

An Analysis of the Effect of Renewable Portfolio Standards on Retail Electricity Prices

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This report describes the results of an analysis of whether states that have adopted a Renewable Portfolio Standard (RPS) have experienced a more rapid increase in average prices than non-RPS states after adopting RPS. Our findings indicate that states that adopted an RPS program subsequently experienced a 0.35% larger annual increase in average retail prices than those that did not adopt RPS. The analysis includes the years from 1990 through 2005, controlling for natural gas prices, coal prices, and the generation mix for each state thereby filtering out these other price effects so we can discover any specific effect strictly due to RPS.

1. APPROACH

We conducted a fixed-effects regression analysis to estimate the growth rates in average prices for RPS and non-RPS states. This method allows us to control for state-level characteristics that do not change during the sample period. In addition, the model controls for natural gas prices, coal prices, and the share of generation by fuel used in each state. The analysis uses data from 1990 through 2005 for fifty states and the District of Columbia.

The price data are the state-level average retail prices for all sectors from the Energy Information Administration (EIA) Form EIA-826. The RPS status for each state was determined using data from the Database of State Incentives for Renewable Energy.¹ The percentage of generation by fuel source was taken from EIA Form 906. Annual natural gas and coal prices were taken from the EIA web site.²

2. RESULTS

Across the entire analysis period and all non-RPS states, the average annual price increase was 0.48%, controlling for fixed state effects, coal prices, natural gas prices, and each state's generation mix. States that adopted RPS experienced an additional 0.35% annual increase in prices following adoption, for a total rate of increase of 0.83% per year. The 0.35% difference is highly statistically significant and is consistent with a hypothesis that meeting an RPS leads to increases in rates.

The additional 0.35% increase will have a cumulative effect over time. For example, according to these results, a state can expect that, after ten years, rates will be about 3.5% higher (equals 10 years times 0.35% per year) with RPS than they otherwise would have been without RPS.

¹ See www.dsireusa.org.

² For natural gas prices, see: <http://tonto.eia.doe.gov/dnav/ng/hist/n9190us3a.htm>. For coal prices, see: <http://www.eia.doe.gov/emeu/aer/txt/stb0708.xls>.

Other findings from the analysis are consistent with our expectations. Specifically, higher coal and natural gas prices are associated with higher retail prices; a higher share of hydroelectric generation is associated with lower retail prices; and higher shares of natural gas and “other renewable” (non-hydro) generation is associated with higher retail prices.

3. TECHNICAL FINDINGS

We surmised that, for each state, the logarithm of average retail price depends upon a time trend, an interaction of the time trend with the state’s adoption of RPS, the share of generation by fuel, the logarithm of natural gas prices, and the logarithm of coal prices according to the following equation:

$$\begin{aligned} \ln(P) = & B_0 + B_1*Y + B_2*Y*RPS + B_3*Hydro\% + B_4*NatGas\% + B_5*Nuclear\% \\ & + B_6*OtherRenewable\% + B_7*Other\% + B_8*\ln(NatGas\ Price) \\ & + B_9*\ln(Coal\ Price) \end{aligned}$$

where P is average retail price, Y is the year, RPS is a dummy that equals 1 for RPS states and 0 otherwise, coal is the omitted generation fuel source³, and the B ’s are the parameters that need to be estimated.

Table 1 shows our result. The “Time Trend” coefficient shows that prices in non-RPS states rise, on average, by 0.0048 – that is, 0.48% – per year. The “Time Trend x RPS” coefficient shows that prices in RPS states rise, on average, by 0.0035 per year more – that is, 0.35% per year more – than prices in non-RPS states. The “% Hydroelectric” coefficient shows that a 1% shift in the fuel mix from coal to hydroelectric power would reduce prices by 0.383%. The “% Natural Gas” coefficient shows that a 1% shift in the fuel mix from coal to natural gas-fired power would increase prices by 0.172%. The “% Other Renewables” coefficient shows that a 1% shift in the fuel mix from coal to other renewables would increase prices by 0.564%. The “ln(Natural Gas Price)” coefficient shows that a 1% increases in gas prices leads to a 0.073% increase in electricity prices. The “ln(Coal Price)” coefficient shows that a 1% increases in coal prices leads to a 0.196% increase in electricity prices.⁴ (The coefficients of the Nuclear and All Other Generation shares are not significantly different from zero.)

³ One of the fuel shares must be omitted because of a technical characteristic of regression analysis. If all of the fuel shares were included in the regression, they would naturally sum to exactly 100% in every year. Because the regression includes a constant term (1, equal to 100%), including all of the fuel sources would result in perfect multi-collinearity between the fuel shares and the constant term, which would cause the regression to fail. The solution is to exclude either the constant term or any one of the fuel sources. The results would be identical regardless of the fuel that was chosen for exclusion.

⁴ Because more electrical energy is generated by coal than by gas, the coal prices have a larger impact on electricity prices than do gas prices.

Table 1: Effect of RPS and Other Factors on the Natural Log of the Retail Price

Parameter	Estimate
Time Trend	0.0048* (0.0019)
Time Trend x RPS	0.0035* (0.0008)
% Hydroelectric	-0.383* (0.103)
% Natural Gas	0.172* (0.079)
% Nuclear	0.096 (0.081)
% Other Renewables	0.564* (0.260)
% All Other Generation	0.085 (0.113)
ln(Natural Gas Price)	0.073* (0.012)
ln(Coal Price)	0.196* (0.075)
Constant	1.162* (0.255)

Standard errors are in parentheses.

