ABSTRACT
The U.S. shale oil and gas boom provides a unique opportunity to study economic growth in a “boom town” environment, derive insights about labor market expansions more generally, and identify the causal effects of economic growth on specific margins of business adjustment. Creation of new establishments—separate from expansion of existing establishments—accounts for a disproportionate share of the multi-industry employment growth sparked by the shale boom, an intuitive but not inevitable empirical result that is consistent with models of firm dynamics. New firms, in particular, contribute nearly half of the cumulative employment growth resulting from the shale boom.
I. Introduction

What does an economic boom town look like? More broadly, when economic growth occurs, who does the growing? In response to positive economic shocks, firms can either expand their existing business operations or create new “greenfield” business establishments. Alternatively, entrepreneurs may enter with entirely new firms. Canonical models of firm dynamics suggest that the business entry margin plays a critical role in facilitating the economy’s aggregate response to economic shocks, but the question is difficult to study empirically due to the paucity of exogenous growth shocks. Yet the question is of critical importance to researchers and policymakers alike. Firm dynamics models in wide use must be disciplined by empirical patterns of business adjustment. Well-designed policy depends on an understanding of the margins of business activity that are most responsive to stimulus.¹

The U.S. shale oil and gas revolution provides a unique opportunity to study the dynamics of boom towns experiencing an exogenous economic shock—in response to a rapid expansion of oil and gas activity, areas affected by the shale boom saw significant employment growth in many other local industries. We describe the evolution of the U.S. shale boom towns in terms of the formation and growth of businesses both in and outside of the shale oil and gas industries, contributing a new dimension to our understanding of booming economies and the shale boom specifically. Net new establishments accounted for a large share of overall boom town employment growth. Additionally, as compared to plausible counterfactuals, new firms and establishments contributed disproportionately to the growth caused by the shale boom. The role of new firms is particularly notable a few years after the shale boom began; more than 40 percent of cumulative employment growth caused by the shale boom was supplied by firms founded after 2006.

While a focus on the shale boom does present challenges in terms of generalizability and external validity, it is nevertheless an important opportunity to seek lessons about economic growth in general. Natural experiments in which growth shocks can be thought of as exogenous are rare, but the shale boom presents one such case. After many years of declining crude oil production in the United States, recent technological developments made the extraction of previously inaccessible energy resources feasible in regions with certain preexisting geological characteristics. Specifically, the advent of horizontal drilling and hydraulic fracturing techniques enabled the exploration and production of oil and gas from shale geological formations and led to significant new drilling activity. Because of the nature of these geological formations, an economic boom occurred in clearly specified local areas where these previously inaccessible resources could now be profitably extracted. Indeed, many of these areas had no significant oil and gas activity before these discoveries were made. These areas are Anadarko, Appalachia, Bakken, Eagle Ford, Haynesville, Niobrara, and the Permian.

¹ Additionally, many of the official statistics policymakers follow necessarily omit entering businesses, a costly omission if entry is an important growth margin. For example, the monthly BLS Current Employment Statistics jobs report (commonly referred to as “the establishment survey”) relies on a sample of continuing establishments, filling in the estimated job contribution of establishment births with an ARIMA forecasting model. See CES Net Birth-Death Model from the U.S. Bureau of Labor Statistics.
Economic growth was particularly notable (relative to control groups) in Anadarko, Bakken, Eagle Ford, and the Permian Basin. While we study all the main shale areas, we direct extra focus on these four boom town areas.

We tell our story in two stages. First, we provide a descriptive (yet original) portrayal of the shale areas during the shale boom in terms of the evolution of aggregate activity and industry composition. The shale boom sparked broad-based employment growth, though growth was particularly strong in industries providing goods or services that supply or complement the output of the oil and gas industries. From the perspective of these supply-or-complement industries (and others), the shale boom is a large demand shock. A critical element of the description we provide is a parsimonious but powerful analysis of the relative roles of existing establishments and net new establishments in accounting for aggregate employment growth. A significant share of aggregate employment growth occurred through the net addition of new establishments.

Second, we complement our descriptive findings with a more rigorous analysis to better understand the consequences of the shale boom. The shale areas differ from the average U.S. county in important ways, and the coincident nationwide downturn of the Great Recession contaminates simple descriptive analysis. With rich longitudinal business microdata from the Census Bureau, we implement a difference-in-differences (DD) research design. Using propensity score matching we construct a control group of counties that are, ex ante, similar to the shale counties, and we compare the shale “treatment” group to these controls as the shale boom occurred. This exercise, which relies on the plausibly exogenous interaction of shale technology improvements with preexisting geological traits of specific regions, yields estimates of the causal effect of the shale boom on county employment growth. Most importantly, we decompose these estimates into contributions from existing business establishments, new greenfield establishments of existing firms, and entirely new firms.

In our causal analysis, we find that—consistent with our descriptive exercises—new business establishments played a disproportionate role in the employment growth caused by the shale boom, even outside of the oil and gas mining sector. New firms and greenfield establishments of existing firms made similar contributions at an annual frequency, each accounting for between one-fifth and one-third of annual employment growth. Consistent with existing literature on early life cycle dynamics of firms, the strong contribution of new firms continues during their first few years of existence, such that the overall role of entry for cumulative aggregate growth is enhanced. The results highlight the importance of entrepreneurship and the extensive margin of the firm distribution for studying economic fluctuations, while also highlighting the distinction between new firms and greenfield establishments, a distinction that is frequently glossed over in formal treatments.

Sectoral analyses reveal further insights into firm dynamics. In the oil and gas mining sector, where employment gains were largest, new firms account for more than one-third of the overall employment growth response, and the expansion of existing establishments accounts for the majority of the remainder. In the complementary construction, transportation, and warehousing industries, new firms account for about one-fourth of

2. These areas are defined by U.S. Energy Information Administration (2019); see Online Appendix Figure A2.
the employment growth, while greenfield establishments of existing firms likewise contribute little. Moreover, we observe a strong relationship of total employment in the oil and gas sector with employment growth—and business entry—in other industries, consistent with the notion that oil and gas booms are associated with employment growth in a wide range of industries.

Our descriptive and causal analyses yield a rich story of boom town economics: as the shale boom struck local areas, new establishments opened in large numbers, transforming the local economic landscape. In some sectors, such as utilities, transportation and warehousing, professional and business services, and education and health services, new establishments were critical contributors to employment growth. Retail trade and leisure and hospitality grew more through expansion of existing establishments. Manufacturing, which may compete with oil and gas businesses for workers and materials, contracted through both net establishment closure and downsizing by existing establishments, but manufacturing activity fell less in shale areas than elsewhere. Overall, the strong performance of the boom towns relative to a plausible counterfactual was facilitated by disproportionate resilience of firm and establishment entry. The shale boom remade these local economies.

The importance of establishment and firm entry for the boom town growth experience was not theoretically inevitable. Admittedly, the affected counties tended to be small, with fewer workers and businesses than the U.S. average. One might therefore argue that the extensive margin was the only way these areas could have been expected to grow, but this would be assuming the result relative to theoretical questions. These areas did have businesses before the boom, and those businesses could have, in principle, grown sufficiently to meet all the needs of the enlarged post-shale economy. It is not difficult to imagine models, such as representative firm models with perfect competition and constant returns to scale production, in which rapid growth of the existing business footprint is precisely what would occur in response to a positive aggregate shock. Whether this latter view or the more nuanced view afforded by richer models is most appropriate is an empirical question—one that we can answer in our quasi-experimental setting.

