Pass-through and Merger Analysis

E. Glen Weyl

(joint work, in parts, with Michal Fabinger and Sonia Jaffe, Harvard)

Harvard Society of Fellows

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A sort of introduction

Talk based on "Pass-through as an Economic Tool"

- In process of becoming four papers:
  1. "Pass-through and Monopoly Theory" with Fabinger
  2. "Oligopoly Pass-through"
  3. "Demand Forms and Pass-through" w Fabinger
  4. "The First-Order Approach to Merger Analysis" w Jaffe
- Michal+ Sonia = Harvard students, Sonia at FTC now

Pass-through as fundamental quantity under market power

- Many comparative statics/normative properties turn on it
- Yet standard approaches (accidentally) restrict it severely
- So develop approaches that avoid this:
  1. General formulae
  2. Flexible functional forms
  3. Especially, robust approximations to merger effects

Plan for talk

1. Preview of results
2. “Pass-through and Monopoly Theory”: fundamental results
3. “Oligopoly Pass-through”: comparative statics of PT
4. “Demand Forms and Pass-through”: functional forms
5. “The First-Order Approach to Merger Analysis”
   - Review of past work (e.g. Farrell-Shapiro) and weaknesses
   - Our contributions
6. Conclusion and directions for future research

Sneak preview

1. Fundamental theory
   - PT, quantity PT and profit curvature
   - PT and the division of surplus
   - PT, demand PT and strategic interactions
2. Comparative statics of pass-through
   - Why common intuition on effect of competition is wrong
   - Importance of relative residual supply v. demand elasticity
3. Pass-through and functional forms
   - Most functional forms restrict PT, Apt (etc) doesn't
4. Problems with standard first-order approach
   - Specific, incomplete, imprecise and sometimes incorrect
5. How to solve these
   - General conduct for right UPP, rigorous "first-order" notion
   - Correct pass-through, general normative approach

(Quantity) Pass-through and profit curvature

Pass-through is curvature of profits

- Profits sharply peaked, “price market will bear”

$\implies$ Cost shock unimportant

- Profits loose $\implies$ small change makes all the difference
- Unitless, so could apply to many other decisions
- For example quantity pass-through
  - Firm must sell first $\tilde{q}$ at MC $\implies$ incentive to sell more
  - $\rho_Q \equiv \frac{dq^\star}{d\tilde{q}}$
  - $MR = P + P'(Q - \tilde{q})$ so increasing $\tilde{q}$=subsidy of P'

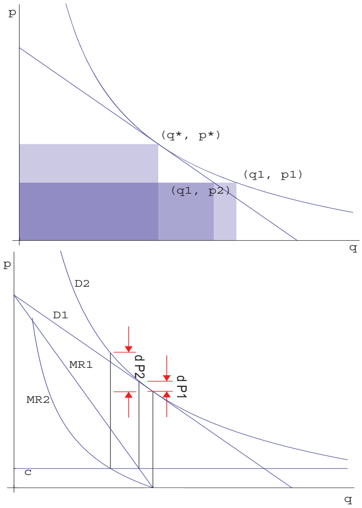
$\implies \rho_Q = \rho$

- W constant MC, equivalent to more Cournot competition
  - Just reduced number of infra-marginal units
  - So $\rho_Q - 1$ is strategic complements v. substitutes

Pass-through and the division of surplus

- Suggests connection between pass-through and surplus
  - What tempts both higher and lower prices?
    - Infra-marginal consumer surplus and deadweight loss
- Argument can be made formal
  1. Consumer-to-producer surplus ratio = avg. pass-through
     - Gradually raise tax on firm
     - Consumer surplus falls at rate ρq (Jevons-Hotelling)
     - Profits fall at rate q (same)
     - Once at 0 no CS or π
  2. DWL-to-profits = avg. quantity pass-through (constant MC)
     - Gradually increase $\tilde{q}$
     - Social surplus rises at rate $m\rho_Q$ (Dupuit-Jevons-Harberger)
     - Profits fall at rate m (Jevons-Hotelling again)
     - Once $\tilde{q} = q^{\star\star}$ no DWL or profits

