemical, glass, cement, iron and steel, aluminum, fabricated metal product, machinery, computers, transportation equipment, electrical equipment, wood products, plastics, and balance of manufacturing) and non-manufacturing industry (including only agriculture, construction, and mining). We classify a firm as having higher electricity intensity if its electricity intensity is above the median value in a year. Column (1-2) reports the RPS' effect on the value of cash holdings using firms in both manufacturing and non-manufacturing industry, while Column (3-4) reports the results only within firms in manufacturing industry only. The empirical *p*-values of Chow tests are presented close to the bottom of the table, indicating that the structural break between subsamples is identified. The structure change justifies the use of subsamples than triple interaction. Following Cleary (1999), we employ Fisher's permutation test (Fisher, 1935; Pitman, 1937; Pitman, 1938) to examine the difference in coefficients between subsamples. The empirical *p*-values of Fisher's tests (1000 simulations) are reported close to the bottom of the table. Appendix 2 provides all variable definitions. *t* statistics are reported in the brackets. *, **, *** represent statistical significance at the 10%, 5% and 1% levels, respectively.

Table 7: The Impact of RPS Stringency on the Value of Cash Holdings

	(1) $Return_{i,t}$	(2) $Return_{i,t}$
	Stringency definition 1	Stringency definition 2
$\triangle C_{i,t} \times RPS\ Stringency_{i,t}$	3.384***	0.394**
	[2.81]	[2.49]
$\triangle C_{i,t}$	1.291***	1.286***
	[22.31]	[22.37]
$RPS\ Stringency_{i,t}$	−0.485*	−0.022
	[−1.76]	[−1.21]
$\triangle E_{i,t}$	0.665***	0.665***
	[25.94]	[25.95]
$\triangle NA_{i,t}$	0.136***	0.136***
	[19.05]	[19.08]
$\triangle RD_{i,t}$	0.866***	0.867***
	[7.28]	[7.33]
$\triangle I_{i,t}$	−0.657***	−0.657***
	[−8.24]	[−8.24]
$\triangle D_{i,t}$	0.855***	0.857***
	[5.79]	[5.79]
$C_{i,t-1}$	0.595***	0.595***
	[16.90]	[16.87]
$ML_{i,t}$	−0.850***	−0.850***
	[−36.22]	[−36.19]
$NF_{i,t}$	0.009	0.009
	[0.62]	[0.62]
$C_{i,t-1} \times \triangle C_{i,t}$	−0.313***	−0.314***
	[−6.56]	[−6.61]
$ML_{i,t} \times \triangle C_{i,t}$	−0.935***	−0.933***
	[−14.69]	[−14.63]
Year fixed effects	Yes	Yes
Firm fixed effects	Yes	Yes
Intercept	0.075***	0.075***
	[10.94]	[10.84]
Adj. R^2	0.226	0.226
N	143264	143264

Note: This table reports the impact of RPS stringency on the value of cash holdings. We refer to Greenstone and Nath (2021) and measure the degree of RPS stringency using the amount of net requirement (the difference between statutory requirements and qualified pre-existing renewable generation), which represents the total amount of new renewable generation required to comply with the policy. In Column (1), we measure *RPS Stringency* as the ratio of net requirement to total electricity consumption, computed as (RPS requirements at year *t* / total electricity consumption at year *t* − RPS achievement at year *t*-1 / total electricity consumption at year *t*-1). In Column (2), we use the ratio of net requirement to total RPS requirements, calculated as (RPS requirements at year *t* − RPS achievement at year *t*-1) / RPS requirements at year *t*. Data is collected from Lawrence Berkeley National Laboratory (LBNL) and Energy Information Administration (EIA). Appendix 2 provides all variable definitions. *t* statistics are reported in the brackets. *, **, *** represent statistical significance at the 10%, 5% and 1% levels, respectively.

Table 8: The RPS' Effect on the Level of Cash Holdings

	(1) $CashHoldings_{i,t}$	(2) $CashHoldings_{i,t}$
$RPS_{i,t}$	0.012***	0.012***
	[2.76]	[2.82]
$Size_{i,t-1}$	−0.034***	−0.036***
	[−10.28]	[−10.17]
$\text{Leverage}_{i,t-1}$	−0.041***	−0.044***
	[−4.66]	[−4.70]
$Tobin's\ Q_{i,t-1}$	−0.016***	−0.016***
	[−12.78]	[−12.13]
$CF_{i,t-1}$	−0.020***	−0.020***
	[−2.90]	[−2.91]
$CF\ Volatility_{i,t-1}$	0.026***	0.025***
	[3.87]	[3.87]
$Working\ Capital_{i,t-1}$	−0.002	−0.002
	[−0.26]	[−0.27]
$R\&D_{i,t-1}$	0.057	0.056
	[1.53]	[1.50]
$Capex_{i,t-1}$	0.108***	0.109***
	[9.75]	[9.78]
$Acquisition_{i,t-1}$	−0.043***	−0.043***
	[−4.23]	[−4.14]
$Payout\ Ratio_{i,t-1}$		0.011***
		[4.42]
$Bond\ Rating_{i,t-1}$		0.017***
		[3.65]
Year fixed effects	Yes	Yes
Firm fixed effects	Yes	Yes
Intercept	0.378***	0.379***
	[24.69]	[24.48]
Adj. R^2	0.470	0.470
N	111776	111776

Note: This table reports the RPS' effect on firms' cash holdings levels. Appendix 2 provides all variable definitions. *t* statistics are reported in the brackets. *, **, *** represent statistical significance at the 10%, 5% and 1% levels, respectively.

