Picking Up the PACE: Loans for Residential Climate-Proofing*

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Abstract

We study PACE, an innovative financing contract that lets homeowners fund energy-efficient and resiliency upgrades through their property tax bills. We link PACE originations to property, credit bureau, and permit data to study how they create and redistribute value. Borrowing costs exceed home equity credit costs, especially for households with weaker outside options, consistent with underwriter market power. PACE also increases property tax delinquency. Investments capitalize into higher property values, partly through lower insurance costs, implying household discount rates of 2.9–3.7%. Combining higher property tax revenues with delinquency losses, we estimate positive net local fiscal gains from PACE adoption.

Keywords: PACE lending, climate retrofitting, home equity loans, delinquency, super seniority, homeowners insurance, property taxes

JEL classifications: G21, G51, Q54, R21, R28

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1 Introduction

A substantial increase in investment is required to make the housing stock more resilient to natural disasters and more energy efficient.[1] From 2002 to 2022, homeowner spending on disaster repairs rose by about 206% in real terms (Harvard JCHS, 2025), while insurance costs grew 8.7% faster than the overall price level between 2018 and 2022 (U.S. Department of the Treasury, 2025). These trends increase the importance of private adaptation (Ge et al., 2025a,b; Sastry et al., 2025, 2026; Sastry, 2026), particularly because homeowners hold a large and difficult to diversify share of their wealth in their homes (Giacoletti, 2021). Yet, households face substantial barriers to financing these projects (DeFusco et al., 2022; Yannelis and Zhang, 2023).

To overcome these barriers, several U.S. states have passed laws enabling residential Property Assessed Clean Energy (PACE) loans. PACE loans are one of the fastest growing public lending policies in the U.S.[2] These loans finance energy efficiency and/or climate resiliency home improvements. They are secured by tax liens that are senior to existing mortgages. Under Modigliani–Miller, issuing a new senior claim should not create value; seniority makes the PACE lender safer by reducing the expected recovery of mortgage creditors, thereby redistributing value across claims (Modigliani and Miller, 1958). Hence, these loans raise a central question: Does PACE financing enable otherwise unrealized investments that increase property values, and how are the resulting gains and costs distributed across households, insurers, lenders, and local governments?

In this paper, we show that PACE disproportionately reaches financially constrained

[1] In 2022, building operations accounted for 26% of global energy-related emissions, with residences alone accounting for 16% (International Energy Agency, 2023). Annual investment in carbon-reducing retrofits would have to increase thirty-fold to meet the residential sector goals of the 2016 Paris Agreement (Buchner et al., 2023).

[2] Residential PACE programs reached $9.1 billion in total loan dollars originated by the end of 2023, growing from $1.4 billion in 2015. The PACE market has grown by 71% since 2020 alone. See Figure 1.

households and sharply increases eligible home improvements around origination. Yet borrowers pay substantially more than for comparable home equity credit, especially when their outside financing options are weak, consistent with provider market power. PACE-financed investments nevertheless create substantial value: house prices rise, particularly for climate-proofing projects, partly through lower homeowners insurance costs, implying household discount rates of 2.9–3.7%. We do not find evidence that PACE borrowers face constraints in refinancing their mortgage. At the same time, property tax delinquency increases. Overall, the expansion of the property tax base more than offsets short-run delinquency losses, generating net fiscal gains of $186–$251 per PACE borrower annually.

To show these results, we construct a new dataset where we observe the economic and financial outcomes of PACE investments at the property owner level. We collect a comprehensive sample of roughly 77,000 PACE loans originated for home improvements across 60 Florida counties between 2015 and 2023 by sending Freedom of Information Act (FOIA) requests to each county in Florida and to coalitions of PACE lenders. We link each PACE loan to property-level data from Cotality and then to borrowers' credit histories from Equifax. The Cotality data allow us to observe household outcomes related to the property, including housing transactions, home equity-secured loans, building permit filings, property tax delinquency, and other involuntary liens, such as bankruptcy judgments. In particular, we develop a novel measure of household home improvement investment by parsing permit application memos to classify projects. The Equifax data complement these property-level records with detailed information on household credit outcomes, including mortgage balances and performance, credit card borrowing, auto and other consumer debt, credit scores, delinquencies, and bankruptcies.

We use two complementary identification strategies. First, a stacked difference-in-differences design compares households around PACE loan origination to otherwise similar households that receive a PACE loan only later, with fixed effects and controls interacted with the treatment cohort. Second, we instrument individual PACE loan take-up with the staggered adoption of PACE programs across Florida counties. Identification comes from differences in the timing of local program availability, which are determined by county officials' policy decisions and therefore shift households' access to PACE financing independently of their underlying financial conditions.

To discipline the empirical analysis, we develop a simple model in which households differ in credit quality and can finance home improvements either with conventional home equity credit or with PACE. Because HELOCs are junior to the existing mortgage, riskier households face tighter borrowing constraints, while the seniority of PACE protects lenders and allows these households to finance projects they otherwise could not undertake. PACE, however, can only finance a restricted set of eligible projects and approved contractors, which raises the average value of investments undertaken through the program relative to the broader set of projects financed with conventional credit. At the same time, PACE providers have market power, so borrowers with weaker outside financing options pay higher rates even though lender exposure to their credit risk is limited. The model therefore predicts that PACE expands investment among constrained households, shifts investment towards higher-value projects, raises delinquency by increasing debt service burdens, and generates capitalization into property values.

All the predictions of our framework are borne out in the data. We begin with the consequences of PACE for household financial distress. PACE borrowing increases financial distress. Using both a stacked difference-in-differences design and an IV strategy based on county-level PACE adoption, we find that PACE take-up raises property tax delinquency. In the stacked design, delinquency increases by 0.1 percentage points, a 14% increase relative to the pre-origination rate. This finding is surprising in light of evidence that expanding access to cheaper credit after disasters improves borrower repayment by relaxing liquidity constraints (Collier et al., 2024, 2025). Instead, our findings are consistent with the model's prediction: relaxing borrowing constraints through PACE increases investment capacity, but also raises households' required debt service burden and exposure to liquidity shocks.

Consistent with the model's market power mechanism, we next find that PACE loans are priced at a substantial premium relative to conventional home equity credit. Even prime borrowers pay roughly 2.5-2.8 percentage points more than on comparable HELOCs, while the premium is an additional 0.28–0.35 percentage points for subprime borrowers. The seniority of PACE claims insulates lenders from borrower default risk, making this pattern difficult to reconcile with a premium that compensates lenders for risk exposure. Instead, it supports the model's market power mechanism: financially constrained households have weaker outside options in conventional credit markets, allowing PACE providers to extract larger rents from precisely those borrowers for whom the program relaxes financing constraints.

Despite this substantial financing premium, PACE-financed investments create value for homeowners by capitalizing into property prices. Using a stacked difference-in-differences design around PACE origination, we find that sale prices increase by roughly 6.2%. This result is notable because, under Modigliani–Miller, adding a senior claim should merely redistribute value across creditors rather than increase the value of the underlying property.

We next examine a mechanism that can rationalize these capital gains. For PACE borrowers investing in resilience measures, part of the increase in property values may reflect lower future homeowners insurance costs. Using administrative data on residential insurance contracts, we find that premia fall by roughly 3% to 5% following a county's adoption of PACE. Scaling this intent-to-treat estimate by county-level PACE take-up rates and applying standard Gordon growth formulas yields discount rates between 2.9% and 3.7%. These estimates are similar to the long-run discount rates reported by Giglio et al. (2015) and Ge et al. (2025a) for real estate investments.

A potential offsetting cost, however, is that the super seniority of PACE liens may restrict households' subsequent access to mortgage refinancing.[3] We find no evidence that PACE borrowing reduces households' ability to refinance their mortgages. The estimates are statistically indistinguishable from zero, including when we restrict the sample to conforming loans, for which the regulatory friction created by a PACE lien should be strongest. This null result is informative because PACE liens could, in principle, lock borrowers into their existing mortgages by limiting access to conforming loan refinancing.

We combine our empirical estimates via back-of-the-envelope calculations to determine the desirability of adopting PACE from the perspective of local governments. Subtracting our estimate of short-term revenue losses due to household tax delinquencies from the expansion of the property tax base through capitalization into housing values translates to higher tax revenue for a county of between \$186 and \$251 per PACE loan-year based on prevailing effective tax rates.[4] Hence, although some PACE borrowers may be worse off from experiencing greater annual tax burdens or default costs, local governments, prospective mortgaged homebuyers, and homeowners now facing lower insurance costs in PACE counties benefit from program adoption.

Contributions. Our first contribution is to the literature on household credit constraints. Prior work shows that housing collateral and creditor rights affect households' borrowing capacity and investment (Lustig and Van Nieuwerburgh, 2005; Liberti and Mian, 2010; Benmelech and Bergman, 2011; Vig, 2013; Corradin and Popov, 2015; Campello and Larrain, 2016; Melzer, 2017; DeFusco, 2018; DeMarzo, 2019). In contrast to this literature, wherein borrowing capacity depends on pledgeable asset values, PACE expands capacity by altering claim seniority and restricting proceeds while holding collateral fixed. Household capital

[3] Since 2010, Fannie Mae and Freddie Mac do not purchase mortgage loans associated with PACE liens due to the latter's super seniority (Fannie Mae, 2025).

[4] We assume that 100% of the tax delinquencies are paid by the local government. This is a strong assumption, as PACE loans can be backed by municipal bond issues purchased by private investors (e.g., insurance companies), which attenuates our finding of a positive fiscal effect.

structure therefore has real consequences for investment because limited pledgeability and default risk break the Modigliani–Miller benchmark.

Our findings also speak to the literature on mortgage refinancing and home equity extraction. Households may fail to refinance because of inattention or underwriting constraints (Keys et al., 2016; Chen et al., 2020; DeFusco and Mondragon, 2020). PACE provides an alternative way to borrow against housing collateral without refinancing the first mortgage. Despite its senior lien, we find no decline in refinancing, as PACE-financed improvements raise property values and offset the senior claim. PACE can therefore expand borrowing capacity without reducing collateral available to future lenders.

Second, we contribute to the literature on consumer credit pricing and lender market power. Borrowing costs reflect search frictions, screening, and lender competition in addition to credit risk (Gan and Riddiough, 2008; Agarwal et al., 2017; DeFusco et al., 2022; Argyle et al., 2023; Yannelis and Zhang, 2023; Bhutta et al., 2026). PACE helps separate these forces because seniority largely insulates lenders from borrower default risk. Yet, PACE rates exceed those on comparable home equity loans, with larger interest rate premia for subprime households with weaker outside options. This pattern points to market power rather than compensation for risk.

We also contribute to work on policies that protect lenders to expand credit. Government guarantees increase credit supply by reducing lender losses (Gete and Zecchetto, 2018; Bachas et al., 2021; Erel and Liebersohn, 2022; Granja et al., 2022; Carletti et al., 2023; Barrot et al., 2024; Altavilla et al., 2025). PACE instead protects lenders through seniority, partly at the expense of existing mortgage holders rather than taxpayers. This protection expands credit to constrained households, although lower lender risk is not fully passed through to borrowers.

Third, we contribute to the literature on green financial contracts and barriers to environmental investment. Credit constraints can limit household adoption of energy-efficient technologies, while realized returns may be uncertain (Fowlie et al., 2018; Berkouwer and Dean, 2022). At the firm level, green bonds and sustainability-linked loans direct capital towards environmental investment through labeled proceeds or performance incentives (Flammer, 2021; Kim et al., 2025). PACE instead works through the debt structure itself, combining restricted proceeds, seniority over the existing mortgage, and repayment through the property tax bill. Our findings demonstrate how financial contract design can relax barriers to household environmental investment.

Fourth, we contribute to the literature evaluating PACE programs. Prior work shows that PACE increases residential clean energy investment (Kirkpatrick and Bennear, 2014; Winecoff and Graff, 2020), generates local economic activity (Rose and Wei, 2020), and may be reflected in resale values (Goodman and Zhu, 2016) or affect mortgage markets (Millar and White, 2024). To our knowledge, we are the first to assemble comprehensive microdata linking individual PACE loans to borrower credit records, mortgage data, building permits, property values, and tax delinquency. This allows us to provide a more complete economic analysis of how PACE creates value and how its benefits and risks are distributed.

Finally, we contribute to the literature on climate finance. Prior work shows that climate risk is reflected in residential property prices and transmitted through insurance and mortgage markets (Bernstein et al., 2019; Baldauf et al., 2020; Murfin and Spiegel, 2020; Bakkensen and Barrage, 2022; Ge et al., 2025a; Sen, 2023; Oh et al., 2026; Sastry, 2026; Hu, 2026). We ask the complementary question of whether investments that reduce climate risk create value. PACE-financed improvements raise transaction prices and assessed improvement values, with larger effects for climate-proofing projects and coastal areas. Homeowners insurance premia also decline following PACE adoption, consistent with insurers passing part of the reduction in expected losses back to homeowners. These savings explain an economically meaningful share of the house price increase. Our results therefore show that markets capitalize household adaptation and identify lower insurance costs as one channel through which PACE creates value.

2 Background on PACE Programs

General background. Over the last two decades, 40 U.S. states plus Washington, D.C. have passed legislation enabling PACE to provide financing for energy efficiency upgrades and disaster resiliency improvements for property owners. While most PACE programs focus on commercial properties, PACE financing is also available to residential property owners in California and Florida. Based on data provided by PACE Nation, Panel A of Figure 1 shows that the aggregate size of the residential PACE loan market has sharply increased since its introduction around 2010. By the end of 2023, the total amount of residential PACE financing reached approximately \$9.1 billion.[5]

We focus on the Florida residential PACE program, for which we obtain a detailed sample of loans from two of the largest coalitions of PACE lenders, combined with public records received via FOIA requests submitted to each of Florida's 67 counties.[6] In Florida, state legislation (Chapter 163.08) has allowed local jurisdictions to record liens for PACE loans since 2010. The Act refers to Chapter 2008-227, Laws of Florida, which outlines the role of PACE in the state's comprehensive plan to reduce reliance on energy-intensive carbon emissions and increase the energy efficiency and conservation of all end-use sectors. Given this goal, the Florida legislature has recognized a "compelling state interest" to provide additional financial means for property owners to undertake energy improvement and hurricane-hardening projects attached to their homes.

[5]The total size of the residential PACE market includes loans originated in Missouri, which adopted PACE in 2021 and repealed its PACE program in August 2024.

[6]Relative to the Florida PACE program, the California PACE program has faced multiple statewide legal challenges and additions to consumer protection regulations, making it difficult to determine precise treatment statuses across jurisdictions.

County-level adoption. Panel B of Figure 1 provides a map of counties classified by the current status of their residential PACE legislation. The figure highlights the prevalence of PACE programs across Florida, with most counties having enabled PACE financing at some point, except for a handful in the panhandle region. In 2011, Miami-Dade became the first Florida county to launch the program. The pace of adoption increased between 2015 and 2018, and by the close of 2020, the majority of large Florida counties had implemented the program. Florida counties with PACE partner with four districts, each of which represents a coalition of administrators who screen loan applicants on behalf of the municipality.[7] During our sample period, there are six administrators operating in Florida. Public-private partnerships between local governments and PACE districts are formalized via an interlocal agreement.

PACE loan procedures. Online Appendix B contains a detailed institutional description of PACE, which we summarize here. Homeowners are eligible for PACE loans regardless of their credit score, provided they have fulfilled all debt and tax obligations in the last three years prior to applying. PACE loans offer up to 100% financing for qualifying home improvements, with the loan amount generally capped at 20% of the appraised property value (as assessed by the county), except in specific cases related to energy audits. For the single-family homes in our estimation sample, the most common loan term is 20 years, with an average origination amount of approximately $25,000 and an average fixed annual interest rate during our sample period of around 6.7%. Under state guidelines, lenders can perform hard credit inquiries to determine applicants' payment histories but do not use credit scores to determine eligibility or pricing.

Unlike traditional financing, PACE loans are repaid through property tax payments levied

[7] The four districts are called: Florida Green Finance Authority, Florida PACE Funding Agency (FPFA), Florida Resiliency and Energy District, and Green Corridor PACE. Of these districts, FPFA and Green Corridor are the two largest, and together they comprise 85% of the loans in our sample.

as a special assessment, which are attached to the property rather than the borrower.[8] This makes PACE loans "super senior" to other claims, such as mortgage liens, because delinquent property tax payments, including those with PACE assessments, take priority over other lienholders. Importantly, mortgage lenders cannot legally enforce covenants regarding the homeowner's decision to take out a PACE loan; for instance, they cannot demand early payment of the mortgage principal if a PACE loan is obtained. However, due to the super senior status of PACE liens, borrowers may be required by lenders or future buyers to pay off the PACE loan in full before refinancing or selling the property (Cox, 2011). The absence of prepayment penalties for PACE loans facilitates such provisions.

Residential PACE loans are available for single-family homes, condos, vacant residential land, and small multifamily buildings. Prospective PACE borrowers can apply either directly through a district or administrator (the underwriter) or indirectly via a registered contractor. Once a loan is underwritten, the district forwards the loan terms to the local tax assessor, who generates a Notice of Assessment, which is also sent to the borrower as a loan disclosure form. In many records offices, clerks attach to the loan contract a Notice of Commencement on the improvement resulting from the building permit, helping to prevent fraud. We provide examples of both notices in Online Appendix C.

PACE project types. The historical purpose of PACE is to finance projects that reduce the energy consumption of the house, such as energy-efficient window installations. PACE-approved projects also include investments that improve the resistance of the house to natural disasters, such as impact-resistant windows. We document clear complementarities between these two types of investment. Figure A.1 shows a strong positive relationship between the energy efficiency and climate resilience ratings of window products sold in the U.S., which are among the most common purchases from PACE funds in Florida. Making

[8]These PACE payments are based on a fixed interest rate determined at the time of loan origination and they fully amortize the loan, similar to a standard fixed-rate mortgage.

a house more resistant to natural disasters can lead to lower energy consumption. This relationship is consistent with diffuse technical progress rendering home improvements using recent products more efficient on multiple dimensions.[9]

3 Conceptual Framework

We develop a simple model to organize the empirical analysis. The formal derivations are presented in Online Appendix D. The model emphasizes three features of PACE financing: the seniority of PACE claims, their availability to households with limited access to conventional home equity credit, and the restriction of PACE financing to eligible projects and approved contractors.

Households differ in credit quality and may finance a home improvement project using either conventional home equity credit or PACE. Lower credit quality households are more likely to experience a low cash flow state and therefore face a greater probability of being unable to service their housing-related debt. Conventional home equity financing is junior to the existing mortgage, so lenders' expected recoveries depend directly on borrower risk. As borrower risk increases, lenders require greater promised repayment and eventually restrict borrowing capacity.

PACE differs from standard home equity financing because the assessment is attached to the property and is senior to conventional mortgage claims. Seniority protects the PACE lender through the value of the collateral, allowing households that cannot obtain sufficient junior financing to borrow through PACE. Importantly, seniority protects the lender rather than the household. PACE still increases the borrower's required debt service and can therefore generate financial distress when cash flow is low.

The model also allows the two lending markets to differ in competitive structure.

[9] This complementarity also highlights the empirical challenges with distinguishing between households' resilience versus energy efficiency motivations behind engaging in home improvement projects.

Conventional home equity lenders are competitive, whereas PACE providers have market power. Households with access to conventional credit therefore have a valuable outside option when choosing whether to borrow through PACE, while constrained households do not. Finally, PACE financing can be used only for eligible projects and approved contractors. We assume that this restriction shifts investment towards projects with greater property value benefits. These features deliver four predictions that guide our empirical analysis.

Prediction 1. *PACE relaxes financing constraints, particularly for riskier households.*

Because conventional home equity claims are junior, borrowing capacity declines with borrower risk. PACE seniority weakens this link between household credit risk and lender recovery, allowing constrained households to finance investments that they could not otherwise undertake. The model therefore predicts that PACE borrowers should be negatively selected on conventional measures of creditworthiness and that PACE should increase home improvement investment primarily by expanding borrowing on the extensive margin.

Prediction 2. *Riskier households pay more for PACE, even though PACE lenders are protected from their credit risk.*

PACE seniority limits lenders' exposure to borrower default risk, so differences in PACE pricing across borrowers need not reflect differences in expected credit losses. Instead, pricing can reflect borrowers' outside options. A prime credit household that can obtain competitively priced home equity credit must receive sufficient surplus to choose PACE, whereas a constrained household with limited access to conventional credit has less bargaining power. A PACE provider with market power can therefore charge higher rates to borrowers with weaker outside financing options. The model predicts that PACE rates should exceed those on comparable conventional credit and that this premium should be larger for lower credit quality borrowers even though the lender is protected by seniority.

Prediction 3. *PACE increases delinquency primarily by expanding borrowing among constrained households.*

Although seniority protects the lender, PACE raises the household's total required debt service. When cash flow is low, this additional obligation can push the household into delinquency, consistent with evidence that liquidity constrained borrowers are particularly sensitive to changes in required debt payments (Ganong and Noel, 2023).[10]

Prediction 4. *PACE financing is associated with greater capitalization into property values.*

PACE can increase property values through two complementary channels. First, restrictions on eligible projects and approved contractors shift financing towards investments that generate greater property value benefits. Second, PACE relaxes financing constraints and enables some households to undertake value-creating projects that would otherwise not occur.[11]

4 Data Sources and Descriptive Statistics

4.1 Data Sources

We combine five datasets in our main analysis: loan-level records on Florida PACE originations, Cotality (formerly named CoreLogic) property and mortgage records, Equifax credit bureau data, the Spatial Hazard Events and Losses Database for the United States (SHELDUS), and Florida's Quarterly and Supplemental Reporting System (QUASR) on

[10] Notice that the effect is ambiguous *ex ante*, as PACE could instead reduce financial distress by replacing more expensive forms of credit and freeing up household cash flow, as observed in the context of disaster loans (Collier et al., 2024, 2025).

[11] The effect of PACE on house prices is far from mechanical. An outstanding PACE lien can create mortgage-market frictions by limiting access to GSE-backed financing, which may reduce the pool of potential buyers. In addition, the market value of an improvement may fall short of its cost when some benefits are specific to the current homeowner, while restrictions on approved contractors may weaken competition, increase project costs, or reduce quality.

homeowners insurance. Since interest rates are not usually recorded on a mortgage deed, we use originations in the Home Mortgage Disclosure Act (HMDA) data to obtain interest rates for HELOCs. We describe how we link our sample of PACE borrowers to their Equifax credit histories in Online Appendix G.2. Because the HMDA, SHELDUS, and QUASR datasets have been widely used in previous research, we relegate a description of these sources to Online Appendix G.3.

PACE loan data. We obtain loan-level records by submitting FOIA requests to Florida counties and the four residential PACE districts operating in the state. For each loan, we observe the property assessor's parcel number (APN), origination year, and PACE district. Our data contain 77,564 loans originated on 74,797 unique properties across 60 counties since 2015, representing approximately 80% of the Florida PACE market by loan count over the period for which aggregate originations are available (Consumer Financial Protection Bureau, 2023). For properties with multiple PACE loans, we aggregate originations to the property-year level. Additional details on the construction and coverage of the PACE loan data are provided in Online Appendix B.

Cotality data. We link PACE loans to several Cotality products using property identifiers. *Owner Transfers* provides arms-length transaction prices and property transaction histories, while *Tax* provides physical property characteristics and annual assessed values. The annual reassessment of Florida properties allows us to track changes in assessed improvement values even for properties that do not transact. Cotality's *Involuntary Liens* database allows us to identify local tax delinquencies and bankruptcy liens, while *Mortgage* provides information on mortgage originations, refinancing, home equity borrowing, loan amounts, and contract characteristics. These datasets allow us to study capitalization, financial distress, mortgage refinancing, and the pricing of PACE relative to conventional home equity credit. Details on variable construction and sample restrictions are provided in Online Appendix G.1.

