Economics of Oil and Gas Royalties

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Capturing Rents from Natural Resource Abundance: Private Royalties from U.S. Onshore Oil and Gas Production
Jason P. Brown,* Timothy Fitzgerald,† and Jeremy G. Weber‡
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Regional Windfalls or Beverly Hillbillies? Local and Absentee Ownership of Oil and Gas Royalties
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The views reflected here are the authors’ own and do not represent official views of the Federal Reserve Board, the Federal Reserve Bank of Kansas City, or any of the universities with which the authors are affiliated.
Come and listen to a story about a man named Jed —
A poor mountaineer, barely kept his family fed.
And then one day he was shootin’ at some food,
And up through the ground came a bubblin’ crude.

Oil, that is...
black gold...
Texas tea.

Well the first thing you know ol’ Jed’s a millionaire,
Kinfolk said “Jed move away from there.”
Said “Californy is the place you ought to be.”
So they loaded up the truck and moved to Beverly.

–Ballad of Jed Clampitt
• Increased U.S. natural gas production due to technological advances has generated substantial welfare gains
    • $74 billion ↑ consumer surplus
    • $26 billion ↓ producer surplus
  • Mason et al. (2015):
    • $4.36 billion ↑ consumer surplus 2007–2014
    • $9.60 billion ↑ producer surplus 2007–2014
    • value reserves ↑ $475 billion 2007–2012
Background

- Increased U.S. natural gas production due to technological advances has generated substantial welfare gains
    - $74 billion ↑ consumer surplus
    - $26 billion ↓ producer surplus
  - Mason et al. (2015):
    - $4.36 billion ↑ consumer surplus 2007–2014
    - $9.60 billion ↑ producer surplus 2007–2014
    - value reserves ↑ $475 billion 2007–2012

- How do effects filter through to the resource owner?
- How does that process affect local economic outcomes?
- Take oil as well as natural gas into account
Previous Work: Brown et al. 2015

Capturing Rents from Natural Resource Abundance

• Estimate pass-through to mineral owner of greater resource in place (technologically-driven)
  • Wide variation in local ownership of private minerals
  • Doubling of ultimate recovery of an average well in a county leads to a 2 percentage point increase in average royalty rate

• In 2014, the six largest oil and gas plays in the United States generated an estimated $39 billion in gross royalties owed to private mineral owners
  • Unclear how much of this wealth is captured where production occurs as opposed to more distant locations
  • Local distribution of benefits may be different from the distribution of costs
  • Structural link important to identifying natural resource curse
Previous Literature

- Effect on local economies during boom phase of development is well established
  - Most focused on employment and lesser extent on income (Fleming et al. 2015)
  - Income from both returns to labor and local assets

- Findings of natural resource curse at county-level have been mixed
  - Most U.S. evidence of slower growth in the long-run has been found in the West
  - Absentee ownership of mineral rights and transitory workforces are highest in that region
Research Questions

- Identify directed flows of royalty income
  - Where does the money go?

- Categorize local economies by different capture of royalty income
  - produce and retain royalties
  - produce and export royalties
  - no production but import royalties

- Compare flows of wages from drilling activity to flows of royalty income
Preview of Results

1. Descriptive results of royalties generated and received
   - state and county levels

2. Categorization of local resource economies
   - local retention, exporters, importers

3. Royalties larger than employment gains; modest multiplier to royalty income (1.13)
   - in line with multipliers for wage income
   - lower than some estimates of economic gains
   - larger impact of royalty income than some previous work
2.2 million leases in 17 states

Information on:

- primary term; royalty rate; grantor and grantee, by ZIP
- bonus payments in some cases (∼10 percent)

Focus on private mineral leases:

- drop federal, state, local government-owned
- drop other instruments (e.g., seismic leases)
- eliminate duplicates (in space or time) to get most recent measure of leasing market for each parcel
- aggregate leasing markets to county level
Observations About Leases

Our sample starts with every lease from DrillingInfo

- don’t have every lease in the country, or even in each county
- legacy production likely excluded
- some things we can’t detect: split estate, fractionated ownership
- bonus payments positively correlated with royalty
Local and Absentee Owners

