**--- EXPECTED FORMAT OF THE SUMMARIES ---**

**Name of paper, year of publication, journal in which published and authors**

**Overview on paper (3-4 sentences):**Few sentences on what is the research question and the result (read abstract and skim introduction)

**Data source (Bullet points of data sources, note what each data source is for):**Record their source of data and try to quickly find a link for the source (if public). If proprietary data just say "proprietary data"

**Identification approach (1-2 sentences):**Record the author(s)' identification strategy and/or instrumental variables used. Start by going to the section on "identification" or "estimation", if such a section exists. Search for terms including: "identifying variation", "exclusion restriction", "instrument", "instrumental variables", "2SLS", "two stage least squares"

**Estimation approach (State the method, for example "instrumental variable regression", if there are multiple methods write them all):**Record the empirical approach used in the paper. This should be relatively quick and should not exceed a sentence.

**Externalities (2-3 sentences):**Does the paper consider the externalities involved with shale gas / fracking? What externality do they care about? How do they quantify it? This part is probably directly related to the overview but good to check.

**Potential extensions and paper limitations (1 sentence):**Check the conclusion of their paper for "limitations" or potential "extensions". Maybe worth doing a quick CTRL + F in the paper for "missing data", "beyond the scope", "issue"

***Paper 1***

Name: Drilling like there’s no tomorrow: bankruptcy, insurance, and environmental risk

Year: 2016

Journal/Authors: American Economic Review/ Judson Boomhower

**Overview on paper (3-4 sentences):**

* In Texas, a law was instated in 2002 that required onshore O&G producers to obtain a surety bond. This bond is a contract whereby firms pay a premium to an insurer, and if the firm goes out of business and is unable to pay for the environmental damages it caused, the insurer pays out. Basically, this requirement made firms pay more in environmental protection costs than previously, this increased cost caused a shift in the market from small players who undertook riskier activities to big players.

**Data source (Bullet points of data sources, note what each data source is for):**

* Administrative data from the Railroad Commission of Texas
* Orphan Well data

**Estimation approach (State the method, for example "instrumental variable regression", if there are multiple methods write them all):**

* Regression Discontinuity Design

**Externalities (2-3 sentences):**

* The externalities dealt with in this paper are where the firm goes out of business before cleaning up their mess. This causes state or other agencies to pick up the cost. Now with the bond requirement the externality is internalized.

**Potential extensions and paper limitations (1 sentence):**

* The paper was unable to directly identify the financial conditions of an individual firm, this caused the author to speculate on whether firms exited for liquidity constraints from the premiums, or for other reasons.

***Paper 2***

Name of paper: Capturing Rents from Natural Resource Abundance: Private Royalties from US Onshore Oil and Gas Production

Year: 2016

Journal/Authors: Federal Reserve Bank of Kansas: Working Papers/ Jason Brown, Timothy Fitzgerald, Jeremy Weber

**Overview on paper (3-4 sentences):**

* This paper focus on variation in the royalty rates of private O&G leases. The royalty rate is what someone gets for letting an oil company extract on their land: usually a cut of the revenue. What can be seen is that the larger the reserve, and the more certain the production the larger the royalty.

**Data source (Bullet points of data sources, note what each data source is for):**

* Private Data from DrillingInfo for individual leases
* USDA County-Level Oil and Gas Production dataset (USDA-ERS, 2014)

**Identification approach (1-2 sentences):**

* They identify individual leases by the geographic area of the lease. One limitation of this approach is that leases near each other are unable to be indentified on whether they are the same acre. To overcome this limitation, they say that the smallest lease they consider is 40 acres.

**Estimation approach (State the method, for example "instrumental variable regression", if there are multiple methods write them all):**

* 2SLS
* 1st stage: lm(Estimated Ultimate Recovery (Production) ~ log well depth + log avg well productivity in county)
* 2nd stage: lm(Percent revenue going to firm ~ quantity, percent of county with oil and gas, Play area)

**Externalities (2-3 sentences):**

* Not a major factor of this paper. This paper primarily analyzes how in a perfectly-competitive market the royalty rate of shale deposits would be invariant with well size, but empirically they are.

