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THE ECONOMIC AFTERMATH OF RESOURCE BOOMS: EVIDENCE FROM BOOMTOWNS IN THE AMERICAN WEST*

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The current US oil and gas boom is injecting labour, capital and revenue into communities near reserves. Will these communities be cursed with lower long-run incomes in the wake of the boom? We study the oil boom-and-bust cycle of the 1970s and 1980s to gain insights. Using annual data on drilling to identify western boom-and-bust counties, we find substantial positive local employment and income effects during the boom. In the aftermath of the bust, however, we find that incomes *per capita* decreased and unemployment compensation payments increased relative to what they would have been if the boom had not occurred.

Due to the recent surge in domestic oil and gas development, US communities located near previously inaccessible reserves are experiencing large and sudden economic shocks.[1] Influxes of oil and gas workers have migrated to towns in North Dakota, Texas and Pennsylvania where much of the new drilling is concentrated. These ‘boomtowns’ are being inundated with injections of capital, revenue and labour. They face the unusual problem described in media outlets as having ‘too many unfilled jobs and not enough empty beds’ (Sulzberger, 2011). The bust will come when profitable stocks are depleted, for example, if accessible reserves are exhausted or prices become depressed.

Boomtowns raise several questions of interest to economists. How will the economic benefits from the boom be distributed among landowners, small businesses and labour? What time paths will local wages, employment, business profits and firm entry and exit follow along the boom, bust and post-bust periods? Will local economic growth simply resume along pre-boom growth paths after the bust? Or, will the booms and busts cause more interesting economic changes in the long run? Will the boom ultimately prove to be a curse for local communities?

We shed light on these questions by studying the price-induced domestic oil boom of the mid 1970s and the western energy boomtowns that it created. We focus on the 1970s’ boom because it was recent enough to study with detailed annual data but long enough ago to enable an examination of the full boom-and-bust cycle and the aftermath. By contrast, the recent boom is not yet mature enough to fully examine because the bust has yet to come. We focus on the western region because it was the frontier for energy boomtowns during the 1970s and 1980s as we explain in Section 2.

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[1] US domestic oil production grew more in 2012 than in any year in history and the Energy Information Administration projects continued rapid growth over the next decade. The growth is largely due to sharp increases in onshore drilling, particularly in shale and other tight formations that have recently been made accessible by new technologies (US Energy Information Administration, 2013).

We conform to existing literature on energy booms by conducting our econometric analysis at the county level using difference-and-difference techniques (Black *et al.*, 2005). We define boom counties based on the number of oil and gas wells drilled as a result of the increase in oil prices in the 1970s and early 1980s. To measure the short- and longer-run impacts we employ annual data on county-level outcomes from 1969 to 1998, which covers the pre-boom (1969–74), boom (1975–81), bust (1982–5) and post-bust (1986–98) periods. We end in 1998 because a new regional gas boom began around that time and we want to isolate the effect of the much larger boom-and-bust cycle of the 1970s and 1980s. The outcomes we study include various measures of income and employment both in total and by sector (e.g. mining, manufacturing, construction, retail, services) and measures of local business profits.

To preview our main results, we find that the boom created substantial short-term economic benefits, but also longer term hardships that persisted in the form of joblessness and depressed local incomes. In particular, we find positive short-term effects of the boom on local income *per capita*, which increased by more than 10% above pre-boom levels during the height of the boom. Local employment also increased considerably during the boom, particularly in the extraction and non-tradable (e.g. construction, services, retail) sectors, which is consistent with the findings of previous research (Carrington, 1996; Black *et al.*, 2005; Marchand, 2012).[2] In the longer run, after the full boom-and-bust cycle had concluded, we find that local *per capita* income was about 6% lower than it would have been if the boom had never occurred. Local unemployment compensation payments – which proxy for job loss – increased immediately following the peak of the boom and did not contract back to pre-boom levels during the entire post-bust period.

Our findings contribute to the large literature on the 'natural resource curse', which has debated whether resource booms are a catalyst or hindrance to economic growth. On the one hand, models of agglomeration imply that booms can stimulate complementary investments in local non-extraction sectors and augment growth (Duranton and Puga, 2004; Glaeser and Gottleib, 2009). On the other hand, models of the 'Dutch Disease' imply that local booms can crowd out growth in non-extraction sectors that produce tradable goods, such as manufacturing and commercial agriculture, because the booms raise local wages and these additional input costs cannot be passed on to non-local consumers (Corden and Neary, 1982). The crowd-out reduces long-run growth if the tradable sectors have better long-run growth potential than non-renewable resources (Sachs and Warner, 1995; van der Ploeg, 2011).[3]

Empirically, there is competing evidence about whether resources are a blessing or a curse. Early studies relied on cross-country growth regressions to amass widespread evidence that countries endowed with natural resources were cursed by weak *per capita* income growth (Deacon, 2011; van der Ploeg, 2011). More recent empirical work has shown the early findings to be fragile, by demonstrating their sensitivity to improve-

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[2] Carrington (1996), Black *et al.* (2005) and Marchand (2012) examine the effects of the Trans-Alaska pipeline during 1974–7, the Appalachia-region coal boom of the 1970s and Canadian oil and gas booms of the 1970s and 2000s respectively.

[3] Other theories imply that resource booms can slow growth by corrupting political institutions (Melhum *et al.*, 2006; Deacon, 2011), or by leaving footprints of pollution that repel amenity-driven economic activity (Deller *et al.*, 2001; Power and Barrett, 2001). These mechanisms are not the focus of our study.

ments in regression specifications (Brunnschweiler and Bulte, 2008; Alexeev and Conrad, 2009). In general, resource curse theories have proved difficult to test with cross-country data. For that reason, reviews of the literature recommend that further research instead rely on within-country resource windfalls for identification (Deacon, 2011; van der Ploeg, 2011).

Among the subset of studies that rely on windfalls, ours is the first that we are aware of to find evidence of sustained negative effects on income *per capita* within a developed country that has well-functioning institutions. Collier and Goderis (2008), for example, use time series data to conclude that increases in commodity prices for metals and fuels reduce long-run GDP *per capita* in countries with weak institutions but have insignificant (but positive) effects in countries with strong institutions. In all countries, there are generally positive short-run effects that last a couple of years. Caselli and Michaels (2013) find that local, municipal level windfalls from offshore oil revenues within Brazil have minimal effects on living standards, so the windfalls appear to be neither a blessing nor a curse. By contrast, Aragón and Rud (2013) find that the expansion of a mine in a Peruvian city generated significant economic benefits to residents in the surrounding areas, although their study focuses on the short run rather than long-run impacts.

Our methodology and findings also contribute to the literature assessing the presence of the resource curse within the US. These studies have produced mixed evidence regarding whether or not resources have been harmful to local economies. Papyrakis and Gerlagh (2007) and James and Aadland (2011) find negative correlations between resource dependency in the 1980s – at state and county levels respectively – and subsequent *per capita* income growth in the following two decades.[4] However, Michaels (2011) finds that oil endowments stimulated county-level development by augmenting manufacturing and agricultural sectors and increasing *per capita* income in the US South over a long period of time, from 1890 to 1990. Our approach adds context to the negative correlations found in the former set of studies because we highlight the benefits of resource dependency (which peaked during the 1980s) as well as the costs. Our finding of adverse effects provide an interesting contrast with Michaels (2011) and may indicate that certain pre-conditions for agglomeration were not met in the setting we study, which was a short-lived resource boom in a relatively remote and land-locked region endowed with fewer large oil fields.

1. Analytical Framework

Although our main question – which is how local economies will be affected in the wake of a resource boom – is largely an empirical one, we present an analytic framework in this Section to frame the issues using insights from Corden and Neary (1982) as the starting point. We consider three sectors within oil-endowed communities: oil and gas extraction,

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[4] Papyrakis and Gerlagh (2007) find a negative relationship between a state's share of income from natural resources in 1986 and subsequent growth rates from 1986 to 2000. At the county level, James and Aadland (2011) find a negative relationship between the percentage of 1980 earnings from natural resources and subsequent rates of income growth. Their correlation is economically large, leading them to conclude that 'Wyoming's decision to specialise in natural resource extraction and production appears to have limited its relative potential for economic growth, at least for sample periods since 1980' (James and Aadland, p. 450).

tradable goods and non-tradable goods.[5] The starting point, prior to the boom, is a local economy in equilibrium. The pre-boom equilibrium is characterised by transitional unemployment but, otherwise, labour is fully employed and competitive firms are earning zero economic profits. Our main objective is to describe why the amount of local income generated in a post-bust economy could deviate from the amount of local income generated in the pre-boom equilibrium.

1.1. *The Boom*

Whether triggered by an unanticipated shock to the world price of oil or an improvement in drilling technology, the initial effect of an oil boom is an increase in the demand for local prospecting and extraction. To enable extraction or exploration from beneath private land, drilling companies must pay landowners for leasing the land and provide royalties from oil extraction. Therefore, we expect one initial effect of the boom to be an increase in local income from land rent payments.

To attract labour for drilling, the booming extraction sector must offer higher wages. If extraction requires specialised labour, or if demand for extraction is high relative to the pre-boom population of the local economy, then the booming sector will attract an influx of migrant labour from outside the community. Thus, during the boom, we expect expansion of wages and employment in the extraction sector, and possibly local population growth.

The influx of land rental income, and the expansion of employment and wages in the booming sector, will raise the demand for non-tradable goods and services in construction, services and retail industries. Therefore, we expect wages and employment in the non-tradable sector to rise during the boom period. Much of the existing literature has emphasised this spillover expansion in its estimates of ‘multiplier effects’.[6]

We expect the set of competitive firms operating at the onset of the boom in the extraction sector (e.g. drilling businesses) and in the non-tradable sector (e.g. local restaurants and hotels) to earn windfall profits during the early part of the boom due to the positive demand shock and short-run constraints on the entry of competitor firms. Over time, however, the entry of competing firms should push profits for each firm back down towards equilibrium levels. Importantly, proprietors of firms must make site and industry-specific investments in capital before entering (e.g. equipment to service mobile home facilities, vehicles to transport drilling equipment, capital to operate bars or restaurants). We expect firms to enter as long as potential proprietors expect the boom to last long enough to justify the specific investments.

Turning to models of Dutch Disease, consider the impact of the boom on the tradable goods sector (i.e. manufacturing and commercial agriculture). Like the non-tradable sector, firms in the tradable sector must also pay higher wages during the

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[5] The tradable sector produces goods sold in the larger, non-local economy. The non-tradable sector produces goods and services sold locally. In the tradable sector, output prices are determined by aggregate (non-local) supply and demand. In the non-tradable sector, prices are determined by local supply and demand.

[6] The extent of positive employment and wage spillover from the extraction sector into the non-tradables sector is an empirical matter that has been found to vary across settings (Carrington, 1996; Black *et al.*, 2005; Marchand, 2012).

boom. Unlike the non-tradable sector, firms producing tradables cannot pass on the higher wages to consumers through higher output prices because tradable goods are sold in large, non-local markets (Corden and Neary, 1982). Hence, profits in tradable sectors will fall during the boom unless there are offsetting positive effects. One offsetting effect could come from agglomeration benefits. The oil boom could stimulate the building of new roads and public infrastructure for example, and this could lower production costs in agriculture and manufacturing (Michaels, 2011).

1.2. *The Bust and Aftermath*

When triggered by an unanticipated decline in the world price of oil, as in our empirical setting, the bust is characterised by a sharp decline in drilling and extraction. We expect the effects to be first felt in declining lease income and in declining extraction sector employment and wages. Next, we expect the effects of the bust to reverberate into the non-tradable sectors (i.e. construction, services and retail) in the form of falling employment and falling wages due to multiplier effects.[7]

If labour and capital are not fully mobile, or if there are strong transitional frictions, then the post-bust local economy may not return to its pre-boom equilibrium. There are three main reasons why post-bust incomes may be lower than pre-boom incomes, at least on a per-labourer or per-unit-of-capital basis. First, if the boom caused the tradable sector to contract, or if it redirected growth in this sector to non-booming areas, then the tradable sector may remain relatively contracted after the bust. Firms in tradable sectors that located or expanded elsewhere due to the high wages associated with the boom may be hesitant to shift new production to the boom counties due to economies of scale from expanding production at their present locations or concerns about a future boom occurring in the formerly booming area.

Second, firms in the extraction and non-tradable sectors may be rendered less profitable post-bust due to a combination of contracted demand and difficulties in shedding excessive industry and site-specific capital that was sunk by the bust. Exit from industries with sunk capital tends to be slow, because firms can often earn a higher return on sunk capital by staying in business (Caves and Porter, 1977; Siegfried and Evans, 1994).[8] The end result is an overcapitalised extraction and non-tradable sector with low earnings per unit of capital when compared to the pre-boom equilibrium.

