Financial Constraints and Investment: A Quasi-Experiment in the Electricity Sector

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Abstract

We study the impact of financial constraints on the investment behavior of electricity generating utilities. The pollution permit allocation rule of the US SO_2 regulation introduced variation in internally available funds, in an industry where firms are otherwise very similar. We use this exogenous variation to identify the relationship between cash flow and investment. Consistent with a financial constraints explanation, this relationship is on average positive but decreases with firm size.

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1 Introduction

One of the most widely documented regularities in corporate finance is the positive correlation between internally available funds and investment, the so called *investment cash flow sensitivity*. This relationship is at the heart of a fundamental theme in finance, the connection between firms financing and investment decisions. In this paper we study this relationship exploiting variation in internally available resources that results from the pollution regulation introduced by the US SO_2 program. This is a cap-and-trade program implemented in 1995 to control sulfur dioxide emissions (SO_2) in the electricity generation industry. Every year, a given stock of pollution permits is distributed (the cap), some plants receive the permits for free and a fraction of the cap is auctioned. At the end of the year plants have to back each ton of pollution they produced with a permit. Once distributed, these permits can be freely traded in the market. A firm with an excess of permits can sell its excess, while a firm with more pollution than permits has to go to the market to buy its shortage.

We study investment behavior in this novel setting where the regulatory framework generates variation in internally available resources in an industry where firms are otherwise very similar. This exogenous variation allows us to identify the relationship between cash flow and investment. Moreover, since the introduction of the program, the price of permits has fluctuated wildly. This is important for our purposes as is allows us to exploit within firm variation in the regulation induced component of cash flow, by controlling firm specific heterogeneity that is constant through time with firm level fixed effects. In 2000 the average price of a permit allowing a polluting unit to emit one ton of SO_2 was $130,[1] this price reached a peak of $890 in 2006, and decreased in the following years reaching an average of just $38 per permit in 2010. This change in permit prices was a consequence of changes in factors unrelated to the demand for electricity. Particularly, the big price increase between 2005 and 2007 was to a great extent the result of the introduction of a new SO_2 regime in the eastern states. For this reason and in addition to the heterogeneity in the allocation, we

[1] This is the Environmental Protection Agency (EPA) auction price.

consider that the permit cash flow constitutes a good instrument to identify the effect of the availability of internal resources on firm investment.

While there is no good reason to expect financing and investment decisions to be independent of each other, unless one believes in the perfect capital markets benchmark (Modigliani and Miller (1958)), it is hard to agree on the reason(s) for the correlation. Incentive problems, asymmetric information, taxes, and mismeasurement of investment opportunities, can all drive a wedge between the internal and external cost of funds and help explain this relationship.[2] In this paper we keep constant some of these explanations and get a better grasp of the effect of financing frictions in the investment cash flow sensitivity. By working within a single industry we are able to keep several dimensions relatively constant across firms, while at the same time take advantage of a particular feature of the regulation generating variation in the availability of internal resources. Firms in this industry produce a homogeneous good, information differences about the quality and characteristics of investment projects is low, but at the same time internally available funds vary for a reason that is arguably exogenous to the investment opportunities of each firm.

The finance literature has generally avoided the inclusion of firms from this industry in tests of investment related theories (Almeida and Campello (2007), Bakke and Whited (2010)). With the typical argument being that their investment behavior is influenced by the regulatory environment. We agree that this is indeed the case, nonetheless, this is more so the case for transmission and distribution of electricity, which are natural monopolies, and not so for the electricity generation sub-sector. Excluding this sector makes sense if one wants to draw conclusions for a typical firm in the economy and the regulatory environment varies significantly between sectors, but on the other hand focusing on a single industry allows

[2]See for example: on incentive problems Jensen and Mecking (1976), Grossman and Hart (1982), Jensen (1986), Zwiebel (1996); on asymmetric information Leland and Pyle (1977), Myers and Majluf (1984), Brennan and Krauss (1987), Stein (1992), Hennessy et al. (2010); on taxes Stiglitz (1973), Miller (1977), DeAngelo and Masulis (1980), Brennan and Schwartz (1984), Shleifer and Vishny (1992), Hennesy and Whited (2007); on mismeasurement of investment opportunities Erickson and Whited (2000), Hennessy (2004), Cummins et al. (2006).

for a cleaner study of the channels that influence investment. In particular, this regulatory environment lowers the information asymmetries between the firms and providers of capital. Further, investment in this industry is relatively easy to monitor, the electricity generation technology is well understood, and the basic method of production (discovered during the 1820s) is still used today. These features allow us to isolate the effect of financial constraints by studying the relationship between investment and internally available resources.

Our paper is related to the longstanding literature that studies the behavior of corporate investment (Brainard and Tobin (1968), Brainard et al. (1980), Bond and Meghir (1994), Carpenter et al. (1994), Chirinko and Schaller (1995)) and focuses on an industry where Hayashi's (1982) conditions for the equivalence between marginal and average Q are satisfied.[3] Most importantly our paper is related to the literature on the interpretation on investment cash flow sensitivities (Fazzari at al. (1988), Kaplan and Zingales (1997), Cleary (1999, 2006), Cooper and Ejarque (2003), Alti (2003), Abel and Eberly (2011)), to this literature we add an analysis that uses variation in internally available resources that is unlikely to be correlated with investment opportunities. Our approach follows the insights of the literature exploiting natural experiments, interactions or thresholds to improve the identification of the cash flow - investment relationship (Hoshi et al. (1991), Blanchard et al. (1994), Calomiris and Hubbard (1995), Lamont (1997), Rauh (2006), Hovakimian and Titman (2006), Almeida and Campello (2007), Cohn (2011), Bakke and Whited (2012)).

To test the relationship between cash flow and investment, we follow an approach similar to the one used by Rauh (2006), and decompose cash flow into two components. Unlike Rauh (2006), our identification strategy does not depend on a potentially endogenous threshold as pointed out in Bakke and Whited (2012). We separate cash flow into a non-permit and a pollution permit cash flow. The later is defined as the market value of the difference between the pollution permits the firm holds at the beginning of the period and the permits the firm needs to back up its emissions.

While firms have to adjust their permit holding to comply with the regulation, they

[3] Constant returns to scale, and price taking in both input and output markets

may adjust their permit holdings for other reasons too. Some of these adjustments could be related to investment opportunities (e.g. a firm may decide to hoard more permits if it expects to increase its production in the future). For this reason our measure of permit cash flow is potentially endogenous. We account for this by instrumenting the current permit cash flow with an analogous measure based on the initial allocation of free permits decided by the regulation. Every year, power plants receive a set amount of free permits based on a rule implemented in 1990. This rule is based on each unit's output and emissions between 1985 and 1987.

Our investment regressions control for a set of firm level as well as aggregate level variables that can plausibly be related to investment behavior. Our firm level controls include firm size, emission rate, sales growth, leverage, and profitability. And to control for aggregate level changes in investment opportunities we include a full set of year dummies. Since we cannot construct Tobin's Q for private firms, we imputed its value based on observables. In our robustness checks, we add placebo permit cash flows to study whether potential correlation between our measure of permit cash flow and investment opportunities could explain the results. They do not.

