Residential Solar Market and Utility Policy in New Mexico

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DEPARTMENT OF ECONOMICS

Executive Summary

Expanding residential solar energy is a central component of New Mexico's energy transition strategy for meeting its renewable energy and climate goals. Despite the declining costs of solar technology and the presence of financial incentives, considerable variation in installation prices persists across communities. This raises important questions about how market structure may contribute to these disparities and whether policy design can help promote more equitable adoption by alleviating these disparities. This paper examines whether market concentration influences solar installation prices and evaluates how two major policies, Net Energy Metering (NEM) and the Investment Tax Credit (ITC), shape market outcomes.

The analysis draws on aggregated solar market data from both New Mexico and a national sample of residential solar markets, as well as individual household-level solar adoption data. Using city-year-level panel data and fixed effects regression models, the study investigates two central questions: (1) whether market concentration, measured by the Herfindahl-Hirschman Index (HHI), helps explain observed variation in prices, and (2) how the Investment Tax Credit (ITC) and Net Energy Metering (NEM) influence firm entry, market concentration, and pricing. In a subsequent analysis, individual-level data are used to assess whether differences in NEM program design affect the size of installed solar systems.

Our key findings are:

- In New Mexico, higher HHI is associated with higher installation prices only in urban and highly concentrated city-year markets. In rural or moderately concentrated markets, this relationship is absent or even reversed. At the national level, however, market concentration is positively associated with prices across all HHI groups.

- The ITC is correlated with increased firm entry, lower market concentration, and reduced installation prices, particularly in more concentrated markets. In contrast, NEM is associated with fewer active firms and increased market concentration in competitive markets, with little effect on price reductions.

- Differences in NEM program design appear to affect the capacity choice of rooftop solar systems. Households under the credit rollover NEM structure tend to install larger systems than under monthly true-up, suggesting that NEM structure influences consumer investment behavior.

These findings carry several policy implications. First, they suggest that market structure can mediate the pass-through of solar incentives to consumers, with concentrated markets more likely to exhibit higher prices and limited firm participation. Second, while both ITC and NEM aim to promote solar adoption, the ITC appears more effective at encouraging competition and

reducing prices, particularly in more concentrated markets. Finally, NEM structure influences installation sizing, with credit rollover provisions associated with larger systems under the current market conditions. This implies that tailoring NEM structures to policy goals, such as accelerating clean energy deployment or managing grid stability, can be a valuable tool for guiding adoption behavior. For example, if the goal is to prevent rapid, concentrated growth in residential solar that could strain local distribution infrastructure or complicate grid balancing due to midday generation surges, a monthly true-up NEM design may help moderate system sizing and promote more incremental expansion.

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1 Introduction

Since 2010, New Mexico (NM) has experienced exponential growth in residential solar photovoltaic (PV) installations. The average annual growth rate from 2010 to 2023 is approximately 27%. Currently, over 6% of NM households have solar PV systems installed on their rooftops and the total capacity of residential solar (280 MW in 2023) accounts 15% of the states total solar capacity. In alignment with NM's zero-carbon objective, the existing solar PV capacity is projected to expand sixfold by 2035 (National Renewable Energy Laboratory 2021).

There is an expanding body of literature examining the equity implications of the current trend in solar installations (Darghouth et al. 2022; Gao and Zhou 2022; Sovacool et al. 2022). In a previous white paper on solar equity in NM, we investigated the adoption and distribution equity within the NM context (Yang and Zhao 2024). We find that while residential solar PV adoption in New Mexico has grown rapidly since 2010, this growth has been unevenly distributed, favoring higher-income, urban, and White-majority census tracts. However, the primary source of adoption disparity stems from differences in income and education, with minimal racial disparities observed. State-level solar tax credits have proven effective in mitigating these disparities, especially during periods when incentives are available, although the distribution of tax credit benefits remains concentrated among wealthier households with higher electricity consumption.

With the extensive dataset we collected for the residential solar market in NM, which includes household-level solar installation data, housing characteristics, utility-level solar incentives, and tract-level demographic information, we aim to conduct a deeper analysis of the solar market structure and utility incentives in NM in this white paper. Specifically, we explore how differences in market structure and utility incentives affect solar adoption. The findings from this project offer insights into policy and incentive designs that could accelerate residential solar adoption to meet the state's zero-carbon goal.

1.1 Market structure, dynamics, and solar pricing

The rapid growth in the adoption of residential solar PV systems has been accompanied by a steady decline in average installation costs. However, despite broad cost declines, significant variation in system prices persists across local markets. A key factor contributing to this price dispersion is the variation in market structure and the degree of competition among solar installers across regions (Gillingham et al. 2016).

Economic theory suggests that higher market concentration can reduce competitive pressure, allowing firms with greater market power to charge higher prices relative to those in more competitive environments. In such environments, consumers may face fewer choices and pay higher markups for comparable systems. However, in emerging technology markets like residential solar, market concentration does not uniformly lead to higher prices. Dominant firms may realize cost advantages through economies of scale and learning-by-doing (E. O'Shaughnessy 2019), enabling them to lower prices while remaining profitable.

Indeed, research has documented substantial learning effects in solar panel production. Williams and Terzian (1993) estimate a global learning rate of 18% for panel prices between 1976 and 1992, and subsequent studies report similar rates of around 20% (IEA 2000; Van der Zwaan and Rabl 2004). At the local level, installer experience also contributes to lower prices, as shown by Gillingham et al. (2016). These findings suggest that the relationship between market concentration and prices is complex. As E. O'Shaughnessy (2019) argues, the effect is non-monotonic: while concentration may lower prices in relatively competitive markets due to efficiency gains, it can raise prices in already concentrated markets where firms exercise market power.

Public policy incentives also influence price outcomes in emerging markets. However, the effectiveness of these incentives depends critically on local market structure. In competitive markets, lower concentration tends to enhance the likelihood that subsidies and incentives are passed through to consumers in the form of lower installation prices. For instance, studies of the relatively competitive California solar market find that consumers captured nearly the full value of available incentives (Dong et al. 2018; Pless and Van Benthem 2019). In contrast, in more concentrated markets, pass-through rates tend to be lower. As Adachi and Fabinger (2022) point out, the degree of pass-through in imperfectly competitive settings is shaped by factors such as the elasticity of demand, marginal costs, and the pricing behavior of firms.

In this study, we investigate how market structure influences pricing in the residential solar PV market and how policy incentives affect market dynamics. We focus on two key policy instruments: net energy metering (NEM) and the investment tax credit (ITC). During the study period, both NEM and ITC were in place in NM. NEM has been uniformly implemented across NM since 2008, with all utility companies—including investor-owned utilities (IOUs), rural cooperatives, and public utilities—mandated by the New Mexico Public Regulation Commission (NMPRC) to offer NEM programs.

The ITC, on the other hand, is available at both federal and state levels. The federal ITC, introduced under the Energy Policy Act of 2005, consistently provided a 30% credit for solar installations throughout our study period. In contrast, state-level ITC policies exhibit meaningful variation over time. NM introduced the Solar Market Development Tax Credit (SMDTC) in 2006, offering a 10% credit on total solar PV installation costs, capped at $9,000 per taxpayer annually, and remained in effect until December 31, 2016. NM reinstated this incentive in 2020 through the New Solar Market Development Tax Credit (NSMDTC). Due to data limitations, our data set is restricted to periods when the state-level ITC was in effect.

Figure 1 illustrates changes in market outcomes during these periods. Following the initial introduction of the SMDTC in 2006, the number of active installers increased substantially. The tax credit was suspended between 2017 and 2019. After the policy was reinstated in 2020, the market experienced renewed firm entry and a relatively stable market concentration level, measured by the Herfindahl-Hirschman Index (HHI), suggesting sustained competition. These patterns suggest that state-level policy incentives play a crucial role in supporting market entry and maintaining industry competitiveness. However, given that the federal ITC remained consistently in place throughout the period, observed effects may reflect the combined influence of both federal and state-level incentives. In Section 2, we examine both theoretically and empirically how policy incentives influence firm entry and exit, and how these dynamics affect equilibrium prices in the residential solar market.

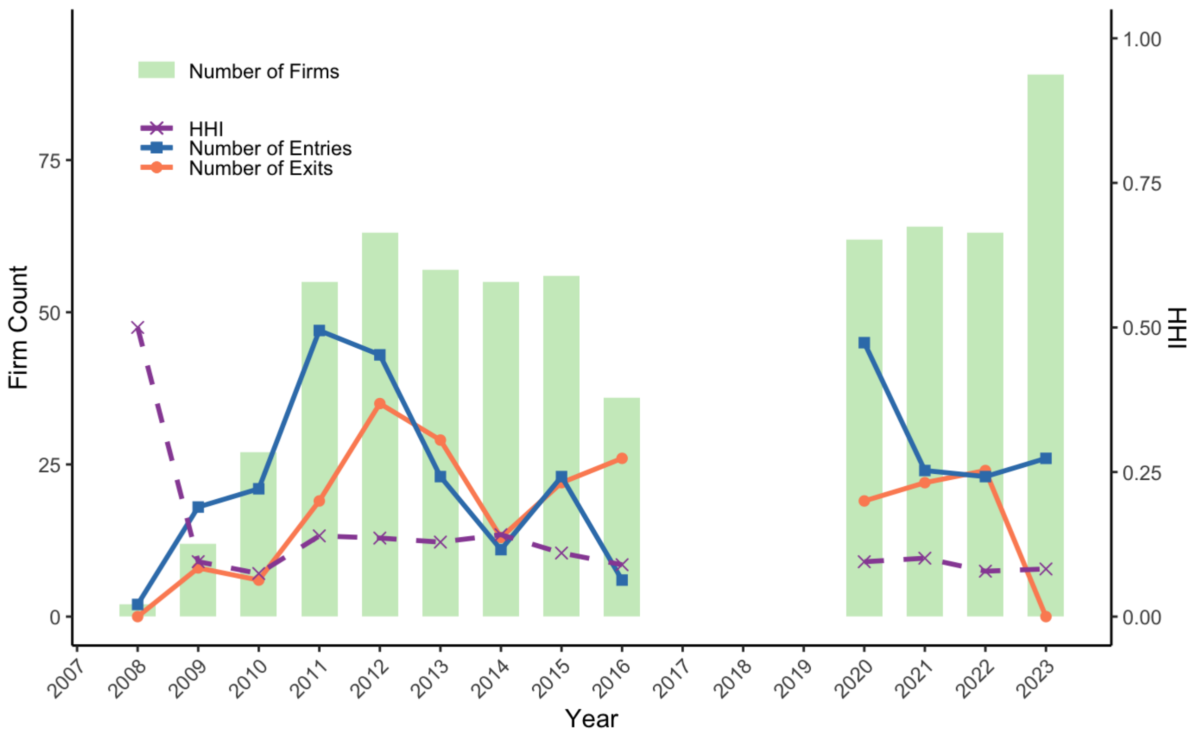


Figure 1: Market Dynamics in New Mexico

Note: The market dynamics shown in the figure—number of active firms, entries and exits, and the state-level HHI—reflect the combined effects of multiple state and federal incentives, including NEM and ITCs. NEM has been in effect in NM since 2008. The federal ITC was introduced in 2005. The NM ITC was implemented in 2006, suspended from 2017 to 2019, and reinstated in 2020. The data source, Lawrence Berkeley National Laboratory Tracking the Sun (2024) dataset, contains no observations during this policy discontinuity.

1.2 Utility policies and solar adoption

1.2.1 Net Energy Metering

A key policy incentive for the adoption of solar PV is NEM.[1] NEM allows consumers to sell excess solar generation back to the grid at the retail electricity price and received bill credit for these net excess (Figure 2). Therefore, NEM effectively enhances the financial attractiveness of solar investments, shortens the payback period and improves returns on these investments (Borenstein 2017). In the United States (US), NEM has been widely adopted, with all but four states having implemented state-level NEM mandates (Figure 3).

