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Driving while unauthorized: Auto insurance remains unchanged when providing driver licenses to unauthorized immigrants in California

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Abstract

Several states have recently implemented driver license reforms that give unauthorized immigrants access to driver licenses, aiming to reduce uninsured driving and lower premium costs. We test this expectation in the context of California's Assembly Bill 60 (AB60). AB60 gives about 2.6 million unauthorized immigrants access to driver licenses, making it the largest policy of its kind. Exploiting cross-county variation in the estimated number of AB60 licenses, we find no measurable effects on auto insurance uptake or premium costs. A power analysis and multiple robustness checks corroborate this conclusion. We interpret our results to suggest that most newly licensed unauthorized immigrants were already driving before the reform to access work and basic services. Furthermore, unauthorized drivers may already have had access to an insured vehicle. Our research revisits prominent claims about the effects of driver license reforms and provides much-needed empirical evidence to a controversial policy debate.

KEYWORDS

AB60, auto insurance, driver licenses, insurance premiums, insurance uptake, unauthorized immigrants

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1 | INTRODUCTION

As of April 2022, 16 US states have implemented reforms that give unauthorized immigrants access to driver licenses (henceforth: "driver license reforms"). One of the main arguments in favor of such legislation is that it would lower the number of uninsured motorists and decrease insurance premiums (Institute for Social Research, 2018). For example, legislators in California argued that licensing unauthorized immigrants would "improve traffic safety by ensuring that drivers on the road are properly trained, have passed a background and driving test, know state driving laws, and become insured" (California State Assembly, 2013, p. 3). Their colleagues in New Jersey argued that "our roads are safer when our drivers are trained, tested and insured" (Tully & Gold, 2019), while New York state legislators hoped that "auto insurance premiums will decrease" (New York State Senate, 2019). Similarly, Vasan (2018) estimated that Colorado drivers could save about $29.5 million in insurance premiums every year if all of of the state's unauthorized immigrants were to get driver licenses.[1]

Opponents of such legislation, by contrast, claim that driver license reforms will worsen traffic safety and increase insurance rates because unauthorized immigrants "generally are working in low-wage jobs and have difficulty affording insurance, and their cars are frequently older and more accident-prone" (FAIR, 2011). They argue that such reforms "will not positively impact the number of insured drivers on the road, will roll back public safety, will encourage more people to live here illegally, and will give state-endorsed documentation to the undocumented" (Protect Oregon Driver Licenses, 2014).

Yet, while arguments about the potential effects of driver license reforms abound, few studies test these competing claims empirically. By and large, past work on driver license reforms has focused on their consequences for traffic safety (Lueders et al., 2017) and the labor market (Amuedo-Dorantes et al., 2020; Cho, 2020; Lueders, 2021), mostly disregarding their implications for auto insurance outcomes. How, then, do reforms that give unauthorized immigrants access to driver licenses affect the share of uninsured vehicles (henceforth: "insurance uptake") and auto insurance premium costs?

In this paper, we present results that are inconsistent with the arguments of both supporters and opponents of driver license reforms. Our focus is on the largest driver license reform to date: California's Assembly Bill 60 (AB60), which was implemented in 2015 and authorized the state's Department of Motor Vehicles (DMV) to issue special driver licenses to those applicants unable to document legal presence in the country. In doing so, it gave an estimated 2.6 million unauthorized immigrants in the state access to driver licenses. We find that across a variety of outcome measures, granting unauthorized immigrants access to driver licenses affected neither insurance uptake nor premium costs. Numerous checks probe the robustness of these results, while a power analysis rules out that our null result is due to a lack of statistical power.

We interpret these results as evidence that reforms to grant unauthorized immigrants access to driver licenses are neither a panacea nor an obstacle to better auto insurance uptake and

[1]Besides positive consequences for auto insurance, driver license reforms are also intended to improve racial equity (Johnson, 2004; Mounts, 2003) and socioeconomic equality (Guelespe & Gomberg-Munoz, 2012; Hendricks, 2014; Karoly & Perez-Arce, 2016).

lower premiums. Instead, we conclude that in a highly car-dependent society such as the United States, where access to basic services and jobs requires private transportation (Hendricks, 2014; Pucher & Lefèvre, 1996), unauthorized immigrants have no choice but to drive, even if doing so is illegal. We substantiate this claim by showing that California's driver license reform did not markedly increase the number of registered cars in the state. This finding supports the idea that most newly licensed unauthorized drivers had already been driving before the reform. We also suggest that unauthorized immigrants may have already had access to an insured vehicle. In support, we show that areas with higher concentrations of AB60 licenses did not experience greater increases in premium costs, number of policies, or insurer losses, as compared to areas with lower concentrations.

Our research is most closely related to three existing studies. First, we build on work by Query and Kumazawa (2011) who document a positive relationship between driver license reforms, the percent uninsured motorists, and traffic fatalities. We expand the authors' work by examining the effect of driver license reforms on a larger set of outcomes, including auto insurance premiums and car registrations. We also improve the authors' research strategy. Because their analysis is cross-sectional, Query and Kumazawa (2011) cannot rule out that the patterns they observe are driven by unmeasured confounders—such as overall policy environment, economic situation, or population density—that may simultaneously influence the size of a state's unauthorized population, traffic safety, and its driver license policies. By contrast, we analyze panel data in which we observe the same counties over time. This strategy allows us to better account for unobserved variables that may potentially confound our analysis.

Second, we build on work by Cáceres and Jameson (2015) who demonstrate that *restricting* unauthorized immigrants' access to driver licenses comes with a slight increase in auto insurance premiums. We, by contrast, ask about the effects of *expanding* access to driver licenses. It is unclear to what extent we should expect liberalizing reforms to make up for the negative effects of restrictive ones. Moreover, we consider a larger set of outcome variables and move beyond the authors' focus on insurance premiums.

Third, we build on recent work by Churchill et al. (2020) who examine the effect of driver license reforms in a panel analysis of US states. They find that driver license policies come with a slight increase in licensed drivers and liability insurance coverage but leave claims and vehicle registrations unchanged. We expand on these authors' findings by examining more direct measures of insurance uptake.

More broadly, we make two crucial improvements over all three studies. First, while past work exploits cross-state variation in auto insurance outcomes and driver license policies, we focus on cross-county variation within one particular state: California. This strategy has two key advantages. On the one hand, many of the states who have expanded eligibility for driver licenses to unauthorized immigrants in recent years are actually characterized by very small unauthorized populations. For instance, while Connecticut, Delaware, Hawaii, Utah, or Vermont allow unauthorized immigrants to obtain driver licenses, their unauthorized populations make up between close to 0 (Vermont) and no more than 3.5% (Utah) of the total population (Warren & Warren, 2013). This small population share makes it exceedingly difficult to identify meaningful effects. That is, we cannot rule out that any (null) effects reported in past work are driven by a lack of statistical power. This problem is less concerning in California, where close to 8% of the population is estimated to be unauthorized (Passel & Cohn, 2011; Warren & Warren, 2013). More so than in other states, these unauthorized immigrants have strong incentives to obtain driver licenses. Due to the lack of public

transportation outside urban areas, unauthorized immigrants in California are particularly reliant on private transportation. Moreover, AB60 license-holders receive an additional layer of protection, as AB60 explicitly protects unauthorized residents from having their license used to infer their immigration status in a criminal investigation, arrest, or detention. While not a valid form of identification for federal purposes, AB60 licenses are accepted at banks, bars, and liquor stores. Unsurprisingly, then, take-up of the reform was strong. More than one million licenses have been issued under the policy to date (DMV, 2018), making it the largest-scale policy of its kind. In short, we regard California as the state where we should be most likely to identify effects of driver license reforms if such effects existed. Conversely, if we found no such effects, we should be particularly confident that such null results are not driven by a lack of statistical power.

Additionally, our focus on variation in exposure to one particular policy change within one state holds constant other statewide factors—such as economic conditions, policies such as cell phone bans (Karl & Nyce, 2017), or enforcement regulations (Ma & Schmit, 2000)—that can confound cross-state analyses. We believe that this approach enables us to better isolate the effect of driver license reforms.

The second improvement we make over existing work is the way we identify areas where we expect the reform to have a strong impact (henceforth: "treatment intensity" or "exposure"). Our identification strategy relies on the idea that if California's driver license reform had an effect on auto insurance outcomes, we should find larger effects in counties with stronger take-up of the reform. Past work has measured treatment intensity using estimates of the size of the unauthorized population. Such an approach has several shortcomings. Estimates of the unauthorized population rely on strong and often empirically unverifiable assumptions that can introduce a large amount of noise (Lueders, 2021; van Hook & Bachmeier, 2013; van Hook et al., 2015). Moreover, using the share of the unauthorized population requires the equally strong assumption that unauthorized immigrants have the same propensity to apply for driver licenses everywhere. Yet, this assumption disregards that counties vary considerably regarding the need for unauthorized immigrants to drive. Our solution to these challenges is to create our own measure of treatment intensity. Specifically, we follow an approach developed by Lueders et al. (2017) and estimate the share of all driver licenses issued under the policy. The key advantage of our measure is that it explicitly accounts for any cross-county heterogeneity in the take-up of the reform.