We find a positive and significant relation between permit cash flow and capital expenditures. The point estimate on the permit cash flow in our baseline regression is 1.64, meaning that a 1% higher permit cash flow is associated with a 1.64% higher investment rate. This effect however is not the same for all firms. When we separate large and small firms it is stronger for smaller firms and zero for the largest firms. When we add an interaction term between cash flow and firm size, we find that consistently with the sub-sample analysis the coefficient on the permit cash flow and firm size interaction is negative. We obtain similar results when we add the imputed Tobin's Q and when we add the placebo cash flows to the regressions.

We organize the paper as follows. In section 2 we present our empirical framework and introduce the data. In section 3, we report and discuss the results. In section 4, we present robustness checks. Finally, in section 5 we conclude.

2 Empirical Strategy and Data

2.1 The US SO_2 program

To test how important are internally generated funds in determining fixed capital investment we take advantage of some nice characteristics of the US SO_2 program. This program established a pollution permit system to regulate the amount of SO_2 emissions produced by the electricity generation sector. The program started in 1995 and affects coal, gas and oil plants. To satisfy the target levels of pollution, the government issues and distributes a fixed amount of pollution permits every year. Every year individual power plants, if entitled, receive a fixed amount of permits at no cost, they can then participate in the secondary permit market to cover any differences that might occur between their actual emissions and the permits they hold. At the end of each year, every power plant has to back up each ton of SO_2 they produced with a permit.

While permits are allocated at the plant level we think that the relevant decision unit for investment purposes is the electric utility. Each electric utility can have several power plants; therefore we aggregate the permits and pollution data for the various power plants that each utility controls.

Unfortunately, we are restricted to work on the subgroup of relatively large investor-owned electric utilities because we could not obtain financial information for the group of independent power producers participating on the SO_2 program. We expect this sample selection restriction to work against us finding a result for two reasons. The first one is that there is evidence that financial constraints are more likely to be important for smaller firms (Carpenter et al. (1994), Almeida et al. (2004), Beck et al. (2005), Forbes (2007), Hadlock and Pierce (2010)), and the second one is that they are not as regulated as the bigger electric utilities.

The dataset covers the years 2000 to 2010 when all the polluting units were participating in the cap-and-trade program. To assemble the dataset we had to merge and match several sources. We obtained the financial data from Form 1 (Annual Report of Major Electric

Utility) of the Federal Energy Regulatory Commission (FERC). We obtain the data on the allocation of allowances, emissions, compliance and output from Data and Maps of the U.S. Environmental Protection Agency (EPA), and the data on generating capacity from Form 860 of the Energy Information Administration (EIA). We obtained the data on the type of utility,[4] parent company information and NERC region from the EGRID data sets. We obtained detailed data on type and costs of fuels from Form 423 of the EIA, and data on environmental devices and abatement capital expenditures from Form 767 and Form 923 also of the EIA.[5]

To have a measure of how the cash flow of the firms are affected by the free permits, we construct the following variable for each firm:

$$PermitCash_{H,t} = p_t^e(e_{H,t} - e_t)$$

where p_t^e is the price of permits in period t, e_t are the observable emissions of the firm during in period t and $e_{H,t}$ are the current of past vintage permits the firm held at the beginning of period t.

Our measure of the pollution permit price is the EPA auction price.[6] An issue that arises with the use of this price is whether the price of permits is correlated with demand factors that affect investment opportunities. While the permit price could be correlated with these factors, in this paper we take advantage of a jump in the price due to relatively exogenous factors. Figure (1) shows the pollution permit price evolution over the past decade. In 2000, the price was below \$200 and it reached almost \$900 in 2006.[7] The main factor that explains the high prices in 2005 and 2006 is the introduction of the Clean Air Interstate Rule (CAIR). This rule imposed further reductions of SO_2 emissions in the eastern US states. Additionally, Boutabba et. al (2011) find a positive relation between SO_2 permit

[4]Investor Owned Utility, Cooperative, etc.

[5]Due to a change in the data collection procedure, there is no environmental investment data available for the years 2006 and 2007.

[6]The CAAA mandates the EPA to hold yearly auctions to help ensure that new units have access to a public source of allowances beyond those initially allocated to existing units.

[7]These are average yearly prices but the market spot price reached almost $\$1,600$ at its peak.

prices and weather conditions and argue that one of the causes of the high prices in 2006 was that years high temperature (2006 was the warmest year on record). After the CAIR passed the pollution permit price started to rapidly decrease. This decrease was accompanied by a fall in gas prices and the installation of pollution scrubbers[8] to comply with the future requirements of SO_2 emissions. This reduced the expected demand for permits in the future bringing down its price (EPA White Paper (2009), Boutabba et. al (2011)).

The changes in permit prices due to regulatory changes and temporary extreme weather allow us to have a source of variation that does not depend strongly on changes in future demand conditions. Had this been the case, our permit cash variable could have been correlated with investment opportunities and therefore make the identification of causal effects more complicated.

The data set is an unbalanced panel of 70 electric utilities covered over 10 years between 2000 and 2010. Table (1) presents the summary statistics for the main utility level variables used throughout the paper. The electricity generating utilities are generally very large firms, the average book value of assets is \$6,404 million, however, they vary widely in size, the smallest utility in our sample is the Indiana-Kentucky Electric Corp. whose total assets averaged about \$300 million during the sample period while the largest one is Pacific Gas and Electric Co. whose total assets averaged more than \$30,000 million during the sample period.

Yearly capital expenditures averaged \$508 million. This represents 8.1% of beginning of the period total assets. The investment rate ranges from -6.5% to 60.0%, the few negative values of this variable (only 4) are due to divestitures being reported as negative capital expenditures. Our main explanatory variable, permit cash flow, has a mean value that is very close to zero (averages 0.1%). This is not surprising as the total allocation of permits is supposed to equal the total emissions, therefore, the aggregate permit cash flow is supposed to be on aggregate zero. However, some program participant firms are not in our sample,

[8]In our sample, more than 70 percent of the FGD units (scrubbers) added during our sample period were added in 2005.

and firms were allowed to bank permits during our sample period. Therefore, utilities had small differences between the permits they held and their emissions (on average 68,464 tons of permits and 74,373 tons of SO_2 emissions). Important for our purpose, while the average is close to zero, the yearly permit cash flow has variation in the sample. It ranges from -7.0% of beginning of the year total assets to a maximum of 4.3% of total assets. It is variation in this variable, particularly the time series variation within each utility, what we exploit in our empirical analysis.

Figure (2) graphs the $PermitCash_{H,t}$ variable for each firm and the price of permits over time. When the price of permits is low, for example in 2010, the permit cash is similar and small in absolute value across all firms. The dollar value of the difference between yearly emissions and permits held at the beginning of the year is low. When the permit price is high, the dispersion in permit cash flow increases. A higher difference between emissions and permit holdings creates more cash flow exposure to permit prices (either positive or negative). Utilities can disburse up to 7% of the value of their assets to obtain the permits they need to back up their emissions or obtain up to 4.3% of the value of their assets by selling excess permits.

