

Advancing Technology vs. Energy Costs

Kansas Cooley¹

¹ Department of Economics & Finance, College of Business, Louisiana Tech University



CENTER FOR
ECONOMIC
RESEARCH
LOUISIANA TECH UNIVERSITY
COLLEGE OF BUSINESS



LOUISIANA TECH
UNIVERSITY

Question

How do advancing technologies affect energy costs?

I wanted to see if adding advancing technology into our homes and business would create an impact on energy bills and the energy sectors costs. Energy specific technologies are created for the decrease in energy usage; therefore, our bills should be lowered.

Some of the new technology implemented into the energy sector:

- Smart Meters
 - They are digital applications that can assist in meeting the goals of decreased costs, increased transparency, and increased usage of renewable energy
- Solar Panels
 - This approach allows customers to reduce their dependence on traditional power sources and save money on their energy bills
- Wind Turbines
 - A device that converts the kinetic energy of wind into electrical energy

Method

Global Prices of Energy Index

- Inflation rate that consumers pay.
- Benchmark prices representative of the global market.

PPI (Producer Price Index)

- Measure of inflation at the wholesale level
- Costs
- Clean energy
- Represents any investments in technology

The Regression Equation is Price = f(cost)

Price_t is modeled as a function of past prices up to 2 lags:

- Auto regressive error terms
- Exogenous variables

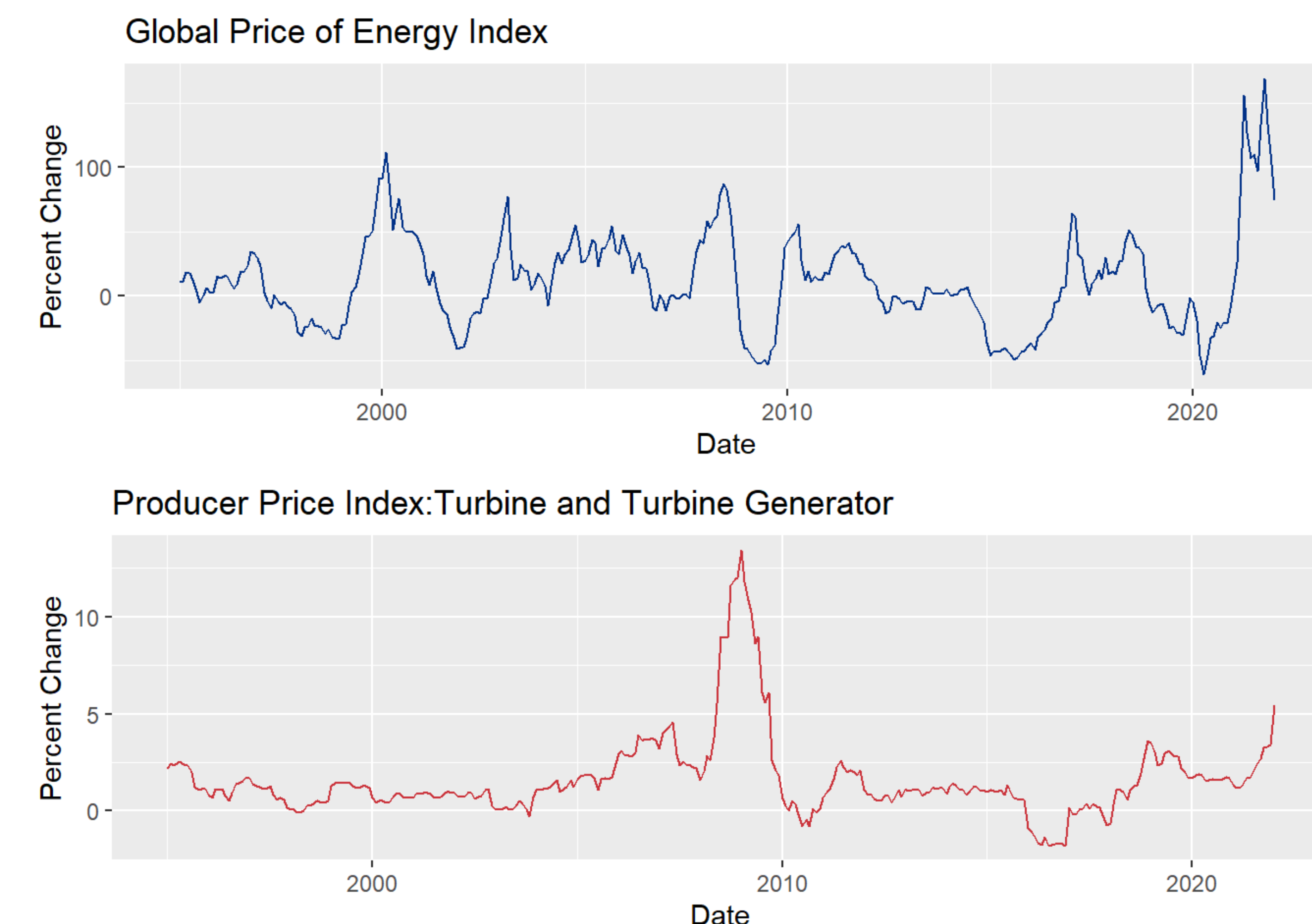
The model could be used to forecast future prices as well.