2 | HOW DRIVER LICENSE REFORMS MAY AFFECT AUTO INSURANCE UPTAKE AND PREMIUMS

An often stated goal of reforms that grant unauthorized immigrants access to driver licenses is to increase the availability and affordability of auto insurance. This section discusses how such reforms may affect these outcomes. We proceed in three steps. We first discuss what determines the probability that motorists obtain auto insurance, followed by a review of the determinants of premium costs. This discussion then allows us to make predictions about the possible effects of driver license reforms on insurance uptake and premiums. We find that these predictions depend on our assumptions about the driving behavior of unauthorized immigrants before they were granted access to driver licenses. To our knowledge, we are the first to explicate these assumptions. We also explain how differences in these assumptions may explain

why proponents and opponents of driver license reforms arrive at divergent predictions regarding the effects of these reforms.

2.1 | Determinants of insurance uptake

The existing literature identifies two major determinants of insurance uptake. The first determinant is the costs of insurance (Dahlby, 1983; Sun & Yannelis, 2016). High insurance premiums change the cost–benefit calculus of drivers, while at the same time making insurance unaffordable for low-income motorists. Fewer motorists seek insurance as a consequence. Economic conditions can also influence the decision to purchase or maintain auto insurance: uninsured motorist claims tend to rise with unemployment (Insurance Research Council, 2011).

The second determinant is enforcement rigidity. For example, drivers are more likely to hold a valid insurance policy if proof of insurance is required when registering or operating a vehicle, when involved in an accident, and when penalties for not having auto insurance are high and strictly enforced (Ma & Schmit, 2000). In that case, incentives to free-ride are weaker.

California has several mechanisms in place to encourage insurance uptake. The cost of insurance is subsidized for low-income individuals via the California Low Cost Auto Insurance Program (CIC§11629.7). In addition, proof of insurance is required to register a vehicle and whenever operating a vehicle on public roads (CVC§§16050–16058.1). Insurance companies are also required by law to electronically report their active private-use vehicle insurance policies, as well as any changes to the policy (i.e., cancellations, amendments, etc.), to the DMV (CVC§16058). This allows the DMV to suspend vehicle registrations for lapses in insurance coverage.

2.2 | Determinants of premium costs

Beyond the specifics of the insurance policy—such as the desired coverage limits, the type and age of the insured's car, and vehicle miles traveled (The Zebra, 2018)—the characteristics of the policy-holder and the location in which they seek to insure their vehicle are central factors in determining premium costs. In California, for instance, insurers are required to give the most weight to the following three factors, in decreasing order of importance (CIC§1861.02(a)(1-3); see California Legislative Information, 2021): (1) the insured's driving record; (2) their annual mileage; and (3) their driving experience.

The most important factor is the insured's own risk behavior. Insureds who have a history of accidents are considered a higher liability and thus are charged higher insurance premiums. Premium surcharges following other risky driving behaviors—such as DUI convictions—are also intended to deter reckless driving (Sloan & Githens, 1994).

Another important factor is the number of years of driving experience. Inexperienced drivers are more likely to be involved in accidents, so a newly licensed driver will pay higher premiums than a driver who has had a license for many years (Insurance Information Institute, 2019). Importantly, driving experience is measured by the number of years of being licensed, as insurers have no alternative to verify insureds' de facto driving experience (e.g., from driving unlicensed).

Less important individual-level factors are gender and marital status, as women are less likely to be involved in accidents (though some states ban gender-specific rate setting), while married insureds have been shown to drive more defensively (Gardner & Marlett, 2008).

Auto insurance premiums are also determined by the location in which motorists garage their car. A larger share of uninsured and underinsured motorists in the location raises insurance premiums for all other motorists because their own policy has to insure them against the risk of being involved in an accident with an uninsured motorist unable to pay for the damages or injuries they caused (Smith & Wright, 1992; Sun & Yannelis, 2016).

Other rate-setting factors concern the risk of being involved in an accident. For example, insurance premiums are often higher in urban areas, where a higher density of cars comes with higher accident rates (Gardner & Marlett, 2008). Likewise, Karl and Nyce (2017) identify bans on the hand-held use of cellphones as promising response to rising premiums because such bans reduce distracted driving, the losses for insurers and, eventually, premiums for motorists. Feber et al. (2003), in turn, show that infrastructure improvements on road intersections—such as the addition of left-turn lanes or left-turn phases in traffic lights—reduce insurers' claim costs.

Of course, insurance costs also depend on the extent to which these regulations are enforced. In this regard, California's auto insurance market is one of the most heavily regulated in the United States. Strict enforcement and oversight by the California Department of Insurance (CDI) ensure that insurers follow the rules. First, insurers must submit their rating plans to the Rate Regulation Branch, who reviews and analyzes them for compliance with the law. All insurance rate changes require prior approval from the CDI. To receive approval, the insurer must share the factors used to calculate rates and the weight given to each (10 CCR§2632.9). Second, the Field Rating and Underwriting Bureau reviews each insurer's market conduct at least every 5 years. In those reviews, a sample of policies is evaluated for compliance with the regulatory requirements. This review involves manually rating the policies to confirm that the premiums charged match the rating process filed with and approved by CDI. Third, if an insurer is found to be in violation of the regulations, CDI asks the insurer to take corrective actions, including issuing refunds to affected policyholders and possible monetary penalties.

2.3 | Possible effects of driver license laws on auto insurance uptake and premium costs

The preceding sections suggest several channels through which granting unauthorized immigrants access to driver licenses may affect auto insurance uptake and premium costs. We propose that a useful starting point for thinking through these various channels is to consider the driving behavior of unauthorized immigrants before driving was legal for them. This is because driver license reforms should only have an effect on auto insurance in the aggregate if they change the composition of the driving population (i.e., the average risk of a driver getting into an accident) or if the reform affects the propensity to purchase insurance—that is, if driver license reforms introduce a large number of inexperienced drivers onto the roads or change the demand for auto insurance. Consequently, our discussion below focuses on two parameters: whether unauthorized immigrants were driving unlicensed before the reform and, if so, whether their vehicle had insurance.

The first parameter is whether driver license reforms actually alter the composition of the driving population in a state. In the first 2 years after the implementation of California's AB60

reform in 2015, for instance, more than one million driver licenses were issued to unauthorized immigrants (DMV, 2018). It is possible that most of these licenses went to unauthorized immigrants who did not drive before 2015. If that were the case, the driver license reform would have significantly altered the state's driving population by introducing a large number of new, inexperienced drivers onto Californian roads. Yet, it is equally possible that most of these licenses went to unauthorized immigrants who were already driving. The United States is one of the most car-dependent societies in the world (Pucher & Lefèvre, 1996). In 2017, about 272.5 million motor vehicles—833 per 1,000 inhabitants—were registered in the country (U.S. Department of Transportation, 2019).[2] Private transportation is often a precondition for accessing basic public services and participating in economic or social life (Hendricks, 2014). It is therefore plausible that many unauthorized immigrants have no choice but to drive, irrespective of their state's driver license policy. If that were the case, driver license reforms would have much smaller effects on the risk composition of a state's driving population.

The second parameter is the propensity of unauthorized immigrants to obtain auto insurance. It is possible that if unauthorized immigrants drove illegally before the reform, they would have done so without insurance, as proof of a valid driver license is often required to purchase insurance. However, it is also possible that unauthorized immigrants had access to insured vehicles: many immigrants live in families that comprise both authorized and unauthorized immigrants or even US citizens (Taylor et al., 2011). In such mixed-status families, unauthorized immigrants can drive cars that are insured under a legal resident's name. Unauthorized immigrants could also use a car insured under a friend's name. Such a strategy is possible because car insurance policies cover other drivers as long as they are not using the car regularly. The burden of proof that a car was used regularly by another driver lies with the insurance company and is typically very hard to establish.

Combined, the different assumptions about the pre-reform behavior of unauthorized immigrants lead us to formulate differing predictions about the effect of driver license reforms. We summarize these predictions in three scenarios, or hypothetical ways in which unauthorized immigrants respond to driver license policies in the aggregate (Table 1). Of course none of the scenarios perfectly captures the prereform driving behavior of all unauthorized immigrants. Each of the hypothetical scenarios likely describes the behavior of a subset of unauthorized immigrants. But where the scenarios differ is with respect to the assumed driving behavior of the *majority* of unauthorized immigrants.

The first scenario assumes that the majority of unauthorized immigrants were not driving before gaining legal access to driver licenses. Here, driver license reforms would introduce a large number of new and inexperienced drivers onto the roads. This is the scenario that opponents of driver license reforms usually have in mind. In this scenario, the effect on insurance uptake depends on whether the propensity of the newly licensed drivers to purchase auto insurance is higher, lower, or the same as that of the existing driving population. While in theory all three cases are possible, we believe that the most plausible case is that unauthorized immigrants would be less likely to purchase insurance than other drivers. This is because most unauthorized immigrants have below-average incomes; an estimated 58% of them lives below 200% of the federal poverty level (Migration Policy Institute, 2021). In other words, auto insurance is

[2]This number significantly exceeds car ownership in other major developed countries such as Italy (625 vehicles per 1000 inhabitants), Germany (561), or the United Kingdom (471) (Eurostat, 2019).