Building permits. We use Cotality *Building Permits* to construct a novel measure of household home improvement investment. The data contain permit-level descriptions of the work performed, which we link to PACE and non-PACE properties. Using the text of permit applications, we classify projects into five mutually exclusive categories: HVAC, Roofing, Solar, Windows and Doors, and Other. The first four categories correspond to common PACE-eligible investments, while Other captures projects such as interior renovations, expansions, and landscaping. Online Appendix E describes the permit sample construction, text-parsing procedure, and classification keywords.

Credit bureau data. We supplement the property-level records with Equifax credit bureau data. The Equifax data provide borrower-level measures of creditworthiness and financial distress, including credit scores, account balances, credit limits, derogatory events, delinquencies, and bankruptcies, which we use to characterize selection into PACE and control for *ex ante* borrower financial conditions. We anonymously match the Cotality variables to borrowers' credit histories based on their names and property addresses, following the procedures outlined in Online Appendix G.2.

4.2 Descriptive Statistics

Table 1 examines the determinants of county-level PACE adoption. Although counties with lower unemployment, stronger climate concerns, and greater lagged disaster exposure are more likely to adopt PACE in the cross-section, most economic, demographic, and political characteristics no longer predict adoption once county and year fixed effects are included.[12] Instead, adoption timing is related to changes in local tax assessor leadership. Using hand-collected data on assessor turnover, we find that the interaction between turnover and local climate concerns is positively associated with PACE adoption, consistent with newly

[12] Online Appendix H further shows that local governments' financial conditions, including debt-to-revenue, liquid assets, and interest coverage, do not predict PACE adoption.

elected assessors' climate preferences affecting program introduction. Because turnover itself could respond to local conditions, we repeat the analysis using only turnovers associated with the retirement of assessors aged 62 or older and obtain similar results.[13] Together with the predetermined timing of assessor elections, these findings support the identifying assumption that the timing of county-level PACE adoption is plausibly quasi-random conditional on county and year fixed effects.

We next turn to the complementary identifying assumption underlying our borrower-level design: whether households originating PACE loans at different points in time are comparable before treatment. This distinction is important because PACE borrowers are strongly selected relative to other homeowners, making non-PACE households an unsuitable control group, as shown in Figure 2. Our borrower-level design therefore restricts the sample to eventual PACE borrowers and compares each origination cohort with borrowers who receive PACE later. Table 3 tests whether these early and late cohorts are similar on observable borrower and property characteristics measured before origination. All normalized differences are economically small and remain below the conventional 0.25 threshold proposed by Imbens and Wooldridge (2009). For instance, the largest normalized difference is only 0.106 for year built. The differences are also modest in levels. Early borrowers have an average credit score of 639.4 versus 638.62 for later borrowers, a gap of only 0.8 points, while their homes are about 48 square feet larger on average and have 0.07 fewer bedrooms. Although some differences are statistically significant, their economic magnitudes are small, indicating that early and late PACE cohorts are closely comparable.

Figures A.2 and A.3 show that PACE financing is closely associated with home improvements, particularly disaster-proofing investments; non-repair window and door and roof replacements together account for approximately half of likely PACE-financed projects. Stacked event studies comparing borrowers with later, not-yet-treated borrowers show sharp

[13] For most public employees, Florida state pensions vest at age 62.

increases in permitting around PACE origination. Window and door permits rise by 9.5 p.p. in the origination year and 14.0 p.p. the following year, while roofing permits rise by 5.6 and 7.0 p.p. The corresponding increases are smaller for HVAC (3.2 and 4.0 p.p.) and solar (1.1 and 0.6 p.p.), confirming the particularly strong uptake of disaster-resilience improvements.

5 Main Empirical Results

In this section, we examine how PACE affects borrowers' financial outcomes, loan pricing, and property values, and test the main mechanisms predicted by our framework.

5.1 The Effect of PACE Loans on Borrower Delinquency

We examine whether PACE loans increase property tax delinquency. Our framework predicts that they should (Prediction 3). Seniority protects the lender, not the borrower: taking up PACE raises total housing-related debt service. Because PACE attracts financially constrained households, the additional obligation may push some borrowers into delinquency. The direction of the effect is not obvious *ex ante*, however. PACE could instead *reduce* distress by substituting for more expensive credit, such as unsecured credit card debt, and freeing up cash flow, much as access to cheaper disaster loans has been shown to improve household repayment after natural disasters (Collier et al., 2024, 2025). Which force ultimately dominates is an empirical question.

To test this prediction, we estimate the effect of PACE take-up on property tax delinquency using a stacked difference-in-differences design:

$$Delinquent_{i,c,t} = \beta \cdot PACE_{i,c,t} + \gamma_c' \cdot \mathbf{X}_{i,t-1} + \eta_{i,c} + \theta_{c,t} + \varepsilon_{i,c,t} \tag{5.1}$$

The outcome $Delinquent_{i,c,t}$ equals one in cases where property-by-owner combination i in loan cohort c has a local tax lien involuntarily and newly placed on it in year t, indicating a missed property tax payment. Since lien removals are infrequently recorded in the Cotality *Involuntary Liens* data, we measure changes in tax delinquency based on new lien events. We define delinquency at the property-by-owner level using the name(s) recorded on the deed matched to the name(s) listed on the lien flag.[14] $PACE_{i,c,t}$ is a dummy variable equal to one if household i has had a PACE lien placed as of year t and zero otherwise. We include property-cohort $\eta_{i,c}$ and cohort-year $\theta_{c,t}$ fixed effects in all specifications.

To improve comparability between properties with and without PACE loans, we compare each origination cohort with borrowers whose loans originate more than three years later. Comparisons of earlier- and later-treated units are common in staggered-adoption settings. For example, Keiser et al. (2026) estimate the effects of Safe Drinking Water Act loans by comparing water systems receiving loans in earlier versus later years.

Figure 3 presents the dynamic event study version of equation (5.1), estimated with the full set of controls. In the three years before origination, the estimates are close to zero and statistically indistinguishable from zero, with no build-up towards the origination date. This pattern supports the parallel trends assumption and is consistent with the cohort balance documented in Table 3. In the origination year itself, the estimate is essentially zero, consistent with the first tax bill carrying the PACE assessment typically arriving after origination. Delinquency then rises sharply: the estimates jump to roughly 0.15 percentage points one year after origination and climb to roughly 0.25 percentage points by year three. The timing is informative about the mechanism. The increase in delinquency materializes precisely when the new assessment first comes due, and, the continued growth of the estimates indicates that additional borrowers keep entering delinquency in each post-origination year rather than a one-time reclassification.

[14]Using the property-by-owner combination as the unit of analysis rather than individual properties helps isolate cases where a property may have been in arrears on its taxes, after which the previous owner sold the property, extinguishing the initial lien, and then the new owner who became a PACE borrower subsequently defaulted on their property tax bill.

Table 4 reports the corresponding pooled difference-in-differences estimates. Overall, we find that PACE take-up raises the probability that a borrower becomes tax delinquent. The post-origination estimate is 0.1 percentage points and statistically significant at the 1% level, and it is unchanged to three decimal places as property-characteristic bins and borrower credit controls are added. This is unsurprising given that the design already conditions on property fixed effects and compares eventual borrowers to one another, which absorbs the negative selection into PACE documented in Figure 2. Relative to the pre-origination delinquency rate of 0.7% among PACE borrowers, the pooled estimate represents a 14.3% increase in the incidence of delinquency. These effects apply to the household's entire property tax bill because the PACE assessment is collected alongside the *ad valorem* tax liability. The results therefore indicate that the additional debt service burden dominates any relief obtained by substituting PACE for more expensive credit.

We complement this analysis by instrumenting household PACE take-up with the staggered adoption of PACE programs across Florida counties. County adoption determines when PACE becomes *available* to a household, and its timing is driven by local government decisions rather than by any individual household's financial conditions. Conditional on property and year fixed effects, the identifying assumption is that the county's adoption date affects a borrower's delinquency only through its effect on the household's own take-up. Supporting this design, Table 1 shows that local economic conditions do not predict county-level PACE adoption. Table 5 reports the results. Panel A shows that the instrument has substantial bite: county adoption raises the probability that a sample household holds a PACE loan by 7.4 percentage points, and the Kleibergen–Paap F-statistic of roughly 29 across specifications indicates that weak instruments are not a concern. Panel B reports the second stage: instrumented PACE take-up raises the annual probability of tax delinquency by 4.7 percentage points, statistically significant at the 1% level and stable across all three control sets, with standard errors clustered at the county level.

The IV and stacked difference-in-differences coefficients are not directly comparable because they identify different causal parameters. Our stacked design compares earlier-treated units with later-treated units during periods in which the latter have not yet received treatment. The resulting coefficient is therefore a weighted average of cohort- and event-time-specific treatment effects, for earlier-treated cohorts, with weights determined by the composition of the stacks and the event-time window. Identification relies on parallel trends between earlier- and later-treated cohorts over the relevant untreated periods. By contrast, the IV estimate exploits variation in treatment generated by the instrument. Under the standard IV assumptions, it identifies a LATE for compliers, that is, units whose treatment status is changed by the instrument (Imbens and Angrist, 1994). With heterogeneous treatment effects, there is no reason for the treatment effect among earlier-treated cohorts to equal the treatment effect among IV compliers. In addition, the two estimators apply different weights across units, cohorts, and treatment margins. Consequently, differences in coefficient magnitudes need not reflect disagreement between the designs. That said, the estimates are consistent in sign and broadly similar in magnitude.

Overall, these results confirm an important cost of PACE financing. The program expands borrowing capacity for constrained households, but the additional senior obligation causes some borrowers to fall behind on their property taxes. Because seniority largely protects the PACE lender from this risk, the resulting costs fall primarily on borrowers and, in the short run, local governments.

5.2 Borrower Sorting into PACE versus HELOC Contracts

The conceptual framework in Section 3 predicts sorting across PACE and HELOCs on borrower credit risk. Because a HELOC is junior to the existing mortgage, riskier borrowers face higher borrowing costs and eventually tighter borrowing limits. PACE assessments, by contrast, are senior to conventional claims and secured by the property. The model therefore predicts that households with strong credit use competitively priced HELOCs, while riskier households with limited access to junior credit turn to PACE (Prediction 1). Because the property secures the PACE claim, this sorting should occur primarily on borrower characteristics rather than collateral quality.

The two borrower pools occupy sharply different segments of the credit distribution. Figure 4 shows that PACE borrowers have an average credit score of 675, compared with 774 for HELOC borrowers. Moreover, 44.9% of PACE borrowers are subprime (credit score < 670), compared with only 6.8% of HELOC borrowers. Figure 2 shows that this negative selection extends across measures of financial fragility. PACE borrowers are roughly four times more likely to have a bankruptcy on their credit file, have substantially worse delinquency histories, and have less available revolving credit. Moreover, their average bankcard credit limit is $15,500, less than half the $36,200 limit of HELOC borrowers, while their utilization rate is 38% rather than 22%. Together, these characteristics describe households up against their borrowing constraints, precisely where the model predicts junior home equity capacity binds.

These differences do not simply reflect where PACE programs operate. Conditioning on census block fixed effects leaves the gaps nearly unchanged. The credit score difference falls only from 98 to 94 points, while the subprime gap falls from 38 to 36 percentage points. PACE therefore sorts borrowers within neighborhoods rather than merely across neighborhoods.

In contrast, the collateral underlying the two loans is remarkably similar. Land area and bedrooms are statistically indistinguishable, and the building size difference shrinks to fewer than 30 square feet within a census block. This borrower-collateral asymmetry is consistent with the framework: PACE financing reaches households with substantially weaker credit without being concentrated in substantially weaker properties. PACE loans are also much smaller, averaging $25,000 compared with $107,000 for HELOCs, consistent with PACE providing project-sized financing rather than broad home equity extraction.

Taken together, the evidence supports the central sorting mechanism of the model. By lending against the house rather than the household, PACE extends credit to financially fragile borrowers whom the junior home equity market prices out. Because this comparison is descriptive, it cannot by itself separate borrower demand from lender screening: PACE borrowers may prefer PACE, or they may have been rationed out of the junior market. The pricing evidence in the next section makes the pure preference explanation unlikely.

5.3 The Pricing of PACE Loans

We now examine the pricing of PACE loans relative to conventional home equity credit. The conceptual framework in Section 3 yields a distinctive prediction. Because PACE assessments are senior to conventional claims on the property and are collected through the property tax bill, the PACE lender's expected loss is largely insulated from borrower credit risk. Under the risk-based pricing that characterizes junior home equity credit, PACE rates should therefore command, at most, a modest premium over comparable credit and, importantly, should exhibit little sensitivity to borrower creditworthiness. By contrast, if PACE pricing reflects borrowers' outside options, then a different pattern should emerge. Households that cannot obtain sufficient conventional credit have limited alternatives when negotiating with PACE providers that possess market power. In this case, PACE rates should include a premium that cannot be accounted for by observable credit risk, and this premium should be largest among borrowers with the weakest access to conventional credit. The empirical tests in this subsection distinguish between these two mechanisms.

Figure 5 plots the distribution of interest rates at origination for PACE loans and for HELOCs used towards home improvements in our matched sample.[15] The two distributions differ markedly. HELOC rates are centered around 5 percent, whereas PACE rates are concentrated between 6 and 9 percent and exhibit a substantial right tail extending beyond

[15] See Appendix G for more details on how we conduct the matching.

10 percent. A Kolmogorov–Smirnov test strongly rejects equality of the two distributions ($D = 0.401$, $p < 0.001$). The difference in mean interest rates is 1.83 percentage points.

The unconditional difference in interest rates is difficult to interpret in isolation. As Figure 2 shows, PACE borrowers are observably riskier than HELOC borrowers along nearly every dimension that we measure. A junior lender serving the PACE borrower pool might therefore also charge higher rates. To assess whether the observed pricing gap simply compensates lenders for differences in borrower risk, we estimate

$$\text{Rate}_{\ell,g,t} = \beta \cdot \text{PACE}_\ell + \gamma' \mathbf{X}_\ell + \psi_g + \delta_t + \varepsilon_{\ell,g,t} \tag{5.2}$$

where the dependent variable is the interest rate at origination of loan ℓ, measured in percentage points, and $PACE_\ell$ is an indicator equal to one for PACE loans and zero for HELOCs. County fixed effects ψ_g and origination-year fixed effects δ_t restrict the identifying comparison to loans originated in the same county and year, thereby absorbing local credit market conditions and aggregate variation in market interest rates. The vector $\mathbf{X}_\ell$ always includes the loan amount and progressively incorporates the borrower's credit characteristics measured in the year preceding origination, including the credit score, major derogatory events, credit file age, and the severe distress index. Subsequent specifications add *ex ante* mortgage controls, including outstanding balances and contract terms, the tax assessed property value, bins for housing characteristics, and counts of *ex post* permitted projects by category. Standard errors are clustered at the property level.

Panel A of Table 6 reports the OLS results. Across specifications, we find a large PACE interest rate premium that observable borrower risk does not explain. With year and county fixed effects and loan amount as the only additional control in column 1, PACE loans carry interest rates that are 2.63 percentage points higher than those on HELOCs. This conditional premium exceeds the unconditional difference of 1.83 percentage points, indicating that differences in the timing and geographic composition of originations compress rather than generate the raw pricing gap. More importantly, adding borrower credit controls in column 2 leaves the estimated premium essentially unchanged at 2.59 percentage points. Further saturating the specification with mortgage, housing, and project controls in columns 3 and 4 increases the estimated premium to 2.71 and 2.90 percentage points, respectively. All estimates are statistically significant at the 1% level. If the PACE premium primarily compensated lenders for expected credit losses, conditioning on borrower characteristics that predict those losses should substantially reduce the estimated coefficient. Instead, borrowers with similar observable risk profiles, equity positions, and project characteristics pay substantially higher interest rates when financing through PACE.

The fees associated with PACE financing do not account for the observed rate premium. We perform a conservative calculation in which fees equal 5% of the PACE balance and are fully rolled into the principal, while assigning no comparable fees to HELOCs. For the average $25,000 PACE loan with a 20-year maturity and a 6.7 percent interest rate, the standard fixed-rate amortization formula implies an annual payment of approximately $2,305. If 5 percent of the financed balance consists of fees, so that the borrower receives $23,750 in net proceeds, the same payment stream implies an annualized borrowing cost of approximately 7.36 percent. Thus, even under this deliberately conservative assumption, fees add at most about 66 basis points to all-in PACE borrowing costs.

We next examine the framework's distinctive cross-sectional prediction. If the PACE premium reflects borrowers' outside options rather than lender exposure to credit risk, the premium should be largest among borrowers with the weakest access to conventional credit. This heterogeneity test also helps address a natural concern with interpreting the average premium reported in Panel A of Table 6. PACE loans differ from HELOCs along several dimensions other than seniority, including longer maturities, contractor-mediated origination, and underwriting that relies more heavily on home equity than on income.

Such product-level differences could account for part of the average pricing differential. Because these features are common across PACE borrowers, however, they may shift the average level of the premium without necessarily generating systematic variation in the premium across borrower types. Cross-sectional variation therefore provides a sharper test of the underlying mechanism. Under a risk-based pricing interpretation, the seniority of PACE claims implies that the premium should not increase substantially with borrower risk. Under the outside-option mechanism, by contrast, the premium should increase as access to conventional credit deteriorates.

Panel B of Table 6 tests this prediction by interacting the PACE indicator with an indicator for subprime borrowers, defined as borrowers with a credit score below 670 in the year prior to origination. Three results emerge. First, within the same county and year, prime borrowers pay a substantial PACE premium of between 247 and 279 basis points. Thus, even households that plausibly have access to competitively priced HELOC credit pay considerably more when financing through PACE. Second, the interaction term indicates that the PACE premium is between 0.28 and 0.35 percentage points larger for subprime borrowers, corresponding to an increase of approximately 11 to 14 percent relative to the premium paid by prime borrowers. The interaction coefficient is positive in all four specifications and statistically significant. Third, the additional controls absorb some of the variation associated with subprime status, which may attenuate the interaction coefficient. Nevertheless, it remains positive and statistically significant across specifications.

The economic magnitudes are substantial. Applying the column 4 estimate of a 290 basis point premium to the average PACE origination amount of approximately $25,000 implies roughly $725 in additional annual interest payments relative to HELOC financing. This amount is one-third of the average annual PACE assessment payment of $2,305. For the average subprime borrower, the implied excess payment is larger still.

Taken together, the pricing evidence suggests that the PACE premium reflects providers' ability to extract surplus from borrowers with limited outside options rather than compensation for credit risk. Consistent with this interpretation, the premium is largest among lower credit quality households for whom PACE most relaxes financing constraints.

5.4 Capitalization of PACE Loans into House Prices

We next examine whether PACE-financed investments are capitalized into property values. Under the Modigliani–Miller benchmark, the seniority of a PACE claim should only redistribute value across creditors rather than increase the value of the underlying property. Prediction 4 of our framework provides two reasons capitalization may nevertheless occur: PACE restricts financing to eligible projects and approved contractors, shifting investment towards higher-value improvements, and it enables financially constrained households to undertake projects that otherwise would not occur. Both channels predict that property values should rise following PACE origination, with larger effects for investments that generate greater benefits to homeowners, such as climate-proofing retrofits.

The effect of PACE on house prices is far from mechanical. First, PACE can create a mortgage market friction because properties with an outstanding PACE lien are generally ineligible for mortgages purchased or guaranteed by the GSEs unless the obligation is repaid, which can shrink the pool of potential buyers and depress sale prices (Millar and White, 2024). Second, the market value of an improvement need not equal its cost, particularly when projects generate consumption or non-pecuniary benefits for the current homeowner that prospective buyers value less. Finally, restrictions on approved contractors may weaken competition, raise project costs, or reduce quality. Through any of these channels, the value created by a PACE-financed improvement may fall short of its financed cost, making the net effect on house prices small or even negative.

To estimate these effects, we use Cotality *Owner Transfers* transactions over a symmetric seven-year window around PACE origination, merged with property characteristics from Cotality *Tax*. Because PACE borrowers are selected relative to other households, we restrict the sample to properties that eventually receive a PACE loan and compare each origination cohort with not-yet-treated properties whose PACE loan originates more than three years later. This design identifies the differential change in property values when a borrower exercises their PACE financing option and undertakes the associated investment, relative to borrowers who leave the option unexercised until later.

We estimate the capitalization effect using a stacked difference-in-differences design following Cengiz et al. (2019):

$$\log(Price_{i,c,z,t}) = \beta \cdot PACE_{i,c,t} + \gamma_c' \cdot \mathbf{X}_{i,t-1} + \theta_{z,c} + \delta_{m,c} + \varepsilon_{i,c,t} \tag{5.3}$$

where the dependent variable is the log arms-length transaction price of property i in ZIP code z sold in year t and associated with PACE borrower cohort c, and $PACE_{i,c,t}$ is an indicator equal to one for transactions occurring after property i receives a PACE loan and zero for transactions occurring beforehand. The sample consists of owner-occupied, single-family properties. All fixed effects and controls are interacted with the stacked cohort and include ZIP code, sale month, and sale sequence fixed effects, bins of property characteristics (building square footage, bedrooms, stories, and effective year built), and borrower credit characteristics (credit score, major derogatory events, credit file age, and the severe distress index). Standard errors are clustered at the property level.

The within-treatment-group comparison is credible only if earlier and later PACE cohorts are drawn from similar populations. Table 3 supports this premise. Across cohorts, standardized differences in credit score, derogatory events, credit file age, financial distress, and property characteristics are small, all well below the conventional 0.25 threshold of Imbens and Wooldridge (2009), and mostly shrink further once we compare cohorts within the same census block ("adjusted" columns). To the extent that modest differences remain, notably in property square footage and number of bedrooms, we include the corresponding observables in equation (5.3) as controls.

Figure 6 presents the event study. Price differences between treated and not-yet-treated properties are modest and insignificant before origination and show no build-up towards treatment. The capitalization effect emerges after origination; the estimate is small and statistically insignificant in the origination year, then rises to 0.047 after one year, 0.055 after two years, and 0.092 after three years. This timing is consistent with the permit evidence in Section 4.2, since PACE-financed improvements are generally completed within a year of origination.

Table 7 reports the pooled difference-in-differences estimates. Across specifications, properties sell at a significant premium following PACE origination, with coefficients ranging from 0.052 to 0.063. Our preferred estimate implies that post-origination sale prices are approximately $100 \times (\exp(0.060) - 1) \approx 6.2\%$ higher than those of comparable not-yet-treated properties.

The stability of the estimates across columns also helps address several alternative interpretations of the capitalization effect. First, the estimated premium could reflect differences in the composition of properties sold before and after PACE origination rather than the value of the financed improvement itself. If post-origination transactions involved systematically larger, newer, or otherwise higher-quality homes, the coefficient should fall once we compare properties with similar observable characteristics. Column 2 therefore adds detailed bins for building square footage, number of bedrooms, number of stories, and effective year built. The last of these controls is particularly demanding because assessors update effective year built following major renovations, so this control may absorb part of the improvement generated by PACE. Second, the premium could arise mechanically from repeat sale patterns. Post-origination transactions occur later in a property's sales history, and frequently traded properties may appreciate differently for reasons unrelated to PACE. Sale sequence fixed effects address this concern by comparing transactions occupying the same position in the property's transaction history. Third, differences in sellers' financial condition could affect observed sale prices. Financially distressed households may accept lower prices to sell quickly, while financially stronger households may be better able to maintain the property or undertake complementary renovations. Column 3 therefore controls for pre-origination credit score, major derogatory events, credit file age, and financial distress. Despite targeting these three distinct channels, the coefficient moves only from 0.052 to 0.060 while the adjusted R^2 rises from 0.469 to 0.590. The capitalization effect is therefore difficult to attribute to differences in housing quality, transaction history, or seller financial condition.