The relationship between firm entry and job creation has been documented thoroughly from an accounting standpoint (Haltiwanger, Jarmin, and Miranda 2013; Decker et al. 2014), as has the cyclicity of entry of firms (Fort et al. 2013; Pugsley and Sahin 2015; Sedlacek and Sterk 2017) and establishments (Lee and Mukoyama 2015; Decker, D’Erasmo, and Moscoso Boedo 2016). Some literature studies the effect of aggregate shocks on firm entry empirically (Adelino, Ma, and Robinson 2017; Bernstein et al. 2022) or in a quantitative theory context (Clementi and Palazzo 2016; Moreira 2018). Other literature studies the opposite effect, that is, the effect of business entry on aggregate job creation (Gourio, Messer, and Siemer 2016; Sedlacek 2020). Cao et al. (2020) explicitly decompose the growth of existing firms into within-establishment employment gains and greenfield establishment formation for the U.S. as a whole, showing that greenfields account for a substantial share of aggregate job growth during 1990–2015. However, little has been written specifically on differing roles of new firms and greenfield establishments in facilitating aggregate job growth in response to shocks. Our contribution to the business dynamics literature is twofold. First, we provide a clean empirical identification of the effects of a broad aggregate shock on business entry and its role in facilitating job creation. Second, we focus specifically on both margins of business entry—firm entry and greenfield establishment entry—yielding a richer understanding of margins of aggregate adjustment.
II. Theory and Relevant Literature

A. The Role of New Businesses in Employment Growth

Models of representative firms—often characterized by perfect competition and constant returns to scale production—give rise to intuition in which economic shocks are accommodated entirely by homogeneous existing firms that scale up or down as necessary. In contrast, models of firm heterogeneity allow for a more realistic firm distribution with entry and exit. A common way to create this more realistic environment is to impose curvature on firms’ revenue functions, either due to decreasing returns to scale production technology (for example, through span-of-control limitations, as in Lucas 1978) or to imperfect competition (for example, through product—or, perhaps, geographic—differentiation). More concretely, this could reflect physical costs or constraints on business expansion (for example, a retailer can only sell as much product as can fit in their building), limits arising from customer demand for a given product or the size of the local customer population, or managers’ difficulties overseeing large operations due to monitoring or transaction costs (Coase 1937). When facing such revenue function curvature, the responsiveness of businesses (in terms of, for example, employment growth) to profitability shocks is dampened.

Moreover, models with entry and exit typically use some version of a free entry condition that links the value of even incumbent firms to entry costs; that is, in the face of a positive aggregate shock, entrepreneurs enter the market until the value of operating a firm is driven down to the entry cost. Intuitively, the incentive to create a new business is determined by the amount of revenue available to the market generally, and the value of existing firms is constrained by the threat of entry. In such an environment—one characterized by revenue function curvature and some sort of free entry condition—existing businesses do not grow enough to accommodate aggregate shocks fully, so the resulting increase in aggregate production depends also on growth in the number of firms, including through increased entry.

In their simplest form, these models—roughly speaking—suggest the following testable hypotheses about the economy’s response to a positive aggregate shock:

**Hypothesis 1.** A positive aggregate shock causes a surge in business entry, with entrants making a significant contribution to overall employment growth. More precisely, we can test the following hypotheses:

3. For the purposes of our *theory* discussion, we use the terms “firm” and “establishment” interchangeably, since standard models do not distinguish between the two. In model terms, the focus is on productive units.
4. Since our contribution is empirical, we do not explicitly describe such a model here, but in Online Appendix A, we provide a mathematical sketch of an illustrative firm dynamics model with discussion.
5. Though not covered in our model discussion, another consideration for business entry is uncertainty, or volatility of economic variables, which can *dissuade* entry under “real options” intuition; that is, in the presence of nonconvex adjustment costs, wider dispersion of possible economic outcomes can lead to investment “inaction,” including hesitancy to enter, because specific investments could be rendered unprofitable in a wide range of future states (for example, Bloom 2009). We discuss relevant literature on the economic volatility associated with resource booms in Section II.B. If this effect is dominant, we might even expect to see resource booms *deter* entry.
6. For this item, we refer to baseline models in which potential entrants do not observe productivity prior to entry. In such models, entrants’ employment share rises in response to a positive aggregate shock.
**Hypothesis 1.** Entrants’ contribution to overall employment growth is *proportionate* to their normal prevalence in the economy, that is, similar to (or less than) their overall proportion of employment levels.

**H\textsubscript{A}:** Entrants’ contribution to overall employment growth is *disproportionate*, that is, larger than their overall proportion of employment levels.

In the areas we study, prior to the shale boom, new firms and new establishments each accounted for roughly 3 percent of employment; \(H_0\) above suggests new firms or establishments would contribute about 3 percent (or less) of the employment growth caused by an aggregate shock.

**Hypothesis 2.** New entrants make sustained contributions to overall employment for several years after entry.\(^7\)

**H\textsubscript{0}:** Entrants’ contribution to overall employment growth is immediate upon entry.

**H\textsubscript{A}:** Entrants’ contribution to overall employment growth persists for some time after entry.

These hypotheses are suggested by models with rich post-entry dynamics, but, importantly, workhorse theories study productive units generically without distinguishing between firms and establishments. We might actually expect new *firms* to make gradual contributions to growth, while greenfields’ contributions are immediate, if new firms enter undercapitalized or face learning dynamics and greenfields enter at optimal size determined by well-resourced parent firms. We reflect on these considerations as we discuss our results below.

New firms have often been treated as synonymous with “entrepreneurship,” largely due to the importance of business age for key job creation and productivity results (Decker et al. 2014; Haltiwanger, Jarmin, and Miranda 2013). However, other concepts have been studied in relation to energy booms. Gilje and Taillard (2016) find that publicly traded natural gas firms are more responsive to changes in investment opportunities than private firms, a finding that may be thought of as contrary to the view that new firms are key but may be supportive of our findings on greenfield establishments. Boomhower (2019) studies oil and gas firms specifically and finds that smaller firms with limited liability are less environmentally conscious when drilling, providing them a potential advantage over larger rivals; this is interesting in light of our findings below on the remarkable contribution of new firms to oil and gas activity gains. Using American Community Study (ACS) data, Tsvetkova and Partridge (2017) document modest negative impacts to self-employment in energy boom towns in 2001–2013, consistent with previous evidence that resource sector booms may crowd out entrepreneurial activity (Davis and Haltiwanger 2001; Glaeser, Kerr, and Kerr 2015; Betz et al. 2015), though Jacobsen and Parker (2016) find that the oil boom of the 1970s–1980s marginally increased the number of farm and nonfarm business proprietors. Our data cover employer businesses, so nonemployer self-employment is outside the scope of our study. We therefore view our work as complementary to Tsvetkova and Partridge (2017), as we add the employer-business side of entrepreneurship, which likely has a stronger association with later economic growth but has somewhat different interpretations in terms of the entrepreneurial occupational choice. In this respect, we

\(^7\) This prediction is suggested by richer models in which entrants begin undercapitalized or face learning dynamics, resulting in rapid growth for several years after entry as firms approach their optimal size.
add employer entrepreneurship to the list of economic outcomes that have been studied in relation to resource booms, a literature that we review next.

B. Economic Effects of Oil and Gas Booms

A growing body of work quantifies the economic effects of localized natural resource-based booms, motivated by the well-documented U.S. shale boom of recent decades. While this literature began before the recent shale oil and gas boom (Black, McKinnish, and Sanders 2005; Allcott and Keniston 2018), this new era of shale has created a significant resurgence in this literature, in part because of the clean empirical identification afforded by the nature of the shock.

