



United States Department of Agriculture

The Role of Land Ownership for Oil and Gas Development

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Introduction

Shale revolution: Oil and gas production grew by 69 percent
2005-2014

67 percent of production in 2014 occurred on farmland

Importance of subsurface ownership for farmers to benefit
financially from development and shape the terms on which it
occurs



Research Questions

What characteristics of landowners drive them to lease out their oil and gas rights?

Are non-operator landlords more likely than owner-operators to allow energy development on their land?

Among non-operator landlords, does any of the following affect the likelihood of leasing out oil and gas rights:

- Being a retired farmer / never having farmed before
- Being related to the tenant
- Distance between home and land that is rented out



Data

Tenure, Ownership, and Transition of Agricultural Land (TOTAL) Survey for 2014 (USDA NASS and ERS)

- Survey of farm operators AND non-operator landlords
- Mandatory (response is required by US law)
- Information on income, expense, debt, assets, transition plans, demographic and other landlord characteristics

Soil quality data from the USDA-NASS June Area Survey

County-level oil and gas production from DrillingInfo



Drilling on Agricultural Land (1/2)

Land for drilling pad, access roads, wastewater impoundment pit is taken (temporarily/permanently) out of agricultural production

- 5 acre multi-well drillpad can drain gas/oil from 500-1,000 acres (NETL 2013)
- Vegetation removal due to oil and gas development from 2000-2012 affected about 7.4 million acres of land (47% rangeland, 37% cropland, 13% forestland) (Allred et al. 2015)
- Agricultural production can continue, but soil disturbance can lower crop yields

Labor and transportation costs may increase

- In the Bakken shale, farmers had difficulty finding seasonal workers (Deede 2014)
- Rail shipment delays caused a loss of \$66.6 million in North Dakota's farm-level revenue for crops that were sold from Jan-Apr 2014 (Olson 2014)



Drilling on Agricultural Land (2/2)

Risk of air pollution, soil and water contamination

- Exposure to dust from truck traffic in dry areas
- Exposure to drilling chemicals from a blowout
- Exposure to wastewater through leakage or improper fencing of impoundments, dumping of water on creeks and land

Potential impacts on livestock (Bamberger and Oswald 2012)

- Dust pneumonia
- Sudden death
- Difficulty breeding
- Increased incidence of stillborn offspring and offspring with congenital abnormalities



Lease and Royalty Income

- Energy firms access oil and gas through a lease with the owner of the oil and gas rights
- Upon signing, firms make a one-time bonus payment to the owner
- Compensation occurs through royalty payments (average royalty rate is 18%)
- Because royalty payments are based on the value of production, they will vary substantially over time as the productivity of wells and energy prices change.