We formalize the stability of the estimated capitalization effect using the selection-on-observables framework of Oster (2019). The intuition is that the limited movement in the coefficient as increasingly rich controls are added can be used to assess how strongly selection on unobservables would have to operate to eliminate the estimated effect. The results, reported in Table 8, indicate that unobserved heterogeneity would need to be substantially stronger than selection on observables and operate in the opposite direction to explain away the capitalization estimate.

Specification curve. The capitalization estimate depends on the conditioning set of variables. Our baseline already controls for property and borrower credit characteristics, but other observable differences may account for the estimated price premium. We therefore go beyond the baseline and add new control blocks, including *ex ante* and *ex post* improvement type, census block fixed effects, and mortgage terms and amounts. We estimate every combination of the six blocks and report the full distribution of 63 estimates in Figure 7, following Cookson (2018). All specifications retain the core design, namely, cohort-interacted sale month, sale sequence, and ZIP code fixed effects, and use the fully saturated model's sample. Importantly, some additional controls may absorb the economic effect we seek to measure. *Ex post* permit controls address the possibility that PACE borrowers undertake additional projects around origination, beyond the PACE-financed improvement, and that these renovations explain higher sale prices. Yet permits around origination also capture PACE-financed projects themselves. Our prediction is that PACE raises property values partly by enabling investments that otherwise would not occur and shifting households towards higher-value eligible improvements. Conditioning on *ex post* project type may therefore remove part of this capitalization channel along with the confounding effect of additional renovations. Similar concerns apply to mortgage outcomes measured at sale, effective year built following major renovations, and census block fixed effects if capitalization spills over to nearby homes. By contrast, *ex ante* improvement type is clearly predetermined, so the most saturated specifications should be viewed as deliberately conservative. The capitalization effect nevertheless survives all of them: all 63 estimates are positive and statistically significant at the 5% level, ranging from 0.048 to 0.093, with a median of 0.062. Our preferred estimate of 0.060 lies near the center of the distribution, while the fully saturated model yields 0.067.

Which projects are capitalized? The project composition channel in Prediction 4 has a distinctive cross-sectional implication: if capitalization reflects the value generated by the financed improvement rather than the financing itself, the premium should vary systematically with the nature of the retrofit. Table 9 supports this prediction. Properties with climate-proofing improvements to the building envelope exhibit a coefficient of 0.074, compared with 0.052 for other properties. Similarly, the premium is 0.070 in coastal areas compared with 0.046 inland, consistent with resilience improvements being more valuable where storm exposure is greater. By contrast, the estimate for properties with solar permits is statistically indistinguishable from zero, consistent with the literature that shows a low capitalization effect of solar panels (e.g., Gillingham and Watten, 2024).

Economic magnitudes. Evaluated at the average sale price of $266,548 (Table 2), the 6.2% average post-origination premium corresponds to $\$266,548 \times (\exp(0.060) - 1) = \$16,482$, or 66% of the average PACE origination amount of $25,000 in this subsample. Capitalization of this magnitude also matters for the PACE lender's collateral and for incumbent mortgage holders. Because the average PACE loan-to-value ratio is only 10%, a household that cannot service the assessment out of cash flow can generally sell the improved property and retire the obligation in full. This fact helps explain why we do not observe any tax foreclosures in our sample after submitting FOIA requests for each county's lien auction records.

Tax assessed values. Transaction prices are observed only for properties that sell, so we complement the sale price analysis with annual tax assessments observed for all PACE properties. We focus on the assessed improvement value, which isolates the assessor's valuation of structures from land and directly determines the property tax base used in Section 6.2. We estimate the same stacked difference-in-differences design on annual assessments of owner-occupied, single-family properties, comparing each PACE origination cohort with not-yet-treated borrowers.

Table 10 shows that assessed improvement values increase by approximately 1.5% following PACE origination, with estimates of 0.014–0.015 across specifications. Because these assessments are observed annually for all properties, this result is not driven by selection into sale and confirms that PACE-financed investments increase the assessed value of the physical structure itself. The smaller response relative to the 6.2% transaction price effect is consistent with the statutory cap on annual assessment growth in Florida, which allows assessed value to converge to market value only gradually.[16]

Refinancing. The increase in property values generated by PACE investments may offset a

[16] Fla. Const. art. VII, § 4(d) and Fla. Stat. § 193.155(1) limit annual growth in the assessed value of homestead property to the lesser of 3% or the change in the CPI-U; Fla. Const. art. VII, § 4(g) and Fla. Stat. §§ 193.1554–193.1555 impose a 10% cap on non-homestead property. Assessed value resets to just value only upon a change of ownership (§ 193.155(3)).

potential refinancing friction created by the senior lien. Because a mortgage generally cannot be sold to the GSEs while a PACE assessment retains senior priority, a borrower seeking to refinance into a conforming mortgage may need to repay the outstanding assessment. If this requirement meaningfully constrains refinancing, PACE origination should reduce the probability that the same property-owner pair subsequently refinances its mortgage.

We test this prediction using the stacked difference-in-differences design above, replacing the outcome with an indicator for whether the property-owner pair refinances in each period. The identifying comparison asks whether refinancing falls after PACE origination for treated households relative to otherwise similar households that have not yet originated PACE. We find no such decline. The post-origination estimates in Table 11 are close to zero and precisely estimated, with 95% confidence intervals ruling out changes in the cumulative probability of refinancing greater than roughly 0.45 percentage points in absolute value.

We then restrict the sample to conforming mortgages, for which the GSE restriction should generate the strongest refinancing friction. Table A.1 of the Online Appendix again shows economically negligible effects, ruling out declines larger than roughly 0.4 percentage points. Thus, even where the institutional constraint should bind most strongly, PACE does not appear to reduce refinancing. This finding is consistent with the increase in collateral value generated by the financed improvements offsetting the additional senior claim.

Taken together, the transaction price and assessment results support the capitalization prediction of our framework. Property values rise following PACE origination, with the largest effects for climate-proofing investments, and the increase is also reflected in the assessed value of the underlying structure. The evidence therefore indicates that PACE finances value-creating improvements.

6 Discussion of Cost-Benefit Implications

We assess PACE's impact on homeowners insurance premia and use our estimates to quantify its effect on local property tax revenues.

6.1 Pass-Through to Homeowners Insurance Premia

We next examine whether the capitalization of PACE-financed projects reflects the cash flows they generate. While most benefits from home improvements are unobservable, homeowners insurance premia provide an observable payoff. Florida Statutes §627.0629 requires insurers to discount premia for wind-mitigation measures such as impact-resistant windows and roof reinforcement, two common PACE-financed improvements. Using administrative data from the Florida Office of Insurance Regulation, we exploit staggered county adoption of PACE in a stacked difference-in-differences design. Because premia are measured at the county level, the estimates capture an intent-to-treat effect.

Table A.2 shows that PACE adoption reduces homeowners insurance premia by 2.8% to 4.6%, with somewhat larger effects for wind-only policies and similar estimates when excluding Citizens Property Insurance Corporation, the state-run insurer. Figure 8 shows no differential pre-trends and a gradual decline reaching 5.5% five years after PACE passage, consistent with the accumulation of hardening improvements. In Online Appendix I, we conduct two additional tests to strengthen this interpretation. First, to rule out changes in insurer composition across counties, a shift-share design holding insurers' county exposure fixed at 2009 levels yields similar results (Table I.1). Second, to test whether hardening affects insurance availability, we show that PACE adoption slows the growth of Citizens' local market share (Table I.2), with no evidence of differential pre-trends (Figure I.1).

We can now relate the cash flow savings from reduced premia to our estimated capitalization effects using a standard Gordon growth formula applied to an infinitely lived asset, under which the long-run discount rate equals $r = \Delta Premium/\Delta P$. For our preferred estimate in column 3 of Table A.2 which uses the full sample, county average wind premia decline by $100 \times (\exp(-0.032) - 1) = 3.1\%$, or \$56 per insured home per year at the average annual wind premium of \$1,785. Attributing the entire county-level decline to PACE borrowers and scaling by the 7.4% first-stage take-up rate from county-level PACE adoption from Table 5 yields annual premium savings of $\Delta Premium = \$757$ per borrower. Comparing this figure to the average price increase upon sale of $\Delta P = \$20{,}473$ for PACE-funded climate-proofing projects based on Table 9 implies a discount rate of 3.7%. Using instead the upper bound of our house price capitalization estimates from the specification curve in Figure 7 ($\Delta P = \$26{,}066$) lowers the implied rate to 2.9%. The lower bound of our discount rate estimates is therefore close to the 2.6% rate reported by Giglio et al. (2015) for leasehold contracts and the 2.7% rate computed by Ge et al. (2025a) for flood insurance costs.

If homeowners have rational expectations about future increases in their insurance costs, the pro-rated growth in savings will also be capitalized into house prices. Suppose the annual premium savings from a climate-proofing PACE project grow at a rate consistent with historical premium inflation during the pre-COVID period from 2015 to 2019: 3.9% average year-on-year growth for wind-damage policies in the QUASR data.[17] Applying this growth factor adds 4.1 percentage points to each discount rate above, for a range of 7.0% to 7.8%. Some of the capitalization may additionally reflect the energy savings of climate-proofing projects. A new roof or set of windows also improves the efficiency of air conditioning (Figure A.1). Incorporating utility cost savings would imply slightly greater discount rates still. Overall, these calculations show that the premium savings generated by PACE-financed climate-proofing can rationalize the observed house price capitalization at discount rates within the range reported in the real estate literature, supporting external validity.

[17]This assumption is conservative to the extent that average premia have increased dramatically in Florida since 2019, tripling between 2019 and 2023 by some estimates (Bloomberg, 2024).

6.2 Local Property Tax Revenues

By contrasting the benefits of capitalizing PACE loans into house prices with the potential costs of increasing delinquency rates, the evidence presented above highlights the tension surrounding the introduction of PACE programs, as raised by policymakers and regulators. We perform a simple back-of-the-envelope calculation to assess the direct net benefit (cost) of PACE from the perspective of the local tax office:

$$\Delta R_{t,t+1} = \underbrace{\tau_{t+1}}_{\text{effective tax rate}} \times (\underbrace{\Delta P_{t,t+1}}_{\text{capitalization effect}} - \underbrace{\Delta D_{t,t+1} \cdot P_t}_{\text{revenue lost from delinquency}}) \tag{6.1}$$

where $\Delta R_{t,t+1}$ is the change in local property tax revenue. The first term in (6.1) represents the benefit of PACE, which is the positive change in revenues due to the average increase in home values. We subtract from the capitalization effect revenues lost from an uptick in the delinquency rate $\Delta D_{t,t+1}$ on the prior year's tax bill. This is a short-run revenue calculation to the extent that local governments always eventually recover back taxes through the tax lien auction or foreclosure process, with a lag of up to one year in Florida (LaPoint, 2023).

Evaluating equation (6.1) using our estimates from Sections 5.1 and 5.4, we calculate an average net tax benefit of between \$186 and \$251 per borrower-year. To calculate county-level effective tax rates $\tau_{j,t+1}$, we follow the methods of Horton et al. (2024). Since our estimates of the capitalization effects of PACE are in terms of market prices, we use an effective tax rate (ETR), which is equal to the tax bill divided by the sale price. In contrast, a statutory tax rate is the tax bill divided by the tax assessed value. We use the pre-COVID period overlapping with our PACE loan sample (2015–2019) to calculate tax rates to avoid any mis-measurement related to tax assessments being delayed by the pandemic. We find the average Florida county levies a 1.15% ETR; if we instead drop extreme transaction values at the 1% tails of the distribution, the average ETR is 1.24%.

Based on our estimates in Section 5.1 and Section 5.4 and ETRs across Florida counties, the potential net effect on local tax income is $1.15\% \times (\$16,482 - 0.001 \times \$266,548) = \$186$ at the lower end. The analogous fiscal gains if we further restrict to capitalization due to climate-proofing projects (column 2 of Table 9) are $1.15\% \times (\$20,473 - 0.001 \times \$266,548) =$ \$232, or \$251 if we adopt a 1.24% average ETR. The average property sales price in our estimation sample is \$266,548. We use the three-year change in the delinquency rate of 0.1 p.p. from our difference-in-differences estimates of Table 4 in this calculation. Note that this calculation excludes broader local economic and environmental spillovers, including effects on local economic activity and reductions in environmental externalities. We therefore interpret it as a direct fiscal calculation rather than a comprehensive welfare analysis.

7 Conclusion

Property Assessed Clean Energy (PACE) programs expand credit to financially constrained homeowners and enable investments that increase property values and reduce homeowners insurance costs, but these benefits come with important costs. PACE loans have substantial premia, especially to borrowers with weak outside financing options, and PACE borrowing increases property tax delinquency. These findings highlight both the promise and the limits of using debt contract design to finance household climate investment. Giving lenders senior claims can expand credit without subsidizing borrowing, but it can also shift repayment risk towards financially fragile households and give providers greater scope to extract surplus. For local governments, the resulting expansion of the property tax base more than offsets short-run delinquency losses, generating potential net fiscal gains of roughly \$250 per PACE borrower annually. More broadly, PACE does more than add a senior claim to the household balance sheet: it enables value-creating investments while redistributing the resulting gains and risks across borrowers, lenders, insurers, and local governments.

Several caveats are important when interpreting these results. PACE is not a uniform program, and its implementation varies across jurisdictions in eligibility requirements, underwriting standards, consumer protections, and program administration. Our analysis studies the Florida residential PACE program, whose institutional design and housing and insurance markets differ from those of other states. The effects of PACE may therefore depend on the specific contractual and regulatory environment in which the program operates. In addition, our analysis focuses on the direct effects of PACE on participating households and local governments and abstracts from peer and other general equilibrium effects. For example, PACE-financed improvements may affect neighboring households' investment decisions, contractors' employment, or nearby property values. Quantifying these spillovers and understanding how alternative PACE designs shape the allocation of benefits and costs are important directions for future research.

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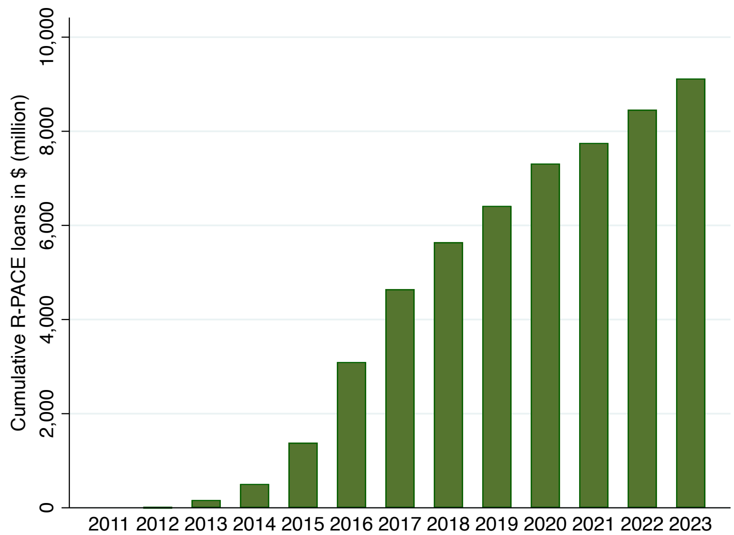
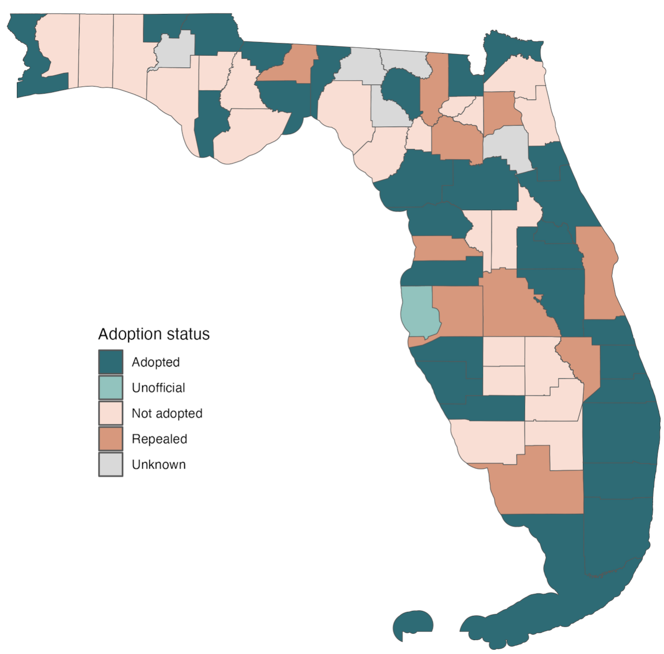
FIGURE 1. PACE Program Size and County-Level Adoption in Florida

A. Total Amount of PACE Loans Originated

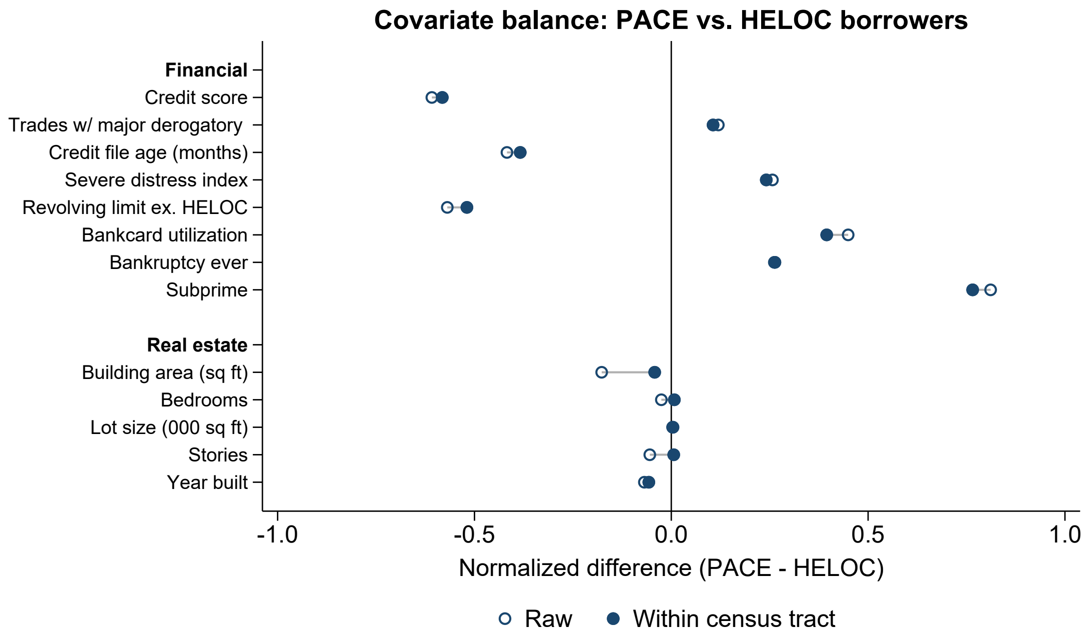


B. County-Level Adoption of Florida Residential PACE Programs



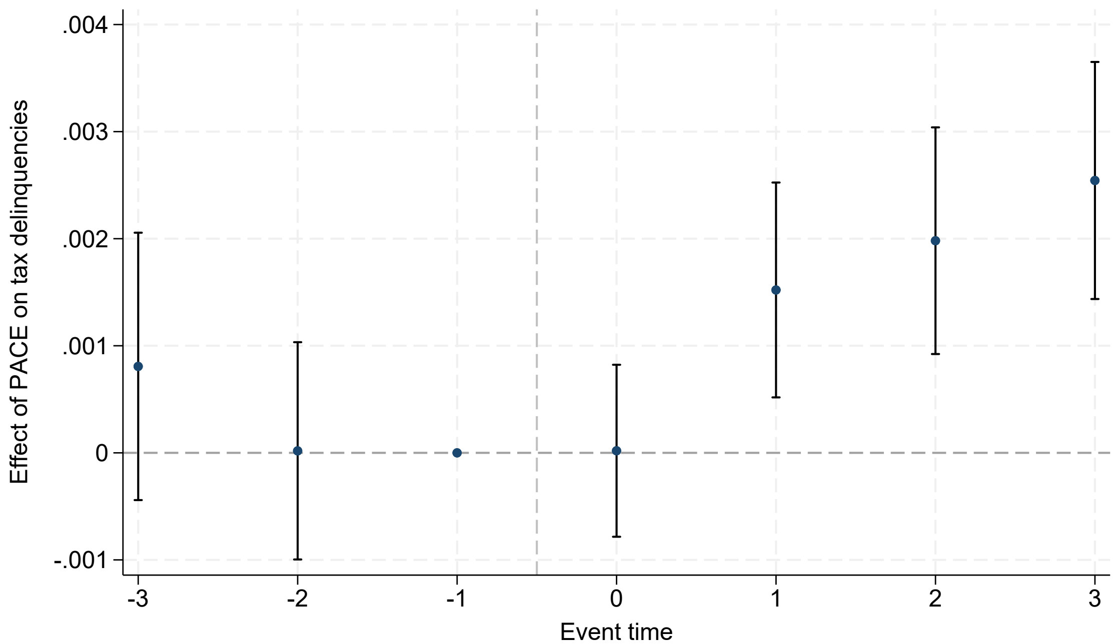
Notes: Panel A plots the cumulative amount of loans (in millions of nominal U.S. dollars) originated from the residential PACE programs between 2011 and 2023. Residential PACE programs are available in California, Florida, and Missouri. Source: https://www.pacenation.org/pace-market-data/. Panel B provides a map of Florida counties that have adopted residential PACE programs as of December 2023. We classify counties into five categories: "Adopted" if PACE is adopted and currently enabled; "Unofficial" if there is no official adoption of PACE but PACE lenders have originated loans to properties in that county; "Not adopted" if PACE has not yet been adopted; "Repealed" if the county adopted PACE at one point but lenders withdrew due to legal challenges; "Unknown" if adoption information is not yet available and we have no record of PACE loans originated in those counties.