Third, in spite of the contracted demand for labour during and after the bust, outward migration of labour may be constrained by personal or financial ties to the community (e.g. family commitments, mortgages, etc.), or by limited employment opportunities elsewhere. Outside employment opportunities will be limited if workers in boomtowns acquired skills during the boom era that are mismatched with

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[7] To the extent that wages are sticky and are slow to drop, we expect the employment effects of the bust to be more dramatic than the wage effects.

[8] Low-earning firms in the extraction and non-tradable sectors might also stay in business in hopes that a future upturn in oil prices would create another local oil boom. Theoretical and empirical work suggests that uncertainty about the prices of natural resources is a deterrent to firm entry or exit in resource-based economies (Barham *et al.*, 1989; Foltz, 2004).

opportunities in economies that are not experiencing an energy boom.[9] Stagnant outward migration would raise local unemployment relative to pre-boom conditions. While these impacts are caused in part by the influx of migrants, the weaker labour market conditions that result would also negatively affect long-term community residents in the labour market.

In the Sections that follow, we subject this theoretical reasoning to empirical tests by tracking the economic outcomes of western US boom-and-bust communities. Although we are not able to test precisely for each of the mechanisms through which community income was affected due to data limitations, we are able to estimate the overall impact of the boom-and-bust cycle and identify some channels through which it operated.

2. The Western Region Boom and Bust

Our empirical analysis focuses on a unique period of rapid US energy development in the American West. Figure 1 displays the annual number of new oil and gas wells from 1960 to 1998 in the 'Rocky Mountain' region, which includes Arizona, Colorado, Idaho, Montana, North Dakota, South Dakota, Utah, Wyoming and most of New Mexico.[10] Drilling activity was relatively stable from 1960 to 1974, ranging from 2,645 to 3,526 new wells with no obvious trend. Drilling began to trend upwards beginning in 1975, about one year after the first major world oil price spike in decades. Drilling peaked in 1981 with 7,426 new wells but crashed to 2,477 by 1986. From 1987 to 1998, drilling ranged from 2,780 to 4,475 new wells. A smaller regional boom in natural gas drilling began in about 1999–2000 and continued through much of the 2000s (Weber, 2012), which is why we conclude our analysis in 1998.

Based on Figure 1(*a*) we can see that the full boom-and-bust cycle roughly spanned 1975 to 1985, although oil prices first spiked in 1973. Importantly, the post-bust level of drilling was comparable to the level of pre-boom drilling. This enables a clean comparison of pre-boom and post-bust outcomes because energy development had settled back to its pre-boom state.

Although the boom-and-bust cycle affected other US regions, we focus on the western region because it has not yet been examined in the boom-bust literature, and because media portrayals of 1970s western boomtowns resemble media accounts of oil-fracking boomtowns today. Media outlets at the time were reporting on the high wages and surplus of available jobs in western boomtowns but also on the social disruptions taking place.[11] By 1976, US governmental agencies indicated that many Rocky Mountain communities were at risk of having their public infrastructure systems overwhelmed by the influx of incoming labour to support surging oil or gas development (Mountain Plains Federal Regional Council, 1976). Media writings also

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[9] See Pissarides and Wadsworth (1989) and Manacorda and Petrongolo (2006) for related analysis of regional labour markets, skill mismatch and worker mobility.

[10] The omitted New Mexico counties are Roosevelt, Lea, Eddy and Chaves.

[11] Scholars were cautioning that booms could afflict communities with increased pollution, crime, congestion and other ills (Jacquet, 2009), in part because public services might be stretched too thin (Cummings and Schulze, 1978). This is why Gilmore (1976, p. 535) asserted that the 'energy boom town in western US is apt to be a bad place to live'. These concerns are broadly expressed in a large sociology literature on energy booms. See, for example, Freudenburg (1992) and Jacquet (2009).

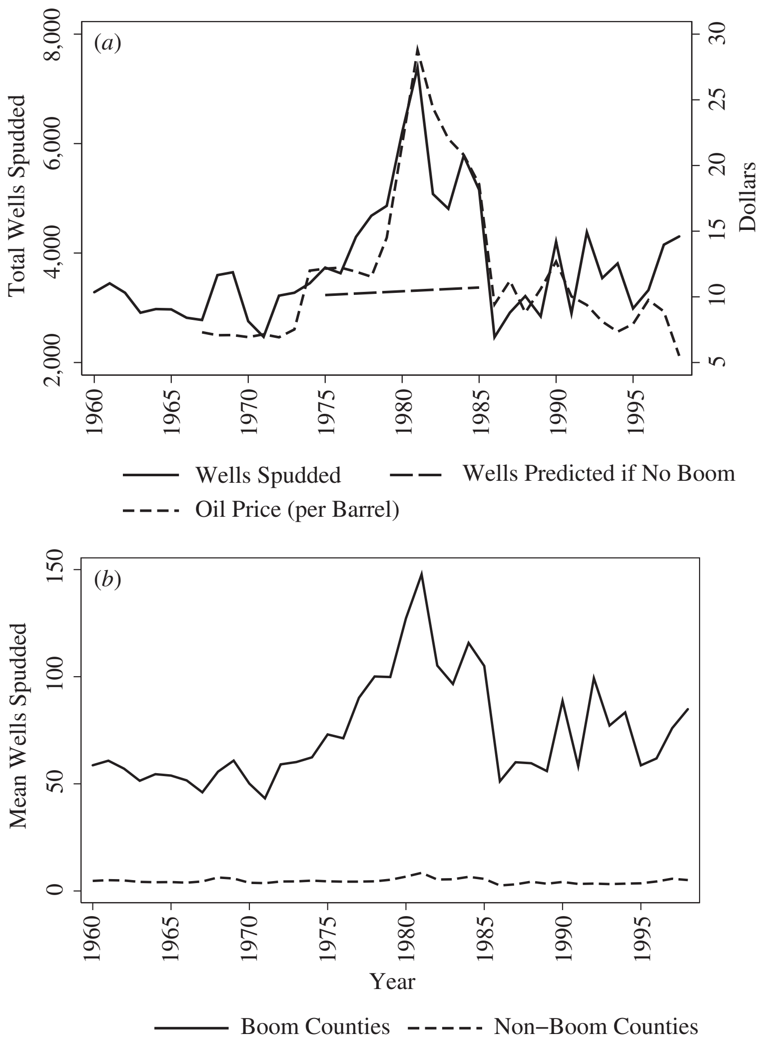

Fig. 1. *Trends in Drilling and Oil Prices*

Notes. The top panel presents the total number of wells spudded, oil prices and the predicted number of wells that would have been drilled absent the boom. The bottom panel presents the mean number of wells drilled in boom and non-boom counties.

hinted at how the energy boom was affecting agriculture through increased wage rates, which is consistent with Corden and Neary's (1982) Dutch Disease analysis.[12]

To put our later empirical estimates into context, it is important to emphasise that the western boom differed from earlier booms in other parts of the US in that it was characterised by fewer major discoveries. Although 1,849 new fields were discovered in

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[12] An article in *National Geographic*, for example reported that hourly wages for unskilled labour in the energy sector of a Wyoming boomtown exceeded cowhand ranching wages by about 4 to 1, which created incentives for cowboys to work in the energy sector and presumably put upward pressure on cowhand wages (Richards and Psihoyos, 1981).

the western region during 1975–85, only one of these fields – Wyoming's Hartzog Draw – is among the list of large US oil fields with ultimate recoveries exceeding 100 million barrels. By contrast, the early 1900s oil boom in the southern US involved the discovery of 69 large oil fields in the state of Texas alone.[13] Additionally, the southern oil boom was triggered by a series of successful discoveries (e.g. the gigantic Spindletop oil field), whereas the western boom of the 1970s and 1980s was brought about by a price spike that made an increased development and exploration in the west temporarily profitable. The sharp decline in world prices in the 1980s is likely to have caused a sharper and more dramatic bust than occurred in other booms that ended due to the declining probability of a new major field discovery.

3. Defining Boom Counties

To identify 'boom counties' that were exposed to unanticipated demand shocks for local extraction and prospecting, we use data from the iHS proprietary database on gas and oil wells in the western region. The database includes information on every well drilled in the region dating back to the beginning of the 1900s, including the well's location, permit date and spud date. We aggregate these data such that each observation reports the number of wells spudded in a county in a given year.

We focus on the number of new wells drilled, rather than the production of oil and gas, because drilling triggers the influx of capital and labour most often associated with boomtowns. A recent case study in Wyoming describes the labour requirements of a typical drilling rig, which are summarised in Table 1 (Jacquet, 2006). A typical drilling rig required 30 days of around-the-clock operation by 18–24 general labourers who alternated week-on/week-off scheduling. Another 8–10 engineers, managers and other specialised workers remained at the drilling site at all times, living in on-site mobile homes. On average, ten support workers fulfilled the remaining miscellaneous site needs. After drilling, there is a short, labour intensive completion stage before the well enters a less labour intensive production stage, which continues for the life of the well. As Jacquet (2006, p. 7) notes, the production tasks 'are relatively simple [and] a small number of workers can service a large number of wells', which is why we measure booms and busts based on the number of new wells drilled instead of the flow of oil and gas extracted. Overall, a typical well requires about 900 worker days to complete. Hence, the drilling of 200 wells, which is the primary threshold that we use to classify 'boom' counties (as we described below) would require approximately 180,000 worker days.

Our approach to defining a set of 'boom counties' is based on estimating the number of 'extra wells' drilled in each county as a result of the boom.[14] To estimate the

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[13] Information on the number of field discoveries by county was obtained from the US Energy Information Administration's Oil and Gas Field Code Master List. Information on the number of large oil fields was reported in the 1999 Oil and Gas Journal (Petzet and Beck, 1999) and has provided the basis for subsequent empirical studies (Michaels, 2011; Boyce, 2013).

[14] We use the 'extra wells' measure for defining boom counties because it captures the extent to which a county experienced a sudden and dramatic increase in drilling activity during the boom–bust era. Our main results, however, are robust to relying on measures of oil endowments to separate boom and non-boom counties.

Table 1

Average Estimated Workforce Requirements for a New Well in Wyoming

	Days	Workers	Worker-days
Well construction			
Well pad and access road construction	4.00	4.00	16.00
Rig transportation and setup	5.00	15.00	75.00
Drilling			
Roughnecks	31.75	12.00	381.00
Tool-pushers and supervisors	31.75	9.00	285.75
Completion			
Cementing	2.00	6.00	12.00
Stimulation	6.00	13.00	78.00
Perforating	3.00	5.00	15.00
Logging	1.00	3.00	3.00
Pipeline construction	4.00	6.00	24.00
Total per well	88.50	73.00	889.75

Source. Jacquet (2006).

'extra wells', we first produce a counterfactual estimate of how many wells would have been drilled in a county during the boom–bust period (1975–85) if the boom had not occurred. To generate the counterfactual estimates, we regress the actual number of wells drilled on a set of fixed effects for each county and a yearly linear time trend using only the data from the periods of relatively stable drilling that surrounded the boom period (i.e. 1960–74 and 1986–98), as shown in the following equation,

$$\textit{Wells Spudded}_{it} = \alpha_i + \delta \textit{year}_t + \varepsilon_{it}. \tag{1}$$

where i indexes counties, t indexes year and α_i represents the set of county fixed effects. We use these estimates to predict the level of drilling in each county during the boom–bust period if the boom had not occurred. The counterfactual number of wells in a county in a given year is calculated using the following equation,

$$\textit{Counterfactual Drilling}_{it} = \textit{Predicted drilling in } 1974_i \times (1 + \hat{\delta})^{t-1974}, \tag{2}$$

where predicted drilling in 1974 and $\hat{\delta}$ are both produced from the initial regression. The $\hat{\delta}$ estimate is positive and statistically significant but small in magnitude, at 0.04 additional wells per year.[15] The dashed line in Figure 1(*a*) shows our estimate of the total number of wells that would have been drilled between 1975 and 1985 if there had not been a boom.

We calculate 'extra wells' by subtracting the counterfactual estimate from the actual wells drilled such that $\textit{Extra Wells}_{it} = \textit{Wells Spudded}_{it} - \textit{Counterfactual Drilling}_{it}$. We then define 'boom counties' as the set for which the total number of extra wells during the boom period exceeds 200. This cut point corresponds to 35 of 356 of counties being classified as boomtown; these 35 counties clearly had much higher mean levels of drilling during 1975–85, as displayed in Figure 1(*b*).