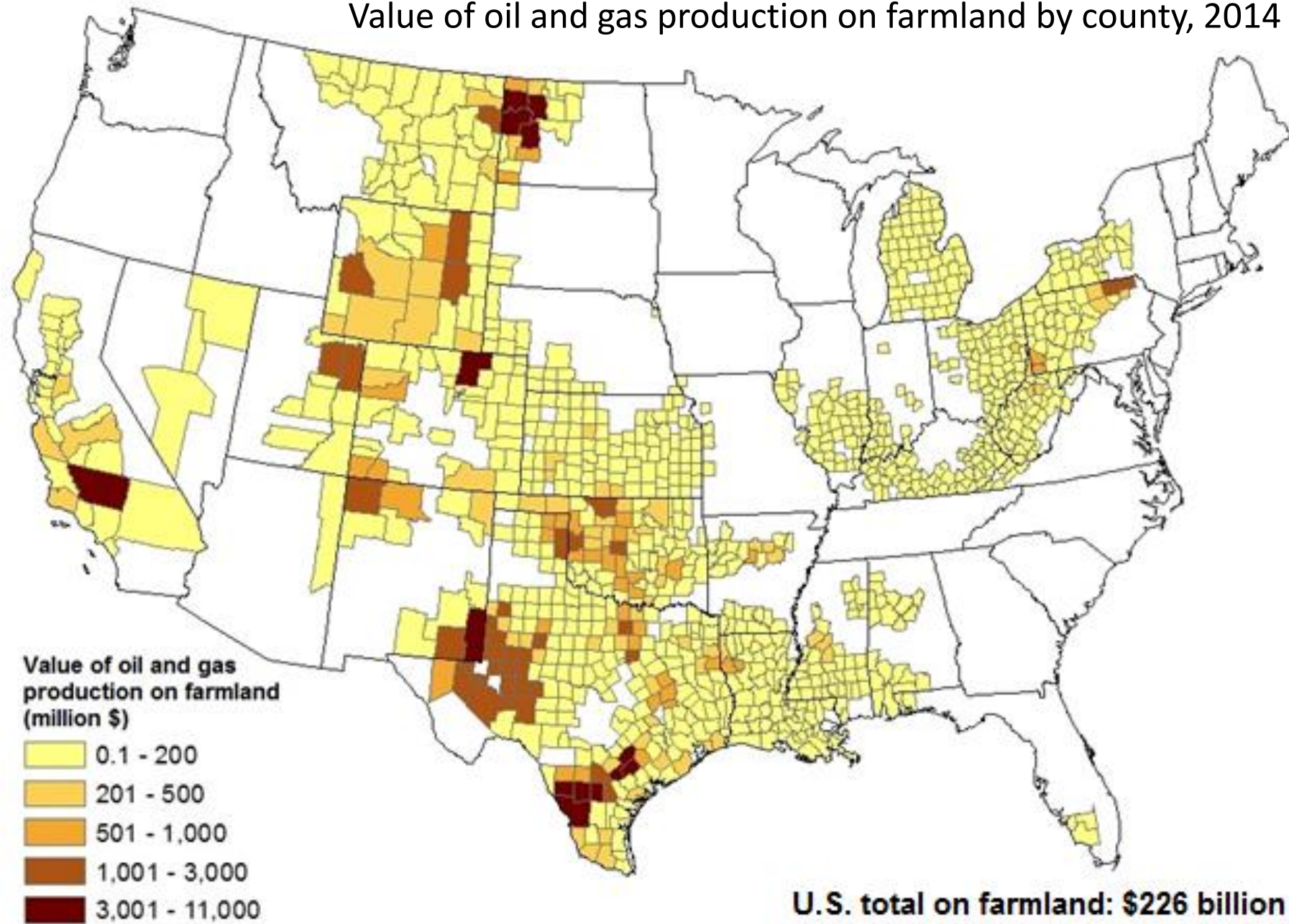


Split Estates

- Ownership of mineral rights determines whether farmers can receive lease and royalty income.
- Split-estate situations occur when the surface (land) rights and subsurface (oil and gas) rights are owned by different entities.
- Oil and gas rights are considered the dominant estate.
- The surface owner receives payments to compensate for use of (or damages to) the surface.