Feyrer, Mansur, and Sacerdote (2017) find that the shale boom specifically created significant economic shocks to local labor markets. Every million dollars of oil and gas extracted is estimated to generate $243,000 in wages, $117,000 in royalty payments, and 2.49 jobs within a 100-mile radius. In total, the authors estimate that the shale boom was associated with 725,000 jobs in aggregate and a 0.5 percent decrease in the unemployment rate during the Great Recession. Marchand (2012) similarly finds both direct and indirect impacts of the shale boom on employment; for every ten jobs created in the energy sector, three construction, 4.5 retail, and two services jobs are created. Agerton et al. (2016) find that one additional rig results in the creation of 31 jobs immediately and 315 jobs in the long run. Other studies corroborate the positive impact of the shale boom on local labor markets (Weber 2012; Marchand 2012; Komarek 2016; Bartik et al. 2019; Upton and Yu 2021; McCollum and Upton 2018; Unel and Upton 2020). While positive effects associated with the economic activity spurred by drilling and production have been documented extensively, negative effects might also be observed, specifically in the manufacturing sector (Cosgrove et al. 2015; Freeman 2009). Resource booms are often followed by a bust (Baumeister and Kilian 2016). For instance, Jacobsen and Parker (2016) study the oil and gas bust period in the 1970s and 1980s. Although they find substantial positive local employment and income effects during the boom, they also find that income per capita decreased and unemployment compensation payments increased relative to what they would have been if the boom had not occurred; this volatility may matter for business entry decisions.

Our work adds to this growing body of literature in that ours is the first study to investigate the margins by which the business sector adjusted to the shale boom, directly tying the event to broader questions in firm dynamics and macroeconomics.

III. Data

For our purposes (and consistent with U.S. Census Bureau definitions), an establishment is defined as a specific business operating location, while a firm is a group of establishments under common ownership or operational control.

8. Due to the oil and natural gas price declines of 2014, there is also an emerging literature on the “bust” side of the cycle that will likely grow in upcoming years. For instance, Brown (2015) finds that elimination of each active rig eliminates 28 jobs in the first month, and this increases to 171 jobs eliminated in the long run.

9. To be clear, we are interested in short-term boom town effects, in contrast to the large literature on resource endowments and long-run economic growth (Sachs and Warner 2001; van der Ploeg 2011; Venables 2016; Alexeev and Conrad 2009; Michaels 2010; Smith 2015; Oliver and Upton 2022).
We focus on two main data sources for our analysis. First, for our descriptive analysis, we use the Census Bureau’s County Business Patterns (CBP) data set, a publicly available annual tabulation of employment, payroll, and establishment counts at the county-by-industry level (with data recorded as of the pay period including March 12 of a given year). The CBP allows us to paint a broad picture of the industry and establishment dynamics that followed the shale boom, and its public availability affords flexibility in the number and nature of calculations we can perform. The CBP is based on the Census Bureau’s Business Register (see DeSalvo, Limehouse, and Klimek 2016) and covers the near-universe of private nonfarm business establishments in the United States. We provide more detail about the CBP and, in particular, how we address the problem of disclosure avoidance data censoring in some industry-by-county cells, in Online Appendix B.1.

For our causal analysis we use the Census Bureau’s Longitudinal Business Database (LBD), which consists of longitudinal establishment-level microdata covering almost all private nonfarm businesses in the United States (see Jarmin and Miranda 2002, for extensive detail on the LBD). Like CBP, the LBD is based on the Census Bureau’s Business Register, and the two data sets have the same industry scope. Unlike CBP, however, LBD data are confidential, require special sworn status for access, and feature limitations on the number and nature of calculations we can report. But the LBD microdata yield a number of benefits relative to CBP. The LBD provides annual data on establishment location and detailed NAICS industry identifiers, as well as annual employment counts (also corresponding to the pay period including March 12); importantly for our purposes, the LBD provides firm identifiers that allow us to link establishments together as firms and to track firm age.10 Even in LBD-based exercises, we aggregate the data to the county level to facilitate study of entry.11

IV. Describing the Shale Boom

In this section we describe how shale county economies evolved during the boom. Throughout the paper we define the “shale boom” as comprising the years 2007–2014; we initiate the boom in 2007 to be consistent with other literature and because 2007 appears to mark the beginning of significant shale-related expansions in many shale areas. We end our analysis in early 2014 at the peak of shale activity. Starting in mid-2014, oil prices declined, and shale activity slowed, until a recovery began in mid-2016 (we leave study of the 2014–2016 “shale bust” to future research). We focus particularly on the evolution of industry composition and the relative roles of establishment growth and entry in facilitating shale county employment growth.

A. The Pre-boom Period

We first characterize the shale counties prior to the boom. Panel A of Table 1 reports average employment, establishment counts, and prevalence of oil and gas mining

10. The LBD is the premier source of business microdata for the United States. An alternative data source is the publicly available National Establishment Time Series (NETS) based on Dun & Bradstreet data, or the similarly constructed InfoGroup USA data. Crane and Decker (2020) document the significant limitations of NETS for studying business dynamics.

11. See Online Appendix B.2.
activity for shale and nonshale counties for the 2000–2006 pre-boom period.12 During 2000–2006, shale counties had total private nonfarm employment of about 21,000, on average, compared with about 38,000 for nonshale U.S. counties. We also report on a subset of shale plays, which we call boom towns, chosen because they exhibit statistically significant, positive overall employment effects of the shale boom in our causal analysis described further below. These areas are Anadarko, Bakken, Eagle Ford, and Permian Basin, and their counties were even smaller than shale counties generally, with about 9,000 employees on average.13

The fourth line of the table, “Nonshale control set,” refers to the set of counties from which our control group will later be drawn for causal analysis. We discuss this restriction more below (Section V.A), but the set omits counties that are in the same state as, or in a state adjacent to, the control counties; these counties are just slightly larger than U.S. nonshale counties generally. Importantly, while boom town counties (and

12. We do not employ our propensity score control groups in this section but will use them in our causal analysis further below.
13. For disclosure avoidance reasons, in our causal analysis below we do not report point estimates for Anadarko and Bakken; our boom town taxonomy is determined in part by unreported results of those exercises.

| Panel A: Treated and Control Areas | Employment (Counts) | Establishments (Counts) | Oil & Gas Mining Share of Employment (%) | Oil & Gas Mining Share of Establishments (%) |
|-----------------------------------|---------------------|-------------------------|----------------------------------------|------------------------------------------|
| Shale counties                    | 20,800              | 1,440                   | 3.5                                    | 2.8                                      |
| Boom towns                        | 8,800               | 700                     | 6.8                                    | 4.9                                      |
| Nonshale counties                 | 38,200              | 2,410                   | 0.7                                    | 0.9                                      |
| Nonshale control set              | 43,800              | 2,790                   | 0.2                                    | 0.3                                      |

| Panel B: Major Shale Plays        | Employment (Counts) | Establishments (Counts) | Oil & Gas Mining Share of Employment (%) | Oil & Gas Mining Share of Establishments (%) |
|-----------------------------------|---------------------|-------------------------|----------------------------------------|------------------------------------------|
| Anadarko                          | 17,600              | 1,290                   | 5.5                                    | 5.4                                      |
| Appalachia                        | 30,600              | 1,950                   | 0.9                                    | 1.1                                      |
| Bakken                            | 3,000               | 310                     | 3.6                                    | 2.8                                      |
| Eagle Ford                        | 8,100               | 690                     | 4.1                                    | 2.9                                      |
| Haynesville                       | 17,600              | 1,170                   | 2.0                                    | 1.9                                      |
| Niobrara                          | 30,500              | 2,380                   | 2.5                                    | 2.3                                      |
| Permian Basin                     | 6,600               | 530                     | 9.7                                    | 6.2                                      |

Source: County Business Patterns.
Notes: Average county-level figures by play and NAICS sector for 2000–2006. Employment and establishment counts rounded to nearest 100 and 10, respectively. Oil & gas mining includes NAICS 211 and 213. Boom towns include counties in Anadarko, Bakken, Eagle Ford, and Permian Basin. Nonshale counties include all U.S. counties outside shale areas. Nonshale control set includes all counties except those in shale states and states adjacent to shale counties (see text).
shale counties generally) are smaller than other counties in the United States, their establishment counts are still nontrivial. Boom town counties had, on average, 700 establishments during the 2000–2006 pre-boom period. In principle, there is no reason these existing establishments could not expand sufficiently (in terms of product variety and output) to accommodate the economic boom that followed.