Graphical proof of pass-through properties



Pass-through and demand pass-through

- Pass-through tied to response to demand
  - $1 tax on monopolist, subsidy to consumers
    - Increases inverse demand and marginal cost by $1
  - By tax neutrality prices rise by $1
  - Thus cost and demand pass-through sum to 1
  - If $\rho > 1$, inverse demand increase reduces prices!
- Core idea for oligopoly theory
  - Change in other prices shift demand...
    - So ρ v. 1 determined Bertrand strategic sub v. comp

Graphical illustration of demand pass-through

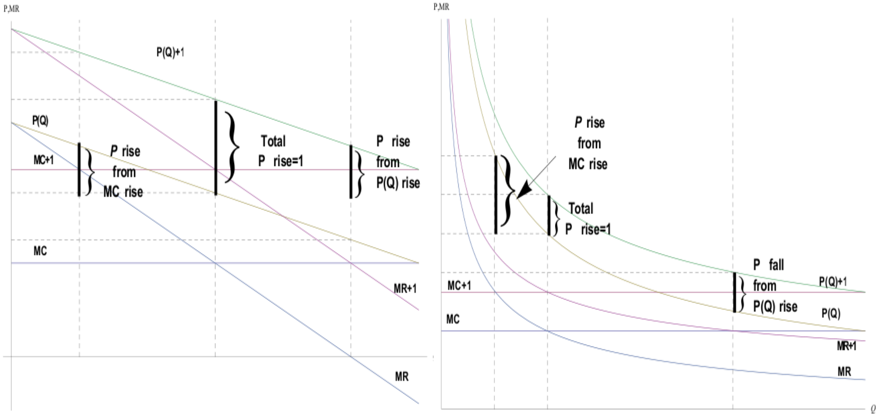


Figure: A graphical illustration of Bulow's argument

The effect of competition on pass-through

Common intuitions: competition

1. Drives individual-firm pass-through to 0
   - Can't pass-through when you face fierce competition
   - But can't afford not to with very low starting margin...
2. Drives industry pass-through to 1
   - But if supply not perfectly elastic, perfect comp PT $\neq$ 1

What is actually right on individual-firm?

- With constant MC pass-through actually rises w comp!
  - Competitive interactions raise PT by Le Chatelier's principle
- But with imperfectly elastic supply dwindles to 0!
  - Raising pricing and lowering production re-lowers cost
  - Effect strongest when demand very elastic
- So effect of competition depends on *relative* elasticity
  - $\epsilon_S \gg \epsilon_D \implies$ like constant MC monopoly, $\epsilon_D \gg \epsilon_S \implies 0$

The limitations of standard functional forms

	$\rho < 1$	$\rho > 1$	Price-dependent
ρ' $\wedge$ 0			AIDS
ρ' $\vee$ 0	Normal (Gaussian) Logistic Type I Extreme Value (Gumbel) Double Exponential Type III Extreme Value (Reverse Weibull) Weibull with shape $\alpha > 1$ Gamma with shape $\alpha > 1$		Type II Extreme Value (Fréchet) with shape $\alpha > 1$
Price-dependent			
Does not globally satisfy DMR		Type II Extreme Value (Fréchet) with shape $\alpha < 1$ Weibull with shape $\alpha < 1$ Gamma with shape $\alpha < 1$	

Apt demand

How can we get flexibility (and tractability)?