FIGURE 2. Comparison of Household and Property Characteristics for PACE vs. HELOC Borrowers



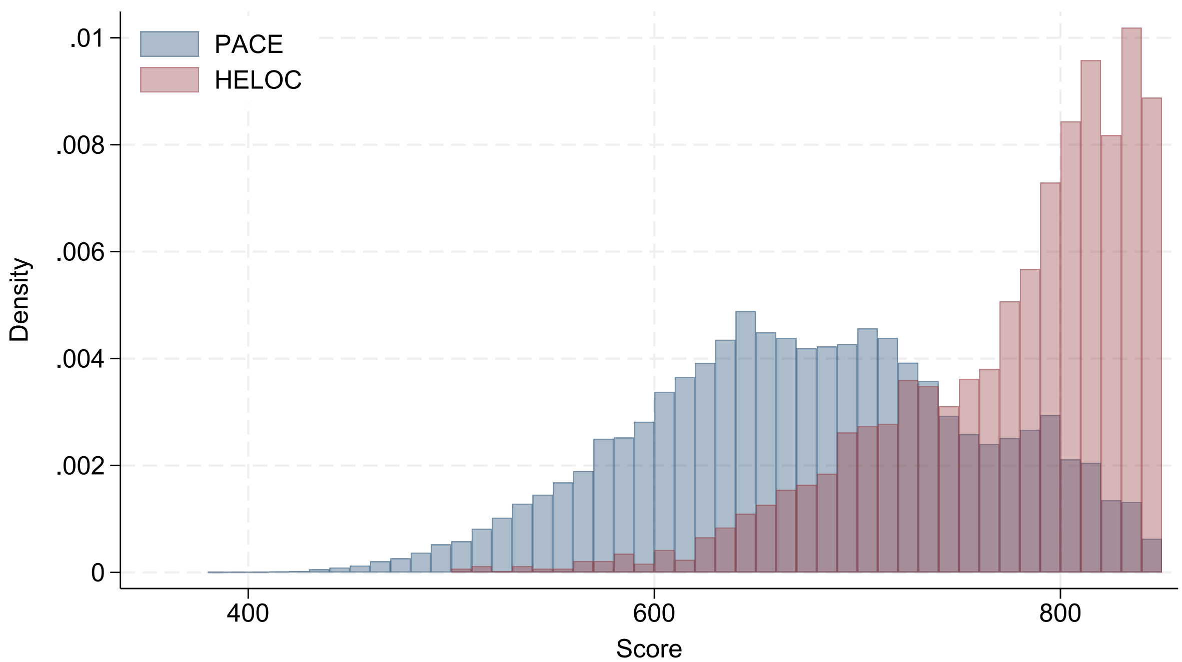
Notes: This figure compares the characteristics of borrowers who financed home improvements with a PACE loan and borrowers with a home equity line of credit (HELOC). To conduct this comparison, we measure all characteristics as of the last credit bureau archive preceding the year of loan origination for each loan product. Hollow markers report the unconditional difference in means between PACE and HELOC borrowers; solid markers report the difference in means within census blocks, estimated as the coefficient on a PACE indicator in a regression with census block fixed effects. The x-axis expresses both differences as normalized differences: the difference in means scaled by the pooled standard deviation of the two groups. Borrower-level credit variables (Credit score, Trades w/ major derogatory, revolving limit ex. HELOC, bankcard utilization, bankruptcy ever, subprime status, delinquency history, credit file age, and the severe distress index) come from Equifax credit bureau archives. Property-level variables (building and land square footage, bedrooms, number of stories, and property age) come from the Cotality tax roll. The sample comprises PACE and HELOC borrowers in owner-occupied, single-family Florida homes. All differences are statistically significant at the 1 percent level, both raw and within census block, with the following exceptions: year built (5 percent raw, 1 percent within block); number of stories (5 percent raw, not significant within block); bedrooms and land square feet (not significant in either specification).

FIGURE 3. Dynamic Event Study: Impact on Property Tax Delinquencies



Notes: This figure plots the dynamic event study version of equation (5.1), estimated with property and year fixed effects, property characteristic bin fixed effects, and borrower credit controls, using properties that have not yet received a PACE loan as the control group. All fixed effects and borrower credit controls are interacted with stack fixed effects. The outcome is a delinquency flag equal to one if the property-by-owner combination has a local tax lien involuntarily and newly placed on it in year t, indicating a missed property tax payment. Time on the x-axis is measured in years relative to PACE loan origination ($t = 0$), and coefficients are normalized relative to the omitted reference period $t = -1$. Bars indicate 95% confidence intervals with standard errors clustered at the property (APN) level.

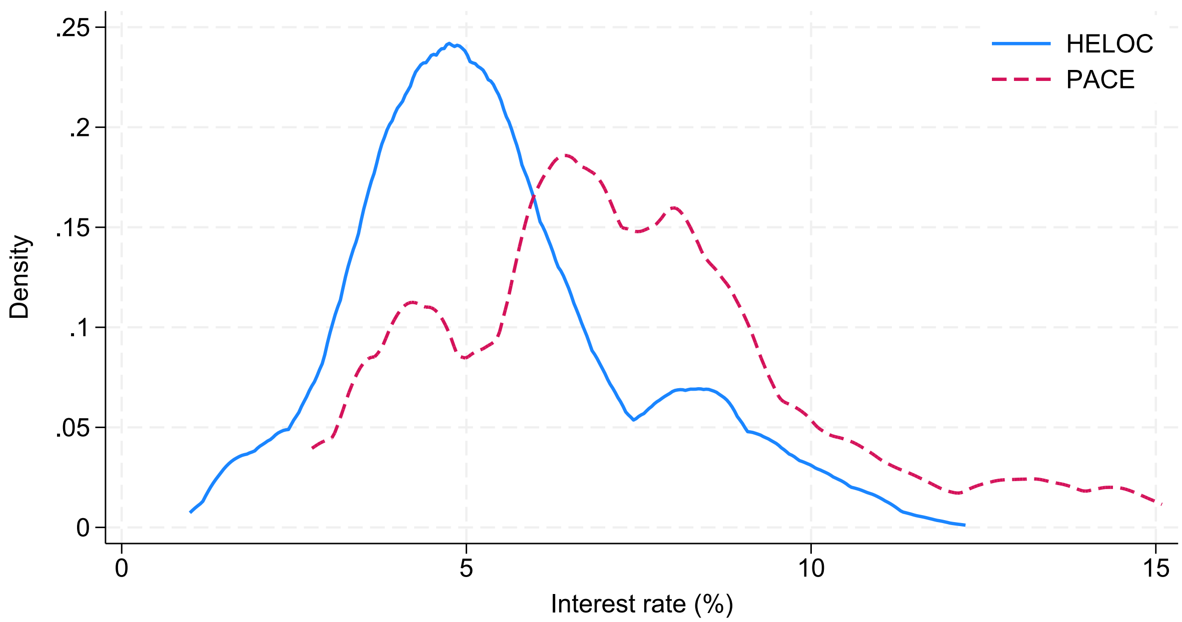
FIGURE 4. Comparison of Credit Scores for PACE Loans vs. HELOCs



Kolmogorov-Smirnov D = 0.506 (p < 0.001). Difference in means (PACE - HELOC) = -98.3 points (s.e. = 1.0, p < 0.001).

Notes: This figure plots the distribution of credit scores for Florida PACE borrowers and a comparison group of Florida HELOC borrowers. Credit scores are measured in the year preceding origination: the year prior to the PACE assessment tax year for PACE borrowers, and the year prior to the origination year for HELOC borrowers. Measuring scores prior to origination ensures that the comparison reflects borrower creditworthiness at the time of the financing decision and is not contaminated by the effect of the loan itself on subsequent credit outcomes. Both distributions are plotted as densities using a common bin width of 10 points beginning at 300, so that the two groups remain comparable notwithstanding differences in sample size.

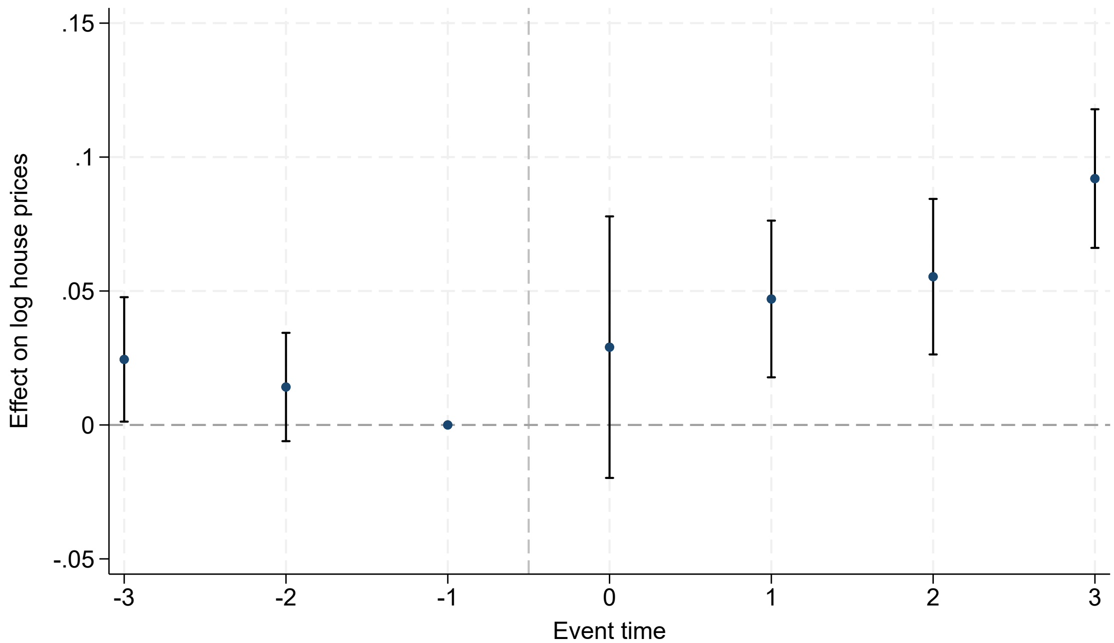
FIGURE 5. Comparison of Interest Rates for PACE Loans vs. HELOCs



Kolmogorov-Smirnov D = 0.401 (p = 0.000). Difference in means (PACE - HELOC) = 1.829 pp (s.e. = 0.067, p = 0.000).

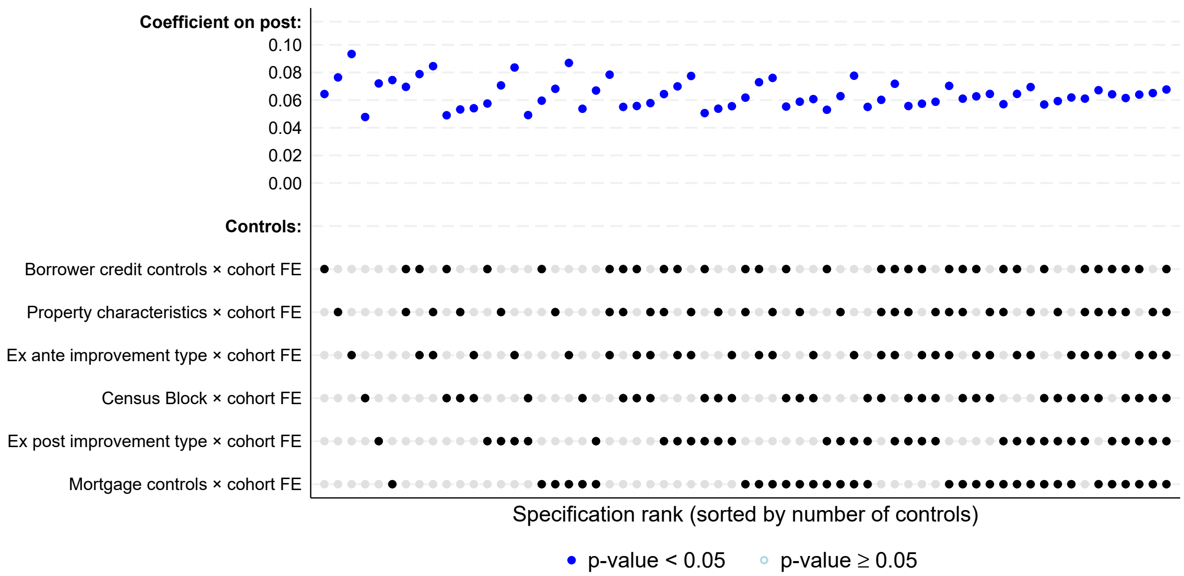
Notes: This figure plots kernel density estimates of the distribution of interest rates at origination for PACE loans and for home equity lines of credit (HELOCs) used towards home improvement, measured in percentage points. The unit of observation is a loan. For PACE loans, the interest rate is imputed from the property tax amortization schedule as the weighted average of the rates implied by 15-, 20-, and 30-year terms, with weights of 0.25, 0.50, and 0.25, respectively; for HELOCs, the interest rate is the rate at origination reported in HMDA for Florida home improvement loans matched to the Cotality tax roll. The sample is restricted to owner-occupied, single-family properties with a non-missing interest rate and a matched Equifax credit bureau record in the year prior to origination. The figure reports the Kolmogorov–Smirnov test statistic for the equality of the two distributions and the difference in mean rates (PACE minus HELOC) together with its standard error and p-value.

FIGURE 6. Dynamic Event Study: Capitalization of PACE Lending into House Prices



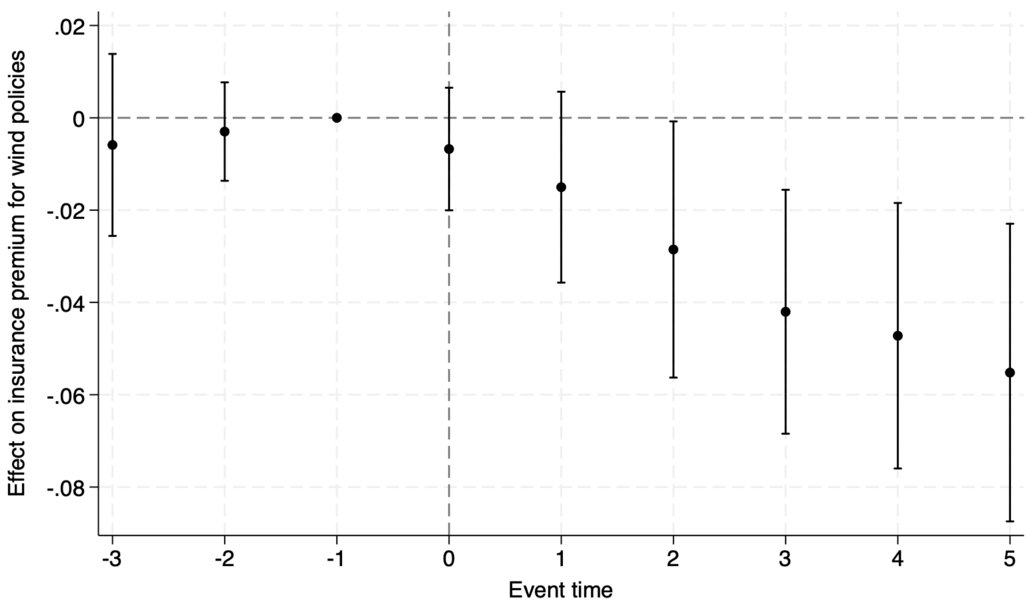
Notes: This figure plots the dynamic event study version of equation (5.3), estimated on the specification in column 3 of Table 7 using the stacked difference-in-differences estimator of Cengiz et al. (2019) and Baker et al. (2022), in which properties that have not yet received a PACE loan serve as the control group for currently treated properties. The dependent variable is the log arms-length transaction price. Time on the x-axis is measured in years relative to PACE loan origination (t = 0). All fixed effects and controls are interacted with the stacked cohort and comprise cohort × sale month, cohort × 5-digit ZIP code, cohort × sale sequence number, and cohort × property characteristic bin fixed effects, plus cohort-interacted borrower credit controls as described in Section 5.4. The sample is restricted to owner-occupied, single-family properties. Bars indicate 95% confidence intervals with standard errors clustered at the property (APN) level.

FIGURE 7. Specification Curve: Robustness of House Price Capitalization Results



Notes: This figure reports the difference-in-differences coefficient on the post-treatment indicator across 63 alternative specifications, estimated by OLS on a stacked panel of cohort sub-experiments, following Cookson (2018). The dependent variable in every specification is the log sale price of a property; the unit of observation is a property sale within a cohort sub-experiment. Treatment is a PACE loan attached to the property, and the control group is composed of not-yet-treated properties. We hold fixed the sample across all specifications to correspond to the set of observations used in the fully saturated model. Every specification absorbs sale month × cohort, sale sequence × cohort, and ZIP code × cohort fixed effects. The six control blocks listed on the vertical axis are then switched on and off in all 2^6 combinations, and the cell containing no block is omitted. Mortgage controls are the terms and amounts of purchase, construction, home equity, and refinance mortgages, entered as continuous regressors interacted with cohort. *Ex ante* and *ex post* improvement-type fixed effects distinguish the categories of home improvement financed before and after the sale, respectively. Property characteristics are quartile bins of building square footage, dummies for number of bedrooms, number of stories, and quartile bins of effective year built. Borrower credit controls are the credit score, share of accounts in major derogatory status, credit file age, and the severe distress index, measured at the property-year level. The vertical position of each marker in the upper panel gives the estimated coefficient; the lower panel indicates with a filled dot which blocks enter that specification. The horizontal axis orders specifications by the number of blocks included, so the leftmost specification is the sparsest and the rightmost is the fully saturated model. Filled markers denote estimates significant at the 5% level; hollow markers denote estimates that are not. Robust standard errors clustered by property (APN) in all specifications.

FIGURE 8. Dynamic Event Study: County-Level PACE Adoption Effects on Homeowners Insurance Premia



Notes: This figure plots the reduced-form effects of county-level PACE adoption on homeowners insurance premia from event study difference-in-differences regressions, estimated via the Cengiz et al. (2019) stacked estimator. The dependent variable is the log annual home insurance premium for wind-damage policies on owner-occupied residences at the county level. We weight observations by their lagged county-level population. Time on the x-axis is measured in years relative to PACE program adoption ($t = 0$). We use dates on which official PACE ordinances or the first interlocal agreements are enacted to assign treatment timing. To compute average county-level premia, we collapse the data after first isolating contracts which only offer protection against damages from wind. Bars indicate 95% confidence intervals with standard errors clustered by county.

TABLE 1. Determinants of PACE Adoption at the County Level

Dep. variable: PACE Adopted	(1)	(2)	(3)	(4)	(5)	(6)
Population	-0.011	0.005	-0.470	-0.070	0.457	0.111
	(0.070)	(0.071)	(1.012)	(0.982)	(1.362)	(0.983)
Household median income	0.735**	0.500	-0.244	-0.236	-0.001	-0.148
	(0.348)	(0.397)	(0.341)	(0.334)	(0.427)	(0.334)
% Bachelor's degree or higher	-1.890**	-1.808**	1.592	1.227	1.553	1.316
	(0.782)	(0.778)	(1.300)	(1.206)	(1.380)	(1.164)
% Black	0.746	1.763	1.090	0.841	-0.826	0.093
	(2.505)	(2.374)	(2.590)	(2.505)	(4.040)	(2.490)
% Latino	1.126	1.820	-1.566	-0.721	-5.305	-2.846
	(2.180)	(2.067)	(7.204)	(6.824)	(8.790)	(6.657)
% White	0.734	1.915	-4.792	-1.394	-5.562	-3.184
	(2.171)	(2.033)	(4.791)	(5.033)	(6.930)	(4.962)
Unemployment rate	-4.364***	-4.046***	-0.931	-1.259	-0.894	-0.926
	(1.435)	(1.248)	(1.212)	(1.209)	(1.294)	(1.127)
Municipal debt/Revenue	0.017	-0.005	-0.014	-0.021	0.005	-0.018
	(0.038)	(0.039)	(0.027)	(0.026)	(0.024)	(0.024)
Democratic leaning	1.322**	0.535	-0.607	-0.928	-1.338	-1.235
	(0.635)	(0.584)	(1.076)	(0.959)	(1.241)	(1.002)
Neighbor PACE	0.051	-0.048	0.065	0.045	0.006	0.065
	(0.104)	(0.099)	(0.085)	(0.086)	(0.077)	(0.083)
#Declared natural disasters	0.132***	0.097***	-0.009	-0.015	-0.018	-0.024
	(0.025)	(0.027)	(0.027)	(0.028)	(0.036)	(0.027)
Abnormal property damage	-0.000	-0.000	-0.000	-0.000	-0.001	-0.000
	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)
Climate concerns		0.036***		0.021	0.029	0.020
		(0.012)		(0.019)	(0.021)	(0.018)
Assessor turnover		0.001		-1.250**	-1.367*	
		(0.724)		(0.515)	(0.697)	
Assessor turnover × Climate concerns		-0.000		0.023**	0.025*	
		(0.013)		(0.009)	(0.013)	
Retirement turnover						-1.719**
						(0.681)
Retirement turnover×Climate concerns						0.031***
						(0.011)
Sample	All	All	All	All	Pre-2020	All
Observations	466	466	466	466	344	466
R-squared	0.343	0.384	0.710	0.726	0.692	0.730
County FE			x	x	x	x
Year FE			x	x	x	x

Notes: This table examines whether a county's local conditions predict PACE adoption. The dependent variable, $Adopted_{c,t}$, equals one if a county c has adopted PACE in year t. Columns 1–2 report cross-sectional regressions; columns 3–6 add county and year fixed effects. Standard errors are reported in parentheses and clustered at the county level. County population is from the Census; Black, Latino, and White population shares, household median income, education attainment, and unemployment rate are from annual American Community Survey estimates; county-level debt-to-revenue ratio is from Willamette University's Government Finance Database; Democratic leaning is the vote share for the Democratic presidential candidate in the most recent election (Florida Department of State); Neighbor PACE is a dummy variable equal to one if at least one neighboring county has an effective PACE program in year t; "climate concerns" is the share of people who are worried about global warming (Yale Program on Climate Change Communication surveys); Assessor turnover (Retirement turnover) equals one in the year a new county appraiser assumes office (following the predecessor's retirement); # Declared natural disasters is the number of FEMA-declared disasters in year $t-1$; Abnormal property damage is the deviation of per capita property damage (SHELDUS) in $t-1$ from its 1960–2008 mean. We identify retirement-related turnover by matching assessors to their L2 voter registration file and determining whether they are over age 62 (the age at which Florida state pensions vest) at the time they leave their office. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

TABLE 2. Summary Statistics for House Price and Insurance Samples

Panel A: Individual data				
	Mean	SD	P25	P75
Credit score	631.70	157.74	568.00	748.00
Revolving limit ex. HELOC	24,183.82	34,047.38	1,500.00	34,526.50
Bankruptcy ever	0.07	0.25	0.00	0.00
Share with major derogatory	0.13	0.98	0.00	0.00
Credit file age (months)	185.17	127.25	100.00	259.00
Severe distress index	1.16	0.61	1.00	1.00
Building area (sq. ft.)	1,731.92	639.72	1,310.00	2,002.00
Bedrooms	3.09	0.80	3.00	3.00
Lot size (sq. ft.)	11,336.13	30,995.29	6,000.00	10,000.00
Stories	1.15	0.36	1.00	1.00
Sale price (conditional on selling)	266,548.74	206,165.25	153,699.95	328,999.84
Year built	1,976.41	18.27	1,960.00	1,991.00
Observations		1,681,344		
Panel B: County-level Insurance Analysis				
log(Premium)$_{c,t}$ (all)	7.469	0.282	7.265	7.634
log(Premium)$_{c,t}$ (wind)	7.485	0.300	7.268	7.660
Observations		680		

Notes: This table reports the summary statistics of the key variables used in the analysis (Panel A) and in the insurance premia analysis (Panel B). P25 and P75 denote the 25th and 75th percentiles.