TABLE 1 Predicted effects of driver license policies on auto insurance uptake and premiums.

	Behavior before the reform		Predicted effects of the reform	
Scenario	**Driving?**	**Auto insurance?**	**Insurance uptake**	**Premiums**
1: Not driving	No	NA	↓	↑
2: Driving and not insured	Yes	No	↑	↓
3: Driving and insured	Yes	Yes	↔	↔

simply unaffordable for many unauthorized immigrants (Gardner & Marlett, 2008).[3] Consequently, we should see a decrease in the share of insured drivers (i.e., less insurance uptake in the aggregate).

If driver license reforms introduced many inexperienced drivers onto the roads, we should also see an increase in insurance premiums. Inexperienced drivers are more likely to cause accidents (Insurance Information Institute, 2019), while lower insurance uptake should raise premiums as well: lower insurance uptake means a higher risk of accidents with uninsured motorists, increasing claim costs that insurers pass on through premium increases.[4]

The second scenario assumes that the majority of unauthorized immigrants were driving before the reform, albeit in mostly uninsured vehicles. This is the scenario that many supporters of driver license reforms have in mind. While in this scenario driver license reforms would not change the risk composition of the driving population, holding an official driver license would facilitate access to insurance and thus improve insurance uptake. The resulting decline in instances of uninsured driving should translate into lower insurance premiums. Increased competition among insurers for the newly licensed drivers could further drive down insurance rates: for example, to win new customers following the implementation of California's driver license reform, many insurers—such as Infinity (2021), AIS (2021), or Freeway Insurance (2021)—set up websites specifically to show how to apply for an AB60 license and how to get an insurance policy from their company.

The third scenario assumes that the majority of unauthorized immigrants were already driving before the reform. It further assumes that unauthorized immigrants drove vehicles insured under someone else's name. In this scenario, driver license reforms should not affect auto insurance uptake, as most unauthorized immigrant drivers who wanted to insure their vehicle or were able to afford such insurance would have done so already. Likewise, it should not affect premium costs because it would leave the composition of the driving population and, hence, average risk profiles, unchanged. Moreover, average insurance premiums would have already priced in the same number of uninsured motorists as before the reform.[5] In other

[3]Of course, proof of valid car insurance is required when taking the driving test. However, given lower incomes, the propensity of unauthorized immigrants to keep their insurance upon passing the test is likely lower than for other drivers.

[4]Note that California law rules out a range of other potential channels. For example, it explicitly prohibits insurers from discriminating against insureds based on their race or religion (Insurance Information Institute, 2019). Insurers are not allowed to take an insured's immigration status into account or to consider the share of a locality's population that is estimated to be unauthorized when determining auto premiums.

[5]Naturally, it is possible that obtaining a driver license may make unauthorized immigrants less careful drivers because the possession of a driver license reduces their risk of prosecution by the police (i.e., moral hazard). Yet, given a political environment that has turned increasingly hostile toward unauthorized immigrants in recent years, we believe that such a scenario is less plausible.

words, the expectations of neither supporters nor opponents should materialize if this scenario were true.

In sum, there are reasonable arguments why driver license reforms should have positive, no, or negative effects on the share of insured vehicles and auto insurance premiums. These arguments are derived from diverging assumptions about the driving behavior of unauthorized immigrants before the reform. Empirical evidence is needed to adjudicate between these competing claims.

3 | EMPIRICAL STRATEGY

3.1 | Data

Public discussion of how driver license reforms affect auto insurance focuses on two insurance-related outcomes, which inform the selection of our dependent variables. On the one hand, we examine auto insurance premiums: is there a change in the cost of car insurance as more individuals are allowed to drive legally? On the other hand, we look at insurance uptake: to what extent do driver license policies for unauthorized immigrants reduce the share of uninsured vehicles?[6]

3.1.1 | Insurance premiums

We use data from California's Department of Insurance (CDI) to measure auto insurance premiums. California's insurance regulations require two types of auto insurance coverage: Bodily Injury (BI) and Property Damage (PD) (CVC§16056). They protect the insured against claims and lawsuits arising from the injuries or damage to another person and their vehicle, respectively, caused by the insured in a car accident. California's insurance regulations further mandate that all vehicles be covered by at least a "basic limit" insurance policy, which is $15,000 per person for BI coverage and $5,000 for PD coverage.

To provide the most consistent comparisons throughout our analyses, we focus only on premiums for policies with basic limit coverage. We chose to use BI instead of PD because many insurers offer greater than the basic limits for PD coverage as part of their standard auto insurance policy (i.e., $10,000 limit instead of $5,000), while BI is usually offered at the basic limits. As such, BI provides a more consistent measure of the trends in the market for basic limits coverage.[7]

Our first measure is the *average monthly BI premium* with basic limit coverage. To generate this variable, we first calculated the average monthly premium by dividing the amount of premium that all insurers earned by the number of covered vehicle-months (CIC§11628(a)). The resulting premiums, which are available at the zip code-level, were aggregated by county and are measured in log US$.

We take two additional measures from the Auto Premium Survey (APS). The APS is an annual survey of insurers to provide the public with a fair and consistent price comparison tool

[6]Replication data and code can be accessed at https://doi.org/10.7910/DVN/ETG4OS. See Lueders and Mumper (2022).
[7]However, our results remain the same when considering PD premiums, as shown in Online appendix section C.1.

for personal auto insurance (see California Department of Insurance, 2019). All insurers who earned at least $20 million in private-use auto premiums in the previous year are required to respond. The survey asks insurers to estimate the annual premium for multiple hypothetical profiles of insureds in 270 representative zip codes. The profiles vary in coverages, location, gender, marital status, years licensed, annual mileage, driving record, and vehicle type. The data thus allow for a precise comparison of insurance premiums across insurers and zip codes, as well as across different profiles of drivers.

We use the data to contrast insurance premiums for experienced and inexperienced drivers. The two profiles selected are those of a young (22 years), inexperienced (licensed for 4 years) driver (*average yearly premiums for inexperienced drivers*) and a middle-aged (43 years old), experienced (licensed for 25 years) driver (*average yearly premiums for experienced drivers*). We hold all other factors constant: both profiles drive an inexpensive sedan with the basic mandatory coverage and have no history of accidents or tickets. The premiums for these profiles were aggregated by county and year and are again expressed in log US$.

Giving driver licenses to unauthorized immigrants might affect the premiums for these two profiles differently by altering the risk profile of inexperienced drivers. Unauthorized immigrants are treated as inexperienced by insurance companies because they do not have an official driving record, no matter whether they drove illegally before the reform. Insofar as unauthorized immigrants were not driving before the reform (Scenario 1), "are not able to read road alerts in English," and come from countries "where it is not uncommon for motorists involved in accidents to flee the scene" (FAIR, 2011), the introduction of unauthorized immigrants into the group of inexperienced drivers would increase the overall risk profile of this group and thus raise average premiums. By contrast, insofar as unauthorized immigrants were driving before the reform (Scenario 2), they would be more experienced than other drivers in the group of inexperienced drivers. The group's overall propensity to be involved in accidents would decline, resulting in lower premiums.

Experienced drivers, by contrast, should see no change in their risk profile. Thus, they are a useful control group against which to compare the profile of inexperienced drivers. If, after the implementation of the reform, there were significant changes in average premiums for the inexperienced drivers, but not for older, experienced drivers, and those differences were stronger in places where more driver licenses were issued to unauthorized immigrants, it would strongly suggest that the changes in premiums were due to changes in the risk profile of inexperienced drivers, likely as a result of the introduction of many unauthorized immigrants into the insurance pool.

3.1.2 | Insurance uptake

There are several methods to estimate the share of uninsured drivers. A prominent approach is to take the ratio between the frequency of uninsured motorist bodily injury (UMBI)[8] claims to the frequency of bodily injury claims (BI). For instance, this method is used by Insurance Research Council (2011) to quantify the share of uninsured drivers, while Sun and Yannelis (2016) employ it in their study of the effect of uninsured motorists on auto insurance premiums.

[8]UMBI (and uninsured motorist claims for property damage [UMPD]) covers injuries and property damage resulting from an accident caused by an under- or uninsured motorist or from a hit-and-run accident. According to California's insurance regulations, insurers are required to offer UMBI coverage at the same limits as the BI coverage limits (CIC§11580.2(m)) and are required to offer UMPD coverage with a minimum limit of $3,500 (CIC§11580.26(a)(2)).

