Regulation


Not a ground breaking paper; repeating what someone else did with new econometric twist; reasons why you might redo a study:
1. better model
2. better data
3. better technique

Ai's Take - R&J is well written; good "sell" for why redoing a study

Technology - not covered in micro course; just assumed in production function; we assume technology does one of two things (or both): improve product quality or reduce cost; technology adoption is a big issue in international economics

Speed of Adoption - factors that influence the speed from general theory (not specific to electric utilities or this paper)
1. Competition - if it's a mature, cost saving, low-risk technology, more competition results faster adoption (required because \( P = MC \)); for high-risk technology, more competition results in slower adoption (if it fails, the firm could go out of business whereas a monopoly has room for error) \( \therefore \) ambiguous effect on adoption
2. Market Structure - Schumpeterian theory argues less competition results in faster adoption (less risk and more benefit from cost savings... in perfect competition \( P = MC \) so lowering MC doesn't have a benefit); if concentration ratio increases (i.e., fewer firms) then adoption is faster... not an issue in this paper because all firms are local monopolies
3. Firm Size - "proxy for risk aversion, participation in R&D, economies of scale"; previous studies show bigger firms adopt faster: Mansfield (1968), Romeo (1975), Nasbeth & Ray (1974)... reasons:
   - internal R&D team ("engineering, design & maintenance")
   - economies of scale
   - less risk aversion (e.g., new technology for small firm is 70% of output, but smaller % for large firm)
   - build plants more frequently - R&J's big contribution: "we will observe a utility's decision to adopt one of these technologies only when the utility decides to add new baseload capacity"
   - discount rate (higher means future savings not worth as much)
   - cost of capital
Mixed results -
   - Oster (1982) - negative effect of firm size on adoption
   - Levin, Levin & Meisel (1987) - negative effects of concentration (market structure), but positive effects of market share... didn't discuss size
   - Hannan & McDowell (1984) - adoption probability rises with size and market concentration
   - Sommers (1980) - large utilities more likely to try nuclear technologies... didn't look at time to adopt
4. Expected Cost Savings
(5) **Time** - as more time passes since the innovation, more firms adopt it working out the bugs and reducing the risk so the rate of adoption should increase with time

(6) **Ownership** - could argue either way

(7) **Capital Configuration** - how old is the "old" technology (e.g., if firm just invested in 2400 psi, it’s not going to switch to 3200 psi)... David (1986) "new technologies will be relatively disadvantaged when they are embodied in indivisible capital goods... pattern of technology diffusion across firms dependent upon their history of capital investment"

(8) **Regulation** - (didn’t really say anything about this); R&J "ignore possible differences in the regulatory environment"

**2 Technologies** - 2400 psi generators and 3200 psi generators; both are "new" technology, but 2400 units were developed first (call it "old-new")

**Model 1** - look at firms that go from "old" to "old-new" (2400)

**Model 2** - look at firms that go from "old" or "old-new" to "new" (3200)

**Problem** - there are four types of firms: (i) don’t adopt, (ii) adopt 2400, (iii) adopt 3200, (iv) adopt both; R&J don’t address firms that adopt twice

**Sample** - 144 electric utilities

**4 Factors** -

1. expected cost savings - proxied by fuel cost ("significant variation")
2. utility size - same as (3) above
3. utility ownership structure - (i) investor-owned utilities (IOUs), (ii) government-owned utilities (primarily municipal utilities; "munis"), (iii) cooperatives (primarily rural electric cooperatives; "coops")... Electric Power Research Institutes (EPRI, 1987) reports 73% of IOUs are members vs. 37% of munis and 32% of coops .. IOUs more likely to be involved in R&D
4. time - same as (5) above

**Competing Risk Model** - look at old vs. new (not old vs. "old-new" vs. new); speed of technology adoption is measured from time technology is commercially available until it's adopted

**Duration** - $t_i$ - date technology adopted by firm $i$ - date available

**Characteristics** - $X_i$ - measured at some time common to all utilities; can include discount rate (not used in paper), firm size, cost saving (proxied by fuel cost), ownership structure

**Problem 1** - firm size varies over time; cost saving should be discounted; fuel cost varies over time; R&J use $X_i$ for specific point in time (doesn’t vary)

**Problem 2** - population growth not included

**Solution** - R&J use $X_i$ from two periods, 1960 and 1970

**Three Models** - "naïve," hazard rate, & hazard rate conditioned on building opportunities

**Normal Probability Model** - Tobin or linear probability model; assumes time to adoption is distributed as a log-normal random variable

\[ \ln t_i = X_i \beta + u_i \quad \text{if} \quad X_i \beta + u_i < \ln T \quad (T = \text{end date}) \]

\[ \ln t_i = \ln T \quad \text{if} \quad X_i \beta + u_i \geq \ln T \]