Table 9: The RPS' Impact on the Value of Cash Holdings, Estimated Using the PSM Sample

Panel A: Regression Results

	$Return_{i,t}$
$\triangle C_{i,t} \times RPS_{i,t}$	0.145**
	[2.63]
$\triangle C_{i,t}$	1.392***
	[20.22]
$RPS_{i,t}$	−0.002
	[−0.21]
$\triangle E_{i,t}$	0.808***
	[22.00]
$\triangle NA_{i,t}$	0.160***
	[13.95]
$\triangle RD_{i,t}$	0.829***
	[3.84]
$\triangle I_{i,t}$	−1.105***
	[−7.23]
$\triangle D_{i,t}$	0.566**
	[2.17]
$C_{i,t-1}$	0.573***
	[17.97]
$ML_{i,t}$	−0.785***
	[−24.59]
$NF_{i,t}$	−0.027
	[−1.24]
$C_{i,t-1} \times \triangle C_{i,t}$	−0.451***
	[−5.47]
$ML_{i,t} \times \triangle C_{i,t}$	−0.925***
	[−9.94]
Year fixed effects	Yes
Firm fixed effects	Yes
Intercept	0.081***
	[11.03]
Adj. R^2	0.221
N	56173

Panel B: Sample Balance Test

Variables	Mean of control group	Mean of treated group	Mean Diff.	*p*-value
$\triangle C_{i,t}$	0.009	0.011	−0.002	0.683
$\triangle E_{i,t}$	0.021	0.015	0.007	0.238
$\triangle NA_{i,t}$	0.074	0.074	0.001	0.969
$\triangle RD_{i,t}$	0.000	0.001	−0.001	0.186

$\triangle I_{i,t}$	0.002	0.003	−0.001	0.553
$\triangle D_{i,t}$	0.000	0.000	0.000	0.515
$C_{i,t-1}$	0.168	0.158	0.010	0.193
$ML_{i,t}$	0.233	0.222	0.011	0.146
$NF_{i,t}$	0.056	0.058	−0.002	0.786
$C_{i,t-1} \times\triangle C_{i,t}$	−0.010	−0.005	−0.005	0.174
$ML_{i,t} \times\triangle C_{i,t}$	−0.001	0.003	−0.003	0.112
N	2121	2121		

Note: In Panel A, we report the RPS' impact on the value of cash holdings based on PSM sample during 1971–2020. $Return_{i,t}$ is the excess stock return, i.e., $r_{i,t} - R_{i,t}$, where $r_{i,t}$ is the cumulated monthly stock return over the fiscal year of firm *i* in year *t* and $R_{i,t}$ is the return on stock *i*'s benchmark portfolio in year *t* (Louis et al., 2012; Tong, 2011; Rapp et al., 2014). The benchmark portfolios are Fama-French 25 size and book-to-market value-weighted portfolios (Fama and French, 1993). In Panel B, we report the average characteristics of the treated and control firms and their differences for the PSM sample. To construct the PSM sample, we use a logit model to estimate the likelihood that a firm is in a state that has adopted the RPS, where the propensity score of RPS adoption is modeled as a function of all the control variables included in the baseline value-of-cash model (Table 3) together with industry- (three-digit SIC code) and year-fixed effects. For each treatment firm we select a control firm, from all firms in those states that never adopt the RPS in our sample period, whose propensity score in year $t-1$ is the closest to that of the treated firm, without replacement and with a maximum radius of 0.01. The empirical *p*-values are from the *t*-tests that compare the mean values between the treated and control firms. Appendix 2 provides all variable definitions. *t* statistics are reported in the brackets. *, **, *** represent the statistical significance at the 10%, 5% and 1% levels, respectively.

Table 10: The RPS' Impact on the Value of Cash Holdings, Estimated Using the Entropy-balanced Sample

	$Return_{i,t}$
$\triangle C_{i,t} \times RPS_{i,t}$	0.139***
	[4.65]
$\triangle C_{i,t}$	1.333***
	[21.11]
$RPS_{i,t}$	−0.015
	[−1.31]
$\triangle E_{i,t}$	0.728***
	[17.41]
$\triangle NA_{i,t}$	0.128***
	[12.73]
$\triangle RD_{i,t}$	0.889***
	[6.71]
$\triangle I_{i,t}$	−0.676***
	[−5.53]
$\triangle D_{i,t}$	0.790***
	[4.97]
$C_{i,t-1}$	0.688***
	[16.45]
$ML_{i,t}$	−0.850***
	[−27.27]
$NF_{i,t}$	0.047**
	[2.27]
$C_{i,t-1} \times \triangle C_{i,t}$	−0.315***
	[−3.77]
$ML_{i,t} \times \triangle C_{i,t}$	−1.054***
	[−13.23]
Year fixed effects	Yes
Firm fixed effects	Yes
Intercept	0.015*
	[1.79]
Adj. R^2	0.240
N	143264

Note: This panel reports the RPS' impact on the value of cash holdings based on EB sample during 1971–2020. $Return_{i,t}$ is the excess stock return, i.e., $r_{i,t} - R_{i,t}$, where $r_{i,t}$ is the cumulated monthly stock return over the fiscal year of firm *i* in year *t* and $R_{i,t}$ is the return on stock *i*'s benchmark portfolio in year *t* (Louis et al., 2012; Tong, 2011; Rapp et al., 2014). The benchmark portfolios are Fama-French 25 size and book-to-market value-weighted portfolios (Fama and French, 1993). Appendix 2 provides all variable definitions. *t* statistics are reported in the brackets. *, **, *** represent the statistical significance at the 10%, 5% and 1% levels, respectively.

Table 11: Excluding the Confounding Effect of ISOs and RTOs

	$Return_{i,t}$
$\triangle C_{i,t} \times RPS_{i,t}$	0.200***
	[8.03]
$\triangle C_{i,t}$	1.239***
	[23.38]
$RPS_{i,t}$	−0.021**
	[−2.07]
$\triangle E_{i,t}$	0.665***
	[25.77]
$\triangle NA_{i,t}$	0.136***
	[18.84]
$\triangle RD_{i,t}$	0.848***
	[7.13]
$\triangle I_{i,t}$	−0.650***
	[−8.03]
$\triangle D_{i,t}$	0.900***
	[5.92]
$C_{i,t-1}$	0.593***
	[16.47]
$ML_{i,t}$	−0.851***
	[−36.20]
$NF_{i,t}$	0.011
	[0.77]
$C_{i,t-1} \times \triangle C_{i,t}$	−0.336***
	[−6.49]
$ML_{i,t} \times \triangle C_{i,t}$	−0.893***
	[−14.65]
Year fixed effects	Yes
Firm fixed effects	Yes
Intercept	0.080***
	[14.48]
Adj. R^2	0.226
N	140468

Note: This table reports the RPS's impact on the value of cash holdings based on the sample excluding firms located in the non-RPS states that share the same Independent System Operator (ISO) or Regional Transmission Organization (RTO) with the RPS states. ISOs or RTOs administer regional wholesale electricity markets and ensure fair electricity prices, to promote economic efficiency, reliability, and non-discriminatory practices. Therefore, electricity prices in the same ISO or RTO converge. Appendix 2 provides all variable definitions. *t* statistics are reported in the brackets. *, **, *** represent statistical significance at the 10%, 5% and 1% levels, respectively.