However, the use of the UMBI/BI ratio relies on numerous assumptions that are difficult to verify and may bias the estimation. Most importantly, it assumes that both uninsured and insured motorists are equally likely to be involved in an accident. As Khazzoom (2000, p. 15) finds, the UMBI/BI ratio is "likely to overstate the percentage of uninsured motorists in many states, and we do not know the range of the overestimate." Similarly, Hunstad (1999a, p. 5) concludes that "until the magnitude and stability over time of the different sources of biases can be established, it is impossible to tell if a year-to-year change in the ratio is due to a change in the actual UV [uninsured vehicle] rate or a change in one of the biases affecting the estimate."

Given these concerns, we opted to examine the effect of driver license reforms on auto insurance uptake using alternative measures. The first one uses county-level estimates of uninsured vehicles produced by CDI. This approach estimates the share of uninsured vehicles as ratio of the estimated number of insured vehicles (i.e., the number of private personal auto insurance policies reported by insurers) to the estimated number of noncommercial cars and trucks on the road. According to Hunstad (1999b), this method yields more accurate estimates than alternative approaches.[9]

The second one is the natural logarithm of the number of *uninsured motorist bodily injury claims* (UMBI claims) per 1000 vehicles, which we obtained from CDI. If giving unauthorized immigrants access to driver licenses introduces a large number of uninsured motorists onto the roads, the number of accidents involving an uninsured motorist should increase, resulting in more UMBI claims.[10]

3.2 | Model specification

Our paper establishes causality through a difference-in-differences strategy. This strategy is feasible because unauthorized immigrants are unevenly distributed across the state. As a result, the intensity of the reform should differ across California's 58 counties. It should have stronger effects where a large number of driver licenses were issued under the new policy ("exposure"). Our regression model is specified as follows:

$$y_{it} = \beta_0 + \beta_1 \text{Post-AB60}_t + \beta_2 [\text{Post-AB60}_t \times \text{exposure}_i] + \mu_i + \delta_t + \epsilon_{it},$$

where y_{it} is the outcome of interest (i.e., one of the five variables introduced above) in county i and year t; Post-AB60_{it} is a dichotomous indicator of the period after the implementation of AB60—2015 and thereafter—with the corresponding regression coefficient β_1. exposure_i is a measure of county i's anticipated treatment intensity—that is, its estimated exposure to AB60—which identifies the counties where we expect the policy to have the strongest effect (see below). μ_i are fixed effects for county i that capture all time-invariant county-specific factors that may impact the insurance market in this county; δ_t are time-fixed effects that capture all temporal factors that may impact insurance premiums in all counties equally in year t; and ϵ_{it} is the error term, which captures all idiosyncratic variation in y_{it}.

Of interest is the coefficient on the interaction term between the post-AB60 indicator and our measure of exposure (β_2). It identifies the effect of the driver license reform by estimating the change in the difference between counties with varying levels of exposure to the reform

[9]The data suggest very high shares of uninsured vehicles in Alpine county, exceeding 60%. Per CDI, the estimates for this county are not reliable due to small vehicle counts. Therefore, Alpine county was excluded from the analysis.
[10]For summary statistics, see Table A.1 in Online appendix section A.

before and after its implementation.[11] This approach relies on the idea that if California's driver license reform affected auto insurance uptake or average premium costs, counties with more exposure (i.e., relatively more licenses were issued to unauthorized immigrants in that county) should show greater change in the outcome than counties with less exposure.

Our difference-in-differences model relies on two identifying assumptions. First, there must be no spillovers across counties. This assumption would be violated if the issuance of many driver licenses to unauthorized immigrants in one county affected auto insurance uptake or premiums in another. For example, it is possible that when setting premiums, insurers considered factors outside of the zip code in which the insured's car is garaged. However, California insurance regulations explicitly prohibit insurance companies from doing so.[12] The no-spillover assumption would also be violated if California's driver license reform affected insurance premiums before its implementation. But again, California's insurance regulations prohibit insurers from raising premiums in anticipation of a future reform. Given strict enforcement of these regulations, we are confident that insurers obey these regulations.

The second identifying assumption is parallel trends: the outcomes of interest must have followed the same trajectories before 2015. Otherwise, it is possible that differences in outcomes after the implementation of AB60 started to emerge already before the reform and are thus unrelated to it. To support this assumption, we plot all outcomes over time for counties with low, medium, and high levels of treatment intensity. As shown below, the data move in parallel in the period before the implementation of AB60. Online appendix section B provides additional support by reporting event study plots for each outcome of interest. For all outcomes, the coefficients on the interaction terms between exposure and each year are close to zero and lack statistical significance across all years after the implementation of AB60.

3.3 | Estimating exposure to AB60

Our empirical strategy requires us to classify counties based on the extent to which they were affected by California's driver license reform (i.e., “treatment intensity” or “exposure”). To that end, we use each county's share of licenses that were issued to unauthorized immigrants. This indicator directly measures take-up of the policy. As the California DMV does not publish information on the number of AB60 licenses by county, we use a procedure developed by Lueders et al. (2017) to estimate this quantity instead.

We proceed in four steps. First, we use information on the total number of outstanding driver licenses by county and year from 2011 to 2014 (source: DMV, 2019)—a period in which the number of driver licenses increased almost linearly everywhere—to model the yearly increase in licenses before the implementation of AB60.[13] This is done by regressing the number of driver licenses on county-fixed effects and county-specific linear time trends.

[11]Exposure is constant for each county. The county-fixed effects (μ_i) thus absorb this lower-order term.

[12]Note that 10 CCR§2632.5 allows insurers to ask drivers about the location of their workplace, school, or other commuting destination. However, this information may only be used to compute the annual mileage. It cannot be used to determine the driver's likelihood of being involved in an accident.

[13]Ideally, our estimation strategy would consider basic demographic characteristics of the license holder to account for the fact that most unauthorized immigrants in California are Hispanic, middle-aged, and have relatively low levels of education (Migration Policy Institute, 2021). Unfortunately, such information is unavailable. However, the lack of demographic data on license-holders is unlikely to invalidate our estimation strategy. AB60 was the only major

Second, the resulting regression coefficients are used to predict the number of licenses for each county in 2015. That is, we use the county-specific trend in driver licenses before the implementation of AB60 to create a counterfactual estimate of the number of driver licenses in the absence of the driver license reform. The difference between the observed and the predicted number of licenses (i.e., the resulting "residuals") is our estimate of the number of driver licenses issued to unauthorized immigrants in each county.[14]

Third, we divide the estimated number of AB60 licenses by the total number of outstanding driver licenses in 2015 to obtain our county-specific measure of exposure to the driver license reform: the share of all driver licenses in 2015 that were issued under AB60. It ranges from 0% (Alpine and Trinity counties)[15] to 5.9% (Monterey county). The map in Figure 1a reports each county's estimated exposure.

Finally, we use these estimates of exposure in two ways. In one model, we measure exposure continuously. In a separate model, we divide counties into three bins of equal size (containing 19–20 counties each) using terciles on the distribution of this variable. The first tercile (low exposure) ranges from 0% (Trinity and Alpine counties) to 1.30% (Inyo county). The second tercile (medium exposure) ranges from 1.39% (Calaveras county) to 2.31% (San Bernardino county). The third tercile (high exposure) ranges from 2.35% (Los Angeles county) to 5.91% (Monterey county).

We corroborated the data in two ways. First, we find that our estimate of the number of AB60 licenses comes very close to the true value: our method yields an estimate of about 560,000 AB60 licenses, while the California DMV (2016) reports that 605,000 licenses were issued in the first 12 months after the reform's implementation.

Second, we should find more AB60 licenses in counties with a larger unauthorized population. This idea finds support in Figure 1b, which reports the bivariate relationship between our measure of exposure and estimates of each county's unauthorized population (data from Hill & Johnson, 2011). As expected, the correlation between both measures is positive and strong, with a correlation coefficient of 0.62. As most deviations are found in small counties, we are confident that the large majority of Californians live in counties where the association between both measures is strong.

We believe that our county-level estimates of exposure to the driver license reform are better suited for our empirical analysis than a county's unauthorized population, which is often used in past work (Cáceres & Jameson, 2015; Churchill et al., 2020; Query & Kumazawa, 2011). First and foremost, creating estimates of the unauthorized population requires strong, empirically unverifiable assumptions—for example, regarding the age profile or education level of unauthorized immigrants—that can introduce a large amount of noise into the estimates (van Hook & Bachmeier, 2013; van Hook et al., 2015). These assumptions often restrict the analysis to an unrepresentative subset of unauthorized immigrants, as discussed in more detail

transportation-related legislation in California in 2015, and it is implausible that any legal individuals applied for this license instead of a regular driver license.

[14]We estimate county-level exposure to AB60 using only 1 year of postimplementation data on the number of driver licenses. We do so in an effort to minimize the potential for measurement error. However, it is possible that take-up of AB60 was slower in some counties than others. Online appendix section C.4.1 addresses this concern by estimating exposure to AB60 over the first 2 years after its implementation (i.e., 2015 and 2016). We find that the correlation between this alternative and our preferred measure of exposure is exceptionally strong (0.90) and that the use of this alternative measure of exposure leaves our results unchanged.