**Potential extensions and paper limitations (1 sentence):**

* The authors state that because the market for shale leases is not perfectly competitive, that it is possible not as much oil is produced as possible. Further work could focus on the production as it varies with the royalty rate: basically flipping the 2nd stage.

***Paper3***

Name of paper: Dutch Disease or Agglomeration? The local economic effects of natural resource booms in Modern America

Year: 2014

Journal/Authors: Review of Economic Studies/ Hunt Allcott Daniel Keniston

**Overview on paper (3-4 sentences):**

* This paper seeks to see if a boom in oil production decreases manufacturing activity locally, which may be bad for long term economic growth if the short-lived oil crowds out the long-term factory. They find that manufacturing actually benefits from the introduction of oil and also real wages are increasing with production.

**Data source (Bullet points of data sources, note what each data source is for):**

* Census of Manufacturers: micro data every 5 years on all manufacturing plants with location, employees, wage bills, value of materials, and total revenue
* DrillingInfo: Well Data
* Proven reserves data are from the EIA’s survey 23L
* US Geological Survey: Undiscovered Reserves
* Regional Economic Information System: county level data on employment, earnings, and population.

**Identification approach (1-2 sentences):**

* The effect of an oil plant is identified on the assumption that all effects are felt within 300-450 miles.

**Estimation approach (State the method, for example "instrumental variable regression", if there are multiple methods write them all):**

* Shift-share strategy inspired by Bartik 1991

**Externalities (2-3 sentences):**

* Policy implications depend on whether externalities from booming industry are outweighed by the industry crowding out.

**Potential extensions and paper limitations (1 sentence):**

* The identifying assumption is in place to account for general equilibrium effects. Could be a model extension that follows movement across a wider range.
* The authors state that spillovers in the same county positively affecting manufacturers shows that spillovers also benefit firms in the same country.

***Paper 4***

Name of paper: Experiential and Social Learning in Firms: The Case of Hydraulic Fracturing in the Bakken Shale

Year: 2015

Journal/Authors: NA/ Thomas R Covert

**Overview on paper (3-4 sentences):**

* This paper studies the introduction of fracking technology to the South Dakota Bakken Shale. It shows that firms do not employ optimal techniques of exploring new technologies, learning from their peers, and are slow to respond to new info.

**Data source (Bullet points of data sources, note what each data source is for):**

* US Energy Information Agency (EIA) production volume
* North Dakota Industrial Commission(NDIC): location, fracking inputs (sand and water), firm id, and production.
* North Dakota Geographical Survey: geographical characteristics
* WTI daily spot prices for oil
* Spears and Associates: costs of vertical boring
* DrillingInfo.com: mineral rights lease data
* IHS international: fracking knowledge from before 2005

**Identification approach (1-2 sentences):**

* Using mineral rights leases and geographical data of the wells from NDIC to construct firm well ownership.

**Estimation approach (State the method, for example "instrumental variable regression", if there are multiple methods write them all):**

* Gaussian Process
* Cobb-Douglas
* Learning-by-doing model
* Regression of production function errors on cohort dummies
* Maximum likelihood of production function

**Externalities (2-3 sentences):**

* Not mentioned

**Potential extensions and paper limitations (1 sentence):**

* Author states that a limitation identified in the petroleum engineering literature is that operators overestimate their level of confidence in their expected yield. This leads them to cut costs rather than expand production, due to not enough info and not experimenting. This insight could be extended to other industries, circumstances.

***Paper 5***

Name of paper: The effect of uncertainty on investment: Evidence from Texas Oil Drilling

Year: 2014

Journal/Authors: AER/Ryan Kellogg

**Overview on paper (3-4 sentences):**

* This paper seeks to test the theory of real options by seeing if when uncertainty increases, investment decreases. The paper approaches this through the lens of Texas Onshore Oil Wells, seeing how investment changes in relation with implied volatility of oil futures on the NY Mercantile Exchange. It finds that indeed investment goes down when uncertainty is high and that the views of the future are aligned in the financial and industrial markets.