Value of oil and gas production on farmland by county, 2014



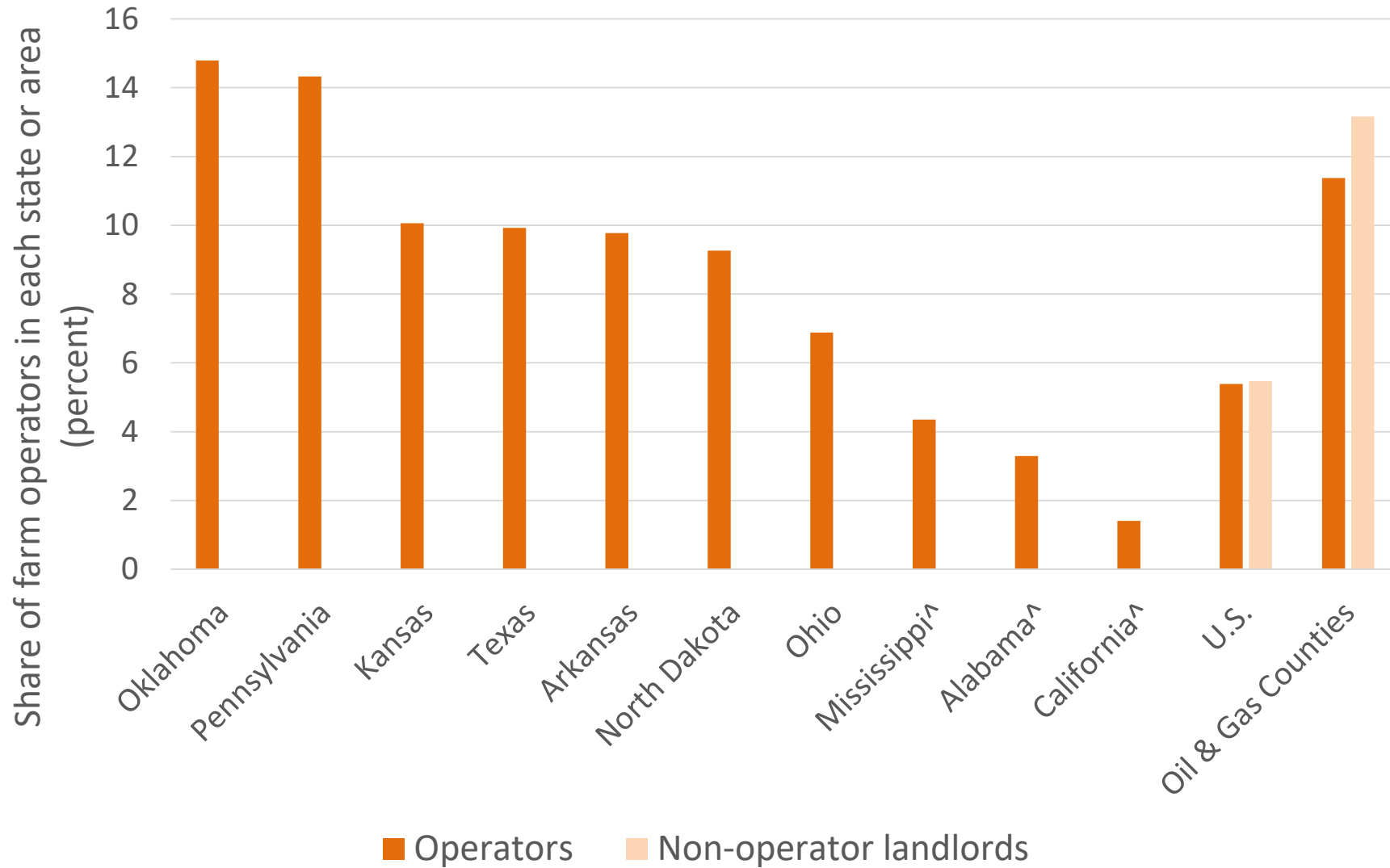
Source: ERS analysis using data from DrillingInfo; USDA-NASS 2012 Census of Agriculture

Estimated and reported value of oil and gas (O&G) production on farmland

| | Value of O&G production in 2014 (billion \$) | Estimated value of O&G production in 2014 on farmland (billion \$) | Estimated O&G payments to farmland owners assuming 17.8% royalty rate (billion \$) | O&G payments in 2014 from TOTAL survey (billion \$) | Estimated incidence of split estates (%) |
|------|--|--|--|---|--|
| U.S. | 338.1 | 225.5 | 40.1 | 7.4 | 82 |
| TX | 138.5 | 115.5 | 20.6 | 3.0 | 85 |
| OK | 22.1 | 20.1 | 3.6 | 1.2 | 66 |
| PA | 19.2 | 5.6 | 1.0 | 0.6 | 38 |
| ND | 36.5 | 26.6 | 4.7 | 0.4 | 91 |
| OH | 3.6 | 1.4 | 0.2 | 0.1 | 44 |
| AR | 5.5 | 2.3 | 0.4 | 0.1 | 71 |

