Comments on "Productivity Dispersion and Input Prices: The Case of Electricity"

by

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Objective

- Continuation of a productive research agenda by Haltiwanger and Davis with others taking advantage of a unique set of large scale databases developed at the US. Census

- Looked at the aggregate **and allocative** effects of oil price shocks on the macroeconomy.
  - Positive oil shocks have adverse aggregate effect
  - No direct aggregate impact from negative oil shocks
  - Positive and negative shocks have allocative effect
    - Allocative effects in turn yield adverse aggregate effect
  - Implication: Asymmetric effects of positive and negative oil price shocks on macroeconomy
- The important transmission mechanism is through allocative effects

- **This paper focuses on the allocative effects**
- Recent previous work found a wide range of industrial electricity prices and differences faced by producers regionally and by industry.
- Here, they examine the impact this has on industrial producers in the prices they pay and their energy efficiency.

The PQEM Database and Analysis of Firm level Heterogeneity

- **PQEM Database**: Annual customer-level data on price per kWh and purchase quantity for about 50,000 U.S. manufacturing plants per year
- Available years: 1963, 1967, 1972-2000
- Also, consider subset of 7 homogenous product industries: **Boxes, Plywood, Ice, Motor Gasoline, Ready Mix Concrete, Roasted Coffee, White Pan Bread**
- Even within narrowly defined industries, there is tremendous heterogeneity in the growth and productivity of firms
  - TFP
  - Location
  - Process
  - High pace of output and input reallocation
- **One potentially important explanation is the differences in electricity prices and electricity productivity**

Electricity Productivity and its Decomposition

- Electricity productivity for plant *e* in year *t*:

$$\varphi_{et} = \frac{V_{et}}{E_{et}} = \frac{A_t}{P_t} \frac{V_{et}}{K_{et}} \frac{A_t}{W_{et}}$$

taking natural logs

$$\ln(\varphi_{et}) = \ln\left(\frac{V_{et}}{K_{et}}\right) + \ln(\gamma_{et}) = \ln(P_t) - p_{et}$$

where

γ_{et} = electricity physical efficiency

p_{et} = electricity price "efficiency"

1. Dispersion of Electricity Productivity is Greater than Labor Productivity
2. Significant Price "Efficiency"

Log Deviation (from Industry Mean) Sample Weighted Statistics				
	Electricity Productivity	Physical Efficiency	Price per kWh	Labor Productivity
	Primary Analysis Sample			
Standard Deviation	**0.87**	**0.92**	**0.38**	**0.66**
90-10 Differential	**1.96**	**2.13**	**0.86**	**1.44**
	Homogeneous Products Sample			
Standard Deviation	**0.85**	**0.91**	**0.38**	**0.69**
90-10 Differential	**1.94**	**2.12**	**0.87**	**1.44**

What is the Relationship Between Physical Efficiency and Price?

- **Hypothesis 1:** A plant that is more efficient in terms of physical efficiency will also be more efficient in terms of price .

$$\beta < 0$$

- **Hypothesis 2:** There is a tradeoff between electricity physical efficiency and price. This tradeoff will be more important in electricity intensive industries.

$$\beta > 0$$

- Plant Level, 4-digit SIC, OLS (in industry-year mean deviations)

$$\tilde{\gamma}_{ei} = \alpha_i + \beta \tilde{p}_i + \varepsilon_i$$

- They break the sample into four different price regimes capturing two electricity price declines, one sharp price increase, and high price.

What is the Relationship Between Physical Efficiency and Price?

- **Plant Level, 4-digit SIC, OLS (in industry-year means)**

$$\tilde{\gamma}_{e} = \alpha_{i} + \beta_{e} \tilde{p}_{i} + \varepsilon_{i}$$

- **Hypothesis 2: dominates Hypothesis 1: using simple OLS or IV**

$$\beta_i > 0 \; and statistically signific$$

- ***The tradeoff or responsiveness is less than unity, but close*.**
- **They attempt to control for measurement error and attenuation bias.**
- **IV approach (based on utility) suggests that measurement error likely due to kWh not price (average annual price)**
- ***First three periods IV sample is relatively small.***

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- ***The tradeoff or responsiveness is less than unity, but close*.**
- **They attempt to control for measurement error and attenuation bias.**
- ***The IV approach (based on firms' utility) suggests that measurement error likely due to kWh not price (average annual price)***
- ***<u>This may be the result of the difficulty government statistical agencies like EIA have had in not being able to obtain data from NUGS, Non Electric Utility Generators. It currently is a problem for EIA in data collection, the STEO and NEMS.</u>***
- ***First three periods IV sample is relatively small.***

What is the Relationship Between Price and Energy Intensity (cost share)?

- **Hypothesis:**

$$\beta_i > 0 \; and \; rises \; with \; industry \; energy \; cost \; sh$$

- **The results appear consistent with hypothesis in all four periods, particularly in periods when electricity prices were declining.**

- ***The responses appear to be reasonably close across all four price regimes. Are they equal?***

Competition Effects on Productivity and Price Dispersion

- **Hypothesis:** For local goods, dispersion in electricity productivity, physical efficiency and prices, will decline with the number of local producers in the industry.

  - Transportation costs and Product Durability can lead to more local production.
  - This was tested using a differences in differences approach or 2-step procedure.
  - The indicator variables (0-1) are interacted and include:
  - =1 if more than one plant is in a BEA **C**omponent **E**conomic **A**rea
  - =1 if industry characterized by goods being shifted less than 100 miles

- ***An increase in local market density with locally traded goods reduces the dispersion in electricity productivity by 8%.***

- ***They find the elasticity is similar to that for labor productivity.***

Conclusions

- The Allocative effect is important for understanding the Aggregate response to changes in energy prices
  - There is a large dispersion in electricity productivity, physical efficiency and prices - even within narrow industries.
  - There is a positive tradeoff within industries between electricity physical efficiency and price.
  - This tradeoff is more pronounced in electricity intensive industries.
  - The dispersion of electricity productivity and physical efficiency declines as competition increases due to
    - local market density, and
    - locally traded good

- *Reexamine the electricity intensity effect.*

- *Is there a problem with autocorrelation in estimates?*

- *Should the competition effects necessarily be orthogonal to the first stage estimates.*

- *Next steps: Trace out dynamic response of firms to changes in energy prices HOW?*

Author's Historical Note

- The author has used EIA data since 1978.
- He was an RA at Resources for the Future in 1980-81 working for Kerry Smith, Ray Kopp, and Michael Hazilla.
- They were estimating KLEM models for US Mfg 1958-74.
- The energy data came from EIA. The author visited the sub-basement of the Forrestal Building numerous times working off of the Jack Faucett Database.
- Data was transcribed to tables and entered onto an IBM 370(?) using a 1200 baud line printer.