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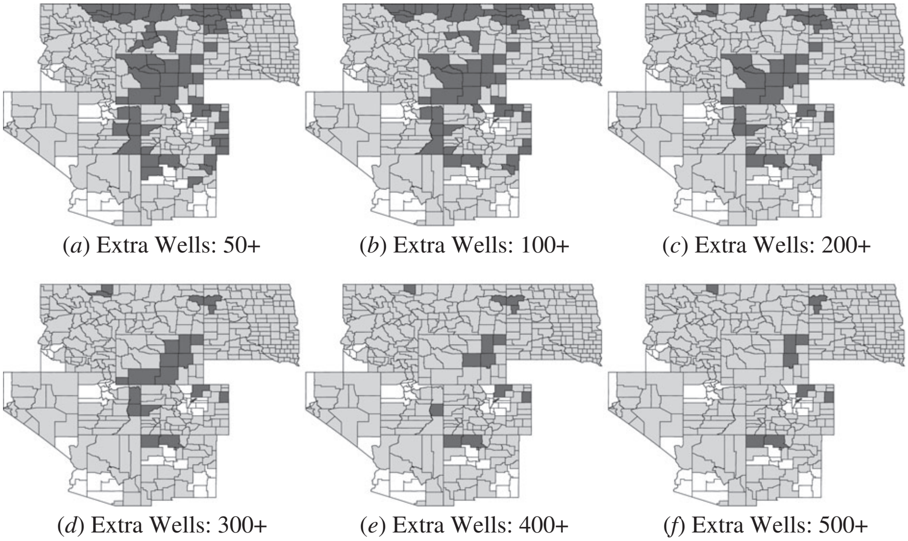
[15] Our results are robust to alternative methods of computing counterfactual drilling, including the use of a more flexible model that allows counties with large oil endowments have different time trends than counties lacking such endowments.

Although this binary measure of 'boom' and 'non-boom' status sacrifices detail relative to basing the analysis on the continuous number of estimated extra wells, the binary-variable approach has advantages. First, it makes it easier to study the dynamic effects of the boom-and-bust cycle using transparent, graphical comparisons of boom and non-boom counties. Second, our approach avoids making subjective decisions about how to model non-linear effects of drilling on outcomes. Third, our approach is consistent with the literature on booms and busts, which also relies on binary indicators of boom locations (Black *et al.*, 2005; Marchand, 2012; Weber, 2012).

Because the choice of 200 wells as the boom threshold is subjective, we examine alternative definitions of boom counties as Figure 2 illustrates. As the threshold required to be classified as a boom county increases, the number of counties identified as boom counties naturally decreases. As we will discuss in Section 5, our main empirical results are robust to these alternative thresholds for boom counties and to a continuous definition of boom status, in addition to thresholds that normalise for a county's population and land area.

Whether or not a county exceeds a boom threshold is closely related to its exogenous geologic endowments as shown in Figure 3. Figure 3(*a*) compares the presence of a large oil field with ultimate oil recovery exceeding 100 million barrels across boom and non-boom counties. About 37% of boom counties overlaid large oil fields compared to 9% for the non-boom counties. Figure 3(*b*) compares the mean number of oil and gas fields, which is more than thirteen times larger for the boom counties. These comparisons are consistent with other studies, which also show that boom 'treatment' is largely determined by geologic endowments (Black *et al.*, 2005;


(*a*) Extra Wells: 50+ (*b*) Extra Wells: 100+ (*c*) Extra Wells: 200+

(*d*) Extra Wells: 300+ (*e*) Extra Wells: 400+ (*f*) Extra Wells: 500+

Fig. 2. *Boom Counties*

Notes. Extra wells refers to the estimated number of wells drilled in a county over the 1975–85 boom-and-bust period. The darkly shaded counties are the counties that exceed the corresponding thresholds of extra wells, as indicated by the labels. The counties without shading are omitted from the sample.

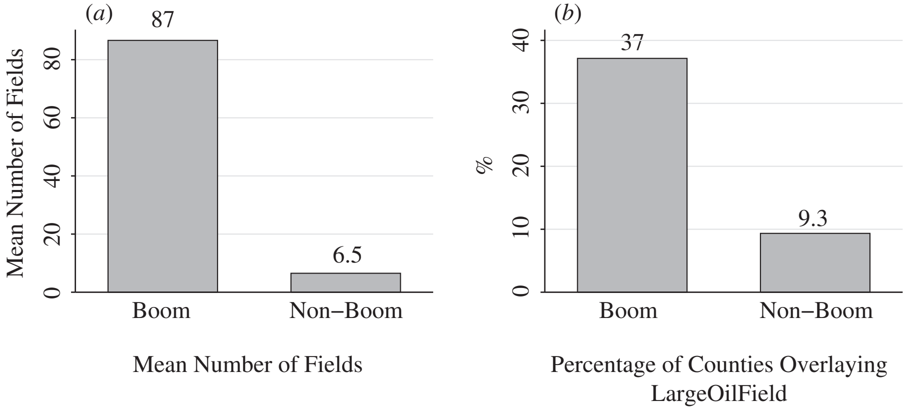


Fig. 3. *Comparison of the Presence of a Large Oil Field and the Number of Oil and Gas Fields across Boom and Non-boom Counties*

Notes. The data on the presence of oil fields exceeding 100 million barrels of ultimate recovery come from the 1998 *Oil and Gas Journal.* The fields data express the cumulative number of oil and gas fields discovered since the 1800s and come from the US Energy Information's Oil and Gas Field Code Master List.

Weber, 2012). In our case, the 1970s and 1980s world oil price spikes interacted with local endowments to generate local drilling booms. We examine the impacts on local economies in the following Sections.

4. Economic Variables and Descriptive Statistics

The county-level data on economic activity come from the Bureau of Economic Analysis (BEA) and include information on population, and various employment and income measures. For all measures, data are available from 1969 to 1998. In addition to being the time period that best isolates the effects of the 1970s and 1980s boom, focusing on these years is convenient because sector data based on the Standard Industrial Classification (SIC) system, which was the system employed in government record keeping through the mid-1990s, are available primarily during the range that we have selected.[16]

We merge the well data with the economic data to form the county-level annual panel dataset. The entire dataset consists of 11,730 total observations and includes information on 391 counties in the Rocky Mountain region over 30 years.[17] However, we omit 35 urban counties from the analysis which reduces the number of observations to 10,680.[18] We omit the urban counties because they may not be good counterfactuals

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[16] Industrial classification is currently based on the North American Industry Classification System (NAICS), which began in 1997.

[17] We exclude Lapaz, AZ and Yuma, AZ, from the sample because Lapaz was formed by separating from Yuma in 1983. We exclude Cibola, NM and Valencia, NM, from the sample because Cibola was formed by separating from Valencia in 1981.

[18] Data on whether a county is an urban or rural area were obtained from the National Center for Health Statistics' Urban-Rural Classification Scheme for Counties. We code any county classified as a medium or large metropolitan as an urban area. These counties overlap the Reno, Las Vegas, Boise, Salt Lake, Phoenix, Denver and Albuquerque metropolitan areas.

for rural boom counties and to follow precedent from other boom-and-bust studies (Black *et al.*, 2005; Marchand, 2012; Weber, 2012). We convert all income and earnings measures to 1980 dollars using the CPI for the western region of the US.

Summary statistics are presented in Table 2. The variables fit in four basic categories, which are drilling and endowments, employment, proprietors and income. In terms of drilling and endowments, 11 wells were spudded during the average year in the average county and we estimate that, during the boom, the average county spudded two 'extra' wells per year (the majority spudded zero). The time variation in wells spudded arises

Table 2

Summary Statistics

Variable	Mean	SD	Minimum	Maximum	Observation
Panel (a): drilling and endowment					
Wells spudded	11.19	47.62	0	1,473	10,680
Extra wells	1.81	14.26	−148	446	10,680
Boom county	0.10	0.30	0	1	10,680
Overlays large oil field	0.06	0.25	0	1	10,680
Number of oil and gas fields	14.39	39.06	0	445	10,680
Panel (b): employment					
Population	16,133	22,525	202	172,057	10,680
Total employment	8,050	11,860	80	121,913	10,680
Mining employment	348	774	0	10,331	6,701
Agricultural employment	111	167	0	2,404	8,658
Construction employment	491	811	0	6,567	10,106
Manufacturing employment	625	1,223	0	13,704	9,607
Retail employment	1,388	2,260	12	22,173	10,634
Service employment	1,872	3,324	10	37,948	10,174
Transportation employment	415	708	10	7,444	9,705
Panel (c): proprietors					
Number of farm proprietors	499	360	0	3,904	10,680
Number of NF proprietors	1,347	2,029	14	18,963	10,680
Panel (d): Income					
Total income (1,000s)	148,905	222,070	1,145	2,021,509	10,680
Total income *per captia*	9,023	2,193	2,492	28,458	10,680
Total wages (1,000s)	75,799	126,491	372	1,361,466	10,680
Total wages *per capita*	4,037	3,704	889	96,954	10,680
Wage earn. per wage job	10,943	2,522	6,179	26,318	10,680
Div/Int/Rent Inc. (1,000s)	29,220	45,149	207	538,515	10,680
Div/Int/Rent Inc. *per capita*	1,928	849	131	13,573	10,680
Pers. Curr. trans. (1,000s)	19,993	30,792	98	355,638	10,680
Pers. Curr. trans. *per capita*	1,266	429	237	3,165	10,680
Unemployment compensation (1,000s)	820	1,210	0	19,156	9,218
Unemployment compensation *per capita*	47	37	0	541	9,218
Farm proprietor income (1,000s)	6,266	10,495	−30,968	185,948	10,680
Farm proprietor income *per capita*	861	1,401	−4,492	15,968	10,680
Average farm proprietor income	10,966	15,749	−52,082	770,559	10,584
NF proprietor income (1,000s)	13,362	19,788	49	213,783	10,680
NF proprietor income *per capita*	864	412	77	4,177	10,680
Average NF proprietor Inc.	10,523	4,431	1,051	51,133	10,680

Notes. The data sources for panel (*a*) are the iHS wells database, the 1998 Oil and gas journal and the US energy information's 2013 oil and gas field code master list. The data source for panels (*b*), (*c*) and (*d*) is the Bureau of Economic Analysis.

almost exclusively from boom counties as shown in Figure 1(*b*). The statistics on endowments relate to Figure 3 and indicate that 23 out of 356 counties overlay large oil fields and the number of all fields averaged 14 with a maximum of 445.

Turning to panel (*b*), we note that population ranges from a minimum of 252 to maximum of 172,057 with a mean of 16,133 demonstrating the relatively rural nature of our sample. Because the population range is large, we include robustness checks that exclude counties in the lower and upper tail of the population distribution, as we describe in Section 3. For some observations, the BEA did not report employment for some sectors to avoid disclosure of confidential information or for other reasons. The omission of data results in an unbalanced panel for some variables, with the mining sector having the lowest number of observations at 6,701. Of the sectors, mining sector employment should be most directly impacted by oil and gas drilling because this sector comprises establishments that extract and/or explore for liquid minerals, such as crude petroleum, and gases, such as natural gas.[19] The other sectors can be divided into those that produce 'non-tradable' goods and services that are primarily consumed locally, and those that produce 'tradable' goods that are primarily consumed non-locally. The non-tradable sectors include services, retail, construction and transportation and the tradable sectors are manufacturing and agriculture.

Panel (*c*) shows the number of local proprietors that are sole proprietors, partnerships and tax-exempt cooperatives. These are predominantly small businesses, and are distinct from corporations, which are typically much larger. The BEA divides the number of proprietors into non-farm (NF Proprietors) and farm (Farm Proprietors). These categories are convenient for our analysis because farm output is tradable but many non-farm proprietors produce non-tradable goods (e.g. restaurant owners, construction companies etc.). On average, there were many more non-farm proprietors – 1,347 compared to 499 – but farm proprietors comprise a large part of economic activity in some farm-based counties in our sample.

Panel (*d*) shows statistics for income, both in total and *per capita*, for the main categories reported by the BEA.[20] Wage and salary earnings (Total Wages) comprise the largest proportion of overall earnings followed by dividend, interest and rental income. The latter category includes royalties received by persons for rights to natural resources, including oil and gas. The other components of income are personal current transfers, which includes unemployment compensation, social security and welfare payments, and proprietor net earnings or profits. We highlight the unemployment compensation in our study as a proxy for unemployment data, which are not available at the county-level for our full study period.[21] The final component of

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[19] Some government datasets, such as the County Business Patterns data, report information on employment in the oil and gas subsector but the data are not reported in a large number of cases due to data disclosure policies, making it unusable for our purposes.

[20] In the BEA data, wages and salaries are recorded by place of work but overall incomes – and the other components of incomes – are recorded by place of residence. In a few isolated instances, this can lead to wages exceeding total income for a particular county.