Source: ERS analysis using data from DrillingInfo; USDA-NASS 2012 Census of Agriculture; NASS/ERS 2014 TOTAL Survey

Ownership of oil and gas rights with positive value in 2014

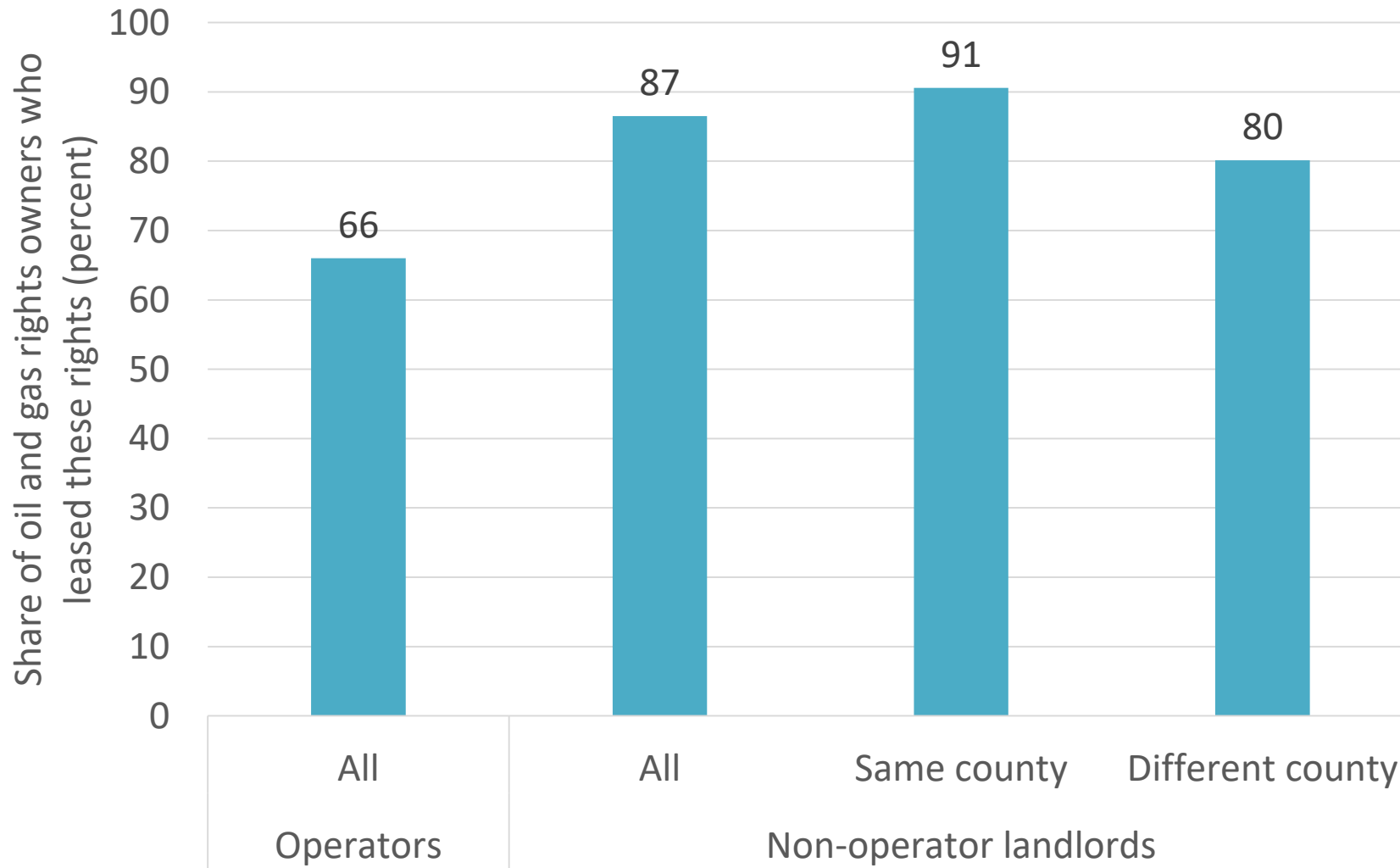


Note: NOL data shown only for the U.S. and Oil & Gas Counties

[^] Coefficient of variation (CV) between 25 and 50, # CV greater than 50

Source: 2014 TOTAL Survey

Share of oil and gas rights owners who leased these rights, by type in 2014



Source: 2014 TOTAL Survey

Methods

Estimate a series of discrete-choice models to measure the extent to which landlord/operator, land, and lease arrangement characteristics affect the decision to lease oil and gas rights.