TABLE 3. Balance Tests Comparing Early vs. Late PACE Borrower Cohorts

A. Differences

	Group means		Difference	
	Early	Late	Unadjusted	Adjusted
Credit score	639.40	638.62	0.79	1.07
Trades w/ major derogatory (%)	0.10	0.11	−0.010	0.011
Credit file age (months)	190.25	191.07	−0.82	−0.21
Severe distress index	1.07	1.11	−0.041***	−0.052
Building area (sq. ft.)	1,760.51	1,712.09	48.42***	32.79***
Bedrooms	3.05	3.11	−0.066***	0.030**
Lot size (sq. ft.)	12,096.05	10,855.10	1,240.95***	328.11
Stories	1.15	1.15	−0.003	−0.006
Year built	1978.08	1976.12	1.95***	0.04
Observations		65,478		

B. Standardized Differences (Z-Scores)

	Group means		Difference	
	Early	Late	Unadjusted	Adjusted
Credit score	0.16	0.154	0.005	0.007
Trades w/ major derogatory (%)	−0.05	−0.041	−0.010	0.011
Credit file age (months)	0.13	0.139	−0.007	−0.002
Severe distress index	−0.18	−0.113	−0.064***	−0.083
Building area (sq. ft.)	0.06	−0.019	0.077***	0.052***
Bedrooms	−0.06	0.018	−0.082***	0.037**
Lot size (sq. ft.)	0.03	−0.011	0.045***	0.012
Stories	−0.01	0.002	−0.008	−0.017
Year built	0.08	−0.026	0.106***	0.002
Observations		65,478		

Notes: This table reports balance tests comparing the pre-treatment characteristics of early and late cohorts of PACE borrowers. The unit of observation is a property–borrower pair, measured once in the calendar year preceding the origination of the property's PACE loan. Early cohorts originate their PACE loan before the sample median and late cohorts after the sample median; every observation in the table is an eventual PACE borrower, so the comparison is between treated properties and the not-yet-treated properties that form the control group in the difference-in-differences specifications. Panel A reports characteristics in levels. Panel B expresses each variable as a z-score, standardized by the mean and standard deviation of the borrower panel, so that differences are measured in standard deviations of the pooled distribution. In both panels, columns 1 and 2 report the group means; column 3 reports the unadjusted early-minus-late difference clustered at the property level; and column 4 reports the same difference within census block. Because the census block fixed effects drop properties that are the only PACE borrower in their block, column 4 is estimated on a smaller sample than column 3. Robust standard errors are clustered at the property (APN) level. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

TABLE 4. Stacked DiD Estimates for Property Tax Delinquency

	Tax Delinquent		
	(1)	(2)	(3)
Post PACE loan	0.001***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)
Observations	1,209,194	1,209,194	1,209,194
Adj. R-squared	0.346	0.346	0.346
Cohort × Year FE	x	x	x
Cohort × Property FE	x	x	x
Cohort × Building sq. ft. FE		x	x
Cohort × Bedrooms FE		x	x
Cohort × Stories FE		x	x
Cohort × Effective year built FE		x	x
Cohort × Borrower credit controls			x

Notes: This table reports estimates of β from equation (5.1), following the estimator of Cengiz et al. (2019). The outcome is a dummy variable equal to one if the property-by-owner combination has a local tax lien involuntarily and newly placed on it in year t, indicating a missed property tax payment. Post PACE loan is an indicator equal to one if i has had a PACE lien placed as of year t. Properties that have not yet received a PACE loan serve as the control group. All columns include property and year fixed effects. Column 2 adds fixed effects for bins of property characteristics, and column 3 adds borrower credit controls measured as of the year prior to origination, as described in Section 5.1. All fixed effects and borrower credit controls are interacted with cohort fixed effects. Standard errors are clustered at the property (APN) level and reported in parentheses. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

TABLE 5. IV Analysis of PACE Adoption on Property Tax Delinquency

	(1)	(2)	(3)
Panel A: First stage — has a PACE loan			
County adopted PACE	0.074***	0.074***	0.074***
	(0.014)	(0.014)	(0.014)
Observations	1,681,344	1,681,344	1,681,344
Panel B: Second stage — tax delinquent			
Has a PACE loan	0.047***	0.047***	0.047***
	(0.012)	(0.012)	(0.012)
Kleibergen-Paap F-statistic	29.50	29.50	29.13
Observations	1,681,344	1,681,344	1,681,344
Counties	59	59	59
Year FE	x	x	x
Property FE	x	x	x
Property characteristic bin FE		x	x
Credit controls			x

Notes: This table reports instrumental variables estimates of the effect of individual PACE loan take-up on property tax delinquency, using the staggered adoption of PACE programs across Florida counties as the instrument. The sample is an annual property-by-owner panel of Florida PACE borrowers and their respective controls. Panel A reports the first stage: the dependent variable is an indicator equal to one once property i has a PACE loan attached as of year t, and the instrument, County adopted PACE, is an indicator equal to one once the county in which the property is located has an active PACE program. Panel B reports the second stage: the outcome is a dummy variable equal to one if the property-by-owner combination has a local tax lien involuntarily and newly placed on it in year t, indicating a missed property tax payment; the variable "Has a PACE loan" is instrumented with county-level adoption. All columns include property and year fixed effects. Columns 2 and 3 add fixed effects for bins of property characteristics (quartile bins of building square footage, dummies for number of bedrooms, number of stories, and quartile bins of effective year built), and column 3 adds borrower credit controls: credit score, the incidence of a major derogatory event, credit file age, and the severe distress index. The Kleibergen–Paap F-statistic refers to the first-stage strength of the excluded instrument. Standard errors clustered at the county level in parentheses. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

TABLE 6. PACE vs. HELOC Interest Rate Premium

A. Raw Differences

	Interest Rate			
	(1)	(2)	(3)	(4)
PACE loan	2.633***	2.594***	2.710***	2.895***
	(0.124)	(0.127)	(0.128)	(0.130)
Observations	6,583	6,583	6,581	6,581
Adj. R-squared	0.230	0.231	0.237	0.257
Year FE	x	x	x	x
County FE	x	x	x	x
Credit bureau controls		x	x	x
Mortgage controls			x	x
House characteristics				x
Permit controls				x

B. Differences for Subprime Borrowers

	Interest Rate			
	(1)	(2)	(3)	(4)
PACE loan	2.467***	2.490***	2.602***	2.794***
	(0.135)	(0.136)	(0.137)	(0.138)
PACE loan × Subprime borrowers	0.353**	0.278*	0.310**	0.295**
	(0.143)	(0.151)	(0.151)	(0.150)
Observations	6,583	6,583	6,581	6,581
Adj. R-squared	0.231	0.232	0.238	0.257
Year FE	x	x	x	x
County FE	x	x	x	x
Credit bureau controls		x	x	x
Mortgage controls			x	x
House characteristics				x
Permit controls				x

Notes: This table reports OLS estimates of the interest rate premium charged on PACE loans relative to home equity lines of credit (HELOCs) used towards home improvement. The unit of observation is a loan, and the dependent variable is the interest rate at origination, in percentage points: for PACE loans it is imputed from the property tax amortization schedule as a weighted average of the rates implied by 15-, 20-, and 30-year terms, and for HELOCs it is the rate at origination reported in HMDA. The sample is restricted to owner-occupied, single-family Florida properties matched to an Equifax credit bureau record in the year prior to origination. In Panel A, PACE loan is an indicator equal to one for PACE loans and zero for HELOCs. All columns control for the loan amount and include year and county fixed effects. Column 2 adds borrower credit controls measured as of the year prior to origination: credit score, the incidence of a major derogatory event, credit file age, and the severe distress index. Column 3 adds mortgage controls, comprising the amounts and terms of all outstanding, purchase, construction, home equity, and refinance mortgages, together with the tax assessed property value. Column 4 adds bins for house characteristics (quartile bins of building square footage, dummies for number of bedrooms, number of stories, and quartile bins of effective year built) and controls for the number of *ex post* permits filed in each project category. In Panel B, the PACE indicator is interacted with an indicator for subprime borrowers, defined as a credit score below 670 in the year prior to origination; columns 2 through 4 repeat the progressive control sets of Panel A. Standard errors are clustered at the property level in parentheses. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

TABLE 7. Stacked DiD Estimates for PACE Loan Effects on House Prices

	Log House Price		
	(1)	(2)	(3)
Post PACE loan	0.052***	0.063***	0.060***
	(0.010)	(0.009)	(0.009)
Observations	88,033	88,033	88,033
Adj. R-squared	0.469	0.589	0.590
Cohort × Sale month FE	x	x	x
Cohort × ZIP FE	x	x	x
Cohort × Sale number FE		x	x
Cohort × Building sq. ft. FE		x	x
Cohort × Bedrooms FE		x	x
Cohort × Stories FE		x	x
Cohort × Effective year FE		x	x
Cohort × Credit controls			x

Notes: This table reports estimates of β from the stacked difference-in-differences specification in equation (5.3), following the estimator of Cengiz et al. (2019). The dependent variable is the log arms-length transaction price of property i sold in year t. Post PACE loan is an indicator equal to one for transactions occurring after property i receives a PACE loan and zero for transactions occurring beforehand. The sample is restricted to owner-occupied, single-family properties which receive at least one PACE loan between 2015 and 2023 and which transact within a seven-year window around origination; properties which have not yet received a PACE loan serve as the control group for currently treated properties. For each property we retain only the first transaction within a calendar year. All fixed effects and control variables are interacted with the stacked cohort. Column 1 includes cohort × sale month and cohort × 5-digit ZIP code fixed effects. Column 2 adds cohort-interacted fixed effects for the sale sequence number and for quartile bins of building square footage, dummies for number of bedrooms, number of stories, and quartile bins of effective year built. Column 3 adds cohort-interacted borrower credit controls measured as of the year prior to origination: credit score, an indicator for a major derogatory event, credit file age, and the severe distress index. Standard errors clustered at the property (APN) level in parentheses. $^{***}p < 0.01,^{**} p < 0.05,^{*} p < 0.1$.

TABLE 8. Statistical Diagnosis of Unobservable Characteristics (Oster Tests)

δ	Bias	Adjusted β	% of baseline
0.50	-0.0131	0.0731	140.3
0.75	-0.0197	0.0796	152.9
1.00	-0.0263	0.0862	165.5
1.25	-0.0328	0.0928	178.1
1.50	-0.0394	0.0993	190.7
Uncontrolled $\beta = 0.0521$, $R^2 = 0.487$			
Controlled $\beta = 0.0599$, $R^2 = 0.605$			

Notes: This table reports Oster (2019) bounds assessing the sensitivity of our baseline capitalization estimate to selection on unobservables. δ denotes the degree of selection on unobservables relative to selection on observables, so that $\delta = 1$ corresponds to unobserved determinants of house prices covarying with PACE treatment to the same degree as the controls included in column 3 of Table 7. For each value of δ we report the implied bias, the bias-adjusted coefficient β, and β as a percentage of the baseline estimate. Calculations take the estimate in column 3 of Table 7 as the controlled coefficient and the corresponding specification excluding property characteristic and credit controls as the uncontrolled coefficient, both estimated on the column 3 sample. Negative implied bias indicates that the observed controls are negatively correlated with treatment status.

TABLE 9. Impact on House Prices: Subsample Analysis

	Log House Price					
	Climate proofing		Coastal location		Ex post solar	
	No	Yes	Inland	Coastal	No	Yes
Post PACE loan	0.052***	0.074***	0.046***	0.070***	0.063***	-0.037
	(0.012)	(0.015)	(0.012)	(0.014)	(0.009)	(0.117)
Observations	63,350	24,144	44,305	43,647	83,331	2,987
Adj. R-squared	0.580	0.644	0.616	0.571	0.599	0.431
Cohort × Sale number FE	x	x	x	x	x	x
Cohort × Sale month FE	x	x	x	x	x	x
Cohort × ZIP FE	x	x	x	x	x	x
Cohort × Property characteristics FE	x	x	x	x	x	x
Cohort × Credit controls	x	x	x	x	x	x

Notes: This table reports estimates of β from equation (5.3) using different subsamples of the baseline (column 3 of Table 7). The dependent variable is the log arms-length transaction price of property i sold in year t. Post PACE loan is an indicator equal to one if i has had a PACE lien placed as of year t. Properties that have not yet received a PACE loan serve as the control group. Columns 1 and 2 split properties according to whether the permits filed at PACE origination include a climate-proofing improvement to the building envelope, defined as a roofing or a window and door permit. Columns 3 and 4 split by coastal location, defined as above or below the median distance from the coast. Columns 5 and 6 split by whether a solar permit is filed after origination. Standard errors clustered at the property (APN) level in parentheses. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

TABLE 10. Stacked DiD Estimates for PACE Loan Effects on Tax Assessed Values

	Log Tax Assessed Value		
	(1)	(2)	(3)
Post PACE loan	0.014***	0.014***	0.015***
	(0.006)	(0.006)	(0.006)
Observations	152,383	152,383	152,383
Adj. R-squared	0.936	0.936	0.936
Cohort × Year FE	x	x	x
Cohort × Property FE	x	x	x
Cohort × Building sq. ft. FE		x	x
Cohort × Bedrooms FE		x	x
Cohort × Stories FE		x	x
Cohort × Effective year built FE		x	x
Cohort × Borrower credit controls			x

Notes: This table reports estimates of the effect of PACE borrowing on tax assessed property values from a stacked difference-in-differences design (Cengiz et al., 2019). The dependent variable is the log tax assessed improvement (structure) value of property i in tax year t, from Cotality tax assessment records. Post PACE loan is an indicator equal to one for treated properties in the year of PACE loan origination and in the three years thereafter, and zero otherwise. Each stack pairs one PACE origination cohort with not-yet-treated properties — borrowers whose PACE loan originates more than three years after the stack's cohort — over an event window running from three years before to three years after origination. The sample comprises owner-occupied, single-family Florida properties of PACE borrowers observed between 2015 and 2023, with one observation per property and year drawn from the Equifax credit bureau archive. Column 1 includes property and year fixed effects. Column 2 adds fixed effects for quartile bins of building square footage, dummies for number of bedrooms, number of stories, and quartile bins of effective year built. Column 3 adds borrower credit controls, comprising the credit score, the incidence of a major derogatory event, credit file age, and the severe distress index. Standard errors clustered at the property (APN) level in parentheses. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

TABLE 11. Stacked DiD Estimates for PACE Loan Effects on Refinancing Probability

	$\mathbb{1}\{\text{Refinance Mortgage}\}$		
	(1)	(2)	(3)
Post PACE loan	-0.0014	-0.0014	-0.0016
	(0.0015)	(0.0015)	(0.0015)
Observations	1,209,194	1,209,194	1,209,194
Adj. R-squared	0.918	0.918	0.918
Cohort FE × Year FE	x	x	x
Cohort FE × Property FE	x	x	x
Cohort FE × Building sq. ft. FE		x	x
Cohort FE × Bedrooms FE		x	x
Cohort FE × Stories FE		x	x
Cohort FE × Effective year built FE		x	x
Cohort FE × Credit bureau controls			x

Notes: This table reports estimates of the effect of PACE loan take-up on mortgage refinancing using a stacked difference-in-differences specification. The dependent variable is an indicator equal to one if property-by-owner pair i originates a refinance mortgage in year t, and zero otherwise. Refinance originations are identified using Cotality mortgage records, with property-years without a recorded mortgage origination coded as zero. *Post PACE loan* is an indicator equal to one in the year in which i receives a PACE lien and in all subsequent years. Properties that have not yet received a PACE loan serve as the control group. All specifications include property and year fixed effects interacted with the stacked cohort. Columns 2 and 3 add fixed effects for quartile bins of building square footage, dummies for number of bedrooms, number of stories, and quartile bins of effective year built, while column 3 further adds borrower credit controls: credit score, an indicator for a major derogatory event, credit file age, and the severe distress index. Standard errors are clustered at the property level and are reported in parentheses. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

Online Appendix to

Picking Up the PACE: Loans for Residential Climate-Proofing

by Aymeric Bellon (UNC Chapel Hill), Cameron LaPoint (Yale SOM), Francesco Mazzola (ESCP Business School), and Guosong Xu (Rotterdam School of Management)

Contents

A Additional Tables and Figures **OA-3**

B Additional Institutional Background on PACE **OA-8**

C Sample PACE Loan Documents **OA-12**

D Details on Conceptual Framework **OA-17**

D.1 Environment . . . OA-17
D.2 Home Improvement Projects . . . OA-18
D.3 Parameter region . . . OA-18
D.4 Model Propositions . . . OA-19

E Building Permit Methodology **OA-24**

E.1 Classifying Building Permit Activity . . . OA-24
E.2 Identifying permits backed by PACE loans . . . OA-27

F Data on Window Resiliency and Energy Efficiency **OA-28**

G Data Appendix **OA-28**

G.1 Cotality (Corelogic) database . . . OA-28
G.2 Equifax Credit Bureau Data . . . OA-29
G.3 Description of Supplemental Datasets . . . OA-33

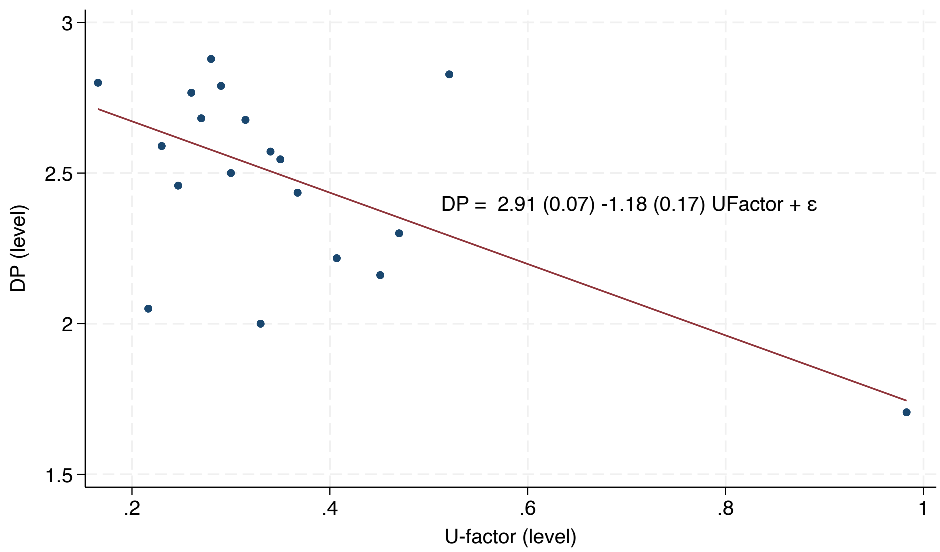
H Do Counties' Finances Predict PACE Program Adoption? **OA-35**

I Additional Results for Homeowners Insurance Market **OA-36**
I.1 Results Using Insurers' Exposure to PACE Counties OA-36
I.2 Effects on Local Market Share of State-Run Insurer (Citizens) OA-38

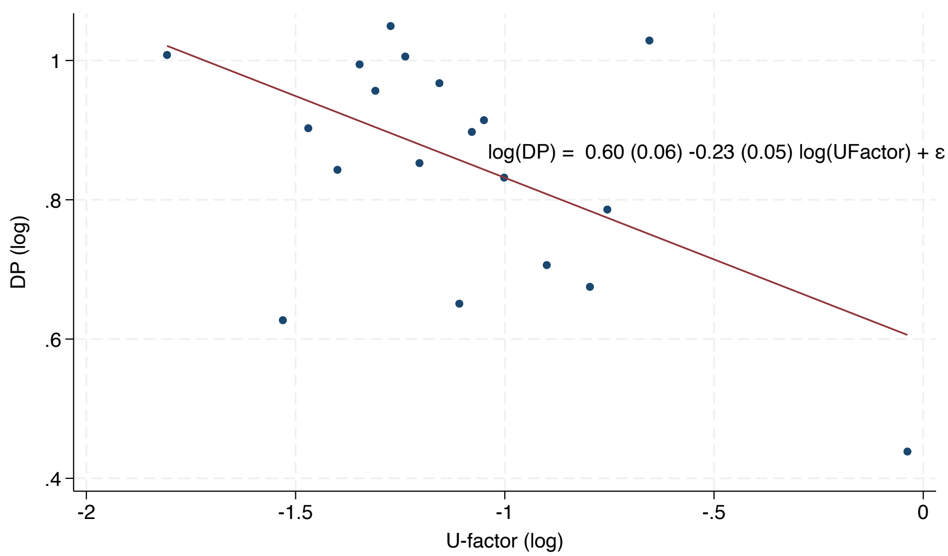
A Additional Tables and Figures

FIGURE A.1. Relationship between Window Product DP Ratings and U-Factors

A. Relationship in Levels



B. Relationship in Logs

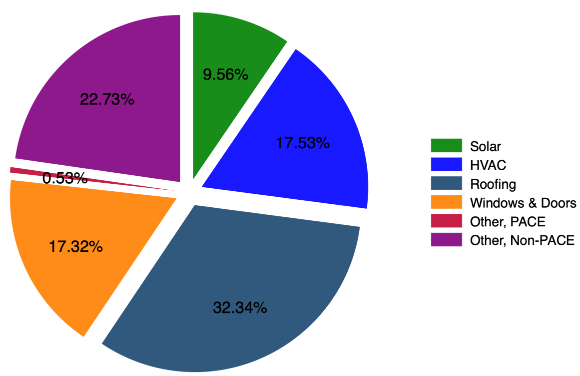


Notes: This graph shows the relationship between the Design Pressure (DP) ratings and the U-Factor of window products using data from 500 window models currently sold in the United States. We sort the windows into 20 equally-sized bins using `binscatter`. The U-Factor measures how well the window insulates. The lower the U-Factor, the better the window insulates the house. U-factor ranges from 0.20 to 1.20. The DP rating measures the load created by wind that a window can withstand. Windows with higher DP ratings are more resistant to high-velocity wind. Panel A shows the relationship in levels, while Panel B shows the relationship in logs. See Online Appendix F for details on how we collected the data displayed in this figure.