**Data source (Bullet points of data sources, note what each data source is for):**

* NY Mercantile Exchange: Implied volatility
* Texas Railroad Commission “Final Oil and Gas Annuals”: Oil wells

**Identification approach (1-2 sentences):**

* Wells are identified in the data by when it was drilled, which field it was drilled in, whether it was oil or gas, and the firm behind it.
* The author also identifies wells on the merit that they are drilled on leases with no prior or subsequent wells.

**Estimation approach (State the method, for example "instrumental variable regression", if there are multiple methods write them all):**

* Structural model of the drilling investment problem with time-varying uncertainty

**Externalities (2-3 sentences):**

* The author avoids fields where multiple firms have leases to the land, as the drilling-decision is an informational and extractional externality to other firms and would require a game theoretic setup.

**Potential extensions and paper limitations (1 sentence):**

* The author states that the results of this paper show that financial markets and firms are in sync with views on uncertainty, but is there a time when they are not? How could a change in one affect the other if they aren’t in perfect sync?

***Paper 6***

Name of paper: Hotelling Under Pressure

Year: 2018

Journal/Authors: JPE/Soren Anderson, Ryan Kellogg, Stephen Salant

**Overview on paper (3-4 sentences):**

* This paper analyzes Hotelling’s model of natural resource extraction. It seeks to understand the relationship between oil price and drilling wells, well production, and costs. It finds that firms react more strongly as to when to drill, but production is constrained by well pressure so there is less room to maneuver.

**Data source (Bullet points of data sources, note what each data source is for):**

* Texas Rail Road Commission: Drilling Permit Master Data set
* Texas Rail Road Commission: Oil and Gas Annuals
* RigData: Rental Prices
* New York Mercantile Exchange: WTI crude

**Identification approach (1-2 sentences):**

* Identifying leases with rig work requires matching the drilling data set to the production data set.
* The exclude reentries as they have higher upfront costs than operational wells, but lower expected production than new wells.

**Estimation approach (State the method, for example "instrumental variable regression", if there are multiple methods write them all):**

* Estimation of the transition probability in a hoteling model

**Externalities (2-3 sentences):**

* Only mentioned in online appendix A which says that open-access externalities cause a race to oil.

**Potential extensions and paper limitations (1 sentence):**

* They model the supply curve as fixed and upward sloping, they say that this could be extended to be modelled as a dynamic problem wherein the creation of new wells is allocated to the highest value and the production capacity of new wells can change over time.

***Paper 7***

Name of paper: Are Energy Executives Rewarded For Luck?

Year: 2020

Journal/Authors: The Energy Journal/ Catherine Hausman

**Overview on paper (3-4 sentences):**

* This paper analyzes the effect of the price of oil on executive compensation. The paper finds that Executive compensation changes just as much to changes in oil value as it does to generic firm value(Positive NPV projects?), therefore there is a mechanism of ‘pay for luck’. This effect is asymmetric across the range of oil prices, rising more when oil goes up than it falls when oil goes down.

**Data source (Bullet points of data sources, note what each data source is for):**

* Compustat (1992-2016): Executive Compensation
* Energy Information Administration: WTI
* FRED: macro conditions

**Identification approach (1-2 sentences):**

* Firms are identified by their unique ID code in the compustat data set, and are created/destroyed by IPO or acquisition.

**Estimation approach (State the method, for example "instrumental variable regression", if there are multiple methods write them all):**

* Linear Regression with fixed effects
* Instrumental Variables:
  + 1st stage: lm(log(market value) ~ log(oil price))
  + 2nd stage: lm(log(compensation) ~ log(market value))

**Externalities (2-3 sentences):**

* Not Mentioned

**Potential extensions and paper limitations (1 sentence):**

* Bertrand and Mullainathan were the first to find examples of executive pay reacting to things that were beyond manager control. This paper is an extension of that paper, perhaps this could enriched.