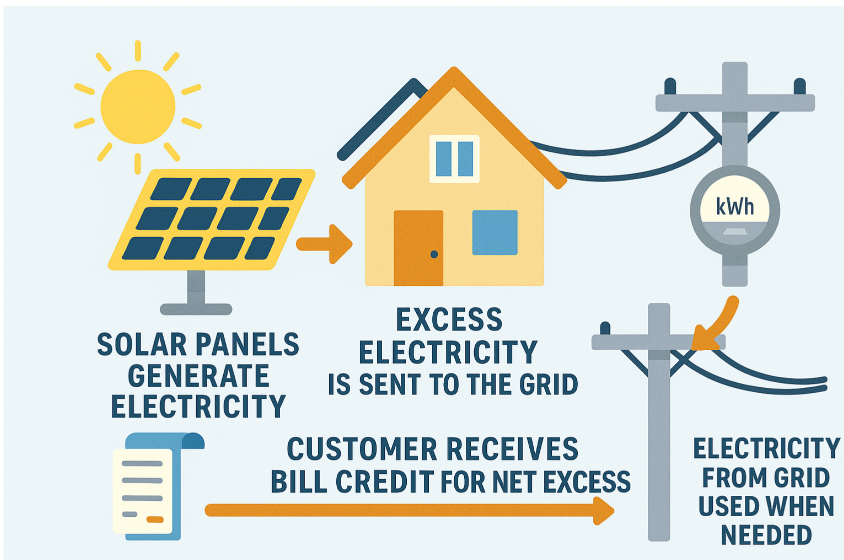


Figure 2: How NEM works for solar households

Note: The info graphic is generated by ChatGPT 4o.

Despite the general mandate of NEM, variations exist across utilities in terms of specific incentive structures, which can affect investment decisions and consumer participation in the solar market. These structures range from monthly true-ups, often based on the avoided cost rate and typically regarded as the least generous policy, to indefinite credit rollover, which is considered the most generous. In between, there are other structures such as annual true-ups, credit rollover within the year and excess credit granted to the utility at the end of the year, credit rollover with eventual surrender, and the option for annual true-up or rollover, offering varying degrees of benefit to consumers.

[1] Other policy incentives includes solar tax credit, property tax exemption, sales tax exemption, and renewable energy credit. See Yang and Zhao (2024) for a detailed summary of the policy incentives.

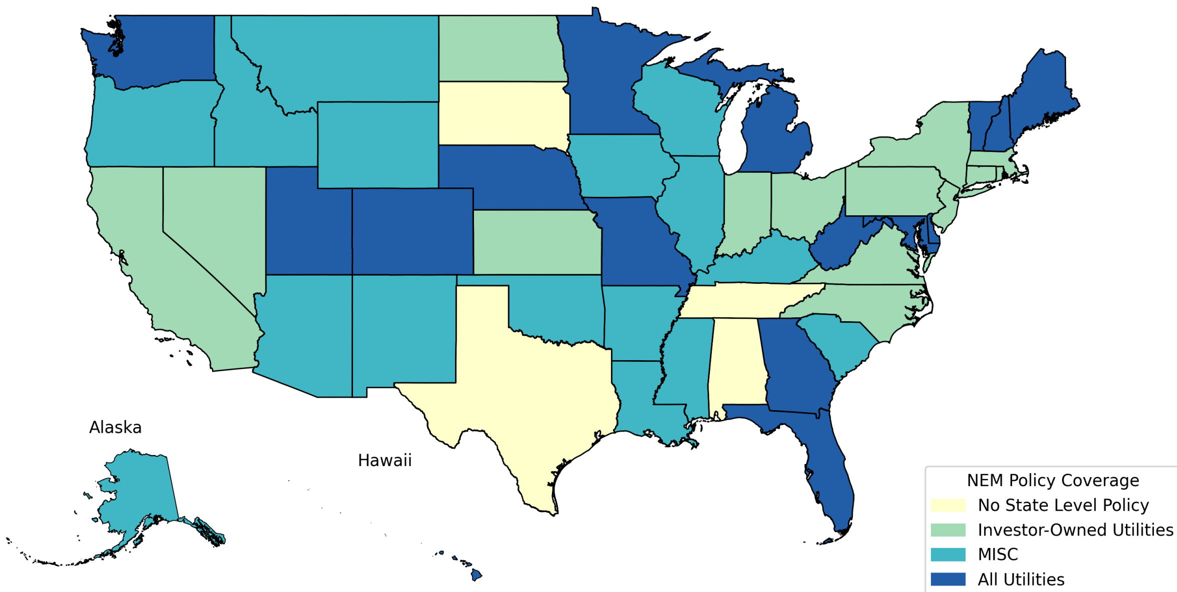


Figure 3: NEM mandates in US states

Note: States shown in yellow do not impose state-level NEM mandates; however, individual utilities may choose to adopt NEM practices. States in green mandate NEM policies only for investor-owned utilities, with no specific regulations for cooperatives or public utility companies (see Appendix A.1 for detailed utility coverage). States in turquoise (MISC) enforce NEM policies for a subset of utilities, typically including IOUs and cooperatives. States in dark blue have NEM mandates that apply to all utilities.

In the *credit rollover* NEM structure, any excess electricity generated by a customer in a given month is credited to their account and can be rolled over to offset future electricity usage. These credits never expire, remaining on the customer's account until it is closed. The remaining credits at the time of account closure are cashed out at some future purchase price, typically much lower than the retail electricity rate. The Public Utility Company of New Mexico (PNM) currently adopts this NEM structure.[2]

In the *true-up* NEM structure, excess generation of the billing period is compensated at a predetermined wholesale rate that is lower than the retail rate. True-up structures can vary by utility and typically fall into either monthly or annual settlement schedules. For example, El Paso Electric (EPE) utilizes a monthly true-up, where excess generation is credited to the customer at the end of each billing cycle at the lower, wholesale rate.[3] In contrast, Jemez Mountains Electric Cooperative (JMEC) implement an annual true-up structure.[4] In this setting, credits for excess

[2]For details on PNM's NEM policy, see https://www.pnm.com/solar-interconnection-benefits#netmetering.

[3]EPE's NEM policy: https://www.epelectric.com/renewables-tech/distributed-generation/new-mexico-interconnection-of-facilities-less-than-10-kw.

[4]JMEC's NEM policy: https://www.sdge.com/residential/savings-center/solar-power-renewable-energy/

generation are accumulated throughout the year and cashed out at the end of a 12-month period at the wholesale rate. These structural differences in NEM policies across utilities can lead to varied investment and consumption decisions by households, as they adapt to optimize their returns based on the incentives offered.

It is worth noting that New Mexico's state-level NEM mandate applies only to regulated utilities, including all investor-owned utilities (IOUs) and rural electric cooperatives. Publicly owned utilities are not subject to this mandate and may independently determine their compensation structures. For example, the Los Alamos Department of Public Utilities and the City of Farmington Electric Utility System adopt a net billing structure. Table A.2 lists the NEM structure of all NM utilities that serve residential customers.

1.2.2 Literature on NEM and solar adoption

A significant body of work has examined the impact of NEM on solar adoption, with studies showing that NEM policies can significantly reduce the payback period for solar systems, thereby incentivizing adoption among residential consumers (Borenstein 2017; Brown and Sappington 2017; Gautier, Jacqmin, and Poudou 2018; Ros and Sai 2023). Further research has explored the effect of NEM policies on energy consumption patterns and solar rebound effects (Boccard and Gautier 2021; Gautier, Hoet, et al. 2019; La Nauze 2019; Oliver et al. 2024). Additionally, the impact of NEM policies on utility revenue and rate design has been discussed, as utilities face challenges in adjusting their rate structures to account for the cost-shifting effects of distributed solar generation (Eid et al. 2014; Manuel de Villena et al. 2021). However, there is little research that compares optimal capacity choices under varying NEM structures.

Many studies have also examined solar PV adoption and its distributional impacts, which focuses on the factors influencing who adopts solar energy and how the benefits of adoption are distributed across different socio-economic groups. Literature in this area identifies various factors affecting solar adoption, such as income, subsidies, and peer effects (Bollinger and Gillingham 2012; De Groote and Verboven 2019; E. O'Shaughnessy 2022; O'Shaughnessy et al. 2021). Furthermore, studies on the distributional impacts of solar adoption reveal that solar energy uptake is often unequal across different demographic groups, particularly in terms of income and race (Best et al. 2023; Borenstein and Davis 2016; Darghouth et al. 2022; Dorsey and Wolfson 2024). Yet, few paper studies how NEM policies may influence the intensive margin of solar PV adoption (i.e., capacity choices) and whether these policies disproportionately benefit certain groups. In Section 3, we examine the impact of NEM structure on capacity choices using the NM residential solar data.

net-energy-metering/billing-information/excess-generation

2 Market structure and pricing

To understand how market power shapes pricing outcomes in the residential solar industry, we begin by examining the relationship between market concentration and installation prices. Economic theory suggests that in markets with limited competition—where a few firms dominate—prices are typically higher due to reduced competitive pressure and potential for markups. To empirically evaluate whether this relationship holds true in the solar market, we calculate the HHI at the city level to measure market concentration and examine its correlation with residential solar installation prices. Unlike some other studies, such as E. J. O'Shaughnessy (2018), which define a customer's market as the set of zip codes within a certain radial distance to better capture underlying economic interactions—we define markets based on city boundaries in this study. In the context of NM, cities tend to be moderately sized, governed by uniform regulations, and have accessible and similar population characteristics. These features make city-level analysis a contextually appropriate and tractable choice for capturing competitive dynamics. Our analysis focuses on NM and also compare our findings against national patterns to contextualize state-specific dynamics.

Beyond the direct relationship between market power and prices, the effectiveness and pass-through of solar tax incentives may also depend on the underlying market structure. In the second part of the analysis, we examine how state-level solar incentive policies interact with existing market concentration to influence market dynamics—specifically, firm entry and exit patterns. We then assess how these resulting structural changes affect installation prices, shedding light on whether incentives lead to more competitive outcomes or are absorbed by dominant firms in concentrated markets.

2.1 Data description

To conduct the empirical analysis, we assemble a dataset from various public sources. The primary component is solar PV system-level installation data from Lawrence Berkeley National Laboratory's Tracking the Sun database, which provides information on installation year, installer company name, and geographic location at the zip code level. We aggregate the installation counts by installer to the city level, mapping zip codes to cities using the Census Bureau's reference file[5]. Based on this aggregation, we define a firm's entry year into a city-level market as the first year in which it recorded a non-zero number of installations, and the exit year as the last year with non-zero installations in that city.[6] We then calculate the HHI at the city-year level to measure the degree of market concentration. The HHI is computed as the sum of squared

[5] We used the Zip Code Tabulation Area 5-Digit (ZCTA5) to Place mapping from the Census Bureau's reference file available at https://www2.census.gov/geo/docs/maps-data/data/rel2020/zcta520/tab20_zcta520_place20_natl.txt

[6] A firm may be inactive but still considered in the market if a year with zero installations is followed by a year with positive installations.

market shares of all active firms within a city in a given year:

$$\mathrm{HHI}ct = \sum_{i \in \mathcal{F}_{ct}} s_{ict}^2, \tag{1}$$

where s_{ict} denotes the market share of firm i in city c and year t, and $\mathcal{F}_{ct}$ is the set of active firms in that city-year.

We complement the solar installation dataset with city-level demographic characteristics obtained from the U.S. Census Bureau, including total population, number of housing units, area median income, share of the population with at least a high school diploma (or equivalent), share of the White population, and the indicator of urban city if the share of urban population is more than 50%. Additionally, we incorporate state-level solar policy incentives (ITC and NEM) into the final dataset. The installation price and the area median income are inflation adjusted into 2023 dollars.

The final dataset includes 26,318 complete observations from 2010 to 2023. For the main empirical analysis, we focus on the sample from NM with 687 city-year observations. Summary statistics for the NM sample by HHI range over the study period is presented in Table 1.

