Oil and gas incidents in the United States: impact on energy companies and prices

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with Marc Joets (IPAG) and Maria Eugenia Sanin (Univ. Evry and Ecole Polytechnique)

WORK IN PROGRESS
Outline

• Pipeline incidents: the context
• Pipeline safety regulation
• Incidents, safety, oil and gas firms market value: is there a link?
• Data, methodology, results (Exxon and ANR case study)
• Further steps and ongoing work
Pipeline economics: the context

- Oil and gas production increase in the US should call for infrastructure building

- Environmental and safety issues are more and more constraining
  - Long debate over the « Transcanada ANR XL Pipeline » actually blockated
    - Risk of oil spills, air and water pollution, CO2 emissions.
Pipeline are safe but incidents occur (I)

- ExxonMobil to pay $5 million to government over Mayflower oil spill April 22, 2015

ExxonMobil pipeline rupture in Mayflower, Arkansas, April 1, 2013 (Reuters)
• The **2013 Mayflower oil spill** occurred on March 29, 2013, when an **ExxonMobil** pipeline carrying **Canadian Wabasca heavy crude** from the **Athabasca oil sands** ruptured in **Mayflower, Arkansas**, about 25 miles northwest of **Little Rock**.

• Approximately 12,000 barrels (1,900 m³) of **oil** mixed with water had been recovered by March 31. Twenty-two homes were evacuated.

• The **United States Environmental Protection Agency** (EPA) classified the leak as a **major spill**. A reported 5,000–7,000 barrels of crude were spilled.
The infrastructure-Gas

Source: American Energy Mapping (AEM) 2013
The infrastructure-Oil
Safety Regulation: An Overview

**Pipeline Operators**
- Safely operating & maintaining
- Expanding system to meet needs
- Recognizing & managing risks

**Federal Government Agencies**
- Evaluate incident causes
- Communicate implications of incidents
- Permit pipelines on federal lands
- Evaluate security
- Evaluate proposed regulations

**Operators & Trade Associations**
- Recognize safety issues
- Organize members to determine how best to resolve safety issues
- Communicate safety perspective
- Assemble & evaluate safety performance data

**Assuring Pipeline Safety: Stakeholder Roles**

**Safety Regulators**
- Establish safety standards
- Inspect & enforce compliance
- Recognize & address risks (communication, change standards, conduct R&D)
- Advocate statutory changes

**Local and State Government**
- Establish land use restrictions
- Promote effective rate regulation
- Provide emergency management services

**Rate Regulators**
- Evaluate rate proposals
- Evaluate & approve innovative cost recovery processes to address serious risks
- Balance safety, reliability and cost

**The Public**
- Call 811 before digging
- Call 911 in case of gas leak or emergency
- Evacuate building if necessary
- Advocate in safety rate cases
- Understanding and mitigating the risks

**Representatives of the Public Interest**
- Provide forum for responsible debate
- Communicate with stakeholders
- Advocate statutory changes
- Assemble & communicate best practices
- Service the public
PHMSA (The U.S. Department of Transportation’s Pipelines and Hazardous Materials Safety Administration)

States may issue regulations over intrastate pipelines if they are consistent with federal regulations. These state pipeline safety agencies are usually members of the National Association of Pipeline Safety Representatives (NAPSR).

The National Transportation Safety Board (NTSB) investigates some pipeline incidents and issues reports and recommendations to regulators, companies, and industry groups.
Research Question

Which is the impact of incidents on stock market value of gas and oil firms?
• Based on the efficient market approach study the impact of incidents on equity value...

  – Capelle-Blancard & Laguna, 2010. JEEM

    • Stock market reaction to industrial disasters: 64 explosions in chemical plants and refineries worldwide in 1990-2005 belonging to 38 firms
      
      – Petrochemical firms experience a drop in their market value of 1.3% over 2 days immediately following the disaster.
      