***Paper 8***

Name of paper: The Local Economic and Welfare Consequences of Hydraulic Fracturing

Year: 2019

Journal/Authors: AEJ: Applied Economics/ Alexander Bartik, Janet Currie, Micheal Greenstone, Christopher Knittel

**Overview on paper (3-4 sentences):**

* The introduction of fracking results in some good things, higher wages; lower unemployment; and housing prices, and results in some bad things, more crime and worse health. The authors use a spatial model to estimate the willingness-to-pay to allow fracking. The paper finds that on average fracking is good for communities, but there is substantial heterogeneity of the effect.

**Data source (Bullet points of data sources, note what each data source is for):**

* Energy Information Agency: shapefiles of plays and historic oil and gas.
* Drillinginfo.com: production data
* Rystad Energy: Prospectivity estimates
* BEA Regional economic and information systems: employment and earnings
* QCEW : supplementary wages by industry
* American Community Survey: housing price data
* FBI Uniform Crime Reporting: crime data
* Census of governments: local government spending and revenues
* Common core: school district enrollment

**Identification approach (1-2 sentences):**

* Identification is based on variation within shale formations and local variation in fracking adoption.
* Comparing counties within shale play, and then when they started fracking.

**Estimation approach (State the method, for example "instrumental variable regression", if there are multiple methods write them all):**

* Difference in difference

**Externalities (2-3 sentences):**

* Not mentioned

**Potential extensions and paper limitations (1 sentence):**

* Understanding why the effect of fracking is heterogenous across communities.

***Paper 9***

Name of paper: The Housing Market Impacts of Shale Gas Development

Year: 2015

Journal/Authors: AER/Lucija Muehlenbachs, Elisheba Spiller, Christopher Timmons

**Overview on paper (3-4 sentences):**

* Properties surrounding Shale gas development may experience growth or decline if the benefits outweigh the costs. The authors find that houses near developments, experience losses in home value if they are dependent on the nature around them, or in eyesight of the well. Houses where the wells are hidden and who don’t rely on the nature around them experience home value growth when a well is developed.

**Data source (Bullet points of data sources, note what each data source is for):**

* CoreLogic: Universe of transactions for properties sold between 1995 and 2012. Data contains price, address, land/lot boundaries, square footage, year built, lot size, number of rooms, bathrooms, and stories.
* Pennsylvania Department of Environmental Protection (PADEP) Spud Data combined with Department of Conservation and Natural Resources Well Information System. Most comprehensive data set on wells drilled in PA.
* PADEP natural gas production and public water access.

**Identification approach (1-2 sentences):**

* Really cool method of using arcGIS viewshed tool with National elevation data set to see if a five-foot-tall observer could see the well.
* They assume from the public water supplier’s data set that houses outside of the area are groundwater dependent.

**Estimation approach (State the method, for example "instrumental variable regression", if there are multiple methods write them all):**

* Triple difference
* Diff in diff nearest neighbor matching
* Fixed effects

**Externalities (2-3 sentences):**

* This paper is all about the externality of opening a well, near a house. Drillling a well has an effect on the ground water beneath it and thus may make a home uninhabitable. Also having a well within sight of a house may cause property values to go down as they are unsightly.

**Potential extensions and paper limitations (1 sentence):**

* The authors admit that well placement is not random and so they cannot definitively say that the well was responsible for the price shift.
* Another limitation of the identification strategy is that they assume royalty rates are invariant with (potentially destroyed) groundwater resources.

***Paper 10***

Name of paper: Shale gas Development and Drinking Water Quality

Year: 2017

Journal/Authors: AER Papers and proceedings/Elaine Hill, Lala Ma

**Overview on paper (3-4 sentences):**

* This paper uses a difference in difference strategy to estimate the effect of shale gas development on drinking water quality. They do this by linking drinking water particulates data with the source of the water and the introduction of shale development nearby. They find that even post-treatment there is a significant decrease in water quality.