- Generalize Bulow-Pfleiderer constant PT demand

$$Q(p) = \lambda\left(|\overline{\rho} - 1|\sqrt{|p - \tilde{p}|} - 2\overline{\rho}\alpha\right)^{\frac{2\overline{\rho}}{1-\overline{\rho}}}$$

- Apt demand (modulo technicalities)
- Many nice properties
  1. All nice standard demand assumptions
  2. Flexible on level, elasticity, PT and slope of PT
  3. Quadratic solutions to monopoly pricing
     - And simple explicit solution to very wide range
  4. Easily estimated
  5. Simple closed form surplus, estimates from formula
  6. Software we made makes easy to use

The first-order approach to merger analysis

- A natural policy application is to mergers
- Proposed by Froeb et. al. (05) and Farrell-Shapiro (10a,b)
- Crest merges with Colgate

$\Longrightarrow$ Opportunity cost of profits lost on diverted sales=UPP

- Potential metric for investigation screen
- Now that Farrell-Shapiro at DOJ and FTC lots of attention
  - Explicitly included in draft horizontal merger guidelines
- Approach has many benefits compared to alternatives
  1. Compared to market definition...
     - Explicit basis in economics, better adapted to diff. products
  2. Compared to merger simulation...
     - Transparent, intuitive, robust, general
  3. Compared to retrospective merger analysis (alone)...
     - Need some structure to regressions, more accuracy

Holes in the argument thus far

While I like the approach, clearly many weaknesses

1. Only allows Bertrand conduct, robust to other?
2. Based on predicting direction, not quantity, of price change
   - But how to do default efficiencies, combine products?
   - Monotonicity assumptions very strong, kill robustness
3. But to do quantitative currently only conjectures
   - Requires some pass-through to turn costs into prices
   - Need vector/matrix not scalar to see all price effects
   - Even then, in what sense does this approximate effects?
   - And which pass-through (pre- or post-merger)?
   - Current claims incorrect, never rigorously stated
4. Only positive price effects, but wants consumer surplus

$\Longrightarrow$ Externalities, quality effects etc. kill methodology

Sonia and I have been building rigorous, general foundations

Allowing for general conduct

- Let me try to deal with each problem in turn
- Warning: all very preliminary/still in progress
- Start with conduct: standard approach assumes Bertrand
  - But why not Bertrand, consistent conjectures, dynamic etc.
    - E.g. consistent conjectures lowers identification burden
    - Can use “real world” elasticities, not artificial Bertrand

  $\Longrightarrow$ Many fewer instruments needed
  - Such specific assumptions not needed
  - Generally prices and quantities depend on strategies
  - Given other firms’ strategies, mine is equivalent to price

  $\Longrightarrow$ *Residual demand* holding fixed other strategies
  - Pre-merger: Lerner rule, elasticity along residual demand
  - Post-merger: hold fixed partner’s price, not strategy

Generalized Upward Pricing Pressure

A bit of mathematics shows effect on cost is:

$$\underbrace{\tilde{D}_{ij}\left(P_j - MC_j\right)}_{\text{proper standard UPP}} - \underbrace{P_i\left(\frac{1}{\epsilon_i} - \frac{1}{\tilde{\epsilon}_i}\right)}_{\text{end of accommodating reactions}}$$

Two effects:

1. UPP: $\tilde{D}_{ij}\left(P_j - MC_j\right)$ where $\tilde{D}_{ij}$ holds fixed
    - Merging prices and other firms' strategies
2. $-P_i\left(\frac{1}{\epsilon_i} - \frac{1}{\tilde{\epsilon}_i}\right)$: partner's reaction no longer anticipated
    - More accommodating reactions $\implies$ offsets UPP more

Different from (simplifies to) FS: reactions + proper UPP

- First term larger with reactions, but second more negative
    - Merger predictions more robust than underlying models?

Pass-through and approximate merger effects

How do these incentives translate to price changes?

