Does Size Matter: The Effect of Firm Size on Environmental and Human Health Risks from Fracking Operations

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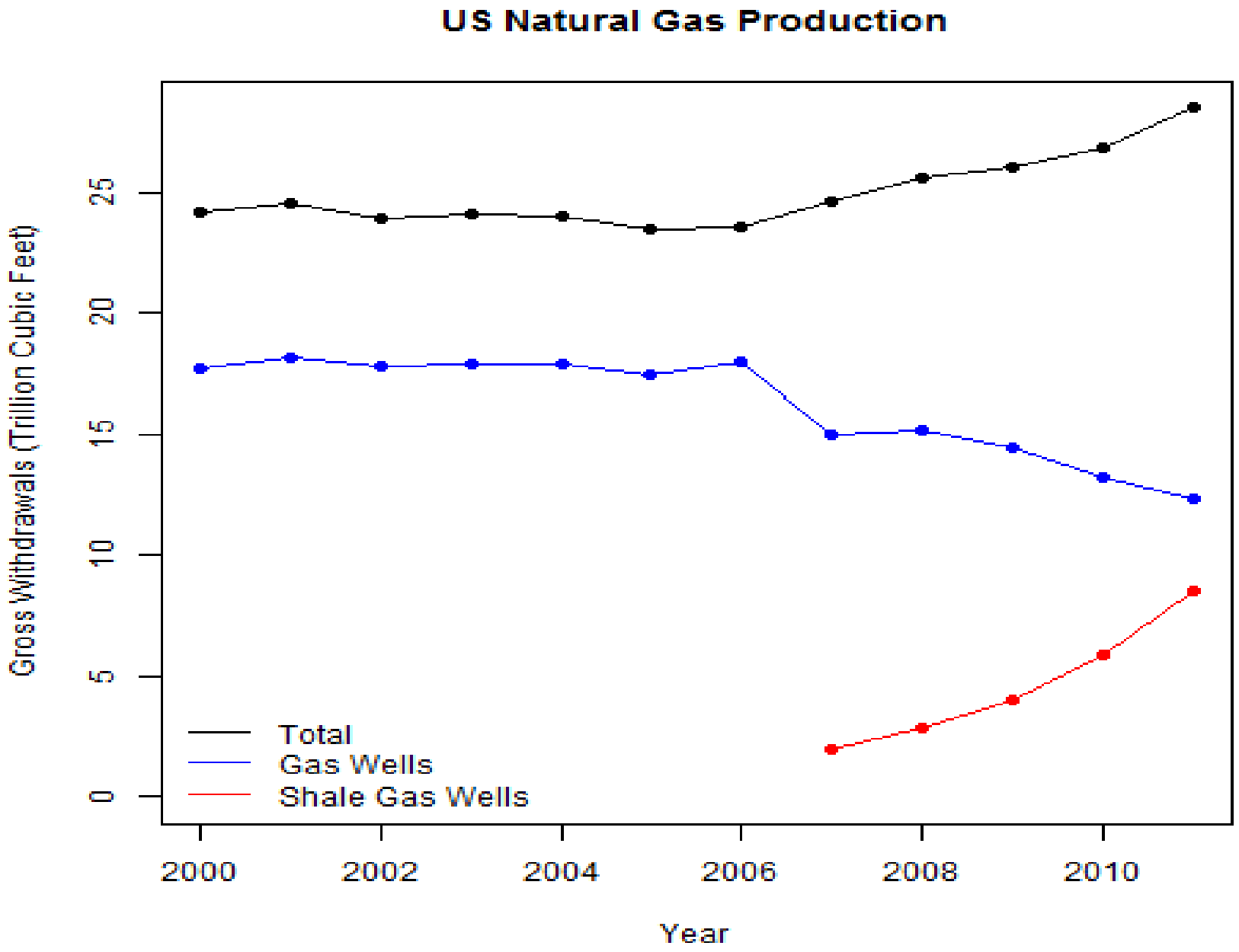
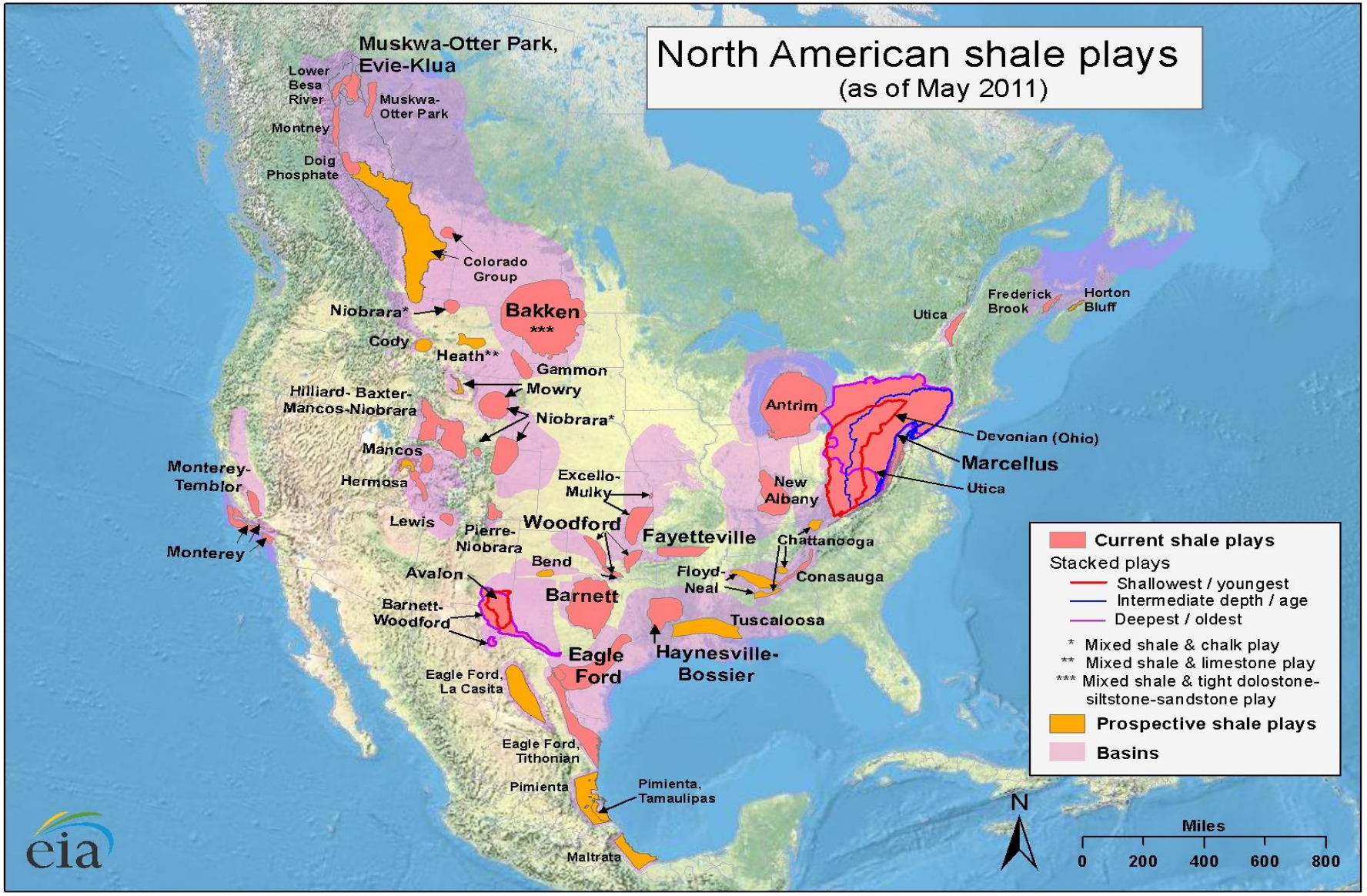
US Natural Gas Production is Booming