      – Each casualty corresponds to a loss in market value of $164 million and a toxic release to a loss of $1 billion.

  – Borenstein & Zimmerman, 1998. AER

    • Stock market reaction to airplane incidents.
Literature Review (II)

• Technical literature
    • Data on 1582 incidents related to hazardous liquid pipelines for the period 2002–2005 are analyzed.
    • Logistic regression modeling is used to determine what factors are associated with nonzero product loss cost, nonzero property damage cost and nonzero cleanup and recovery costs.
      – The results of these models are then used to construct illustrative scenarios for hazardous liquid pipeline incidents.
    • A review of safety and incident statistics provided by the U.S. Department of Transportation for the extensive network of existing U.S. pipelines show that, in addition to enjoying a substantial cost advantage, pipelines result in fewer spillage incidents and personal injuries than road and rail.
Methodology

• Event study under the market model approach:

1. Using a window of 194 days prior to each incident (precisely [-199,-4]) we estimate the expected return of each company as a constant plus a slope times the NYSE return.

2. We calculate the abnormal returns (AR) as the difference between actual returns and the returns calculated in 1 for an estimation window of [-4,+10].

3. We calculate the cumulative abnormal returns (CAR).
   – The abnormal returns can be interpreted as resulting losses for which the firm was not insured.

\[
R_{it} = \alpha_i + \beta_i R_{mt} + e_{it}
\]

\[
AR_{it} = Ri - \bar{\alpha}i + \bar{\beta}i R_{mt}
\]
Data

- Unique database of 7517 incidents on oil and gas pipeline in the USA from January 1st., 1986 to August 31st, 2012.
  - For each incident we identify the cause, the value of damage, injured and fatalities as well as the age of the pipeline involved and the company that owns it.
  - We cross reference the previous database with equity value of the companies involved.
Incidents: examples

<table>
<thead>
<tr>
<th>Incidents</th>
<th>Fatalities</th>
<th>Injuries</th>
<th>Total barrel lost</th>
<th>Property Damage</th>
<th>Av. Fatalities Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Texas</td>
<td>1669</td>
<td>78</td>
<td>371</td>
<td>1214640</td>
<td>6680000000</td>
</tr>
<tr>
<td>Louisiana</td>
<td>590</td>
<td>20</td>
<td>96</td>
<td>271318</td>
<td>1420000000</td>
</tr>
<tr>
<td>California</td>
<td>573</td>
<td>43</td>
<td>198</td>
<td>17411</td>
<td>7250000000</td>
</tr>
</tbody>
</table>

Most frequent enterprise present and percentage of accidents

- **Texas**: ExxonMobil Pipeline Co. (7%)
- **Louisiana**: Tennessee Gas Pipeline Co (13%)
- **California**: Pacific Gas & Electric Co (26%)
# Incidents for two main firms