Table 1: Descriptive statistics (NM sample by HHI level group)

	Low HHI (N = 32) (HHI≤ 0.15)		Moderate HHI (N = 92) (0.15 <HHI≤ 0.25)		High HHI (N = 563) (HHI> 0.25)	
	mean	sd	mean	sd	mean	sd
HHI	0.13	0.02	0.21	0.03	0.70	0.29
Installation count	254.34	434.36	29.91	55.35	8.78	26.57
Median unit installation price ($/kW)	5021.56	1098.79	5680.14	1373.81	6631.73	2734.88
Housing units	61839.53	100933.66	10340.53	35406.45	3556.27	15075.68
Area Median Income	62500.71	30525.37	57907.99	14133.39	58134.91	28064.72
Population	139158.62	226801.37	23544.79	81290.93	8140.7	34474.51
Pct_HighSCH	11.11	19.89	18.13	21.09	25.09	26.67
Pct_WH	64.61	11.81	71.67	16.95	74.72	20.98
Pct_Urban	74.35	43.64	63.44	45.17	36.2	45.54

Notes: We define the low HHI group as observations with a HHI of 0.15 or less, the moderate HHI group as those with HHI values between 0.15 and 0.25, and the high HHI group as those with HHI greater than 0.25. Installation counts are aggregated by installer at the city level. Records with missing or invalid installer information (e.g., self-installed systems) are excluded from the calculation.

The summary statistics reveal substantial variations in NM solar PV markets with different levels of market concentration. More competitive markets exhibit significantly higher installation counts compared to moderately and highly concentrated markets. However, this pattern may partly reflect underlying differences in city characteristics, such as higher income levels, larger populations, and higher number housing units in low-HHI cities, which naturally generate greater demand for solar installations.

Notably, price dispersion exists in our dataset, as unit installation prices are significantly higher in concentrated markets. This pattern aligns with theoretical predictions that greater market concentration can lead to higher prices. Furthermore, the share of urban populations varies significantly across HHI groups, with low-HHI cities exhibiting much higher urban residency rates. This suggests that highly concentrated solar markets are disproportionately located in rural areas, where limited installer presence may restrict competition and drive up prices.

Figure 4 shows a right-skewed distribution of median unit installation prices across all city-years in the NM sample.[7] Most observations cluster around \$4,000–\$6,000 per kW, with a long tail extending beyond \$15,000. The upper end of the distribution likely reflects data from earlier years in the sample, when solar installation prices were higher. Nonetheless, the distribution illustrates meaningful variation in market prices.

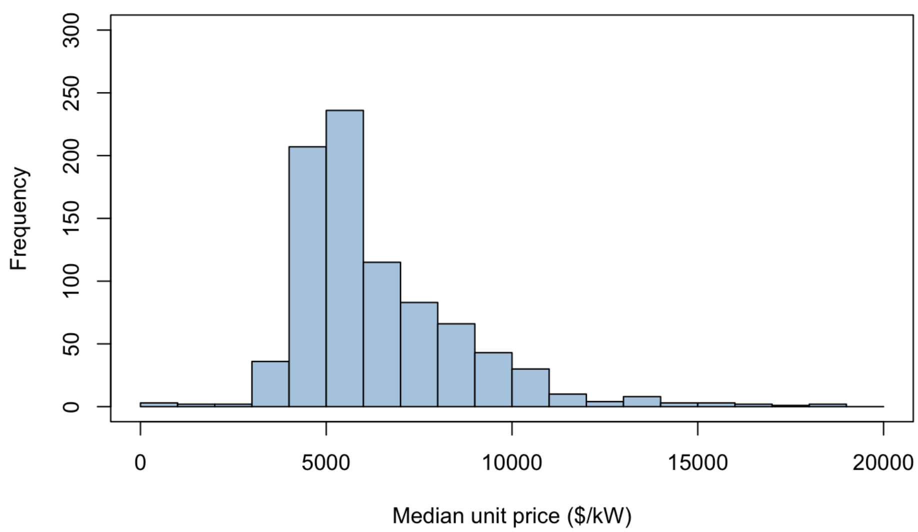


Figure 4: Density of city-year median unit installation prices across NM cities

Note: All the prices are inflation adjusted into 2023 dollars

Figure 5 displays the distribution of HHI values across city-years in the NM sample. A sharp spike at an HHI of 1 indicates that many city-year markets are monopolistic, with only one active installer. More than 80% of cities fall outside the "highly competitive" (HHI≤ 0.15) and "moderately competitive" ($0.15 <$HHI≤ 0.25) thresholds. This highlights the presence of market concentration and suggests that limited competition may contribute to the price disparities observed in NM's residential solar market.

[7] The unit prices are not inflation adjusted.

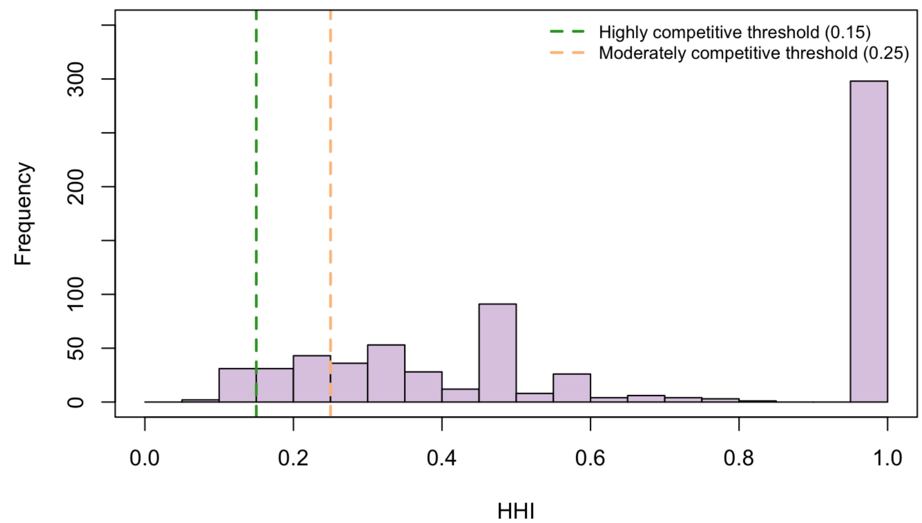


Figure 5: Density of HHI across NM cities

Building on the descriptive evidence, the observed variation in unit installation prices across markets with different levels of concentration raises an important question: to what extent does market structure, as captured by the HHI, influence solar installation prices in NM? To formally examine this relationship, the next section presents the empirical analysis that estimates the impact of HHI on installation prices.

2.2 Market concentration and installation price

To empirically assess whether more concentrated local solar markets result in higher prices for consumers, we estimate the effect of HHI on the median unit installation price using the following panel fixed-effect model.

$$P_{it} = \alpha_0 + \alpha_1 HHI_{it} + \alpha_2 X_{it} + \zeta_i + \theta_t + \epsilon_{it}, \tag{2}$$

where P_{it} denotes the median unit installation price ($/kW) in city i year t; the key variable of interest is HHI_{it}, which measures the market concentration in city i year t; X_{it} is the vector of controls variables at city level, which includes the share of population with high school diploma ($Pct\_HighSCH$); the share of white population (Pct_WH); log of total population ($ln\_Population$), total housing units ($ln\_Housing\ units$), and area median income (ln_Income). ζ_i controls for the city fixed effects and θ_t represents year of installation fixed effects. The key coefficient α_1 captures the effect of changing in the HHI on the unit median installation price. Table 2 shows the estimated coefficients of Equation (2) with NM city-level data.

Table 2: HHI Effect on Median Unit Installation Price (All NM samples)

	All sample	Low HHI	Moderate HHI	High HHI
HHI	1,174***	-7,410	-6,412	1,214**
	(432.1)	(11,439)	(5,829)	(512.9)
Pct_HighSCH	14.04***	48.20***	18.58*	12.76**
	(4.723)	(12.16)	(9.820)	(5.673)
Pct_WH	40.96***	1.517	44.62**	47.24***
	(7.890)	(21.40)	(19.99)	(9.785)
ln_Population	1,389*	12,119**	-1,267	1,759*
	(782.6)	(5,098)	(2,133)	(923.3)
ln_HousingUnits	-1,521	-13,486***	-4,043*	-1,411
	(946.5)	(3,188)	(2,309)	(1,141)
ln_Income	-64.22	2,197	1,789	53.20
	(594.2)	(2,198)	(1,860)	(695.8)
N	687	32	92	563
R-squared	0.123	0.825	0.377	0.107
Year FE	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes
HHI level	-	<0.15	0.15-0.25	>0.25

Notes: Robust standard errors in parentheses. * p<0.05; ** p<0.01; *** p<0.001.

Despite the lack of statistical significance for HHI in results, the direction of the coefficients provides suggestive evidence that the pricing behavior of firms may differ under varying market structures. In all samples model, the positive coefficient of HHI is consistent with the theoretical expectation that more concentrated markets may charge higher prices due to the market power. When we separate the sample by market concentration levels, the relationship becomes more nuanced. In highly concentrated markets, HHI is again positively associated with installation prices. In contrast, the coefficient on HHI turns negative for moderate and low concentration markets, suggesting that within more competitive environments, further increases in market concentration may actually reduce prices. This pattern aligns with the findings of E. O'Shaughnessy (2019), that market concentration has non-monotonic effects on solar installation prices. In competitive markets, modest increases in concentration may reflect efficiency gains, such as economies of scale or learning-by-doing, which can lead to lower installation costs. However, in already concentrated markets, further increases in concentration may enhance firms' market power, enabling them to charge higher prices. Our results reinforce this non-linear relationship.

To further explore the heterogeneous effects of market concentration on pricing, we extend our analysis by segmenting the sample by urban and rural status. A city is defined as urban if the percentage of urban population (Pct_Urban) is greater than 50%.Due to limitations in sample size, we combine the low and moderate HHI groups to improve the precision of our estimates.

The results of this analysis are presented in Table 3.

Table 3: HHI Effect on Median Unit Installation Price (Urban and Rural Cities in NM)

Panel A: Urban Cities			
	All Urban	Low and Moderate HHI	High HHI
HHI	1,486***	-5,023	1,721**
	(531.7)	(3,529)	(687.5)
Pct_HighSCH	16.44***	31.68***	11.53*
	(5.566)	(9.265)	(6.913)
Pct_WH	35.56***	41.36***	46.60***
	(10.30)	(15.33)	(14.48)
ln_Population	2,064	-3,841	3,251*
	(1,545)	(3,808)	(1,950)
ln_Housing units	-1,414	-4,957*	-681.5
	(1,740)	(2,711)	(2,210)
ln_Income	347.6	3,847*	1,308
	(984.6)	(2,054)	(1,305)
N	293	83	210
R-squared	0.170	0.487	0.134
Year FE	Yes	Yes	Yes
City FE	Yes	Yes	Yes
Panel B: Rural Cities			
	All Rural	Low and Moderate HHI	High HHI
HHI	1,050	-191.0	1,076
	(668.7)	(6,431)	(729.7)
Pct_HighSCH	12.08	4.554	13.36
	(7.400)	(13.68)	(8.465)
Pct_WH	43.60***	22.12	48.81***
	(11.63)	(30.42)	(13.12)
ln_Population	1,382	-652.6	1,699
	(1,009)	(2,549)	(1,144)
ln_Housing units	-1,707	-3,832	-1,747
	(1,248)	(2,623)	(1,452)
ln_Income	-270.3	1,116	-333.5
	(803.8)	(2,280)	(881.8)
N	394	41	353
R-squared	0.105	0.389	0.105
Year FE	Yes	Yes	Yes
City FE	Yes	Yes	Yes

Notes: Robust standard errors in parentheses. * $p<0.05$; ** $p<0.01$; *** $p<0.001$.

In urban cities, HHI is positively and significantly associated with higher median unit installation prices. A 0.01 increase in HHI is associated with a $14.86 increase in the median installation price per kW, which supporting the theoretical prediction that greater market concentration leads to higher consumer costs due to reduced competition. When the sample is further segmented by HHI levels, the positive association between market concentration and installation prices remains statistically significant only in highly concentrated urban markets. This finding suggests that the price impact of market power is most pronounced in urban areas, where a small number of dominant firms may exert greater pricing influence.

Consistent with our hypothesis, the coefficient on HHI is positive in the concentrated markets across both urban and rural samples, although the coefficient is insignificant in rural sample. To further evaluate our hypothesis, we extend the analysis to the national sample (summary statistics is shown in Table 4), and compare the results with those from the NM sample.