[21] County-level unemployment data are available from 1975 to 1996 from Haines (2010). During this period, the annual correlation between total unemployment and total unemployment compensation across counties in our sample ranges from 0.87 to 0.94. The annual correlation between unemployment rates and unemployment compensation per person ranges from 0.53 to 0.71.

income is proprietor profits, which can be negative and often are for farm proprietors.[22]

Figure 4 presents initial evidence on the effects of the boom-and-bust cycle by comparing trends in the means of key outcomes across boom and non-boom counties. For most outcomes, the pre-boom trends in means are similar across the two types of counties. The pre-boom trends were similar for income *per capita* and the unemployment compensation variables, even though the pre-boom movement in means was erratic on a year-to-year basis. In the case of *per capita* income, the gap between the two means did not begin to grow until about 1975 and the 1972–3 increase was experienced region wide.[23]

The post-1974 time paths of the means shown in Figure 4 preview some of our main empirical findings. During the boom period, as drilling increased, the boom counties experienced a relative expansion across all the population, employment and income outcomes. After the peak of the boom, which occurred in the early 1980s, the boom counties experienced a relative contraction across these measures and, by the late 1990s, the mean differences between the two groups returned to levels close to those of the pre-boom period. The means for unemployment compensation trended similarly across the two sets of counties until the bust, after which the boom counties experienced a relative increase in unemployment compensation that persisted through the end of the sample. Focusing on income *per capita*, the boom county economies appeared to be only equally as healthy as those of the non-boom counties in 1998, despite starting from a healthier relative position pre-boom.

5. Empirical Estimation and Results

5.1. *Estimation Strategy*

We estimate a series of regressions to evaluate the differences between boom and non-boom counties formally across time. All regressions are based on a fixed effects model of the general form,

$$Outcome_{it} = \boldsymbol{\alpha}_i + \gamma_t + \boldsymbol{\lambda}_t Boom\ County_i \times Time\ Period_t + \varepsilon_{it} \tag{3}$$

where i indexes counties; t indexes years; $\boldsymbol{\alpha}_i$ is a vector of county-specific intercepts that control for time-invariant differences across counties; γ_t is a vector of year effects that control for the time shocks experienced uniformly by all counties; $\boldsymbol{\lambda}_t$ is a set of coefficients on the interaction terms of the boom county indicator variable and a dummy variable corresponding to a year, or grouping of years; and ε_{it} is a normally distributed error term.

The set of outcome variables include each variable in Table 2, with the exception of extra wells, the boom county indicator and our two measures of endowments. For all outcome variables except wells spudded and proprietor income, we employ a log-linear

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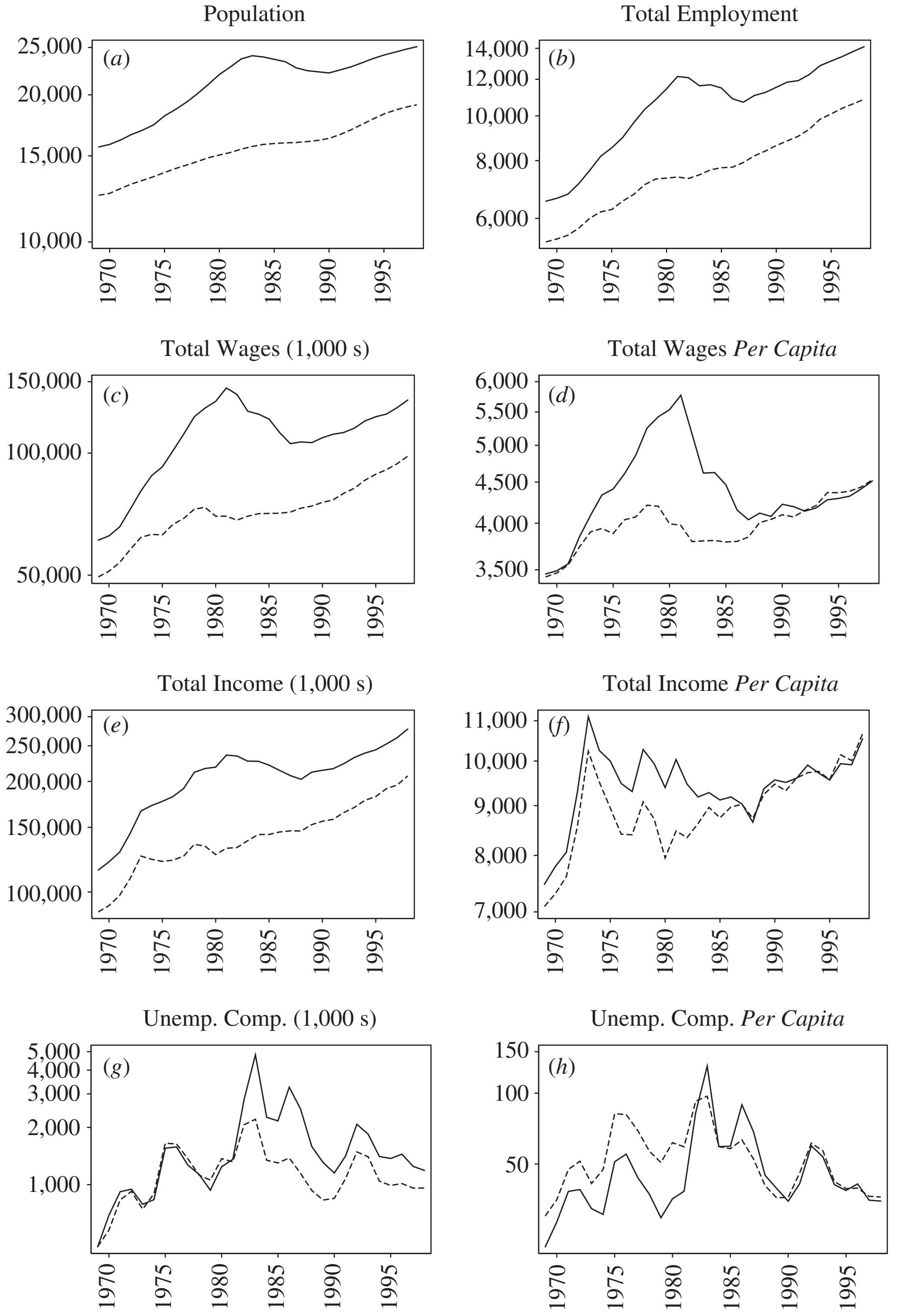
[22] Proprietor income represents current production income and is not, strictly speaking, a pure measure of economic profits because it includes the imputed earnings of small business owners who live off the proceeds without paying themselves a salary or charging interest on funds they have loaned to their businesses.

[23] The mean *per capita* incomes in both sets of counties spiked during 1972–3, due to a general boom in the prices of several commodities ranging from agricultural outputs (food and fibres) to metals but generally pre-dating the oil price spike of late 1973 (Cooper *et al.*, 1975).



Population

Total Employment

Total Wages (1,000 s)

Total Wages *Per Capita*

Total Income (1,000 s)

Total Income *Per Capita*

Unemp. Comp. (1,000 s)

Unemp. Comp. *Per Capita*

Fig. 4. *Mean Values of Key Outcomes by County Type, 1969–98*
Note. The solid lines represent boom counties and the dashed lines represent non-boom counties.

specification which enables the best fit of the data. We do not log the wells spudded variable because it often takes a value of zero, and we do not log proprietor income because it takes a negative value in 2,029 occurrences.[24] We cluster the standard errors at the county level to correct for the possibility that serial correlation in within-county errors has overstated the precision of our estimates (Bertrand *et al.*, 2004; Cameron and Miller, 2013).

We estimate two versions of (3), and these models differ only in the time periods included in the set of interaction terms. In the 'annual' model, we include interaction terms for each year except 1969. In this model, the coefficients on the interaction terms indicate the average difference between boom counties and non-boom counties in the corresponding year relative to the difference in 1969. In the 'time-period' model, we consider five time periods based on different stages of the boom-bust era: the pre-boom (1969–74), the early boom (1975–9), the peak boom (1980–1), the bust (1982–5) and the post-bust (1986–98). We omit the pre-boom era interaction term from the regression estimates. Hence, each coefficient indicates the average difference between boom and non-boom counties in each time period, relative to the pre-boom era. The annual model highlights the dynamics of the boom-and-bust cycle in detail, which facilitates graphical presentation (we present results for primary outcomes in Figure 3 and for other outcomes in Figures A1, A2, A3 and A4 in the Appendix). The time period model enables more concise presentation of results and we report these estimates in Table 3.

The validity of the difference-in-differences approach depends on the assumption that economic trends in non-boom counties provide a valid counterfactual for the trends that would have occurred in boom counties absent the boom. This assumption is questionable if boom and non-boom county economies were on different trajectories prior to the boom, or if trends in non-boom counties were affected by the boom and bust, due to supplying boom counties with labour and capital. The evidence in Figure 4 allays concerns about pre-boom trends. It shows that outcomes in boom and non-boom counties were on similar trajectories until at least 1973, when the boom was triggered by the spike in oil prices (see Figure 1(*a*)).[25] With respect to the possibility that the boom impacted economic trends in non-boom counties, it is worth noting that boom counties comprised only 35 of 356 counties in our sample and only 12% and 14% of the region's 1969 and 1980 population base respectively. The relatively small size of the booming areas implies that any impact of the boom on non-boom counties is limited, even if one assumes that the entire influx of labour and capital into boom counties came from within the Rocky Mountain region rather than from elsewhere in the US Turning to evidence on this issue, Figure 4 shows no indication that

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[24] Farm proprietor income is often negative but non-farm proprietor income is always positive. We log neither in order to enable clearer comparisons across the two types of business profit measures. Unemployment compensation is only zero for 21 observations, so we log it at the expense of losing 21 observations in our regression analysis.

[25] For most of our empirical analysis, we assume the boom started in 1975 rather than 1973 because 1975 marks the first year during which the number of wells spudded first began an obvious upward trend on a region-wide basis. There is some evidence that certain outcomes diverged as early as 1973 and our robustness checks show that the main results are equivalent if we instead assume the boom began in 1973 rather than 1975 as we discuss below.

Table 3

Estimated Difference Between Boom Counties and Non-boom Counties Relative to Pre-boom Difference

Dependent variable	Wells spudded	ln(pop.)	ln(total emp.)	ln(mining emp.)	ln(ag. emp.)	ln(const. emp.)	ln(man. emp.)	ln(retail emp.)	ln(service emp.)	ln(trans. emp.)
Boom × early boom period	23.98***	0.02	0.07***	0.39***	0.05	0.13**	−0.02	0.05*	0.06**	0.06**
	(7.50)	(0.02)	(0.02)	(0.08)	(0.07)	(0.06)	(0.06)	(0.03)	(0.03)	(0.03)
Boom × peak boom period	72.17***	0.10***	0.19***	0.79***	0.06	0.31***	−0.06	0.13***	0.18***	0.24***
	(12.53)	(0.04)	(0.04)	(0.15)	(0.08)	(0.08)	(0.08)	(0.04)	(0.05)	(0.05)
Boom × bust period	41.95***	0.13***	0.18***	0.72***	0.13	0.28***	−0.01	0.15***	0.15***	0.23***
	(9.36)	(0.04)	(0.04)	(0.14)	(0.09)	(0.08)	(0.09)	(0.04)	(0.06)	(0.06)
Boom × post-bust period	8.09	0.04	0.04	0.18	0.02	−0.10	0.02	0.05	0.03	−0.03
	(12.42)	(0.05)	(0.05)	(0.14)	(0.10)	(0.07)	(0.10)	(0.06)	(0.07)	(0.06)
R^2 (within)	0.07	0.12	0.34	0.11	0.56	0.23	0.16	0.28	0.63	0.23
Observations	10,680	10,680	10,680	5,759	8,614	10,104	9,438	10,634	10,174	9,705

Dependent variable	ln(no. of farm prop.)	ln(no. of NF prop.)	ln(tot. income)	ln(tot. income *per capita*)	ln(tot. wages)	ln(tot. wages *per capita*)	ln(wage earn, per wage job)	ln(div., int., rent, Inc.)	ln(div., int., rent, inc. *per capita*)	ln(pers. curr. trans.)
Boom × early boom period	0.02	0.06***	0.06*	0.05**	0.13***	0.11***	0.04***	0.03	0.01	−0.03**
	(0.02)	(0.02)	(0.03)	(0.02)	(0.03)	(0.03)	(0.01)	(0.02)	(0.02)	(0.01)
Boom × peak boom period	0.02	0.10***	0.19***	0.10***	0.36***	0.26***	0.12***	0.07**	−0.02	−0.01
	(0.04)	(0.03)	(0.06)	(0.03)	(0.07)	(0.06)	(0.02)	(0.03)	(0.03)	(0.02)
Boom × bust period	0.02	0.15***	0.14**	0.01	0.32***	0.18***	0.09***	0.10***	−0.03	0.05*
	(0.05)	(0.04)	(0.06)	(0.02)	(0.07)	(0.05)	(0.02)	(0.03)	(0.03)	(0.03)
Boom × post-bust period	0.07	0.02	−0.02	−0.06***	0.06	0.02	−0.00	−0.03	−0.07**	0.05
	(0.05)	(0.06)	(0.06)	(0.02)	(0.06)	(0.03)	(0.02)	(0.05)	(0.03)	(0.04)
R^2 (within)	0.04	0.55	0.31	0.39	0.19	0.15	0.33	0.75	0.82	0.83
Observations	10,584	10,680	10,680	10,680	10,680	10,680	10,680	10,680	10,680	10,680