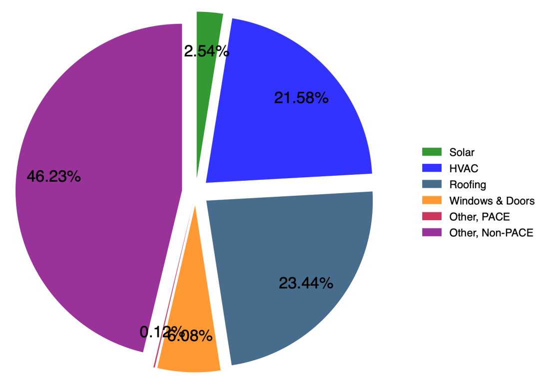
FIGURE A.2. Composition of Permitted Home Improvement Projects

A. Permit Types Pooled over Sample Period

Permits on PACE Properties

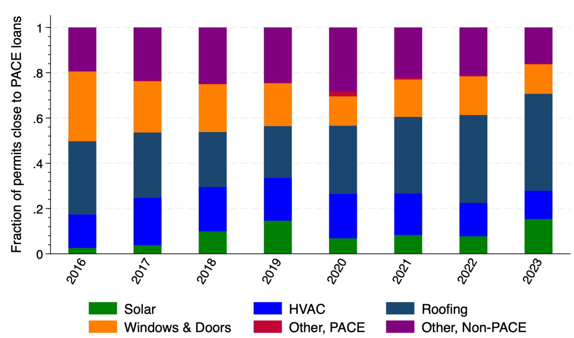


Non-PACE Florida Residential Permits

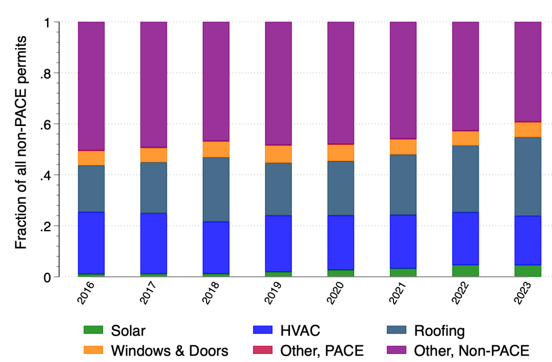


B. Evolution of Permit Type Activity Over Time

Permits on PACE Properties

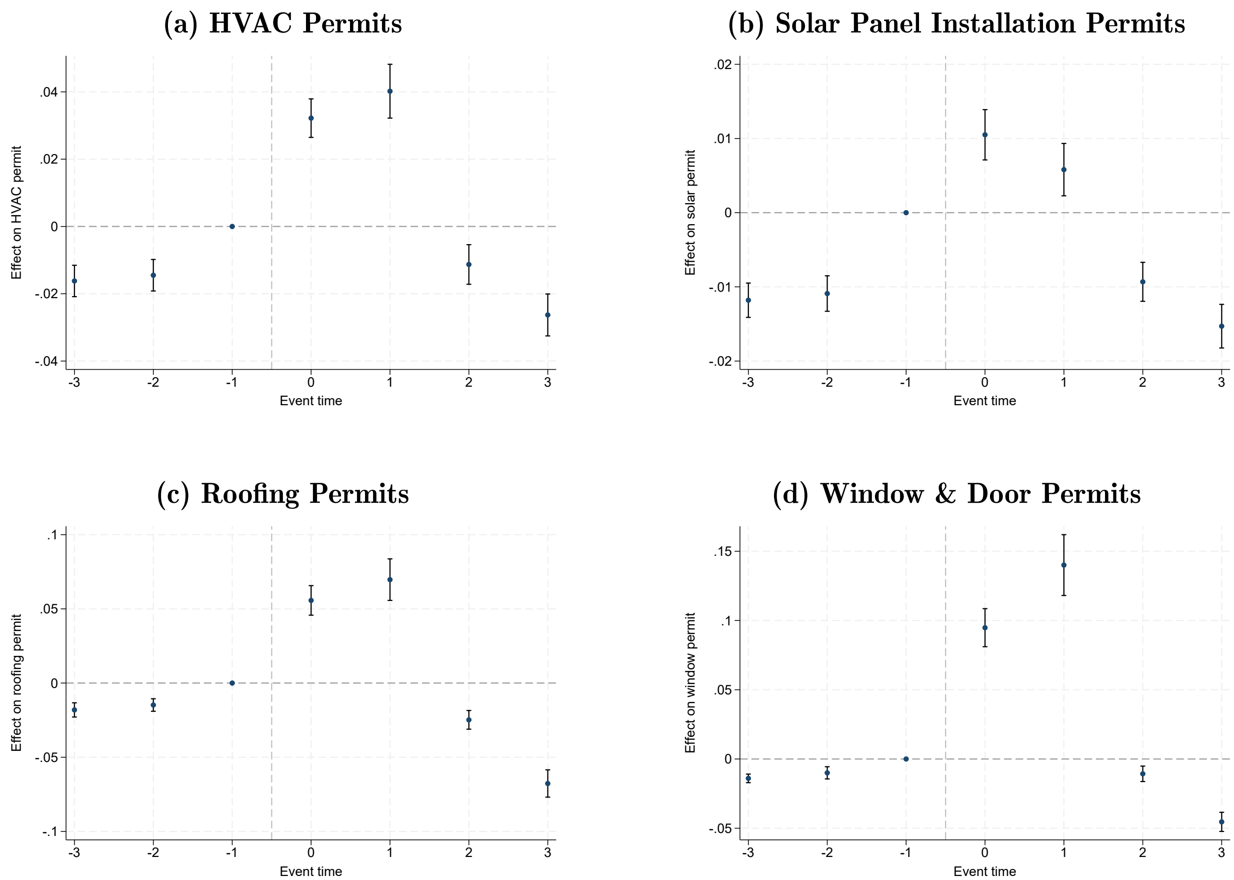


Non-PACE Florida Residential Permits



Notes: We classify building permits tied to residential properties with a PACE loan by string parsing the description of the home improvement project filed with the town clerk as part of the permit application. The five mutually exclusive categories are: HVAC, roofing, solar, windows and doors, and other. We define roofing as replacing the roof of the house, which distinguishes permits involving solar panel installations on the roof. "Other, PACE" pertains to permits for projects which could have a PACE-eligible use in more niche categories, including: septic-to-sewer conversions, wind anchors, insulation, water efficiency, energy storage, and natural lighting installations. "Other, Non-PACE" includes any permits which would not qualify for PACE based on the project description, such as kitchen or other cosmetic renovations. Panel A shows the breakdown of permits into these categories over the full sample time period, tax years 2016 − 2023, for only residential PACE properties (left) and for all single-family homes in Florida (right). Panel B shows how the proportions of permits evolve over the sample period. For permits associated with a PACE property, we tabulate only for permits issued with an effective date within the same year of loan origination. We restrict the sample to permits on single-family homes, excluding repairs, newly constructed units, and teardowns of existing units. See text for further details on the Cotality building permits data and Online Appendix E for how we sort permits into these categories.

FIGURE A.3. Dynamic Event Studies: Building Permits Issued around PACE Origination



Notes: This figure presents event study coefficient estimates from stacked difference-in-differences specifications following Cengiz et al. (2019) and Baker et al. (2022). For each PACE origination cohort, we construct a separate stack in which properties receiving a PACE loan are compared to later, not-yet-treated PACE borrower cohorts. The dependent variable in each graph is an indicator equal to one if a permit is issued within one of four mutually exclusive PACE-qualified project categories. Panels (a) and (b) display energy efficiency adaptations (HVAC and solar), while Panels (c) and (d) display disaster-proofing adaptations (roofing and window and door installations). The year prior to PACE loan origination, $t = -1$, is the omitted reference period. Each regression includes property × stack and county × year fixed effects. Time on the x-axis is measured in years relative to PACE loan origination ($t = 0$). We restrict the sample to permits on single-family homes, excluding repairs, newly constructed units, and teardowns of existing units. See text for further details on the Cotality building permits data and Appendix E for how we sort permits into these categories. Bars indicate 95% confidence intervals with standard errors clustered at the 5-digit zip code level.

TABLE A.1. Stacked DiD Estimates for PACE Loan Effects on Refinancing Probability: Conforming Loans

	$\mathbb{1}\{\text{Refinance Mortgage}\}$		
	(1)	(2)	(3)
Post PACE loan	-0.002	-0.002	-0.002
	(0.001)	(0.001)	(0.001)
Observations	934,096	934,096	934,096
Adj. R-squared	0.947	0.947	0.947
Cohort FE × Year FE	x	x	x
Cohort FE × Property FE	x	x	x
Cohort FE × Building sq. ft. FE		x	x
Cohort FE × Bedrooms FE		x	x
Cohort FE × Stories FE		x	x
Cohort FE × Effective year FE		x	x
Cohort FE × Credit bureau controls			x

Notes: This table reports estimates of the effect of PACE loan take-up on mortgage refinancing using a stacked difference-in-differences specification. The sample excludes non-conforming mortgage loans. The dependent variable is an indicator equal to one if property-by-owner pair i originates a refinance mortgage in year t, and zero otherwise. Refinance originations are identified using Cotality mortgage records, with property-years without a recorded mortgage origination coded as zero. *Post PACE loan* is an indicator equal to one in the year in which i receives a PACE lien and in all subsequent years. Properties that have not yet received a PACE loan serve as the control group. All specifications include property and year fixed effects interacted with the stacked cohort. Columns 2 and 3 add fixed effects for quartile bins of building square footage, dummies for number of bedrooms, number of stories, and quartile bins of effective year built, while column 3 further adds borrower credit controls measured in the year prior to origination: credit score, an indicator for a major derogatory event, credit file age, and the severe distress index. Standard errors are clustered at the property level and are reported in parentheses. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

TABLE A.2. Homeowners Insurance Premia Effects of County-Level PACE Adoption

	Log Insurance Premium					
	All policies		Wind policies		Private wind policies	
	(1)	(2)	(3)	(4)	(5)	(6)
PACE	-0.028***	-0.040***	-0.032***	-0.045***	-0.031***	-0.046***
	(0.010)	(0.011)	(0.010)	(0.011)	(0.010)	(0.012)
Observations	4,060	1,184	4,060	1,184	4,060	1,184
Adj. R-squared	0.981	0.988	0.982	0.989	0.977	0.989
Cohort × Year FE	x	x	x	x	x	x
Cohort × County FE	x	x	x	x	x	x
County controls		x		x		x

Notes: This table presents results from estimating the county-year stacked difference-in-differences regressions. The dependent variable in each column is the log property insurance premium for owner-occupied homes, collapsed to the county-year level. *PACE* is a dummy variable that takes the value of one if county c has adopted PACE in year t, and zero otherwise. In columns 3 and 4 we take average premia for policies which only cover wind-related damages. In columns 5 and 6 we include only contracts from private insurers, excluding contracts underwritten by Citizens Property Insurance Corporation. Even-numbered columns include lagged county-level controls, including population, proportion of Black, proportion of Hispanic, proportion of population with a Bachelor's degree or higher, unemployment rate, and abnormal property damage caused by natural disasters as reported by SHELDUS. These control variables account for possible selection into treatment status, as suggested by the results in Table 1. In each regression, we weight observations by their lagged county-level population. All fixed effects are interacted with the stacked cohort. Robust standard errors are clustered at the county-cohort level and reported in parentheses. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

B Additional Institutional Background on PACE

This section provides additional institutional background on PACE loans in Florida.

Legal implementation of PACE. To generate the map in Figure 1 and assign treatment date cutoffs, we track the progress of PACE adoption across all 67 Florida counties using a combination of local news stories about the entry of PACE districts, cross-referenced with LexisNexis links to the local property tax code and, whenever possible, by obtaining the dated list of PACE liens recorded with each county's tax assessor's office or the circuit court clerk, whichever is the applicable records custodian. For most counties, the first PACE lien ever recorded occurs within the same year of statutory adoption. Most of our outcome variables come from local tax records and are thus available at annual frequency, and so it makes no difference in our analysis whether we use the statutory adoption date or the first year a PACE loan appears on the tax roll as the treatment time cutoff.

This process also allows us to account for cases where PACE is in flux in a county due to legal challenges. In our main difference-in-differences analyses, we consider county-level PACE adoption to be an absorbing state even if there is a city or town within the parent county which attempts to nullify PACE. 10 counties have experienced such legal challenges, but all of them have continued recording new PACE liens, indicating that, from the lender's perspective, there is continued legal ambiguity about which level of government has the ultimate authority to enable PACE. Our results are robust to simply excluding contentious PACE liens in these defector jurisdictions.

Eligibility and rules. All homeowners are eligible for PACE loans, regardless of their credit score, as long as (i) the homeowner has paid all their property taxes and has not been delinquent over the preceding three years; (ii) there are no involuntary liens attached to the property, such as those imposed as a result of a bankruptcy court order; (iii) there are no notices of default or other property-based debt delinquency for the last three years; and (iv) the homeowner is the borrower for all mortgage debt secured by the property [5 F.S. Chapter 163.08(2)(b)(9)].[1] Policymakers contend that the unique design of PACE loans makes financing available to homeowners who are unable to obtain credit through traditional channels, such as home equity lines of credit (HELOCs), or to those who resist making investments due to the concern that they will have to repay the full loan amount when the property is sold or refinanced (Cox, 2011).

PACE loans provide qualifying home improvements with up to 100% financing. Under CS/HB 7179, which established the PACE program in Florida in 2010, the total PACE loan amount is limited to 20% of the (market) appraised property value assessed by the county

[1] We find evidence of loose enforcement of the eligibility requirement that PACE borrowers not have a record of property tax or mortgage delinquency in the three years preceding origination. Figure 2 shows that PACE borrowers are far more likely than HELOC borrowers to have a prior derogatory event on their credit file. The loose enforcement of this provision could be due to the difficulty administrators face in determining the prior tax delinquency status of a property owner, especially in jurisdictions where such records are not digitized.

unless mortgage lenders with a lien on the property consent to higher LTV loans.[2] However, home improvements that show through an energy audit that the annual energy savings equal or exceed the annual repayment amount are not subject to this limit. As a result of this rule, the mean PACE LTV is 10%, compared to 18% for a comparable home improvement HELOC, with 97% of PACE loans having an LTV below the 20% statutory threshold. In cases where the borrower engages in a project which undergoes an energy audit, the LTV is allowed to exceed 20%.

Unlike other forms of financing, PACE credit is repaid in the form of property tax payments, and these payments are attached to the property rather than the borrower. Delinquent property tax payments with the PACE assessment take priority over other lienholders, such as a mortgage lender, making PACE loans super senior to other claims to the property used as collateral. Importantly, mortgage lenders cannot legally enforce a covenant related to a homeowner's decision to use a PACE loan. For example, they cannot demand payment in anticipation of the principal amount of the mortgage if the debtor obtains a PACE loan.

Single-family homes, condos, vacant residential land, and small multifamily buildings are all eligible for residential PACE loans. In our sample of PACE loans with permits, 95% are single-family homes, 4% are condos, and the remaining 1% are multifamily properties with fewer than ten units. Properties also qualify for residential PACE loans if they start out with a non-residential land use and convert to residential through construction.[3]

Application process. Prospective PACE borrowers can apply directly through the website of a district or administrator (the lender) or indirectly through a registered contractor.[4] If initiated through a contractor, the contractor forwards the quoted cost for the home improvement project and any permit information to the PACE lender operating in that area. Unlike traditional consumer credit products, under state guidelines lenders do not use credit scores to determine eligibility, which leads to lax screening compared to other home equity lines. However, lenders do perform a hard credit inquiry to determine whether the applicant satisfies the eligibility criteria, including whether they have a recent history of mortgage delinquency or bankruptcy.[5]

At the time of origination, the district involved in underwriting the loan sends the loan terms to the local tax assessor, who then generates a Notice of Assessment. The borrower is then CC'ed on this notice, which serves as a loan disclosure form. In many records offices,

[2] The full text of the law establishing Florida PACE can be found here: https://www.flsenate.gov/Session/Bill/2010/7179.

[3] Most counties offering residential PACE (R-PACE) also partner with districts and administrators specializing in commercial PACE (C-PACE) loans. The structure of C-PACE is very similar to R-PACE in that the owners pay back the loan through the local property tax assessment. Yet, since commercial properties are typically much greater in value there are multiple contributors to the capital stack. Hence, many PACE administrators specialize in either R-PACE or C-PACE loans.

[4] See, for example, the application tool from Florida PACE Funding Agency, one of the four districts: https://floridapace.gov/apply/.

[5] See, for instance, the PACE FAQs compiled by Palm Beach County's Office of Resilience: https://discover.pbcgov.org/resilience/pages/pace-frequently-asked-questions.aspx.

clerks attach to the loan contract a Notice of Commencement on the improvement resulting from the building permit, which mitigates the scope for fraud. Without this paper trail, borrowers might otherwise attempt to take out a PACE loan by listing an eligible project, but then use the funds for some other purpose. Figure A.2 illustrates that the vast majority of PACE borrowers apply funds towards permitted projects within four major categories: HVAC, roofing, solar, and window and door upgrades.

Loan repayment. A defining feature of PACE is that the loans are government-backed. This means that the borrower repays through their annual local property tax assessment. Annual local property tax payments are based on an interest rate fixed at origination, and the payments fully amortize the loan, just like with a standard fixed-rate mortgage.

Since PACE loans are fixed-rate term loans, to back out the interest rate we require the origination amount, the required annual payment, and the loan term. In most cases, we do not observe the loan term, but PACE loans are only originated with 5, 10, 15, 20, 25, or 30-year term lengths. We therefore compute a vector of possible interest rates for each loan corresponding to these possible 5-year term bins and average the rates across the bins to compare to the distribution of HELOC interest rates. We do not observe any 5-year term loans in our data.

We assign a fixed required payment amount to each loan based on the first annual payment made on the loan. In some cases the annual payments can differ year to year by small amounts due to administrative fees levied by the county for maintaining records of the PACE assessment. Since such fees are capped at 2% of the loan payment in Florida, linearly amortized over the loan term, we keep the initial year's payment as the fixed required payment as long as the "drift" in payments across years is within this tolerance. We drop any loans for which we compute an average interest rate of over 16% in any of the 5-year term buckets, as such cases likely feature multiple loans recorded as a single PACE assessment or nearly full prepayment in the initial tax year; PACE loans do not carry prepayment penalties.[6]

For our estimation sample of single-family homes, we find the most common loan term is 20 years, the average origination amount is around \$25,000, and the average fixed interest rate is approximately 6.7%. This would imply an annual tax payment of \$2,305 towards the PACE loan balance.[7] Local tax assessors separately itemize the PACE loan payment amount in each annual tax bill as a non-*ad valorem* assessment – in contrast to the property tax itself which is *ad valorem*. However, the *ad valorem* and non-*ad valorem* components are lumped together into a single tax liability. This means that if a primary mortgage lender requires the PACE borrower to submit a monthly payment into an escrow account, the total monthly mortgage payment will increase to cover the resulting increase in property taxes.

[6] The sample of PACE loans for California and Florida used by Consumer Financial Protection Bureau (2023) overlaps with our sample and features a maximum annualized interest rate of 10%.

[7] It is straightforward to compute the implied annual payment in Excel as $PMT(0.067, 20, -25000) =$ \$2,305.08, where 20 is the loan term in years. Other possible loan terms are 5, 10, 15, 25, and 30 years, with 15 and 30 being the two other most common terms. There is no statutorily mandated index rate but the rates track the 10-year Treasury rate, just like a fixed-rate mortgage.

There are no prepayment penalties attached to PACE loans. Due to the super seniority of the PACE lien, lenders can require that borrowers pay off the PACE loan in full before refinancing or selling the property. In the event a borrower is overdue on their property tax bill, and thus becomes delinquent on the PACE loan, the only way they can remove the lien is by redeeming the tax debt. Because they follow the property (*in rem*) and not the individual (*in personam*), local tax liens cannot be discharged through personal bankruptcy (LaPoint, 2023).[8] Hence, since the ultimate penalty for severe delinquency is tax foreclosure or forced sale of the property, strategic default motives are limited for PACE borrowers.

In Online Appendix C we offer examples of official PACE documents attached to recorded loans in Florida. We obtain these documents directly from local tax authorities, and they form the basis for the merged property-loan-level data we use in our empirical analysis of the program.

PACE project types. The primary and historical purpose of PACE is to finance projects that reduce the energy consumption of the house, such as the installation of more energy-efficient windows. PACE-approved projects also include investments that improve the resistance of the house to natural disasters, such as impact-resistant windows. In Figure A.1, we show a strong positive relationship between the energy efficiency and climate resilience of home improvement projects. To do so, we collect data on 500 window products. We describe the data collection process in Online Appendix F. There is a strong negative correlation between the Design Pressure (DP) rating and U-Factor for window products. The U-Factor measures how well the window insulates the house. The lower the U-Factor, the better insulation the window provides. The DP rating measures the load created by wind that a window can withstand. Windows with high DP ratings are more resistant to high-velocity wind. We document a strong relationship between the two indicators. Specifically, a 1% increase in a window's U-Factor is associated with a 0.23% decrease in that product's DP rating. Overall, making a house more resistant to natural disasters can lead to lower energy consumption.

Tax implications. PACE financing does not generally confer an additional federal income tax advantage relative to mortgage refinancing or a HELOC used to finance qualifying home improvements. Although PACE assessments are collected through the property tax bill, the principal portion of the assessment is not deductible as a state or local property tax. The interest portion may qualify for the home mortgage interest deduction when the PACE obligation is secured by the residence and the proceeds are used to buy, build, or substantially improve the property.[9] This treatment is similar to that of a HELOC used for qualifying home improvements, for which interest may likewise be deductible. In either case, the household must itemize deductions rather than claim the standard deduction, and the deduction is subject to the aggregate limit on qualifying home acquisition debt. For debt incurred after December 15, 2017, this limit is generally \$750,000 (\$375,000 for married taxpayers filing

[8] Tax liens cannot be discharged unless the house is abandoned. Moreover, only property tax debts that are at least one year old can be discharged through personal bankruptcy, and even then, only if the household declares bankruptcy before a tax auction occurs.

[9] See Internal Revenue Service, Topic No. 503: Deductible Taxes (June 20, 2016); Internal Revenue Service, Publication 936: Home Mortgage Interest Deduction.

separately), inclusive of other qualifying mortgage debt secured by the taxpayer's main or second home.

C Sample PACE Loan Documents

In this appendix, we offer examples of recorded PACE loan contracts and accompanying documents, including local property tax bill stubs and home improvement permit filings. Some jurisdictions – mostly less-populated ones – do not maintain digitized records of PACE assessments. For such counties, our FOIA requests for information on PACE loans tied to property APNs yielded a combination of PDF scans of the "Notice of Assessment" (Figure C.1) confirming the loan details and the "Notice of Commencement" (Figure C.2) confirming the improvement being financed by the PACE loan. The document fields and formatting are standard across all Florida counties. As discussed in Section 2, the Notice of Commencement renders it difficult for the borrower to apply PACE funds towards consumption of goods or services other than the project listed on the assessment notice.

The format of property tax bills is also standard across counties, although the particular line items comprising the total local tax bill will vary due to overlapping sub-county jurisdictions and the existence of any non-*ad valorem* assessments specific to the property (like a PACE loan). For instance, in the sample tax bill pictured in Figure C.3, the borrower received a PACE loan from the Green Corridor PACE District operating in the county, and this annual payment towards the loan balance represents about one-third of the property owner's overall property tax bill.

Property owners are responsible for paying both *ad valorem* and non-*ad valorem* tax bills according to the same calendar schedule, meaning that failing to pay the full balance due for a tax year (payment deadline of March 31st in Florida) means being in default on a PACE obligation. The March 31st payment deadline for the preceding tax year's liability also means that depending on the month of origination, some PACE borrowers can effectively defer any payment on the loan for over a year. The maximum length of time between PACE loan origination and the due date for payment on that loan is 16 months if the loan is originated in late November. This long lag time between the funds being disbursed and the first payment could contribute to the uptick in tax delinquency within a year of origination that we observe in Section 5.1 if the lag reduces the salience of the increased tax burden (Cabral and Hoxby, 2012).

FIGURE C.1. Sample PACE Contract and Property Lien Recording

GADSDEN COUNTY NICHOLAS THOMAS
Instrument: 230005183 Recorded: 07/17/2023 1:47 PM

OFFICIAL RECORDS: 1 of 4
Book: 937 Page: 241

Recording Fee: $35.50

This instrument prepared by and executed by a public office of the Florida PACE Funding Agency and after recording return to:
Home Run Financing
750 University Ave #140
Los Gatos, CA 95032

SPACE ABOVE THIS LINE RESERVED FOR RECORDER'S USE

NOTICE OF ASSESSMENT

GADSDEN

THIS NOTICE OF ASSESSMENT ("Notice") provides a summary memorandum of a Financing Agreement entered into by and between the FLORIDA PACE FUNDING AGENCY (the "Agency") and the record owner(s) of the Assessed Property (the "Property Owner"), both as described hereinafter. This Notice is executed pursuant to such Financing Agreement in substantially the form appended to Agency Resolution #2016-0809-3, a certified copy of which is recorded in the Official Records at 160008599; a Final Judgment, a certified copy of which is recorded at 140007031; a Final judgment, a certified copy of which is recorded at 220010257; all in the Public Records of GADSDEN, Florida, and all of the terms and provisions thereof are incorporated herein by reference. Agency has levied and imposed a non-ad valorem assessment as a lien of equal dignity to taxes and assessments, and as more particularly described herein and in such Financing Agreement, on the Assessed Property in conformance with Section 163.08, Florida Statutes (the "Supplemental Act").

1. Property Owner: [redacted]
2. Assessed Property: See Legal Description in Attachment I. OR 873 P 138 OR 579 P 1338 OR
3. Street Address of Assessed Property: 388 Charlie Harris Loop, Quincy FL 32352
4. Property Appraiser Parcel Identification Number: 2-17-3N-3W-0000-00244-0100
5. Qualifying Improvements:
   Energy Efficiency Improvement:
   Roof - Asphalt Shingle
6. Financed Amount (pursuant to the Financing Agreement; this amount may be reduced WITH SUCH REDUCED AMOUNT REFLECTED IN A SUPPLEMENTAL NOTICE OF ASSESSMENT): $22,777.37
7. Interest Rate (to be applied to the principal amount of the Financed Amount): 9.99%
8. Assessment Installment (pursuant to the Financing Agreement; this amount may be reduced WITH SUCH REDUCED AMOUNT REFLECTED IN A SUPPLEMENTAL NOTICE OF ASSESSMENT): $2,992.92
9. Period of years (number of Annual Payments): 15 years
10. The Annual Payment of the Assessment will appear on the same bill as for property taxes, and will include the Assessment Installment, plus any annual costs of administration and charges associated with the Assessment, annual collection costs, and annual charges required by the local property appraiser and tax collector.
11. The Assessment is NOT due on sale or transfer of the Assessed Property. Payoff and release

information may be obtained by contacting the Florida PACE Funding Agency at: www.floridapace.gov or Home Run Financing, 750 University Ave #140,Los Gatos, CA 95032; Telephone: (844) 873-7223; Email operations@homerunfinancing.com; Websites: www.homerunfinancing.com and www.floridapace.gov.