Table 4: Descriptive statistics (US sample by HHI level group)

	Low HHI (N = 6,003)		Moderate HHI (N = 4,934)		High HHI (N = 15,381)	
	mean	sd	mean	sd	mean	sd
HHI	0.1	0.03	0.2	0.03	0.65	0.29
Installation count	250.73	561.14	62.2	191.91	14.43	61.49
Unit installation price ($/kW)	5155.9	1497.33	5388.68	1668.23	6080.25	40551.24
Housing units	28381.41	147975.54	14020.5	115615.84	5687.34	43877.25
Income	101375.75	44323.36	90246.49	39862.99	77593.05	34731.82
Population	74214.85	365867.87	35154.27	284068.54	13790.32	107255.34
Pct_HighSCH	16.81	22.57	22.36	23.96	25.95	24.29
Pct_WH	70.47	19.86	79.93	17.78	86.21	15.39
Pct_Urban	80.61	37.04	72.13	42.31	52.81	48.06

Notes: We define the low HHI group as observations with a HHI of 0.15 or less, the moderate HHI group as those with HHI values between 0.15 and 0.25, and the high HHI group as those with HHI greater than 0.25. Installation counts are aggregated by installer at the city level. Records with missing or invalid installer information (e.g., self-installed systems) are excluded from the calculation.

Table 5 presents the estimated relationship between HHI and median unit installation prices using the full US sample. Across all HHI levels, greater market concentration is associated with higher prices, with the effect being particularly pronounced in low-HHI markets. This contrasts with the findings from the NM sample, where the relationship is negative in low and moderate HHI markets.

One possible explanation is that the NM market is still in an earlier stage of development compared to other states such as California and Arizona. In emerging markets, the learning-by-doing effect may outweigh the market power effect in less concentrated environments, leading to lower prices. In contrast, in more mature markets elsewhere in the US, the market power effect may dominate regardless of HHI level, resulting in consistently higher prices as concentration increases.

For the high HHI group, we conduct a robustness check by excluding city-year observations with only a single installation, which mechanically results in an HHI value of one. In total, 8,674 observations were removed from the sample, including 2,130 from urban areas. Table A.7 presents the results of the robustness check, in which results are consistent with our finding using full sample.

Table 5: HHI Effect on Median Unit Installation Price (US samples)

	All sample	Low HHI	Moderate HHI	High HHI
HHI	1,637***	10,923***	4,784***	1,481***
	(52.02)	(724.7)	(785.6)	(75.91)
Pct_HighSCH	18.01***	24.49***	16.00***	14.64***
	(0.602)	(0.968)	(1.159)	(0.965)
Pct_WH	43.49***	37.23***	42.71***	39.86***
	(1.681)	(2.240)	(3.515)	(3.071)
ln_Population	869.1***	-415.6	200.1	1,280***
	(124.3)	(263.9)	(283.9)	(182.0)
ln_HousingUnits	-2,270***	-1,517***	-2,068***	-2,345***
	(152.5)	(302.8)	(336.7)	(226.0)
ln_Income	-839.2***	-1,249***	-459.3**	-541.0***
	(85.98)	(147.0)	(178.8)	(134.5)
N	26,318	6,003	4,934	15,381
R-squared	0.146	0.308	0.147	0.082
Year FE	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes
HHI level	-	<0.15	0.15-0.25	>0.25

Notes: Robust standard errors in parentheses. * p<0.05; ** p<0.01; *** p<0.001.

2.3 Policy incentives and market dynamics

To foster the adoption of solar energy, various federal and state-level incentive policies have been implemented in the US, with NEM and ITC being among the most prominent. These policies primarily reduce the effective cost faced by consumers, thus increasing the quantity demanded. However, when such incentives stimulate demand and lead to higher market prices or installer margins, they may also encourage firm entry and expand overall market supply then further reshaping the competitive landscape and influencing market outcomes. In this context, we examine how state-level solar incentive policies affect residential solar market structure. Specifically, we analyze how the presence of these incentives is associated with firm entry and exit dynamics, the number of active installers, and installation prices, using both theoretical modeling and empirical evidence.

2.3.1 Theoretical model

We first outline a stylized theoretical model that unfolds over three sequential periods to illustrate how policy incentives might impact market dynamics depending on the competitiveness of a market. In Period 1, the market begins in equilibrium under Cournot competition with a fixed number of identical firms and no policy intervention. Prices and quantities are determined by baseline consumer demand and firms' cost structures. In Period 2, a policy incentive is introduced, effectively shifting the demand curve upward as consumers are willing to pay more for solar installations. This leads to a new short-run equilibrium with higher prices and increased firm profitability, assuming no immediate change in the number of firms. Finally, in Period 3, the market adjusts in response to these profit opportunities. New firms enter, increasing market supply and driving competition. This results in a new equilibrium where the number of active firms is higher and the market price may adjust accordingly, depending on the strength of the demand shock and the extent of firm entry.

Period 1 starts with a Cournot oligopoly model, where n identical firms compete in quantities. The inverse market demand is linear and given by

$$P_1 = a - bQ \tag{3}$$

where P_1 is the market price, $Q = \sum_i^n q_i$ is the total quantity demanded, and q_i is the output of firm i. Each firm has a constant marginal cost c. Under Cournot competition, each firm chooses its output to maximize profit, taking other firms' output as given. The profit-maximizing condition for each firm yields the symmetric Cournot-Nash equilibrium quantity:

$$q_1^* = \frac{a-c}{b(n+1)}, \tag{4}$$

and the market equilibrium quantity is

$$Q_1^* = nq_i = \frac{n(a-c)}{b(n+1)}. \tag{5}$$

Substituting into the demand function, the market equilibrium price is:

$$P_1^* = a - bQ_1^* = a - \frac{bn(a-c)}{b(n+1)} = a - \frac{n(a-c)}{n+1} = \frac{a+nc}{n+1}. \tag{6}$$

In Period 2, we consider the introduction of the ITC (or an equivalent NEM) that effectively increases consumer willingness to pay, shifting the demand curve upward to

$$P_2 = a + \tau - bQ, \tag{7}$$

where $\tau > 0$ captures the magnitude of the tax credit. The Cournot-Nash equilibrium with shifted demand becomes:

$$q_2^* = \frac{a+\tau-c}{b(n+1)}, \tag{8}$$

$$Q_2^* = \frac{n(a+\tau-c)}{b(n+1)}, \tag{9}$$

and the new equilibrium price is

$$P_2^* = a+\tau-bQ_2^* = a+\tau-\frac{bn(a+\tau-c)}{b(n+1)} = a+\tau-\frac{n(a+\tau-c)}{n+1} = \frac{a+\tau+nc}{n+1}. \tag{10}$$

Given $\tau > 0$, it is straightforward that $P_2^* > P_1^*$, indicating that the market price increases following the policy implementation. This higher equilibrium price increases each firm's profit margin (the number of firms stays the same), thereby improving the profitability of market participation. Consequently, the post-policy market becomes more attractive to potential entrants if there is low barriers to entry.

In Period 3, new firms enter the market in response to the increased profitability. Let m denote the number of entrants, so that the total number of firms becomes $n+m$. Assuming all firms remain identical and the cost structure unchanged. The market demand now post tax credit remains at the same level as Equation (7). The Cournot-Nash equilibrium now reads:

$$q_3^* = \frac{a+\tau-c}{b(n+m+1)}, \tag{11}$$

$$Q_3^* = \frac{(n+m)(a+\tau-c)}{b(n+m+1)}, \tag{12}$$

with the new equilibrium price

$$P_3^* = a+\tau-bQ_3^* = a+\tau-\frac{b(n+m)(a+\tau-c)}{b(n+m+1)} = a+\tau-\frac{(n+m)(a+\tau-c)}{n+m+1} = \frac{a+\tau+(n+m)c}{n+m+1}. \tag{13}$$

Comparing the post-policy, post-entry equilibrium price P_3^* with the pre-policy price P_1^*, the net change in price is:

$$P_3^* - P_1^* = \frac{a+\tau+(n+m)c}{n+m+1} - \frac{a+nc}{n+1}, \tag{14}$$

which depends on the level of tax credit τ and the number of entrants m. To determine when the price increases following the policy, we set $P_3^* > P_1^*$,and solve the inequality $\frac{a+\tau+(n+m)c}{n+m+1} > \frac{a+nc}{n+1}$. Rearranging terms, we find the condition: $\tau(n+1)-m(a-c) > 0 \Rightarrow m < \frac{\tau(n+1)}{a-c}$.

Given demand intercept a is typically greater than the marginal cost c, we have two cases for the same level of τ:

(i) when market entry is limited (i.e., small m), then $P_3^* > P_1^*$;

(ii) when market entry is extensive, then $P_3^* \leq P_1^*$.

This ambiguous result highlights the dual role of the incentive: while it boosts demand, it also attracts additional suppliers into the market. Thus, the equilibrium effect on market prices depends on whether the demand effect or the supply effect dominates.

2.3.2 Empirical model and results

To empirically test the theoretical Cournot framework, we now turn to examining how policy incentives affect market dynamics and further shape pricing outcomes under different levels of market concentration in the US. In particular, we assess whether state-level solar incentives such as NEM and ITC affect firm entry, firm exit, market concentration, and pricing outcomes. To do so, we estimate the following empirical model:

$$Y_{it} = \alpha_0 + \alpha_1 NEM_{it} + \alpha_2 ITC_{it} + \alpha_3 X_{it} + \zeta_i + \theta_t + \epsilon_{it}, \tag{15}$$

where the outcome variable is the number of firm entries, the number of firm exits, total number of firms, HHI, and median unit installation price in city i year t depending on the model specifications. X_{it} is the vector of controls variables at city level, which includes the share of population with high school diploma ($Pct\_HighSCH$); the share of white population (Pct_WH); log of total population ($ln\_Population$), total housing units ($ln\_Housing\ units$), and area median income (ln_Income). ζ_i controls for the city fixed effects and θ_t represents year of installation fixed effects. Table 6 shows summary statistics for the main variables with the US city-year sample.[8]

Table 6: Summary statistics of regression model (15)

	N	Mean	Std. Dev.	Min	Max
Firm Entry	26318	5.69	9.32	0	158
Firm Exit	26318	4.19	7.26	0	113
N Firms	26318	13.29	24.27	0	365
Price	26318	5739.76	31019.54	0	5000000
HHI	26318	0.44	0.34	0.01	1
NEM	26318	0.88	0.32	0	1
ITC	26318	0.4	0.49	0	1
Pct HighSCH	26318	23.19	24.13	0	100
Pct WH	26318	81.44	18.14	0	100
Population	26318	31578.08	230172.73	9	8740000
Housing Units	26318	12426.01	93325.71	8	3650000
Income	26318	85389.98	39358.99	3970.33	332914.04

[8]We use the US sample instead of only the NM sample in this part of the analysis because state-level policies in NM apply uniformly across all markets, leaving no within-state policy variation to exploit.

Table 7 presents the estimated results and the robustness check result shows in Table A.8 with markets with only one installation removed. As shown, NEM is significantly associated with fewer firm entries and more firm exits, resulting in a decline in the number of active competitors and a slight increase in market concentration. NEM is also correlated with a significant rise in market equilibrium prices. This price increase may stem from both the reduction in competition and the increased demand from NEM.

Table 7: Effect of policy incentives on market outcomes (All Cities in US)

	Firm Entry	Firm Exit	N Firms	HHI	Price
NEM	-3.482***	7.922***	-16.53***	0.0332***	755.4***
	(0.198)	(0.183)	(0.400)	(0.00826)	(64.90)
ITC	3.117***	-5.291***	16.61***	-0.149***	-2,560***
	(0.306)	(0.282)	(0.617)	(0.0127)	(100.1)
Pct HighSCH	-0.0467***	-0.0442***	-0.110***	0.000732***	17.98***
	(0.00185)	(0.00171)	(0.00374)	(7.72e-05)	(0.607)
Pct WH	-0.0812***	-0.0868***	-0.293***	0.00319***	41.05***
	(0.00540)	(0.00497)	(0.0109)	(0.000225)	(1.766)
ln Population	1.217***	0.822**	1.647**	0.0839***	884.6***
	(0.382)	(0.352)	(0.772)	(0.0159)	(125.1)
ln HousingUnits	0.847*	1.389***	6.411***	-0.122***	-2,239***
	(0.469)	(0.433)	(0.948)	(0.0195)	(153.6)
ln Income	1.417***	2.598***	7.044***	-0.0699***	-750.5***
	(0.265)	(0.245)	(0.536)	(0.0111)	(86.91)
N	26,318	26,318	26,318	26,318	26,318
R-squared	0.075	0.116	0.203	0.033	0.135
Year FE	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes

Notes: Robust standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

In contrast, the ITC appears to have the opposite effect on market dynamics. The results show that ITC is significantly associated with fewer firm exits and more new entries, resulting in an overall increase in the number of active firms. More importantly, ITC is linked to a statistically significant reduction in market concentration, as evidenced by a 0.149 decrease in the HHI. This suggests that the ITC fosters a more competitive market environment by keeping more firms in the market. Additionally, ITC is associated with a significant decline in median system prices, indicating that the supply effect dominates the demand effect with the introduction of ITC.