<table>
<thead>
<tr>
<th></th>
<th>ExxonMobil Pipeline Co.</th>
<th>ANR Pipeline Co.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>type</strong></td>
<td>Oil pipelines/Hazardous liquid</td>
<td>Gas Distribution; Gas Transmission or gathering</td>
</tr>
<tr>
<td><strong>avg number of incident per year</strong></td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td><strong>avg damage cost per year</strong></td>
<td>1054167</td>
<td>742445</td>
</tr>
<tr>
<td><strong>avg injuries per year</strong></td>
<td>0,03846</td>
<td>0</td>
</tr>
<tr>
<td><strong>avg fatalities per year</strong></td>
<td>0,00549</td>
<td>0,025</td>
</tr>
<tr>
<td><strong>avg barrel lost per year</strong></td>
<td>752</td>
<td>0</td>
</tr>
<tr>
<td><strong>most frequent cause</strong></td>
<td>Miscellaneous cause</td>
<td>Internal corrosion</td>
</tr>
<tr>
<td><strong>most frequent states</strong></td>
<td>Texas</td>
<td>Louisiana</td>
</tr>
<tr>
<td><strong>date of the oldest pipeline installed</strong></td>
<td>1917</td>
<td>1983</td>
</tr>
<tr>
<td><strong>date of the most recent pipeline installed</strong></td>
<td>2009</td>
<td>2008</td>
</tr>
<tr>
<td><strong>incident with highest cost</strong></td>
<td>07/01/2000</td>
<td>09/16/2008</td>
</tr>
<tr>
<td><strong>state with highest cost</strong></td>
<td>Montana</td>
<td>Louisiana</td>
</tr>
<tr>
<td><strong>highest damage cost</strong></td>
<td>135000000</td>
<td>8250000</td>
</tr>
<tr>
<td><strong>incident with highest fatalities</strong></td>
<td>09/07/2000</td>
<td>02/21/1988; 12/19/2006</td>
</tr>
<tr>
<td><strong>highest number of fatalities</strong></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>state with highest fatalities</strong></td>
<td>Texas</td>
<td>Illinois; Michigan</td>
</tr>
<tr>
<td><strong>incident with highest injuries</strong></td>
<td>04/07/1986; 08/31/1992; 07/01/2000</td>
<td>0</td>
</tr>
<tr>
<td><strong>highest injuries</strong></td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td><strong>state with highest injuries</strong></td>
<td>California; Louisiana; Texas</td>
<td>0</td>
</tr>
<tr>
<td><strong>highest number of barrel lost</strong></td>
<td>20027</td>
<td>0</td>
</tr>
<tr>
<td><strong>incident with highest barrel lost</strong></td>
<td>02/13/1990</td>
<td>0</td>
</tr>
<tr>
<td><strong>state with highest barrel lost</strong></td>
<td>Texas</td>
<td>0</td>
</tr>
</tbody>
</table>
• ExxonMobil Pipeline Company

  – transports over 2.7 million barrels per day of crude oil, refined products, liquefied petroleum gases, natural gas liquids and chemical feedstocks through 8,000 miles of operated pipeline.

  – operates 23 distribution terminals in the US which distribute gasoline, diesel fuel, heating oil, aviation fuel, kerosene and other refined products. ExxonMobil Pipeline Company also operates three salt dome storage facilities.

  – has a strong commitment to safety and environmental protection
• Operates in many US States-higher density network in the Midwest and Southeast
ExxonMobil Pipeline

Stock Market Value

Exxon Mobil

0 500 1000 1500 2000 2500 3000 3500 4000
01/01/1986 01/01/1988 01/01/1990 01/01/1992 01/01/1994 01/01/1996 01/01/1998 01/01/2000 01/01/2002 01/01/2004 01/01/2006 01/01/2008 01/01/2010 01/01/2012
• ANR Pipeline Company
  – From its founding as the Michigan-Wisconsin Pipe Line Company in 1945 to being a member of the TransCanada family of companies in 2007, ANR operates one of the largest interstate natural gas pipeline systems in the United States.

  – With 15,128 kilometres (9,400 miles) of pipeline, ANR connects markets in Wisconsin, Michigan, Illinois and Ohio with supply in Texas, Oklahoma and the Gulf of Mexico.

  – The ANR System is part of TransCanada's network of 60,000 km (37,000 miles) of wholly owned and 7,900 km (4,900 miles) of partially owned pipelines connecting major supply basins with major markets all across North America.
• Operates North to Centersouth
“TransCanada made significant progress on a number of major projects in 2008, including the Keystone oil pipeline system, the North Central Corridor expansion, the Bruce Power refurbishment, and three large-scale, gas-fired power plants. In 2009, we expect to invest approximately $6 billion in these and other capital projects”
## Incidents: examples