Table 12: Controlling for Confounding Policies

	(1) $Return_{i,t}$	(2) $Return_{i,t}$	(3) $Return_{i,t}$	(4) $Return_{i,t}$	(5) $Return_{i,t}$
$\triangle C_{i,t} \times RPS_{i,t}$	0.193***	0.197***	0.217***	0.195***	0.191***
	[3.66]	[7.12]	[6.19]	[6.82]	[3.33]
$RPS_{i,t}$	−0.027***	−0.022**	−0.022**	−0.022**	−0.027***
	[−3.40]	[−2.35]	[−2.55]	[−2.36]	[−3.41]
$\triangle C_{i,t} \times EERS_{i,t}$	0.009				0.036
	[0.15]				[0.41]
$EERS_{i,t}$	0.014				0.015
	[1.01]				[1.27]
$\triangle C_{i,t} \times GPP_{i,t}$		0.018			0.032
		[0.26]			[0.34]
$GPP_{i,t}$		0.009			0.008
		[0.54]			[0.51]
$\triangle C_{i,t} \times GHGRP_{i,t}$			−0.044		−0.055
			[−0.51]		[−0.52]
$GHGRP_{i,t}$			−0.001		−0.004
			[−0.04]		[−0.29]
$\triangle C_{i,t} \times NBP_{i,t}$				0.041	0.035
				[0.62]	[0.48]
$NBP_{i,t}$				0.001	0.004
				[0.07]	[0.27]
$\triangle C_{i,t}$	1.239***	1.239***	1.239***	1.238***	1.239***
	[23.60]	[23.56]	[23.49]	[23.18]	[23.17]
$\triangle E_{i,t}$	0.667***	0.667***	0.667***	0.667***	0.667***
	[25.72]	[25.78]	[25.77]	[25.80]	[25.74]
$\triangle NA_{i,t}$	0.136***	0.136***	0.136***	0.136***	0.136***
	[19.34]	[19.32]	[19.42]	[19.35]	[19.39]
$\triangle RD_{i,t}$	0.860***	0.861***	0.861***	0.861***	0.860***
	[7.23]	[7.21]	[7.23]	[7.23]	[7.21]
$\triangle I_{i,t}$	−0.653***	−0.653***	−0.653***	−0.653***	−0.652***
	[−8.19]	[−8.18]	[−8.17]	[−8.20]	[−8.19]
$\triangle D_{i,t}$	0.864***	0.865***	0.863***	0.864***	0.863***
	[5.85]	[5.85]	[5.83]	[5.85]	[5.85]
$C_{i,t-1}$	0.596***	0.596***	0.596***	0.596***	0.596***
	[16.80]	[16.73]	[16.76]	[16.77]	[16.82]
$ML_{i,t}$	−0.850***	−0.850***	−0.851***	−0.850***	−0.850***
	[−36.19]	[−36.22]	[−36.17]	[−36.15]	[−36.18]
$NF_{i,t}$	0.007	0.007	0.007	0.007	0.007
	[0.47]	[0.46]	[0.48]	[0.46]	[0.47]
$C_{i,t-1} \times \triangle C_{i,t}$	−0.331***	−0.331***	−0.329***	−0.330***	−0.329***
	[−6.41]	[−6.42]	[−6.25]	[−6.41]	[−6.27]
$ML_{i,t} \times \triangle C_{i,t}$	−0.888***	−0.887***	−0.889***	−0.887***	−0.890***
	[−14.67]	[−14.61]	[−15.09]	[−14.54]	[−15.13]
Year fixed effects	Yes	Yes	Yes	Yes	Yes

Firm fixed effects	Yes	Yes	Yes	Yes	Yes
Intercept	0.079***	0.080***	0.081***	0.081***	0.079***
	[15.14]	[14.01]	[15.14]	[13.05]	[13.71]
Adj. R^2	0.227	0.227	0.227	0.227	0.227
N	143264	143264	143264	143264	143264

Note: This table reports the RPS' impact on the value of cash holdings, controlling for confounding policies. *EERS* is the Energy Efficiency Resource Standards, under which the utilities must procure a percentage of their future electricity and natural gas needs using energy efficiency measures. *GPP* is EPA's Green Power Partnership program that encourages organizations to buy green power to reduce the environmental impacts of their electricity use. *GHGRP* is the Greenhouse Gas Reporting Program, which requires certain facilities to report their emissions of greenhouse gases, to identify emission sources, guide policy development, and reduce emissions. *NBP* is Budget Trading Program, a regional cap-and-trade program aimed at mitigating the NOx emissions in the United States. These policies may potentially impact electricity consumption and pricing and hence confound our empirical findings. Appendix 2 provides all variable definitions. *t* statistics are reported in the brackets. *, **, *** represent statistical significance at the 10%, 5% and 1% levels, respectively.

Table 13: Alternative Measures of Change in Cash

	Portfolio-adjusted $\triangle C_{i,t}$	*Unexpected* $\triangle C_{i,t}$ *Parsimonious*	*Unexpected* $\triangle C_{i,t}$ *Augmented*
	(1)	(2)	(3)
	$Return_{i,t}$	$Return_{i,t}$	$Return_{i,t}$
$\triangle C_{i,t} \times RPS_{i,t}$	0.191***	0.219***	0.202***
	[6.86]	[9.15]	[5.06]
$\triangle C_{i,t}$	1.111***	1.001***	1.083***
	[23.77]	[21.83]	[20.31]
$RPS_{i,t}$	−0.021**	−0.017*	−0.028***
	[−2.21]	[−1.80]	[−2.72]
$\triangle E_{i,t}$	0.681***	0.716***	0.735***
	[25.34]	[22.96]	[21.78]
$\triangle NA_{i,t}$	0.131***	0.137***	0.143***
	[17.79]	[17.76]	[14.70]
$\triangle RD_{i,t}$	0.920***	0.790***	0.646***
	[7.75]	[4.82]	[4.23]
$\triangle I_{i,t}$	−0.659***	−0.748***	−0.738***
	[−8.33]	[−9.79]	[−7.38]
$\triangle D_{i,t}$	0.878***	0.941***	0.948***
	[6.00]	[6.49]	[6.29]
$C_{i,t-1}$	0.570***	0.545***	0.543***
	[16.96]	[17.12]	[15.37]
$ML_{i,t}$	−0.882***	−0.899***	−0.900***
	[−35.88]	[−29.60]	[−29.49]
$NF_{i,t}$	0.025	0.012	−0.023
	[1.59]	[0.74]	[−1.26]
$C_{i,t-1} \times \triangle C_{i,t}$	−0.289***	−0.260***	−0.337***
	[−5.53]	[−5.25]	[−6.11]
$ML_{i,t} \times \triangle C_{i,t}$	−0.772***	−0.711***	−0.788***
	[−13.99]	[−11.47]	[−11.18]
Year fixed effects	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes
Intercept	0.106***	0.121***	0.127***
	[19.94]	[18.60]	[17.22]
Adj. R^2	0.219	0.215	0.221
N	143264	121555	97765