Leases Differ

<table>
<thead>
<tr>
<th></th>
<th>Local</th>
<th>Absentee</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Local Owners are In-State</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>1,437,535</td>
<td>522,753</td>
<td></td>
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<tr>
<td>Royalty (percentage)</td>
<td>0.180</td>
<td>0.185</td>
<td>0.004***</td>
</tr>
<tr>
<td>(0.034)</td>
<td>(0.040)</td>
<td></td>
<td></td>
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<tr>
<td>Primary Term (months)</td>
<td>41.47</td>
<td>40.90</td>
<td>-0.58***</td>
</tr>
<tr>
<td>(0.01)</td>
<td>(0.02)</td>
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<tr>
<td>Acreage (acres)</td>
<td>260.7</td>
<td>614.8</td>
<td>354.2***</td>
</tr>
<tr>
<td>(1.04)</td>
<td>(3.74)</td>
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<tr>
<td>Bonus ($/acre)</td>
<td>378.24</td>
<td>91.67</td>
<td>-286.57***</td>
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<tr>
<td>(36.55)</td>
<td>(10.79)</td>
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<td></td>
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<tr>
<td><strong>Local Owners are In-County</strong></td>
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<tr>
<td>Observations</td>
<td>358,251</td>
<td>1,602,037</td>
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<tr>
<td>Royalty (percentage)</td>
<td>0.160</td>
<td>0.190</td>
<td>0.030***</td>
</tr>
<tr>
<td>(0.000)</td>
<td>(0.000)</td>
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</tr>
<tr>
<td>Primary Term (months)</td>
<td>46.25</td>
<td>40.22</td>
<td>-6.03***</td>
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<td>(0.03)</td>
<td>(0.01)</td>
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<tr>
<td>Acreage (acres)</td>
<td>389.7</td>
<td>347.1</td>
<td>-42.6***</td>
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<tr>
<td>(2.54)</td>
<td>(1.43)</td>
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<tr>
<td>Bonus ($/acre)</td>
<td>580.22</td>
<td>190.89</td>
<td>-389.34***</td>
</tr>
<tr>
<td>(85.98)</td>
<td>(16.56)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- absentee owners receive higher royalty rates
- some of this comes at expense of lower bonus
- absentee can be defined different ways
- don’t bear local environmental costs
In 2011, gross private oil and gas royalties:

- $15.9 billion generated from oil and gas production in Texas
- $11.6 billion paid to owners in Texas
- Texas also *imported* $3.5 billion generated in other states
- 1.43 percent of 2011 personal income (BEA)
Texas is the biggest producing state

- magnitudes are such that Texas cannot really be compared to other states

**Typology of States**
Typology of States

Texas is the biggest producing state
  • magnitudes are such that Texas cannot really be compared to other states

Types of states:
  • producing and retaining local royalties, or largely replacing exports
  • net exporters
  • non-producers importing “mailbox money”
Outflow of O&G Royalties, 2011

- different patterns of ownership across states
  - Texas keeps retains large share w/in state, but not county
  - Pennsylvania much more local retention
  - North Dakota sends large share out-of-state
Inflow of O&G Royalties, 2011

- other states import royalties from elsewhere, again with variation
  - California is an important producing state, but also brings in large royalties to urban and coastal areas
  - New York has banned fracking, but still cashes checks
  - Florida has little home production, but substantial inflows
## Differences Across Producing States