Table 3

(*Continued*)

Dependent variable	ln(pers. curr. trans, *per capita*)	ln(unemp. comp.)	ln(unemp. comp. *per capita*)	Farm prop. inc. (millions)	Farm prop. inc. *per capita* (100s)	Avg. farm prop. inc. (100s)	NF prop. inc. (millions)	NF prop. inc. *per capita* (100s)	Avg. NF prop. inc (100s).
Boom × early boom period	−0.05***	−0.19***	−0.20***	−2.26*	−1.23	−27.80*	3.51**	0.89***	5.74*
	(0.02)	(0.07)	(0.06)	(1.37)	(1.57)	(14.88)	(1.67)	(0.28)	(2.98)
Boom × peak boom period	−0.11***	−0.11	−0.21**	−4.00	−1.05	−29.03*	3.07**	0.07	−1.81
	(0.02)	(0.09)	(0.09)	(3.30)	(2.67)	(17.19)	(1.19)	(0.30)	(3.54)
Boom × bust period	−0.08***	0.57***	0.45***	−5.68*	−3.80*	−53.12***	2.08**	−0.66*	−12.32***
	(0.02)	(0.10)	(0.08)	(3.02)	(2.26)	(14.06)	(0.90)	(0.35)	(4.70)
Boom × post-bust period	0.01	0.35***	0.33***	−3.00	−2.60	−21.56	0.02	−1.62***	−19.81***
	(0.02)	(0.09)	(0.07)	(2.21)	(2.15)	(14.92)	(2.10)	(0.51)	(7.10)
R^2 (within)	0.87	0.41	0.41	0.31	0.31	0.27	0.12	0.36	0.66
Observations	10,680	9,197	9,197	10,680	10,680	10,584	10,680	10,680	10,680

Notes. Estimates are based on equation (3). The coefficients represent the estimated difference between boom counties and non-boom counties relative to difference over the pre-boom era, defined here as 1969–74. The early boom is 1975–9. The peak boom is 1980–1. The bust is 1982–5. The post-bust is 1986–98. Standard errors are reported in parentheses and clustered by county. *, **, and *** indicate significance at the 10%, 5% and 1% levels respectively.

populations in non-boom counties broke substantially from their pre-boom trends during the boom-and-bust cycle. Although these indications suggest the impacts of the boom on non-boom counties were diffuse and minor, we also include a robustness check in our empirical analysis that omits the subset of non-boom counties that were most likely to be impacted by the boom (i.e. the set of non-boom counties that are spatially adjacent to the booming counties).

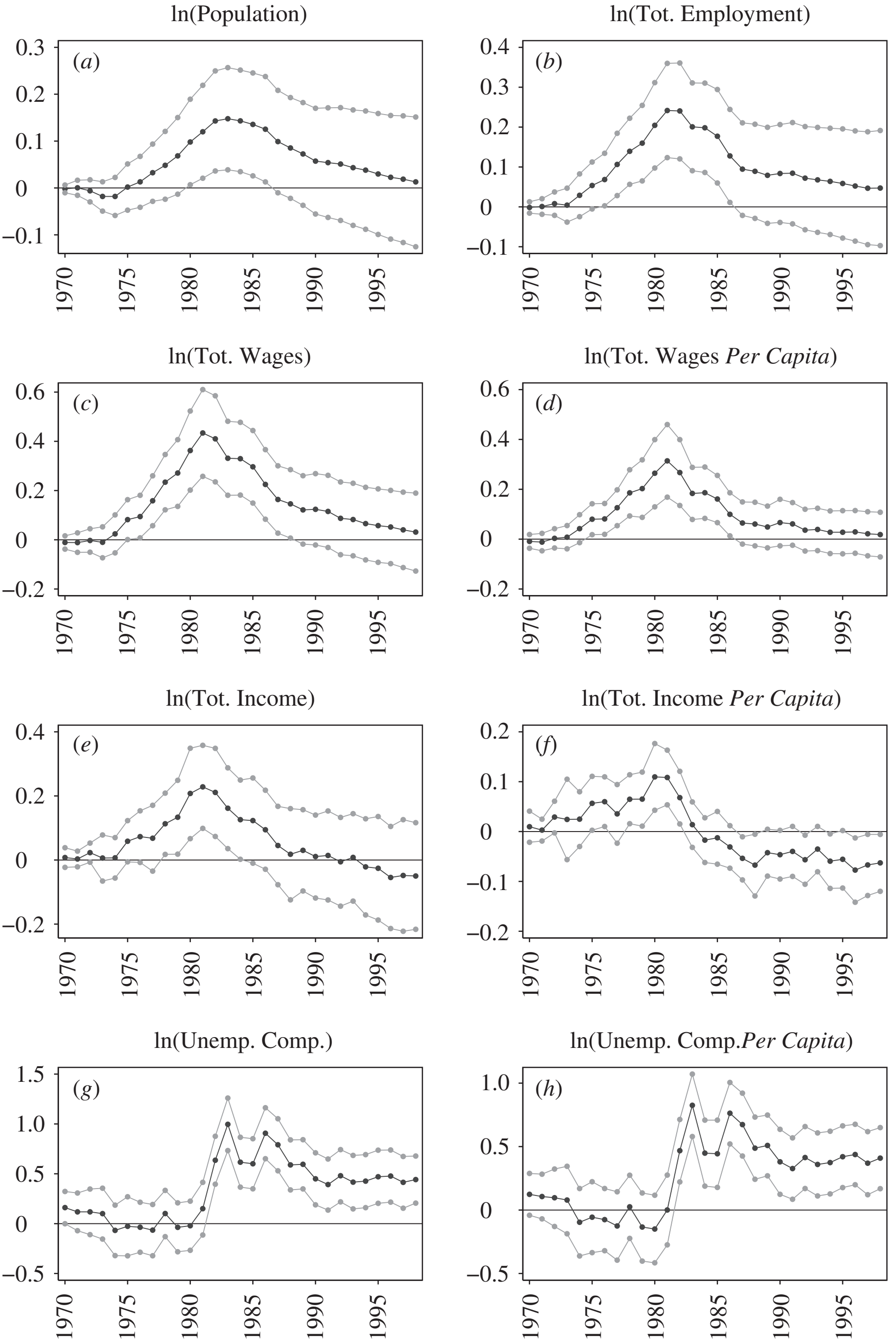
5.2. *Boom Period Estimates*

To give context to the estimates, recall our boom-period predictions from the analytical framework of Section 1. First, boom counties will be characterised by rising wages, population and employment in extraction and non-tradable sectors and increased landowner lease income. Second, firms operating in extraction and non-tradable sectors at the onset of the boom will earn increased profits initially but entry of new firms will dissipate excessive profits over time. Third, profits in the tradable sector may be negatively impacted, due to Dutch Disease forces, if rising wage costs dominate any agglomeration benefits.

With respect to the first set of predictions, Figure 5 shows that wages, population and employment in boom counties increased with the boom. Wages per person were relatively high from 1975 until 1986, peaking in 1981 at a 31% increase. Based on the point estimates, population first increased in 1976, temporally lagging behind the wage increases by one year and peaking in 1983 at 15%. This dynamic suggests that higher wages were offered to attract labour to booming areas. Employment followed a pattern similar to population, peaking in 1981 at 24%. The empirical results also show a relative increase in dividend, interest and rental income during the peak boom period. The increased income from these sources is likely to have resulted from oil and gas royalties but also from increased demand for land for housing.

Other results indicate that the employment expansion was driven by augmented labour demand in the extraction (i.e. mining) and non-tradable goods sectors. Relative employment in the mining sector increased immediately in 1975 (by 29%) and peaked in 1981 at 89%. The construction, services, retail and transportation sectors also experienced increased relative employment but to a lesser degree (see Table 3) and with somewhat of a temporal lag behind mining sector employment increases (see Figures A1 and A2). In summary, the boom most directly impacted the extraction sector but it also had positive multiplier effects on non-tradable sectors.

With respect to the second set of predictions, Table 3 shows how the relative average income of non-farm proprietors (which mainly consist of small firms in the non-tradable and extraction sectors) briefly expanded during the early boom period but contracted to pre-boom levels by the peak boom period. By 1976, the windfall profits per non-farm proprietor had vanished (see Figure A4(*c*)), probably due to a combination of entry by competing businesses and rising wages that had to be paid to labour. With respect to competing businesses, the number of non-farm proprietors was elevated throughout the entire boom-and-bust periods, peaking at 18% above pre-boom conditions by 1983 (see Figure A2(*d*)).



ln(Population)

ln(Tot. Employment)

ln(Tot. Wages)

ln(Tot. Wages *Per Capita*)

ln(Tot. Income)

ln(Tot. Income *Per Capita*)

ln(Unemp. Comp.)

ln(Unemp. Comp.*Per Capita*)

Fig. 5. *Estimated Difference Between Boom Counties and Non-boom Counties Relative to Difference in 1969*
Notes. Estimates are based on equation (3). The black lines represent the coefficients on the interaction terms and the gray lines represent the 95% confidence intervals.

To test whether or not the profits of firms producing tradable goods fell during the boom, we focus on the agricultural sector rather than manufacturing because we have data on farm proprietor profits but not on manufacturing profits. Table 3 shows that income per farm proprietor declined during the boom years, for example, by an average of −\$2,903 per year during the peak boom period. This loss is economically significant, as it is relative to the \$22,296 mean level of average proprietor income during the pre-boom years.[26] An explanation for these results that is consistent with Corden and Neary's (1982) model of Dutch Disease is as follows:

(*i*) the boom increased the wage rate that had to be paid for farm labour (including the wages of outside contractors); and
(*ii*) the higher input costs could not be passed to consumers because farm output was sold in non-local markets.

Evidence of the first condition is found in our estimates of rising wages per wage job during the boom, and the second condition was likely met for most farmers and ranchers in the Rocky Mountain region during the 1970s and 1980s. This explanation may seem difficult to reconcile with our other finding that agricultural employment did not fall during the boom (see Table 3 and Figure A1(*c*)) but the finding is compatible if demand for farm labour is wage inelastic in the short run, which is generally what a meta-study of elasticities concludes (Espey and Thilmany, 2000).[27]

In summary, the results show the boom positively affected wages, employment and the profits of firms in non-tradable and extraction sectors and it increased rental income. The boom negatively affected farm profits. The net effects on total and *per capita* income were positive. Total incomes increased by an average of 6% and 19% during the early and peak boom periods respectively (see Table 3). *Per capita* income increased to a lesser extent – by 5% and 10 % during the same periods – because the boom induced in-migration.

5.3. *Bust and Post-bust Period Estimates*

According to the analytical framework, the bust should first be felt in declining extraction sector employment and wages and then reverberate into the non-tradable sectors (i.e. construction, services and retail) in the form of falling employment due to multiplier effects. The empirical estimates bear out this dynamic. Mining employment began to decline from 1981–2 but employment in construction, retail, services and transportation did not begin to fall until 1982–3 (Figures A1 and A2 in the Appendix). Total employment receded through the rest of the bust period, along with total wages and wages *per capita* (see Table 3 and Figure 5(*c*) and (*d*)).

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[26] We scale some of the proprietor variables slightly differently than they are presented in the summary statistics so that the coefficients can all be presented on a page. To avoid confusion, units are reported in Table 3 in parenthesis with the variable names.

[27] Table 3 and Figure A1(*e*) in the Appendix, also indicate the boom did not affect employment in manufacturing, which is a sector that produces tradable goods. This result is similar to Carrington (1996) and Black *et al.* (2005) who also find small or no effects of booms on manufacturing employment in their studies of the Alaskan Pipeline and the Appalachian coal boom, respectively.

During the bust, population and employment levels started to decline but remained elevated relative to their pre-boom levels. However, the early signs of negative consequences that persisted beyond the bust were already emerging. Unemployment compensation spiked dramatically during the first year of the bust in 1981 (see Figure 5(*g* and *h*)). Meanwhile, while the number of non-farm proprietors remained elevated, average proprietor income fell below pre-boom levels. The downturn in profits is probably best explained by over-entry and over-capitalisation in boom-specific capital by local business proprietors who inaccurately anticipated that conditions experienced at the peak of the boom would persist for a longer time period.