[15]Our procedure yielded slightly negative values for these two very small and rural counties. We set both counties' exposure levels to 0.

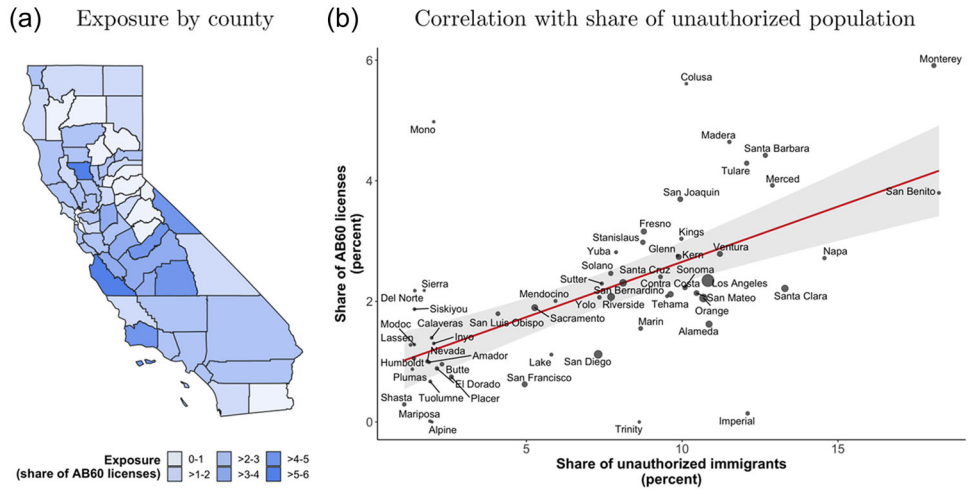

FIGURE 1 Estimated exposure to AB60 (2015). (a) Each county's estimated level of exposure to AB60, expressed as share of all driver licenses in 2015 that were issued under AB60. (b) Relation between the estimated share of each county's unauthorized population (horizontal axis; source: Hill & Johnson, 2011) and our measures of exposure to AB60 (vertical axis). Point size is proportional to (log) county population. [Color figure can be viewed at wileyonlinelibrary.com]

in Lueders (2021). Moreover, using the share of the unauthorized population requires another strong assumption that unauthorized immigrants are equally likely to apply for driver licenses everywhere. However, this assumption disregards that counties vary considerably regarding the need for unauthorized immigrants to drive, given large variation in the availability of public transportation, in the accessibility of job opportunities, or in the age profile of unauthorized immigrants, for instance.[16]

4 | RESULTS

4.1 | Auto insurance uptake

We begin by visually inspecting the development of auto insurance uptake over time. Figure 2 depicts, for each exposure tercile, the average annual (a) share of uninsured vehicles and (b) number of uninsured motorist claims for bodily injury per 1000 vehicles. Both variables trend almost in parallel in the preimplementation period, which supports the parallel trends assumption of our difference-in-differences design. The estimated share of uninsured vehicles went down in the aftermath of the Great Recession, but then increased again afterward (Figure 2a). However, this increase appears unrelated to the driver license reform as the three exposure terciles do not develop differently after its implementation (highlighted in blue). Likewise, we notice no association between changes in UMBI claims and California's driver license reform (Figure 2b).

[16]Nevertheless, our findings remain substantively unchanged when we use data on the unauthorized population to measure county-level treatment intensity (see Online appendix section C.4.2).

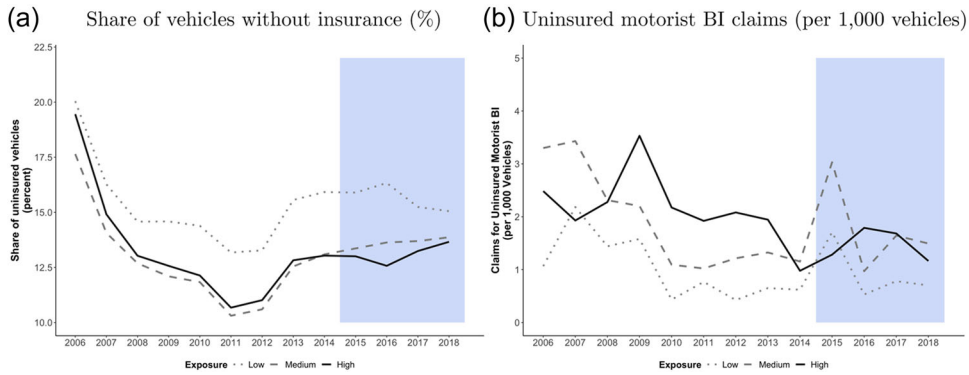

FIGURE 2 Insurance uptake over time: average share of vehicles without insurance (a) and the average number of uninsured motorist bodily injury claims per 1000 vehicles (b) by year and separately for counties with low, medium, and high exposure. The postimplementation period (2015 onward) is emphasized in blue. [Color figure can be viewed at wileyonlinelibrary.com]

TABLE 2 AB60 did not affect insurance uptake.

	Share uninsured		UMBI claims	
	(1)	(2)	(3)	(4)
Post-AB60 × Medium exposure	0.006		0.113	
	(0.006)		(0.159)	
Post-AB60 × High exposure	−0.005		0.033	
	(0.006)		(0.149)	
Post-AB60 × Exposure (continuous)		−0.013		0.029
		(0.206)		(3.660)
County-FE?	✓	✓	✓	✓
Year-FE?	✓	✓	✓	✓
Observations	741	741	754	754
Adjusted R^2	0.921	0.920	0.499	0.499

Note: Robust standard errors, clustered by county, in parentheses.
*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

Our regressions confirm that the driver license reform had little effect on insurance uptake. In Table 2, the dependent variables are the estimated share of all vehicles that lack insurance (Models 1 and 2) and the log number of uninsured motorist claims for bodily injury per 1000 vehicles (Models 3 and 4). Models 1 and 3 code exposure as terciles, while Models 2 and 4 measure it continuously.

Of interest are the coefficients on the interaction terms between the postimplementation period and exposure. Statistically significant ($p < 0.05$) coefficients would suggest an effect, while insignificance would mean that the driver license reform did not alter insurance uptake. All coefficients are close to zero and lack statistical significance, which suggests that access to

driver licenses had no effect on insurance uptake in California. Even if the coefficients were significant, they would imply only very small changes in the dependent variables. For instance, the coefficient on the interaction term in Model 1 reflects a reduction in the share of uninsured vehicles in high-exposure counties by only about 0.5 percentage points ($p \approx 0.436$). Similarly, Model 2 suggests that if a county's exposure level increased to the empirical maximum (about 0.06), it would witness a decrease in the share uninsured by 0.078 percentage points ($=-1.3 \times 0.06$; $p \approx 0.952$), or 0.56% relative to the mean of this variable in 2014 ($=-1.3 \times 0.06/14$; $p \approx 0.952$). Even if the coefficients of interest in Models 3 and 4 were significant, they would reflect only very small increases in the number of UMBI claims: by 11.3% ($p \approx 0.477$) in the medium- and 3.3% ($p \approx 0.827$) in the high-exposure tercile. Similarly, according to Model 4, moving from 0 to the highest exposure level would result in a trivial increase in UMBI claims by no more than 0.174% ($=2.9 \times 0.06$; $p \approx 0.994$).

4.2 | Auto insurance premiums

We now consider the effect of driver license reforms on insurance premium costs. Figure 3 reports the development of (a) average monthly premiums for bodily injury coverage as well as (b) average annual premiums for inexperienced and (c) experienced drivers by year and exposure tercile. While counties with higher levels of exposure have higher average premiums, we find that premiums again develop almost in parallel over time and throughout the postimplementation period. This finding provides initial evidence that California's driver license reform did not affect auto insurance premiums.[17]

Regression analysis confirms this finding. Models 1 and 2 in Table 3 examine average monthly premiums for bodily injury coverage, Models 3 and 4 look at average annual premiums for inexperienced drivers, and Models 5 and 6 focus on experienced drivers. All three outcome variables are logged. Treatment intensity is coded using terciles in Models 1, 3, and 5, while the other three models use the continuous measure.

The coefficients of interest are close to zero and statistically insignificant across all models, suggesting that California's AB60 reform had no effect on auto insurance premiums. They are also substantively small and would only reflect trivially small changes if they were significant. For example, the coefficients in Model 1 imply that the driver license reform reduced auto insurance premiums by only about 0.02% ($p \approx 0.990$) in the medium- and 0.6% ($p \approx 0.687$) in the high-exposure terciles. According to Model 2, moving a county from zero to the maximum level of exposure (0.06) would raise auto insurance premiums by only 0.76% ($=0.126 \times 0.06$; $p \approx 0.715$). Similarly, the coefficients imply that the driver license reform increased premium costs for inexperienced drivers by an insignificant 0.1% ($p \approx 0.860$; Model 3) in counties with a

[17]Figure 3 documents a strong increase in premiums after 2016. We note that this increase is unlikely to be related to California's driver license reform as it is of similar magnitude across all counties. As noted above, insurers are not allowed to increase insurance premiums in anticipation of future reforms. Moreover, insurers are only allowed to consider factors in the zip code in which the insured's auto is garaged. Given the uneven distribution of unauthorized immigrants in California, it is implausible that AB60 had uniform effects across all counties. Instead, the increase in insurance premiums after 2016 likely follows a broader, nation-wide trend: auto insurance premiums have shot up across the country in recent years, reaching an average of $1,427 in 2017 (The Zebra, 2018). Factors such as extreme weather events, wildfires, and more distractions caused by increased smartphone use have brought insurance claims to record highs, and insurance providers are responding by raising premiums (Fried, 2016; Value Penguin, 2017).