**Table: Summary of Royalties by Producing State, 2011**

<table>
<thead>
<tr>
<th>State</th>
<th>Private Revenue</th>
<th>Generated Royalty</th>
<th>In-State Royalty</th>
<th>Imported Royalty</th>
<th>Total Royalty</th>
</tr>
</thead>
<tbody>
<tr>
<td>AR</td>
<td>4,601</td>
<td>706</td>
<td>373</td>
<td>143</td>
<td>516</td>
</tr>
<tr>
<td>CA</td>
<td>18,119</td>
<td>2,375</td>
<td>320</td>
<td>1,427</td>
<td>1,747</td>
</tr>
<tr>
<td>CO</td>
<td>8,087</td>
<td>1,202</td>
<td>713</td>
<td>770</td>
<td>1,483</td>
</tr>
<tr>
<td>KS</td>
<td>5,134</td>
<td>709</td>
<td>571</td>
<td>211</td>
<td>782</td>
</tr>
<tr>
<td>LA</td>
<td>15,217</td>
<td>3,366</td>
<td>2,522</td>
<td>321</td>
<td>2,843</td>
</tr>
<tr>
<td>MI</td>
<td>930</td>
<td>143</td>
<td>80</td>
<td>117</td>
<td>197</td>
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<tr>
<td>MS</td>
<td>4,141</td>
<td>828</td>
<td>429</td>
<td>129</td>
<td>558</td>
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<tr>
<td>MT</td>
<td>2,038</td>
<td>319</td>
<td>164</td>
<td>145</td>
<td>309</td>
</tr>
<tr>
<td>NM</td>
<td>4,141</td>
<td>465</td>
<td>147</td>
<td>448</td>
<td>595</td>
</tr>
<tr>
<td>ND</td>
<td>7,782</td>
<td>1,340</td>
<td>466</td>
<td>37</td>
<td>503</td>
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<tr>
<td>OH</td>
<td>760</td>
<td>99</td>
<td>88</td>
<td>448</td>
<td>536</td>
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<tr>
<td>OK</td>
<td>13,365</td>
<td>2,510</td>
<td>1,406</td>
<td>765</td>
<td>2,171</td>
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<tr>
<td>PA</td>
<td>5,539</td>
<td>748</td>
<td>624</td>
<td>89</td>
<td>713</td>
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<tr>
<td>TX</td>
<td>74,752</td>
<td>15,941</td>
<td>11,620</td>
<td>3,475</td>
<td>15,095</td>
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<tr>
<td>UT</td>
<td>1,801</td>
<td>293</td>
<td>144</td>
<td>111</td>
<td>255</td>
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<tr>
<td>WV</td>
<td>1,781</td>
<td>234</td>
<td>126</td>
<td>33</td>
<td>159</td>
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<tr>
<td>WY</td>
<td>4,291</td>
<td>669</td>
<td>185</td>
<td>86</td>
<td>271</td>
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</tbody>
</table>

Notes: All amounts are reported in millions of nominal dollars.
# Differences Across Non-Producing States

## Table: Imported Royalties to Non-Producing States, 2011

<table>
<thead>
<tr>
<th>State</th>
<th>Received Royalties</th>
<th>Income Share</th>
<th>State</th>
<th>Received Royalties</th>
<th>Income Share</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Above Median</strong></td>
<td></td>
<td></td>
<td><strong>Below Median</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AZ</td>
<td>327</td>
<td>0.142</td>
<td>CT</td>
<td>15</td>
<td>0.007</td>
</tr>
<tr>
<td>DC</td>
<td>29</td>
<td>0.068</td>
<td>DE</td>
<td>8</td>
<td>0.019</td>
</tr>
<tr>
<td>FL</td>
<td>352</td>
<td>0.045</td>
<td>GA</td>
<td>133</td>
<td>0.037</td>
</tr>
<tr>
<td>HI</td>
<td>30</td>
<td>0.051</td>
<td>IA</td>
<td>38</td>
<td>0.029</td>
</tr>
<tr>
<td>ID</td>
<td>64</td>
<td>0.121</td>
<td>MA</td>
<td>11</td>
<td>0.003</td>
</tr>
<tr>
<td>MN</td>
<td>174</td>
<td>0.072</td>
<td>MD</td>
<td>59</td>
<td>0.019</td>
</tr>
<tr>
<td>MO</td>
<td>297</td>
<td>0.130</td>
<td>ME</td>
<td>2</td>
<td>0.004</td>
</tr>
<tr>
<td>NC</td>
<td>216</td>
<td>0.061</td>
<td>NH</td>
<td>4</td>
<td>0.006</td>
</tr>
<tr>
<td>NE</td>
<td>65</td>
<td>0.081</td>
<td>NJ</td>
<td>19</td>
<td>0.004</td>
</tr>
<tr>
<td>NV</td>
<td>77</td>
<td>0.075</td>
<td>NY</td>
<td>170</td>
<td>0.017</td>
</tr>
<tr>
<td>OR</td>
<td>180</td>
<td>0.124</td>
<td>RI</td>
<td>1</td>
<td>0.002</td>
</tr>
<tr>
<td>SC</td>
<td>79</td>
<td>0.049</td>
<td>VA</td>
<td>145</td>
<td>0.037</td>
</tr>
<tr>
<td>SD</td>
<td>26</td>
<td>0.071</td>
<td>VT</td>
<td>2</td>
<td>0.006</td>
</tr>
<tr>
<td>TN</td>
<td>107</td>
<td>0.045</td>
<td>WI</td>
<td>52</td>
<td>0.022</td>
</tr>
<tr>
<td>WA</td>
<td>270</td>
<td>0.088</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Income share is calculated as percent of the BEA SA1 series (State Annual Personal Income). Median income share for non-producing states is 0.041 percent.
Texas

