1. Introduction

The solar photovoltaic (PV) industry comprises sub-industries such as silicon mining, module manufacturing, and system installation. PV installation is largely unique among these industries for its large and localized population of firms. The PV installation industry consists of about 3,000 companies in the United States alone, and most installation firms serve a customer base in a local geographic area [1]. Employment in the installation industry more than tripled from 2010 to 2016, with over 130,000 people employed in the United States in 2016, making PV installation among the fastest growing industries in the country [2]. The rapid expansion of the new industry and the localized nature of PV installation prompts questions about the installation industry's market structure, such as how market shares are distributed among installers, how the distribution of market shares affects inter-installer competition, and how that competition affects PV deployment.

Market structure comprises multiple variables that determine an industry's competitive intensity, such as the number of firms, market concentration (distribution of market shares), rates of market entry and exit, and degree of product differentiation [3]. An improved understanding of market structure can provide insights into an industry's firms' strategies [4], operational efficiency [5], and innovation [6], among other factors.

In the context of residential PV, policymakers and researchers are particularly interested in the relationship between PV market structure and installed prices. PV prices continue to exhibit price dispersion despite significant price reductions [7-11]. Differences in local market structure may explain price dispersion and spatial price variation [8]. Several studies suggest that prices are lower in markets with more competing installers [9, 12, 13], and that prices are lower in more concentrated markets (markets where some installers hold disproportionately high market shares) [9, 11, 14]. In a working paper, Bollinger et al. [12] show that more competitive market structures can accelerate PV adoption rates. PV market structure could thus be a key variable in the future trajectory of installed prices and PV deployment.

The residential PV industry consists of many low-volume localized installers competing with a few high-volume regional- and national-scale installers [1, 11, 15-17]. Residential PV market structure is described broadly in [15, 17, 18], however it has not been described at a granular level. This article fills this research gap by leveraging a rich data set to describe trends in residential PV market structure from 2000 to 2016. Several market structure metrics show how the industry has evolved in terms of the number of installers and market concentration. A descriptive analysis of the relationship between PV market structure and emerging customer financing options is also provided. The

article does not evaluate the effects of market structure trends on industry competition, prospects, and so forth; the implications of the observed trends will be examined in future research.

The article is organized as follows. Section 2 describes the data and methods used for this study. Section 3 summarizes market structure trends in the U.S. residential PV installation industry in terms of number of installers and market concentration. Section 4 presents a descriptive analysis of the relationship between PV market structure and recent trends in customer financing options. Section 5 provides a discussion and conclusion of the article.

2. Data and Methods

The study data are from the Lawrence Berkeley National Laboratory's *Tracking The Sun* (TTS) data set. TTS comprises installed PV system data from about 80% of the U.S. market collected from more than 60 PV incentive and interconnection programs [19]. To limit the study to residential PV systems, observations were dropped that self-reported as non-residential, as well as observations with system sizes larger than 15 kW.

The raw TTS data include self-reported installer names that may be used to distinguish between different installers. More than 30,000 unique installer names are reported in the raw data. However, most self-reported names are variants of other installer names or data reporting errors. For instance, a company such as "Blue Solar" may be self-reported as "Blue Solar Company" (variant) and "Blue Soolar" (error). In these cases, all installer names were changed to a single base name (e.g., "Blue Solar"). Other cases of duplication required additional judgment. For instance, "Blue Solar" and "Blue Solar & Electric" may be variants or may represent two unique companies. These possible matches were addressed through an additional geographic criterion. If two possible matches shared the same modal county (the county where the named installer installed the most systems), then the possible matches were changed to a single base name. Otherwise the possible matches were treated as separate companies. When necessary, additional web searches supplemented the name-matching process. However it is still possible that some unique installers were erroneously grouped under a single installer name, or that a single installer was erroneously separated into multiple installer names (see Section 2.3). Finally, personal names (e.g., John Smith) were commonly self-reported. When personal names were self-reported for multiple systems, it was assumed that the personal name represented a real installer. When a unique personal name was self-reported for a single system, it was difficult to conclude whether the name represented a real installer, an employee of an installer, or a homeowner who self-installed the system. The 451 names of this type were treated as missing values and

dropped from the data. The resulting data set used in this study consists of 938,955 systems installed between 2000 and 2016 in 20 states. The number of unique installer names dropped from more than 30,000 to about 8,700.

2.1 Market definitions

Measurements of market structure are sensitive to the geographic boundaries used to define markets [20-22]. In this study, market structure results are presented at the national, state, and local levels. Local markets are defined according to the methodology developed in [1]. The concept of the local market is to draw boundaries between dissimilar groups of local installers. The method does not rely on jurisdictional boundaries, such that markets can comprise multiple cities and may cross state borders. Applied to the study data, this approach generates 961 local markets.

2.2 Market structure metrics

Three metrics are used to describe market structure in this article: the number of installers, market shares of the highest-volume installers, and the Herfindahl-Hirschman index (HHI). For all metrics, an "active" installer refers to a company that installed at least one system in a given year. Note that any company that installed at least one PV system is considered an installer. This definition includes companies from related service industries such as electrical contracting that install PV as a side business.

Market concentration refers to the distribution of market shares in an industry. A market where many firms hold relatively even market shares is said to be un-concentrated, whereas a market with few firms or where a few firms hold disproportionately high market shares is said to be concentrated. A simple measurement of market concentration is the market share of an industry's highest-volume firms. All else equal, an industry's high-volume firms hold higher market shares in more concentrated markets.

HHI provides a numerical value for the degree of market concentration within an industry. HHI is the most common metric used to describe market concentration due to its strong basis in oligopoly theory, its ability to summarize the entire concentration curve, and its emphasis on the market shares of high-volume firms [23]. By its construction, the HHI always increases when market shares shift from low-share to high-share firms, all else equal, and always decreases when more firms enter the market, all else equal [3]. HHI has been the primary market concentration metric used in PV econometric research [9-11, 14]. HHI is the sum of the squared market shares of all companies in a given market and period:

$$HHI_t = \sum_{i=1}^{N_t} \left(\frac{v_{it}}{t} \right)^2 \quad (1)$$

Where HHI_t is HHI at time t, N_t is the number of active firms, $_t$ is the total volume of installations, and v_{it} is the volume of an individual installer i. Low HHI (approaching zero) suggests low market concentration, whereas high HHI (approaching one) suggests high market concentration. As a general guide, the U.S. Department of Justice defines un-concentrated markets as HHI<0.15, moderately concentrated markets as 0.15≤HHI≤0.25, and concentrated markets as HHI>0.25.

2.3 Limitations

The study data have limitations. First, despite a rigorous installer name cleaning process, it is still likely that some installers in the data are duplicates of the same company, and that some single names represent multiple companies. The author estimates that installer name misclassifications are on the order of tens, representing less than 1% of installer names and a trivial percentage of the data. Installer counts are rounded to two significant digits to avoid overstating the precision of these estimates. Second, the use of installed system data implies that data are only observed for successful bids in any given period. Some companies may have been actively submitting quotes to prospective customers in certain markets without installing a system, and thus are not "active" by our data-driven definition. The use of installed systems data rather than quote data is valid for market share calculation but may understate the number of active installers.