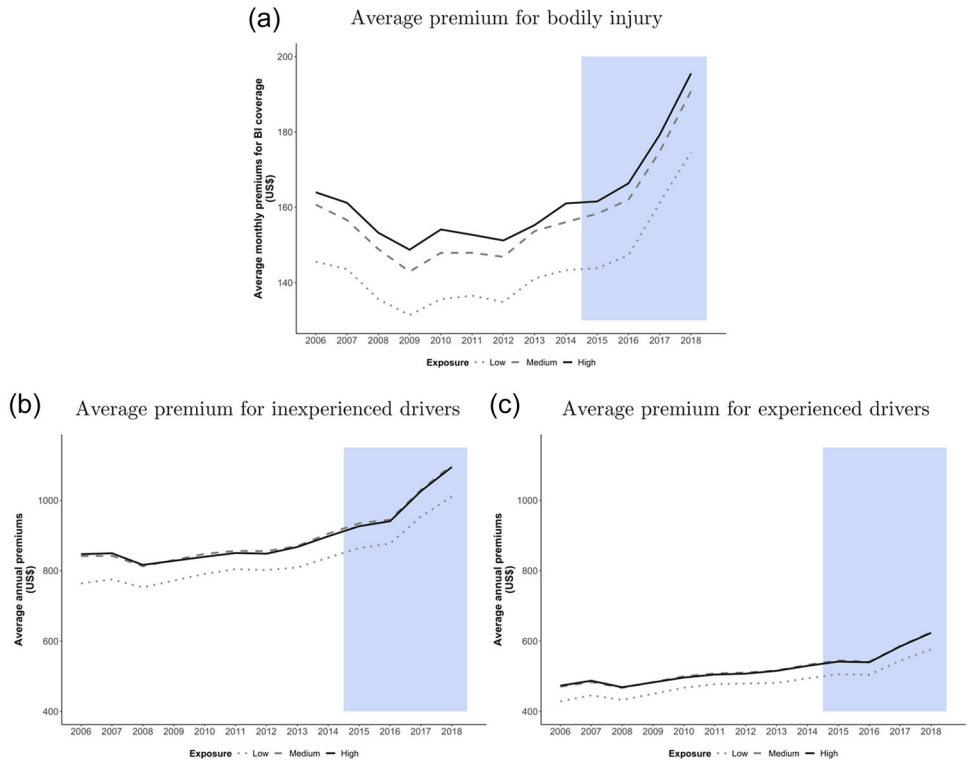

FIGURE 3 Insurance premiums over time: average monthly insurance premiums for bodily injury (a), average yearly insurance premiums for inexperienced drivers (b), and average yearly premiums for experienced drivers (c) by year and separately for counties with low, medium, and high exposure. The postimplementation period (2015 onward) is emphasized in blue. [Color figure can be viewed at wileyonlinelibrary.com]

TABLE 3 AB60 did not affect insurance premiums.

	Bodily injury		Inexperienced drivers		Experienced drivers	
	(1)	(2)	(3)	(4)	(5)	(6)
Post-AB60 × Medium exposure	−0.0002		0.003		0.002	
	(0.015)		(0.005)		(0.005)	
Post-AB60 × High exposure	−0.006		0.001		0.0004	
	(0.015)		(0.005)		(0.005)	
Post-AB60 × Exposure (continuous)		0.126		0.088		0.094
		(0.345)		(0.131)		(0.123)
County-FE?	✓	✓	✓	✓	✓	✓
Year-FE?	✓	✓	✓	✓	✓	✓
Observations	754	754	696	696	696	696
Adjusted R^2	0.941	0.941	0.985	0.985	0.985	0.985

Note: Robust standard errors, clustered by county, in parentheses.

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

high level of exposure and came with an increase in premiums by only about 0.5% in counties with the maximum level of exposure (=0.088 × 0.06; $p \approx 0.501$; Model 4). The results are almost identical for insurance premiums for experienced drivers. The coefficient of interest in Model 5 reflects an increase in premiums by no more than 0.04% in the high-exposure tercile ($p \approx 0.939$), while the relevant coefficient in Model 6 suggests an increase in premiums by less than 0.6% if a county moved from 0% to 6% exposure (=0.094 × 0.06; $p \approx 0.446$).

We hypothesized that if allowing unauthorized immigrants to obtain driver licenses changed the risk profile of insured drivers, these changes should be more noticeable among inexperienced than experienced drivers. If unauthorized immigrants were not driving before the reform and were indeed more risky drivers than other inexperienced drivers (Scenario 1), average premiums for inexperienced drivers should rise. Alternatively, insofar as unauthorized immigrants were driving before the reform (Scenario 2), their introduction into the group of inexperienced drivers should make this group less accident-prone, thus lowering premiums.

We employ a triple-differences strategy to test this argument. Here, we directly compare premiums for experienced and inexperienced drivers. That is, we now observe average premiums in each county and year separately for inexperienced and experienced drivers. To analyze the data, we modified the original difference-in-difference specification by adding a third interaction term that distinguishes between premiums for inexperienced compared to experienced drivers. If the driver license reform changed the risk profile of inexperienced drivers, we should notice this difference in high-exposure counties in the postimplementation period: the coefficient on the triple interaction term should be statistically significantly different from zero.

Table 4 presents the results of two regression models. They use exposure terciles (Model 1) and the continuous measure of exposure (Model 2), respectively. In both models the coefficient on the triple interaction is close to zero and lacks statistical significance. This result implies that auto insurance premiums for inexperienced and experienced drivers did not develop differently following the implementation of AB60.[18]

4.3 | Power analysis

Our analyses thus far have yielded null results: across multiple outcome measures, we have found little evidence that granting unauthorized immigrants access to driver licenses in California affected auto insurance uptake or premium costs. One key concern with our null result is that it may be driven by a lack of statistical power. This section addresses this concern and conducts a formal power analysis to rule out that our study is under-powered.

First, it is possible that the number of driver licenses issued to unauthorized immigrants may be too small to noticeably impact insurance uptake or premiums. This concern is a primary reason why we restrict the analysis to California instead of exploring the effect of driver license reforms on auto insurance outcomes in a nationwide analysis (Cáceres & Jameson, 2015; Churchill et al., 2020; Query & Kumazawa, 2011). We argue that this study

[18]We did, however, observe a statistically significant interaction between the postreform period and inexperienced drivers, which suggests that average premiums increased faster for inexperienced drivers compared to experienced drivers after the reform. It is important to note that this interaction is independent of our measure of exposure and thus unlikely a consequence of AB60. Although speculative, we might attribute this effect to a more general trend of rising insurance premiums due to distracted driving, which occurs more often among younger and less experienced drivers (National Center for Statistics and Analysis, 2020).

TABLE 4 AB60 did not affect insurance premiums 2: Triple differences.

	Insurance premium	
	(1)	(2)
Inexperienced	0.536***	0.537***
	(0.001)	(0.001)
Post-AB60 × Medium exposure	0.002	
	(0.005)	
Post-AB60 × High exposure	0.0004	
	(0.005)	
Medium exposure × Inexperienced	0.002	
	(0.002)	
High exposure × Inexperienced	0.001	
	(0.001)	
Post-AB60 × Exposure (continuous)		0.094
		(0.120)
Exposure (continuous) × Inexperienced		−0.003
		(0.036)
Post-AB60 × Inexperienced	0.016***	0.017***
	(0.001)	(0.001)
Post-AB60 × Medium exposure × Inexperienced	0.001	
	(0.001)	
Post-AB60 × High exposure × Inexperienced	0.001	
	(0.001)	
Post-AB60 × Exposure (continuous) × Inexperienced		−0.006
		(0.028)
County-FE?	✓	✓
Year-FE?	✓	✓
Observations	1392	1392
Adjusted R^2	0.996	0.996

Note: Robust standard errors, clustered by county, in parentheses.

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

design should maximize our ability to identify statistically significant effects if such effects existed because a comparatively large share of California's population is unauthorized. Average exposure in medium-exposure counties is 0.02, while it is 0.036 in high-exposure counties.[19]

[19]Recall that these estimates are based on the first 12 months after the implementation of the driver license reform only. Many more licenses have been issued to unauthorized immigrants by now, such that the true level of exposure is significantly higher.