$$price_t = \alpha_0 + \alpha_1 price_{t-1} + \alpha_2 price_{t-2} + \epsilon_t + \sigma_1 \epsilon_{t1} + \sigma_2 \epsilon_{t-2} + \delta SPPI_t$$

Data

My code is a percent change that measures the inflation rate of costs. Both models represent annual cost inflation which is the percent change over the year.

The producer pricing index is important to explaining global world prices over the long run. It does not help forecast global energy prices after COVID. This is also the same before COVID.



Results

In this forecast, in Figure 2, we want the smallest numbers in each of the following cases.

- (ME) Mean error
- (RMSE) Root Mean Square Error
- (MAE) Mean Absolute Error
- (MPE) Mean Percent Error
- (MAPE) Mean Absolute Percent Error

Model 2 does not have a PPI test, but it is better even though it is significant.

	ME	RMSE	MAE	MPE	MAPE
Test set	-3.636	22.733	16.850	2.789	70.828
	ME	RMSE	MAE	MPE	MAPE
Test set	-1.893	22.407	16.383	252.048	332.836

An optimal ARIMA model was selected based on a minimum AIC calculation. AIC is a number that is a weighted average between log likelihood and number of free parameters to estimate the model. The “2,0,2” was chosen for the two models and one includes the PPI variables as an addition.

- AR(1) and AR(2) are the auto regressive lags
- MA(1) and MA(2) are the moving average lags
- The intercept is the nonzero constant

On average the investments in technology lower prices more. That is why the PPI is negative. The negative PPI estimate includes the cost of:

- operations
- resources
- investments in technology

Regression Model Estimates

	Dependent variable:	
	(1)	(2)
AR(1)	0.208 (0.259)	1.869*** (0.035)
AR(2)	0.627*** (0.238)	-0.889*** (0.032)
MA(1)	1.118*** (0.253)	-0.542*** (0.063)
MA(2)	0.312*** (0.109)	-0.337*** (0.059)
Intercept	17.088* (9.252)	10.546*** (3.763)
δ		-2.416** (1.204)
Observations	324	325
Log Likelihood	-1,248.805	-1,248.862
sigma ²	129.410	126.311
Akaike Inf. Crit.	2,511.611	2,509.725
Note:	$p < 0.1$; $p < 0.05$; $p < 0.01$	

Conclusion

Investments in clean technology have a disproportionately strong off-set for consumer prices. Despite the negativity surrounding advancing technology, through learning aspects, it is one of the core ways we can lower energy costs for customers and for power companies. Advancements in technology over the past few decades have significantly reduced energy costs through policies, improvements in energy efficiency, and the development in digital technology.

References

Nazari, Z., & Musilek, P. (2023, April 18). Impact of digital transformation on the Energy Sector: A Review. MDPI. <https://www.mdpi.com/1999-4893/16/4/211>