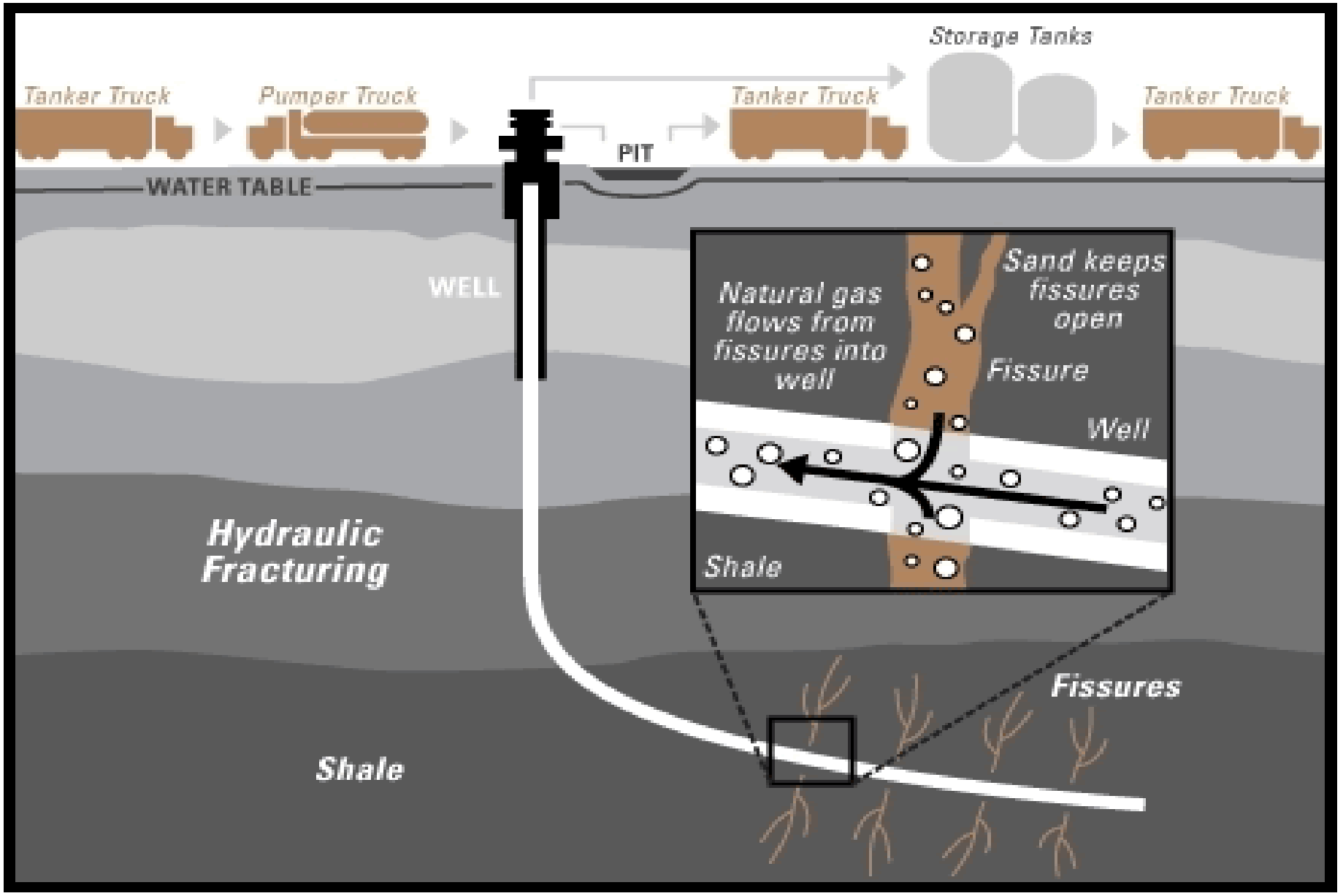


Because of Access to Shale Gas



Source: U.S. Energy Information Administration based on data from various published studies. Canada and Mexico plays from ARI.
Updated: May 9, 2011