2.2 Empirical Strategy

Our identification strategy is based on the disaggregation of cash flow into two components.[9]

The first component of cash flow, $Non - PermitCash$, is defined as net income plus depreciation and amortization. The cost of complying with the pollution regulation (the cost of the used permits), along all the other production costs, is included in this variable as $\mathrm{SO_2}$ emitting firms incorporate the cost of their pollution into their operating costs.

We defined the second component $PermitCash_{H,t}$ in the previous subsection. It is the market value of the permits the firm had to buy or could sell due to the difference between the amount of $\mathrm{SO_2}$ that each firm produced during the year and the quantity of $\mathrm{SO_2}$ pollution

[9]Rauh (2006) follows a similar strategy and uses mandatory contributions to the pension fund to identify a source of non-operating cash flow.

permits that each firm held at the beginning of the year. The permits holdings considered in this case are only those with a current or previous vintage as firms are prohibited from borrowing future vintage permits to comply with the regulation.

One potential caveat with this second cash flow proxy is that even though the Acid Rain Program decided an initial permit allocation for all participant firms, as time passes, firms can trade and save permits to adjust their permit holdings. If firms adjust their holdings for reasons related to investment opportunities that we are not able to control in our tests, then the relationship between this variable and investment will not be capturing a pure cash flow effect. To address this issue, we instrument the $PermitCash_{H,t}$ with an analogous measure based on the free allocation of permits that firms receive at the beginning of every year. We call this variable $PermitCash_{A,t}$.

The original free permit allocation is based on a rule that depends on the output (electricity generation) and emissions of each unit in the mid-1980s. The amount of permits that each unit receives for free every year does not change through time. This is key to our identification strategy. Since the firm characteristics considered for the free permit allocation are based on data from 1985-1987 and our period of analysis, 2000-2010, is more than 15 years after that, new investment opportunities in the later period are likely not highly correlated with firm characteristics more than fifteen years earlier, especially when one considers the entire portfolio of boiler units that each electric utility controls (the permits are allocated at the boiler level and electric utilities can operate many plants, each one with several boilers).

However, despite the significant time elapsed since the design of the allocation rule, we acknowledge that there is still a possible source of correlation between the way permits were initially allocated and investment opportunities. In the initial allocation larger firms received more permits, and past values of output could be correlated with their current values (in the 2000s). If new investment opportunities are correlated with size in the past (larger firms in the past are also larger today and they are more likely to invest) then this could generate an endogeneity problem as firms with more permits may invest more. To partially control this issue, we run our models with firm level fixed effects to account for any kind of time invariant firm heterogeneity.

Key to our strategy, the free allocation of pollution permits generates heterogeneity in the permit cash flow across firms and is arguably less correlated, if any, with current investment opportunities, as it depends on a rule based on firms conditions more than fifteen years before the start of our sample period. Differences in the investment behavior of two firms similar in all dimensions other than the initial permit allocation provides cleaner evidence on the role of cash flow as a determinant of investment.

These two components of cash flow in the equation are crucial to understanding our empirical approach. As previously mentioned, a vast literature discusses the correlation between firm investment and firm cash flow. Nevertheless, there is less agreement on the causes of this correlation. Some argue that this correlation is the reflection of financial constraints (Fazzari et al. (1988)), while others argue that even in perfect markets it is possible for investment to be correlated with cash flow (Alti (2003), Abel and Eberly (2011)). One important explanation for this disagreement is the potential information about investment opportunities that may be embedded in cash flow even after controlling for investment opportunities with Tobin's Q or other proxies. While the interpretation of the $Non-PermitCash$-$Investment$ relationship is contentious, the relationship between the instrumented value of $PermitCash_H$ and $Investment$ is a better measure of the effect that a shock to cash flow can have on investment.

Our basic empirical model can be summarized as follows:

$$\frac{Investment_{i,t}}{A_{i,t-1}} = \alpha_i + \beta_1 \frac{PermitCash_{H,i,t}}{A_{i,t-1}} + \beta_2 \frac{NonPermitCash_{i,t-1}}{A_{i,t-1}} \ldots$$
$$+\beta_3 X_{i,t-1} + \gamma T + \epsilon_{i,t}$$

We normalize all the firm level variables, other than growth rates, by scaling them by lagged total assets $A_{i,t-1}$. $Investment$ is the value of expenditures in additional plant.

In this setup, α_i represents a firm specific error that is constant through time and γ represents the coefficients on a full set of year dummies. The firm specific effect captures the average effect of all possible omitted variables whose effect is constant through time. We include a full set of year dummies to control for the business cycle, that is, for variations in investment opportunities common to all the firms on a given year (e.g.: changes in input prices, changes in the aggregate demand for electricity). The inclusion of a full set of year dummies is very important in this setup, as they capture the potential correlation between investment opportunities and permit prices.

To proxy for the investment opportunities specific to each firm the investment literature typically uses either sale growth or Tobin's Q. We cannot include Tobin's Q in all the regressions because most of the investor-owned utilities in our data do not have publicly traded shares. Therefore, we rely on lagged sales growth as a proxy for investment opportunities. Several papers have used this variable to control for the investment opportunities of private firms (see for example Asker et al. (2012), Billet et al. (2007), Whited (2006)). In robustness checks we proxy investment opportunities with an Imputed Tobin's Q to check our results.

Finally, we include $X_{i,t-1}$, a vector of lagged firm level controls that includes the emission rate, the return on assets, leverage, and total assets. We include total assets to control for the possible relation between firm size and investment. We include the emission rate, the total amount of SO_2 produced by the utility during the year divided by its total heat input use, to control for any possible differences in investment related to the type of technology of the firm (whether it uses coal, gas or petroleum).

3 Results

Table (2) shows the results of our baseline specifications. The dependent variable in all four regressions is the ratio of yearly capital expenditures over beginning of the year total assets. In column (1) the model is estimated using the value of $PermitCash_H$ constructed with the amount of permits held at the beginning of the period, while in column (2) the model is estimated in 2-stages and $PermitCash_H$ is instrumented with its analog variable $PermitCash_A$ which is based on the initial allocation of permits.

The regressions in columns (1) and (2) do not include any interactions with the cash flow variables and therefore capture the average correlation between cash flow and investment. We observe both the $PermitCash_H$ and $Non-PermitCash$ variables are positively related to investment. The results from column (1) show that a 1% higher $PermitCash_H$ is associated with a 0.93% higher investment rate, that is, on average almost all of the permit cash flow shock goes to investment. On the other hand, a 1% increase in the non-permit cash flow is associated with a 0.35% higher investment rate. The magnitude of the later relation is in line with previous studies (Fazzari et al. (1988), Lewellen and Lewellen (2012)).

