Barnett Shale In US

Hydraulic Fracturing
- Breaks the rock
-良くは： 8000 ft
- adds, and cement

Barnett Shale well counts
- 5% in 2010
- 20% in 2015

Natural gas and coal consumption
- Natural gas to peak 15% by 2040
- Coal phase to peak 15% by 2040

Shale gas in the United States
- 1 of the largest
- One of the most efficient
- Built around the conventional areas

Barnett Shale gas
- Controlling square
  - Distribute distribution of negative externalities
  - Ease time for transition

Thank You!!
Economic Analysis on Barnett Shale and its Policy Implication

Jinwon (James), Han
301111213
Barnett Shale In US

Hydraulic Fracturing
- Involves drilling a hole
- 6000 - 10000 feet
- water, sand, and chemicals

Barnett Shale well counts
- 17,494 drills as of 2013
- Produces 6% of US natural gas

Natural gas and coal consumption
- Natural gas to take up 35% by 2040
- Coal plants to take up 32% by 2040

Shale gas in the United States
- One of the largest
- One of the most active
- Drilled around the residential areas
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Barnett Shale gas

Concluding remarks
- Distribution of negative externalities
- Gives time for transition
Benefits from Barnett Shale

**Fiscal Revenue**
- $5.3 billion to local government
- $5.7 billion to state government

**Growth and jobs**
- Since 2008, Barnett Shale development has increased by 28.5% along with economic growth
- Contributed to $50 billion to the state GDP
- Created and supported more than 100,000 jobs

**Household Income**
- 8.5% higher than without the development

**Water usage**
- Fresh water consumption compared to coal plants
  - Compared to coal plants
  - 60% reduction by changing to natural gas

**Methane leakage**

**Blessing or Curse?**
- Jobs associated with shale gas
- Investments and first phase

**Risk of overproduction**
-🏻 Jobs associated with shale gas
- Investments and first phase
### Fiscal Revenue

#### Fiscal Revenues* to Counties, Cities, and School Districts Within the Barnett Shale Region and the State of Texas

<table>
<thead>
<tr>
<th>Date</th>
<th>County</th>
<th>City</th>
<th>School Districts</th>
<th>Total Local</th>
<th>Total State</th>
<th>Total State and Local</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>$10,264,647</td>
<td>$5,666,960</td>
<td>$22,053,237</td>
<td>$37,984,733</td>
<td>$39,766,459</td>
<td>$77,751,192</td>
</tr>
<tr>
<td>2002</td>
<td>$12,969,548</td>
<td>$8,886,302</td>
<td>$27,800,247</td>
<td>$49,668,097</td>
<td>$56,250,097</td>
<td>$105,918,194</td>
</tr>
<tr>
<td>2004</td>
<td>$40,772,515</td>
<td>$26,447,900</td>
<td>$87,473,972</td>
<td>$154,894,387</td>
<td>$172,387,924</td>
<td>$327,082,310</td>
</tr>
<tr>
<td>2005</td>
<td>$73,188,705</td>
<td>$49,723,155</td>
<td>$156,916,878</td>
<td>$279,828,537</td>
<td>$316,439,812</td>
<td>$596,268,349</td>
</tr>
<tr>
<td>2006</td>
<td>$104,089,857</td>
<td>$100,572,696</td>
<td>$222,483,480</td>
<td>$427,146,033</td>
<td>$569,685,954</td>
<td>$996,631,988</td>
</tr>
<tr>
<td>2007</td>
<td>$154,770,012</td>
<td>$145,989,505</td>
<td>$330,751,085</td>
<td>$631,510,603</td>
<td>$769,816,815</td>
<td>$1,421,327,418</td>
</tr>
<tr>
<td>2008</td>
<td>$286,748,867</td>
<td>$207,909,300</td>
<td>$571,149,046</td>
<td>$1,045,807,214</td>
<td>$1,184,493,170</td>
<td>$2,230,390,383</td>
</tr>
<tr>
<td>2009</td>
<td>$147,948,142</td>
<td>$145,263,229</td>
<td>$315,934,992</td>
<td>$609,146,364</td>
<td>$774,317,147</td>
<td>$1,383,463,511</td>
</tr>
<tr>
<td>2011</td>
<td>$178,881,290</td>
<td>$169,628,981</td>
<td>$382,139,101</td>
<td>$730,649,371</td>
<td>$911,833,321</td>
<td>$1,642,469,692</td>
</tr>
</tbody>
</table>

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* Includes not only taxes paid on mineral interests (where applicable) but also the incremental tax receipts stemming from gains in overall business activity.

- $5.3 billion to local government
- $5.7 billion to state government
Since 2001, Barnett Shale development has:

- Generated 38.5% of regional economic growth
- Contributed more than $65 billion to the region’s GDP
- Created, and now supports, more than 100,000 jobs
Household Income

- 8.5% higher than without the development
Water usage

Fresh water consumption compared to coal plants:
- Compared to coal plants
- 60% reduction by changing to natural gas
- mercury, sulfur dioxide, and other chemicals are not produced
- cheaper price
- reduction of carbon dioxide
EXHIBIT 1. BARNETT SHALE FIELD AND SHALE OUTPUT
SOURCE: THE WALL STREET JOURNAL

**Rock Of Ages**

The U.S. is projected to get more of its natural gas from shale rock in the next several decades, based on study of the Barnett Shale.