$$P(\textit{Lease}_i = 1) = f(x_i, y_i, z_i)$$

where \textit{Lease}_i denotes the binary decision to lease oil and gas rights, and x_i , y_i , and z_i are the associated landlord/operator, land, and lease attributes.



Operators and Non-Operator Landlords (NOLs)

| Dep. Var.: Lease oil or gas rights (0/1) | Logistic regression | | | |
|---|----------------------|----------------------|----------------------|----------------------|
| Non-operator landlord (0/1) | 1.0228 (0.150)*** | 0.9834 (0.151)*** | 0.9593 (0.165)*** | 0.9789 (0.188)*** |
| Acres owned | -0.0000 (0.000) | -0.0000 (0.000) | -0.0000 (0.000) | -0.0000 (0.000) |
| Cropland share of owned land | 0.4927 (0.268)* | 0.4828 (0.272)* | 0.4784 (0.273)* | 0.4732 (0.273)* |
| Pastureland share of owned land | 0.5098 (0.280)* | 0.5134 (0.281)* | 0.4796 (0.282)* | 0.4795 (0.281)* |
| Orchard share of owned land | -1.2669 (0.601)** | -1.3104 (0.609)** | -1.2647 (0.623)** | -1.2794 (0.630)** |
| Share of land enrolled conservation program | 0.5263 (0.432) | 0.5074 (0.428) | 0.5140 (0.422) | 0.5028 (0.437) |
| Share of land intended to be transferred in next five years | | 0.1684 (0.088)* | 0.1814 (0.083)** | 0.1744 (0.096)* |
| Share of owned land bought at arm's length | | -0.1259 (0.098) | -0.1492 (0.102) | -0.1500 (0.101) |
| Family farm or sole owner NOL | | | -0.1944 (0.200) | -0.2953 (0.381) |
| Operator or NOL off-farm income | | | 0.0007 (0.000)** | 0.0007 (0.000)** |
| Observations | 1,676 | 1,676 | 1,658 | 1,658 |

Non-Operator Landlords (1/2)

| Dep. Var.: Lease oil or gas rights (0/1) | | Logistic regression | |
|---|--------------------|-----------------------|---------------------|
| NOL, some land owned under sole proprietorship | 0.4807 (0.585) | -3.9136 (1.233)*** | -2.9907 (1.722)* |
| Acres owned | 0.0002 (0.000) | 0.0002 (0.000) | 0.0007 (0.001) |
| Cropland share of owned land | 3.9000 (2.153)* | 4.6090 (1.947)** | 3.4420 (2.398) |
| Pastureland share of owned land | 3.6112 (2.287) | 4.2212 (1.991)** | 2.5881 (2.511) |
| Orchard share of owned land | 0.5998 (3.098) | 1.2071 (2.713) | 1.5824 (3.272) |
| Share of land rented out enrolled in conservation program | 0.9591 (0.664) | 1.4065 (0.806)* | 1.7914 (1.032)* |
| Share of owned land intended to be transferred in next five years | 1.1364 (0.616)* | 0.9980 (0.615) | 0.6708 (0.502) |
| Share of owned land bought at arm's length | 0.0697 (0.546) | -0.5003 (0.449) | -0.2930 (0.554) |
| NOL, off-farm income, if observed | -0.0011 (0.001) | -0.0003 (0.001) | 0.0001 (0.001) |
| Observations | 426 | 426 | 265 |