**ExxonMobil Pipeline Co.**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>state</td>
<td>Texas</td>
<td>Texas</td>
<td>Montana</td>
</tr>
<tr>
<td>fatalities</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>injuries</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>barrel lost</td>
<td>20027</td>
<td>6800</td>
<td>1509</td>
</tr>
<tr>
<td>damage</td>
<td>227.000</td>
<td>38.200</td>
<td>135.000.000</td>
</tr>
<tr>
<td>cause</td>
<td>External corrosion</td>
<td>Damage</td>
<td>Heavy Rains/Floods</td>
</tr>
</tbody>
</table>

**ANR Pipeline Co.**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>state</td>
<td>Louisiana</td>
<td>Louisiana</td>
<td>Michigan</td>
</tr>
<tr>
<td>fatalities</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>injuries</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>barrel lost</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>damage</td>
<td>2.450.000</td>
<td>8.250.000</td>
<td>1.920.000</td>
</tr>
<tr>
<td>cause</td>
<td>Incorrect Operation</td>
<td>Heavy Rains/Floods</td>
<td>Damage</td>
</tr>
</tbody>
</table>
Results: Exxon Mobile’s 13th February 1990

Not the most costly but many barrels lost.
As from the 2nd day following the incident the CAR becomes negative.
No barrels loss but huge damage cost due to explosion. The AR becomes negative the day after and as the CAR shows there is no recuperation afterwards.
Events with deaths but no impact:
Exxon Mobile’s 13th February 1990

No impact.
Ongoing work

1) Event study with rolling windows: accidents effect may overlap

2) Multivariate regressions to relate cross-sectional differences in the loss incurred (measured by CAR and stakeholder loss (SL) for a certain \( +t \)) to the incidents features such as:

- Total number of fatalities and injured (human damage)
- Number of barrels lost (for oil firms only)
- Dummy equal to 1 if there is an explosion
- Reputational variable accounting for number of previous incidents
- Dummy to account for regulatory changes (so far year 2000 identified).
- Regional and time dummies

\[
SL_{i,t[0,+t]} = CAR_{i,t[0,+t]} MV_{i,-1}
\]
Concluding Remarks

• Pipelines are the safest way to transport oil and gas but incidents occur in any case provoking significant equity loss for the firms involved.

– The heterogeneity of such incidents implies that some may have no such impact and the reasons for such a difference is yet to be explored (opposite to efficient market hypothesis).

– Lessons can be learnt from exploring the impact of regulation in the previous relationship as well as the regional market response.
Further steps

1. Interaction between changes in safety regulation after the occurrence of incidents and the impact that the expectations regarding this may have on equity value:
   – Controls regarding regulatory changes.

2. Impact on zonal energy prices:
   – Residential and Industrial use gas prices (monthly)
   – Gasoline (refinery) gas prices (monthly)
   – Import/export/stock (yearly)
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THANK YOU

ALL SUGGESTIONS ARE WELCOME
Safety Regulation: In Practice

**PHMSA** (The U.S. Department of Transportation’s Pipelines and Hazardous Materials Safety Administration):

- issues pipeline safety regulations addressing construction, operation and maintenance
- inspects pipeline operators, and enforces against violations of pipeline safety laws and regulations.
- regulates interstate and intrastate hazardous liquids transmission pipelines, except that approves some state agencies to exercise interstate inspection authority and/or intrastate inspection and enforcement authority.
- regulates gathering pipelines greater than 6 5/8” diameter in all “non-rural” areas and rural areas within a quarter-mile of an “unusually sensitive area” and operating above a certain pressure.
  - Unusually sensitive areas are determined and include drinking water sources and ecological resources unusually sensitive to environmental damage from a liquids release.
  - Other gathering lines can be regulated by states or the Interior Department.

States may issue regulations over intrastate pipelines if they are consistent with federal regulations. These state pipeline safety agencies are usually members of the National Association of Pipeline Safety Representatives (NAPSR).

The National Transportation Safety Board (**NTSB**) investigates some pipeline incidents and issues reports and recommendations to regulators, companies, and industry groups.