Natural gas extracted from shale as a percentage of total U.S. production

![Graph showing projected natural gas extraction from shale](graph.png)

Source: Energy Information Administration

The Wall Street Journal
Costs associated with Barnett Shale

Break even points

Break-even Points for Shale Gas Wells

<table>
<thead>
<tr>
<th>Company</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quicksilver</td>
<td>8.3</td>
<td>7.2</td>
<td>6.3</td>
</tr>
<tr>
<td>XTO</td>
<td>9.3</td>
<td>8.2</td>
<td>7.3</td>
</tr>
<tr>
<td>EOS Resources</td>
<td>8.2</td>
<td>7.1</td>
<td>6.2</td>
</tr>
<tr>
<td>Apache</td>
<td>9.1</td>
<td>8.0</td>
<td>7.1</td>
</tr>
<tr>
<td>Devon Energy</td>
<td>8.0</td>
<td>7.0</td>
<td>6.1</td>
</tr>
<tr>
<td>Chesapeake Energy</td>
<td>7.9</td>
<td>6.9</td>
<td>5.9</td>
</tr>
</tbody>
</table>

Overestimating Natural Gas Production

Risk of overestimation:
- Jobs associated with shale gas
- Investments and bust phase

Blessing or Curse?

Methane leakage

- 20 years time horizon, contributing 1.4-3 times more than does direct CO2 emissions
- During time frame from 2014 to 2015, the effect would be worse than 14x coal
- wells used 56% in 2014

Benefits from Barnett Shale
## Break Even Points

<table>
<thead>
<tr>
<th>Case</th>
<th>EUR, Bcf</th>
<th>Gas Price (DPI @ 10% = 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barnett_DOFP_2008</td>
<td>2.895</td>
<td>3.7</td>
</tr>
<tr>
<td>Barnett_DOFP_2009</td>
<td>2.867</td>
<td>3.74</td>
</tr>
<tr>
<td>Fayetteville_DOFP_2008</td>
<td>2.463</td>
<td>3.65</td>
</tr>
<tr>
<td>Fayetteville_DOFP_2009</td>
<td>3.401</td>
<td>3.2</td>
</tr>
<tr>
<td>Woodford_DOFP_2008</td>
<td>2.544</td>
<td>7.35</td>
</tr>
<tr>
<td>Woodford_DOFP_2009</td>
<td>3.389</td>
<td>6.22</td>
</tr>
<tr>
<td>Haynesville_DOFP_2008</td>
<td>4.579</td>
<td>6.95</td>
</tr>
<tr>
<td>Haynesville_DOFP_2009</td>
<td>6.092</td>
<td>6.1</td>
</tr>
<tr>
<td>Eagle Ford_DOFP_2009</td>
<td>3.793</td>
<td>6.24</td>
</tr>
</tbody>
</table>
### Overestimating Natural Gas Production

Gas producers are more optimistic in their projections than are analysts like Art Berman, a Houston-based petroleum geologist who has studied the average per-well reserves for six producers in the Barnett shale in Texas. Below is a comparison of his projections and company estimates, in billions of cubic feet.

<table>
<thead>
<tr>
<th>COMPANY</th>
<th>MR. Berman's Estimate</th>
<th>Company Claim</th>
<th>Pct. Exceeding Mr. Berman's Estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quicksilver</td>
<td>1.0</td>
<td>4.5</td>
<td>+350%</td>
</tr>
<tr>
<td>XTO</td>
<td>1.4</td>
<td>3.3</td>
<td>+136</td>
</tr>
<tr>
<td>EOG Resources</td>
<td>1.2</td>
<td>2.8</td>
<td>+133</td>
</tr>
<tr>
<td>Encana</td>
<td>1.3</td>
<td>2.4</td>
<td>+85</td>
</tr>
<tr>
<td>Devon Energy</td>
<td>1.2</td>
<td>2.2</td>
<td>+83</td>
</tr>
<tr>
<td>Chesapeake Energy</td>
<td>1.5</td>
<td>2.6</td>
<td>+73</td>
</tr>
</tbody>
</table>

Source: Art Berman, Labyrinth Consulting Services
Blessing or Curse?

Risk of overestimation:
- Jobs associated with shale gas
- Investments and bust phase
Methane leakage

- 20 years time horizon, contributing 1.4- to 3-times more than does direct CO2 emission
- during a well completion is 2 to 3%, the effect would be worse than oil or coal
- emits around 3.6 to 7.9%
Policy Implications

Restriction on Permits Issued

- Increase the quality
- Time for further studies
- Reduction of methane emission
- Time for materials to be removed

Responsibility

Responsibility for the negative externalities that are created

- Following Pennsylvania’s laws
- EPA estimates 46% reduction in leakage
- Clean Water Act and Safe Drinking Water Act
- Methane monitoring systems

Costs associated with Barnett Shale
Restriction on Permits Issued

The restriction on permits:

- Increase the quality
- Time for further studies
- Reduction of Methane emission
- Time for markets to be rational
Responsibility

Responsibility for the negative externalities that are created

- Following Pennsylvania's footstep
- EPA estimate 40% reduction in leakage
- Clean Water Act and Safe Drinking Water Act
- Methane monitoring system
Barriers to the solution

Feasibility

- Companies reluctant to accept costly policies:
  - Competition which may damage the industry
  - Companies lobbying the government

Government

- Government has been keeping promise of bringing prosperity:
  - Officials were optimistic and promised people
  - Fiscal revenue
Feasibility

Companies reluctant to accept costly policies:
  • Competition which may damage the industry
  • Companies lobbying the government
Government

Government has been keeping promise of bringing prosperity:
  • Officials were optimistic and promised people
  • Fiscal revenue
Recommendation

Regulations based on studies:

- Responsibility on the damage
- The bust phase will hurt everyone
- Tariffs on companies who are exporting to Texas and did not meet the standard
Recommendation

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Concluding remarks

- Distribution of negative externalities
- Gives time for transition
Thank You !!