The third and fourth columns show that oil and gas mining activity—establishments classified as NAICS 211 or 213—was not a dominant industry in any counties but did account for a nontrivial share of activity in the pre-boom period, comprising 3.5 percent and 6.8 percent of employment in shale counties generally and boom towns, respectively, compared with 1 percent or less in other counties.

Panel B of Table 1 shows wide variation between the shale plays. Appalachia, which includes metro areas in eastern Ohio and western Pennsylvania, and Niobrara, which includes the Denver metro area, have the largest counties on average, while Bakken, the Permian Basin, and Eagle Ford consist of largely rural counties. Yet even Bakken counties, with average employment of 3,000, still had 310 establishments on average during the pre-boom period. Oil and gas mining activity was more prevalent in shale areas than the United States generally for all plays but Appalachia, with Anadarko and Permian Basin having significant petroleum extraction industries. Importantly, no play or industry sector appears to be at risk of having no establishments, even in shale counties; that is, shale counties had numerous establishments in the pre-boom period that could, in principle, accommodate economic expansion through organic growth.

B. The Boom Period

The shock that struck shale counties during the shale boom is evident in the sharp rise in oil and gas mining activity during that period, which can be seen on Figure 1 (where

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14. Online Appendix Table A2 reports establishment counts by broad sector.
15. Online Appendix Table A3 reports employment by sector and shale play for 2000–2006.
employment and establishment counts in oil and gas mining are shown relative to year-2006 levels). This is most evident in the boom towns, where oil and gas mining employment rose by about 150 percent, while establishment counts rose about 50 percent. The surge in economic activity was not limited to oil and gas drilling and extraction, however. Figure 2 reports employment and establishment counts for all industries except oil and gas mining. While activity in the shale areas does appear to have been affected by the nationwide recession, the decline in employment and establishment counts was shallower in the shale areas than elsewhere. Moreover, activity in the boom towns rebounded rapidly and exceeded the pre-recession peak by 2012, whereas activity in nonshale areas had yet to recover by 2014. Boom town employment grew by more than 10 percent, on net, from 2006 to 2014, and boom town establishment counts grew by nearly 10 percent over the same period. In short, overall economic activity—not just oil and gas drilling and extraction—evolved very differently in the shale areas, and particularly in the boom towns, relative to the rest of the United States.16

The rapid 2006–2014 growth of employment and establishment counts in boom towns reflects considerable underlying heterogeneity across sectors, as seen on Figure 3.17 The only sector to see an employment decline was manufacturing. Interestingly, Cosgrove et al. (2015) find negative effects of the shale boom on manufacturing employment in the Appalachia play. However, not all plays saw a decline in manufacturing activity, and we find that counties outside the shale areas saw even larger manufacturing activity declines than did the shale counties.18

Aside from mining, the largest gains occurred in sectors providing significant inputs to shale activity: construction (employment and establishment gains of 29 percent and 7 percent, respectively) and transportation and warehousing (51 percent and 40 percent).19

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16. The pattern of employment gains varies widely across plays, as shown on Online Appendix Figure A3.
17. Online Appendix Figure A4 repeats this exercise for nonshale counties for comparison.
18. We discuss manufacturing in more detail in Online Appendix C.1.
19. Note that the transportation and warehousing sector includes both pipelines and the many trucks required for drilling and fracking operations, though railroads (NAICS 482) are out of scope for both CBP and the LBD.
Even aside from these shale-adjacent sectors, nontrivial employment gains were seen in utilities (16 percent), retail trade (12 percent), professional and business services (7 percent), education and health services (11 percent), leisure and hospitality services (22 percent), and other services (4 percent). Retail trade saw a modest decline in establishment counts despite employment gains, while professional and business services saw larger gains in establishment counts than in employment. The agriculture sector—not shown on Figure 3—saw mixed results across plays and between employment and establishments during the shale boom; we discuss agriculture in detail in Online Appendix C.2.
We can (descriptively) assess the importance of the establishment entry margin by decomposing total employment growth into the growth of existing establishments (holding the number of establishments constant) and net establishment entry (holding establishment size constant); see Online Appendix C.3 for more detail on the decomposition method. Figure 4 reports the result of this accounting exercise for the boom town plays. The solid line reports the total change in employment after 2006. The dashed line reports the change in total employment holding establishment size constant; this line indicates the portion of employment growth accounted for solely by the change in the number of establishments. Among all industries excluding oil and gas mining, the cumulative employment gain from 2006 to 2014 was about 13 percent; the employment gain accounted for by the changing establishment count was about 9 percentage points, or roughly two-thirds of the total employment gain. Even in oil and gas mining, where the establishment margin is less important, net establishment entry accounted for almost half of total employment gains. While simple, this exercise demonstrates the outsized role of the establishment margin for facilitating overall growth, and it provides support for the alternative Hypothesis 1 we describe in Section II.A.

V. Causal Methodology

We now move from descriptive exercises to an empirical design for estimating and decomposing the causal effect of the shale boom on margins of business growth and entry. For these exercises we rely on LBD data (see Section III) to compare the shale areas with our propensity matched control groups.

A. Treated and Control Areas

The U.S. Energy Information Administration (EIA) provides monthly data and analysis for regions defined by the agency as shale plays. Following EIA, we classify counties in the Anadarko, Appalachia, Bakken, Eagle Ford, Haynesville, Niobrara, and Permian Basin plays as treated areas. Online Appendix Figure A2 shows a map of where these shale plays are located. For our main exercises, we narrow our focus to a more limited group of four plays: Anadarko, Bakken, Eagle Ford, and Permian Basin (though exercises using all plays are reported in the Online Appendix). We refer to these plays as the boom towns, and we focus on them specifically because these four plays experienced statistically significant growth of overall employment relative to plausible counterfactuals. EIA identifies 315 counties in the shale areas, with 125 of these counties classified as boom towns for our analysis.