3. Results: Residential PV Market Structure

This section summarizes residential PV market structure in terms of number of installers (Section 3.1) and market concentration (Section 3.2) over time and space. Most market structure measurements are based on a national market definition unless otherwise noted.

3.1 Number of installers

About 8,700 different companies installed at least one residential PV system from 2000 to 2016 in the U.S. markets covered by the TTS data, with about 2,900 installers active in 2016 (Figure 1). The number of installers grew by about a factor of four from 1,070 in 2008 to 3,800 in 2015. This period of intense growth corresponds to similar growth of

U.S. residential PV markets. The number of installers fell from 2015 to 2016, corresponding with a similar decline in installations in the TTS data. More than half of the drop is attributable to the utility service territory of Southern California Edison (SCE). In 2015, the SCE territory led the United States in number of installers, but the numbers of installations and active installers in the SCE territory declined from 2015 to 2016. Although this reduction may reflect an emerging trend, further data are needed to verify that the trend does not reflect underlying data reporting and collection issues. A similar reduction in number of installers also occurred in other regions of California.

[Figure 1 about here]

Figure 1. Number of installers, 2000–2016

About 2,400 of the 8,700 installers only installed a single system, and more than half (4,700 installers) installed five or fewer systems. Many of these installers were companies from related service industries such as electrical contracting, roofing, and construction that "dabbled" in the residential PV market by installing one or a few systems. According to one survey, about 60% of PV installers continue to offer related services [24]. At the same time, the residential PV industry includes a growing base of specialized PV installation companies. In 2016, more than 1,400 companies specialized in PV installation, employing more than 137,000 people [2].[1] About one-third of residential PV installers also installed at least one non-residential PV system (non-residential includes PV systems installed on commercial, government, non-profit, and other non-residential buildings).

The number of active installers in any given period is a function of market entry (new installers entering the market), incumbency (installers remaining in the market), and exit (installers leaving the market). For the purposes of this study, market entry is measured according to the first year in which an installer installed a system. Market exit is measured as the last year in which an installer installed a system. Installers that were only active in a single year are counted in both the entry and exit categories for that year. Incumbents in a given year are existing installers that did not either enter or exit that year. Observations of market exit are necessarily truncated, given that installer activity is not observed beyond December 2016. For this reason, 2016 data are excluded from Figure 2. From 2000 to 2010, the growth in the number of installers was driven by market entry, with a notable increase in market entry from 2008 to 2010 (Figure 2). Market exits generally correlate with entries, in part owing to dabblers that entered and exited in the same year. Entry peaked in 2010. The sustained increase in the number of

[1] The Solar Foundation's estimate includes residential and commercial-scale installers.

installers from 2012 to 2015 is attributable primarily to incumbency: more installers remained active in the market rather than dabbling and exiting.

[Figure 2 about here]

Figure 2. Market entry, exit, and incumbency, 2000–2016

Geographically, the number of installers by state correlates with the state's market size. California—which has the largest U.S. residential PV market by far—had the largest installer industry in 2016, with about 2,000 active installers. Among the remaining states, Arizona, Massachusetts, New Jersey, and New York all supported more than 100 installers, while all remaining states supported fewer than 100 installers (Figure 3). At the same time, relatively small markets tend to have more installers per kW installed than large markets. For instance, about 2,100 installers installed 904,900 kW in California in 2016, or about 2 installers per 1,000 kW installed, compared to Florida where about 40 installers installed 1,100 kW, or about 36 installers per 1,000 kW installed.

[Figure 3 about here]

Figure 3. Number of installers (logged) by state in 2016, white states represent states with no data

3.2 Market concentration

Most residential PV installers are relatively small: about 61% of installers installed fewer than 10 systems in 2016. At the same time, the industry's highest-volume installers hold disproportionately high market shares: less than 1% of installers installed more than 1,000 systems in 2016, yet these companies accounted for about 60% of installed systems. In other words, the residential PV installation industry is somewhat concentrated and—as will be shown—has become more concentrated over time. However throughout the study period the industry classified as un-concentrated according to U.S. Department of Justice guidelines [25].

The market shares of the industry's highest-volume installers fell from 2000 to 2006, stabilized from 2006 to 2010, then increased from 2010 to 2016 (Figure 4). The industry grew from less than 50 installers in 2000 to more than 700 installers by 2006. As a result, the market shares of the highest-volume installers initially fell from 2000 to 2006 to accommodate this large-scale market entry. Beyond 2006, market entry continued yet the industry's highest-volume installers stabilized their market shares, with the industry's 20 highest-volume installers holding between 34% and 44% market share

between 2006 and 2010. From 2010 to 2015, the industry's 20 highest-volume installers increased market share from about 32% of installed systems in 2010 to 59% in 2015. This increase in market concentration is notable when contrasted with Figure 1: the industry's highest-volume installers increased market share despite ongoing market entry. By way of comparison, 2007 U.S. Census data show that the average 20-firm concentration ratio among U.S. manufacturing industries was about 67%, about 35% among professional, scientific, and technical service industries, and about 36% in retail trade industries [26].[2] It should be noted that the highest-volume installers change over time. Indeed, none of the industry's 20 highest-volume installers in 2000 remained in the top 20 in 2010, and only 7 of the 20 highest-volume installers in 2010 remained in the top 20 in 2016.

[Figure 4 about here]

Figure 4. Market shares of highest-volume 10, 20, and 50 installers, 2000–2016

Figure 5 plots market shares from 2008 to 2016 for the five and 10 highest-volume installers in each state for the eight states with the most installations in the dataset. Similar to national trends, high-volume installers in each state-level market generally increased market shares from 2010 to 2016.

[Figure 5 about here]

Figure 5. Market shares of largest 5and 10 installers bystate, for the eight states with the most installations in the dataset, 2008–2016

HHI measurements depict similar trends in market concentration (Figure 6). Nationwide HHI fell from 2000 to 2006 as the industry accommodated hundreds of new installers. Beginning in 2010, nationwide HHI grew from 0.01 to a peak of 0.13 in 2015, before falling to 0.09 in 2016. Consistent with national trends, state-level HHIs generally increased from 2010 to 2015 and declined in 2016 (Figure 7). Trends in state-level concentration appear to lag behind national-level trends in some states. For instance, in Connecticut, HHI fell from 2010 to 2012 even as HHIs rose in most of the rest of the country, before HHI increased in the state from 2012 to 2015. HHIs increased in all eight states in Figure 7 from 2012 to 2015 and decreased from 2015 to 2016 in every state except New York. The relatively dramatic swing in Nevada reflects state-specific market dynamics: several high-volume installers entered this market around 2013 then left Nevada in 2016 in response to utility rate changes.

[2] Market shares based on sales, receipts, or revenue of industry's 20 largest firms. Unfortunately, the U.S. Census does not provide market concentration data on related service industries such as electrical or roofing contracting.

[Figure 6 about here]

Figure 6. Residential PV installation industry HHI, 2000–2016

[Figure 7 about here]

Figure 7. HHI for the eight states with the most installations in the dataset, 2008–2016

Figure 8 plots HHI over time for the eight largest local markets. Each local market is labeled with the largest city within that market, but local markets may consist of multiple cities or fractions of a city. Local market trends are generally consistent with national-level trends. However, like state-level HHIs, local-level HHI trends appear to lag behind national-level trends in several local markets, notably again in the market around Bristol, Connecticut (CT). HHIs increased from 2012 to 2015 and decreased from 2015 to 2016 in seven of the eight markets.

