Pipeline Incidents, Prevention Effort, and Local Aversion to Infrastructure Expansion
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Hydrocarbon production and demand patterns in the United States have changed dramatically in recent years, largely due to the advent of hydraulic fracturing (fracking). Fracking has caused domestic natural gas production to increase by 50 percent and domestic crude oil production to increase by 80 percent since 2005. In order to capture the full benefits of this technological advancement, significant increases in and improvements to the existing pipeline network are required. The primary impediment to these changes is public concern over pipeline safety, particularly in light of a few high-profile incidents. Landowners may be concerned about the possibility of a spill nearby or in a major body of water, or simply the disruption of their land if used as right-of-way.[1] Are these fears warranted? In this project, we will study this topic empirically by answering the following questions:

- Do pipeline operators underinvest in safety?
- Do existing regulations lead to suboptimal siting or oversight?
- How much is the public willing to pay to avoid a pipeline in their backyard?

Our approach will be twofold: first, we will determine whether pipeline operators allocate their safety efforts to reflect the relative expected damage from a potential incident when these damages vary along the pipeline. Second, we will estimate the willingness of landowners to pay to avoid pipelines. Given the intensity of the not-in-my-backyard (NIMBY) objections to new pipelines, we will examine whether expected disutility from new pipelines is capitalized into housing values and the extent to which this capitalization changes over the lifespan of the pipeline's planning, construction, and operation.

Our first approach addresses the extent to which pipeline operators to respond to the threat of litigation and the cost of insurance. If there is a change in the expected liability in a stretch of a pipeline, but the probability of an incident is unchanged, it is unlikely that the firm is fully internalizing the risk of a spill. We will also explore the mechanisms at play; for instance, a lack of internalization could be driven by a number of factors, such as limited liability, frictions in the legal system, or asymmetric information in the insurance market.

The main dataset we plan to use comes from the U.S. Department of Transportation's Pipeline and Hazardous Material Safety Administration (PHMSA). The role of the PHMSA is to identify and evaluate safety risks, and to develop and enforce standards pertaining to the nation's transport of hazardous materials. As part of this effort, the PHMSA has collected information on over 500,000 pipeline incidents involving hazardous materials since 1971. Although the threshold for reporting an incident has changed over time, these reports have always contained information on the time and location of the incident, the material and volumes discharged, and the pipeline operator. More recent data also includes a detailed description of the nature and cause of the pipeline failure. We plan to combine this incident database

[1] For instance, protests against a variety of pipeline expansion projects are featured in a recent article by Amy Harder, "Protests Slow Pipeline Projects Across U.S., Canada," in the *Wall Street Journal* (9 Dec 2014) at http://www.wsj.com/articles/protests-slow-pipeline-projects-across-u-s-canada-1418173235

with demographic, geographic, hydrologic and ecologic data regarding the areas surrounding the pipelines from various sources, such as the Census Bureau, USDA, EPA, and USGS.

We also plan to incorporate accounting data reported to FERC on Forms 2 (for natural gas) and 6 (for hazardous liquids). Forms 2 and 6 are annual (quarterly for some variables) reports that pipeline firms are required to file if they are sufficiently large. Even relatively small firms have to respond to at least some parts of these reports. These data will allow us to track investment, insurance expenses, and revenues by firm.

A first step will be to look at the correlation between changes in the characteristics of the area surrounding a pipeline segment and incidents along that segment. A negative correlation between the likelihood of an incident and factors that increase the cost of a spill, such as population density, is consistent with a firm responding to expected liability. However, such factors may also be correlated with the cost of maintaining the pipeline or reducing the likelihood of an incident; it is difficult to say for certain how the probability should change when the firm re-optimizes over its full expected cost function. To isolate the firm's response, we need a shock to the expected cost of a spill that does not affect the cost or convenience of maintaining the pipeline. One possible identification strategy would exploit variation in the agency responsible for inspecting the pipelines. State regulators may partner with the DOT and act as the actual inspector of any type of pipeline. The arrangement varies across states, but may also vary within states: it can differ if the pipeline carries gas vs. liquids and whether it is intrastate vs. interstate.

Our second approach addresses the effect of a pipeline on nearby property owners. One of the major impediments to pipeline expansion is NIMBYism, or a breakdown in bargaining for right–of-way access. Presumably, these landowners are concerned about negative effects on health, the environment, and the condition of their property. One way to summarize this complex combination of concerns is through the housing and land markets. That is, is the presence or expected construction of pipelines capitalized into housing prices and land values? While we see significant resistance to new pipelines, existing pipelines do not seem to be the target of such protests or concerns, suggesting that landowners are either unaware of them, or see them as a lost cause.

If housing prices are affected immediately during and after the siting and construction of a new pipeline, does this price penalty (or premium, which could arise due to right-of-way lease payments) decay over time? If the concern relates to the probability of a spill, the price penalty should probably increase as the pipeline ages. The gradient of land and housing values with respect to the age, cohort, size, and purpose of a nearby pipeline could reveal the relative importance of various dimensions of the risk. To credibly isolate the household's willingness to pay to avoid pipelines, we need to control for unobserved housing and geographic characteristics. One possible research design would compare changes in housing values in the periods around well-publicized pipeline incidents for properties near pipelines to those far from pipelines. Differential responses to these shocks suggest that salience and risk perception are driving factors in willingness to pay to avoid pipelines. This would inform our understanding of local aversion to pipeline development.

The data requirements for this project are somewhat demanding. The remarkable dearth of detailed information on pipeline locations has been a major impediment to research in this area. As part of this project, we plan to collect and organize all publicly available information on pipeline locations, and to hopefully purchase additional information necessary to fill in the gaps. We view a detailed panel of pipeline locations over time, which can be used in future research, as a valuable output of our proposal. The hedonic approach outlined in the second half of this proposal would benefit greatly from a large dataset of housing and land transaction prices, likely from an industry source like DataQuick. Having the financial and institutional support of this initiative would significantly improve our ability to obtain this crucial data, and potentially increase our access to knowledgeable FERC and PHMSA officials.

As this project is quite early in its development, it would benefit greatly from the scoping workshop. In particular, the institutional knowledge of the other researchers present could lead to a creative empirical strategy for answering these questions. Further, these scholars may have experience using some of the datasets (especially the housing data for the capitalization question), which would be invaluable.