Discussion of "Some Unpleasant Markup Arithmetic: Production Function Elasticities and their Estimation from Production Data" by Steve Bond, Arshia Hashemi, Greg Kaplan, and Piotr Zoch

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Introduction

- There has been renewed recent interest in measuring price-cost markups, for many interesting questions.
- Since firms generally don't tell us their marginal costs, a key component of doing this is usually to *estimate marginal costs*. Two general approaches:
- Demand approach
  - 1) Estimate demand
  - 2) Assume (or estimate) firm conduct (e.g. Bertrand-Nash, Collusion)
  - 3) Use implied FOCs to "invert out" what firms' marginal costs must have been
- Issues: Often uncomfortable assuming conduct, and there are well known challenges in estimating firm conduct (NEIO - Bresnahan (1982), Corts (1998), Fan and Sullivan (2019)) – "old-new" approach

Introduction

- Production Function approach – ("new-old" approach)
  - 1) Estimate production function
  - 2) Observe relevant input prices
  - 3) Together these determine marginal cost
- Perhaps more straightforward than Demand approach. And no assumptions on firm conduct. But
  - With multiple inputs, which marginal cost? I think less of an issue with Demand approach - "relevant marginal cost for pricing"
  - Estimation of production functions is challenging

Econ 101

- Production Function approach (Econ 101 version) - only labor input

$$Q = f(L)$$

- If you know the production function f, then you know its derivative, i.e. the marginal product of labor, MP_L, at any point.
- So we can estimate the production function f, calculate a firm's MP_L, and use the (PC) price of labor w to calculate marginal cost MC:

$$MC = w \cdot \left(\frac{1}{MP_L} \right)$$

- Compare MC to price, done.....
- If L measured in dollars, then even easier,

$$MC = \frac{1}{MP_L}$$

First Point of Paper

- In firm/plant level data, it is rare to observe direct data on Q. Typically (e.g. ASM) firms report total revenue TR.
- Conceptually, we can think of a revenue production function

$$TR = \widetilde{f}(L)$$

- But when there is market power, $\widetilde{f}$ now contains aspects of both technology and demand (e.g. Klette and Griliches (1996)).
- Derivative of this function is not MP_L. Instead it is MRP_L.

First Point of Paper

- Problem is that knowing MRP_L doesn't tell us MC. This is because an optimizing firm chooses L such that:

$$MRP_L = w$$

- If L measured in dollars you should find that

$$MRP_L = 1$$

which is very different than what we had before

$$MP_L = \frac{1}{MC}$$

- In other words, knowing how an extra dollar of L affects Q does tell us what MC is, but knowing how an extra dollar of L affects TR does not. An extra dollar of L should increase TR by a dollar!
- This doesn't mean estimating a revenue production function is not useful for other things, but not for estimating a firm's MC and markup.

Comments

- 1) Because of this importance of knowing Q, various papers studying production:
  - Use *industry price indices* to convert TR to Q (e.g. DLW (2012))
  - Use *firm specific price indices* to convert TR to Q (e.g. Ornaghi (2006), Doraszelski and Jaumandreu (2018, 2020), Pozzi and Schivardi (2016), Collard Wexler and DeLoecker (2015))
  - Use directly observed data on Q (e.g. Rubens (2020))
- But I've seen many papers that do not seem to appreciate this difference, so I think it is an important point to make.

Comments

- 2) Note that direct data on Q is not always a cure.
  - Does Q mean the same thing across firms?
  - Does Q (or TR/P) mean the same thing across time for a given firm?
- For some questions and data, TR is arguably be better measure of output than Q
- Just not ones trying to measure markup levels.

Comments

- 3) My PSA - Clearly there is an important data issue here. If we want better data to estimate MC, interesting to think more about census design in world of differentiated and multiproduct firms.
- Census questions about *levels* of prices (or units sold) versus *YOY changes* in prices (or units sold).
- Seems like the latter will provide more reliable data for a firm level price index to convert TR to Q
- These are the questions used in the Italian and Spanish surveys above.
- Yes/No questions whether the nature of the product or products has changed since the prior year, and if so, what the % increase would have been if it had not.

Second Point

- Second point of paper: Assume we have perfect data on Q
- Many of the papers that estimate PFs f are based on using "timing and information set" assumptions to address input endogeneity. These include:
  - 1) Proxy Variable Literature – OP/LP/ACF, et. al.
  - 2) Dynamic Panel Literature – BB et. al.
- There are tradeoffs between these approaches in terms of auxiliary assumptions (see e.g. Ackerberg (2020)).
- Current paper argues that in the context of trying to assess markups, auxiliary assumptions of Dynamic Panel approach may be more workable.

Second Point

- Reasoning: A key auxiliary assumption in the proxy variable literature is that an input demand function satisfies a "scalar unobservable" restriction. This restricts unobserved heterogeneity in the model, and implies:
  - 1) The MP_X of variable inputs may not be identified (ACF, Bond and Söderbom (2005), Gandhi, Navarro, and Rivers (2020))

    $\longrightarrow$ obviously problematic for procedure outlined earlier

  - 2) Restrictions on unobserved heterogeneity in demand, which is challenging to rationalize in a model with imperfect competition and potentially varying markups (e.g. Jaumandreu and Lin (2018), Doraszelski and Jaumandreu (2019))
- Dynamic Panel does not require this scalar unobservable assumption (but it does require a linear productivity process, e.g. AR(1))

Comments

- 1) I think this is a good point. For this purpose (i.e. markup estimation), the restrictions of the Proxy Variable literature may be more problematic.
  - But still, since both these approaches make arguably strong (yet different) assumptions, I also think it is beneficial to do things both ways (if can deal with identification issue in Proxy approach)

Comments

- 2) I think the authors could posit a further advantage of the Dynamic Panel approach. It easily allows fixed effects (the Proxy approach is more restrictive in this). Fixed effects are very helpful in combination with a firm level price index formed from % price changes I described earlier (Ornaghi (2006)).

$$TR_{it} = p_i^0 \, p_{it}^{index} \, Q_{it}$$

so

$$\ln\left(\frac{TR_{it}}{p_{it}^{index}}\right) = \ln\left(p_i^0 \, Q_{it}\right) = \ln\left(p_i^0\right) + \ln\left(Q_{it}\right) = \alpha_i + \ln\left(Q_{it}\right)$$

- So fixed effects can control for unobserved base price p_i^0

Comments

- 3) Some other approaches
  - Flynn, Gandhi, and Traina (2019) resolve the Proxy Variable identification problem for a variable input by assuming constant returns to scale. Then can use the Proxy method.
  - Problem with identifying coefficients on variable inputs can also be avoided if observe some exogenous variation (DLW, also discussed in Flynn, Gandhi, and Traina (2019))
  - Can also be avoided if no additional measurement error shock, e.g. Ackerberg and Hahn (2015) assume

$$Q = f(X, \omega) \text{ instead of } Q = f(X, \omega + \epsilon)$$

and can allow arbitrary first order markov process on ω

Comments

- Nice paper that illustrates a couple of important points about production based markup estimation.
- I also liked some other points made in the paper
  - Variable input cannot affect demand as well as technology (e.g. workers hired for promotional activity rather than production)
  - Can't have partially adjustable inputs.
  - May be able to estimate *differences* in markups, e.g. across groups of firms

    $$TR = \widetilde{f}(L, D)$$

    where D is assumed to affect demand but not production technology.