Non-Operator Landlords (2/2)

| Dep. Var.: Lease oil or gas rights (0/1) | | Logistic regression | |
|---|-----|----------------------|-----------------------|
| NOL, never farmed, if observed (0/1) | | 1.3532 (0.326)*** | 0.8149 (0.493)* |
| NOL, age, if observed | | 0.0550 (0.017)*** | 0.0395 (0.020)** |
| NOL, college graduate, if observed (0/1) | | -0.2587 (0.503) | 0.0201 (0.456) |
| NOL, age, if observed (0/1) | | 0.1528 (0.228) | 0.4530 (0.379) |
| Percentage of owned land in land capability class 1-4 (suitable for agriculture) | | | -0.0101 (0.008) |
| NOL address in a metro county (0/1) | | | 1.1305 (0.485)** |
| Distance in km of JAS segment centroid to Zip centroid of NOL | | | -0.0013 (0.000)*** |
| Observations | 426 | 426 | 265 |

Farm Operators (1/2)

| Dep. Var.: Lease oil or gas rights (0/1) | Logistic regression | | |
|---|----------------------|----------------------|--------------------|
| Operation is a corporation or other ownership entity (0/1) | 0.4530 (0.440) | 0.5217 (0.452) | 0.5666 (0.463) |
| Operation is a family farm (0/1) | -1.3120 (0.613)** | -1.4229 (0.597)** | -0.4805 (0.871) |
| Operator tenure class is full owner (0/1) | 0.0731 (0.208) | 0.0545 (0.218) | 0.0934 (0.254) |
| Acres owned | -0.0000 (0.000) | -0.0000 (0.000) | -0.0000 (0.000) |
| Cropland share of owned land | 0.6483 (0.620) | 0.7973 (0.540) | 0.8268 (0.531) |
| Pastureland share of owned land | 0.5318 (0.491) | 0.6501 (0.451) | 0.6634 (0.431) |
| Orchard share of owned land | -4.1502 (2.601) | -3.9426 (2.771) | -3.9234 (2.636) |
| Share of land enrolled in conservation program | -0.8123 (1.752) | 4.0313 (3.890) | 4.0752 (4.277) |
| Share of owned land intended to be transferred in next five years | 0.0249 (0.228) | -0.0197 (0.218) | 0.0974 (0.220) |
| Share of owned land bought at arm's length | -0.0464 (0.332) | -0.0113 (0.307) | -0.0197 (0.307) |
| Observations | 1,250 | 1,207 | 1,207 |

Farm Operators (2/2)

| Dep. Var.: Lease oil or gas rights (0/1) | | Logistic regression | |
|---|-------|---------------------|-----------|
| Operator household debt, if observed | | -0.0000 | -0.0000 |
| | | (0.000) | (0.000) |
| Operator off-farm income, if observed | | 0.0008 | 0.0008 |
| | | (0.000)** | (0.000)** |
| Operator is risk-averse, if observed (0/1) | | 0.1629 | 0.1602 |
| | | (0.314) | (0.321) |
| Operator age, if observed | | | -0.0136 |
| | | | (0.007)* |
| Operator is college graduate, if observed (0/1) | | | -0.2587 |
| | | | (0.203) |
| Operator is female, if observed (0/1) | | | 0.2045 |
| | | | (0.387) |
| Observations | 1,250 | 1,207 | 1,207 |

Conclusions (1/2)

- Farmland accounted for 48 percent of the land area in the US but an estimated 67 percent of onshore oil and gas production in 2014.
- In 2014, 11 percent of farm operators and 13 percent of non-operator landlords in oil and gas counties reported owning oil and gas rights with positive value.