12. NOTE: Prepayment information must be requested ten (10) business days prior to any prepayment. Prepayments must be in immediately available funds.
13. Suggested ALTA, Schedule B exclusion to coverage for title insurance professionals: *"Non-ad valorem assessment, which by its term is not due upon sale, evidenced by notice recorded in Official Record Book____, at Page____,"*
14. The following caveat is intended to be supplemental, constructive notice provided in writing to any prospective purchaser as required by the Supplemental Act. So long as the Assessment provided for hereunder has an unpaid balance, at or before the time Property Owner enters into a contract to sell the Assessed Property, the Property Owner gives any prospective purchaser by law a written disclosure statement in the following form:

QUALIFYING IMPROVEMENTS FOR ENERGY EFFICIENCY, RENEWABLE ENERGY, OR WIND RESISTANCE – The property being purchased is located within the jurisdiction of a local government that has placed an assessment on the property pursuant to s. 163.08, Florida Statutes. The assessment is for a qualifying improvement to the property relating to energy efficiency, renewable energy, or wind resistance, and is not based on the value of the property. You are encouraged to contact the county property appraiser's office to learn more about this and other assessments that may be provided by law.

THE DECLARATIONS, ACKNOWLEDGMENTS AND AGREEMENTS CONTAINED AND INCORPORATED HEREIN SHALL RUN WITH THE LAND DESCRIBED HEREIN AND SHALL BE BINDING ON THE PROPERTY OWNER (INCLUDING ALL PERSONS OR ENTITIES OF ANY KIND), AND ANY AND ALL SUCCESSORS IN INTEREST. BY TAKING SUCH TITLE, PERSONS OR ENTITIES WHO ARE SUCCESSOR SHALL BE DEEMED TO HAVE CONSENTED AND AGREED TO THE PROVISIONS OF THIS NOTICE AND THE REFERENCED FINANCING AGREEMENT TO THE SAME EXTENT AS IF THEY HAD EXECUTED IT AND BY TAKING SUCH TITLE, SUCH PERSONS OR ENTITIES SHALL BE ESTOPPED FROM CONTESTING, IN COURT OR OTHERWISE, THE VALIDITY, LEGALITY AND ENFORCEABILITY OF THIS AGREEMENT.

OFFICIAL RECORDS: 2 of 4
Book: 937 Page: 242

FIGURE C.2. Sample Notice of Improvement Commencement for PACE Loan

GADSDEN COUNTY NICHOLAS THOMAS
Instrument: 230004789 Recorded: 06/30/2023 8:41 AM

OFFICIAL RECORDS: 1 of 1
Book: 936 Page: 705

Recording Fee: $10.00

NOTICE OF COMMENCEMENT

The undersigned hereby gives notice that improvements will be made to certain real property, and in accordance with Chapter 713. Florida Statutes, the following information is provided in this Notice of Commencement.

1. Description of Property
   Legal Description Lot 1 / Block 2-17-3N-3W-0000-00244-0100 / Pin 2-17-3N-3W-0000-00244-0100
   Street Address 388 Charlie Harris loop City Quincy FL. Zip 32351
2. General description of improvement RE-Roofing (Remove + Replace Shingles)
3. Owner information
   A. Name [redacted]
   B. Address 388 Charlie Harris loop City Quincy St FL Zip 32351
   C. Interest in Property
   D. Name & Address of Fee Simple Title Holder (Other than Owner)
4. Contractor Name and Address
   Kevin Krueger 8934 Western Way Jacksonville Fl 32256
5. Surety Name

   ~~Bond amount~~ $ $ 19,500
6. Lender's Name and Address

7. Person within the State of Florida designated by owner upon whom notices or other documents may be served as provided in Section 713.13(1)(a)7 of the Florida Statutes.

8. In addition to self, the Owner designates the following person to receive a copy of the Lienor's Notice as provided in Section 713.13(1)(b) of the Florida Statues. Give name and address.

9. Expiration date of Notice of Commencement. The expiration date is one (1) year from the date of recording unless a different date is specified.

Signature of Owner/ Agent: [signature]

This foregoing instrument was acknowledged, sworn to and subscribed before me this 30th day of June, 20 23.

PREPARED BY:

State of: Florida

County of: Gadsden

Notary Signature: [signature]

Printed Name: Allison Owens

Known personally/ /ID shown: GA DL

Cody Andrew Jaramillo
* physically present.

Notary Seal

ALLISON OWENS
MY COMMISSION # HH 100966
EXPIRES: March 4, 2025
Bonded Thru Notary Public Underwriters

FIGURE C.3. Sample Property Tax Bill after PACE Loan Originated

Sam C. Steele C.F.C.
Monroe County Tax Collector

Monroe County 2019 Paid Individual Tax Certi
NOTICE OF AD VALOREM TAXES AND NON-AD VALOREM ASSESSMENTS

ACCOUNT NUMBER	ESCROW CODE	MILLAGE CODE	PROPERTY ID #
1610844		500K	1610844

MUST PAY BY CASH, CREDIT CARD OR CERTIFIED FUNDS

[redacted]
205 Pirates Dr
Key Largo, FL 33037-2323

NEW OWNER DUP BILL MAILED

00494680000000326139
205 PIRATES Dr

BK 13 LT 14 AND 15 PIRATES COVE PB3-18 KEY LARGO OR502-826 OR672-82D/C OR1170-621AFF OR1170-622 OR117

Paid 06/22/2020 $7,106.47
Receipt # 116-19-00001470
Paid By CORELOGIC

AD VALOREM TAXES

TAXING AUTHORITY	TELEPHONE	ASSESSED VALUE	EXEMPTION AMT	TAXABLE VALUE	MILLAGE RATE	TAXES LEVIED
SCHOOL STATE LAW	305-293-1400	401,428	0	401,428	1.5550	624.22
SCHOOL LOCAL BOARD	305-293-1400	401,428	0	401,428	1.7880	717.75
GENERAL FUND	305-292-4473	401,428	0	401,428	0.7697	308.98
F&F LAW ENFORCE JAIL	305-292-7017	401,428	0	401,428	1.7747	712.41
HEALTH CLINIC	305-296-4886	401,428	0	401,428	0.0437	17.54
GENERAL PURPOSE	305-292-4473	401,428	0	401,428	0.1725	69.25
MOSQUITO CONTROL	305-292-7190	401,428	0	401,428	0.4508	180.96
M C LOCAL ROAD PATROI	305-292-7017	401,428	0	401,428	0.3484	139.86
SFWM DIST	800-432-2045	401,428	0	401,428	0.1152	46.24
OKEECHOBEE BASIN	800-432-2045	401,428	0	401,428	0.1246	50.02
EVERGLADES CONST PR.	800-432-2045	401,428	0	401,428	0.0397	15.94
K L FIRE RESC & EMERG I	305-743-6586	401,428	0	401,428	1.0000	401.43
				AD VALOREM TAXES:	8.1823	$3,284.60

BILL EXPRESS
SCAN TO PAY ONLINE!

WWW.MONROETAXCOLLECTOR.COM
GET BILLS BY EMAIL

NON-AD VALOREM ASSESSMENTS

LEVYING AUTHORITY	TELEPHONE	UNITS	AMOUNT
MO CO SOLID WASTE	305-295-4323	1.000	402.00
KEY LARGO WASTEWATER #4	305-451-4019	0.000	340.23
GREEN CORRIDOR PACE	866-807-6864	1.000	2,198.84
NON-AD VALOREM ASSESSMENTS:			$2,941.07

TOTAL COMBINED TAXES AND ASSESSMENTS:
$6,225.67

D Details on Conceptual Framework

In this appendix, we formalize the theory underlying the conceptual framework described in Section 3.

D.1 Environment

There are two types of homeowners, $\theta \in \{P, S\}$, where P denotes a prime credit household and S denotes a subprime household. Credit quality determines the probability of a low cash flow realization.

At the repayment date, household cash flow takes one of two values,

$$Y \in \{Y_L, Y_H\}, \qquad Y_L < Y_H. \tag{D.1}$$

For a type-θ household,

$$\Pr(Y = Y_L \mid \theta) = p_\theta, \tag{D.2}$$
$$\Pr(Y = Y_H \mid \theta) = 1 - p_\theta, \tag{D.3}$$

where

$$0 < p_P < p_S < 1. \tag{D.4}$$

The household's credit score can be interpreted as a sufficient statistic for p_θ. A lower credit score implies a higher probability of the low cash flow state. Thus, subprime households differ from prime households because they are more likely to experience a cash flow shortfall.

Each household owns a house with pre-investment value V and has an existing one-period mortgage with promised repayment M. A home improvement project costs $I > 0$. Let L^{HELOC} and L^{PACE} denote the HELOC and PACE loan principal amounts, respectively. Let

$$Z^{\text{HELOC}} \equiv R^{\text{HELOC}} L^{\text{HELOC}} \qquad \text{and} \qquad Z^{\text{PACE}} \equiv R^{\text{PACE}} L^{\text{PACE}} \tag{D.5}$$

denote promised HELOC and PACE repayments. Total promised housing debt repayment is

$$B = M + Z^{\text{HELOC}} + Z^{\text{PACE}}. \tag{D.6}$$

The household is in financial distress whenever current cash flow is insufficient to meet total promised housing debt repayment,

$$Y < B. \tag{D.7}$$

Hence the probability of household delinquency is

$$d_\theta(B) \equiv \Pr(Y < B \mid \theta). \tag{D.8}$$

With two cash flow states,

$$d_\theta(B) = \begin{cases} 0, & B \le Y_L, \\ p_\theta, & Y_L < B \le Y_H, \\ 1, & B > Y_H. \end{cases} \tag{D.9}$$

Credit quality determines the probability of reaching the low state through p_θ. Debt service determines whether that state is sufficient to meet the household's obligations.

D.2 Home Improvement Projects

Projects differ in the value they create. Let γ_j denote the increase in house value per dollar invested in project j, so that

$$\Delta V_j = \gamma_j I. \tag{D.10}$$

Conventional home equity credit can finance a broad set of projects, denoted $\mathcal{J}^{\text{HELOC}}$. PACE can finance only a predetermined set of eligible project types, denoted $\mathcal{J}^{\text{PACE}} \subset \mathcal{J}^{\text{HELOC}}$, and the work must be performed by an approved contractor.

The eligibility process restricts household choice but may screen out lower value projects and lower quality contractors. We capture this in reduced form by assuming

$$\gamma^{\text{PACE}} \equiv \mathbb{E}[\gamma_j \mid j \in \mathcal{J}^{\text{PACE}}] > \gamma^{\text{HELOC}} \equiv \mathbb{E}[\gamma_j \mid j \in \mathcal{J}^{\text{HELOC}}] > 0. \tag{D.11}$$

The expected post-investment house values are

$$V'^{\text{HELOC}} = V + \gamma^{\text{HELOC}} I \qquad \text{and} \qquad V'^{\text{PACE}} = V + \gamma^{\text{PACE}} I, \tag{D.12}$$

so $V'^{\text{PACE}} > V'^{\text{HELOC}}$.

Without loss of generality, we assume that the HELOC lender recovers zero when the household defaults, due to foreclosure frictions or a parameter region that is in this range $V + \gamma^{\text{HELOC}} I \le M$. As PACE loans are super senior, we assume that the PACE lender recovers fully from the same house.[10]

D.3 Parameter region

We focus on a parameter region that makes the two state model transparent, economically meaningful, and non-trivial.

Assumption 1 (Cash flow and financing region) *The parameters satisfy*

$$M < Y_L < M + I < M + \frac{I}{1 - p_P} < M + \gamma^{\text{PACE}} I \le Y_H < M + \frac{I}{1 - p_S}. \tag{D.13}$$

[10] In most cases, the lender is a local government, which can recover the outstanding tax debt through the lien auction system.

In addition,

$$\frac{1}{1-p_P} < \gamma^{\text{HELOC}} < \gamma^{\text{PACE}}. \tag{D.14}$$

Assumption 2 (Market structure) *The PACE lender is a monopolist, while the HELOC market is competitive.*

This assumption is consistent with the institutional structure of residential PACE. A PACE assessment can be placed on the property tax roll only where the local government has enrolled in a program and authorized an administrator to do so, and enrolled jurisdictions typically authorize one administrator, or at most a handful. As a result, this market faces significant barriers to entry. The HELOC market differs. Thousands of depositories and non-banks originate a standardized product, entry requires no municipal authorization, and a homeowner can collect competing quotes at low cost, so pricing tracks credit risk rather than lender market power. The assumption is deliberately a limiting case; what the model requires is not literal monopoly, but that the PACE lender retains more pricing power over a captive borrower than a HELOC lender does.

D.4 Model Propositions

Proposition 1 (HELOC access and credit quality) *Under Assumption 1, the prime household can finance the full project with a competitive HELOC at*

$$R^{\text{HELOC}}(p_P) = \frac{1}{1-p_P}, \tag{D.15}$$

while the subprime household cannot finance the full project with a HELOC.

Proof. Consider first a household of type θ that finances the project with a HELOC of size L^{HELOC}. The HELOC lender advances L^{HELOC} today. Because the HELOC is junior to the existing mortgage, the lender recovers zero if the household defaults in the low cash flow state and receives $R^{\text{HELOC}}L^{\text{HELOC}}$ if the household remains solvent in the high cash flow state. The lender's expected profit is therefore

$$\Pi^{\text{HELOC}}(p_\theta, L^{\text{HELOC}}) = (1-p_\theta)R^{\text{HELOC}}L^{\text{HELOC}} - L^{\text{HELOC}}.$$

HELOC lenders are competitive, so expected profits are zero. For $L^{\text{HELOC}} > 0$,

$$\Pi^{\text{HELOC}} = 0 \quad \Longrightarrow \quad (1-p_\theta)R^{\text{HELOC}}L^{\text{HELOC}} = L^{\text{HELOC}},$$

which gives the competitive gross interest rate:

$$R^{\text{HELOC}}(p_\theta) = \frac{1}{1-p_\theta}.$$

The HELOC must also be repayable in the high cash flow state. Hence

$$M + R^{\text{HELOC}}(p_\theta)L^{\text{HELOC}} \leq Y_H.$$

Substituting the competitive rate yields

$$L^{\text{HELOC}} \leq (1 - p_\theta)(Y_H - M).$$

Thus the maximum feasible HELOC is

$$\bar{L}^{\text{HELOC}}(p_\theta) = (1 - p_\theta)(Y_H - M),$$

which is decreasing in credit risk p_θ.

Under Assumption 1, the prime household satisfies

$$M + \frac{I}{1 - p_P} \leq Y_H.$$

Therefore,

$$I \leq \bar{L}^{\text{HELOC}}(p_P),$$

so the prime household can finance the full project with a competitive HELOC. Moreover, Assumption 1 implies

$$Y_L < M + \frac{I}{1 - p_P},$$

so the household defaults in the low state and repays in the high state, exactly as assumed in the lender's profit calculation.

By contrast, for the subprime household,

$$M + \frac{I}{1 - p_S} > Y_H.$$

Equivalently,

$$I > \bar{L}^{\text{HELOC}}(p_S).$$

A competitive HELOC large enough to finance the full project would therefore require repayment exceeding the household's available cash flow even in the high state. Hence the subprime household cannot finance the full project with a HELOC. ■

Thus higher credit risk raises the competitive HELOC repayment factor and lowers HELOC borrowing capacity, generating endogenous sorting between prime and subprime households.

Proposition 2 (PACE relaxes the financing constraint) *Under Assumption 1, the prime household can finance the project with a HELOC while the subprime household cannot. A*

PACE contract can nevertheless finance the full project for the subprime household whenever

$$R_S^{\text{PACE}} \leq \gamma^{\text{PACE}}. \tag{D.16}$$

Proof. The HELOC result follows from Proposition 1. Consider instead a PACE loan financing the full project, $L^{\text{PACE}} = I$. Because the PACE assessment is super senior, the lender is fully protected whenever

$$R_S^{\text{PACE}} I \leq V'^{\text{PACE}}.$$

For a subprime household without an alternative financing option, participation requires that repayment not exceed the value created by the approved project,

$$R_S^{\text{PACE}} \leq \gamma^{\text{PACE}}.$$

Since

$$V'^{\text{PACE}} = V + \gamma^{\text{PACE}} I > \gamma^{\text{PACE}} I,$$

this participation condition implies

$$R_S^{\text{PACE}} I \leq \gamma^{\text{PACE}} I < V'^{\text{PACE}}.$$

Hence the PACE claim is fully collateralized and the lender can finance the entire project even when the household cannot support a junior HELOC. The key distinction is that low cash flow can still cause household delinquency, while super seniority protects the PACE lender from the associated credit loss. The lender must also be willing to lend, i.e. $R_S^{\text{PACE}} \geq 1$; this is compatible with $R_S^{\text{PACE}} \leq \gamma^{\text{PACE}}$ because equations (D.11) and (D.14) give $\gamma^{\text{PACE}} > \gamma^{\text{HELOC}} > \frac{1}{1-p_P} > 1$.

■

Proposition 3 (Differential PACE pricing) *The monopoly PACE repayment factors are*

$$R_P^{\text{PACE}} = 1 + (\gamma^{\text{PACE}} - \gamma^{\text{HELOC}}) \tag{D.17}$$

and

$$R_S^{\text{PACE}} = \gamma^{\text{PACE}}. \tag{D.18}$$

Hence

$$R_S^{\text{PACE}} - R_P^{\text{PACE}} = \gamma^{\text{HELOC}} - 1 > 0 \qquad . \tag{D.19}$$

Subprime households pay more for PACE because they lack the HELOC outside option available to prime households.

Proof. Because PACE claims are fully collateralized, lender profit is

$$\Pi_\theta^{\text{PACE}} = (R_\theta^{\text{PACE}} - 1) I,$$

so the lender chooses the highest repayment factor consistent with household participation.

For the prime household, the expected repayment is: $(1 - p_P)R^{HELOC}(p_p)I = (1 - p_P)\frac{1}{1-p_P}I = I$.

Hence, the HELOC outside option yields surplus

$$\left(\gamma^{\text{HELOC}} - 1\right) I \qquad .$$

Thus PACE participation requires

$$(\gamma^{\text{PACE}} - R_P^{\text{PACE}})I \geq \left(\gamma^{\text{HELOC}} - 1\right) I.$$

Since profit is increasing in R_P^{PACE}, this constraint binds, giving

$$R_P^{\text{PACE}} = 1 + (\gamma^{\text{PACE}} - \gamma^{\text{HELOC}}).$$

This contract is feasible: $R_P^{\text{PACE}} \leq \gamma^{\text{PACE}}$ iff $\gamma^{\text{HELOC}} \geq 1$, which holds by (14); and $M + R_P^{\text{PACE}} I < M + \gamma^{\text{PACE}} I \leq Y_H$, so the contract is repayable in the high state.

The subprime household cannot finance the project with a HELOC, so its outside option is zero. Its participation constraint is

$$(\gamma^{\text{PACE}} - R_S^{\text{PACE}})I \geq 0.$$

The lender therefore extracts the full project surplus and sets

$$R_S^{\text{PACE}} = \gamma^{\text{PACE}}.$$

Hence

$$R_S^{\text{PACE}} - R_P^{\text{PACE}} = \gamma^{\text{HELOC}} - 1 > 0.$$

Thus subprime households pay more for PACE because they lack the HELOC outside option available to prime households, not because they generate greater expected losses for the PACE lender. ■

Proposition 4 (PACE increases delinquency) *Under Assumption 1, PACE financing increases delinquency for both borrower types relative to the no-investment benchmark. Specifically,*

$$D^{\text{PACE}}(\theta) = p_\theta \tag{D.20}$$

and therefore

$$\Delta D(\theta) \equiv D^{\text{PACE}}(\theta) - D_0(\theta) = p_\theta > 0. \tag{D.21}$$

Because $p_S > p_P$,

$$\Delta D(S) > \Delta D(P). \tag{D.22}$$

Proof. Without PACE, total housing debt service is M. Since Assumption 1 implies

$$M < Y_L,$$

the household can repay in both cash flow states, so

$$D_0(\theta) = 0.$$

With PACE, total debt service is

$$M + R_\theta^{\text{PACE}} I.$$

Under Assumption 1 and Proposition 3,

$$Y_L < M + R_\theta^{\text{PACE}} I \leq Y_H$$

for both borrower types. Hence the household is delinquent exactly in the low cash flow state. Since this state occurs with probability p_θ,

$$D^{\text{PACE}}(\theta) = p_\theta.$$

Therefore,

$$\Delta D(\theta) = D^{\text{PACE}}(\theta) - D_0(\theta) = p_\theta > 0.$$

Because $p_S > p_P$,

$$\Delta D(S) > \Delta D(P).$$

Thus PACE increases delinquency by pushing low-state debt service above available cash flow, with a larger effect for riskier households. super seniority protects the PACE lender against loss but does not eliminate the household's repayment burden. ■

Corollary 1 (Capitalization) *Restricting PACE financing to approved project types and approved contractors raises average project value under the assumption* $\gamma^{\text{PACE}} > \gamma^{\text{HELOC}}$*. Conditional on undertaking an investment of size* I*, expected capitalization is larger for a PACE-eligible project by*

$$(\gamma^{\text{PACE}} - \gamma^{\text{HELOC}})I. \tag{D.23}$$

The capitalization result is a project composition effect. PACE does not mechanically make a given physical project more productive. Instead, eligibility rules change the composition of projects and contractors that receive PACE financing.

PACE can also generate an extensive margin capitalization effect for financially constrained households. The subprime household cannot finance the representative project with a HELOC. If it accepts PACE, the project is undertaken and house value rises from V to

$$V'^{\text{PACE}} = V + \gamma^{\text{PACE}} I. \tag{D.24}$$

Observed capitalization among PACE borrowers can therefore contain two components. The first is a project composition effect because $\gamma^{\text{PACE}} > \gamma^{\text{HELOC}}$. The second is an extensive margin financing effect because PACE allows some constrained households to undertake projects that otherwise would not occur.

E Building Permit Methodology

We describe in this appendix how we classify building permits into categories of PACE-eligible and other projects by combining Cotality's standardized permit project types with text parsing of the permit description and contractor-reported type of work. The procedure produces the permit categories shown in Figure A.2. The replication code contains the complete set of text strings and keyword combinations used to implement these rules.

E.1 Classifying Building Permit Activity

Before listing the steps in our algorithm, we begin by noting that Cotality pre-classifies permit applications in its *Building Permits* data into broad project types. We do not rely solely on these pre-populated fields for two reasons. First, each permit can have up to three project types listed, so a single filing can receive several broad labels. For example, a permit may have Cotality-generated project types such as "Demolition," "HVAC," and "Mechanical Work," while the permit description reads "Air conditioning change out." The description therefore contains information useful for distinguishing the underlying improvement from other labels attached to the filing. Second, the standardized project type fields are missing for a nontrivial share of observations, requiring us to use the permit description and, when available, the contractor-reported type-of-work field to classify the improvement.