The differing empirical effects of NEM and ITC may be attributed to how consumers and producers perceive the two policies. Although both are designed to incentivize solar PV adoption, they differ in the timing and salience of the benefits they provide. NEM promotes demand by offering long-term savings through reduced electricity bills and credits for excess generation. In contrast, the ITC delivers a more immediate and salient benefit by lowering upfront installation costs through tax credits. As shown by De Groote and Verboven (2019), consumers tend to discount future benefits, making immediate incentives like the ITC more effective in influencing investment decisions. Therefore, although both policies should theoretically stimulate solar demand and encourage firm entry, NEM may have a weaker demand effect that falls short of triggering new market entry.

In previous analysis, both theoretical and empirical evidence suggest that the effectiveness of policy incentives may depend on the level of competition within a market. To investigate this, we stratify the sample by HHI thresholds and re-estimate the model within each market concentration group. Table 8 presents the estimation results. The full regression results and the corresponding robustness check results with markets with one installation removed are shown in the Appendix A.2.

Table 8: Estimated Effect of Policy Incentives on Market Outcomes

Panel A: Number of Firms				
	All Cities	Low HHI	Moderate HHI	High HHI
NEM	-16.53***	-21.06***	-6.329***	0.120
	(0.400)	(0.985)	(0.753)	(0.188)
ITC	16.61***	16.59***	6.974***	1.660***
	(0.617)	(2.684)	(0.969)	(0.253)
R-squared	0.203	0.370	0.135	0.034
Panel B: Market Concentration (HHI)				
	All Cities	Low HHI	Moderate HHI	High HHI
NEM	0.0332***	0.0120***	0.00313	-0.0172
	(0.00826)	(0.00128)	(0.00314)	(0.0178)
ITC	-0.149***	-0.0171***	-0.0111***	-0.0695***
	(0.0127)	(0.00348)	(0.00403)	(0.0239)
R-squared	0.033	0.103	0.012	0.014
Panel C: Installation Price				
	All Cities	Low HHI	Moderate HHI	High HHI
NEM	112.3**	-52.21	32.82	249.1**
	(44.32)	(42.79)	(88.61)	(102.3)
ITC	-1,131***	-752.1***	-934.6***	-1,279***
	(68.36)	(116.6)	(113.9)	(137.6)
R-squared	0.075	0.181	0.130	0.040
N	26,318	6,003	4,934	15,381
Year FE	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes

Notes: Robust standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

The results show that NEM is significantly and negatively correlated with the number of firms in more competitive markets, but this effect diminishes as market concentration increases. The decline in the number of firms is also associated with rising market concentration in these competitive settings. In contrast, ITC is significantly associated with an increase in the number of firms across all HHI groups, with the strongest effects observed in less concentrated markets. Moreover, the reduction in market concentration is largest in highly concentrated markets. These findings suggest that the ITC may help to disrupt market dominance, particularly in less competitive environments.

Interestingly, although NEM and ITC have opposite effects on the number of firms and market concentration, both are associated with lower market equilibrium prices within each HHI group. This finding aligns with the non-monotonic relationship between market concentration and prices documented by E. O'Shaughnessy (2019). The observed price decline in already competitive markets with NEM, despite an increase in concentration, may be explained by economies of scale achieved by slightly more dominant firms, which can lead to lower overall market prices.

2.4 Policy implications

In this section, we address two research questions. First, we empirically examine whether market concentration can partially explain the price disparities observed in solar installation markets. Second, we investigate—both theoretically and empirically—whether solar adoption incentives affect market dynamics and concentration, and whether these changes subsequently lead to price dispersion.

Our findings show that market concentration, as measured by the HHI, is associated with higher market equilibrium prices, but only in urban and highly concentrated markets in New Mexico. In contrast, when examining the broader U.S. market, we find a positive correlation between market concentration and prices, consistent with economic theory suggesting that greater market power tends to result in higher prices, all else equal.

Importantly, our empirical evidence highlights that not all solar-promoting policies have the same market effects. The ITC is associated with increased firm entry, reduced market concentration, and lower prices. In contrast, NEM appears to have little effect—or even the opposite effect—on these outcomes. These findings suggest that policy design plays a critical role in shaping market structure and equity outcomes. Specifically, when the goal is to promote equitable solar adoption, especially in already concentrated markets, policies like the ITC may be more effective than NEM.

3 Net metering policy on solar adoption

Another research question we are interested in is how does policy incentive impact solar adoption on the intensive margin, i.e., the capacity installed. In this section, we provide evidence on how NEM incentive structures impact capacity choices using residential solar installation data. We use system-level data on solar installations in New Mexico from 2010 to 2016 and 2020 to 2022 and exploit the variation in NEM policy. The unique setting of New Mexico provides an ideal context for comparing the effects of different NEM policies because the state has two major utility companies with distinct NEM structures, which allows for a natural comparison of consumer behavior under varying incentive schemes.

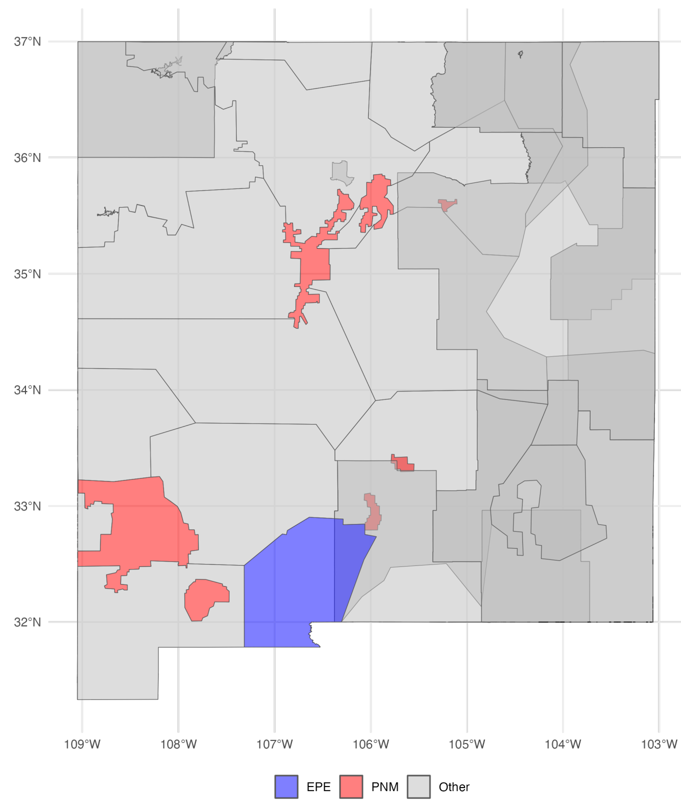
3.1 Background on NEM in New Mexico

In New Mexico, two main utilities serve the population: PNM and EPE. These utilities each operate under different NEM policies that are relevant to consumer capacity decisions.

PNM allows residential systems with a capacity of up to 10 kW to rollover credits with no expiration. This "credit rollover" structure gives households the flexibility to save excess generation credits for future months, essentially banking them indefinitely. However, for larger systems (over 10 kW), PNM applies a monthly true-up policy where excess generation is compensated at the wholesale price, which is typically lower than the retail rate. This dual approach by PNM provides an opportunity to observe how capacity decisions might change when excess generation is compensated at a different rate or when credits cannot be banked for long periods. In contrary, EPE adopts the monthly true-up structure for all systems, regardless of size. This policy offers less flexibility compared to PNM's rollover option, as any excess generation in a given month is cashed out at the wholesale rate, with no possibility of carrying credits forward.

Since these utilities are local monopolies, consumers in each service area have no choice in terms of NEM structure; they are bound to the policy determined by their utility (Figure 6). This ensures that differences in capacity choices are likely to stem from policy structure rather than consumer self-selection in to different compensation schemes, which could otherwise introduce bias.

Figure 6: PNM and EPE service territories



Note: Service area data obtained from the EIA U.S. Energy Atlas - Electric Retail Service Territories, link.

3.2 Data description

The data used in this empirical analysis includes detailed information on solar installations, housing characteristics, and census tract-level socioeconomic factors in New Mexico.

The primary dataset is the system-level information obtained from the New Mexico Energy, Minerals, and Natural Resources Department (EMNRD). Key system-level variables include system capacity, installation year, system cost, installer company name, utility company (PNM or EPE), and system location.

We complement this dataset with housing characteristics gathered from housing websites including type of house, household size (in square footage), number of bedrooms and bathrooms, age of house, estimated housing value, and whether the house has electric cooling. We also obtained solar PV output data from Solargis and matched to the system-level data using longitude and latitude information.

In addition, we matched each system to a census tract and obtained census tract-level characteristics from the Census Bureau and the Energy Information Administration (EIA) regarding the area median income (AMI), population, urban share, and average electricity price.

The final dataset consists of 10,456 unique solar systems installed in New Mexico across the years 2010 to 2016 and 2020 to 2022 in the PNM and EPE service areas. Table 9 and 10 show the summary statistics for final sample by utility and by system capacity range.

Table 9: Descriptive statistics by utility (All system sizes)

	EPE (N=2,391)		PNM (N=8,065)			
	mean	sd	mean	sd	t-test	p-val
System capacity	6.13	3.146	6.09	2.922	0.633	0.527
Under 10kW	0.90	0.307	0.90	0.303	-0.344	0.731
Installation Year	2016.33	4.131	2017.51	4.295	-11.922	0.000
PV output	1950.61	10.814	1902.64	26.872	85.264	0.000
System cost	26932.24	13751.393	28641.68	14018.944	-5.259	0.000
Federal tax credit	6793.57	3478.229	8391.71	4696.780	-11.666	0.000
State tax credit	2667.07	1310.083	2831.01	1309.221	-5.377	0.000
House price	437.12	194.760	606.15	385.770	-20.306	0.000
House tax value	283.47	186.861	384.21	281.558	-16.284	0.000
Single family house	0.96	0.192	0.98	0.149	-4.196	0.000
House size	2331.29	861.919	2452.47	1119.477	-4.881	0.000
N bedrooms	3.33	0.700	3.36	0.817	-2.008	0.045
N bathrooms	2.32	0.758	2.37	0.882	-2.388	0.017
House age	21.03	19.207	33.32	22.431	-24.189	0.000
Electric cooling	0.28	0.449	0.20	0.402	7.966	0.000
AMI	64490.75	26461.136	74465.16	30033.576	-14.642	0.000
Urban percent	0.75	0.286	0.88	0.277	-19.653	0.000
Total population	6199.13	3460.808	4426.48	1808.863	33.186	0.000

Notes: PNM (EPE) in sample is composed by those installations with utility recorded as PNM (EPE) falling in an area only operated by PNM (EPE).

The summary statistics indicate that the average system capacity in the EPE service area is higher than in the PNM area, but this difference is driven by larger systems (above 10 kW). The two utilities have a similar distribution of systems below and above the 10 kW threshold. However, housing characteristics and census tract demographics differ significantly between the two service areas. Compared to EPE, solar adopters in the PNM service area tend to have higher housing values, larger homes, older structures, fewer electric cooling systems, and are located in higher-income but lower-density neighborhoods.