Note: This table reports the RPS' effect on the value of cash holdings, using three alternative measures of the change in cash. The first alternative measure is portfolio-adjusted $\triangle C_{i,t}$, which is calculated by the change in cash and short-term investment net the average change in cash in the benchmark portfolios during the corresponding fiscal year. For the other two measures, we employ the unexpected change in cash, which is obtained from the residuals of the change in cash models proposed by Almeida et al. (2004) (a parsimonious model in Page 1787 and an augmented model in Page 1788). Appendix 2 provides all variable definitions. *t* statistics are reported in the brackets. *, **, *** represent statistical significance at the 10%, 5% and 1% levels, respectively.

Table 14: Alternative Measures of Excess Stock Return

	Fama and French three-factor model	*Carhart four-factor model*	*Fama and French five-factor model*
	(1)	(2)	(3)
	$Return_{i,t}$	$Return_{i,t}$	$Return_{i,t}$
$\triangle C_{i,t} \times RPS_{i,t}$	0.245***	0.196***	0.194***
	[6.30]	[5.78]	[5.13]
$\triangle C_{i,t}$	0.926***	0.819***	0.731***
	[20.02]	[19.90]	[17.16]
$RPS_{i,t}$	-0.025	-0.028**	-0.037**
	[-1.53]	[-2.27]	[-2.40]
$\triangle E_{i,t}$	0.548***	0.494***	0.480***
	[31.37]	[28.89]	[26.49]
$\triangle NA_{i,t}$	0.092***	0.088***	0.076***
	[14.70]	[17.31]	[14.32]
$\triangle RD_{i,t}$	0.447***	0.263**	0.307**
	[4.04]	[2.01]	[2.63]
$\triangle I_{i,t}$	-0.764***	-0.675***	-0.693***
	[-9.17]	[-9.41]	[-6.70]
$\triangle D_{i,t}$	-0.108	-0.135	0.015
	[-0.68]	[-0.81]	[0.09]
$C_{i,t-1}$	0.504***	0.430***	0.409***
	[16.57]	[19.84]	[15.95]
$ML_{i,t}$	-0.449***	-0.403***	-0.339***
	[-20.88]	[-20.20]	[-15.36]
$NF_{i,t}$	0.009	-0.000	0.000
	[0.61]	[-0.01]	[0.02]
$C_{i,t-1} \times \triangle C_{i,t}$	-0.238***	-0.214***	-0.152***
	[-4.70]	[-4.47]	[-3.06]
$ML_{i,t} \times \triangle C_{i,t}$	-0.644***	-0.620***	-0.563***
	[-9.03]	[-9.58]	[-8.12]
Year fixed effects	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes
Intercept	-0.040***	-0.027***	-0.032***
	[-6.68]	[-6.21]	[-4.46]
Adj. R^2	0.089	0.065	0.051
N	134937	134937	131094

Note: This table reports the RPS' effect on the value of cash holdings, using three alternative measures of the excess stock return. We employ unexpected stock returns, which is captured by the value of the residual terms from Fama and French three-factor model (Fama and French, 1993), Carhart four-factor model (Carhart, 1997), and Fama and French five-factor model (Fama and French, 2015), as the alternative measures of excess stock return. Appendix 2 provides all variable definitions. *t* statistics are reported in the brackets. *, **, *** represent statistical significance at the 10%, 5% and 1% levels, respectively.

Table 15: Robustness Test Based on the Impact Threshold for Confounding Variable (ITCV)

Impact	(1) Cor (C, X)	(2) Cor (C, Y)	(3) Impact of each control variable based on raw correlations	(4) Cor (C, X)	(5) Cor (C, Y)	(6) Impact of each control variable based on partial correlations
$\triangle E_{i,t}$	0.0276	0.2770	0.0076	−0.0245	0.2248	−0.0055
$\triangle NA_{i,t}$	−0.0103	0.1330	−0.0014	−0.0060	0.1330	−0.0008
$\triangle RD_{i,t}$	0.0375	0.0250	0.0009	0.0097	0.0380	0.0004
$\triangle I_{i,t}$	0.0056	−0.0469	−0.0003	−0.0033	−0.0580	0.0002
$\triangle D_{i,t}$	−0.0029	0.0595	−0.0002	−0.0176	0.0262	−0.0005
$C_{i,t-1}$	−0.1254	0.0888	−0.0111	−0.0159	0.1313	−0.0021
$ML_{i,t}$	−0.0208	−0.1777	0.0037	0.0111	−0.1683	−0.0019
$NF_{i,t}$	0.1406	0.0566	0.0080	0.0466	−0.0261	−0.0012
Impact threshold for confounding variable ***(ITCV)***	**0.093**	**0.093**	**0.0086**	**0.093**	**0.093**	**0.0086**

Notes: To evaluate the impact of potential omitted confounding variables on our baseline regression result, we follow Larcker and Rusticus (2010, p.202) and Frank (2000) to estimate the Impact Threshold for Confounding Variables (ITCV). ITCV is the value of impact threshold of an unobserved confounding variable, beyond which our findings could be biased or even invalidated if such a confounding variable is incorporated in our model. Following Frank (2000), we calculate ITCV as the lowest product of the raw (partial) correlations between the confounding variable and the independent variable and between the confounding variable and the dependent variable. The greater the magnitude of ITCV is, relative to the raw (partial) impact of the control variables, the less likely that our results of the baseline regressions are subject to the bias of an omitted confounding variable. Appendix 2 provides all variable definitions.