**Problem** - doesn’t acknowledge that probability of adopting in future increases with time... that’s why called "naïve"

**Hazard Rate Model** - original work on hazard rates comes from biology; since used for other applications (e.g., unemployment, school drop out rates, parole of criminals, etc.)
Hazard Rate - \( h(t_i) \) = probability of not surviving given that person \( i \) has survived up to time \( t \); modify terminology to match the problem: probability firm \( i \) will adopt the new technology at time \( t \) conditional on having not adopted it before \( t \)

\[
f(t) = \text{density function of time duration}
\]

\[
F(t) = \text{cumulative distribution of time duration; } F(0) = 0
\]

Survivor Function \( S(t) = 1 - F(t) \)

Equivalence - these 4 are mathematically equivalent (but some are easier to estimate):

\[
h(t) = -\frac{d \ln S(t)}{dt} = -\frac{1}{S(t)} \frac{dS(t)}{dt} = \frac{f(t)}{1 - F(t)} = \frac{f(t)}{S(t)}
\]

\[
\ln S(t) = -\int_{\tau=0}^{t} h(\tau)d\tau \Rightarrow S(t) = \exp\left[-\int_{\tau=0}^{t} h(\tau)d\tau\right]
\]

\[
f(t) = \frac{dF(t)}{dt} = \frac{-dS(t)}{dt} = \exp\left[-\int_{\tau=0}^{t} h(\tau)d\tau\right] h(t)
\]

Data Problem - \( t_i = 1, 2, \ldots, N \), duration for \( N \) firms is actually the difference between the date technology is available and the date technology is adopted or the end of the sample... these are not the true duration so introduce dummy variable for right censoring:

\[
d_i = \begin{cases} 
1 & \text{if true duration is not observed (i.e., true duration } \geq \text{ observed duration)} \\
0 & \text{if duration is observed (i.e., less than period under study)} 
\end{cases}
\]

Log-Likelihood - paper actually uses likelihood function which appears on p.361... author doesn't explain it; Ai used log-likelihood so products become addition:

\[
\text{Naïve Approach} - \sum_{i=1}^{N} d_i \ln S(t_i) + (1 - d_i) \ln f(t_i)
\]

\[
\Pr[\text{duration } \geq t_i] = \Pr[d_i = 1]
\]

Doesn't account for "desire" to adopt, just when new firm is built

Proportional Hazard Rate - \( h(t) = h_0(t)e^{X'\beta} \)

Exponential - \( h_0(t) = t \)

Weibull - \( h_0(t) = \alpha t^{\alpha-1} \) ... this is used by paper

Strong Assumption - hazard rate is monotonic increasing function of \( t \) if \( \alpha > 1 \) .

"Easy" - like this distribution because it makes integration for \( S(t) \) and \( f(t) \) easy

\[
e^{X'\beta} \int_{\tau=0}^{t} \alpha s^{\alpha-1} ds = t^\alpha e^{X'\beta}
\]

\[
\therefore \ h(t) = \alpha t^{\alpha-1} e^{X'\beta} \Rightarrow S(t) = \exp\left[-t^\alpha e^{X'\beta}\right] \Rightarrow f(t) = \exp\left[-t^\alpha e^{X'\beta}\right] \alpha^{\alpha-1} e^{X'\beta}
\]

Logistic - \( h(t) = \frac{\alpha t^{\alpha-1} e^{X'\beta}}{1 + t^\alpha e^{X'\beta}} = \frac{d \ln\left(1 + t^\alpha e^{X'\beta}\right)}{dt} \)
\[ S(t) = \exp\left[-\ln(1 + t^\alpha e^{X_B})\right] = \frac{1}{1 + t^\alpha e^{X_B}} \]

\[ f(t) = \frac{\alpha e^{X_B} t^{\alpha-1}}{\left(1 + t^\alpha e^{X_B}\right)^2} \]

Sign of \[ \frac{dh(t)}{dt} = \alpha t^{\alpha-2} e^{-X_B} \left(1 - t^\alpha e^{X_B}\right) - \alpha^{\alpha-1} e^{X_B} \alpha^\alpha e^{X_B} \ldots \]

If \( \alpha > 2 \) increasing
If \( \alpha < 1 \) decreasing
If \( 1 < \alpha < 2 \) could be either...