We define a set of control counties using propensity score matching. The variables on which we match are cumulative 2000–2006 employment growth, as well as 2000–2006 averages of total county employment, the share of firms in the county that are new, the share of employment in the county that is at new firms, the share of employment in the county that is at greenfield establishments of existing firms, and the share of employment

20. Online Appendix Figure A8 reports this exercise for each NAICS sector.
21. For example, U.S. Energy Information Administration (2019) is the January 2019 Drilling Productivity Report; each report is accompanied by corresponding data on rigs and output, as well as a list mapping specific counties to specific shale plays.
in the county that is at oil and gas establishments (NAICS 211, 213, 324, and 325) and
collection, transportation, and warehousing establishments (NAICS 23, 48, and 49).\textsuperscript{22}
In this way, we construct a control group that is similar to the treatment group in terms of
new firm activity, greenfield establishment activity, and activity of the oil and gas and
related industries in the pre-boom time period. In other words, for each treatment county
we find a (single) corresponding “control” county that has similar patterns of business
dynamics ex ante. We construct a control group for the boom town treatment group, the
shale areas generally (drawn with replacement), and for each play individually (drawn
with replacement). Our results are robust to placebo tests and alternative control groups.\textsuperscript{23}
To reduce the risk of our results being contaminated by spillover effects, counties that
are in states with shale activity but that themselves are not included in EIA-defined shale
plays are removed from the list of potential control counties.\textsuperscript{24} States that directly border
counties with shale activity are also removed.\textsuperscript{25}
As background, we describe key variables in the shale areas and control groups, both
before and during the shale boom, in Table 2. We note two important items. First, average
employment in the shale counties (that is, treatment group) increased only modestly (by
about 2.4 percent) between the pre-shale and post-shale time periods, though control
counties actually experienced a 4 percent decline in employment as the United States
experienced the Great Recession during the early years of the shale boom.
Second, new firm employment as a share of total employment and young firm em-
ployment as a share of total employment declined substantially in both shale and non-
shale areas. New firms’ share of employment declined by more than 18 percent in shale
counties and more than 30 percent in nonshale counties. A similar pattern is observed for
young firm employment as a share of total employment, which declined by 16 percent
and 23 percent in shale and nonshale counties, respectively. But for both new and young
firm employment, shale counties experienced a 12 percentage point (and 7 percentage
point, respectively) slower decline than nonshale counties. It is not surprising that new
and young firm activity declined over this time, given the particular sensitivity of young
firms to the business cycle documented in the literature described above; this fact high-
lights the importance of studying the shale boom with a carefully designed empirical
strategy. For the United States as a whole, new firm employment was about 2.8 percent
of total employment during 2000–2006 and 2.2 percent of total employment during
2007–2014, somewhat less than the share in our treatment and control counties.\textsuperscript{26}
Next, Table 2 shows employment shares of greenfield establishments (that is, new
establishments of existing firms). Note that existing firms need not have existed in the
county of interest beforehand; they could have activity anywhere in the United States.

\textsuperscript{22} Importantly, we do not match on our specific outcomes of interest—the share of employment growth
accounted for by business entry margins.
\textsuperscript{23} See Online Appendix C.5.
\textsuperscript{24} For a technical discussion of spillover effects on empirical estimates, see James and Smith (2020) and
Feyrer, Mansur, and Sacerdote (2020).
\textsuperscript{25} After applying these criteria, the potential control group comes from firms located in counties in the
following 28 states: AL, AZ, CA, CT, DE, FL, GA, HI, ID, IL, IN, IA, ME, MI, MN, MS, MO, NV, NH, NJ,
NC, OR, RI, SC, TN, VT, WA, and WI. These criteria closely follow McCollum and Upton (2018) and Upton
and Yu (2021), with the exception of Oklahoma, which includes the Anadarko play, but was included in the
control group of McCollum and Upton (2018), as EIA had not yet defined the Anadarko play.
\textsuperscript{26} Data for the total United States taken from the Business Dynamics Statistics (BDS), the public-use
tabulations of LBD data.
Thus, some of these firms may have existed in other parts of the country and opened up a new establishment in the shale county. In shale counties, greenfield establishment employment as a share of total employment increased modestly, while greenfield employment shares declined substantially in control counties. Thus, from these basic summary statistics, it appears that employment growth from new establishments of existing firms was particularly important during the shale boom. For the United States as a whole, greenfield establishment employment was about 3.3 percent of total employment during 2000–2006 (higher than in our treatment and control counties) and 2.5 percent of total employment during 2007–2014 (similar to our treatment and control counties).

B. Difference in Differences

We employ a simple and intuitive difference-in-differences (DD) estimation strategy for measuring the effect of the shale boom on economic outcomes:

\[ y_{ct} = \alpha + \delta(S_{Shalec} \times Shale_t) + \tau_c + \gamma_t + \varepsilon_{ct} \]

where \( y_{ct} \) is the outcome of interest for county \( c \) in year \( t \);\(^{28} \) in our main results this is an employment growth component described below, though we also report results for

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27. We calculate greenfield establishment employment for the United States as a whole as job creation by establishment births associated with firms with age greater than zero (BDS data).

28. Recall that establishment-level information is aggregated into counties. Therefore, all regressions will use a panel of counties by year.
employment levels in background exercises. \( S_{\text{Shale}} \) is an indicator variable corresponding to shale counties as defined by EIA (that is, the treatment group) and is zero for nonshale counties, and \( \tau_c \) and \( \gamma_t \) are fixed effects for county and year, respectively. \( \text{Shale}_t \) is an indicator variable that indicates the years during which shale activity occurred, which we specify as 2007–2014. The coefficient \( \delta \) gives the causal effect of the shale boom on shale counties, controlling for aggregate temporal shocks as well as time-invariant differences across counties that remain after the propensity score matching process. For each model, we estimate standard errors clustered at the county level. We find evidence of common pre-treatment trends in our treatment and control counties, though we defer exploration of this important issue to our discussion of cumulative effects in Section VI.C.

C. Annual Growth Rates and Components

We consider several outcome variables in the estimation described by Equation 1. In background exercises, we estimate the effect of the shale boom on log total employment (that is, setting \( y_{ct} \) from Equation 1 equal to log employment). Our main outcome of interest, however, is annual employment growth. Consider the following growth rate concept:

\[
g_{ct} = \frac{\text{emp}_{ct} - \text{emp}_{ct-1}}{0.5(\text{emp}_{ct} + \text{emp}_{ct-1})}
\]

where \( c \) indexes counties, \( t \) indexes years, and \( \text{emp}_{ct} \) is total employment for county \( c \) in year \( t \). The growth rate \( g_{ct} \) is commonly referred to as the “DHS growth rate” after Davis, Haltiwanger, and Schuh (1996) and is widely used in the empirical firm dynamics literature; this growth rate concept has the desirable property of facilitating the inclusion of entry and exit. Now consider a related growth rate, commonly referred to as a growth component:

\[
g_{ct}^j = \frac{\text{emp}_{ct}^j - \text{emp}_{ct-1}^j}{0.5(\text{emp}_{ct} + \text{emp}_{ct-1})}
\]

where \( j \) indicates a grouping based on firm or establishment ages (and lack of superscript indicates inclusion of all groups). In the case of firms, \( j \in J = \{ \text{age 0, age 1–4, age 5+} \} \), where we define the categories as “new,” “young,” and “mature.” In the case of establishments, \( j \in J = \{ \text{new firm, greenfield establishment, incumbent establishments} \} \). Defined in either way, it is straightforward to show that:

\[
\sum_{j \in \{1,2,3\}} g_{ct}^j = g_{ct}
\]

29. Of course, the exact start time of the boom varies across shale plays. In the initial specification, we specify 2007 as the start date for the shale boom, but we also present year-specific estimated treatment effects by shale play in later investigations, and our main results are robust to varying the cutoff year by one or two years in either direction. We end the analysis in 2014 because global oil prices dropped immediately thereafter, and therefore the “bust” plausibly began in 2015 (and recall that the 2014 annual observation in Census Bureau data refers to March of 2014). Therefore, 2007–2014 is the best general time period that can be considered the “boom” or “treatment” period.

