Identification Approaches in Merger Event Studies

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What is Identification?

- Identification (ID) means you want to be able to estimate the price effect of a merger
  - However, effect takes place over time and other events occur—"confounding" factors
  - Must control for these other factors
- Two factors involved:
  - (1) "a priori" can you specify a model that allows you to tell merger effects apart from other factors?
    - Problem posed by Koopmans in late 1940s—always based on non-testable prior knowledge
    - Assumption can be tested if "over-ID' using Sargan or Hausman approaches
  - (2) Given identification can you estimate effects precisely enough to be useful?
    - Question of efficiency of estimator and amount of data
    - Depends on correct size and power of tests

ID: Technical discussion

- Regression gives the conditional distribution of price (or price change) given right hand side (RHS) variables
  - Can always be estimated using OLS

- ID problem: given conditional distribution can you uniquely determine the structural (economic) model that leads to conditional distribution?
  - Since other factors are changing need to control for them or determine based on a priori knowledge that they are orthogonal (uncorrelated) with merger effects

Approaches to ID problem

- (1) Randomized experiment with no attrition imposes orthogonality of other effects. Do not have here.
  - However, may have a "natural experiment" that approximates a randomized experiment
  - Example is a change in regulation
  - Geographic markets affected by a merger compared to markets not affected by a merger
  - Time period before merger compared to time period after merger. Combined with different market get DID approach.
- (2) Method of instrumental variables (IV) uses prior knowledge that instrument is correlated with RHS variables but orthogonal to stochastic disturbance (residual).
  - Hausman (1983) demonstrates that all ID estimation comes down to an IV approach.
  - Example is exogenous change, e.g. world price or oil

Approaches to ID: II

- – Basic OLS orthogonality assumption based on economic analysis
  - • Possible "omitted variable" bias
  - • Need to do a sensitivity analysis
  - • How sensitive are results to a "small" failure of orthogonality assumptions
- – General 'complaints" or questions do not invalidate results
  - • I see this as a general agency problem when staff does not "like" results. Staff wants the "benefit of the doubt."
  - • "Does it matter" should be the key approach
- – Testing approaches with prior information
  - • Hausman specification test of OLS
  - • Sargan test of over-ID when using IV estimation
  - • General orthogonality tests of Hausman-White-Newey-Berans variety

5

ID Approach of Taylor-Hosken (2004)

- C. Taylor and D. Hosken (TH), "The Economic effects of the Marathon-Ashland Joint Venture, May 2004.
  - Question whether MAP led to higher or more volatile gasoline prices in the Midwest
    - Look at Louisville, KY
    - Use the wholesale and retail price of gasoline as controls
    - Compare merger effect in Louisville to "non-merger" geographic markets
    - Use basis DID approach
  - Have data on price changes but must control for exogenous changes in supply and demand that may have affected price

Control Variable or "Matching" Approach

- Look at price in Louisville relative to other markets "unaffected by the merger facing similar supply and demand conditions." (p. 15)
  - Use Chicago, Houston, and Northern VA markets that's use RFG
    - In Chicago Marathon was a small participant and Ashland was not present
    - Claim "similar demand conditions" in Louisville and Chicago
    - Also claim similar cost (supply) conditions
    - However retail margins are significantly higher in Chicago than Louisville by about 50%
  - Crucial not-testable assumption is that Chicago, Houston and NVA are unaffected by the merger

Event Study Setup

- Use one year before merger and two years after merger for comparison
- Look at the difference between Louisville and Chicago for wholesale prices, retail prices, and margins pre and post JV
  - Do not see any significant change in retail prices after JV
  - Find that Louisville wholesale prices increase significantly relative to all 3 control areas about 15 months after JV
  - Then do a regression approach using a "differences in differences" (DID) approach
  - Need to assume that time effects (demand and supply shocks) are common across Louisville and control cities