[Figure 8 about here]

Figure 8. HHI for the eight local markets with the most installations in the dataset, 2008–2016

One limitation of HHI measurements is that the metric simultaneously calculates concentration from the number of firms and the distribution of market shares. For instance, an HHI of 0.1 may reflect an industry with 10 firms all with 10% market shares, or it may reflect an industry with 101 firms where one firm holds 30% market share and the rest hold 1% market shares. Lorenz curves are a way to visually isolate the effects of the distribution of market shares from the number of competing firms. The horizontal axis ranks firms in terms of market share, with the smallest firms on the left and the largest on the right. The vertical axis depicts the cumulative market shares of the firms. The 45° line of market parity shows how the distribution would be shaped if all firms split market shares evenly. The gap between the line of market parity and the actual distribution represents the degree of market concentration. Figure 9 depicts Lorenz curves over time for the national residential PV market. The Lorenz curves suggest that the distribution of market shares became increasingly skewed toward the highest-volume installers between 2000 and 2010, a trend that is not evident in the market share and HHI analyses. In other words, the PV installation industry became less concentrated from 2000 to 2010 due to market entry, even as the distribution of market shares became increasingly skewed. Consistent with the market share and HHI analyses, the Lorenz curves suggest that the PV installation industry became more concentrated between 2010 and 2015 but less concentrated from 2015 to 2016.

[Figure 9 about here]

Figure 9. Residential PV Lorenz curves over time for the national market

To summarize, the data suggest that the U.S. residential PV installation industry has gone through four phases of market structure since 2000:

- **2000–2006**: Market concentration fell as hundreds of new installers entered the market.
- **2006–2010:** By 2006, the market shares of the industry's highest-volume installers had stabilized and remained relatively constant through 2010, even though market entry continued. HHI similarly remained relatively stable from 2006 to 2010.
- **2010–2015**: The industry became increasingly concentrated between 2010 and 2015.
- **2015–2016**: The residential PV industry became less concentrated from 2015 to 2016.

The fourth trend (2015-2016) has been observed elsewhere [17], but it is too early to understand whether the trend will continue or whether it is an anomalous observation based on 1 year of data. The third trend (2010-2015) has been attributed to the emergence of alternative customer financing options. This hypothesis is explored in the following section.

4. Role of Customer Financing in the Evolving PV Market Structure

The U.S. residential PV installation industry became more concentrated between 2010 and 2015. This concentration may be driven by a number of factors, but some have proposed that PV market concentration may be associated with the emergence of alternative customer financing options [11, 14-17]. This section descriptively explores this hypothesis.

4.1 Background: Customer financing options

For much of the 2000s, residential PV customers had to buy PV system hardware to adopt PV. The customer ownership model entails a high up-front cost that serves as a key barrier to PV adoption for cash-constrained customers. Beginning in earnest in 2008 due to policy changes in California, PV installers began to offer a new customer financing option known as third-party ownership (TPO). In a TPO arrangement, the end-use customer "hosts" a third-party owned PV system and procures PV output through a lease or power purchase agreement. The ability to finance PV systems with low or no upfront costs makes TPO an attractive option for many customers [27-30]. Twenty-six states and Washington, DC explicitly allow TPO transactions, 9 states

explicitly prohibit TPO, and the remainder have ambiguous policy language [31]. By 2015, more than half of residential PV systems installed were TPO, including over 60% of systems in California [17]. Falling PV system prices have resulted in a shift back toward customer ownership in recent years [17].

TPO system installation exhibits greater returns to scale than customer-owned system installation for two reasons. First, TPO transactions are administratively complex, requiring financial and legal services that may exceed the capacity of low-volume firms [32]. Second, TPO products generally rely on tax equity whose costs tend to decline with scale. The reliance of TPO products on tax equity is an outcome of U.S. PV policy [16]. PV system owners are eligible for federal tax credits worth roughly half of installed system costs; however, few end-use customers or installers have sufficient tax liabilities to fully monetize these credits. As a result, installers generally sell TPO systems to tax-equity investors with sufficient tax bases to monetize the tax credits on behalf of the end-use customer. Tax-equity investors typically require asset portfolios on the order of tens of millions of dollars [16]. Low-volume installers may thus be unable to access cost-effective tax equity, whereas high-volume installers can aggregate systems at sufficient scale to leverage tax equity and offer more attractive TPO products [16]. As a result of these economies of scale, installers of TPO systems tend to be high-volume companies [11, 14-17].

The TTS data illustrate how high-volume installers have led the emergence of the TPO model. In 2016, high-volume installers (those installing more than 1,000 systems per year) accounted for about 32% of customer-owned systems but 82% of TPO systems. Further, only about 21% of installers installed a TPO system in 2016, although about 56% of all systems were TPO systems. In other words, relatively few installers installed TPO systems despite their popularity with customers.

4.2 Analysis: Relationship between market structure and customer finance

To the extent that the TPO model favors high-volume installers, the recent emergence of TPO products should correlate with and may contribute to increased market concentration. Trends in the data are consistent with this hypothesis. The period of increasing market concentration from roughly 2010 to 2015 corresponds with a period of increasing TPO penetration into the residential PV market (Figure 10). Further, increasing market concentration appears to have lagged behind increased TPO penetration, suggesting that the emergence of TPO drove concentration, rather than the inverse relationship. Falling market concentration from 2015 to 2016 corresponds with a period of falling TPO penetration.

[Figure 10 about here]

Figure 10. HHI and %TPO, 2000–2016

Similar relationships between TPO and market concentration are found at the state (Figure 11) and local (Figure 12) levels. Similar to national trends, increasing market concentration appears to lag behind increased TPO penetration by 1 or 2 years in most states and local markets. HHI appears to have increased sharply and contemporaneously with a rapid increase in TPO in the local market around Las Vegas. In contrast, HHIs showed relatively little response to increasing TPO in local markets around Jackson, NJ and Poway, CA.

[Figure 11 about here]

Figure 11. HHI and %TPO by state, 2008–2016

[Figure 12 about here]

Figure 12. HHI and %TPO by local market, 2008–2016

When treated as separate markets, the market for TPO systems is more concentrated than the market for customer-owned systems (Figure 13). HHIs for customer-owned systems fell from 2000 to 2010 and have remained relatively low through 2016, with no evidence of increasing concentration from 2010 to 2015. In contrast, after an initial reduction in HHI from 2004 to 2008, HHIs for TPO systems rose from 2008 through 2015. In other words, increasing market concentration is only observed among TPO systems. By 2015, the HHI of customer-owned systems was 0.02, whereas the HHI of TPO systems was 0.27. Figure 14 provides further descriptive evidence that residential PV market concentration is associated primarily with TPO systems. The figure plots HHIs in states with high TPO penetration (>10%) and low TPO penetration (<10%). Some states have relatively low or zero TPO penetration due to policy restrictions on electricity sales to retail customers by non-utility companies [31]. Market concentration appears to decline in both state groups from 2000 to 2010. Beginning around 2010, market concentration increases significantly in high-TPO penetration states but increases only marginally in low-TPO penetration states. By 2015, HHI in high-TPO penetration states was 0.13, compared to 0.02 in low-TPO penetration states.