30. Our results are broadly robust to clustering by county and year.
Hence, each $g_j^{ct}$ is a growth “component” such that the components sum to the overall growth rate. This follows the approach of Adelino, Ma, and Robinson (2017) and allows for ease of coefficient interpretation. Moreover, for any group, $g_j^{ct}/g_j^{ct}$ gives the share of aggregate (county) employment growth accounted for by group $j$. Importantly, for the firm-based growth components we focus on “organic” growth (see Online Appendix B.2).

The main outcomes of interest are the shares of annual employment growth accounted for by new firms, “young” firms (those with age 1–4), mature firms, greenfield establishments (of existing firms), and incumbent establishments of existing firms. The use of these growth components as dependent variables in our linear regression framework ensures that regression coefficients are additive in the way described above.

D. Cumulative Effects

Following our main results for annual growth rates, we estimate regressions that will shed light on the roles of various types of businesses in the cumulative employment change at the county level. To do this, we construct the following outcome variable:

\[
e_{ct} = \frac{emp_{ct}}{emp_{2006}}
\]

where $e_{ct}$ is employment in county $c$ in year $t$ relative to employment in county $c$ in the year 2006. We again create a group-specific version of this variable:

\[
e^k_{ct} = \frac{emp^k_{ct}}{emp_{2006}}
\]

where, we emphasize, $k$ is defined differently from the $j$-indexed groups described above. In particular, we focus on three $k$ groupings: (i) establishments that entered in year 2006 or before, (ii) establishments that entered after 2006 belonging to firms that existed as of 2006 or before, and (iii) establishments that entered after 2006 belonging to firms that entered after 2006. That is, for any year $t$, $e^1_{ct}$ gives county $c$ employment of establishments that were incumbents as of year 2007, $e^2_{ct}$ gives county $c$ employment of establishments born after 2006 to firms that were incumbents as of year 2007, and $e^3_{ct}$ gives county $c$ employment of establishments born after 2006 to firms born after 2006. In each case, employment is expressed relative to year 2006 total county employment; therefore, the following convenient condition holds:

\[
\sum_{k \in \{1,2,3\}} e^k_{ct} = e_{ct}
\]

Moreover, note that $e^2_{ct} = e^3_{ct} = 0 \ \forall \ t \leq 2006$ by construction. We choose the year 2006 consistent with our assumption above that the shale boom began in 2007. The general purpose of this set of dependent variables is to study, for any given year after 2006, how much of the cumulative (post-2006) employment growth in a county is accounted for by establishments that existed prior to the boom, establishments born after the boom to firms that existed before it began, and firms born after the boom. This provides an alternative view of the role of the business entry margin in driving aggregate employment that does not depend on single-year growth rates and allows time for early life cycle dynamics to play out. To study these outcomes, we generalize our difference in differences strategy as follows:
where $\delta_t^k$ is the year-specific estimated treatment effect for firms in a given group $k$, and we abuse notation slightly to include the overall group of all establishments as one of our $k$ groups. The difference of means generated by $\delta_t^k$ compares shale counties to control counties in any given year, controlling for aggregate shocks affecting all counties. Conveniently, the set of estimated $\delta_t^k$ for each of the establishment groups $k \in \{1, 2, 3\}$ described above will sum to the $\delta_t$ associated with overall cumulative employment growth (relative to 2006) so that, again, we can easily calculate the share of aggregate employment growth accounted for by different types of establishments. This set of specifications is useful not only because it facilitates the study of cumulative employment effects but also because it allows us easily to inspect the assumption implicit in our difference in differences framework: common pre-treatment trends.

VI. Empirical Results

For background purposes, we first estimate the effect of the shale boom on log total employment for all shale plays. We include all industries except for oil and gas mining (NAICS 211, 213) to focus on industries responding to the shale shock. These results—in particular, estimates of $\delta_t$ from Equation 1—are reported in Online Appendix Table A4. In short, the shale boom is associated with a 6.9 percent increase in total employment relative to the control group. We also estimate these regressions by play, and those plays with statistically significant positive effects are what we refer to as boom towns.

A. Employment Growth Rates

We now explore our main results by estimating Equation 1 with employment growth rates and components as dependent variables (see Equations 2 and 3). Table 3 reports boom town results, where employment growth is expressed in percentage points, again omitting oil and gas mining industries to focus on those industries that respond to the shale boom. First, note that the “Total” column, in which the dependent variable is the growth rate of aggregate (county) employment, is equal to the sum of Columns 1, 2, and 4 or, alternatively, the sum of Columns 1, 5, and 6. Column 3, which reports the growth component for all firms with age less than five, is equal to the sum of Columns 1 and 2.

Column 7 of Table 3 indicates that the shale boom is associated with a 3.864 percentage point increase in annual employment growth rates at the county level in the boom towns, a strong effect. Column 5 shows that greenfield establishments (new establishments of existing firms) account for 0.709 percentage point of the overall effect; that is,}

31. We omit county fixed effects in this specification since they are a linear combination of included variables. But recall that our control counties are chosen to be similar to our treatment counties in the pre-2007 period, and employment is scaled by 2006 county employment.

32. In our causal empirical exercises we are unable to report play-level point estimates for Bakken or Anadarko due to confidentiality restrictions. However, these two plays are included in the “all” and “boom town” groups. Separately, we report employment level results by sector in Online Appendix Table A5.
greenfield establishments account for about 18.3 percent of the effect on net employment growth rates. This is smaller than the 1.182 percentage point contribution (Column 1) of new firms (30.6 percent of the employment growth effect). Incumbent establishments account for the remaining growth, roughly half of the total increase in employment growth rates. Another way to interpret the 3.864 percentage point of growth is as the sum of new firms, young firms, and mature firms. The contribution of new firms (1.182) and young firms (0.672) together accounts for about 48 percent of the total growth rate effect. Mature firms, those aged 5+ years, account for 2.010 percentage points of growth. We report these results for all shale plays together (Online Appendix Table A6), finding qualitatively similar results though new firms and greenfield establishments account for roughly the same share of overall growth—that is, new firms play a larger role in the boom towns than in the shale areas generally. More broadly, the contribution of new firms and young firms generally is significantly disproportionate relative to their typical share of activity levels (each accounting for less than 5 percent of employment), providing support for the alternative Hypothesis 1 described in Section II.A.33

We provide additional sector detail (Online Appendix Table A7), reporting separate results for three industry groups: oil and gas mining (which is excluded from Table 3); construction, warehousing, and transportation (that is, industries that are complementary to the oil and gas industry); and residual industries. The total growth rate effects are strongest in oil and gas mining, followed by the construction, transportation, and warehousing sectors that provide critical inputs to oil and gas activity. We find a smaller, weaker contribution of new firms and greenfield establishments to growth in these other sectors. In this way, the growth experience of boom towns appears to reflect the unique nature of the oil and gas industry. We further explore the role of the oil and gas industry in Section III.

33. Our results are not as dramatic as those found by Adelino, Ma, and Robinson (2017), who find that firms aged less than two account for 90 percent of the local employment growth response to local demand shocks.
but still economically and statistically significant, effect for the remainder of the sectors. We also report results by play in Online Appendix Table A8.