Focusing now on the aftermath of the boom and bust (i.e. 1986–98), we turn to our most prominent findings, which are the effects on income *per capita* and unemployment compensation throughout the post-bust period. As Figure 5(*f*) indicates, *per capita* incomes continued to fall after the bust period and stayed at depressed levels throughout the post-bust era. Averaged over the entire 1986–98 period, the Table 3 coefficient indicates that incomes *per capita* fell 6% below relative pre-boom levels.[28] Over the same period, relative unemployment payments averaged 33% above pre-boom differences in *per capita* terms.[29] We expected a short-run transition period of weakened labour market conditions after the bust but the 17-year period of persistently high unemployment payments is surprising (see Figure 5(*h*)).

5.4. *Robustness of Key Findings*

Because these results on *per capita* income and unemployment compensation best summarise the persistent negative consequences of the boom, we subject each to a series of robustness checks before examining possible mechanisms. Table 4 shows results from 32 separate regression estimates of the time period model to evaluate the extent to which our key results are robust to different definitions of boom and non-boom counties, different sub-samples and different estimation techniques. For robustness checks that investigate different definitions of boom and non-boom counties, the thresholds used for classifying boom counties were chosen, in part, to make comparable the number of counties designated as boom counties under each model.[30]

Panels (*1*)–(*3*) present results based on different thresholds of boom and non-boom counties. Panels (*1*) and (*2*) employ thresholds of 100 and 300 extra wells respectively, which differs from our baseline threshold of 200 extra wells. Our results are qualitatively similar under these alternative definitions. Panel (*3*) employs

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[28] Estimates from the annual model, which we present in Figure 5(*f*) show no signs that income *per capita* was recovering even at the end of the sample. Additionally, income *per capita* remained depressed during the smaller, though non-negligible, increase in drilling in boom counties that occurred during the early 1990s (see Figure 1(*b*)).

[29] Although the unemployment compensation coefficients may seem out of sync with the positive employment coefficients in Table 3, the two sets of results are compatible because unemployment compensation is driven by changes in employment, or increased employee turnover, as opposed to the overall number of employed workers.

[30] The 100 well threshold (panel (1) of Table 4) yields the greatest number of counties classified as boom (54 counties), and the 300 well threshold (panel (2) of Table 4) yields the smallest number (20 counties). The number of boom counties under the baseline definition of 200 wells is 35.

Table 4

Robustness Checks

	Inc. *per capita*	UE compensation *per capita*		Inc. *per capita*	UE compensation *per capita*
Panel (1): threshold = 100 wells			*Panel (2): threshold = 300 wells*		
Boom × early boom period	0.03	−0.06	Boom × early boom period	0.07**	−0.23**
	(0.02)	(0.06)		(0.03)	(0.09)
Boom × peak boom period	0.08***	−0.05	Boom × peak boom period	0.15***	−0.21
	(0.03)	(0.08)		(0.03)	(0.13)
Boom × late boom period	0.00	0.49***	Boom × late boom period	0.02	0.39***
	(0.02)	(0.07)		(0.03)	(0.12)
Boom × bust period	−0.07***	0.44***	Boom × bust period	−0.05	0.37***
	(0.02)	(0.07)		(0.03)	(0.10)
Observations	10,680	9,197	Observations	10,680	9,197
Panel (3): total number of extra wells (100s)			*Panel (4): threshold = 1 well per 100 population*		
Wells (100s) × early boom period	0.01	−0.03**	Boom × early boom period	0.01	−0.11*
	(0.00)	(0.01)		(0.02)	(0.06)
Wells (100s) × peak boom period	0.02***	−0.03*	Boom × peak boom period	0.06**	−0.13
	(0.00)	(0.02)		(0.03)	(0.09)
Wells (100s) × late boom period	−0.00	0.06**	Boom × late boom period	−0.01	0.40***
	(0.00)	(0.03)		(0.02)	(0.08)
Wells (100s) × bust period	−0.01*	0.06**	Boom × bust period	−0.08***	0.36***
	(0.01)	(0.03)		(0.02)	(0.08)
Observations	10,680	9,197	Observations	10,680	9,197
Panel (5): threshold = 1 well per 15 square miles			*Panel (6): threshold = 1 well per 10 private square miles*		
Boom × early boom period	0.01	−0.11	Boom × early boom period	0.04*	−0.17**
	(0.02)	(0.08)		(0.02)	(0.07)
Boom × peak boom period	0.05	−0.16	Boom × peak boom period	0.07**	−0.22**
	(0.03)	(0.11)		(0.03)	(0.10)
Boom × late boom period**	−0.01	−0.40***	Boom × late boom period	−0.00	0.39***
	(0.03)	(0.09)		(0.03)	(0.09)
Boom × bust period	−0.09***	0.34***	Boom × bust period	−0.08***	0.31***
	(0.03)	(0.10)		(0.03)	(0.09)
Observations	10,680	9,197	Observations	10,680	9,197

Table 4

(Continued)

	Inc. *per capita*	UE compensation *per capita*		Inc. *per capita*	UE compensation *per capita*
Panel (7): drop quasi-boom (100–200 wells)			*Panel (8): drop boom-adjacent counties*		
Boom × early boom period	0.04*	−0.12*	Boom × early boom period	0.04*	−0.14**
	(0.02)	(0.07)		(0.02)	(0.07)
Boom × peak boom period	0.10***	−0.12	Boom × peak boom period	0.11***	−0.13
	(0.03)	(0.10)		(0.03)	(0.10)
Boom × late boom period	−0.00	0.52***	Boom × late boom period	0.00	0.54***
	(0.02)	(0.09)		(0.02)	(0.09)
Boom × bust period	−0.07***	0.43***	Boom × bust period	−0.07***	0.45***
	(0.03)	(0.08)		(0.03)	(0.09)
Observations	10,110	8,701	Observations	8,010	6,958
Panel (9): drop 1st and 10th population deciles			*Panel (10): boom = overlays large field*		
Boom × early boom period	0.04	−0.14**	Boom × early boom period	0.08***	−0.19***
	(0.03)	(0.07)		(0.03)	(0.06)
Boom × peak boom period	0.09**	−0.12	Boom × peak boom period	0.17***	−0.09
	(0.04)	(0.10)		(0.03)	(0.09)
Boom × late boom period	−0.01	0.48***	Boom × late boom period	0.03	0.52***
	(0.03)	(0.09)		(0.03)	(0.08)
Boom × bust period	−0.06**	0.39***	Boom × bust period	−0.04*	0.44***
	(0.03)	(0.09)		(0.02)	(0.06)
Observations	8,550	7,596	Observations	10,680	9,197
Panel (11): threshold = 40+ fields			*Panel (12): instrument = overlays large field*		
Boom × early boom period	0.04*	−0.11	Boom × early boom period	0.15***	−0.38***
	(0.02)	(0.07)		(0.03)	(0.09)
Boom × peak boom period	0.10***	−0.05	Boom × peak boom period	0.35***	−0.17
	(0.03)	(0.10)		(0.04)	(0.12)
Boom × late boom period	0.04**	0.49***	Boom × late boom period	0.07**	0.94***
	(0.02)	(0.08)		(0.03)	(0.10)
Boom × bust period	−0.05**	0.43***	Boom × bust period	−0.08***	0.79***
	(0.02)	(0.08)		(0.03)	(0.08)
Observations	10,680	9,197	Observations	10,680	9,197

Table 4

(*Continued*)

	Inc. *per capita*	UE compensation *per capita*		Inc. *per capita*	UE compensation *per capita*
Panel (13): instrument = number of fields			*Panel (14): state-year effects; 200 extra wells*		
Boom × early boom period	0.06***	−0.17***	Boom × early boom period	0.01	−0.09
	(0.02)	(0.06)		(0.02)	(0.06)
Boom × peak boom period	0.16***	−0.13*	Boom × peak boom period	0.04	−0.24**
	(0.03)	(0.08)		(0.03)	(0.10)
Boom × late boom period	0.07***	0.75***	Boom × late boom period	−0.04*	0.27***
	(0.02)	(0.06)		(0.02)	(0.08)
Boom × bust period	−0.08***	0.66***	Boom × bust period	−0.09***	0.20***
	(0.02)	(0.05)		(0.03)	(0.08)
Observations	10,680	9,197	Observations	10,680	9,197
Panel (15): state-year effects; 300 extra wells			*Panel (16): boom starts in 1973 (not 1975)*		
Boom × early boom period	0.03	−0.12	Boom × early boom period	0.04*	−0.14**
	(0.03)	(0.08)		(0.02)	(0.07)
Boom × peak boom period	0.07**	−0.26**	Boom × peak boom period	0.10***	−0.16
	(0.03)	(0.12)		(0.03)	(0.10)
Boom × late boom period	−0.03	0.17*	Boom × late boom period	0.00	0.46***
	(0.03)	(0.09)		(0.02)	(0.09)
Boom × bust period	−0.08***	0.18*	Boom × bust period	−0.06***	0.37***
	(0.03)	(0.09)		(0.02)	(0.08)
Observations	10,680	9,197	Observations	10,680	9,197

Notes. Each column within a panel reports the results from a regression based on equation (3). The dependent variables are reported in the very top row and each dependent variable is logged. The coefficients represent the estimated difference between boom counties and non-boom counties relative to the pre-boom difference. Panels (*1*)–(*6*) and panels (*10*)–(*11*) differ from the baseline specifications reported in Table 3 in terms of how boom counties are defined. Panels (*6*)–(*9*) differ from the baseline specifications because some counties are dropped from the main sample in each of these panels. Panels (*12*)–(*13*) employ instrumental variable estimation. Panels (*14*)–(*15*) add state–year interactions to baseline specification. Panel (*16*) treats 1969–72 as the omitted category instead of the baseline omitted category of 1969–74. *, **, and *** indicate significance at the 10%, 5%, and 1% levels respectively.

continuous, rather than discrete, boom county categorisation by interacting the number of extra wells drilled during the boom period with the five different time periods indicators. The results reinforce what we find using binary boom measures: more drilling has positive effects during the boom and negative effects after the bust. The post-bust coefficient of −0.01 in panel (*3*), for example, indicates that each additional 100 wells drilled is associated with a 1% decline in *per capita* income following the bust.

Panels (*4*)–(*6*) indicate the key findings are generally robust to definitions of boom counties that normalise the number of new wells by a county's population or land area. In panel (*4*), boom counties are defined as those with more than one extra well per 100 people, based on 1969 populations, provided the counties also had at least 100 extra wells drilled over the boom period. Panel (*5*) defines boom counties based on extra wells per square mile, whether publicly or privately owned, and panel (*6*) defines boom counties based on extra wells per privately owned square mile.[31]

Panels (*7*)–(*9*) employ sub-samples that omit certain counties from the set of counterfactual, non-boom counties. Panel (*7*) drops 'quasi-boom' counties from the sample; these are counties with substantial extra wells (100) but still fewer than our main threshold of 200. Panel (*8*) drops counties that are geographically adjacent to boom counties, which is an approach employed by the other county-level analyses of resource booms to mitigate spatial spillover effects from boom into non-boom counties (Black *et al.*, 2005; Michaels, 2011; Marchand, 2012; Weber, 2012).[32] This robustness check removes from the control group the set of non-boom counties whose labour and capital were most likely to have been re-allocated as a result of expansions in boom county economies. Panel (*9*) drops the two deciles with the least and most populated counties in our sample based on 1970 population. The resulting sub-sample is more uniform in population levels and hence less susceptible to outliers when compared to the entire sample.

Panels (*10*)–(*13*) estimate the model by distinguishing boom and non-boom counties based on raw endowments of oil and gas rather than drilling patterns. Panel (*10*) replicates the method of Michaels (2011), by classifying a county as a boom county if it overlays an oil field estimated to contain over 100 million bbl. of oil. In panel (*11*), boom counties are those overlaying at least 40 oil and gas fields, regardless of size. Panels (*12*) and (*13*) employ a two-stage least squares (2SLS) procedure. In panel (*12*), the first stage uses the presence of a large oil field to predict boom county status and panel (*3*) uses the number of fields. The first stage generates large F-statistics in both cases, because endowments are a good predictor of whether or not a county had 200 extra wells (see Figure 3). Panels (*10*)–(*13*) show that our key findings are robust to

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[31] Between panels (*5*) and (*6*), the private land normalisation procedure is likely to be more appropriate because some government owned land tends to be more difficult and costly to access for drilling (and because drilling on some public lands is prohibited). Cross-sectional regression of the amount of federally owned land and the amount of private land in a county on the number of extra wells drilled during the boom–bust era indicate drilling is significantly increasing in the amount of private land and is not related to the amount of government land. We find the same results if we change dependent variable to the number of wells ever drilled in a county. For these regressions, we employ 1984 data on federal government land holdings from the US Department of Interior, through its Payment in Lieu of Taxes (PILT) records.