Instrumenting the permit cash flow in column (2) results in a higher estimate for this relationship. A 1% higher permit cash flow results in a 1.64% higher investment rate. The magnitude of this coefficient is consistent with firms leveraging an extra dollar of cash when funding a new investment (Almeida and Campello (2007)). The control variables give the expected results. An increase in the emission rate is correlated with an increase in investment, this is consistent with firms initially increasing (decreasing) the usage rate of their boilers and then subsequently investing (divesting) in additional capacity. Size is negatively related to investment, as firms grow they lower their investment rate. Finally, the lagged return over assets is positively related to the investment rate.

To explore whether the positive coefficient on $PermitCash_H$ is related to financial constraints, in columns (3) and (4) we run a more flexible specification that allows the relationship between $Investment$ and both $PermitCash_H$ and $Non-PermitCash$ to vary with the size of the firm. To ease with the interpretation of the results, the interaction terms are demeaned. Therefore the coefficients on $PermitCash_H$ and $Non-PermitCash$ give the marginal effect on the investment rate for an average size firm with average cash flow. As in column (2), in column (4) we instrument $PermitCash_H$ with $PermitCash_A$.

The implicit assumption in these models is that larger firms are less subject to the financial frictions that may cause a positive correlation between investment and cash flow. Therefore, we expect a negative coefficient on the interaction terms between cash flows and firm size. The results support this hypothesis. The coefficient on $PermitCash_H$ is indistinguishable from zero, but the coefficient on the interaction of firm size ($Assets$) and

$PermitCash_H$ is negative and statistically significant. That is, the effect of $PermitCash_H$ on investment is stronger for smaller, arguably more financially constrained, firms.[10] The coefficient on the $Non-PermitCash$ and firm size interaction are also negative but of almost half the magnitude.

In further analysis, we divided the sample between observations below and above the median of total assets, and below and above the median emission rate. We present these results in Table (3) and Table (4). For all the specifications, we instrument $PermitCash_H$ with $PermitCash_A$.

Columns (1) and (2) in Table (3) show the results of our baseline regression for the subsamples of firms with a total value of assets below and above the sample median value of assets in the full sample respectively. In the sample of Small firms, column (1), the coefficient on $PermitCash_H$ is positive and significant, while in the sample of large firms, column (2) it is negative but statistically insignificant. Small firms with a one percent higher $PermitCash_H$ invest 2.167% more than other small firms. In column (3) we run a similar model with all the observations, and add the interactions between an indicator variable equal to 1 if the firm has total assets below the sample median ($Small$) with $PermitCash_H$ and also with the full set of year dummies (these coefficients are not reported for brevity). The former interaction captures the difference in the average relation of $PermitCash_H$ and $Investment$ between small and large firms, while the later interactions capture the differential effect between small and large firms of all the aggregate determinants of investment subsumed in the year indicators. In this specification we obtain results in line with those in columns (1) and (2), the coefficient on $PermitCash_H$, the marginal effect of the permit cash flow on investment for large firms, is 0.033 and is statistically insignificant, while the coefficient on the interaction of $PermitCash_H$ and $Small$ is positive and statistically significant. The

[10] We also estimated the models using random effects (RE) instead of fixed effects. The RE model estimated coefficients are of the same sign as those of the FE models, but are generally smaller in magnitude and statistically insignificant. To test for the appropriateness of the RE model in this data set we perform for both specifications tests of overidentifying restrictions. In models (1) and (3) the Sargan-Hansen test rejects the null of RE in favor of FE. For this reason, we only use FE in the reported regressions.

marginal effect of $PermitCash_H$ for small firms is 2.063 (0.033 + 2.030) and is statistically significant at the 1% level.

The variation in our variable of interest, $PermitCash_H$, is highly related to the emission rate of the utility. In particular, the standard deviation of $PermitCash_H$ is just 0.1% of the value of assets for firms with an emission rate below the median, and almost 1% of the value of assets for firms with a high emission rate. To better understand what is driving our identification of the effects we perform the analysis for these two samples separately. Columns (1) and (2) in Table (4) show the results for low and high emission rate firms respectively. It is only within the sub-sample of dirtier firms that we find the positive and significant relationship between $PermitCash_H$ and $Investment$. In this sample, when firms have a 1% higher $PermitCash_H$ they invest 1.8% more. In column (3) we augment this model and add the interaction between the Cash Flow variables and firm size along with the a $Clean$ indicator equal to 1 if the firm has a below median emission rate and zero otherwise. The results show that the effect of $PermitCash_H$ is decreasing in firm size (the coefficient on the interaction between $PermitCash_H$ and firm size is -1.149 and highly significant), but is not statistically different between cleaner and dirtier firms (the coefficient on triple interaction between $PermitCash_H$, firm size and clean is not significant).

4 Robustness

4.1 Imputed Tobin's Q

A potentially important limitation of our data is the lack of stock price information for most firms. This prevents us from using Tobin's Q as a proxy of firm level investment opportunities without severely limiting the size of our sample, and forces us to rely instead on the use of sales growth, the return on assets and year dummies to control for them. One approach to circumvent this potential omitted variable problem is to impute Tobin's Q at the firm level.

Following Campello and Graham (2007) we regress Tobin's Q for firms with publicly traded stock on a set of variables that are thought to be related to the marginal product of capital. We first run the following regression for all the electric service firms with coverage on Compustat (SIC codes 4911 and 4931) between 2000 and 2010.

$$TobinQ_{i,t} = \alpha + \alpha_t + \beta_1 SalesGrowth_{i,t} + \beta_2 ROA_{i,t}$$
$$+\beta_3 Leverage_{i,t} + \beta_4 Size_{i,t} + \epsilon_{i,t}$$

We then use the estimated coefficients to impute Tobin's Q for our sample of privately held utilities. Therefore our Tobin's Q variable is equal to either the firm Tobin's Q for publicly traded firms or equal to the imputed Tobin's Q for the privately held firms. In our second stage regression we include a dummy variable equal to 1 for the imputed observations.

The result from this estimation is:

$$TobinQ_{i,t} = 0.568 + \alpha_t + 0.068 SalesGrowth_{i,t} + 0.566 ROA_{i,t}$$
$$+0.960 Leverage_{i,t} - 0.021 Size_{i,t}$$

Finally, we run the following empirical model:

$$\frac{I_{i,t}}{A_{i,t-1}} = \alpha_i + \alpha_t + \beta_1 \frac{TobinQ_{i,t-1}}{A_{i,t-1}} + \beta_2 \frac{PermitCash_{i,t}}{A_{i,t-1}} + ...$$
$$\beta_3 \frac{OperatingIncome_{i,t-1}}{A_{i,t-1}} + \beta_4 X_{i,t-1} + \epsilon_{i,t}$$

Tobin's Q enters the equation lagged one period as investment between $t-1$ and t is supposed to depend on Tobins Q at the beginning of the period (end of $t-1$).

In Table (5) we present the results of the regressions that use Tobin's Q as a proxy for investment opportunities. In Columns (1) and (4) we do not include any of the first stage regressors as controls, while in columns (2)-(3) and (5)-(6) we add the first stage regressors to the second stage as controls. Further, in columns (3) and (6) we add a full set of year dummies to control for aggregate conditions.