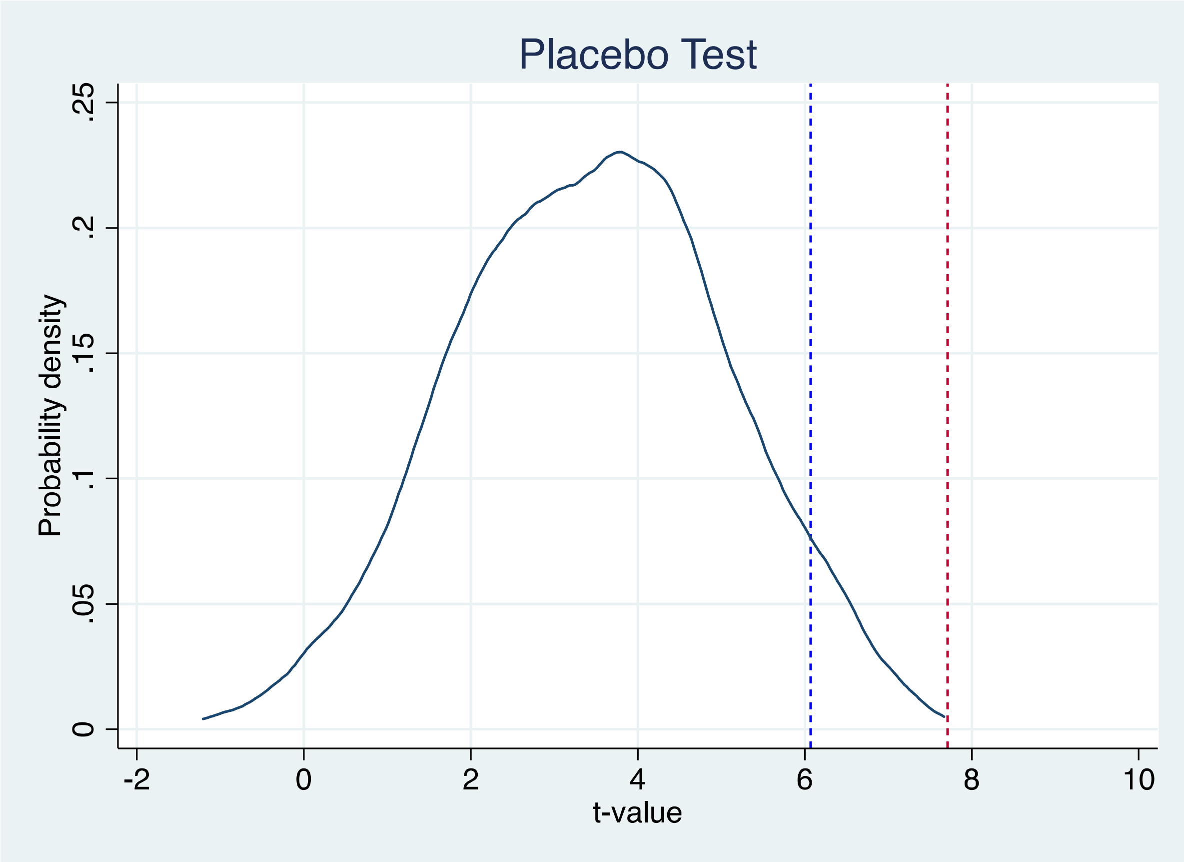
Table 16: Stacked Regression Estimator

	Baseline model	Dynamic effect
	(1)	(2)
	$Return_{i,t}$	$Return_{i,t}$
$\triangle C_{i,t} \times RPS_{i,t}$	0.135***	
	[3.88]	
$\triangle C_{i,t} \times$ *Year (−6, −4)*		0.063
		[0.59]
$\triangle C_{i,t} \times$ *Year (−3, −1)*		0.336***
		[3.38]
$\triangle C_{i,t} \times$ *Year (0, 3)*		0.179***
		[4.08]
$\triangle C_{i,t} \times$ *Year (4, 6)*		0.209***
		[2.82]
$\triangle C_{i,t} \times$ *Year (6+)*		0.113*
		[1.73]
$\triangle C_{i,t}$	1.269***	1.254***
	[58.95]	[58.71]
$RPS_{i,t}$	−0.018**	
	[−2.43]	
Year (−6, −4)		0.001
		[0.11]
Year (−3, −1)		0.020
		[1.63]
Year (0, 3)		−0.006
		[−0.51]
Year (4, 6)		−0.018
		[−1.16]
Year (6+)		−0.011
		[−1.29]
$\triangle E_{i,t}$	0.647***	0.648***
	[56.88]	[56.92]
$\triangle NA_{i,t}$	0.146***	0.146***
	[45.69]	[45.10]
$\triangle RD_{i,t}$	0.905***	0.905***
	[12.02]	[11.88]
$\triangle I_{i,t}$	−0.616***	−0.613***
	[−14.50]	[−14.50]
$\triangle D_{i,t}$	0.402***	0.401***
	[4.92]	[4.92]
$C_{i,t-1}$	0.672***	0.672***
	[43.47]	[43.63]
$ML_{i,t}$	−0.917***	−0.917***
	[−78.69]	[−78.86]
$NF_{i,t}$	−0.015*	−0.016*
	[−1.92]	[−1.93]
$C_{i,t-1} \times \triangle C_{i,t}$	−0.210***	−0.212***
	[−6.46]	[−6.41]

$ML_{i,t} \times \triangle C_{i,t}$	-0.904^{***}	-0.888^{***}
	[−27.14]	[−26.39]
Year fixed effects	Yes	Yes
Firm fixed effects	Yes	Yes
Intercept	0.110^{***}	0.109^{***}
	[37.07]	[36.09]
$Adj.\ R^2$	0.235	0.235
N	413384	413384

Note: This table reports the RPS's effect on the value of cash holdings using stacked regression estimator for robustness check. Column (1) and Column (2) presents the results for our baseline model and dynamic effect, respectively. Appendix 2 provides all variable definitions. *t* statistics are reported in the brackets. *, **, *** represent the statistical significance at the 10%, 5% and 1% levels, respectively.

Figure 2: Placebo Test Based on Block Bootstrap



Note: This figure plots an empirical distribution of the estimates of the t-statistic based on 1000 bootstrap samples. Specifically, a bootstrap sample is constructed via creating pseudo RPS shock and estimating Equation (1) based on all the observations. The solid bule line is the probability density of the t-statistics of the coefficient of $\triangle C_{i,t} \times RPS_{i,t}$ from 1000 simulations of pseudo RPS shock to the value of cash holding. The dashed blue line marks the position of the 95th percentile of the empirical distribution. The dashed red line marks the position of the original t-statistic from our baseline estimation reported in Column (2) of Table 3.