Figure 7 illustrates the distribution of solar PV system capacity over time in the two utility service areas. Both areas exhibit growth in solar installations over the years. In the PNM service area, the adoption of both small and large systems has increased at a similar pace. In contrast, the EPE area shows a different pattern: smaller systems were predominantly installed in the earlier years (before 2016), while larger system installations have become more concentrated in recent years (after 2020).

Figure 8 shows the time trend of average installation capacity. Over time, capacity has

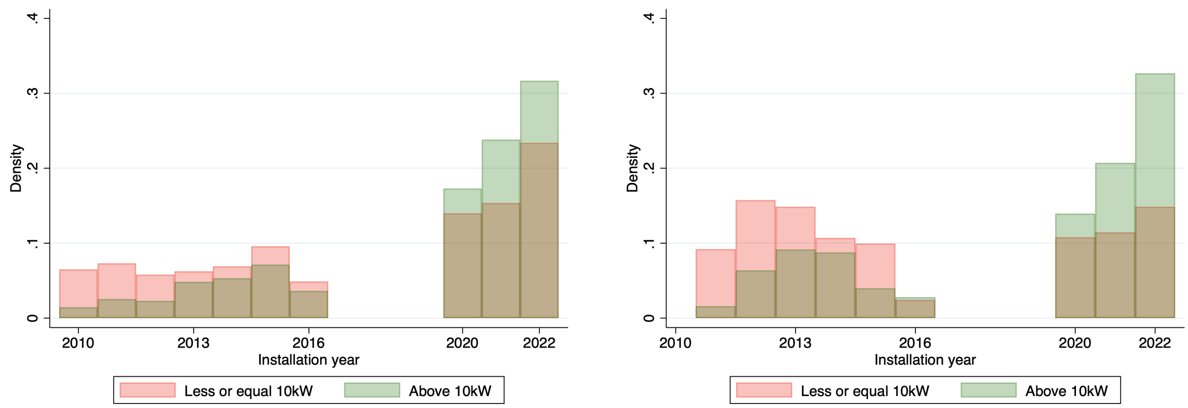
Table 10: Descriptive statistics by utility and capacity

Panel A: systems of less than 10 kW						
	EPE (N=2,140)		PNM (N=7,238)			
	mean	sd	mean	sd	t-test	p-val
System capacity	5.36	2.174	5.41	2.157	-0.998	0.318
Installation Year	2016.05	4.078	2017.32	4.335	-12.122	0.000
PV output	1950.71	10.705	1903.29	26.403	81.137	0.000
System cost	24306.95	11135.255	26257.54	11589.181	-6.901	0.000
Federal tax credit	6350.49	2904.692	7831.50	3947.764	-12.496	0.000
State tax credit	2419.30	1092.160	2608.59	1121.924	-6.898	0.000
House price	420.34	175.702	575.78	353.758	-19.324	0.000
House tax value	269.19	143.425	362.95	259.253	-15.852	0.000
Single family house	0.96	0.186	0.98	0.149	-3.378	0.001
House size	2248.44	771.613	2339.99	990.636	-3.936	0.000
N bedrooms	3.29	0.674	3.32	0.795	-1.335	0.182
N bathrooms	2.27	0.692	2.30	0.831	-1.646	0.100
House age	21.03	19.621	33.64	22.646	-23.234	0.000
Electric cooling	0.27	0.445	0.19	0.396	7.781	0.000
AMI	63533.83	25965.219	72724.71	28376.141	-13.415	0.000
Urban percent	0.76	0.278	0.88	0.272	-17.779	0.000
Total population	6349.29	3509.830	4461.42	1808.769	33.216	0.000
Panel B: systems of more than 10 kW						
	EPE (N=251)		PNM (N=827)			
	mean	sd	mean	sd	t-test	p-val
System capacity	12.74	2.267	12.02	1.807	5.170	0.000
Installation Year	2018.73	3.797	2019.15	3.526	-1.645	0.100
PV output	1949.79	11.690	1897.01	30.109	27.154	0.000
System cost	49315.23	13598.267	49508.02	16005.756	-0.173	0.863
Federal tax credit	14066.46	4028.051	16906.90	6585.090	-3.662	0.000
State tax credit	4779.50	1093.890	4777.61	1215.862	0.022	0.982
House price	585.74	276.030	873.94	527.304	-8.046	0.000
House tax value	405.04	375.549	570.09	382.608	-5.956	0.000
Single family house	0.94	0.238	0.98	0.150	-2.930	0.003
House size	3037.66	1203.466	3436.91	1598.612	-3.655	0.000
N bedrooms	3.60	0.848	3.75	0.905	-2.278	0.023
N bathrooms	2.74	1.095	2.94	1.091	-2.441	0.015
House age	21.06	15.245	30.46	20.239	-6.761	0.000
Electric cooling	0.34	0.476	0.28	0.449	1.930	0.054
AMI	72649.36	29168.020	89697.75	38632.306	-6.455	0.000
Urban percent	0.65	0.333	0.84	0.312	-8.536	0.000
Total population	4918.84	2694.926	4120.67	1781.741	5.454	0.000

Notes: PNM (EPE) in sample is composed by those installations with utility recorded as PNM (EPE) falling in an area only operated by PNM (EPE).

increased for both utilities across both size categories. For systems above 10 kW, the average capacity is consistently lower in the PNM service area compared to the EPE service area. In contrast, for systems under 10 kW, the average capacities are similar across the two utility

Figure 7: Distribution of installations over time by utility



(a) PNM installation year

(b) EPE installation year

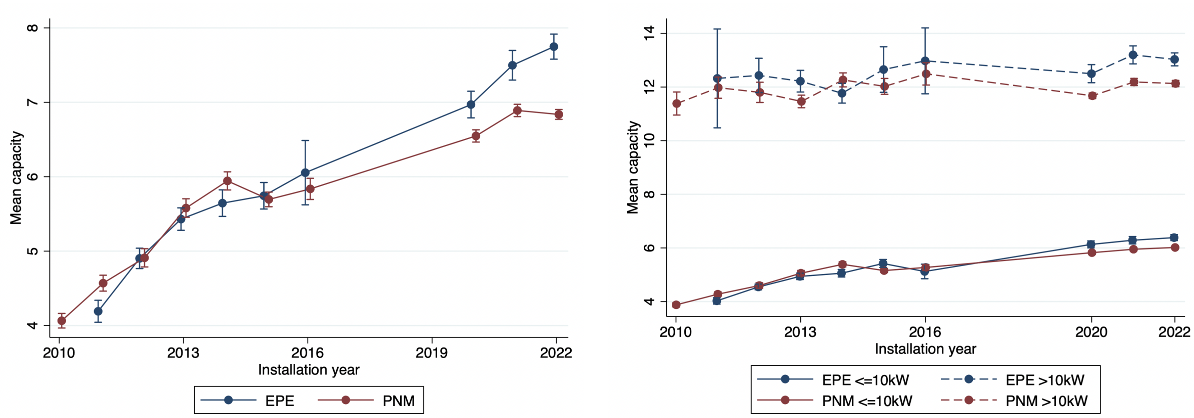
Note: The brown bars are the overlap between the red and green bars for the two capacity ranges.

areas. These descriptive trends suggest that the higher capacity of EPE for systems above 10 kW does not carry over to systems below 10 kW, suggesting that the differences between the NEM structure in PNM for above and below 10 kW may incentivize differential adoption patterns.

Figure 8: Evolution of mean installation capacity

(a) All installations

(b) Installations above and below 10kW



Notes: The whiskers show the standard errors by utility and capacity category.

3.3 Empirical model and results

Does credit roll over induce higher solar capacity choices compared to monthly true-up? We use the following fixed effect linear regression model to estimate the effect of credit rollover on capacity choice.

$$Y_i = \beta_0 + \beta_1 \mathrm{PNM}_i + \beta_2 U10_i + \beta_3 PNM_i * U10_i + \gamma X_i + \psi W_{j,t} + \zeta_j + \lambda_z + \theta_t + \epsilon_i \qquad (16)$$

where Y_i denotes the installed capacity (kW) in system i; PNM_i is an indicator variable taking a value of one if installation i belongs to the PNM service area; $U10_i$ is an indicator variable taking a value of one if capacity of installation i is under 10kW and therefore qualifies for the rollover pricing scheme; X_i is a vector of controls for household characteristics which includes an indicator of whether the household is a single family house, house size, the estimated value of the house, housing age, and whether the house operates under electric cooling; $W_{j,t}$ is a vector of time varying census tract-level controls which includes percentage of urban population, total population, average electricity price, and area median income; ζ_j controls for installer fixed effects; λ_z represents census tract fixed effects; and θ_t represents year of installation fixed effects. The main coefficient of interest is β_3, which represents the marginal effect of rollover policy on installed capacity.

Table 11 shows the results of estimating Equation (16) on our final sample under six different model specifications including different sets of controls. In model specification (6), which includes year, tract, and installer fixed effects as well as household and tract-level controls, the results provide a nuanced view of how credit rollover policies influence installed system capacity. The coefficient on the PNM variable is –1.143 ($p < 0.01$), indicating that for systems larger than 10 kW, systems in the PNM service area have a lower installed capacity than those in the EPE area. Importantly, the interaction term between PNM and Under 10kW is 0.816 ($p < 0.01$), which offsets a large portion of the low installation capacity in the PNM area for small systems under the rollover NEM structure. The combined effect of PNM for systems under 10 kW is –0.327 kW ($-1.143 + 0.816$), a much smaller reduction because of the higher adoption from rollover. Overall, the results suggest that credit rollover increases installed capacity compared to true up by about 15% (≃0.816/5.36, where 5.36 is the mean capacity of EPE for under 10 kW).[9]

[9] Note that the magnitude of the coefficients increases when adding household controls, which slightly reduces the number of observations. To rule out the magnitude of the effect being driven by these observations we replicate specifications 1 to 4 with the sample used in specification 5. Consistent results from this sample restriction indicate that the change in magnitude is not driven by the exclusion of these observations but by the introduction of controls for house characteristics.

Table 11: Rollover effect on system capacity

	(1)	(2)	(3)	(4)	(5)	(6)
PNM	-0.717***	-0.759***	-0.422***	-0.470***	-1.046***	-1.143***
	(0.172)	(0.183)	(0.131)	(0.137)	(0.159)	(0.413)
Under 10kW	-7.386***	-7.005***	-6.771***	-6.639***	-6.119***	-6.084***
	(0.161)	(0.164)	(0.156)	(0.158)	(0.149)	(0.149)
PNM X Under 10kW	0.770***	0.677***	0.892***	0.789***	0.856***	0.816***
	(0.183)	(0.188)	(0.178)	(0.182)	(0.167)	(0.168)
N	10,456	10,456	10,456	10,456	10,129	10,129
R-squared	0.484	0.531	0.584	0.599	0.632	0.633
Year FE	No	Yes	Yes	Yes	Yes	Yes
Tract FE	No	No	Yes	Yes	Yes	Yes
Installer FE	No	No	No	Yes	Yes	Yes
Household Controls	No	No	No	No	Yes	Yes
Tract Controls	No	No	No	No	No	Yes

Notes: Final Sample of installations falling inside utility areas only operated by the utility to which the installation is assigned. Household controls include an indicator of whether the household is a single family house, house size, the estimated value of the house, the assessed tax value of the house, housing age, and whether the house operates under electric cooling. Standard errors are clustered at the zip code level. * p < 0.10, ** p < 0.05, *** p < 0.01.

To explore whether the rollover affects installed capacity heterogeneously across system sizes, we modify Equation (16) by replacing $U10$ with a categorical variable identifying installations in the following capacity ranges: below 2kW, 2–4kW, 4–6kW, 6–8kW, 8–10kW, and more than 10kW. Table 12 reports the results from estimating this model while using installations above 10kW as the baseline category. Consistent with Table 11, installations under credit rollover display higher installed capacity. Yet, the effect is smaller for larger capacity brackets, in terms of percentages of mean capacity, increase.