[Figure 13 about here]

Figure 13. HHI for TPO and non-TPO systems

[Figure 14 about here]

Figure 14. HHI for states with and without high TPO penetration levels

The data provide descriptive evidence that emergence of TPO contributed to increasing residential PV market concentration. Other factors may include falling prices as well as mergers and acquisitions. Falling prices can drive market concentration in emerging industries, as some firms become un-profitable as prices fall and cede market share to more efficient firms [33]. Median installed prices for residential PV systems declined from $11.9/W in 2000 to $4.0/W in 2016 [19]. The effects of falling prices on market concentration may be an area for future research. Mergers and acquisitions can also drive market concentration, given that the market shares of multiple firms are combined into the market share of a single firm in the event of a merger. By one estimate, about 68 mergers and acquisitions occurred in the PV industry in 2016, though this estimate may include non-installation firms such as PV manufacturing and financial services firms [34].

Some high-cost installers that entered the market during a high-price period may have exited the market as prices declined. Such high-cost exits ultimately would cede market share to lower-cost installers. PV market concentration may therefore reflect the accumulation of market share among low-cost or innovative installers [6, 33]. The relationship between PV prices and market structure is an area for further research.

5. Discussion and Conclusion

The U.S. residential PV installation industry is evolving alongside rapidly growing PV markets. In 2000, fewer than 100 companies installed residential PV systems in the United States. By 2015, more than 3,000 residential PV installers were active in the United States. The vast majority of these installers are small local businesses, yet a few high-volume regional- and national-scale installers have emerged and possess disproportionately high market share. As a result, the industry has become somewhat concentrated, with HHI increasing by a factor of ten from 0.013 in 2010 to a peak of 0.13 in 2015, before falling slightly to 0.09 in 2016. The data support the hypothesis that the recent increase in market concentration is driven primarily by increasing concentration for TPO rather than customer-owned systems.

The objective of this study is to describe trends in residential PV market structure rather than analyze the implications of those trends. The implications of market concentration are not unambiguously positive or negative for the residential PV industry. The relationship between concentration and the TPO model suggests that PV market concentration may have facilitated market growth, given that the TPO model resulted in a significant expansion of the residential PV market [27, 28]. Further, several studies indicate that market concentration may generate lower market prices [9, 11, 14]. At the same time, market concentration may allow high-volume installers to exercise more

market power, which could result in higher prices [35, 36]. Further, high-volume installers tend to rely on higher-cost customer acquisition methods such as lead purchasing rather than the lower-cost referral method generally used by small-scale local installers [37, 38], so that high levels of concentration could increase certain industry costs. The effects of market structure on market growth and prices are areas of future research.

This study has provided a data-driven description of the rapidly evolving residential PV installation industry. The implications of these trends, particularly of increasing market concentration, are areas for further research. The evolution of the PV installation industry has shaped and will continue to shape residential PV markets. An improved understanding of the structure of this growing industry will inform future PV installation industry research and policymaking.

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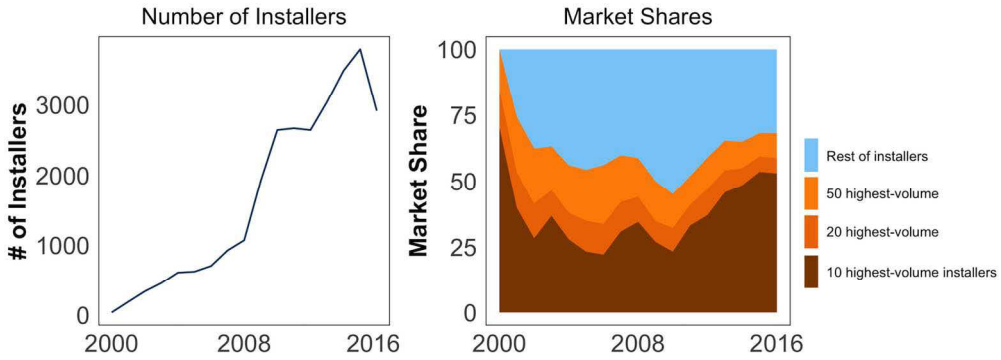
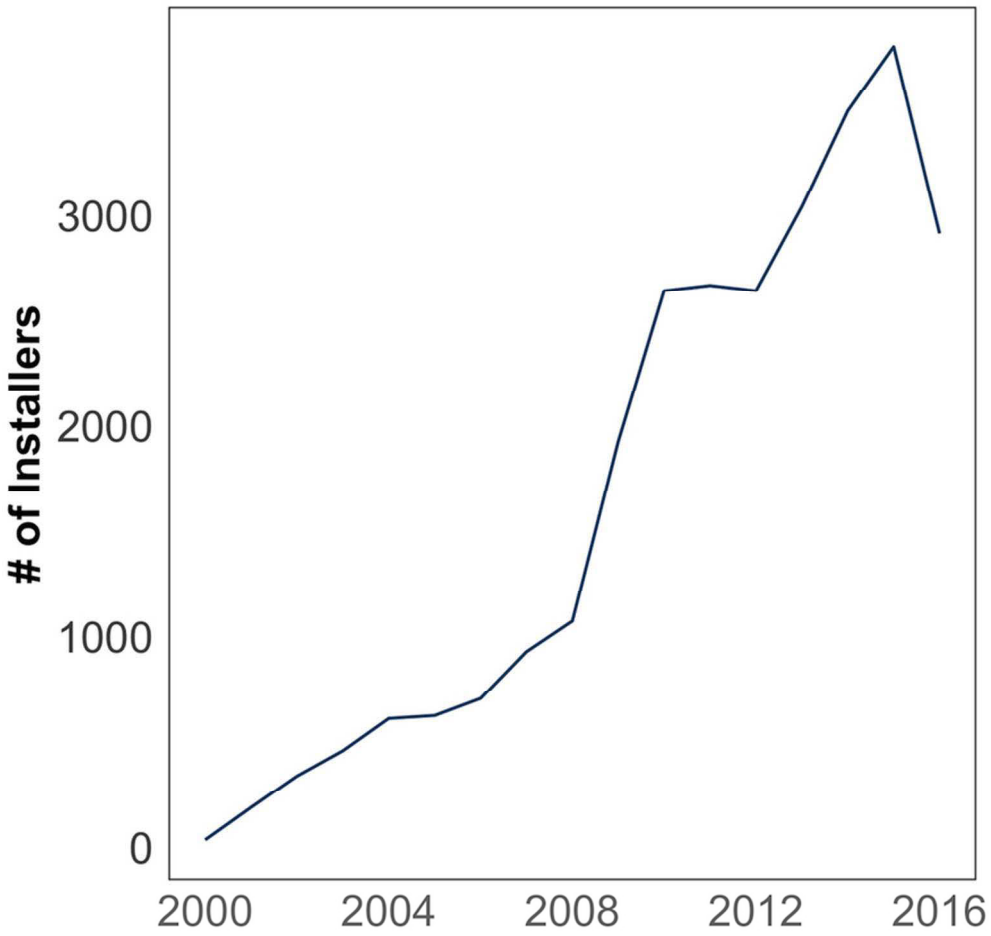