**Problem** - don't observe true duration: time firm build new plant \( \geq \) time firm decided to adopt new technology . real duration between last plant without new technology and first plant with it

**Solution** - ln of equation 7 in paper:

\[
\sum_{i=1}^{N} d_i \ln S(t_i) + (1 - d_i) \ln \left[F(t_{2i}) - F(t_{1i})\right]
\]

Didn't cover how to estimate it,
**Naïve Approach Results**

Table 3 - Time is $\alpha$ for Weibull (3.99) and log-logistic (4.319)... both monotonic increasing Coefficient signs are same; no big difference between 1972 and 1962 data... but hazard rates are very different (Figure 3)... log-logistic looks better

Table 4 - reduce coeff on size 0.07 to 0.05 for Weibull and 0.12 to 0.08 for logistic... point of paper: other models claim size is more important than it is

Excerpts from paper:
"article investigates the effect of firm size and ownership structure on technology adoption";
"traditional models... overstate the effect of firm size"; "we differentiate between firms' opportunities for adoption and their underlying adoption propensities"; "large firms and investor-owned electric utilities are likely to adopt new technologies earlier than are their smaller and publicly owned counterparts"; "conventional statistical models may overstate size effects and understate ownership and factor cost effects by as much as a factor of two" 
"larger firms tended to adopt these technologies earlier than did small firms"
"investor-owned utilities tended to adopt the 2400 psi technology earlier than did government-owned utilities, conditional on equal factor prices"
"controlling for differential opportunities to adopt can be critical to interpreting the results, since large firms have a higher probability of building a new generating unit of any kind in a given year, other things equal... failing to account for these higher building probabilities leads on to overstate size effects on adoption propensities by 35% to 100% and to understate the effects of ownership structure and potential cost savings on adoption propensities by 15% to 60%"
**Jaffe & Kanter.** "Market Power of Local Cable Television Franchises: Evidence From the Effects of Deregulation." (1990)

**History**
Cable was regulated because there was no competition; 3 or 4 cables to every home would not be socially efficient so entry was barred.

1980s brought competition from VHS rentals and satellite dishes, but not perfect competition so cable still had some market power.

**Price Cost Margin** \[ \frac{P - MC}{P} \]; for perfect competition \( P = MC \), but could have positive margin and still have zero long-run profit.

**Change in Market Power from Deregulation** - if market power is increased, there should be a jump in the value of the firm.

**Problem** - Cox Cable is parent company so profit data for Cox is not useful.

**J&K Solution** - transaction of franchises (i.e., sales of franchises between parent companies)... should be valued by discounted future profits.

**Simple Least Squares Regression** - Ai: given data, this work would take less than a week.

**Model** - p.229

\[
\ln \left( \frac{VALUE}{SUBS} \right) = \alpha + \beta_1 \ln (SUBS) + \beta_2 \left[ \ln (SUBS) \right]^2 \\
+ \beta_3 \text{AGE} + \beta_4 \ln (INC) + \beta_5 \text{BIGBUYER} + \gamma_1 \text{DEREG} \\
+ \gamma_2 \text{DEREG} \times \text{BIGBUYER} + \delta_1 \ln (S&P) + \delta_2 \text{INT} + \epsilon, \quad (1)
\]

where

- \( VALUE \) = the sales price in millions of 1982 dollars;
- \( SUBS \) = the number of subscribers at the time of the transaction (in thousands);
- \( AGE \) = the year of the transaction minus the initial year of the franchise (in years);
- \( INC \) = the average household income in the system’s service area (in thousands of dollars);
- \( BIGBUYER \) = 1 if the buyer is one of the top 10 cable system operators in the country and 0 otherwise;
- \( DEREG \) = 1 after October 1984, except for rural systems that were not deregulated, and 0 otherwise;
- \( S&P \) = the deflated level of the S&P 500 index; and
- \( INT \) = the corporate BAA rated bond yield.

**Results** - Table 3... Ai says should use ** for 0.01 and * for 0.05; easier to read.

- **Complete Sample** - DEREG not significant; add interaction term with BIGBUYER and that's significant at 0.05... big firms pay more because: (J&K) big buyer has less competition; (Ai) big buyer gets economies of scale.

- **Most Competition** - top 100 broadcast TV markets; DEREG not significant.

- **Other Broadcast Markets** - DEREG significant; value increases by 30%.

- **Outside Broadcast Markets** - DEREG significant; value increases by 20%.
Excerpts from paper:
"We examine the value at sale of existing cable systems before and after deregulation. Assuming that this value represents the expected present value of future profits."
"The franchising process has often focused more on the nonprice benefits to the franchisor (such as public access channels and free hookups for public institutions) than on the price to customers"
"Congress deregulated most cable television rates. FCC regulation of premium rates was removed, and state and local governments were prohibited from regulating basic rates (effective December 29, 1986)... Thus, Congress has limited franchise competition to nonprice terms"
"Firms being locked into contracts whose ex post returns were negative. In this case, deregulation might unlock these contracts and raise profits (to zero) even if market power were negligible"
"We compare the values of cable franchises sold between firms"

Ai: "You don't have to be complicated; just innovative"