**B. Extensions and Robustness Exercises**

The size of the shale boom shock varies across plays and over time, but our main exercises do not account for this heterogeneity. In Online Appendix C.7 we describe exercises that allow the size of the shale boom shock to be scaled by the pattern of oil and gas activity observed within counties. The role of business entry (both new firms and greenfields) is somewhat larger when we account for the magnitude of the shock. In unreported exercises, we find that our main results are not materially affected by including county size (in terms of employment) as a control variable in Equation 1. Our results are likewise unaffected by including 2000–2006 growth in FHFA county-level house price indexes as part of the criteria for our propensity score match; recent house price growth may be thought of as a proxy for preexisting financial conditions as well as a proxy for vulnerability to the housing crisis and Great Recession that occurred during the shale boom period. That said, our results are not robust to explicitly controlling for contemporaneous annual house price growth, which is likely to be highly correlated with business entry for reasons other than our topics of interest. Our results are quantitatively robust to varying the shale boom cutoff year by one or two years in either direction, dropping any specific year in 2000–2014 from the sample, and dropping consecutive pairs of years around the 2007 shale boom cutoff (which is close in timing to the 2007–2009 recession).

We describe two exercises assessing the robustness of our control group concept in Online Appendix C.5. First, we discard the propensity score match and instead create 20 control groups by selecting counties completely at random (from the set of states that make up the control group choice set) and then estimating our main regressions. Separately, we conduct placebo tests that help us rule out the possibility that our main results are due to random chance.

**C. Cumulative Employment Growth**

The foregoing results focus on annual employment growth contributions using annually based definitions of firm and establishment entry. An alternative approach is to focus on cumulative effects over time, as described in Section V.D. In this section, we briefly summarize our results on cumulative employment growth (see additional discussion in Online Appendix C.9). For this analysis, we focus on establishments and firms created during versus prior to the shale boom. Figure 5 summarizes the results for boom towns; we provide the regression table underlying this figure in Online Appendix Table A12, as well as results for all plays and individual plays.

Importantly, for both boom towns and the shale areas generally, we find no statistically significant effects on total employment prior to 2007, consistent with common pre-treatment trends. But the top of the shaded areas on Figure 5, corresponding with effects on total employment, shows that, as the shale boom gets underway, total employment rises rapidly, with a cumulative effect by 2014 of 36 percent (in the boom towns relative to the control group). The middle and bottom shaded areas show, respectively, the
contribution to the total by greenfield establishments—those born during the boom to firms that existed prior to the boom—and new firms born during the boom. Greenfield establishments contribute almost ten percentage points to the total cumulative gains through 2014—26 percent of the total—while new firms contribute 16 percentage points—43 percent of the total. Summing the middle and bottom areas yields the total contribution of new establishments (of either existing firms or new firms), which starts small but reaches 25 percentage points—or 70 percent of the total—by 2014, providing support for the alternative Hypothesis 2 described in Section II.A.

One other important implication arises from these results. While increased employment among new firms is roughly similar to that of greenfield establishments during the early years of the boom, by 2012 the new firms were contributing substantially more to the total cumulative gains. This is a striking finding about the difference between new firms and greenfield establishments: new firms start small but grow rapidly, consistent with a theory in which greenfield establishments, born with the advantage of existing firm ownership, might begin their life cycle better capitalized or with a stronger customer base than do young firms but are therefore close to their optimal size upon entry. New cohorts of young firms grow rapidly, however, likely as a result of a few extremely fast growers, as documented by Decker et al. (2014). An important implication for theory is that modelers should not conflate firms and establishments.

VII. Conclusion

Waves of business formation transformed the economic geography of local economies during the U.S. shale boom. At an annual frequency, new firms and greenfield establishments each account for at least one-fifth of overall employment gains resulting from the shale shock, while establishment entry broadly accounts for about two-thirds of cumulative gains throughout the boom period.
Relating these findings back to the theoretical discussion in Section II.A, we find support for models in which a positive aggregate shock causes a surge in business entry, and this surge is apparent on an employment-weighted basis consistent with the notion that the marginal entrants are reasonably productive (Hypothesis 1). Moreover, the cumulative exercises confirm that new entrants make sustained contributions to overall employment for several years, suggesting that they enter undercapitalized or learn more about their productivity after entry (Hypothesis 2). Furthermore, though, our results point to important differences between new firms and new establishments of existing firms (greenfield establishments). New firms appear to start small but, as a cohort, grow rapidly. New establishments of incumbent firms appear to start out larger, with a more gradual growth trajectory.

These differences between firms and establishments have important implications for theories of firm dynamics, and our broader results shed additional light on the dynamics of young businesses and their importance for aggregate adjustment. The disproportionate role of business entry also has implications for the measurement of economic activity since workhorse surveys of businesses, such as the “payroll survey” of the BLS (Current Employment Statistics) or the Census Bureau’s Monthly Retail Trade Survey (a critical input for GDP estimates), rely on continuing businesses to track changes in aggregate economic activity.

While our study fills an important gap in our understanding of the shale boom specifically, our attempt to draw broader insights about economic responses to aggregate shocks is admittedly limited in its external validity. The shale boom shock differs from other types of aggregate shocks frequently studied by economists, such as monetary policy, fiscal policy, or exchange rate shocks. The shale boom shock propagated through specific industries—first the oil and gas sector and then complementary industries in transportation and construction—while other shocks may rely heavily on, for example, housing or export industries. Our geographic focus abstracts from broader general equilibrium dynamics, such as effects on oil and gas manufacturing (for example, refining) and transport that occur outside the areas where oil and gas are produced. Moreover, shale counties differ materially from the U.S. economy on average, being relatively sparsely populated, with industrial composition befitting their rural, resource-based nature. Clearly, our results should be interpreted with caution.

On the other hand, exogenous shocks to economic growth are rare, so any opportunity to study the effect of aggregate shocks on business activity margins is useful—at least to the extent that studying responses to any kind of aggregate shock is useful. While the specific sectors through which this shock acted may differ from the sectors through which certain other shocks act, the end result was a shift in demand faced by a wide range of industries that benefit either from complementarity with the originating industries or from consumer spending enabled by elevated household income. In this particular aspect, the shale boom shock is similar to other kinds of shocks. Moreover, the workhorse models we discuss are not particular about the nature of the aggregate shock, nor are these models’ insights necessarily restricted to highly populated geographic areas. Firms and establishments were in fact present in the shale areas prior to the boom.
and could have, in principal, expanded sufficiently to meet the needs of the larger shale economies those areas became; instead, business entry made disproportionate contributions. As such, we view our results as at least suggestive of more general insights.

References

Adelino, Manuel, Song Ma, and David T. Robinson. 2017. “Firm Age, Investment Opportunities, and Job Creation.” *Journal of Finance* 72(3):999–1038.

Agerton, Mark, Peter R. Hartley, Kenneth B. Medlock III, and Ted Temzelides. 2016. “Employment Impacts of Upstream Oil and Gas Investment in the United States.” *Energy Economics* 62:171–80.

Alexeev, Michael, and Robert Conrad. 2009. “The Elusive Curse of Oil.” *Review of Economics and Statistics* 91(3):586–98.

Allcott, Hunt, and Daniel Keniston. 2018. “Dutch Disease or Agglomeration? The Local Economic Effects of Natural Resource Booms in Modern America.” *Review of Economic Studies* 85(2):695–731.

Bartik, Alexander W., Janet Currie, Michael Greenstone, and Christopher R. Knittel. 2019. “The Local Economic and Welfare Consequences of Hydraulic Fracturing.” *American Economic Journal: Applied Economics* 11(4):105–55.

Baumeister, Christiane, and Lutz Kilian. 2016. “Forty Years of Oil Price Fluctuations: Why the Price of Oil May Still Surprise Us.” *Journal of Economic Perspectives* 30(1):139–60.

Bloom, Nicholas. 2009. “The Impact of Uncertainty Shocks.” *Econometrica* 77(3):623–85.