Table 17: The RPS' Effect on Firm Performance and Firm Risk

	Firm performance		*Firm risk*	
	(1)	(2)	(3)	(4)
	$Adj - Cash\ flow_{i,t}$	$Adj - Tobin's\ Q_{i,t}$	$Cash - flow\ volatility_{i,t}$	$Stock - price\ volatility_{i,t}$
$RPS_{i,t}$	−0.012**	−0.042***	0.327**	0.012**
	[−2.05]	[−2.83]	[2.03]	[2.07]
$Size_{i,t-1}$	−0.052***	−0.046***	−0.304***	−0.048***
	[−10.91]	[−4.47]	[−6.04]	[−21.19]
$Return_{i,t-1}$	−0.008***	−0.016*	0.170***	0.025***
	[−2.79]	[−1.79]	[6.32]	[12.96]
$Tobin's\ Q_{i,t-1}$	0.019***	0.280***	−0.025	0.018***
	[8.53]	[33.96]	[−0.63]	[10.77]
$ROA_{i,t-1}$	0.310***	−0.416***	−0.318	−0.024***
	[15.02]	[−8.94]	[−0.92]	[−2.97]
$Leverage_{i,t-1}$	0.339***	−0.717***	1.340***	0.075***
	[11.72]	[−14.52]	[4.14]	[9.80]
$R\&D_{i,t-1}$	0.000	0.001***	−0.002**	−0.000***
	[0.80]	[2.94]	[−2.39]	[−10.08]
$LnAge_{i,t-1}$	0.029***	−0.001	0.552***	−0.030***
	[6.20]	[−0.04]	[3.50]	[−7.14]
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
Intercept	0.118***	−0.009	2.264***	0.805***

	[6.54]	[−0.14]	[6.41]	[54.82]
Adj. R^2	0.201	0.500	0.396	0.680
N	119563	122597	119816	122069

Note: This table reports the RPS' effect on firm performance and firm risk, respectively. In Column (1-2), we employ the portfolio-adjusted cash flow and Tobin's Q as our measures of firm performance (Anderson, Mansi, and Reeb, 2003; Anderson, Duru, and Reeb, 2009; Shenoy, 2012). We follow Minton and Schrand (1999) and define cash flow ratio as sales less cost of goods sold less selling, general and administrative expense less the change in working capital, deflated by the market value of equity. In Column (3-4), we use cash-flow volatility, stock-price volatility as the proxy for firm risk (Gormley and Matsa, 2016). We measure cash-flow volatility as the standard deviation of cash flow scaled by the absolute value of the mean of cash flow over the trailing five years window (Kim and Sorensen, 1986; Sheikh, 2022). And we compute the stock-price volatility as the annualized standard deviation of stock returns using the past five years of monthly stock return data (Kang and Liu, 2008). We control for the logarithm of firm size, stock returns, Tobin's Q, industry-adjusted ROA, Leverage, R&D ratio and the logarithm of firm age (Ang, Hodrick, Xing, and Zhang, 2009; Bernile, Bhagwat, and Yonker, 2018), as well as year and firm fixed effects in the model. *t* statistics are reported in the brackets. *, **, *** represent statistical significance at the 10%, 5% and 1% levels, respectively.

Appendix 1: The Staggered State Adoption of Renewable Portfolio Standards

State	Abbr.	Year	State	Abbr.	Year
Arizona	AZ	2001	Nevada	NV	1997
California	CA	2002	New Hampshire	NH	2007
Colorado	CO	2004	New Jersey	NJ	1999
Connecticut	CT	1998	New Mexico	NM	2004
Delaware	DE	2005	New York	NY	2004
Hawaii	HI	2004	North Carolina	NC	2007
Illinois	IL	2005	Ohio	OH	2008
Iowa	IA	1983	Oregon	OR	2007
Kansas	KS	2009	Pennsylvania	PA	2004
Maine	ME	1999	Rhode Island	RI	2004
Maryland	MD	2004	Texas	TX	1999
Massachusetts	MA	1997	Vermont	VT	2015
Michigan	MI	2008	Virginia	VA	2020
Minnesota	MN	1997	Washington	WA	2006
Missouri	MO	2008	Wisconsin	WI	1999
Montana	MT	2005	Washington. DC	DC	2006

Notes: This table reports the year of RPS adoption for each treated state. The data is collected from National Conference of State Legislatures, U.S. Renewables Portfolio Standards 2021 Status Update of Lawrence Berkeley National Laboratory, U.S. Energy Information Administration, NC Clean Energy Technology Center.

Appendix 2: Variable Definitions

Variable	Definition
$Return_{i,t}$	The excess stock return, which is equals to $r_{i,t} - R_{i,t}$, where $r_{i,t}$ is the cumulated monthly stock return over the fiscal year of firm *i* at time *t* and $R_{i,t}$is stock *i*'s benchmark portfolio return at time *t* (Louis et al., 2012; Tong, 2011; Rapp et al., 2014). The benchmark portfolios are Fama-French 25 size and book-to-market value-weighted portfolios (Fama and French, 1993).
$\triangle C_{i,t}$	The change in cash and short-term investments of firm *i* measured from year *t*−1 to year *t,* deflated by market value of equity in year *t*−1.
$RPS_{i,t}$	RPS is a U.S. state-level policy that requires electricity providers to supply a certain percentage of electricity from renewable resources, such as wind, solar thermal and photovoltaic, geothermal, biomass, and hydropower. By the end of 2021, 31 states and Washington DC have established a mandatory RPS program. Dummy variable that equals one if the RPS has been passed by the state of firm *i* in year *t* and zero otherwise.
$\triangle E_{i,t}$	The change in earnings before interest and taxes of firm *i* measured from year *t*−1 to year *t* deflated by the market value of equity in year *t*−1.
$\triangle NA_{i,t}$	The change in total assets net cash and short-term investments of firm *i* measured from year *t*−1 to year *t* deflated by the market value of equity in year *t*−1.
$\triangle RD_{i,t}$	The change in research and development expense of firm *i* measured from year *t*−1 to year *t* deflated by the market value of equity in year *t*−1. We set *R&D* to zero if their values are missing (Faulkender and Wang, 2006).
$\triangle I_{i,t}$	The change in total interest expense of firm *i* measured from year *t*−1 to year *t* deflated by the market value of equity in year *t*−1. We set interest expenses to zero if their values are missing (Faulkender and Wang, 2006).
$\triangle D_{i,t}$	The change in dividends of firm *i* measured from year *t*−1 to year *t* deflated by the market value of equity in year *t*−1.
$C_{i,t-1}$	The cash and short-term investments of firm *i* in year *t*−1 deflated by the market value of equity in year *t*−1.
$ML_{i,t}$	The market leverage of firm *i* in year *t*, defined as total debt over the sum of total debt and market value of equity at the end of fiscal year *t*, i.e., (Debt in current liabilities +Long-term debt)/ (Debt in current liabilities +Long-term debt+ Price× Common shares outstanding).
$NF_{i,t}$	Net financing of firm *i* during the fiscal year *t,* which is computed as (Current debt changes+ Long-term debt issuance− Long-term debt reduction+ Sale of common and preferred stock− Purchase of common and preferred stock), deflated by the market value of equity in year *t*−1.
$Financial\ Constraint_{i,t}$	An indicator for financial constraint of firm *i* in year *t*. We follow Hodlock and Pierce (2010) and construct *HP Index* as the proxy for financial constraint, calculated as −0.737× Ln(AT)+ 0.043× Ln(AT)× Ln(AT)− 0.040× AGE, where AT is the total assets. AGE is the firm age, which is