The inclusion of Tobin's Q does not affect the estimated relationship between cash flow and investment. While Tobin's Q is statistically significant in the models without year dummies, the coefficients on the cash flow variables or their interactions with firm size continue to show the basic result. Cash flow, and most importantly the permit cash flow is positively related to investment, and this relationship is decreasing on firm size.

Tobin's Q is only statistically significant when we do not include the year dummies. Moreover, when we compare the models without (columns (1)-(2) and (4)-(5)) and with ((3) and (6)) these aggregate conditions controls, the overall fit of the model increases from 7% to 24% in the no interactions model and from 16% to 32% in the interactions model, while at the same time the explanatory effect of Tobin's Q vanishes. Firm level heterogeneity does not explain much of the variation in investment rates once we control for aggregate conditions with the year dummies. For this reason we decide to use these in all our other regressions as controls for investment opportunities.

Overall, we do not get much out of the Tobin's Q imputation exercise, the coefficients of interest remain qualitatively similar and the new proxy for investment opportunities is not significantly related to firm investment.

4.2 Placebo Cash Flow

To construct $PermitCash$ we multiply the difference between the pollution permit holdings and the actual pollution of the firm times the average yearly permits price. It is possible that this price reflects to some extent the overall condition of the industry and therefore may be correlated with investment opportunities. For example, one can argue that in equilibrium a decrease in the price of the more highly contaminating fuel sources (e.g. coal) may result in an increase in high pollution electricity production, a higher demand for pollution permits, and therefore a higher pollution permit price. If at the same time the difference between the pollution permit holdings and the actual levels of pollution is correlated with the type of fuel (e.g. coal user have "extra" permits), then an increase in the permit cash flow may signal an improvement in the investment opportunities of some firms.

So far we presented evidence arguing that the change in permit prices has little to do with fundamental changes in the demand for electricity and more with regulatory uncertainty. To present stronger evidence in favor of our interpretation we perform a falsification exercise. We run a set of placebo regressions to identify whether it is the correlation between the permit price and macro variables that is behind the explanatory power of the permit cash flow. We add to our baseline model two types of placebo permit cash flows, one set aimed at capturing aggregate conditions in the economy, and a second set aimed at capturing conditions in the electricity generation industry. The first set of placebos is constructed using the national GDP growth rate and the national unemployment rate.[11] While for the second set is constructed using the price of electricity and the price of fuel. These prices are related to demand and supply conditions in the electricity generation sector.

The placebo variables are defined as follows:

$$PlaceboCash_{H,t} = PlaceboVariable_t(e_{H,t} - e_t)$$

and

$$PlaceboCash_{A,t} = PlaceboVariable_t(e_{A,t} - e_t)$$

where the $PlaceboVariable$ is either the GDP growth, the rate of unemployment, the price of electricity or the price of fuel depending on the specification. As in the rest of the paper, we instrument $PermitCash_H$ and $PlaceboCash_H$ with $PermitCash_A$ and $PlaceboCash_A$ respectively. To ease with the comparisons we normalize the placebo variables such that they have the same mean as the permit price, to do this we multiply the $PlaceboVariable$ by the mean permit price and divide it by the mean of the $PlaceboVariable$ (GDP, unemployment, electricity price, or fuel price).

Table (6) and Table (7) present the results of these regressions. In Table(6) we only include the placebo and cash flow variables in levels, while in Table (7) we include the placebo and cash flow variables both in levels and interacted with firm size. In both tables, column (1) reproduces the IV regression of Table (2) as reference. The remaining four columns correspond to the models that include the four different $PlaceboVariable$.

The results in Table (6) show that $PermitCash_H$ remains positive and statistically significant at the 5% level in all the specification once we include the alternative $PlaceboCash_H$. The magnitude of the effect is lower in the case of the aggregate conditions placebos (GDP

[11] In unreported results we also use state level GDP growth and unemployment rate and the results are similar.

and unemployment), indeed it is the case that these two placebo cash flows are also significantly correlated with the investment rate, though the magnitude of this relationship is about 50% that of $PermitCash_H$. When we add the GDP placebo cash flow, the estimated coefficient on $PermitCash_H$ is 0.938 and the coefficient on $PlaceboCash_H$ is 0.518; and when we add the national unemployment rate placebo cash flow the coefficients are 1.277 and 0.561 respectively. On the other hand, when we include the placebos that capture conditions in the electricity generation industry, (electricity price and fuel cost) the magnitude of the estimated relationship between $PermitCash_H$ and investment remains similar to the baseline specification, and the coefficients on $PlaceboCash_H$ are relatively small in magnitude and statistically insignificant.

We confirm that after accounting for firm and year fixed effects, the endogeneity of the permit holdings, and the potential correlation between permit prices and investment opportunities through the addition of alternative placebo permit cash flows, the main result is maintained. Internally available resources are positively correlated with firm investment.

We also augment our interactions specification with placebo cash flows and their interactions with firm size. Their inclusion does not affect the direction or statistical significance of our baseline estimation. Column (1) in Table (7) shows the baseline regression including both the cash flow levels and their interaction firm firm size as regressors. As in Table (6) the subsequent columns add a corresponding set of level and size interaction of the alternative placebo permit cash flows. The relationship between the investment rate of larger firms and the permit cash flow is not as strong as that of smaller firms. Thus confirming the baseline result and showing evidence consistent with some firms (the smaller ones) increasing their investment rate significantly more than larger firms when they find themselves having a larger permit cash flow. As in all our previous interactions specifications, the interactions are constructed using the demeaned values of firm size and cash flow, therefore the coefficient on the level cash flow gives an estimate of the marginal effect of cash flow on investment for a firm of average size and with average cash flow.

5 Conclusion

In this paper we study investment behavior in a novel setting where the regulatory framework generates variation in internally available resources in an industry where firms are otherwise very similar. We use a particular feature in the allocation rule of pollution permits introduced by the US SO_2 program to identify the causal relationship between cash flow and investment. Moreover, we take advantage of the panel dimension of the data using firm fixed effects and the within firm variation in the regulatory component of cash flow caused by changes in the price of pollution.

The focus on a single industry allows us to isolate the channels through which internally available resources can potentially influence investment. In particular, in this industry information asymmetries between the firms and providers of capital is relatively low, investment is relatively easy to monitor, and the production technology has not change significantly for a long period.

To test the relationship between cash flow and investment, we separate cash flow into a non-permit and a pollution permit cash flow. The later is defined as the market value of the difference between the pollution permits the firm holds at the beginning of the period and the permits the firm needs to back up its emissions. Since the permit cash flow might be endogenous, we instrument it with the free allocation of permits the plants receive every period, which depends on firms' output and emissions in the mid 1980's.

We find a positive and significant relation between permit cash flow and capital expenditures. The point estimate on the permit cash flow in our baseline regression is 1.64, meaning that a 1% higher permit cash flow is associated with a 1.64% higher investment rate. The magnitude of this effect almost quadruples that of the non-permit cash flow. This effect however is not the same for all firms. When we separate large and small firms it is stronger for smaller firms and zero for the largest firms. When we add an interaction term between cash flow and firm size, we find that consistently with the sub-sample analysis the coefficient on the permit cash flow and firm size interaction is negative. We obtain similar results when we add the imputed Tobin's Q and when we add the placebo cash flows to the regressions.