Table 12: Rollover effect for different capacity brackets

	(1)	(2)	(3)	(4)	(5)	(6)
PNM	-0.704***	-0.703***	-0.890***	-0.771***	-0.868***	-0.844***
	(0.175)	(0.173)	(0.119)	(0.132)	(0.133)	(0.181)
Mg Rollover effect						
<2 kW	0.857***	0.883***	0.910***	0.801***	0.807***	0.810***
	(0.187)	(0.185)	(0.183)	(0.204)	(0.202)	(0.204)
2-4 kW	0.625***	0.633***	0.627***	0.512***	0.506***	0.510***
	(0.177)	(0.175)	(0.171)	(0.185)	(0.185)	(0.186)
4-6 kW	0.623***	0.631***	0.618***	0.548***	0.530***	0.532***
	(0.176)	(0.174)	(0.169)	(0.178)	(0.176)	(0.178)
6-8 kW	0.658***	0.667***	0.647***	0.611***	0.597***	0.598***
	(0.180)	(0.178)	(0.173)	(0.180)	(0.183)	(0.184)
8-10 kW	0.645***	0.655***	0.633***	0.586***	0.521***	0.522***
	(0.177)	(0.175)	(0.177)	(0.178)	(0.180)	(0.180)
N	10,456	10,456	10,456	10,456	10,129	10,129
R-squared	0.919	0.920	0.923	0.926	0.928	0.928
Year FE	No	Yes	Yes	Yes	Yes	Yes
Tract FE	No	No	Yes	Yes	Yes	Yes
Installer FE	No	No	No	Yes	Yes	Yes
Household Controls	No	No	No	No	Yes	Yes
Tract Controls	No	No	No	No	No	Yes

3.4 Policy implications

The observed relationship between net metering policy design and installed system capacity suggests that, under current solar technology costs and retail electricity rates, net metering schemes that allow credit rollover are associated with approximately 15% higher capacity investment compared to monthly true-up. This difference underscores the importance of aligning net metering design with broader policy objectives, as the structure of financial incentives can significantly influence household investment behavior.

If the primary policy objective is to accelerate residential solar adoption in support of decarbonization targets—such as those outlined in New Mexico's Energy Transition Act (Candelaria et al. 2019)—then rollover schemes may be more effective, as consumers tend to believe those are more generous so they encourage higher capacity installations. Larger systems generate more clean electricity and could accelerate the transition to a zero-carbon grid. On the other hand, if the policy objective is to ensure grid stability by moderating the influx of solar generation during peak sunlight hours, monthly true-up may offer a more conservative growth trajectory by discouraging system over-sizing.

It is important to note, however, that these conclusions are based on historical patterns and current market conditions. As solar technology, grid infrastructure, and consumer behavior continue to evolve, NEM policies must be periodically reassessed to ensure they remain aligned with dynamic policy goals. A flexible, evidence-based regulatory approach will be essential to balance renewable energy expansion with grid reliability and economic efficiency.

4 Conclusion

In this white paper, we investigate how market concentration relates to price variation in the residential solar market and evaluates the impacts of two major policy instruments, ITC and NEM, on market structure and pricing outcomes. Using data from NM and the US, we assess whether differences in market conditions and policy environments help explain observed disparities in solar installation prices.

We find that in NM, higher market concentration is associated with higher median unit installation prices, but only in urban areas and city-year markets classified as highly concentrated. In rural and moderately concentrated markets, this relationship is not statistically significant, and in some cases, the correlation is negative. By contrast, in the US sample, a positive and consistent association between market concentration and prices is observed across all levels of HHI. These differences suggest that the effect of concentration on pricing may depend on the stage of market development and local competitive conditions.

The analysis further shows that the two policy instruments under consideration have distinct effects on market dynamics. The ITC is associated with greater firm entry, lower market concentration, and lower prices, particularly in competitive markets. NEM, on the other hand, is associated with fewer active firms and higher concentration in markets that were initially more competitive, with no clear effect on lowering prices. These findings highlight important differences in how policies affect long-run benefits (i.e., NEM) and immediate gains (i.e., ITC) influence market demand and dynamics.

We also document differences in solar system sizing under different NEM program designs. In particular, utilities that allow monthly credits to roll over to future bills are associated with larger installed capacities, indicating that program rules may influence the intensive margin of adoption.

While these findings point to important differences in how solar policies shape supplier behavior and market outcomes, several limitations should be noted. The analysis is correlational and does not establish causal relationships between policy variables and market outcomes. Further, the paper does not directly assess the welfare or equity implications of market concentration or policy design.

Future research should evaluate the effectiveness of solar policies in reducing market concentration and promoting optimal adoption decisions—both at the extensive margin (whether to adopt) and the intensive margin (how much capacity to install). Causal identification strategies and richer data on household-level adoption decisions and firm behavior would support a deeper understanding of how policy design interacts with market structure to influence solar deployment.

A Appendix

A.1 US state-level NEM policy coverage in Figure 3

Table A.1: US state-level NEM policy coverage

States	Coverage	Policy period
Alabama	No regulatory policy	
Alaska	Utilities with annual retail sales of 5,000,000 kWh or more	2010-Current
Arizona	Investor-owned utilities, electric cooperatives	2009-2016
Arkansas	Investor-owned utilities and electric cooperatives	2002-Current
California	Investor-owned utilities	1996-2023
Colorado	All utilities	2005-Current
Connecticut	Investor-owned utilities	2000-2022
Delaware	All utilities	1999-Current
Florida	All utilities	2008-Current
Georgia	All utilities	2002-Current
Hawaii	All utilities	2001-Current
Idaho	Avista Utilities, PacifiCorp, Idaho Power Corp No statewide policy	1997-Current
Illinois	Investor-owned utilities, alternative retail electric suppliers	2008-Current
Indiana	Investor-owned utilities	2004-2021
Iowa	Interstate Power and Light Co, MidAmerican Energy Co	1984-Current
Kansas	Investor-owned utilities	2009-Current
Kentucky	Investor-owned utilities, electric cooperatives (except Tennessee Valley Authority)	2008-2021
Louisiana	All investor-owned utilities and electric cooperatives	2003-2019
Maine	All utilities	1998-Current
Maryland	All utilities	1997-Current
Massachusetts	Investor-owned utilities	2016-Current
Michigan	Investor-owned utilities, MPSC rate-regulated electric cooperatives, all alternative electric suppliers	2009-Current
Minnesota	All utilities	1983-Current
Mississippi	All investor-owned electric utilities, and limited applicability to cooperatives.	2016-Current
Missouri	All Investor-owned utilities, Municipal Utilities, and Electric Cooperatives	2007-Current
Montana	Investor-owned utilities, all co-ops have adopted the policy as well	1999-Current
Nebraska	All utilities	2009-Current
Nevada	Investor-owned utilities	1997-Current
New Hampshire	All utilities	2000-Current

Table A.1: US state-level NEM policy coverage

States	Coverage	Policy period
New Jersey	Investor-owned utilities	1999-Current
New Mexico	Investor-owned utilities, electric cooperatives	2008-Current
New York	Investor-owned utilities	1997-Current
North Carolina	Investor-owned utilities	2006-Current
North Dakota	Investor-owned utilities	1991-Current
Ohio	Investor-owned utilities	2000-Current
Oklahoma	Investor-owned utilities, regulated electric cooperatives	1988-Current
Oregon	All utilities (except Idaho Power)	1999-Current
Pennsylvania	Investor-owned utilities	2005-Current
Rhode Island	Investor-owned utilities	2011-Current
South Carolina	Duke Energy Progress, Duke Energy Carolinas, Dominion Energy South Carolina	2008-Current
South Dakota	No regulatory policy	
Tennessee	No regulatory policy	
Texas	No regulatory policy	
Utah	All utilities	2002-Current
Vermont	All utilities	1998-Current
Virginia	Investor-owned utilities	2000-Current
Washington	All utilities	1998-Current
Washington DC	Investor-owned utilities	2000-Current
West Virginia	All utilities	2007-Current
Wisconsin	Investor-owned utilities, municipal utilities	1982-Current
Wyoming	Investor-owned utilities, electric cooperatives	2001-Current

Note: All information obtained from the Database of State Incentives for Renewables & Efficiency (DSIRE) at https://www.dsireusa.org.

Table A.2: NEM structure of NM utilities

Utility Company	Utility Type	NEM structure for excess generation
Central New Mexico Electrical Cooperative	Cooperative	Monthly true-up
Central Valley Electric Coop	Cooperative	Monthly true-up
Columbus Electric Coop	Cooperative	Annual true-up
Continental Divide Electric Cooperative	Cooperative	Monthly true-up
Duncan Valley Coop	Cooperative	Annual true-up
Farmers Electric Coop	Cooperative	Monthly true-up
Jemez Mountains Electric Cooperative	Cooperative	Annual true-up
Kit Carson Electric Cooperative	Cooperative	Monthly true-up
Lea County Electric	Cooperative	Monthly true-up
Mora-San Miguel Electric	Cooperative	Credit rollover until account closure for system $\leq$25 kW
Navopache Electric	Cooperative	Annual true-up
Northern Rio Arriba Electric	Cooperative	Monthly true-up
Otero County Electric Cooperative	Cooperative	Monthly true-up
Rio Grande Electric Cooperative	Cooperative	No compensation for excess generation
Roosevelt County Electric Coop	Cooperative	Monthly true-up
Sierra Electric Cooperative	Cooperative	Monthly true-up
Socorro Electric Cooperative	Cooperative	Monthly true-up, cashed out at $50
Southwestern Electric Coop	Cooperative	Monthly true-up, cashed out at $50
Springer Electric Coop	Cooperative	Monthly true-up
El Paso Electric	IOU	Monthly true-up
Public Service Company of New Mexico	IOU	Credit rollover until account closure for system $\leq$10 kW; Monthly true-up for systems >10 kW.
Xcel Energy	IOU	Credit rollover until credit exceeds $50
City of Aztec Public Utility	Public utility	Net billing
Farmington Electric Utility System	Public utility	Net billing
City of Gallup Utilities	Public utility	Annual true-up for systems up to 10 kW
Los Alamos County Department of Public Utilities	Public utility	Net billing
Navajo Tribal Utility Authority	Public utility	Semi-annual true-up
Raton Public Service	Public utility	Monthly true-up

Note: Information acquired from each utilities website and the NM Public Regulatory Commission website.

A.2 Robustness check

To examine whether the results in Section 2 are driven by extreme market concentration, we conduct robustness checks by excluding city-year observations with only a single installation, which mechanically results in an HHI value of one. The table below presents the results of the main regressions after removing these city-year observations (i.e., those with HHI= 1 and installation count= 1). In total, 8,674 observations were removed from the sample, including 2,130 from urban areas. The findings remain consistent with those reported in the main analysis.

Table A.3: Summary statistics of robustness check (NM sample)

	N	Mean	Std. Dev.	Min	Max
Firm Entry	489	2.45	2.68	0	25
Firm Exit	489	1.64	2.07	0	14
N Firms	489	4.53	5.46	0	53
Price	489	6221.07	2097.00	2887.29	21639.22
HHI	489	0.45	0.25	0.09	1
NEM	489	1	0.00	1	1
ITC	489	1	0.06	0	1
Pct HighSCH	489	23.02	25.49	0	100
Pct WH	489	74.18	17.93	1.6	100
Population	489	21264.15	82615.90	54	562551
Housing Units	489	9364.26	36518.26	31	256861
Income	489	60288.36	28391.23	17040.27	182443.51

Table A.4: Robustness check on HHI Effect on Median Unit Installation Price (All NM samples)

	All sample	High HHI
HHI	1,239**	918.4
	(503.7)	(625.7)
Pct HighSCH	17.14***	15.62***
	(4.485)	(5.727)
Pct WH	28.94***	32.87***
	(7.850)	(10.78)
ln Population	2,443***	3,282***
	(814.5)	(1,024)
ln HousingUnits	-2,705***	-2,778**
	(947.7)	(1,220)
ln Income	-388.3	-221.6
	(591.6)	(733.6)
N	489	365
R-squared	0.177	0.139
Year FE	Yes	Yes
City FE	Yes	Yes
HHI level	-	>0.25

Notes: Robust standard errors in parentheses. * p<0.05; ** p<0.01; *** p<0.001.