	calculated as the number of years since the firm's IPO. Firms are classified as constrained if *HP index* is above the industry median value (three-digit SIC code).
$Market\ Power_{i,t}$	An indicator for market power of firm *i* in year *t*. We refer to Giroud and Mueller (2010) and measure market power using a three-year moving average sales-based Herfindahl-Hirschman index (*HHI*) for a firm's three-digit SIC code industry, computed as $HHI_{jt} = \sum_{i=1}^{N_j} SALES_{i,j,t}{}^2$, where *SALES* is the firm's net sales as a proportion of all firms' total sales in the same industry. We classify a firm as having high market power if its industry *HHI* falls in the highest quintile across the industries in the sample.
$Internal\ Capital\ Mobility_{i,t}$	An indicator for internal capital mobility of firm i in year *t*. We employ conglomerate and standalone firms to measure the effectiveness of internal capital markets (Shin and Stulz, 1998; Lamont, 1997; Khanna and Tice, 2001). Following Comment and Jarrell (1995), we define a firm as conglomerate if the firm operates in more than one segments with the aggregation of reported segment assets contributing more than 80% of their total assets (Cohen and Lou, 2012). Standalone firms are those operate in only one segment.
$Growth\ Opportunity_{i,t}$	An indicator for growth opportunity of firm i in year t. Following Denis and Osobov (2008), we use *Tobin's Q* as the proxy for growth opportunity. *Tobin's Q* is measured as the ratio of the market value of total capital (book value of total assets − book value of equity + market value of equity) to the book value of total assets. A firm is a high-growth company if its *Tobin's Q* is above its industry median value (three-digit SIC code).
$Electricity\ Intensity_{i,t}$	We calculate firm-level electricity intensity by using business-segment data (the business-segment data is available since 1976, and each segment is assigned with a four-digit SIC code), weighted by the percent of sales in each segment of firm based on industry electricity intensity data. We follow Dang et al. (2022) and define our industry electricity intensity measure as the ratio of the quantity of purchased electricity (measured in trillions of British thermal units) to the value of total shipments (measured in billions of dollars). The industry electricity intensity measure is obtained from the Supplement Tables of Annual Energy Outlook Products of the U.S. EIA during 1996-2010. For the years after 2010, EIA provides the data generated by a computer-based model which produces annual projections of energy markets. We extrapolate remaining missing values linearly using "ipolate" stata code for the years before 1996. To match the EIA data with our Compustat sample, we use SIC code for the following manufacturing and non-manufacturing industries: manufacturing industry includes refining (29), food (20), paper (26), bulk chemical (28), glass (321-323), cement (324-329), iron and steel (331-332), aluminum (333-339), fabricated metal product (34), machinery (351-356, 358-359), computers (357), transportation equipment (37), electrical equipment (36),

	wood products (24-25), plastics (30), and balance of manufacturing, while non-manufacturing industry includes agriculture (01-09), construction (15-17), and mining (10-14). We classify a firm as having higher electricity intensity if its electricity intensity is above the median value in a year.
$RPS\ Stringency_{i,t}$	We use two measurements for *RPS stringency* of firm *i* in year *t*. First, we measure *RPS Stringency* as the ratio of net requirement to total electricity consumption, computed as (RPS requirements at year *t* / total electricity consumption at year *t* − RPS achievement at year *t*-1 / total electricity consumption at year *t*-1. Second, we use the ratio of net requirement to total RPS requirements, calculated as (RPS requirements at year *t* − RPS achievement at year *t*-1) / RPS requirements at year *t*.
$CashHoldings_{i,t}$	The cash and short-term investments of firm *i* in year *t* deflated by the market value of equity in year *t*.
$Size_{i,t-1}$	The natural logarithm of market value of equity of firm *i* in year *t*-1.
$Leverage_{i,t-1}$	The ratio of total debt to total assets of firm *i* in year *t*-1.
$Tobin's\ Q_{i,t-1}$	The ratio of the market value of total capital (book value of total assets − book value of equity + market value of equity) to the book value of total assets of firm *i* in year *t*-1.
$CF_{i,t-1}$	The cash flow of firm *i* in year *t*-1 (income before extraordinary items + depreciation and amortization) deflated by the market value of equity in year *t*-1.
$CF\ Volatility_{i,t-1}$	The standard deviation of cash flows of firm *i* in year *t*-1, computed using the firm's standard deviation of the cash flow ratio for the past 5 years.
$Working\ Capital_{i,t-1}$	The net working capital of firm *i* in year *t*-1 (working capital− cash and short-term investments) deflated by the market value of equity in year *t*−1.
$R\&D_{i,t-1}$	The research and development expense of firm *i* in year *t*-1 deflated by the market value of equity in year *t*−1.
$Capex_{i,t-1}$	The capital expenditures of firm *i* in year *t*-1 deflated by the market value of equity in year *t*−1.
$Acquisition_{i,t-1}$	The acquisitions of firm *i* in year *t*-1 deflated by the market value of equity in year *t*−1.
$Payout\ Ratio_{i,t-1}$	An indicator for financial constraint of firm *i* in year *t*-1. We follow Chen and Chen (2012) and define a firm as financially constrained if its dividend capital ratios (DVP+ DVC+ PRSTKC)/PPE is less than 0.1, where DVP is the preferred dividends. DVC is the common dividends. PRSTKC is the purchase of common and preferred stock. PPE is the total value of property, plant and equipment.
$Bond\ Rating_{i,t-1}$	An indicator for financial constraint of firm *i* in year *t*-1. We follow Almeida, Campello, and Weisbach (2004) and define a firm as constrained if its bonds are not rated by S&P, Moody's, Fitch, or Duff & Phelps.
$EERS_{i,t}$	Dummy variable that equals one if the *EERS* has been passed by the state of firm *i* in year *t* and zero otherwise. *EERS* is the Energy Efficiency Resource Standards, under which the utilities must procure a percentage of