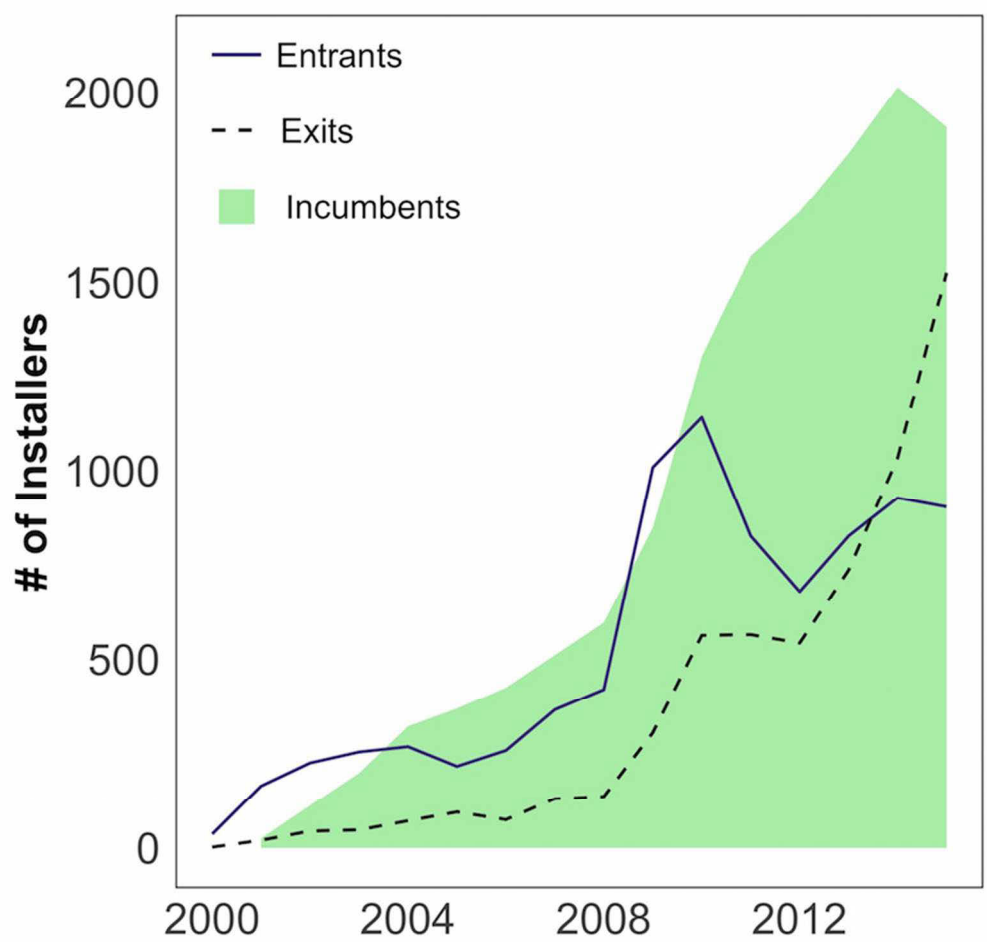
The U.S. residential solar photovoltaic (PV) installation industry grew from fewer than 100 firms installing PV in 2000 to more than 3,000 firms by 2015 (left pane). More than 8,000 different companies have installed at least one residential PV system in the United States. The vast majority of these firms are small, local companies: about 61% of installation firms installed fewer than 10 systems in 2016. At the same time, some high-volume installation companies have grown to hold high market shares (right pane). This research article documents these trends in residential PV market structure in the United States. A rich dataset of nearly one million PV systems is leveraged to describe PV installation market structure and descriptively analyze drivers behind increasing market concentration.

150x55mm (300 x 300 DPI)



Number of installers, 2000-2016

74x74mm (300 x 300 DPI)

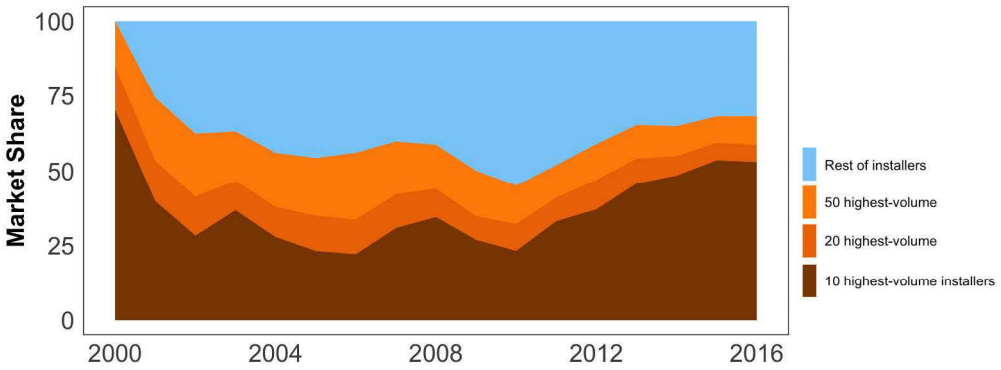


Market entry, exit, and incumbency, 2000-2016

75x75mm (300 x 300 DPI)

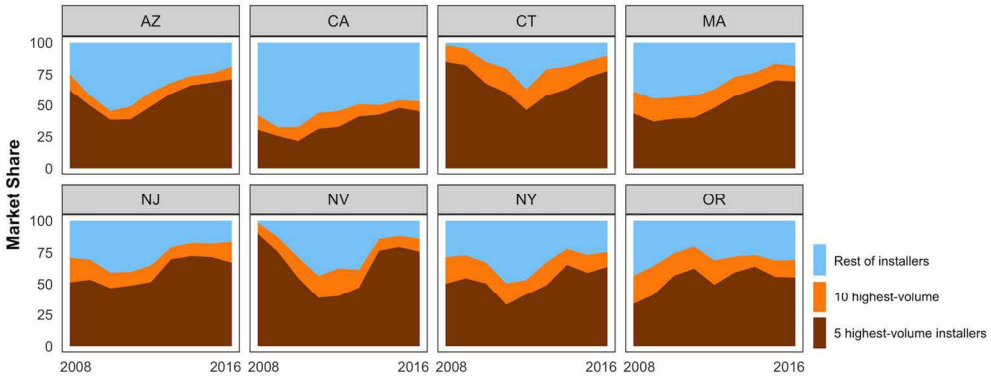
Number of installers (logged) by state in 2016, white states represent states with no data

32x13mm (300 x 300 DPI)