Table A.5: Robustness check on HHI Effect on Median Unit Installation Price (Urban and Rural cities in NM)

	Urban	Rural	Urban High	Rural High
HHI	2,271***	115.3	2,430**	-179.4
	(688.2)	(745.8)	(955.7)	(839.5)
Pct HighSCH	19.69***	13.15*	14.01*	14.26*
	(6.046)	(6.782)	(8.000)	(8.381)
Pct WH	35.18***	21.82*	47.91***	26.64*
	(10.53)	(12.21)	(16.17)	(14.98)
ln_Population	411.1	3,477***	932.9	4,371***
	(1,657)	(993.1)	(2,209)	(1,201)
ln_HousingUnits	-921.9	-3,798***	548.1	-4,142***
	(1,845)	(1,189)	(2,539)	(1,482)
ln_Income	-246.0	-419.3	330.6	-503.5
	(1,102)	(759.2)	(1,629)	(864.4)
N	247	242	164	201
R-squared	0.231	0.158	0.160	0.165
Year FE	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes
Cities	Urban	Rural	Urban	Rural
HHI level	-	-	>0.25	>0.25

Notes: Robust standard errors in parentheses. * p<0.05; ** p<0.01; *** p<0.001.

Table A.6: Summary statistics of robustness check (US sample)

	N	Mean	Std. Dev.	Min	Max
Firm Entry	21407	6.83	9.99	0	158
Firm Exit	21407	5.01	7.82	0	113
N Firms	21407	16.13	26.09	0	365
Price	21407	5625.21	34168.36	.03	5000000
HHI	21407	.31	0.23	.01	1
NEM	21407	.88	0.33	0	1
ITC	21407	.39	0.49	0	1
Pct HighSCH	21407	21.98	23.99	0	100
Pct WH	21407	79.83	18.55	0	100
Population	21407	37167.63	254524.24	9	8740000
Housing Units	21407	14579.63	103212.94	8	3650000
Income	21407	88682.43	40248.65	3970.33	332914.04

Table A.7: Robustness check on HHI Effect on Median Unit Installation Price (All US Samples)

	All sample	High HHI
HHI	1,800***	1,232***
	(70.90)	(109.1)
Pct_HighSCH	17.82***	12.73***
	(0.585)	(1.019)
Pct_WH	44.04***	42.87***
	(1.627)	(3.366)
ln_Population	907.1***	1,707***
	(129.8)	(208.7)
ln_HousingUnits	-2,394***	-2,781***
	(156.1)	(253.9)
ln_Income	-915.0***	-503.1***
	(87.26)	(152.9)
N	21,407	10,470
R-squared	0.165	0.078
Year FE	Yes	Yes
City FE	Yes	Yes
HHI level	-	>0.25

Notes: Robust standard errors in parentheses. * p<0.05; ** p<0.01; *** p<0.001.

Table A.8: Robustness check on the effect of policy incentives on market outcomes (All Cities in US)

	Firm Entry	Firm Exit	N Firms	HHI	Price
NEM	-3.583***	8.872***	-17.43***	0.0430***	732.6***
	(0.227)	(0.209)	(0.457)	(0.00620)	(59.57)
ITC	2.968***	-6.367***	17.08***	-0.113***	-2,452***
	(0.352)	(0.325)	(0.709)	(0.00962)	(92.44)
Pct HighSCH	-0.0549***	-0.0519***	-0.130***	0.000398***	17.23***
	(0.00223)	(0.00205)	(0.00448)	(6.08e-05)	(0.584)
Pct WH	-0.0897***	-0.101***	-0.331***	0.00233***	40.55***
	(0.00648)	(0.00598)	(0.0131)	(0.000177)	(1.702)
ln_Population	1.582***	1.220***	1.879*	0.0316**	836.8***
	(0.493)	(0.455)	(0.993)	(0.0135)	(129.5)
ln_HousingUnits	0.919	1.610***	7.976***	-0.0901***	-2,302***
	(0.594)	(0.547)	(1.196)	(0.0162)	(155.9)
ln_Income	1.444***	3.229***	8.343***	-0.0492***	-767.7***
	(0.333)	(0.307)	(0.671)	(0.00910)	(87.50)
N	21,407	21,407	21,407	21,407	21,407
R-squared	0.082	0.131	0.224	0.036	0.170
Year FE	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes

Notes: Robust standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A.9: Effect of policy incentives on number of firms (All Cities in US)

	N Firms			
	All Cities	HHI < 0.15	0.15 ≤ HHI ≤ 0.25	HHI > 0.25
NEM	-16.53***	-21.06***	-6.329***	0.120
	(0.400)	(0.985)	(0.753)	(0.188)
ITC	16.61***	16.59***	6.974***	1.660***
	(0.617)	(2.684)	(0.969)	(0.253)
Pct HighSCH	-0.110***	-0.346***	-0.0853***	-0.0161***
	(0.00374)	(0.0146)	(0.00628)	(0.00125)
Pct WH	-0.293***	-0.586***	-0.164***	-0.0300***
	(0.0109)	(0.0366)	(0.0196)	(0.00401)
ln_Population	1.647**	6.062	1.088	-0.442*
	(0.772)	(3.983)	(1.527)	(0.235)
ln_HousingUnits	6.411***	22.79***	4.868***	1.184***
	(0.948)	(4.571)	(1.815)	(0.292)
ln_Income	7.044***	21.18***	1.848*	0.122
	(0.536)	(2.213)	(0.966)	(0.174)
N	26,318	6,003	4,934	15,381
R-squared	0.203	0.370	0.135	0.034
Year FE	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes

Notes: Robust standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A.10: Robustness check on the effect of policy incentives on number of firms (All Cities in US)

	N Firms			
	All Cities	HHI < 0.15	0.15 ≤ HHI ≤ 0.25	HHI > 0.25
NEM	-17.43***	-21.06***	-6.329***	0.219
	(0.457)	(0.985)	(0.753)	(0.260)
ITC	17.08***	16.59***	6.974***	1.921***
	(0.709)	(2.684)	(0.969)	(0.341)
Pct HighSCH	-0.130***	-0.346***	-0.0853***	-0.0190***
	(0.00448)	(0.0146)	(0.00628)	(0.00174)
Pct WH	-0.331***	-0.586***	-0.164***	-0.0343***
	(0.0131)	(0.0366)	(0.0196)	(0.00583)
ln_Population	1.879*	6.062	1.088	-0.656*
	(0.993)	(3.983)	(1.527)	(0.357)
ln_HousingUnits	7.976***	22.79***	4.868***	1.700***
	(1.196)	(4.571)	(1.815)	(0.434)
ln_Income	8.343***	21.18***	1.848*	0.0461
	(0.671)	(2.213)	(0.966)	(0.261)
N	21,407	6,003	4,934	10,470
R-squared	0.224	0.370	0.135	0.035
Year FE	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes
HHI level	All	<0.15	0.15–0.25	>0.25

Notes: Robust standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A.11: Effect of policy incentives on HHI (All Cities in US)

	HHI			
	All Cities	HHI < 0.15	0.15 ≤ HHI ≤ 0.25	HHI > 0.25
NEM	0.0332***	0.0120***	0.00313	-0.0172
	(0.00826)	(0.00128)	(0.00314)	(0.0178)
ITC	-0.149***	-0.0171***	-0.0111***	-0.0695***
	(0.0127)	(0.00348)	(0.00403)	(0.0239)
Pct HighSCH	0.000732***	8.74e-05***	6.14e-05**	0.000718***
	(7.72e-05)	(1.89e-05)	(2.61e-05)	(0.000118)
Pct WH	0.00319***	0.000359***	0.000220***	0.00285***
	(0.000225)	(4.74e-05)	(8.17e-05)	(0.000379)
ln_Population	0.0839***	0.0178***	0.000665	0.0734***
	(0.0159)	(0.00517)	(0.00636)	(0.0222)
ln_HousingUnits	-0.122***	-0.0261***	-0.00736	-0.0971***
	(0.0195)	(0.00593)	(0.00756)	(0.0276)
ln_Income	-0.0699***	-0.0261***	-0.00233	-0.0233
	(0.0111)	(0.00287)	(0.00402)	(0.0164)
N	26,318	6,003	4,934	15,381
R-squared	0.033	0.103	0.012	0.014
Year FE	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes

Notes: Robust standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A.12: Robustness check on the effect of policy incentives on HHI (All Cities in US)

	HHI			
	All Cities	HHI < 0.15	0.15 ≤ HHI ≤ 0.25	HHI > 0.25
NEM	0.0430***	0.0120***	0.00313	-0.0186
	(0.00620)	(0.00128)	(0.00314)	(0.0159)
ITC	-0.113***	-0.0171***	-0.0111***	-0.0589***
	(0.00962)	(0.00348)	(0.00403)	(0.0209)
Pct HighSCH	0.000398***	8.74e-05***	6.14e-05**	0.000271**
	(6.08e-05)	(1.89e-05)	(2.61e-05)	(0.000107)
Pct WH	0.00233***	0.000359***	0.000220***	0.00202***
	(0.000177)	(4.74e-05)	(8.17e-05)	(0.000357)
ln_Population	0.0316**	0.0178***	0.000665	0.0275
	(0.0135)	(0.00517)	(0.00636)	(0.0218)
ln_HousingUnits	-0.0901***	-0.0261***	-0.00736	-0.0588**
	(0.0162)	(0.00593)	(0.00756)	(0.0266)
ln_Income	-0.0492***	-0.0261***	-0.00233	-0.000226
	(0.00910)	(0.00287)	(0.00402)	(0.0160)
N	21,407	6,003	4,934	10,470
R-squared	0.036	0.103	0.012	0.009
Year FE	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes
HHI level	All	<0.15	0.15–0.25	>0.25

Notes: Robust standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A.13: Effect of policy incentives on market prices (All Cities in US)

	Price			
	All Cities	HHI < 0.15	0.15 ≤ HHI ≤ 0.25	HHI > 0.25
NEM	112.3**	-52.21	32.82	249.1**
	(44.32)	(42.79)	(88.61)	(102.3)
ITC	-1,131***	-752.1***	-934.6***	-1,279***
	(68.36)	(116.6)	(113.9)	(137.6)
Pct HighSCH	10.97***	15.93***	8.624***	8.793***
	(0.414)	(0.634)	(0.739)	(0.679)
Pct WH	14.24***	9.922***	11.64***	13.57***
	(1.206)	(1.588)	(2.307)	(2.186)
ln_Population	360.1***	-430.7**	-142.0	592.2***
	(85.45)	(173.1)	(179.6)	(127.9)
ln_HousingUnits	-1,180***	-659.1***	-809.2***	-1,278***
	(104.9)	(198.6)	(213.5)	(158.9)
ln_Income	-243.5***	-493.2***	143.8	-130.1
	(59.35)	(96.17)	(113.7)	(94.59)
N	26,318	6,003	4,934	15,381
R-squared	0.075	0.181	0.130	0.040
Year FE	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes
HHI level	All	<0.15	0.15–0.25	>0.25

Notes: Robust standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A.14: Robustness check on the effect of policy incentives on market prices (All Cities in US)

	Unit installation price			
	All Cities	HHI < 0.15	0.15 ≤ HHI ≤ 0.25	HHI > 0.25
NEM	732.6***	-428.3***	580.0***	953.9***
	(59.57)	(66.04)	(135.8)	(151.1)
ITC	-2,452***	-1,807***	-2,180***	-2,793***
	(92.44)	(180.0)	(174.7)	(198.6)
Pct HighSCH	17.23***	25.17***	13.95***	11.58***
	(0.584)	(0.978)	(1.132)	(1.015)
Pct WH	40.55***	36.28***	36.54***	38.31***
	(1.702)	(2.451)	(3.537)	(3.392)
ln_Population	836.8***	-289.8	65.23	1,583***
	(129.5)	(267.1)	(275.3)	(207.5)
ln_HousingUnits	-2,302***	-1,670***	-1,759***	-2,598***
	(155.9)	(306.5)	(327.2)	(252.5)
ln_Income	-767.7***	-1,379***	-181.3	-343.6**
	(87.50)	(148.4)	(174.3)	(152.1)
N	21,407	6,003	4,934	10,470
R-squared	0.170	0.291	0.200	0.092
Year FE	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes
HHI level	All	<0.15	0.15–0.25	>0.25

Notes: Robust standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

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