	their future electricity and natural gas needs using energy efficiency measures.
$GPP_{i,t}$	Dummy variable that equals one if the *GPP* has been passed by the state of firm *i* in year *t* and zero otherwise. *GPP* is EPA's Green Power Partnership program that encourages organizations to buy green power to reduce the environmental impacts of their electricity use.
$GHGRP_{i,t}$	Dummy variable that equals one if the *GHGRP* has been passed by the state of firm *i* in year *t* and zero otherwise. *GHGRP* is the Greenhouse Gas Reporting Program, which requires certain facilities to report their emissions of greenhouse gases, in the aim to recognize the sources of emissions to guide development of policies to reduce emissions.
$NBP_{i,t}$	Dummy variable that equals one if the *NBP* has been passed by the state of firm *i* in year *t* and zero otherwise. *NBP* is Budget Trading Program, a regional cap-and-trade program aimed at mitigating the NOx emissions in the United States.
Portfolio-adjusted $\triangle C_{i,t}$	The change in cash and short-term investment of firm *i* in year *t* minus the cross-firm average change in cash in the firm's benchmark portfolio in the same year. The benchmark portfolio is one of the Fama-French 25 size and book-to-market value-weighted portfolios (Faulkender and Wang, 2006).
Unexpected $\triangle C_{i,t}$ *Parsimonious*	*Unexpected* $\triangle C_{i,t}$ *Parsimonious* is estimated as the residual from a regression: $\triangle C_{i,t} = \beta_0 + \beta_1 CF_{i,t} + \beta_2 Tobin's\ Q_{i,t} + \beta_3 Size_{i,t} + \varepsilon_{i,t}$ (see Almeida et al., 2004, p.1787).
Unexpected $\triangle C_{i,t}$ *Augmented*	*Unexpected* $\triangle C_{i,t}$ *Augmented* is estimated as the residual from a regression: $\triangle C_{i,t} = \beta_0 + \beta_1 CF_{i,t} + \beta_2 Tobin's\ Q_{i,t} + \beta_3 Size_{i,t} + \beta_4 Expenditures_{i,t} + \beta_5 Acquisitions_{i,t} + \beta_6 \triangle NWC_{i,t} + \beta_7 \triangle Short\ Debt_{i,t} + \varepsilon_{i,t}$ (see Almeida et al., 2004, p.1788).
$R_{i,t}$	The annual stock return on individual security in year *t*.
$R_{f,t}$	The risk-free return in year *t*.
$R_{m,t}$	The return on the value-weight market portfolio in year *t*.
SMB_t	The difference between the returns on a diversified portfolios of small and big stocks in year *t*.
HML_t	The difference between the returns on diversified portfolios of high and low B/M stocks in year *t*.
RMW_t	The difference between the returns on diversified portfolios of stocks with robust and weak profitability in year *t*.
CMA_t	The difference between the returns on diversified portfolios of stocks of low and high investment firms in year *t*.
Mom_t	One-year momentum in stock returns in year *t*.

Appendix 3: ISOs or RTOs

Name	Year	State	RPS
CAISO	1998	California	Yes
MISO	1998	North Dakota	No
		South Dakota	No
		Nebraska	No
		Minnesota	Yes
		Iowa	Yes
		Wisconsin	Yes
		Illinois	Yes
		Michigan	Yes
		Arkansas	No
		Louisiana	No
		Missouri	Yes
ISO-NE	1997	Connecticut	Yes
		Maine	Yes
		Massachusetts	Yes
		New Hampshire	Yes
		Rhode Island	Yes
		Vermont	Yes
NYISO	1999	New York	Yes
PJM	1996	Delaware	Yes
		Indiana	No
		Kentucky	No
		Maryland	Yes
		New Jersey	Yes
		Ohio	Yes
		Pennsylvania	Yes
		Virginia	Yes
		West Virginia	No
SPP	2004	Kansas	Yes
		Oklahoma	No
Texas	1999	Texas	Yes

Note: This table presents the currently seven ISOs or RTOs in the U.S. and the year of ISOs or RTOs formed. We also present whether each of the members in an ISO or RTO adopts RPS policy. Since ISOs or RTOs coordinate the transmission of wholesale electricity, the electricity prices of states in the same ISO or RTO converges.

Appendix 4: Confounding Policies

State	Year	State	Year
Panel A: Energy Efficiency Resource Standards (*EERS*)			
Alaska	2010	Mississippi	2009
Arkansas	2010	Nevada	2005
Arizona	2010	New Hampshire	2016
California	2006	New Jersey	2018
Colorado	2007	New Mexico	2008
Connecticut	2011	New York	2007
Delaware	2009	North Carolina	2008
D.C	2008	Ohio	2008
Hawaii	2009	Oregon	2016
Illinois	2007	Pennsylvania	2008
Iowa	2008	Rhode Island	2006
Maine	2009	Texas	1999
Maryland	2008	Vermont	1999
Massachusetts	2008	Virginia	2007
Michigan	2008	Washington	2006
Minnesota	2007	Wisconsin	2006
Panel B: Green Power Partnership program (*GPP*)			
Connecticut	2004	Massachusetts	2007
Maine	2003	Rhode Island	2015
Maryland	2001	Wisconsin	2006
Panel C: Greenhouse Gas Reporting Program (*GHGRP*)			
Arizona	2007	Montana	2008
California	2007	New Hampshire	2009
Connecticut	2009	New Jersey	2009
Delaware	2009	New Mexico	2007
Illinois	2012	New York	2009
Iowa	2012	Oregon	2007
Kansas	2012	Rhode Island	2009
Maine	2009	Utah	2008
Maryland	2009	Vermont	2009
Massachusetts	2009	Washington	2007
Michigan	2012	Wisconsin	2012
Minnesota	2012	Montana	2008
Panel D: Budget Trading Program (*NBP*)			
Alabama	2004	Connecticut	2003
Illinois	2004	Delaware	2003
Indiana	2004	Maryland	2003
Kentucky	2004	Massachusetts	2003
Michigan	2004	New Jersey	2003
North Carolina	2004	New York	2003
Ohio	2004	Pennsylvania	2003
South Carolina	2004	Rhode Island	2003
Tennessee	2004	Washington	2003
Virginia	2004	Missouri	2007
Vest Virginia	2004		

Notes: This table reports the years in which the confounding policies, namely Energy Efficiency Resource Standards (*EERS*), Green Power Partnership program (*GPP*), Greenhouse Gas Reporting Program (*GHGRP*), and Budget Trading Program (*NBP*), were first adopted for each state. Data is collected based on the work of Dang et al. (2022). Appendix 2 provides all confounding policy definitions.