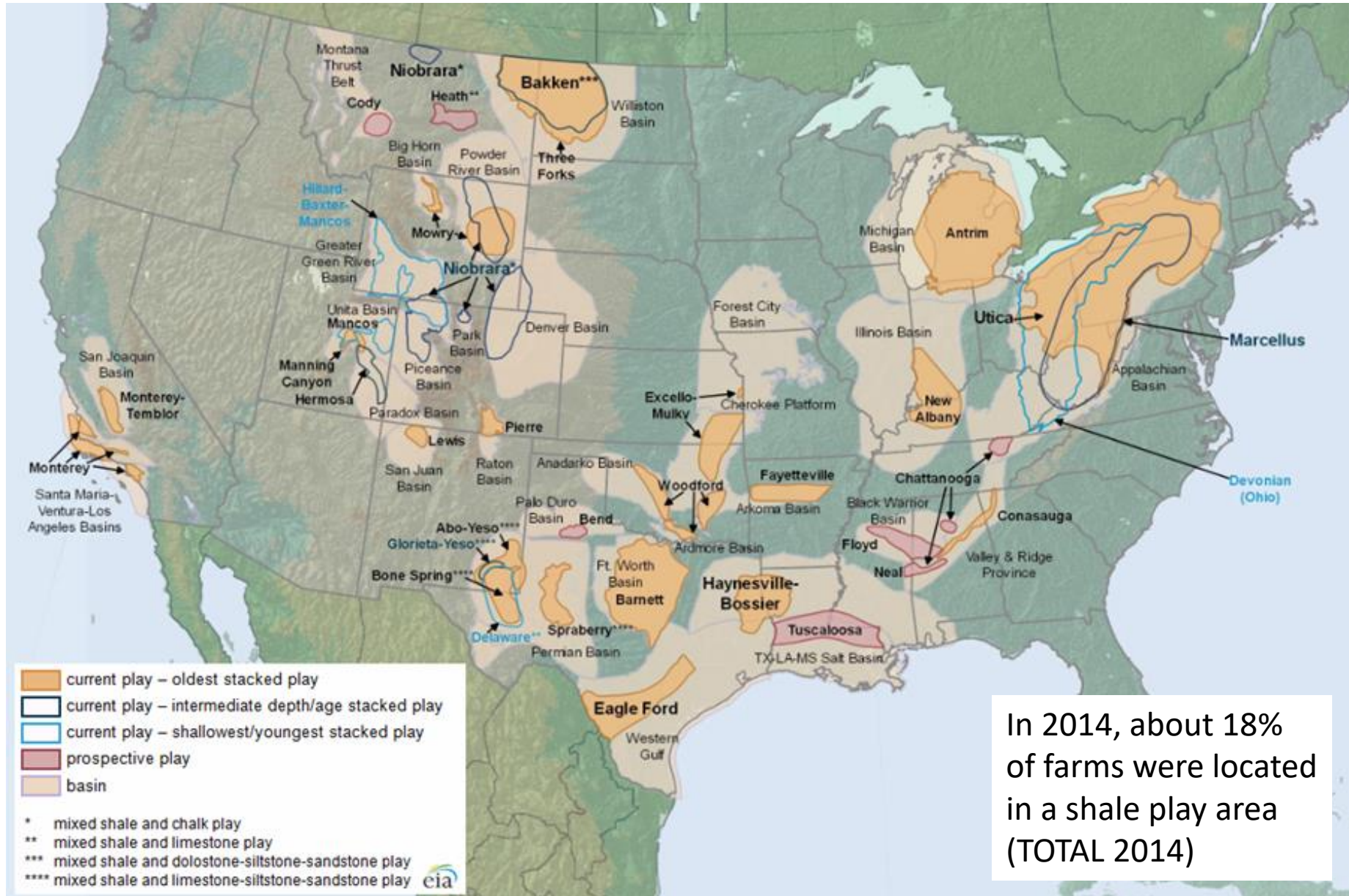


Conclusions (2/2)