The results highlight the ubiquitous nature of financial constraints. Even relatively large firms investing in highly tangible fixed assets, find themselves adjusting their investment levels when their availability of internal resources changes.

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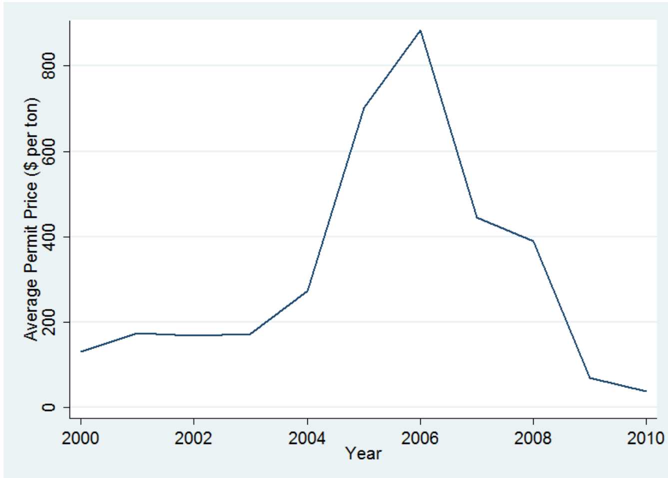

Figure 1: Permit Prices. This figures shows the evolution of the EPA auction price for the years 2000 to 2010. The CAAA mandates the EPA to hold yearly auctions of allowances to help ensure that new units have a public source of allowances beyond those initially allocated to existing units. The auction is held usually on the last Monday of March.

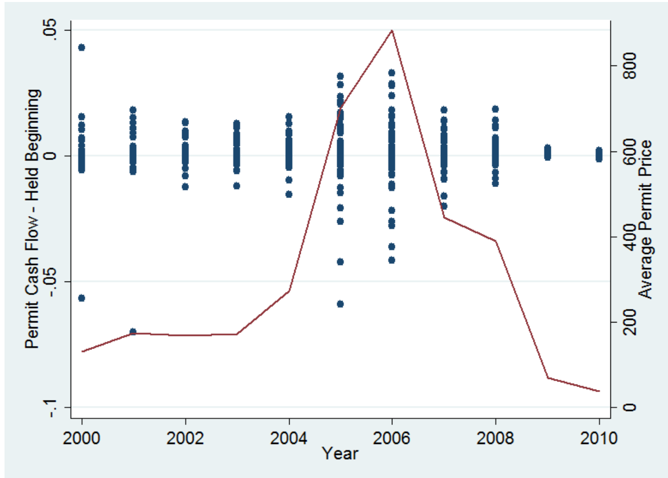

Figure 2: Permit Cash Flow - Held. This figures shows the evolution of the "*held permit cash flow*" for all utilities (right vertical axis) and the EPA auction permit price (left vertical axis) for the years 2000 to 2010. The permit cash flow for each firm is defined as $p^e(e_H - e)$ where p^e is the price of permits, e are the observable emissions of the firm and e_H are the permits the firm held at the beginning of the year.

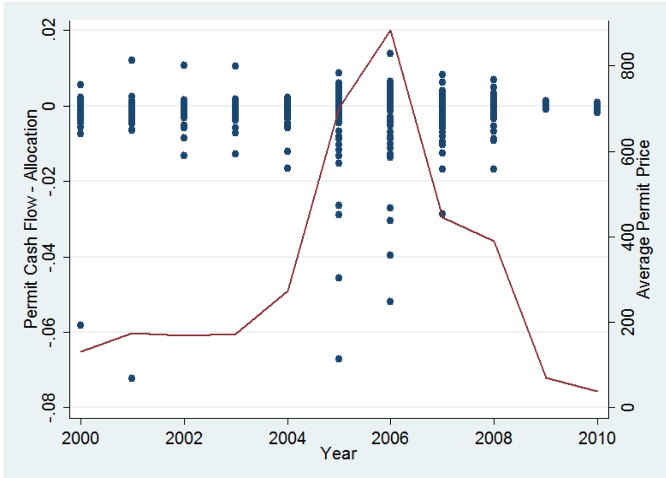

Figure 3: Permit Cash Flow - Allocated. This figures shows the evolution of the "*allocated permit cash flow*" for all utilities (right vertical axis) and the EPA auction permit price (left vertical axis) for the years 2000 to 2010. The allocated permit cash flow for each firm is defined as $p^e(e_A - e)$ where p^e is the price of permits, e are the observable emissions of the firm and e_A are the free permits the firm gets every year.

Table 1: Summary statistics

This table presents the summary statistics of the main variables used throughout the paper. The data on Emissions, Allowances, and Output was constructed by aggregating the plant level data obtained from the EPA Data and Maps at the utility level. Financial statements data at the utility level was obtained from the FERC Form 1. *Tobin's Q* is a proxy of Tobin's Q in which missing values are replaced by either the parent company's value or by an imputed value constructed after regressing Tobin's Q for electric services firms with publicly traded stock on a set of variables thought to be related to the marginal product of capital (ROA, Sales Growth, Leverage, and Size), and then using those estimated coefficients to impute its value for private firms.

Variable	Mean	Std. Dev.	Min	25	50	75	Max
Emissions (tons)	74,373	93,549	0	14,213	48,275	89,756	636,827
Output (Gwh)	18,569	17,296	0	5,607	15,520	24,364	103,383
Allowances (tons)	68,464	72,290	0	15,220	53,216	83,883	603,335
Total Assets (million $)	6,404	6,844	164	2,297	3,765	7,678	40,455
Capital Exp. (million $)	508	659	-116	132	277	618	5,373
Investment (rate)	8.054	5.239	-6.547	5.173	6.871	9.770	59.966
Cash Flow (rate)	6.830	2.635	-13.324	5.428	6.805	8.197	17.431
Permit CF - Held (rate)	0.099	0.796	-7.006	-0.007	0.039	0.193	4.325
Permit CF - Alloc. (rate)	-0.139	0.667	-7.233	-0.120	0.000	0.040	1.379
Non Permit CF - Held (rate)	6.730	2.643	-13.298	5.335	6.573	8.110	17.278
Non Permit CF - Alloc. (rate)	6.968	2.661	-13.288	5.519	6.880	8.380	17.422
Tobin's Q_{-1}	1.158	0.132	0.904	1.042	1.141	1.212	1.863
Emission $rate_{-1}$ (x100)	0.041	0.033	0.000	0.018	0.033	0.058	0.186
$Log(assets)_{-1}$	8.299	1.006	5.100	7.739	8.234	8.946	10.608
Sales $growth_{-1}$ (rate)	6.227	26.046	-77.179	-0.982	4.639	10.983	304.333
ROA_{-1} (rate)	8.516	2.428	-4.405	7.048	8.452	10.035	18.023
$Leverage_{-1}$ (rate)	68.967	10.279	17.364	64.500	68.730	72.556	99.471
N				676			

Table 2: The Effect of Permit Cash on Investment

This table shows the results from regressions of investment on cash flow, investment opportunities, and firm level controls. The dependent variable is the ratio of capital expenditures to total assets at the beginning of the period ($Investment$). Cash flow is decomposed into $PermitCash_H$ and $Non-PermitCash$. Columns (2) and (4) present the second stage of instrumental variable regressions where we instrument $PermitCash_H$ with the free permit allocation, $PermitCash_A$. The regressions are estimated with fixed effects and a full set of year dummies. Robust standard errors. * significant at 10%,** significant at 5%; *** significant at 1%.