While these numbers may appear small, they in fact reflect extraordinarily large increases in the number of licensed drivers: in medium-exposure counties, the median annual increase in outstanding driver licenses was 0.9% between 2011 and 2014 but 3.2% in 2015: an increase by about 239%. Likewise, the median annual change in outstanding licenses in high-exposure counties increased by 325% in high-exposure counties: from 1.1% between 2011 and 2014 to 4.5% 1 year later.

Second, it is possible that the insurance market responds only with a delay to driver license reforms. However, we note that our analysis covers 4 years after the implementation of California's AB60. Past work suggests that reforms take less than 4 years to change insurance uptake or premiums. For example, Karl and Nyce (2017) find that reforms banning the hand-held use of cellphones while driving had an immediate effect on incurred losses and loss ratios and started reducing premiums 2 years later. And even if the effect of California's driver license reform was delayed, we should notice an initial divergence in the outcomes we consider before the end of the fourth year after the implementation of AB60. However, all outcomes continue to trend in parallel throughout the postimplementation period (Figures 2 and 3).

Lastly, we conducted a power analysis to show that our empirical design has sufficient statistical power to identify small effects. The power analysis was implemented as follows. To ensure interpretability of the results, we simplify our analysis by distinguishing between low- and high-exposure counties using the median on the distribution of estimated AB60 licenses as threshold. We first add a range of pseudo-treatment effects to the high-exposure counties. We next draw, for each pseudo-treatment effect, 2500 samples from the data (with replacement). Sampling is implemented at the county-level, such that a particular county is either included with all years or fully excluded. The number of counties in each treatment groups is kept constant. The pseudo-treatment effect of the driver license reform is then estimated in each of the 2500 data sets. We subtract the estimated effects of AB60 in the actual data from the resulting coefficients to remove any bias. This procedure yields, for each chosen pseudo-treatment effect, 2500 estimated coefficients for the interaction term between high-exposure counties and the postimplementation period. Our power estimate equals the share of these 2500 estimated coefficients that result in statistically significant coefficients. Following the convention, the minimum detectable effect (MDE) is defined as the effect size at which statistical power exceeds 80%.

Figure 4 summarizes the results. It depicts the statistical power (vertical axis) for each pseudo-treatment effect (horizontal axis). Regarding the *share uninsured vehicles* (Figure 4a), the estimated MDE is 0.017. That is, our model specification has enough power to detect changes in insurance rates by as little as 1.7 percentage points. This figure is small in comparison with other studies. Cohen and Dehejia (2004, p. 373), for instance, find that compulsory insurance is associated with a 2.4 percentage point decrease in the share of uninsured motorists, equaling 18.6% relative to the base level (12.9%). Regarding *UMBI claims* (Figure 4b), our regression models have sufficient statistical power to detect effects of 40% on this outcome. While this MDE may appear large, it is still smaller than the effects of other policies. The results reported in Ma and Schmit (2000, p. 291), for example, imply that moving from the most to least restrictive auto insurance enforcement regime increases the estimated share of uninsured motorists by up to 86%.

The results are comparable for insurance premiums. Our power analysis suggests that the MDE for *average premiums for bodily injury* is 4% (Figure 4c). It is 1.4% and 1.3% for average premiums for inexperienced (Figure 4d) and experienced drivers (Figure 4e), respectively. These MDEs are in line with the average treatment effects found in other research.

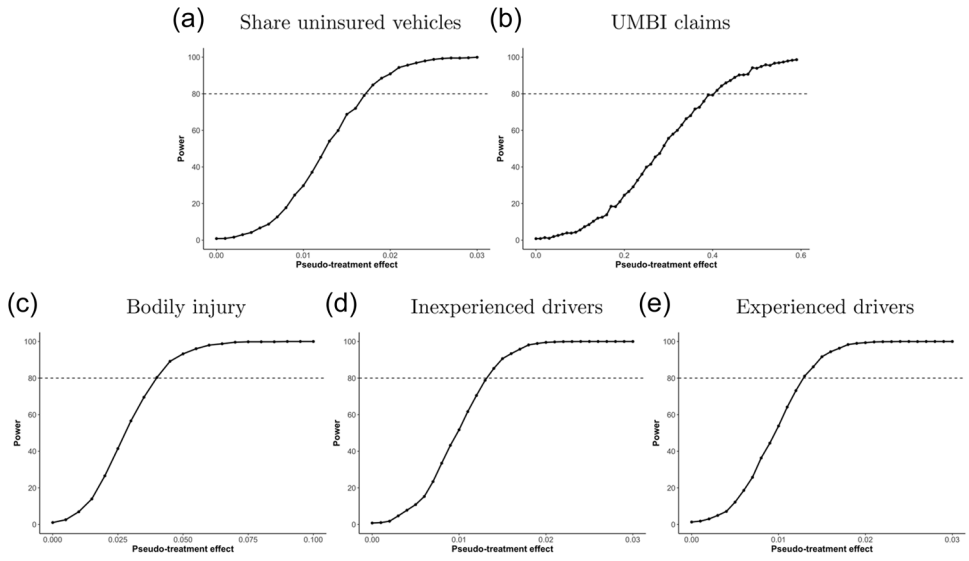

FIGURE 4 Power analysis. Reports of the results of the power analysis simulations for all five outcomes. For each pseudo-treatment effect (horizontal axis), it reports the share of draws for which a statistically significant treatment effect was recovered (vertical axis).

For example, Cáceres and Jameson (2015, p. 920) find that restricting unauthorized immigrants' access to driver licenses increases premiums by about 2.2% relative to the median, while Karl and Nyce (2017, p. 586) estimate that bans on the hand-held use of cellphones decrease premiums by more than 3%.

Taken together, the power analysis increases our confidence in the validity of our empirical results and our conclusion that California's driver license reform did not have any measurable effect on auto insurance uptake or premiums.

4.4 | Robustness

We conducted numerous robustness checks to ensure that our findings are not driven by particular modeling choices, our measures of insurance uptake and premiums, or the way we determine county-level treatment intensity. This section summarizes these robustness checks. They are discussed in further detail in Online appendix section C. By and large, the robustness checks are consistent with the main conclusions presented in the paper: granting unauthorized immigrants access to driver licenses in California led to little measurable change in auto insurance premiums or uptake.

First, we examine three alternative measures of insurance uptake and premiums (Online appendix section C.1). Above, we have argued that the UMBI/BI ratio, which is often used in extant work on auto insurance uptake, is based on several strong and hard-to-justify assumptions, which casts doubt on the validity of this measure (Hunstad, 1999a; Khazzoom, 2000). Nevertheless, we also examine the effect of driver license reforms on the UMBI/BI ratio. The evidence is inconsistent. While we find some increase in the UMBI/BI ratio in high-exposure counties, this effect is only marginally significant at $p < 0.1$ and does not replicate

when using the continuous measure of exposure. It also does not replicate when using any of the alternative measures of county-level treatment intensity discussed below, thus strongly suggesting that there is no effect of driver license reforms on this outcome. In addition, we examine the number of uninsured motorist claims for property damage (UMPD) and again find no effect of driver license reforms. Lastly, we also find no effect on insurance premiums when focusing on coverage for property damage instead of bodily injury.

Second, we address concerns about the comparability of Californian counties given their vastly different population sizes (Online appendix section C.2). Assigning equal weight to each may artificially inflate the statistical influence of small counties (such as Alpine or Sierra counties) or deflate the influence of large counties (such as Los Angeles or San Diego counties). Yet, when weighting each county by its (log) population, we continue to find no evidence that California's driver license reform altered auto insurance uptake or premiums.

Third, we probe the robustness of our findings to the inclusion of control variables (Online appendix section C.3). While the county- and year-fixed effects in our main model specification absorb both county-specific time-invariant (e.g., local labor market characteristics) and year-specific county-invariant factors (e.g., state-wide economic shocks), it remains possible that county-specific changes in economic circumstances may influence auto insurance uptake or premiums while at the same time being influenced by unobserved variables that correlate with the propensity of unauthorized immigrants to obtain a driver license. To address this concern, we added control variables for the unemployment rate (source: California Employment Development Department, 2020), per-capita personal income (source: California Employment Development Department, 2020), and population density (source: Bureau of Economic Analysis, 2020) to all regressions. Reassuringly, all findings remain substantively unaltered.

Fourth, we show that our findings remain robust to two alternative measures of county-level treatment intensity (Online appendix section C.4). On the one hand, we consider the number of outstanding driver licenses at the end of 2016 (as opposed to 2015) to determine each county's exposure status. This analysis accounts for the possibility that take-up of the policy may have proceeded at different speeds across counties. For example, it is possible that the better availability of public transportation or different enforcement standards in some counties may have reduced the urgency for unauthorized immigrants to drive or obtain driver licenses. But again, our results are robust to this adjusted measure of exposure.

On the other hand, even though we prefer our own estimate of county-level exposure, we verify that our results remain unchanged when using the estimated share of each county's unauthorized population as measure of exposure. For most outcomes, the results are substantively unaltered. The one exception is the triple-differences analysis, according to which driver licenses for unauthorized immigrants came with an increase in insurance premiums for inexperienced drivers. However, these effects are substantively trivial and do not exceed 0.2%. Combined with the strong assumptions necessary to use the share unauthorized as valid measure of exposure to California's driver license reform (as discussed previously), we maintain that driver license reforms have little substantive effect on insurance premiums.