**Data source (Bullet points of data sources, note what each data source is for):**

* Carnegie Museum of Natural History Pennsylvania Unconventional Natural Gas Wells Geodatabase: Cleaned version of PADEP spuds data
* PADEP: Drinking Water Reporting System
* PADEP website: Drinking water sources

**Identification approach (1-2 sentences):**

* Wells have unique identifiers and so do drinking water sources.

**Estimation approach (State the method, for example "instrumental variable regression", if there are multiple methods write them all):**

* Fixed effect regression
* Difference in difference

**Externalities (2-3 sentences):**

* This paper like others focuses on the effect of shale development on groundwater resources. These water resources have closely linked effects with health outcomes. This paper finds that wells drilled in 1km of a community water system intake increases shale related gas contaminants in drinking water.

**Potential extensions and paper limitations (1 sentence):**

* This paper could be extended with other health consequences that could be measured, such as lung diseases or heart conditions. Potentially measured through health insurance payouts.

***Paper 11***

Name of paper: A dynamic model of cleanup: estimating sunk costs in oil and gas production.

Year: 2015

Journal/Authors: International Economic Review/ Lucija Muehlenbachs

**Overview on paper (3-4 sentences):**

* This paper returns to real option theory to examine the decision to close a well, an irreversible and expensive investment. This is motivated by the financial incentive managers face to label a close as temporary and delay cleanup expenditure even if they intend it to be permanent. The model finds that well cleanups are being delayed.

**Data source (Bullet points of data sources, note what each data source is for):**

* HIS (collects Alberta Energy Regulator Data): Monthly production
* Alberta Energy Regulator: reserve estimates
* Alberta Energy Regulator: decommissioned wells
* Petroleum Services Association of Canada: GIS Shape files
* Canadian Association of Petroleum Producers Statistical Handbook: average wellhead price of crude oil and natural gas in Alberta

**Identification approach (1-2 sentences):**

* Decommissioned wells are identified in the decommissioned data set, active wells have produced in the past year and inactive wells haven’t.

**Estimation approach (State the method, for example "instrumental variable regression", if there are multiple methods write them all):**

* Structural model
  + 1) Parametric estimation of producer belief on state transition variable
  + 2) Nested Fixed point algorithim on the bellman equation
  + 3) Maximum likelihood

**Externalities (2-3 sentences):**

* This paper deals with the externality that wells left unattended might damage the environment, but so long as a firm doesn’t declare their intent to close the well they can delay paying for the expensive cleanup.

**Potential extensions and paper limitations (1 sentence):**

* Identifying all fixed costs is impossible. To identify all absolute costs external information external information on well sale prices would be needed.

***Paper 12***

Name of paper: Price Regulation and Environmental Externalities: Evidence from Methane Leaks

Year: 2018

Journal/Authors: Catherine Hausman, Lucija Muehlenabchs

**Overview on paper (3-4 sentences):**

Basically the natural gas distribution industry is a natural monopoly, as such the producer is able to pass the costs of environmental damages onto consumers. This leads distribution firms to underspend on preventative maintenance and overspend on accelerated repair.

**Data source (Bullet points of data sources, note what each data source is for):**

* SNL: info from EIA-176 database which identifies all utilities firms by ownership type and location. Also info on volumes of gas purchased and delivered. Deliveries are broken down by sector, and within sectors we observe revenue and customer count.
* SNL: utilities infrastructure
* SNL: Operation and maintenance expenditures
* EIA: annual state-level citygate price.
* LAUF: emissions data

**Identification approach (1-2 sentences):**

* Changes in distribution related incentives.

**Estimation approach (State the method, for example "instrumental variable regression", if there are multiple methods write them all):**

* OLS
* Instrumental Variabbles

**Externalities (2-3 sentences):**

* This paper explores the effect of market power on the internalization of externalities.

**Potential extensions and paper limitations (1 sentence):**

* Author clearly states that this paper focuses on investor-owned utilities and that a worthwhile extension would be to look at municipality owned utilities.