- They are changes is (marginal opportunity) cost
- Multiply them by pass-through (matrix) for price changes
  - So long as this is small, local pass-through appropriate
  - But if large, investigate merger anyway
- But which (matrix of) pass-through rate(s)?
  1. Pre-merger
     - But once merged, pass-through changes
  2. Post-merger
     - But cost changes affect diversion term there, but not here
- Thus *neither* is right exactly
  - Instead mixture: *merger pass-through*
  - Identified by pre-merger pass-through

Normative interpretation and generalizations

So robust approximation using pre-merger information

- When a measurable statistic is small
- But when large, definitely want to review merger anyway

But these are price, not welfare, effects

- Generates a full matrix of price effects, need to combine
- Natural way: multiply by **Q**; valid by Jevons-Hotelling
- Solves basic conundrum of aggregation in other approach
- Also more generalizable; other welfare effects may exist
- Two examples:
  1. Firms choose product quality, welfare from Spence (1975)
     - Average v. marginal consumer, in addition to Jevons
  2. Similar effects in network industries/multi-sided platforms
- Our approach is robust: these can just be added in
  - Paper will have an example from Rochet and Tirole (2003)

Directions for future research

Obviously a work in progress:

1. Need to get all the other papers together
2. Make rigorous, add identification, RT2003 from other paper
3. Add more explicit dynamic conduct analysis
4. What else would be helpful to you?
5. Will be ready by September 1, Northwestern conference

We hope this can be useful in policy:

1. Broad, transparent intuitions simplifying many problems
2. Caution against sensitive/deceptive techniques
3. Rigorous and robust foundations for merger analysis

Still lots to be done!

1. Higher-than-first-order approximation
2. Political impacts of mergers and first-order approach
3. Entry responses, general network effects (w Alex White)

In what sense first-order?

We now have equilibrium conditions:

1. Pre-merger: $\mathbf{f}(\mathbf{P}) = 0$
2. Post-merger: $\mathbf{f}(\mathbf{P}) = \mathbf{g}(\mathbf{P}), \mathbf{g}$ is GUPP

$\mathbf{f}(\mathbf{P}) = t\mathbf{g}(\mathbf{P})$ for $t \in [0, 1]$ defines path $\mathbf{P}^\star(t)$:

- $\mathbf{P}^\star(0)$ pre-merger, $\mathbf{P}^\star(1)$ post: assume analytic, unique
- Then $P^\star(1) - P^\star(0) = \sum_{n=1}^{\infty} \frac{1}{n!} \frac{\partial^n \mathbf{P}^\star}{\partial t^n}(0)$
- Can easily be shown: $\frac{\partial \mathbf{P}^\star}{\partial t}(0) = \left. (\nabla \mathbf{f})^{-1} \mathbf{g} \right|_{\mathbf{P}^\star(0)}$
- Polynomial in this; if small, neglect higher powers...
- Complicated math, but if $\frac{\partial \mathbf{P}^\star}{\partial t}(0)$ is small then:

$$\mathbf{P}^\star(1) - \mathbf{P}^\star(0) \approx \left. \underbrace{(\nabla \mathbf{f} - \nabla \mathbf{g})^{-1}}_{\text{“pass-through matrix”}} \underbrace{\mathbf{g}}_{\text{GUPP matrix}} \right|_{\mathbf{P}^\star(0)}$$

The appropriate pass-through rate

We understand $\mathbf{g}$, but what is $(\nabla \mathbf{f} - \nabla \mathbf{g})^{-1}$?

- $(\nabla \mathbf{f})^{-1}$ is pre-merger pass-through matrix
  - Matrix because has all cross-product and cross firm rates
  - $(\nabla \mathbf{f})^{-1}\, \mathbf{g}$: what must be small for approximation to hold
- Post-merger pass-through is

$$(\nabla \mathbf{f} - \nabla \mathbf{g})^{-1} \begin{bmatrix} 1 & -\tilde{D}_{12} & \mathbf{0} \\ -\tilde{D}_{21} & 1 & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & \mathbf{I} \end{bmatrix}$$

  - *Not* $(\nabla \mathbf{f} - \nabla \mathbf{g})^{-1}\, \mathbf{I} = (\nabla \mathbf{f} - \nabla \mathbf{g})^{-1}$
  - Post-merger, costs also affect diverted profits
- Thus *neither* pre-merger *nor* post-merger!

$\Longrightarrow$ Some "mixture" of two, when identifiable from either?

  - Slutsky symmetry may help