Fifth, we probe the robustness of our main results to multiple alternative ways to group counties by their treatment intensity (Online appendix section C.5). Specifically, we distinguish between treated and control counties based on whether they are (1) above or below the mean value of the share of AB60 licenses; (2) above or below the median value of the share of AB60 licenses; or (3) in the highest tercile on the distribution of exposure. All results are the same when these alternative thresholds are used.

Sixth, we examine whether our findings are driven by the particular period we examine (Online appendix section C.6). Our main analysis covers the period 2006-2018—that is, 9 years before and 4 years after the implementation of California's driver license reform. A potential concern may be that we are including too many years before the reform, leading our findings to be driven by other policy changes that may influence auto insurance in previous years. To address this concern, we re-estimated all regressions for a smaller period: 2012–2018. The results by and large support our main conclusions. While some coefficients of interest are marginally statistically significant at $p < 0.1$, the implied effects are trivially small and indicate that giving unauthorized immigrants access to driver licenses raised insurance premiums by no more than 0.8%.

Seventh, and finally, some of our regression models have very high model fit values, which might indicate problems of over- or misspecification. To address this concern, we re-estimated all of our regressions without county-fixed effects (Online appendix section C.7). We note that the resulting coefficients no longer reflect difference-in-difference estimates, but instead average differences between groups of counties with varying levels of treatment intensity. Still, we continue to find that California's driver license reform had no effect on auto insurance uptake and premiums.

4.5 | Summary and additional evidence

In summary, the evidence presented thus far suggests that providing unauthorized immigrants with access to driver licenses had little effect on auto insurance uptake and premiums. This result is particularly noteworthy in the context of California. Compared to other states with similar legislation, a much larger share of California's population is unauthorized. The state can thus be considered a "most likely" case to find effects of driver license reforms if such effects existed. That we do no find such effects raises confidence in our null results, a conclusion bolstered by our power analysis. Moreover, numerous robustness checks demonstrate that our results are not sensitive to particular modeling or coding choices.

Our results stand in marked contrast to common arguments about the impact of driver license reforms. Contrary to the hopes of supporters of such legislation, we do not find that driver license reforms come with more insurance uptake and lower premiums. Contrary to the concerns of opponents of such legislation, in turn, we do not find that driver license reforms come with more uninsured motorists and rising premiums.

What, then, do these results imply about unauthorized immigrant drivers? If it were true that most unauthorized immigrants were not driving before California's driver license reform (Scenario 1 in Table 1 above), we should find that the introduction of a large number of inexperienced, low-income drivers increased the number of uninsured motorists and overall risk, resulting in higher insurance premiums. However, our results are inconsistent with this prediction. If, in turn, it were true that most unauthorized immigrants were already driving before the reform but had not obtained auto insurance (Scenario 2), California's driver license reform should have reduced the number of uninsured motorists and lowered average premiums. Yet, our results are again inconsistent with this idea. They are instead most consistent with the prereform behavior of unauthorized immigrants summarized in Scenario 3: namely, that unauthorized immigrants had no choice but to drive even when doing so was illegal for them and that the driver license reform did not alter their propensity to insure their vehicle.

We now examine the effect of driver license reforms on several additional outcomes to further substantiate this conclusion. As before, we regress each outcome on an interaction between indicators for the period following the implementation of the reform and county-level

TABLE 5 The effect of AB60 on additional outcomes.

	Registered cars		Premium volume		Policy volume		Claim frequency	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post-AB60 × Medium exposure	0.019		−0.029		−0.030		−0.0004	
	(0.033)		(0.038)		(0.032)		(0.0003)	
Post-AB60 × High exposure	0.051		−0.014		−0.019		−0.0004	
	(0.032)		(0.036)		(0.031)		(0.0003)	
Post-AB60 × Exposure (continuous)		1.083		−0.805		−0.749		−0.015
		(1.175)		(1.050)		(0.978)		(0.013)
County-FEs?	✓	✓	✓	✓	✓	✓	✓	✓
Year-FEs?	✓	✓	✓	✓	✓	✓	✓	✓
Observations	754	754	754	754	754	754	754	754
Adjusted R^2	0.999	0.999	0.993	0.993	0.993	0.993	0.160	0.162

Note: Robust standard errors, clustered by county, in parentheses.

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

measures of exposure along with county- and year-fixed effects. For each outcome, we estimate separate models using terciles and the continuous measure of exposure to determine each county's treatment intensity. All results are summarized in Table 5.

We first examine the (log) number of registered cars, taken from DMV (2022). If most unauthorized immigrants indeed drove before the reform, we should find little change in the number of registered cars. Consistent with this idea, the coefficients on the interaction terms are statistically insignificant and small; allowing unauthorized immigrants to drive in California did not lead to more registered cars.

Next, we examine whether California's driver license reform altered the overall volume of premiums collected (Models 3 and 4). If driver license reforms indeed did not alter the propensity of unauthorized immigrants to purchase auto insurance, we should find no effect on premium volume. Our analyses are consistent with this idea: the coefficients of interest are substantively small and statistically insignificant. We also find that California's driver license reform had no effect on the volume of active policies either (Models 5 and 6).

Lastly, Models 7 and 8 consider insurer losses, as measured by claim frequency (number of claims divided by number of insurance exposures). The coefficients of interest are again substantively small and statistically insignificant, implying no change in this outcome.

Taken together, these analyses provide additional support for our interpretation that providing driver licenses to unauthorized immigrants does not suddenly increase the number of registered cars or drivers, alter the propensity of unauthorized immigrants to obtain auto insurance, or change the overall insurer risk.

5 | CONCLUSION

When California implemented AB60 in 2015, lawmakers and immigration advocates believed that granting unauthorized immigrants access to driver licenses would improve traffic safety by ensuring unauthorized immigrants pass driving tests and encourage them to purchase auto

insurance to legalize their driving, leading to fewer uninsured motorists and lower premiums (California State Assembly, 2013). Opponents of the law, by contrast, feared that the reform would encourage more unauthorized immigrants to drive without insurance, resulting in higher auto insurance premiums (FAIR, 2011). Our paper is unable to confirm either of these predictions. We find instead that the share of uninsured vehicles and insurance premiums remained unaffected by the reform. This result is most consistent with the idea that most unauthorized immigrants were already driving before the reform. We interpret this finding as reflecting that private transportation in the United States is often necessary to access work and basic services (Hendricks, 2014; Pucher & Lefèvre, 1996). Unauthorized immigrants thus may have had no choice but to drive, irrespective of whether doing so was legal for them.

While our empirical evidence comes from an analysis of the auto insurance market in California, we believe that our findings can inform our understanding of similar legislation in other states. On the one hand, with an estimated 8% of its population unauthorized, California is a state "most likely" to experience a change in automobile insurance outcomes following the driver license reform. The fact that we still do not find any effect in this setting strongly suggests that similar legislation elsewhere would have no effect on auto insurance outcomes either.

On the other hand, California resembles other states in some important scope conditions. Given the poorly developed public transportation infrastructure outside a few large metropolitan areas in the United States, unauthorized immigrants are often reliant on private transportation to access jobs and basic services in other states. As a consequence, they face similar incentives to drive cars, even though doing so may be illegal for them. Legalizing their driving would not suddenly foist many new, inexperienced drivers on the roads either. It is hence unlikely for these drivers to have a dramatic impact on insurance rates once they are licensed. Moreover, while California has one of the most regulated insurance markets in the United States, most other states also disallow insurers to charge unfairly discriminatory rates that target individuals based on factors unrelated to their driving risks. These regulations impose important constraints on the ability of insurers to increase auto insurance rates in response to policies that allow unauthorized immigrants to obtain driver licenses.

At first sight, there appears to be a tension between the large take-up of California's driver license reform and our finding that it came with no change in auto insurance uptake, premiums, or car registrations. We believe that an explanation is rooted in the advantages of driver licenses that go beyond the right to drive. Driver licenses allow unauthorized immigrants to establish their identity in police stops[20] or for the purposes of opening bank accounts.[21] They can also be useful in numerous other everyday interactions—for example, to enter bars or purchase liquor. Consequently, the large number of driver licenses may not directly translate into new drivers on the road, but may come with other benefits. As such, our null finding does not suggest that California's driver license reform had no impact on the state's unauthorized population. For instance, it is possible that driver licenses increased the frequency with which unauthorized immigrants drive (Lueders, 2021), thus enabling them to better participate in and contribute to economic and social life in the United States (Amuedo-Dorantes et al., 2020; Cho, 2020). Investigating these effects remains an important task for future research.

[20]See, for example, here: https://www.aclusocal.org/en/know-your-rights/your-rights-ab-60-drivers-license.
[21]See, for example, here: https://www.landerholmimmigration.com/blog/2017/september/how-to-open-a-bank-account-without-documents/.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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