	(1)	(2)	(3)	(4)
	CF-B	IV	CF-B	IV
$PermitCash_H$	0.933**	1.642***	-0.105	0.099
	(2.000)	(3.809)	(-0.185)	(0.143)
$Non-PermitCash$	0.349*	0.334*	0.460**	0.447**
	(1.698)	(1.746)	(2.276)	(2.375)
$PermitCash_H \times Assets_{-1}$			-0.989***	-1.040***
			(-4.146)	(-3.712)
$Non-PermitCash \times Assets_{-1}$			-0.472**	-0.461**
			(-2.167)	(-2.251)
$EmissionRate_{-1}$	35.850**	44.850**	41.808*	45.809**
	(2.054)	(2.323)	(1.954)	(2.147)
$Assets_{-1}$	-0.041***	-0.047***	-0.034*	-0.037**
	(-4.743)	(-5.426)	(-1.782)	(-2.130)
$SalesGrowth_{-1}$	0.002	0.002	0.003	0.003
	(0.278)	(0.292)	(0.356)	(0.373)
ROA_{-1}	0.313**	0.289**	0.175	0.164
	(2.178)	(2.142)	(1.326)	(1.317)
$Leverage_{-1}$	-0.042	-0.045	-0.032	-0.034
	(-1.196)	(-1.281)	(-0.702)	(-0.778)
Observations	676	674	676	674
R-squared (within)	0.249	0.240	0.323	0.321
Firms	70	68	70	68

Table 3: The Effect of Permit Cash on Investment - Size

This table shows the results from the second stage of instrumental variable regressions of investment on cash flow, investment opportunities, and firm level controls. The dependent variable is the ratio of capital expenditures to total assets at the beginning of the period ($Investment$). Cash flow is decomposed into $PermitCash_H$ and $Non{-}PermitCash$. $Small$ is equal to one if the firm is below the median in assets and zero otherwise. $PermitCash_H$ based on permits held at the beginning of the year is instrumented with $PermitCash_A$ based on the free permit allocation. The regressions are estimated with fixed effects and a full set of year dummies. Robust standard errors. * significant at 10%,** significant at 5%; *** significant at 1%.

	(1)	(2)	(3)
	Small	Large	All
$PermitCash_H$	2.167***	-0.088	0.033
	(4.460)	(-0.081)	(0.025)
$Non - PermitCash$	0.817*	0.058	0.108*
	(1.734)	(1.077)	(1.736)
$PermitCash_H \times Small_{-1}$			2.030
			(1.492)
$Non - PermitCash \times Small_{-1}$			0.578
			(1.478)
$EmissionRate_{-1}$	72.728**	-2.345	41.813**
	(2.141)	(-0.168)	(2.216)
$Assets_{-1}$	-0.028**	-0.069***	-0.045***
	(-2.071)	(-5.938)	(-5.036)
$SalesGrowth_{-1}$	0.004	0.003	0.002
	(0.310)	(0.836)	(0.281)
ROA_{-1}	0.385	0.168**	0.256**
	(1.426)	(2.340)	(1.963)
$Leverage_{-1}$	-0.029	-0.037	-0.035
Observations	335	338	674
R-squared (within)	0.282	0.365	0.256
Firms	40	41	68

Table 4: The Effect of Permit Cash on Investment - Emissions

This table shows the results from the second stage of instrumental variable regressions of investment on cash flow, investment opportunities, and firm level controls. The dependent variable is the ratio of capital expenditures to total assets at the beginning of the period ($Investment$). Cash flow is decomposed into $PermitCash_H$ and $Non-PermitCash$. $Clean$ is equal to one if the firm is below the median emission rate and zero otherwise. $PermitCash_H$ based on permits held at the beginning of the year is instrumented with $PermitCash_A$ based on the free permit allocation. The regressions are estimated with fixed effects and a full set of year dummies. Robust standard errors. * significant at 10%,** significant at 5%; *** significant at 1%.

	(1) Clean	(2) Dirty	(3) All
$PermitCash_H$	0.382	1.796***	-0.020
	(0.467)	(3.144)	(-0.028)
$Non-PermitCash$	0.132	0.556	0.353**
	(1.440)	(1.291)	(2.560)
$PermitCash_H \times Assets_{-1}$			-1.149***
			(-3.770)
$Non-PermitCash \times Assets_{-1}$			-0.594**
			(-2.470)
$PermitCash_H \times Assets_{-1} \times Clean_{-1}$			0.485
			(0.481)
$Non-PermitCash \times Assets_{-1} \times Clean_{-1}$			0.399*
			(1.898)
$Clean_{-1}$			0.005
			(0.513)
$EmissionRate_{-1}$	6.230	47.751	50.084*
	(0.106)	(1.372)	(1.829)
$Assets_{-1}$	-0.023*	-0.048***	-0.038**
	(-1.681)	(-3.557)	(-2.139)
$SalesGrowth_{-1}$	-0.001	0.004	0.004
	(-0.185)	(0.476)	(0.428)
ROA_{-1}	0.082	0.486*	0.203
	(0.990)	(1.872)	(1.456)
$Leverage_{-1}$	-0.106	-0.033	-0.043
	(-1.582)	(-0.644)	(-1.032)
Observations	331	335	674
R-squared (within)	0.343	0.256	0.332
Firms	42	40	68

Table 5: Imputed Q

This table shows the results from the second stage of instrumental variable regressions of investment on cash flow and investment opportunities. Following Campello and Graham (2007) we regress Tobin's Q for firms with publicly traded stock on a set of variables that are thought to be related to the marginal product of capital and then used the estimated coefficients to create the Imputed Q, this value is used as a proxy for Tobin's Q for private firms. The dependent variable is the ratio of capital expenditures to the total assets at the beginning of the period ($Investment$). Cash flow is decomposed into $PermitCash_H$ and $Non - PermitCash$. $PermitCash_H$ based on permits held at the beginning of the year is instrumented with $PermitCash_A$ based on the free permit allocation. The regressions are estimated with fixed effects. Robust standard errors. * significant at 10%,** significant at 5%; *** significant at 1%.