[32] Marchand (2012) uses Canadian data and his spatial unit of observation is a Census division rather than a county.

estimation based on raw endowments, either in reduced form or through standard instrumental variable techniques.[33]

Panels (*14*) and (*15*) present results from a less restricted version of 3 that includes state-by-year effects. The state-by-year effects control for temporal shocks that are experienced commonly by all counties in a state, such as changes in state tax or spending policies, or state-wide shifts in demographics. We present results based on both the 200 and 300 extra wells threshold in panels (*14*) and (*15*) respectively. In this case, we favour the 300 wells threshold because it enables relatively more within-state variation in boom county status, particularly for the state of Wyoming (see Figures 2 (*c* and *d*)). The estimates indicate that boom counties experienced increases in income *per capita* during the boom era and decreases in income *per capita* after the bust, reinforcing our main findings.[34]

Finally, panel (*16*) shows that our key findings are robust to assuming the boom started in 1973, when oil prices first spiked, instead of in 1975 when drilling first expanded (see Figure 1). Panel (*16*) constitutes an important robustness finding because the comparative trends in boom and non-boom counties for some outcomes began to deviate around 1973 (see Figure 4), and the panel (*16*) results should reduce concern that our results are driven by contamination of the pre-boom control period (1969–74) used for Table 3.[35] Overall, the robustness checks indicate that the key inferences are generally insensitive to changes in specifications, samples and boom county definitions.

5.5. *Possible Mechanisms*

Our analytical framework highlights three channels that could have caused lower *per capita* incomes and high unemployment to persist through the post-bust period. These are:

(*i*) tradable sectors contracted during the boom and remained relatively contracted after the bust;
(*ii*) the boom induced local residents to over-specialise their investments towards boom-specific capital and skills; and
(*iii*) the boom induced selective migration of specialised labour and firms that did not exit after the bust.

Although we cannot precisely test each mechanism, our empirical results shed light on the relative contribution of each. With respect to tradable sectors, we note that farm profits did not remain statistically below pre-boom levels during the post-bust period (see Table 3), presumably because farm labour wages contracted back to pre-boom levels. Moreover, neither agricultural nor manufacturing employment contracted

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[33] Counties overlaying large oil fields experienced a 17% peak boom period expansion in income *per capita* (panel (*10*)) compared to a 10% expansion for our primary set of boom counties (see Table 3).

[34] The coefficient on income *per capita* and the peak boom time period is not significant in panel (*14*), reflecting the reduced power of the estimation from the inclusion of a large number of non-parametric controls.

[35] This issue is less of a concern for the estimates from the annual specification presented in Figure 3 because all differences are relative to 1969.

during the post-bust period. We conclude that the boom did not in general crowd-out tradable sectors in the post-bust period.

By contrast, our results suggest that boom counties did become overcapitalised with boom-specific capital and skills in the non-tradable and extraction sectors. The *per capita* profits of non-farm businesses dropped on average to \$166 below pre-boom differences during the post-bust era (Table 3). This contraction probably resulted from two forces. First, *per capita* demand for extraction sector services and non-tradable goods contracted – in the latter case, because income per person was falling from sources such as oil royalties and mining sector wages, and because the bust may have triggered more cautious consumption of non-tradables. Second, the skill and capital acquired by the pool of local proprietors during the boom (e.g. operating boomtown restaurants, owning equipment to service mobile home parks, organising the transportation of drilling equipment etc.) became sunk and this limited the extent to which proprietors could change practices or relocate their businesses during the post-bust era.[36] The increases in unemployment compensation also suggest increased joblessness or job loss due to local workers acquiring boom-specific skills that became mismatched with employment opportunities in post-boom economies.[37]

The third possibility – that the poor economic performance of boom counties after the bust simply reflects selective migration – seems inconsistent with the finding that the overall population of boom counties eventually returned to pre-boom levels during the post-bust period while income *per capita* and unemployment payments did not (see Table 3 and Figure 5). It is possible, however, that some people who were local residents prior to the boom departed, while other immigrants stayed, causing a new demographic composition of boom counties.

To further assess the 'selective migration' explanation, we examine changes in the demographic composition of boom counties during and after the boom using data on age and gender composition that are available by decade, for 1970, 1980, 1990 and 2000 from Haines (2010). Table 5 shows the decadal differences in median age and the percent of males in boom and non-boom counties, relative to the differences in 1970, based on the following model,

$$Demographic_{it} = \alpha_i + \gamma_t + \lambda_t BoomCounty_i \times Decade_t + \varepsilon_{it}, \tag{4}$$

where i indexes counties, t indexes the four decades and the omitted decade is 1970. The results suggest that the boom attracted young males to boom counties, a clear form of selective migration. Near the peak of the boom, in 1980, relative median age in boom counties had fallen by one year and the relative percentage of males had increased by 0.44 percentage points. For perspective, the median age in boom counties prior to the boom was 28.2 years and the mean percentage of males was 50.2%. By 1990, however, the age and gender demographics were not statistically different than pre-boom differences. We consider these results to be evidence against the selective migration explanation: it does not appear to have

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[36] Proprietors may have invested in boomtown-specific capital and skills if they lacked perfect foresight about when the bust would happen or because they rationally anticipated but discounted future declines in profits.

[37] See Pissarides and Wadsworth (1989) and Manacorda and Petrongolo (2006) for related analysis of regional labour markets, skill mismatch and worker mobility.

Table 5

Decadal Differences in Demographics in Boom and Non-boom Counties Relative to Difference in 1970

	Median age	Percent male
Boom × 1980	−0.98*	0.44*
	(0.55)	(0.26)
Boom × 1990	−0.33	−0.39
	(0.55)	(0.26)
Boom × 2000	0.59	−0.30
	(0.55)	(0.26)
R^2 (within)	0.78	0.03
Observations	1,424	1,424

Notes. Estimates are based on county-level data from the 1970, 1980, 1990 and 2000 census. Each model includes county and year effects. The unit of observation is a county and a year. Standard errors are reported in parentheses. *, **, and *** indicate significance at the 10%, 5% and 1% levels respectively.

played a dominant role in weakening the economies of boom counties during post-bust era.

5.6. *Net Present Value*

In order to provide some context for our estimates, we calculate the aggregate effect of the positive short-run and negative longer-run income effects that we document. Table 6 shows the net present value (NPV) calculation of the boom effects on income *per capita* under different discount rates, based on estimates from the annual regression model version of (3) (which generates the Figure 5 coefficient estimates).[38] If we assume the negative post-bust effects would have ended immediately after 1998, then the net effect of the boom on income *per capita* is positive under all reasonable discounting scenarios. However, if we assume the 1998 coefficient of −0.06 would have persisted for a full generation (which we define as 20 years for the 1970s) in the absence of further resource shocks, then the net effect of the boom is negative only when discount rates are low. If we assume the boom would have persisted in perpetuity, then the net effect of the boom remains positive under the 5% discount rate scenario.

The NPV calculations highlight our reluctance to conclude that the boom was a resource curse for western boomtowns and it more broadly points to the benefit of distinguishing between what we call a ‘weak resource curse’ and what we call a ‘strong resource curse’. The resource curse debate has arguably focused too much on the ‘weak curse’, perhaps because the empirics have relied so heavily on cross-sectional variation in abundance and dependency rather than windfalls. The weak curse occurs

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[38] We perform the calculations in four steps. First, we calculate predicted values for each county for ln(income *per capita*), and then we raise e to the power of the predicted value in order to convert the predicted outcomes to dollars. Second, we calculate the mean values of the transformed predicted values for each year for the boom and non-boom counties. Third, we calculate the annual ‘boom’ effect as the difference between the two sets of means relative to the difference in means in 1969. Fourth, we sum the annual boom effects across all years, discounting for time as shown in Table 6.

Table 6

Net Present Value Calculations Based on Income per capita Coefficients

	Discount rate		
Periods	1%	3%	5%
All sample years (1970–98)	2,861	3,322	3,425
All sample years + 1998 effect for one generation (20 years)	−3,653	220	1,908
All sample years + 1998 effect in perpetuity	−33,236	−3,627	991
Significant years (1970–98)	1,957	2,376	2,477
Significant years + 1998 effect for one generation (20 years)	−4,557	−725	961
Significant years + 1998 effect in perpetuity	−34,140	−4,573	43

Notes. All calculations are generated by converting the annual coefficient estimates illustrated in Figure 5(*f*) into dollars (as opposed to percentages), discounting each yearly coefficient using the corresponding discount rate and 1969 as a base year, and summing across all years in the sample. The second row is computed assuming the effects we estimate for 1998 continued for one generation. The third row is computed assuming the effects we estimate for 1998 continued in perpetuity. The rows in the bottom panel are analogous to the top panel, except the calculations disregard years from the sample period in which the coefficient on the interaction between the corresponding year and the boom indicator was insignificant ($\alpha = 0.10$).

when natural resource booms are responsible for lowering long-run incomes *per capita*.[39] By contrast, 'strong curses' require the NPV of a resource boom to be negative. The strong curse is paradoxical but the weak curse is not, a point seemingly overlooked in the empirical literature but confronted in theoretical work by Matsen and Torvik (2005). In fact, natural resources may actually be economic blessings – even for economies that suffer from the weak curse – once the full accounting is performed. The American western counties that we study might be a case in point but an important caveat is worth noting, which is that the demographic composition of boom counties changed during the boom due to in-migration, implying that the population that benefited from the boom is not exactly the same as the population that bore the costs during the bust and post-bust periods. Because many of the benefits of the boom were likely to have been accrued by temporary migrants, the net effects of the boom-and-bust cycle on long-term residents were likely worse overall than those we calculate in Table 6.

6. Conclusion

US communities near endowments of oil and gas are at the epicentre of a new kind of gold rush. New drilling technologies and high energy prices have made their endowments attractive to energy developers, inducing large influxes of labour, capital and revenue and creating new boomtowns. Today's boomtowns are havens for high

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[39] The precedent set in the resource curse literature is to evaluate the condition of *per capita* income as a bottom-line gauge of whether or not a country or geographic region suffers from the 'resource curse'. The seminal article by Sachs and Warner (1995) focuses on income *per capita* and most country-level studies thereafter followed suit (Deacon, 2011; van der Ploeg, 2011). Within-country studies of the resource curse also typically assess the curse with a bottom-line measure of income *per capita*. For example, this is the convention used in articles that study the curse within the US (Papyrakis and Gerlagh, 2007; James and Aadland, 2011).

wages, business expansions and royalty payments but the media routinely raises questions about the potential downsides and long-run impacts for local communities. Boomtowns also raise several questions of interest to economists. The dominant is: will the boom ultimately prove to be an economic blessing or a curse for local communities?

Our study of the 1970s and 1980s western region oil and gas boom sheds light on this question. The results indicate the boom induced positive short-term effects through relative increases in employment, wages, dividends and non-farm proprietor income, and negative short-term effects through reduced farm proprietor income. In the longer-run, relative *per capita* incomes in boom counties became depressed after the bust and showed no clear signs of recovery at the end of our sample period. We also find persistent depressed earnings per non-farm proprietor and increased joblessness, as indicated by elevated levels of unemployment compensation, which did not appear to be waning during the 1990s, long after the bust.

Do our findings mean the boom was a curse for western US communities located near oil and gas reserves? The answer seems to be ‘yes’ if we follow precedent set in the resource curse literature and use income *per capita* as our bottom-line gauge of ‘resource curse’. After the bust, *per capita* incomes were lower in boom counties than we would predict them to be if the boom had never occurred. Thought of in this way, our article is the first (that we are aware of) to identify the curse from a resource windfall that occurred within a country that has well-functioning institutions. This conclusion should be qualified, however, because our NPV calculations indicate that increases in incomes during the boom outweighed the losses under reasonable discounting assumptions. The aggregate calculations do not imply that everyone in boom counties made net gains, because some of the longer term costs were not borne by migrants who entered and exited, but the NPV calculations at a minimum imply that one should use the word ‘curse’ cautiously when referring to this historical episode.

Regardless of interpretation, the negative effects we identify provide an interesting contrast with Michaels (2011), who finds a positive long-run relationship between oil endowments and county-level incomes *per capita* in the US South that he attributes to agglomeration benefits. We speculate that the boom we study was too short and unpredictable in duration to trigger important agglomeration effects in the Rocky Mountain region, in part because the region is relatively less suited for agglomeration benefits due to having fewer large oil fields and being relatively more remote and land-locked. More generally, the distinctions raise questions about the pre-conditions that must be met for a resource boom to trigger agglomeration, which we hope is the subject of further study.