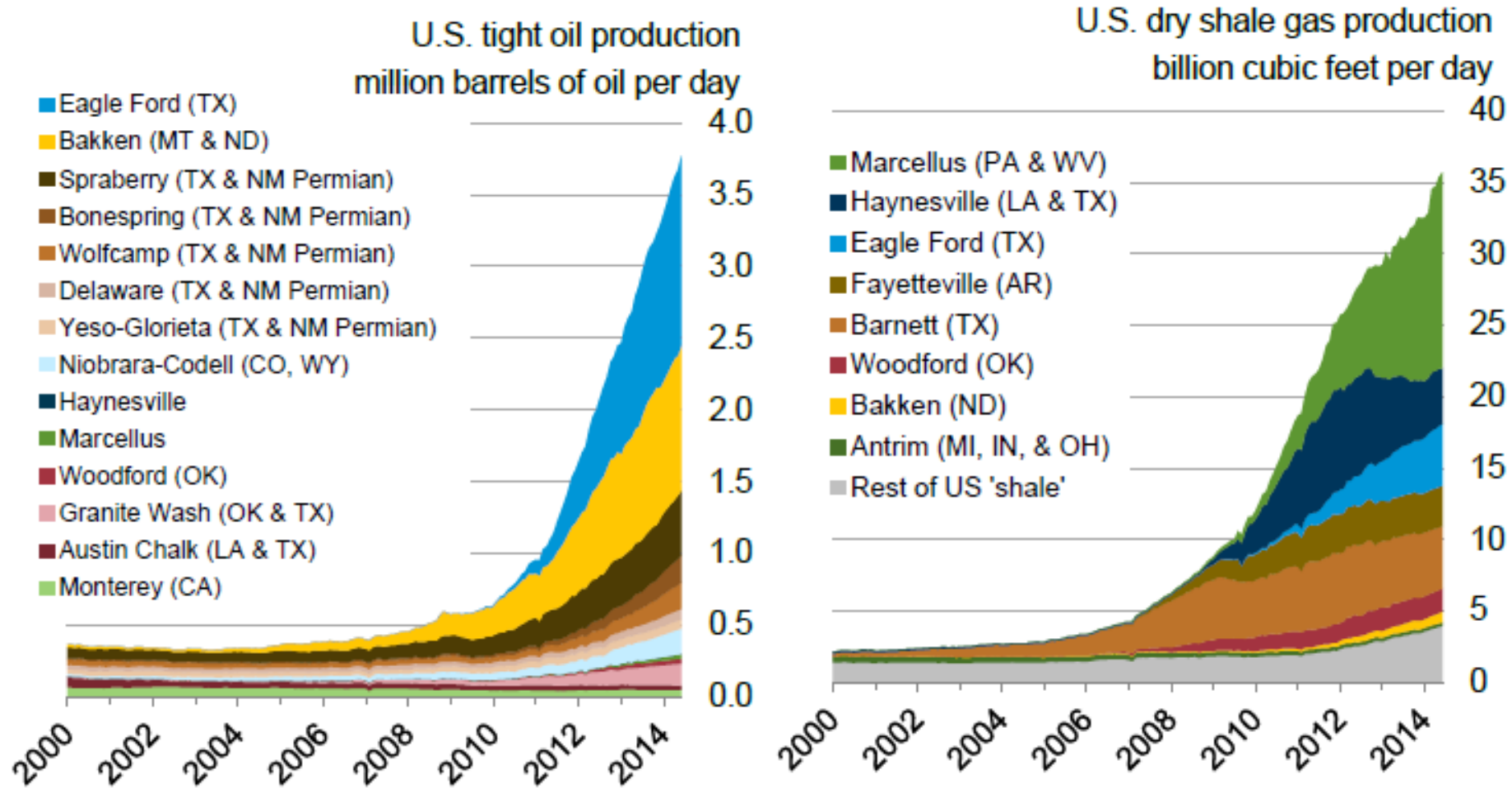
- The odds of non-operator landlords leasing their rights to energy firms and allowing energy production to occur on their land are almost 3 times higher than for operators.
- High-value agricultural land, such as orchards, are less likely to lease their rights to energy firms
- Family farms or non-operator landlords with sole proprietorship over the land are less likely to lease their oil and gas rights



Shale Plays in the Lower 48 States



Shale Production



Sources: EIA derived from state administrative data collected by DrillingInfo Inc. Data are through June 2014 and represent EIA's official tight oil & shale gas estimates, but are not survey data. State abbreviations indicate primary state(s).