Boomhower, Judson. 2019. “Drilling like There’s No Tomorrow: Bankruptcy, Insurance, and Environmental Risk.” *American Economic Review* 109(2):391–426.

Brown, Jason P. 2015. “The Response of Employment to Changes in Oil and Gas Exploration and Drilling.” *Economic Review—Federal Reserve Bank of Kansas City* 2015(Q II):57–81.

Cao, Dan, Henry R. Hyatt, Toshihiko Mukoyama, and Erick Sager. 2020. “Firm Growth through New Establishments.” Working Paper.

Clementi, Gian Luca, and Berardino Palazzo. 2016. “Entry, Exit, Firm Dynamics, and Aggregate Fluctuations.” *American Economic Journal: Macroeconomics* 8(3):1–41.

Coase, Ronald H. 1937. “The Nature of the Firm.” *Economica* 4(16):386–405.

Cosgrove, Brendan M., Daniel R. LaFave, Sahlan T. M. Dissanayake, and Michael R. Donihue. 2015. “The Economic Impact of Shale Gas Development: A Natural Experiment along the New York/Pennsylvania Border.” *Agricultural and Resource Economics Review* 44(2):20–39.

Decker, Ryan A., Pablo N. D’Erasmo, and Hernan Moscoso Boedo. 2016. “Market Exposure and Endogenous Firm Volatility over the Business Cycle.” *American Economic Journal: Macroeconomics* 8(1):148–98.
Decker, Ryan, John Haltiwanger, Ron Jarmin, and Javier Miranda. 2014. “The Role of Entrepreneurship in US Job Creation and Economic Dynamism.” *Journal of Economic Perspectives* 28(3):3–24.

DeSalvo, Bethany, Frank Limehouse, and Shawn D. Klimek. 2016. “Documenting the Business Register and Related Economic Business Data.” U.S. Census Bureau Center for Economic Studies Paper CES-WP-16-17. Washington, DC: U.S. Census Bureau.

Feyrer, James, Erin Mansur, and Bruce Sacerdote. 2017. “Geographic Dispersion of Economic Shocks: Evidence from the Fracking Revolution.” *American Economic Review* 107(4):1313–1334.

———. 2020. “Measuring Geographic Spillovers: Reply.” *American Economic Review* 110(6):1914–20.

Fort, Teresa C., John Haltiwanger, Ron S. Jarmin, and Javier Miranda. 2013. “How Firms Respond to Business Cycles: The Role of Firm Age and Firm Size.” *IMF Economic Review* 61(3):520–59.

Freeman, Donald G. 2009. “The ‘Resource Curse’ and Regional US Development.” *Applied Economics Letters* 16(5):527–30.

Gilje, Erik P., and Jerome P. Taillard. 2016. “Do Private Firms Invest Differently than Public Firms? Taking Cues from the Natural Gas Industry.” *Journal of Finance* 71(4):1733–78.

Glaeser, Edward L., Sari Pekkala Kerr, and William R. Kerr. 2015. “Entrepreneurship and Urban Growth: An Empirical Assessment with Historical Mines.” *Review of Economics and Statistics* 97(2):498–520.

Gourio, Francois, Todd Messer, and Michael Siemer. 2016. “Firm Entry and Macroeconomic Dynamics: A State-level Analysis.” *American Economic Review: Papers & Proceedings* 106(5):214–18.

Haltiwanger, John, Ron S. Jarmin, and Javier Miranda. 2013. “Who Creates Jobs? Small versus Large versus Young.” *Review of Economics and Statistics* 95(2):347–61.

Jacobsen, Grant D., and Dominic P. Parker. 2016. “The Economic Aftermath of Resource Booms: Evidence from Boomtowns in the American West.” *Economic Journal* 126(593):1092–128.

James, Alex, and Brock Smith. 2020. “Geographic Dispersion of Economic Shocks: Evidence from the Fracking Revolution: Comment.” *American Economic Review* 110(6):1905–13.

Jarmin, Ron S., and Javier Miranda. 2002. “The Longitudinal Business Database.” Technical Report. Washington, DC: Center for Economic Studies, U.S. Census Bureau.

Komarek, Timothy M. 2016. “Labor Market Dynamics and the Unconventional Natural Gas Boom: Evidence from the Marcellus Region.” *Resource and Energy Economics* 45:1–17.

Lee, Yoonsoo, and Toshihiko Mukoyama. 2015. “Entry and Exit of Manufacturing Plants over the Business Cycle.” *European Economic Review* 77:20–27.

Lucas, Robert. 1978. “On the Size Distribution of Business Firms.” *Bell Journal of Economics* 9(2):508–23.

Marchand, Joseph. 2012. “Local Labor Market Impacts of Energy Boom-Bust-Boom in Western Canada.” *Journal of Urban Economics* 71(1):165–74.

McCollum, Meagan, and Gregory B. Upton Jr. 2018. “Local Labor Market Shocks and Residential Mortgage Payments: Evidence from Shale Oil and Gas Booms.” *Resource and Energy Economics* 53:162–97.

Michaels, Guy. 2010. “The Long-Term Consequences of Resource-Based Specialisation.” *Economic Journal* 121:31–57.

Moreira, Sara. 2018. “Firm Dynamics, Persistent Effects of Entry Conditions, and Business Cycles.” Working Paper.

Oliver, Matthew, and Gregory B. Upton Jr. 2022. “Are Energy Endowed Countries Responsible for Conditional Convergence?” *Energy Journal* 43(3):201–24.

Pugsley, Benjamin W., and Aysegul Sahin. 2015. “Grown-up Business Cycles.” U.S. Census Bureau Center for Economic Studies Paper CES-WP-15-33. Washington, DC: U.S. Census Bureau.
Sachs, Jeffrey D., and Andrew M. Warner. 2001. “Natural Resources and Economic Development: The Curse of Natural Resources.” *European Economic Review* 45:827–38.

Sedlacek, Petr. 2020. “Lost Generations of Firms and Aggregate Labor Market Dynamics.” *Journal of Monetary Economics* 111:16–31.

Sedlacek, Petr, and Vincent Sterk. 2017. “The Growth Potential of Startups over the Business Cycle.” *American Economic Review* 107(10):3182–210.

Smith, Brock. 2015. “The Resource Curse Exorcised: Evidence from a Panel of Countries.” *Journal of Development Economics* 116:57–73.

Tsvetkova, Alexandra, and Mark Partridge. 2017. “The Shale Revolution and Entrepreneurship: An Assessment of the Relationship between Energy Sector Expansion and Small Business Entrepreneurship in US Counties.” *Energy* 141(15):423–34.

Unel, Bulent, and Gregory B. Upton Jr. 2020. “Effects of the Shale Boom on Entrepreneurship in the U.S.” USAEE Working Paper 20-461.

Upton, Gregory B., and Han Yu. 2021. “Labor Demand Shocks and Earnings and Employment Differentials: Evidence from the U.S. Shale Oil & Gas Boom.” *Energy Economics* 102:105462.

U.S. Energy Information Administration. 2019. “Drilling Productivity Report: For Key Tight Oil and Shale Gas Regions.” Technical Report.

van der Ploeg, Frederick. 2011. “Natural Resources: Curse or Blessing?” *Journal of Economic Literature* 49(2):366–420.

Venables, Anthony J. 2016. “Using Natural Resources for Development: Why Has It Proven so Difficult?” *Journal of Economic Perspectives* 30(1):168–84.

Weber, Jeremy G. 2012. “The Effects of a Natural Gas Boom on Employment and Income in Colorado, Texas, and Wyoming.” *Energy Economics* 34(5):1580–88.