The average dollar in gross revenue generates 21.3 cents in gross royalties (before deductions and allowances).

- 15.5 cents in TX (73 percent)
- 1.3 cents goes to CA (6 percent)
- 0.7 cents goes to OK (3 percent)
- 0.5 cents goes to CO (2 percent)
- Next largest: NM, LA, FL, AZ

Royalties are paid to all 50 states and DC.
North Dakota

The average dollar in gross revenue generates 17.2 cents in gross royalties (before deductions and allowances).

Royalties are paid to all 50 states and DC.

- 6 cents stays in North Dakota (35 percent)
- 1.5 cents goes to Minnesota (8.5 percent)
- 1.3 cents goes to Texas (7.7 percent)
- 1 cent goes to Montana and California (5.9 & 5.6 percent)
- 0.8 cents goes to both Colorado and Washington
- Next six largest shares go to AZ, IL, FL, OR, OK, WI
Aggregate Gross Oil and Gas Royalties
2011
Aggregate Gross Oil and Gas Royalties per Capita

2011
County-Level Descriptive Analysis

County Typology
- Non-Producing Importer
- Producing Retainer
- Producing Importer
- Producing Exporter
County-Level Descriptive Analysis
Texas

City Population
- 10,430 - 54,159
- 54,160 - 149,734
- 149,735 - 373,933
- 373,934 - 736,677
- 736,678 - 2,109,413

County Typology
- Non-Producing Importer
- Producing Retainer
- Producing Importer
- Producing Exporter

- Fixed effects panel model
  \[ Y_{it} = \text{Wells}'_{it}\beta + \text{Royalty}'_{it}\delta + \text{LMC}'_{it}\theta + z_i\lambda_i + \gamma_t + \varepsilon_{it} \]  

- Dynamic panel model
  \[ Y_{it} = Y_{it-1}\alpha + \text{Wells}'_{it}\beta + \text{Royalty}'_{it}\delta + \text{LMC}'_{it}\theta + z_i\lambda_i + \gamma_t + \varepsilon_{it}, \]  

- From ??, long-run effect is \(\beta/(1 - \alpha)\) for drilling and \(\delta/(1 - \alpha)\) for royalty
Data Sources

- Production
  - County-level oil & gas value of production from USDA ERS, 2001 to 2011 with additional data collected for 2011-2013

- Adjusted gross income — Internal Revenue Service
  - place of residence

- Population and employment — BEA (REIS)

- First purchase price of oil (state level) and well head price of natural gas — EIA