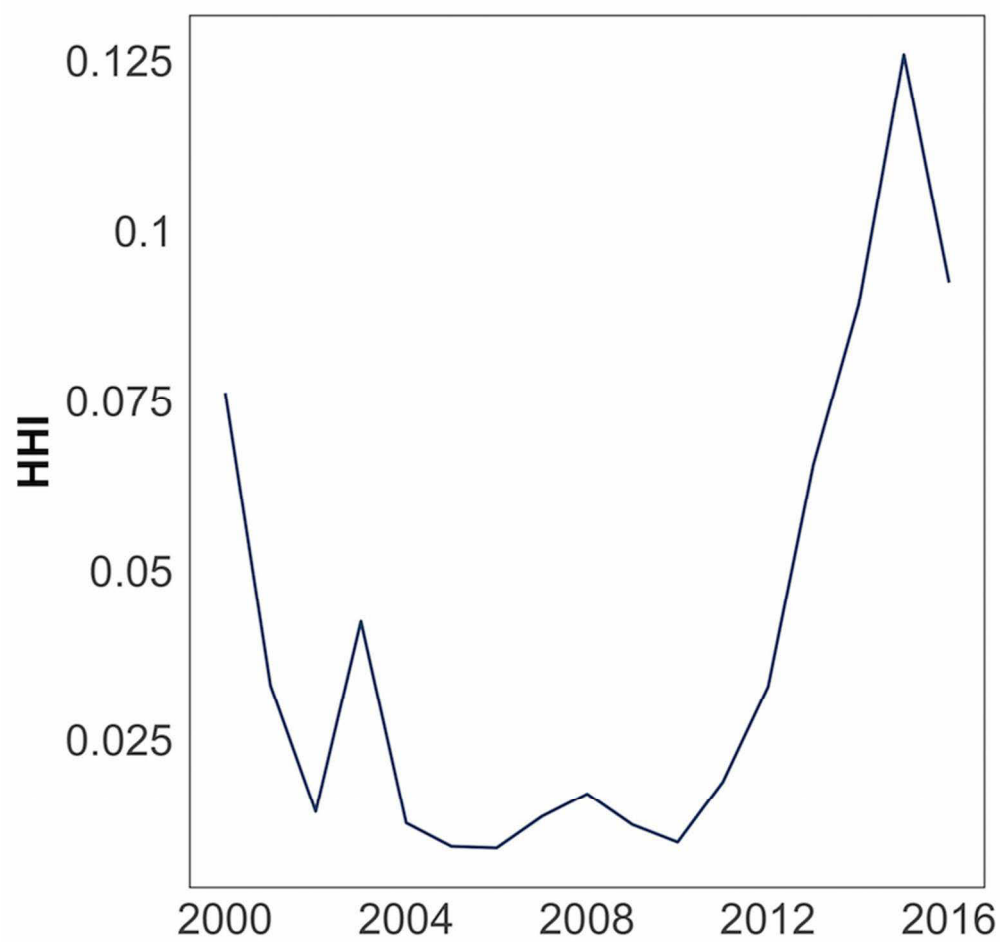
Market shares of highest-volume 10, 20, and 50 installers, 2000-2016

386x150mm (300 x 300 DPI)



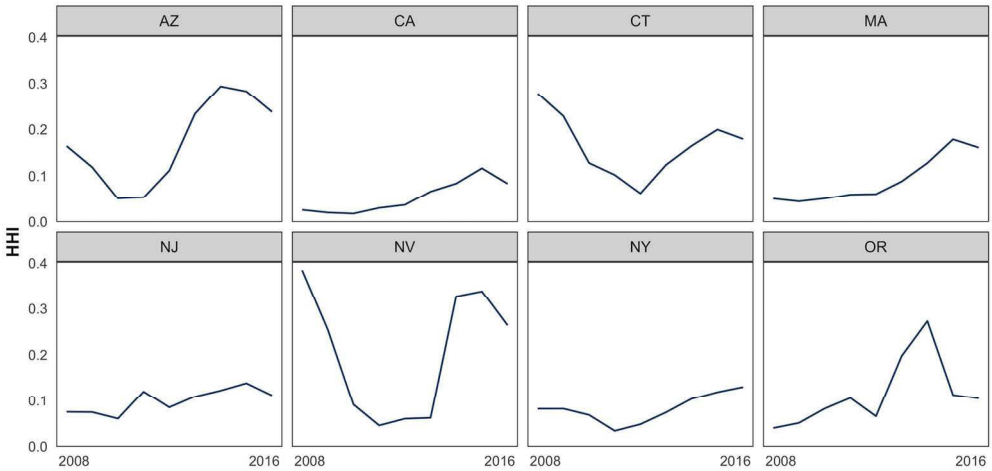
Market shares of largest 5 and 10 installers by state, for the eight states with the most installations in the dataset, 2008-2016

150x59mm (300 x 300 DPI)



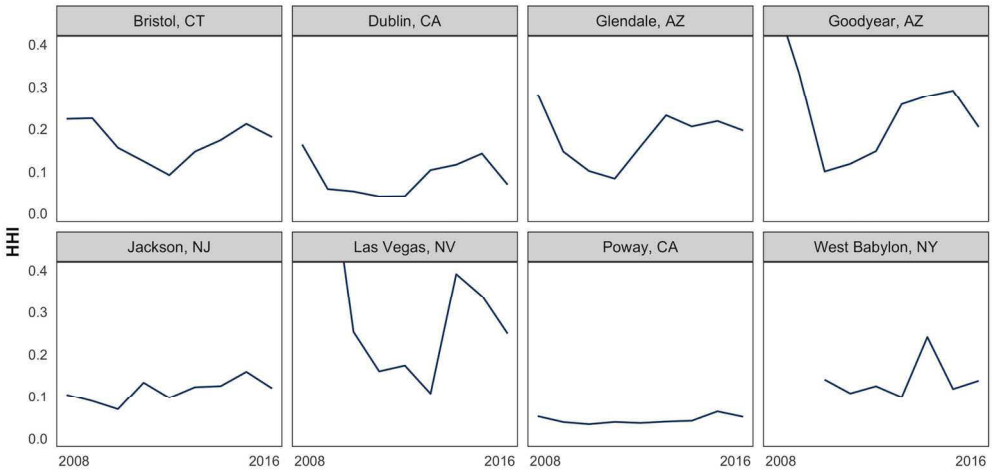
Residential PV installation industry HHI, 2000-2016

75x75mm (300 x 300 DPI)



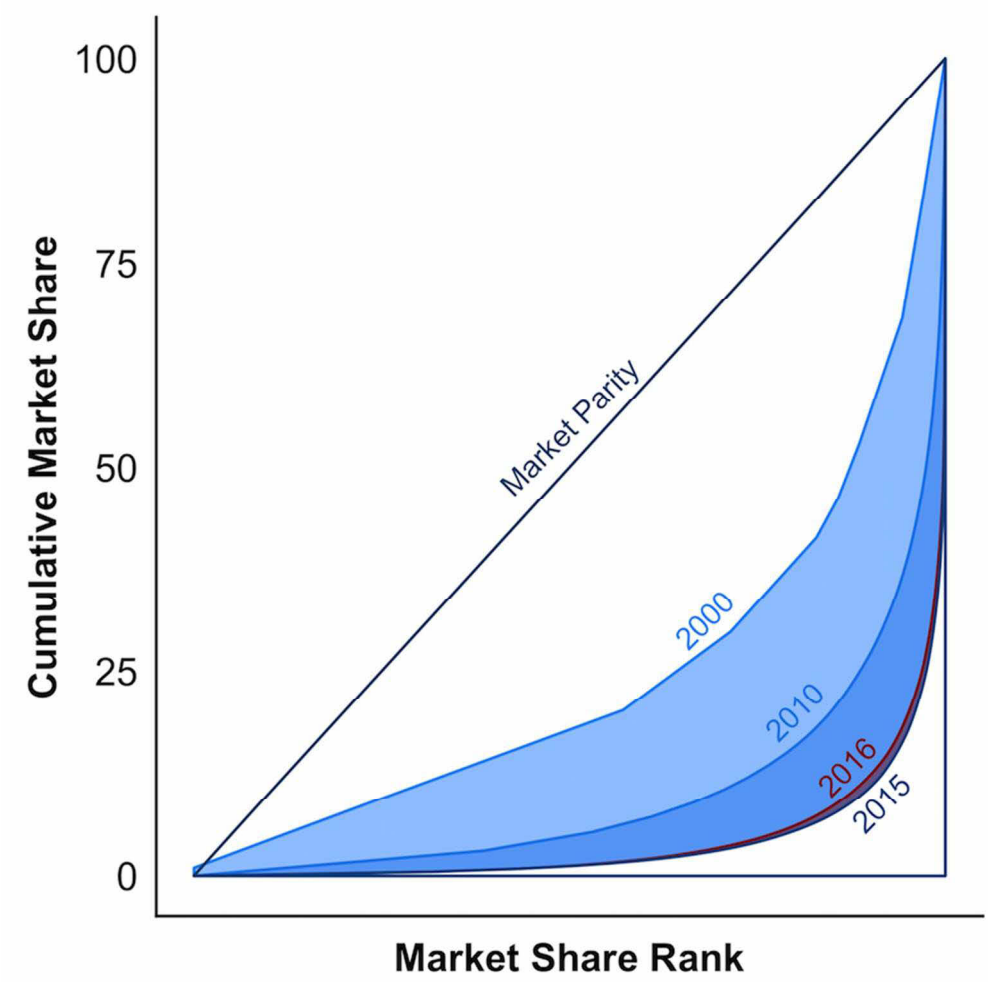
HHI for the eight states with the most installations in the dataset, 2008-2016