* indicates statistical significance at the 5 percent level.

4. GRAPHS

Figure 1 shows annual average electricity rates for RPS and non-RPS states, where RPS states are defined as states that adopted RPS sometime during the 1990 through 2005 time period. The bars at the bottom of the figure show the number of RPS states in each year. (The twenty states that eventually adopted RPS are included in all of the data points for the “RPS” average price line.)

Notice that both RPS and non-RPS states experienced an increase in average prices starting around the year 2000. However, the rate of increase for RPS states was higher following 2000, which is around the time that RPS was adopted in many of the states.

Figure 2 shows annual average rate increases for RPS and non-RPS states. The divergence in the RPS and non-RPS state lines from 2002 to 2005 is apparently what has driven our statistically significant finding that the RPS states have higher rates of price increase than non-RPS states.

FIGURE 1
AVERAGE ANNUAL ELECTRICITY RATES: RPS vs. NON-RPS STATES

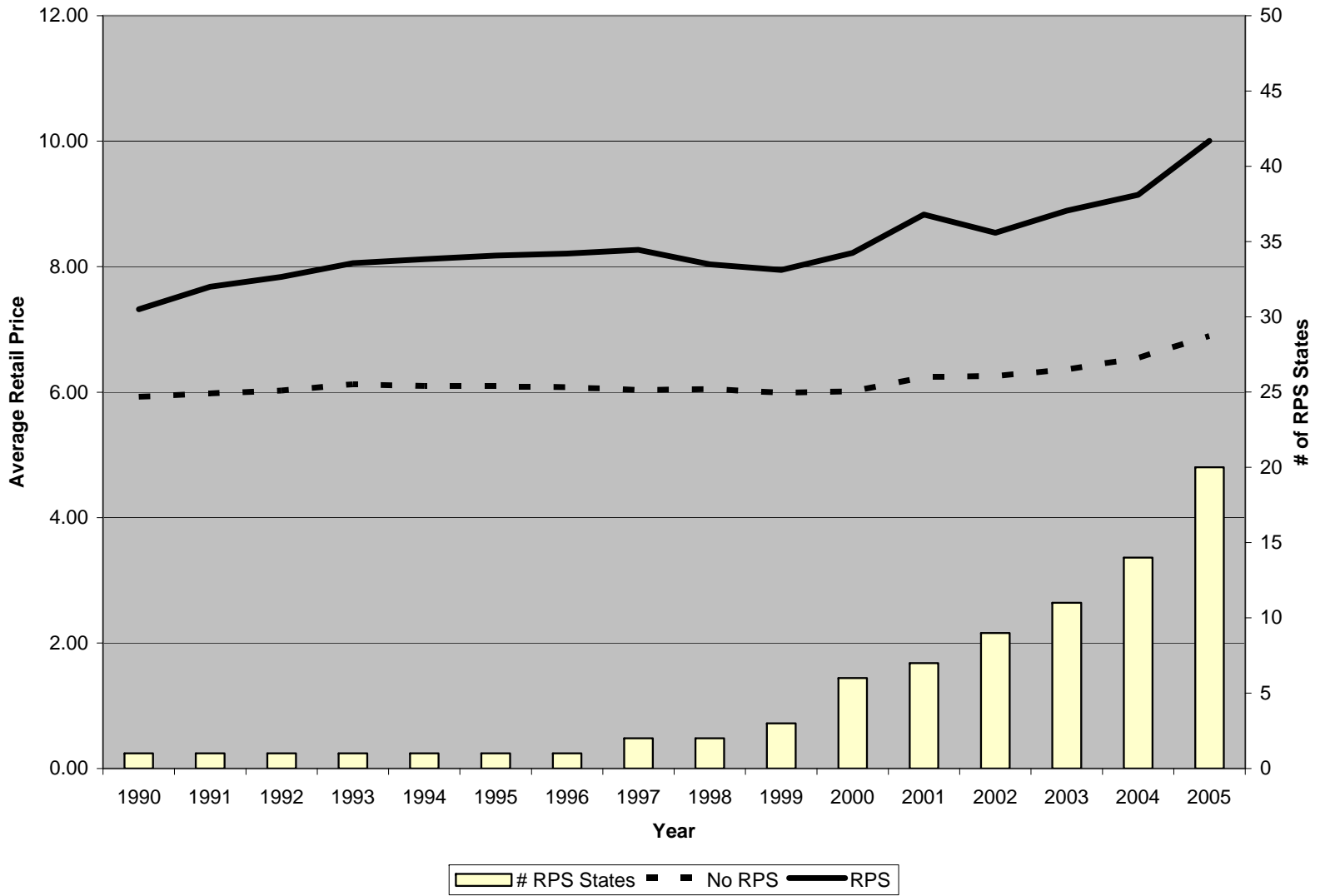


FIGURE 2
AVERAGE ANNUAL ELECTRICITY RATE CHANGES: RPS vs. NON-RPS STATES