Estimation

- Taking difference between cities then eliminates time effects (demand and supply shocks)
  - **Crucial assumptions:** (1) time indicator variables are same across Louisville and control cities or (2) differences in time indicator variables are orthogonal to other RHS variables—mainly futures prices
- Do not find statistical significant effect of JV on retail prices
  - Do one city at a time
  - Might have pooled data because stochastic disturbances are likely correlated across cities pairs.
  - Finding: retails prices did not change in "after period" but wholesale prices did (retail margins contracted)
  - Conclude change in wholesale price due to demand shift from St. Louis entering RPG program

Interpretation

- St. Louis explanation is plausible, but not part of model
  - Would have been better to model St. Louis to estimate what happened there
  - "Ex post" explanation of results
  - Reason why a "structural model" that explicitly controls for supply and demand factors may be superior to DID or "event study" approach
- Surprising that retail margins contracted given degree of expected competition among retail outlets
  - Explanation of company owned versus other stations may not be consistent with profit maximization

GAO Study

- I will look at ID strategy for individual mergers, not effect of increased concentration (later panels)
- Use data from 1994-2000 on wholesale gasoline prices
- Built a "reduced form" econometric model
  - LHS variable is wholesale gasoline price minus crude oil price (assume constant relationship and takes care or potential I(1) problem)
  - RHS variables: city fixed effects and time fixed effects, indicator variables for mergers (or HHIs), and gasoline inventories ratio, refinery capacity utilization rates, and supply disruptions

ID Assumptions

- Assume all RHS variables are exogenous and are orthogonal to stochastic disturbances (although also did IV estimation)
    - Assume variable are measured without error (no EIV) (however, realize this assumption may no be true, e.g. p. 81)
    - Use fixed effects (FE) estimation
        - FE allows RHS variables to be correlated with city component of stochastic disturbances
        - FE can exacerbate EIV problem (see Hausman-Griliches, 1986). Could test using "long differences"
    - Assume merger effects are the same across racks
    - Assume coefficients are constant across racks so effects of e.g. inventory ratio and capacity utilization rates are constant across cities
        - Might want to test this assumption. Difference in coefficients might be correlated with stochastic disturbances. 12

Further Assumptions

- Do a Hausman specification test for possible joint endogeneity of inventory ratio and capacity utilization
  - However, use time, time^2, and weekly dummies as excluded instruments which is questionable assumption
    - Get mixed results on joint endogeneity
  - Also do a test of over ID restrictions which does not reject
  - Use FGLS which assumes you know covariance matrix
    - Possible bias in true size of tests. See Hausman-Kueirsteiner (2004) for corrections
    - Alternatively can do FE (OLS) and correct for estimated standard errors

Comparison of TH Approach with GAO Approach to ID

- Interesting contrast between the 2 approaches seen in the context of program evaluation across many years

- TH using a "matching model"
  - Choose "nearly identical" control units not affected by the intervention and do DID
  - Critical assumption is that control units are nearly identical and not affected by the event (GAO comments)
  - Assumption of control units is fundamentally non-testable since it is based on a priori assumptions

Regression Approach of GAO

- GAO use a "reduced form" econometric approach which controls for other factors
  - Crucial assumption is that included RHS variable control for other economic factors that affect prices
  - Assumption is that left out factors are not correlated with included RHS variables (or instruments)
  - Crucial non-testable assumption
    - Basis of many of FTC comments
  - However can test basic orthogonality assumption because OLS and GLS estimates should be quite close
    - Can use a Hausman-White-Newey approach to test
    - FTC Staff Report (Dec 2004, p. 20) states that estimates are sensitive to use of GLS
    - Could be used to test orthogonality

Conclusion on ID Approaches

- TH approach must assume that "control areas" are not affected by the merger
  - Time effects in control areas must be the same as in merger areas. Means control areas are "similar" to merger areas. May be difficult to find valid control areas.
  - Time effects from these control cities used to eliminate time effects in merger cities
- GAO approach must assume that RHS regression variables control for economic effects after merger
  - Right hand side variables must control for economic changes over time and over markets
  - May be difficult to specify a robust single model with same coefficients that works across multiple mergers since a merger changes the market structure

16