150x75mm (300 x 300 DPI)



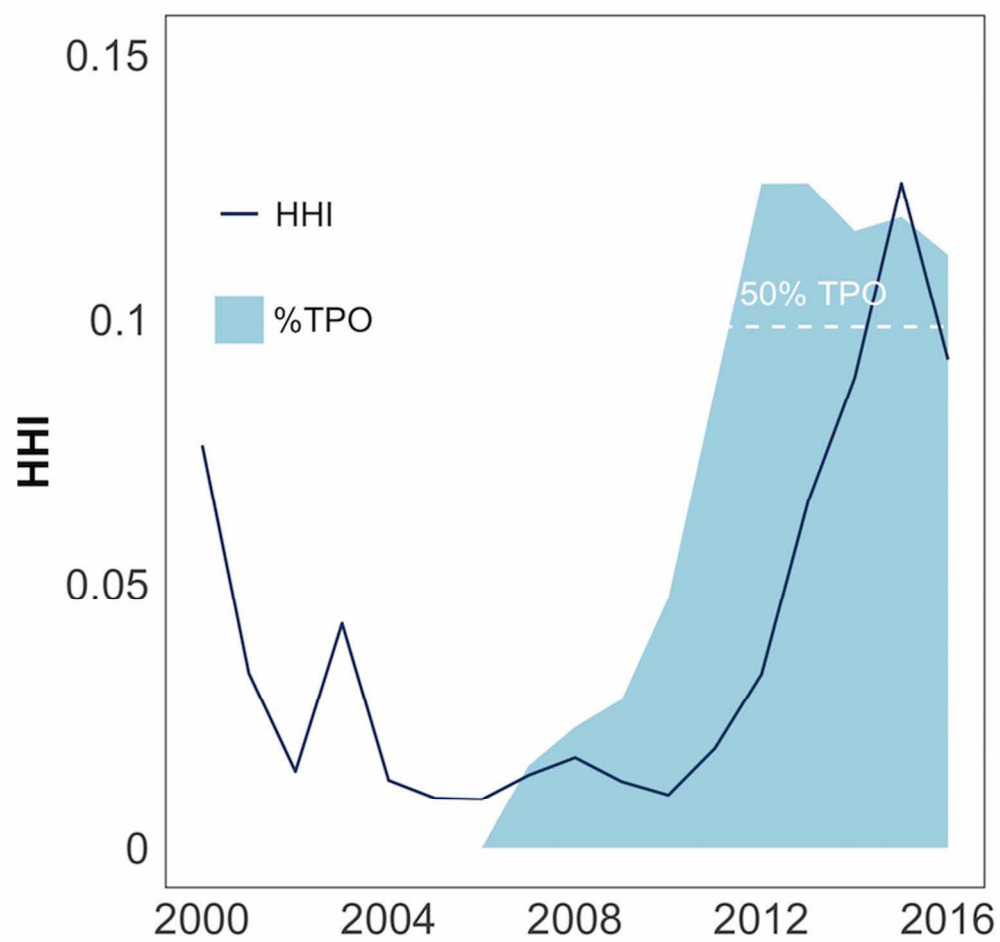
HHI for the eight local markets with the most installations in the dataset, 2008-2016

150x75mm (300 x 300 DPI)



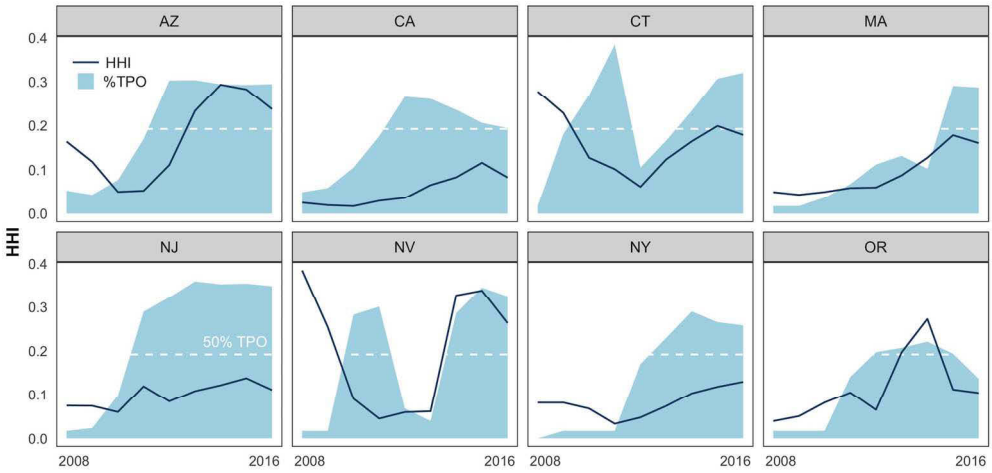
Residential PV Lorenz curves over time for the national market

75x75mm (300 x 300 DPI)