Released by Fracking



Environmental Concerns

- Watershed Contamination
  - Fissures over-extend
  - Faulty Vertical Casing
  - Surface Spills
- Earthquakes
- Local air quality
- Automobile Accidents
- Regulatory Wariness
  - State Moratoria: MD,NY, NC, VT
  - Local Moratoria:CO, IL,IN,MI, NM,PA, TX, WV,

Are Some Firms Safer than Others?

- MC of safety = MB of safety
  - MC: hiring personnel, slowed production
  - MB: lower probability of expensive accident
- Historically, small firms dominated fracking
- Big Oil is gearing up
  - Exxon buys XTO Energy (December 2009)
  - Shell buys East Resources (July 2010)
- If MC/MB is different across size, safety implications

Drivers of Marginal Benefit

- Legal
  - Fines, Settlements, Lawsuits
  - Capped by bankruptcy
- Regulatory
  - Lost revenue from additional regulation/delays
  - Safety record as a public good
- Brand

"Just when I start to forgive* Exxon for the whole Valdez thing, they go and do something like this"

- * "And by forgive I mean no longer avoid Exxon stations"
- -John Whitehead, env-econ.net

Previous Literature

- Occupational Safety
  - Fewer accidents at large firms (Sorensen,2007)
  - Some Evidence of U-shaped relationship
- Energy
  - No effect of firm size on offshore spills (Illedare, 1997)

Well Inspections

- Dispatched from one of three state Department of Environmental Quality offices
- Violations
  - Administrative :
    - Failure to post permit info on site
  - Health/Safety:
    - Failure to Minimize Erosion
- Inspection may yield multiple violations

Data

- PA Department of Environmental Protection
  - Inspections
  - Production
  - Permits
- Million Dollar Database
  - Firm Employee Count
  - Firm Sales
- 13500 inspections at 6600 wells operated by 58 firms

Estimating Equation

$$y_{j,k,t} = \beta X_{k,t} + \gamma Z_k + f(t) + g(j) + \epsilon_{j,k,t}$$

- $y_{j,k,t}$: Environmental Violations given at well j to firm k in time t
- $X_{k,t}$: Time varying firm attributes
- Z_k : Time invariant firm attributes
- f(t): Time trend
- g(j): Location dummies
- $\epsilon_{j,k,t}$: Idiosyncratic error

Liability Variables

- Legal Liability: Employee Count
  - Time Invariant
- Regulatory Liability: Cumulative permits
- Brand Liability: Dummy variable for firms with retail component
  - Chevron, Exxon, Shell
  - Time Variant when wells are purchased by majors

Results – Negative Binomial

Drilled Dummy	0.29399**	0.21678
Producing Dummy	0.28071**	0.19597
Production Quantity	$-7.87*10^{-8}$	$1.93*10^{-7}$
Cumulative Firm Production	**$3.21*10^{-9}$***	$1.71*10^{-9}$
Employee Count	**-0.00066*** **	0.00008
Employee Count 2	**$5.5*10^{-8}$*** **	$6.39*10^{-9}$
Brand*Emp Count	**0.75772***	0.39050
Brand*Emp Count 2	**-0.00001***	6.4-*10^{-6}
Brand	**-4.5043****	2.0007
Permitted Wells	**-0.00100*** **	0.00038

Implications

- Bigger is Better
  - More employees → fewer violations
  - Retail components → fewer violations
  - More permitted wells → fewer violations
- Expectations about future fracking risk may be overstated
- Caps on legal liability may increase risk