- Wells and raw data on leases— DrillingInfo

- All dollar values converted to 2010 price levels
**County Income Results**

**Table:** Per capita real adjusted gross income

<table>
<thead>
<tr>
<th>Variable</th>
<th>FE</th>
<th>FE</th>
<th>Dynamic FE</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGI_{t-1}</td>
<td>–</td>
<td>–</td>
<td>0.478***</td>
</tr>
<tr>
<td>Wells</td>
<td>127,091.8***</td>
<td>77,897.270***</td>
<td>59,071.430***</td>
</tr>
<tr>
<td></td>
<td>(35,466.84)</td>
<td>(21,488.270)</td>
<td>(16,453.640)</td>
</tr>
<tr>
<td>Royalty</td>
<td>–</td>
<td>1.139***</td>
<td>0.686***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.086)</td>
<td>(0.132)</td>
</tr>
<tr>
<td>Unemp(%)</td>
<td>-745.697</td>
<td>-718.645***</td>
<td>-465.973***</td>
</tr>
<tr>
<td></td>
<td>(142.915)</td>
<td>(135.568)</td>
<td>(143.551)</td>
</tr>
<tr>
<td>Goods(%)</td>
<td>27,756.67</td>
<td>21,093.740**</td>
<td>11,489.550*</td>
</tr>
<tr>
<td></td>
<td>(8,639.56)</td>
<td>(7,092.116)</td>
<td>(6,097.096)</td>
</tr>
<tr>
<td>Services(%)</td>
<td>18,837.89</td>
<td>16,391.810**</td>
<td>8,801.946**</td>
</tr>
<tr>
<td></td>
<td>(6,863.51)</td>
<td>(5,503.301)</td>
<td>(3,968.433)</td>
</tr>
</tbody>
</table>

N 6,664 5,382 5,382

Adjusted $R^2$ 0.741 0.766 0.816

F 84.14 80.03 194.13

Note: Year fixed effects not shown. Robust standard errors in parentheses.

*** p < 0.01, ** p < 0.05, * p < 0.1

**Long run estimates**

- Each new well drilled associated with 78k-113k of income
- Each dollar of royalty payments generates additional $0.14 - $0.30
Contrast with Feyrer et al. 2015

- $1 mm production $\rightarrow$ $61,000$ locally, $117,000$ w/in $100$ mi
- $69,223$ per well, compared to our estimate if $77,897$
- estimate wages $2x$ important as royalties
- our estimate suggests royalties end up being much more important
Average Income Generated from Oil & Gas Activity

The chart shows the income generated from oil & gas activity from 2005 to 2013. The income is categorized into two types: income from drilling and income from royalties. The income from drilling is represented by black bars, while the income from royalties is represented by white bars.

- Income from Drilling:
  - 2005: $6.5 million
  - 2006: $7.0 million
  - 2007: $7.5 million
  - 2008: $9.0 million
  - 2009: $5.5 million
  - 2010: $6.0 million
  - 2011: $6.5 million
  - 2012: $7.0 million
  - 2013: $7.5 million

- Income from Royalties:
  - 2005: $9.5 million
  - 2006: $10.5 million
  - 2007: $11.5 million
  - 2008: $13.0 million
  - 2009: $10.5 million
  - 2010: $11.0 million
  - 2011: $11.5 million
  - 2012: $12.0 million
  - 2013: $12.5 million
Average Income Generated: Oil Counties

$ Millions

- Income from Drilling
- Income from Royalties

$ Millions

2005 2006 2007 2008 2009 2010 2011 2012 2013
Average Income Generated: Gas Counties

- Income from Drilling
- Income from Royalties
Summary

- Areas with local production differ in important ways with respect to retention of income

- Some states received significant inflows of royalty payments with limited to no production in-state

- Modest income multiplier from royalty payments of 1.3
  - consistent with small employment multipliers found in other studies

- Although sizable, flows of income from drilling activity were 2 to 4 times smaller compared to flows from local royalty payments in a given year
Implications

- regional studies may misspecify local economic shocks by ignoring absentee ownership
- direct employment gains may be small relative to benefits of resource ownership
- publicly-owned minerals generate sizable royalties that may/may not be returned to local regions
- mechanisms of tax collection different for absentee owners
- political mechanisms may be affected by royalty flows and local environmental costs
National Royalty Heat Map
## Rules for Classification of Counties

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Producing Importer</td>
<td>No local production revenue, positive royalties received</td>
</tr>
<tr>
<td>Producing Retainer</td>
<td>Locally-retained royalties greater than two-thirds of all generated, and locally-retained royalties greater than half of all received</td>
</tr>
<tr>
<td>Producing Importer</td>
<td>Positive local production revenue, locally-retained royalties less than half of total received, locally-retained royalties greater than or equal to half of locally-generated</td>
</tr>
<tr>
<td>Exporter</td>
<td>Locally-retained royalties less than half of locally-generated</td>
</tr>
</tbody>
</table>