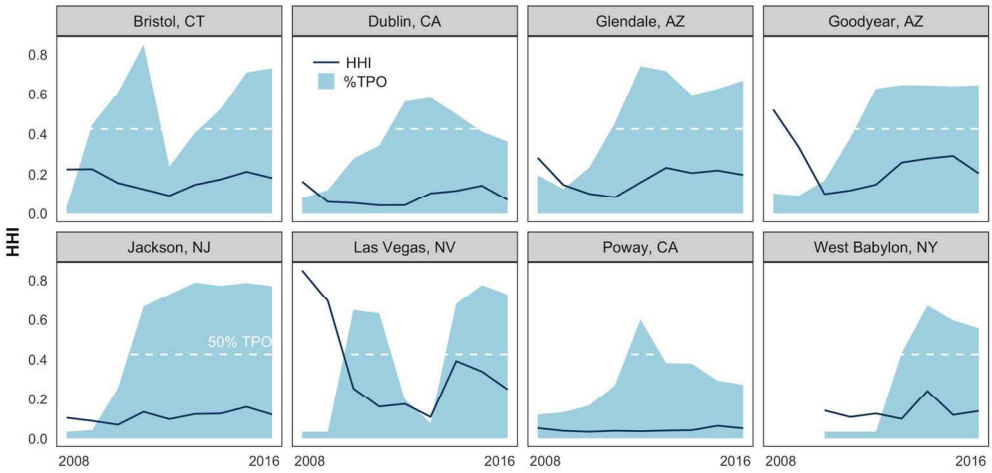
HHI and %TPO, 2000-2016

75x75mm (300 x 300 DPI)



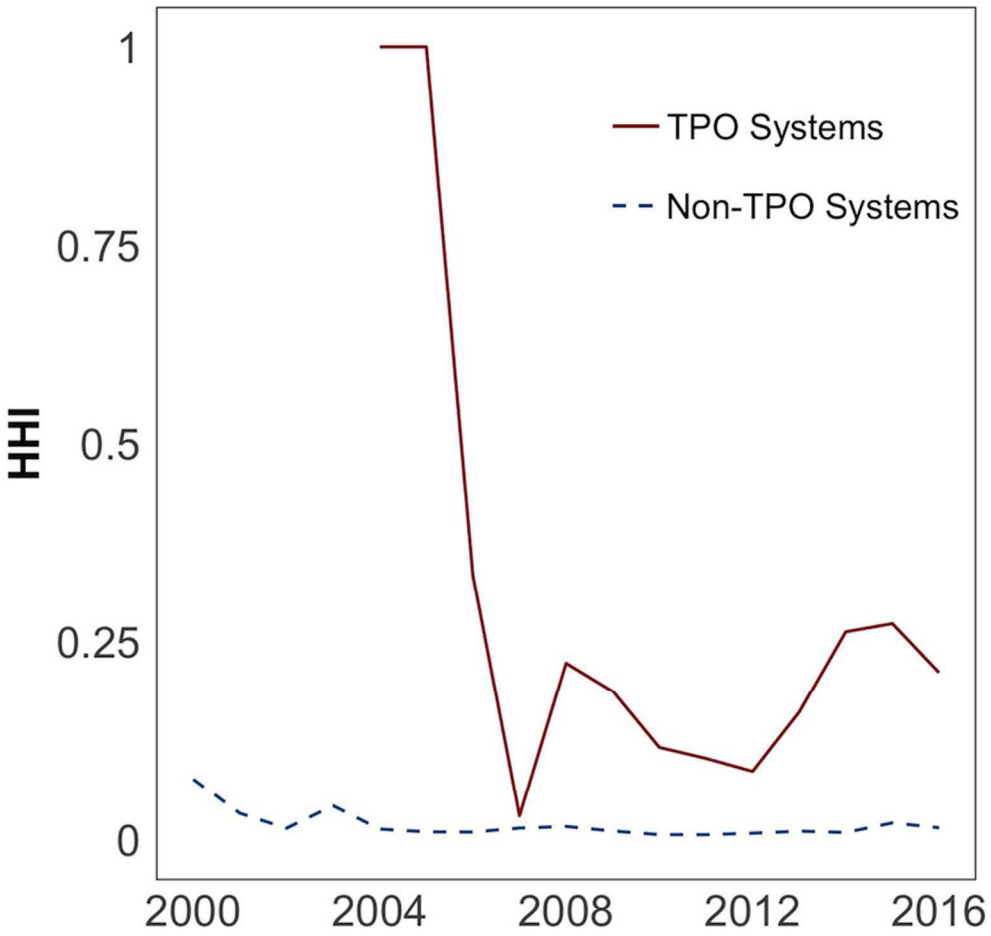
HHI and %TPO by state, 2008-2016

150x75mm (300 x 300 DPI)



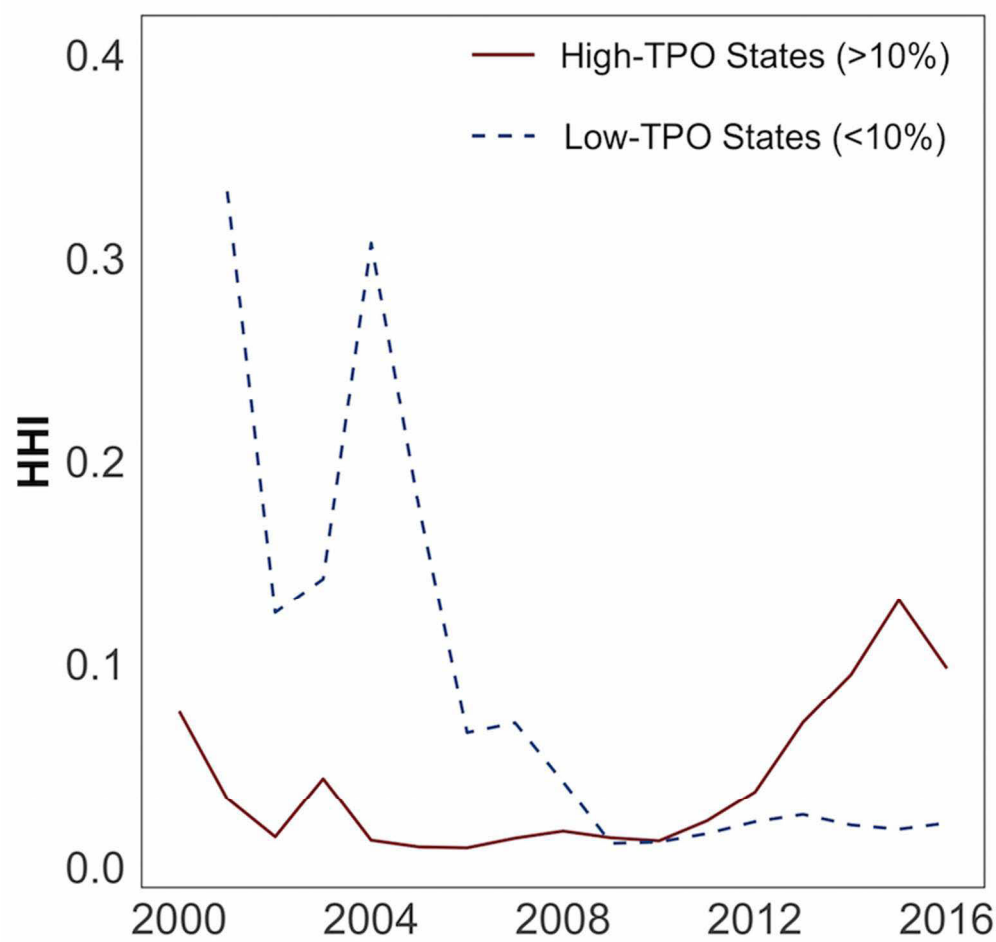
HHI and %TPO by local market, 2008-2016

150x75mm (300 x 300 DPI)



HHI for TPO and non-TPO systems

75x75mm (300 x 300 DPI)



HHI for states with and without high TPO penetration levels

75x75mm (300 x 300 DPI)