	(1)	(2)	(3)	(4)	(5)	(6)
$PermitCash_H$	1.472***	1.448***	1.644***	1.021	0.935	0.105
	(2.606)	(2.719)	(3.840)	(1.268)	(1.137)	(0.150)
$Non - PermitCash$	0.452*	0.451**	0.332*	0.583***	0.581***	0.442**
	(1.911)	(1.993)	(1.721)	(2.835)	(2.888)	(2.353)
$PermitCash_H \times Assets_{-1}$				-0.584*	-0.627*	-1.038***
				(-1.809)	(-1.945)	(-3.683)
$Non - PermitCash \times Assets_{-1}$				-0.553**	-0.540**	-0.464**
				(-2.544)	(-2.468)	(-2.252)
$Tobin'sQ_{-1}$	0.057**	0.052*	0.005	0.068**	0.063**	0.011
	(2.122)	(1.933)	(0.250)	(2.371)	(2.186)	(0.536)
$EmissionRate_{-1}$	18.256	21.891	44.993**	24.609	27.319	45.177**
	(0.976)	(1.179)	(2.355)	(1.053)	(1.179)	(2.075)
$Assets_{-1}$	0.029***	0.031***	-0.047***	0.040***	0.039**	-0.037**
	(2.822)	(2.770)	(-5.396)	(2.636)	(2.390)	(-2.127)
$SalesGrowth_{-1}$		0.003	0.002		0.003	0.003
		(0.359)	(0.284)		(0.384)	(0.325)
ROA_{-1}		0.080	0.288**		-0.017	0.162
		(0.697)	(2.136)		(-0.160)	(1.309)
$Leverage_{-1}$		-0.122*	-0.044		-0.095	-0.030
		(-1.777)	(-1.230)		(-1.211)	(-0.659)
Observations	674	674	674	674	674	674
R-squared (within)	0.054	0.066	0.240	0.151	0.157	0.322
Firms	68	68	68	68	68	68
Year	No	No	Yes	No	No	Yes

Table 6: Placebo Permit Cash Flows - Panel A

This table shows the results from the second stage of instrumental variable regressions of investment on cash flow and investment opportunities for different samples of firms. The dependent variable is the ratio of capital expenditures to the total assets at the beginning of the period ($Investment$). Cash flow is decomposed into $PermitCash_H$ and $Non-PermitCash$. $PermitCash_H$ based on permits held at the beginning of the year is instrumented with $PermitCash_A$ based on the free permit allocation. The regressions are estimated with fixed effects. $PlaceboCash$ is defined as $PlaceboVariable \times (e_H - e)$ and is instrumented with $PlaceboVariable \times (e_A - e)$. The regressions are estimated with fixed effects and a full set of year dummies. Robust standard errors. * significant at 10%,** significant at 5%; *** significant at 1%.

	(1) IV	(2) GDP	(3) Unemp	(4) Elec	(5) Fuel
$PermitCash_H$	1.642***	0.938**	1.277***	1.431**	1.737**
	(3.809)	(2.028)	(2.687)	(2.402)	(2.090)
$Non-PermitCash$	0.334*	0.326	0.330*	0.333*	0.370*
	(1.746)	(1.573)	(1.712)	(1.717)	(1.672)
$PlaceboCash_H$		0.518***	0.561*	0.294	-0.327
		(5.886)	(1.689)	(0.791)	(-0.212)
$EmissionRate_{-1}$	44.850**	52.000**	49.256**	47.275**	41.772*
	(2.323)	(2.309)	(2.278)	(2.328)	(1.893)
$Assets_{-1}$	-0.047***	-0.051***	-0.049***	-0.048***	-0.047***
	(-5.426)	(-3.967)	(-4.922)	(-4.741)	(-5.396)
$SalesGrowth_{-1}$	0.002	0.003	0.003	0.003	0.001
	(0.292)	(0.391)	(0.403)	(0.351)	(0.132)
ROA_{-1}	0.289**	0.279*	0.289**	0.287**	0.348***
	(2.142)	(1.664)	(2.034)	(2.042)	(2.601)
$Leverage_{-1}$	-0.045	-0.055	-0.051	-0.049	-0.024
	(-1.281)	(-1.533)	(-1.495)	(-1.360)	(-0.639)
Observations	674	674	674	674	635
R-squared (within)	0.240	0.217	0.240	0.240	0.237
Firms	68	68	68	68	65

Table 7: Placebo Permit Cash Flows - Panel B

This table shows the results from the second stage of instrumental variable regressions of investment on cash flow and investment opportunities for different samples of firms. The dependent variable is the ratio of capital expenditures to the total assets at the beginning of the period ($Investment$). Cash flow is decomposed into $PermitCash_H$ and $Non-PermitCash$. $PermitCash_H$ based on permits held at the beginning of the year is instrumented with $PermitCash_A$ based on the free permit allocation. The regressions are estimated with fixed effects. $PlaceboCash$ is defined as $PlaceboVariable \times (e_H - e)$ and is instrumented with $PlaceboVariable \times (e_A - e)$. The regressions are estimated with fixed effects and a full set of year dummies. Robust standard errors. * significant at 10%,** significant at 5%; *** significant at 1%.

	(1)	(2)	(3)	(4)	(5)
	IV	GDP	Unemp	Elec	Fuel
$PermitCash_H$	0.099	-0.627	-0.535	-0.426	-0.140
	(0.143)	(-0.637)	(-0.664)	(-0.433)	(-0.162)
$Non-PermitCash$	0.447**	0.445**	0.446**	0.446**	0.458**
	(2.375)	(2.266)	(2.377)	(2.421)	(2.494)
$PlaceboCash_H$		1.257	1.339	0.966	-0.188
		(1.018)	(0.700)	(0.356)	(-0.095)
$PermitCash_H \times A_{-1}$	-1.040***	-1.123***	-1.569***	-1.415***	-1.689***
	(-3.712)	(-2.770)	(-4.129)	(-3.704)	(-3.745)
$Non-PermitCF \times A_{-1}$	-0.461**	-0.466**	-0.450**	-0.451**	-0.451**
	(-2.251)	(-2.158)	(-2.192)	(-2.216)	(-2.429)
$PlaceboCash_H \times A_{-1}$		0.323	0.738	0.498	1.012*
		(0.799)	(1.414)	(0.638)	(1.912)
$EmissionRate_{-1}$	45.809**	51.772**	45.107*	44.760*	33.902
	(2.147)	(2.075)	(1.940)	(1.869)	(1.458)
$Assets_{-1}$	-0.037**	-0.037*	-0.034**	-0.034**	-0.039***
	(-2.130)	(-1.836)	(-2.147)	(-2.202)	(-2.730)
$SalesGrowth_{-1}$	0.003	0.003	0.004	0.003	0.001
	(0.373)	(0.422)	(0.479)	(0.415)	(0.110)
ROA_{-1}	0.164	0.152	0.171	0.171	0.201*
	(1.317)	(1.116)	(1.456)	(1.474)	(1.711)
$Leverage_{-1}$	-0.034	-0.044	-0.037	-0.036	-0.009
	(-0.778)	(-0.923)	(-0.852)	(-0.787)	(-0.204)
Observations	674	674	674	674	635
R-squared (within)	0.321	0.291	0.327	0.328	0.349
Firms	68	68	68	68	65