The results and limitation of our study provoke several other immediate questions. First, to what extent did the boom have heterogeneous impacts across different types of individuals, such as, men *versus* women, educated *versus* non-educated, landowners *versus* renters, etc.? Second, how did the boom impact non-monetary outcomes, such as, local crime, education and pollution? Third, should public policies promote the management of windfall earnings to help ease transitions for economies after resource busts? This question is raised by Matsen and Torvik (2005) in the general context of the resource curse and by Cummings and Schulze (1978) in the specific context of boomtowns, and its importance is highlighted by our empirical findings. These questions are beyond the scope of the present article but we hope our study stimulates future research in these areas.

Appendix A. Figures

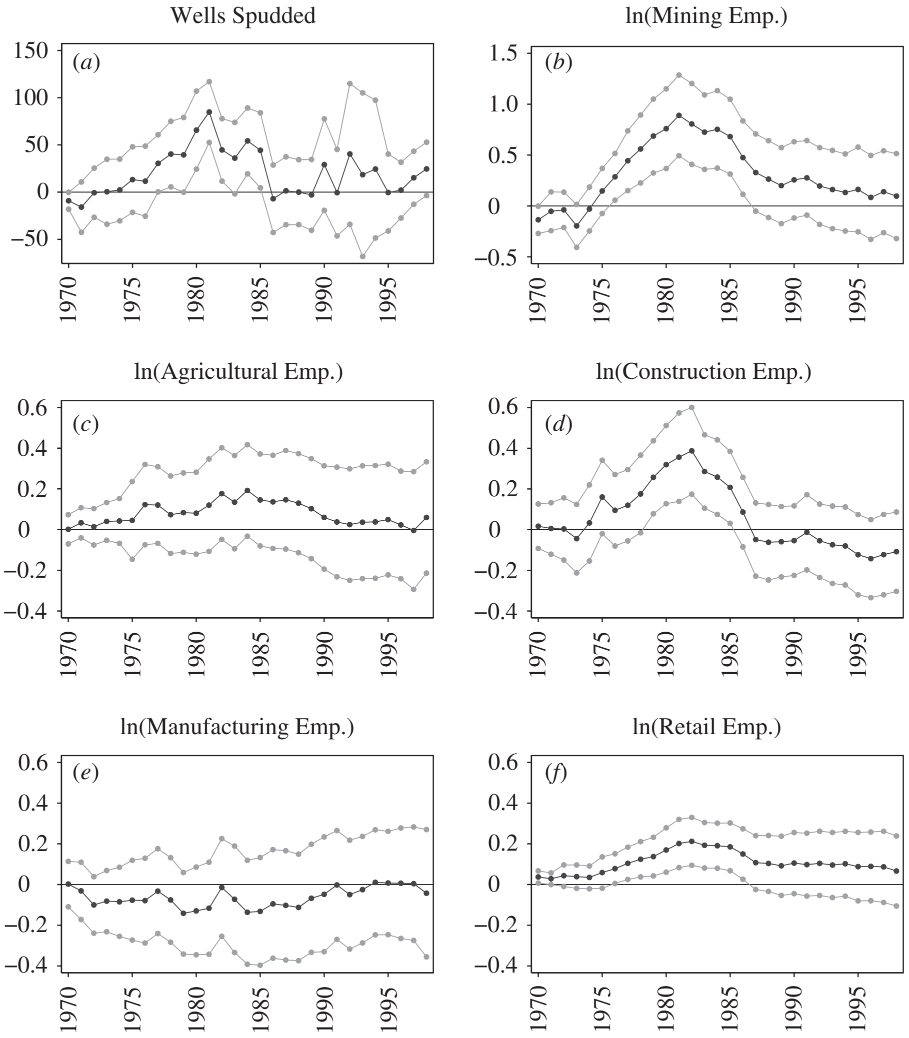

Fig. A1. *Estimated Difference Between Boom Counties and Non-boom Counties Relative to Difference in 1969*

Notes. Estimates are based on equation (3). The black lines represent the coefficients on the interaction terms and the gray lines represent the 95% confidence intervals. Set 1 of 4.

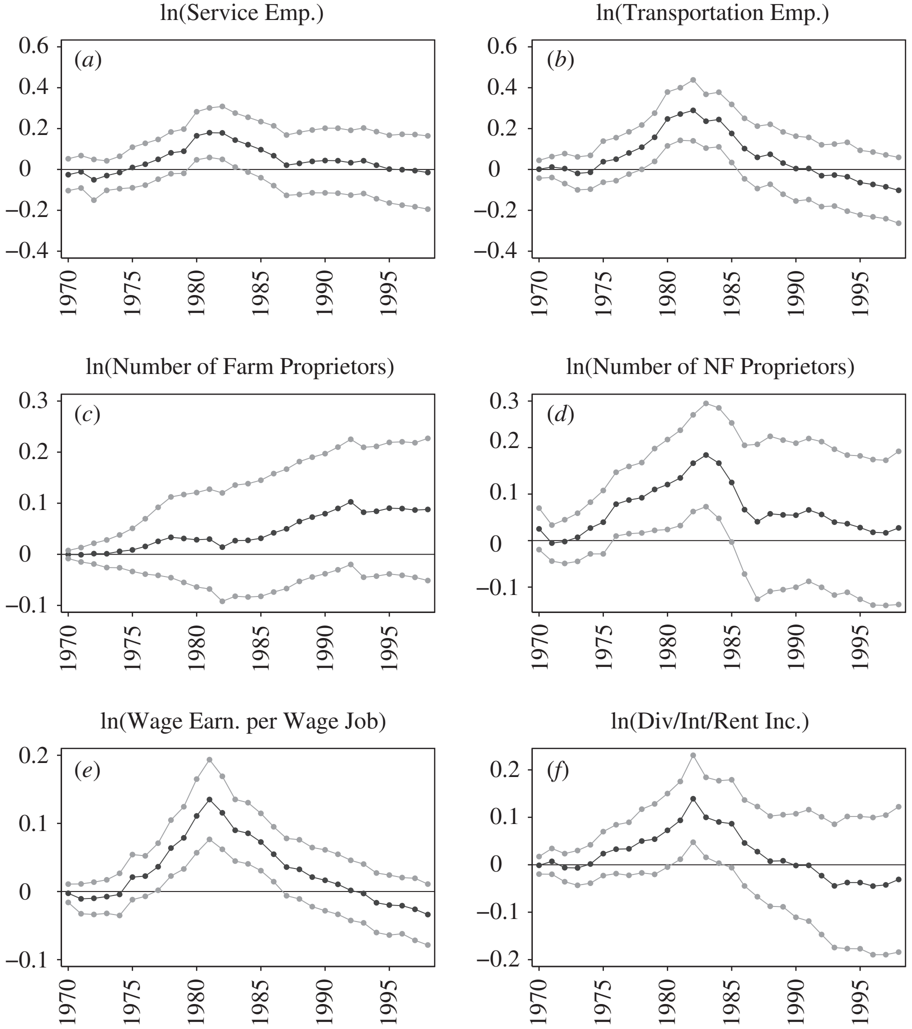

Fig. A2. *Estimated Difference Between Boom Counties and Non-boom Counties Relative to Difference in 1969*

Notes. Estimates are based on equation (3). The black lines represent the coefficients on the interaction terms and the gray lines represent the 95% confidence intervals. Set 2 of 4.

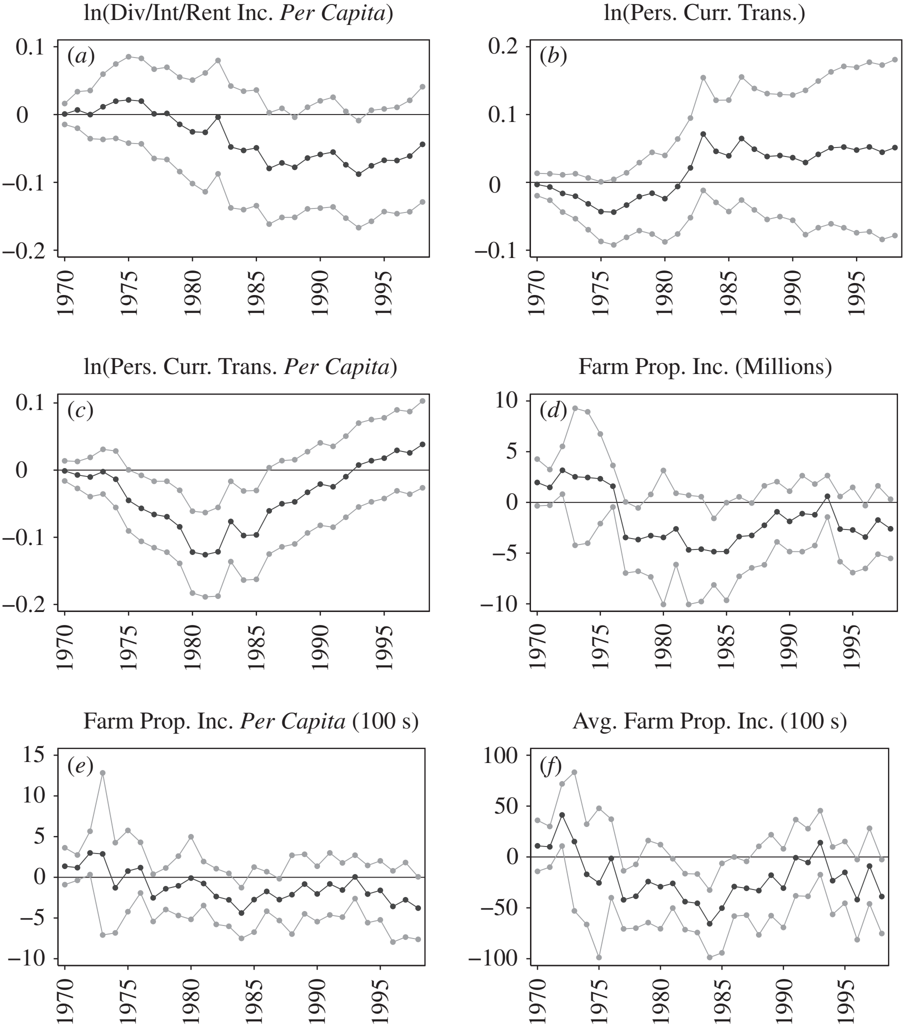

Fig. A3. *Estimated Difference Between Boom Counties and Non-boom Counties Relative to Difference in 1969*

Notes. Estimates are based on equation (3). The black lines represent the coefficients on the interaction terms and the gray lines represent the 95% confidence intervals. Set 3 of 4.

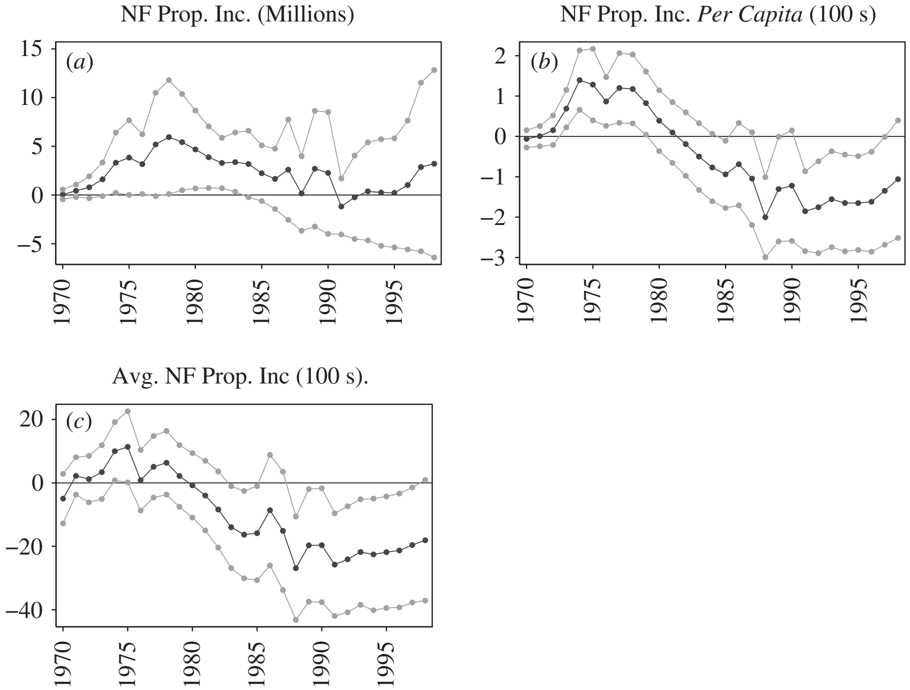

Fig. A4. *Estimated Difference Between Boom Counties and Non-boom Counties Relative to Difference in 1969*

Notes. Estimates are based on equation (3). The black lines represent the coefficients on the interaction terms and the gray lines represent the 95% confidence intervals. Set 4 of 4.

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Additional Supporting Information may be found in the online version of this article:

Data S1.

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