We adopt an iterative classification procedure. The four largest PACE-related categories in the data are solar, HVAC, windows and doors, and roofing. The current classification also identifies a set of less common PACE-eligible improvements—including water and sewer improvements, building envelope and electrical efficiency improvements, generators, natural-lighting projects, alternative-energy projects, and other wind- or flood-resilience projects—which we combine into an "other PACE" category. Permits not assigned to any PACE-eligible category are classified as "other, non-PACE." Because a single permit can describe more than one project, these categories need not be mutually exclusive. We use the mutually exclusive subset when tabulating category-specific permit activity.

1. We first restrict the permit data to residential properties using Cotality's state land use description, supplemented by the county land use description when the state field is missing. The analysis sample retains single-family homes, condominiums, and small multifamily properties. The single-family flag includes descriptions containing or equal to terms such as "SFR," "SINGLE FAMILY," "TOWNHOUSE," "TOWNHOME," "SINGLE FAM," "DUPLEX," "MULTIPLE SFR'S," and "SINGFAM - COOP." The small-multifamily classification generally captures properties with fewer than ten units, including explicitly identified two- through nine-unit properties and related Cotality land use descriptions. We retain permits with effective dates from 2012 onward.

2. We next map each of Cotality's three standardized permit project type fields into 13 broad types:

   - Type 1 (interior remodel): "Bathroom Remodel," "Multi-Room Remodel," "Kitchen Remodel"
   - Type 2 (exterior remodel): "Fences," "Patios," "Siding," "Signage"
   - Type 3 (HVAC): "HVAC," "Mechanical Work"
   - Type 4 (plumbing): "Plumbing," "Sewer Laterals"
   - Type 5 (roofing): "Roofing"
   - Type 6 (solar): "Solar Installation"
   - Type 7 (electrical): "Electrical Work"
   - Type 8 (doors and windows): "Doors and Windows"
   - Type 9 (construction): "Demolition," "New Construction"
   - Type 10 (add-ons): "Pool and Spa Construction," "Mobile Homes," "Home Addition," "Garage Construction," "Docks," "Decks and Porches"
   - Type 11 (paving, concrete, and landscaping): "Flatwork Concrete," "Paving, Driveways, and Sidewalks," "Landscape," "Foundations," "Excavation and Grading," "Retaining Walls"
   - Type 12 (residential): "Residential"
   - Type 13 (commercial): "Commercial," "Commercial Renovation"

   A permit receives each type indicated by any of its three standardized project type fields. We then initialize the four main PACE categories: HVAC if any project type is Type 3, roofing if any is Type 5, solar if any is Type 6, and windows and doors if any is Type 8.

3. We supplement these standardized project types by parsing the full permit description. For windows and doors, we identify descriptions mentioning impact-resistant improvements and subsequently add more specific wind-resilience combinations involving impact windows or doors, shutters, hurricane protection, and storm panels. Roofing is expanded using terms such as "roof," "shingle," and roof-truss combinations. Solar is expanded using terms such as "solar," "photovoltaic," "photo voltaic," and "cell." HVAC is expanded using terms related to heating and cooling, including "HVAC," "cool," "heat," "air condition," and "duct," together with more specific eligible technologies described below. When a description is classified as both roofing and solar at this stage, we assign it to solar rather than roofing by resetting the roofing indicator to zero. This rule is intended to distinguish rooftop solar installations from roof replacement itself.

4. We next use the contractor-reported permit type of work as a supplemental field. This field is relatively terse and is missing for a substantial share of permits, so we use it only to reclassify permits that have not yet been assigned to HVAC, roofing, solar, or windows and doors. We apply the corresponding roof/shingle, HVAC/heating/cooling, solar/photovoltaic, and window/shutter/impact keywords to this field.

5. We then add a final set of text rules designed to capture less common PACE-eligible energy-efficiency and resilience improvements. These rules use combinations of keywords in the permit description rather than Cotality's broad project types. They include:

   - *Windows, doors, and wind protection*: impact- and wind-related windows and doors, shutters, hurricane protection, storm panels, and related opening protection
   - *Roofing*: roof-truss improvements
   - *Water and sewer*: selected sewer or septic repairs, replacements, laterals and conversions, trenchless sewer work, efficient water-heating systems, and selected pool covers, heaters, heat pumps, pumps, and motors
   - *Building envelope and electrical efficiency*: air sealing, electrical-panel upgrades, wiring, reflective coatings, insulation, radiant barriers, and weather stripping
   - *Natural lighting*: selected natural-light openings, awnings, sliding or French glass doors, light tubes, patio covers, skylights, and window film
   - *Alternative energy*: energy storage, co-generation, electric-vehicle charging, fuel-cell power, and wind turbines
   - *Other wind and flood resilience*: anchors, hold-down systems, foundation strengthening, gable bracing, opening protection, seawalls, water barriers, sill-plate attachments, and basement membranes
   - *Additional HVAC*: selected eligible heating, cooling, ventilation, and air-quality technologies, including furnaces, heat pumps, boilers, evaporative coolers, hydronic or radiant heat, and recovery or exhaust ventilation

   The sewer, water, envelope, generator, natural-lighting, alternative-energy, and other wind/flood-resilience indicators are combined into a single "other PACE" category.[11] A permit is classified as having a PACE-eligible use if it belongs to HVAC, roofing, solar, windows and doors, or other PACE. Permits with none of these indicators are assigned to the residual "other, non-PACE" category.

6. We exclude permit applications whose status is "canceled," "rejected," "revoked," "suspended," "triage," or "withdrawn," as well as applications that never progressed beyond "applied," "filed," or "plancheck." We then measure the number of category

[11] Sewer conversions became eligible only in July 2024, at the end of our sample period. For tabulations of permit types, permits classified solely as sewer are therefore reassigned out of "other PACE."

indicators attached to each permit. A value of one identifies permits that map to a single category, while larger values identify filings that describe multiple categories of work. The category-specific tabulations and figures use permits with a single classification. We also exclude permits carrying Cotality's new-construction or demolition project type from the permit type tabulations.

7. Finally, we remove duplicate permit records. Because Cotality's permit identifier is not used as the deduplication key, we sort records using the property identifier, contractor-reported type of work, all three standardized project type fields, the first 500 characters of the permit description, municipality, PACE use indicator, and permit effective date. We then retain the earliest observation within records sharing the property identifier, contractor-reported type of work, standardized project types, shortened permit description, municipality, and PACE use classification. This step is particularly relevant when the same property is associated with multiple PACE loans.

E.2 Identifying permits backed by PACE loans

One challenge we face is that multiple projects can be filed under the same permit application, leading to instances in which the permit filing describes both PACE-eligible and PACE-ineligible projects. Households might combine different projects under the same contractor given fixed costs (e.g., receiving a quote and scheduling the job), leading to complementarity between PACE investments and non-PACE investments and other sources of home-improvement financing, whether internal (cash) or external (HELOCs).

To address this measurement problem, we impose several restrictions when constructing category-specific measures of permitting activity:

(i) We restrict the underlying permit sample to single-family homes, condominiums, and small multifamily properties as defined above. For the permit type tabulations, we additionally drop permits carrying a Cotality project type for new construction or demolition.

(ii) We classify each permit into HVAC, Roofing, Solar, Windows and Doors, Other PACE, and Other Non-PACE using the layered procedure described in Online Appendix E.1. These categories capture the major projects associated with PACE lending while allowing the classification to incorporate less common eligible improvements. For category-specific tabulations, we restrict attention to permits for which exactly one of these category indicators equals one, thereby excluding filings that combine multiple categories of work.

(iii) We remove duplicate permit observations using the property identifier, contractor-reported type of work, Cotality project type fields, shortened permit description, municipality, and PACE use classification, retaining the earliest observation when otherwise identical records occur on different effective dates. Such duplicates can arise when a property is associated with multiple PACE loans that point to the same underlying permit.

F Data on Window Resiliency and Energy Efficiency

The U-Factor data is collected from the NFRC (National Fenestration Rating Council).[12] The design pressure (DP) rating is discretized into three categories: low, average, and high. There is no central database to collect the DP rating. As a result, we adopt a multi-step approach to collect this information:

1. We first research the rating from the NFRC Search Directory, the respective website of the product, and any other sources. When a rating is available, we assign "low" if the rating is between 0% and 40% of the total grade, "average" if this percentage is between 40.1% and 59.9%, and "high" if this percentage is between 60% and 100%.
2. Second, we look at specific text descriptions. For instance, if the window is "Hurricane Certified/Resistant," we assign it to the high DP rating category.
3. Third, we look at the materials used to construct the window. A window made out of triple-paned glass is far more hurricane-resistant than a window made out of tempered single-paned glass. If the window being analyzed has a grid, it is generally less resistant to hurricanes than windows without a grid. Grids create additional seams and joints, which can be weak points in the structure during high-impact events like hurricanes. Moreover, we consider whether the window was made out of a specific material that affects the rating score. For example, fiberglass vs. argon windows receive different scores. We confirm our own evaluation of the data using ChatGPT, by specifically asking ChatGPT for a DP rating based on the material and structure of the windows.

G Data Appendix

In this appendix, we describe how we linked our sample of PACE borrowers to their Equifax credit histories and offer details on supplemental data containing home equity loan interest rates, natural hazard incidence, and homeowners insurance.

G.1 Cotality (Corelogic) database

CoreLogic Data. CoreLogic provides property-level information on real estate transactions, tax assessments, super seniority, mortgage contracts, and building permits. We use five

[12] Source: https://search.nfrc.org/search/searchdefault.aspx

complementary datasets, linked through CoreLogic's property identifier (CLIP), and match them to our PACE loan records using assessor parcel numbers (APNs). We restrict the sample to owner-occupied, single-family residences. Economically, these restrictions focus the analysis on homeowners who both own and occupy the financed property, excluding rental, investment, and multifamily properties for which the incentives, financing decisions, and consequences of property tax delinquency may differ.

Owner Transfers records property transactions, including transaction dates and prices, buyer and seller identities, property use, and location. It also contains indicators distinguishing arms-length transfers from other transactions.[13]

The *Tax* dataset contains property tax assessment records, including records for tax-exempt properties, and physical characteristics such as building size, lot size, number of bedrooms, number of housing units, and age. It also provides the property classification and owner-occupancy indicators used to define our sample. These records allow us to track assessed valuations, ownership status, and recorded property improvements over time.

Involuntary Liens records tax liens and liens arising from bankruptcy judgments. Local tax liens include property tax liens and liens associated with overdue user or impact fees, such as sewer, trash, and public utility charges. A limitation of this dataset is that separate lien events cannot be reliably linked to the same underlying delinquency spell, preventing us from consistently identifying when a delinquency is resolved. For this reason, in the analysis of property tax delinquency in Section 5.1, we define the delinquency outcome as a dummy equal to one if the property-by-owner combination has a local tax lien involuntarily and newly placed on it in a given year, indicating a missed property tax payment.

Mortgage contains records of purchase mortgages, refinancing loans, home equity loans, and home equity lines of credit. Available fields include loan amounts, recording dates, maturities, interest rate types, contract rates at origination, and lender and borrower names.[14]

Building Permits records permit applications associated with properties covered by CoreLogic. It includes project descriptions, projected construction costs, contractor and applicant names, and permit status. The descriptions identify the type of work, including heating and cooling systems, roofing, solar installations, windows and doors, and other renovations.[15] See section E for how we classify permits based on their descriptions.

G.2 Equifax Credit Bureau Data

Equifax credit bureau data. We supplement the property-level outcomes used in the main analysis with a custom matched dataset linking PACE borrowers to their consumer credit histories from Equifax. The starting point for this linkage is the property-owner panel

[13]CoreLogic renamed its legacy *Deeds* product *Owner Transfers*. The latter includes the CLIP identifier, which facilitates linkage across CoreLogic datasets.

[14]Some mortgage information previously appeared in CoreLogic's legacy *Deeds* product and is now provided in the separate, more detailed *Mortgage* dataset.

[15]Depending on the jurisdiction, project descriptions reflect information supplied by the applicant or entered by the local clerk.

constructed from the Cotality data described in Section 4.1.[16] In addition to PACE borrowers, we construct comparison samples of observationally similar property owners and HELOC borrowers, as well as a sample of households that subsequently purchase properties on which a PACE loan had previously been originated.

We perform the linkage by providing Equifax with an input file constructed from the PACE and Cotality records. Personally identifiable information used for matching includes the first and last names of up to two owners and detailed situs-address information. Equifax was instructed to first attempt to match the first listed owner and, if that match was unsuccessful, to attempt the match using the second listed owner. Each row of the input file is additionally assigned a tokenized identifier, `efx_id`. Equifax uses the identifying information to perform the record linkage and removes personally identifiable information before delivering the analytic credit bureau files to us. The resulting data therefore allow us to link the Equifax credit histories back to the PACE and Cotality information without retaining the names and street-address fields used to conduct the match.

Information appended to the Equifax input file. In addition to the fields required for record linkage, we provide Equifax with the non-PII PACE and Cotality variables required to reconstruct our research sample. These include the PACE loan identifier, origination tax year, origination and tax assessment amounts, district and agency, county, and property identifiers, together with the Cotality clip and property characteristics described in Section 4.1. The latter include property type and owner-occupancy status, assessed value, property taxes, land area, year built, building square footage, number of bedrooms, stories, and units, and parcel location.

The input file also contains the transaction histories already assembled from the other Cotality products used in the paper. Its wide-format layout accommodates up to ten Owner Transfers records and ten Mortgage records for each input observation, including transaction dates and amounts, mortgage contract characteristics, and lender information. We similarly append up to twenty Building Permit records, including project descriptions, dates, values, and contractor identifiers, and up to five Involuntary Liens records. Finally, the file includes variables identifying the research subsample, subsequent PACE-property buyers, HELOC originations, and additional PACE contract information such as closing date, maturity date, and implied loan term. Carrying these source variables through the linkage allows us to merge the returned bureau histories directly to the property and loan information used elsewhere in the analysis.

Construction of the Florida linkage sample. The Florida sample submitted for credit bureau linkage contains 225,875 records across four groups:

[16]CoreLogic rebranded as Cotality in March 2025. We refer to the company as Cotality in this appendix and throughout the main text.

Sample	Input records
PACE borrowers	72,725
Buyers of PACE properties	10,944
Matched general controls	71,455
Matched HELOC controls	70,751
Total	225,875

The comparison samples are constructed using characteristics measured prior to the corresponding PACE origination, so that the selection of controls does not depend on subsequent credit outcomes.

For each PACE loan originated in property tax year t, we identify the corresponding property using the Cotality clip and select the Tax record from $t-1$. When a $t-1$ record is unavailable, we use the record from the origination year t, which occurs for approximately 0.6% of borrowers; if that record is also unavailable, we use $t+1$, which occurs in approximately 0.1% of cases. We exclude records for which the property owner's last name is unavailable and properties held by a trust, because these observations cannot be reliably linked to an individual credit file. Approximately 5.6% of candidate Florida PACE borrower observations have a missing last name.

We separately construct a sample of purchasers of properties previously financed through PACE. For each property with a PACE origination in year t, we identify the first subsequent Owner Transfers record occurring in year t or later and retain the transaction when it is classified as arms-length. We then use the purchaser's name and address information for the Equifax linkage. As with the borrower sample, we exclude transactions for which individual purchaser information cannot be recovered. Approximately 16% of candidate Florida PACE property sales lack the buyer-name information needed for this linkage.

General matched controls. We construct the primary non-PACE comparison group in three steps. First, for each PACE borrower we form a pool of properties with similar pre-origination observable characteristics. We require exact matches on county FIPS code, five-digit ZIP code, coarsened property type, and owner-occupancy status. We additionally match on coarsened measures of assessed property value, total land square footage, year built, and building square footage. For each of these continuous characteristics, missing observations constitute a separate category and nonmissing observations are divided into quintiles of the corresponding ZIP-code-by-year distribution.

Second, among the properties satisfying these restrictions, we retain up to the twenty geographically closest candidate parcels using Cotality parcel centroids. Third, we use the `wru` R package of Imai and Khanna (2016) to construct predicted race and ethnicity probabilities from the name of the first listed owner. The WRU methodology uses Bayesian surname-based prediction to generate a probability that an individual belongs to each race or ethnicity category, rather than assigning each individual deterministically to a single category. Among the geographically proximate candidates, we select the control whose vector of WRU probabilities is closest to that of the corresponding PACE borrower, measured by

Euclidean distance across all categories. Candidate controls with missing owner names or ownership by a trust are excluded. This procedure yields 71,455 general matched-control records in Florida.

HELOC matched controls. We construct a second comparison group from property owners who originate a home equity line of credit. This group provides a benchmark consisting of households that access a conventional home equity product rather than PACE financing. We first restrict the candidate pool to Cotality properties associated with a HELOC and require exact matches to PACE borrowers on county FIPS code, coarsened property type, and owner-occupancy status. We additionally match on missing-value or quintile bins of assessed property value and total land square footage, with quintiles defined within county-by-year cells.

As in the general-control procedure, we retain up to the twenty geographically closest candidate parcels. We then construct the WRU probabilities described above and select the candidate whose probability vector is closest in Euclidean distance to that of the corresponding PACE borrower. We again exclude records with missing owner names and properties owned by trusts. The resulting Florida HELOC comparison sample contains 70,751 records.

Credit bureau archive timing and linkage rates. Equifax provides archival credit bureau records at semiannual frequency, with June and December snapshots for each year from 2008 through 2025. The analyses in this paper use the December archives only. Because the Florida property tax year follows the calendar year, these records provide a year-end measure of each household's credit characteristics. The availability of archives beginning in 2008 allows us to observe credit histories prior to PACE origination, while the later archives allow us to follow borrowers after origination.

For our analysis comparing interest rates on PACE and HELOC financing across credit score bins, we measure credit score using the December archive immediately preceding the PACE origination tax year, when that score is observed. Thus, for a PACE loan originated in tax year 2018, the relevant credit score is measured in the December 2017 archive. We use this predetermined measure of creditworthiness to assign borrowers to credit score bins, so that the credit score used in the interest rate comparison is measured before the PACE origination itself.

Equifax reports an archive-specific "hit rate," defined as the fraction of submitted records receiving an accepted credit bureau match. Across all 32 semiannual archives from June 2008 through December 2023, the hit rate ranges from 83.7% to 85.1%, with an average of 84.6%. Our Florida analyses retain the successfully linked records from the relevant December archives.

Variable construction We construct the following variables using the credit bureau datasets:

- *Credit score* The borrower's credit score from Equifax score model 5402, delivered with each archive. The score is on the standard 300–850 scale, with higher values indicating lower predicted default risk.

- *Subprime* An indicator equal to one when the credit score defined above is below 670, the conventional boundary between subprime and prime borrowers. Borrowers without a score are classified as subprime.
- *Share of trades with a major derogatory.* The denominator is the number of trades (credit accounts) ever reported on the file; the numerator is the number of those trades whose worst status is a major derogatory, such as a charge-off, repossession, foreclosure, or collection, that remains unpaid at the archive date.
- *Credit file age*: the number of months between the opening date of the oldest trade on the file and the archive date. It proxies for the length of the borrower's credit history; a value of 240 means the oldest account was opened twenty years before the archive.
- *Bankruptcy ever* An indicator equal to one when the variable "Number of Public Record Bankruptcies Ever" is positive. The attribute counts public-record bankruptcy filings of any chapter on the file.
- *Severe distress index* An integer from 0 to 3 counting the serious credit events present on the file at the archive date: a major derogatory event in the last 24 months, a bankruptcy on file, and an unpaid third-party non-medical collection account placed within the last 24 months. The bankruptcy measure is the indicator defined above.
- *Revolving credit limit excluding HELOCs* It sums, in dollars, the credit limit of every open revolving trade other than a HELOC that was reported to Equifax within six months of the archive. Revolving trades include bankcards, retail cards, and other revolving lines.
- *Bankcard utilization* the sum of balances divided by the sum of credit limits over all open bankcard trades reported within six months of the archive. It is stored as a fraction, so 0.40 means the borrower uses 40 percent of available bankcard credit.

G.3 Description of Supplemental Datasets

Home Mortgage Disclosure Act data. We use the Home Mortgage Disclosure Act (HMDA) data in Section 5.3 to compare interest rates charged on PACE loans to those charged on comparable HELOCs used for home improvement purposes. Because PACE lenders offer specialized non-mortgage loan products, they are not required to report PACE loans to HMDA. We confirmed that the coalitions of lenders (districts) or the lenders themselves (administrators) originating Florida PACE loans do not appear in HMDA during our sample period. We instead infer PACE interest rates using the annual tax bills from our FOIA-requested data and the loan maturity, applying the standard fixed-rate amortization schedule. For nearly all mortgage types, the deed does not record pricing information, as this is considered privileged information and is not part of the public record. Since Cotality sources its mortgage data from deed records, the interest rate variable is missing for 88% of loans and for over 90% of equity loans.

The public HMDA data are a repeated cross-sectional dataset covering nearly the universe of mortgage applications in the United States, including second lien equity loans. Important for our purposes, HMDA reports interest rates for second lien home improvement loans beginning in 2018. Consequently, we cannot recover comparable HMDA interest rates for HELOCs originated prior to 2018, and the HMDA-based pricing comparison is necessarily restricted to the subset of HELOC originations for which these pricing data are available. In the implementation used here, we match HELOC originations from 2018 through 2020.

Because the public HMDA files do not contain direct borrower or property identifiers that can be linked to Cotality, we use observable loan and geographic characteristics to link a subset of HMDA records to the HELOC sample derived from Cotality. We begin with originated Florida home improvement loans in HMDA and the HELOC borrowers in our Cotality matched-control sample. For originations between 2018 and 2020, we require an exact match on origination year, census tract, and a coarsened measure of loan amount. We construct the census tract identifier in the Cotality data by combining the county FIPS code with the six-digit census tract code. To account for the coarsening of loan amounts in the public HMDA files, we map each Cotality HELOC origination amount to the midpoint of its corresponding $10,000 loan-amount interval before matching. We then retain only Cotality HELOC observations for which these characteristics identify a unique HMDA record.

From the matched HMDA record, we append the reported interest rate, as well as the HMDA rate spread and open-end-line-of-credit indicator, to the corresponding Cotality HELOC record. These HMDA variables are incorporated into the Equifax input file before the credit bureau linkage and removal of personally identifiable information. The resulting matched data therefore allow us to observe the HMDA interest rate jointly with the borrower's anonymized Equifax credit history. As described in Appendix G.2, our comparison of PACE and HELOC interest rates across credit score bins uses the borrower's credit score from the December Equifax archive immediately preceding the PACE origination tax year, when available. Thus, for example, a borrower associated with a PACE origination in tax year 2018 is assigned the credit score observed in December 2017.

SHELDUS natural hazards data. We rely on the Spatial Hazard Events and Losses Database for the United States (SHELDUS) to examine the determinants of counties' enactment of PACE ordinances. We download the complete hazard-level data extract covering all Florida counties from 1960 onward. The database contains most natural disasters, such as thunderstorms, hurricanes, floods, wildfires, and tornadoes. It reports the date of the natural hazard event, the affected counties, and various measures of direct losses caused by the event based on insurance claim payouts (indemnities). We capture *ex ante* risk exposure to natural disasters by calculating the value (in real 2021 dollars) of average property damages at the county level between 1960 and 2021. This variable ranks counties based on their historical exposure to natural disasters. Under rational expectations, this measure should be monotonically increasing in the expected probability of natural disaster risks at the county level.

QUASR Florida Homeowners Insurance Data. We submitted a FOIA request to the Florida

Office of Insurance Regulation (FLOIR) to obtain a complete history of quarterly data on homeowners insurance policies. We use these data in Section 6.1 and Online Appendix I to assess pass-through of PACE to insurance premia. Our data span 2009Q1 to 2024Q2 and are aggregated to the insurer-county-quarter level so that the records can be disseminated to the public.[17] We collapse the data to the annual frequency to avoid any seasonality in insurance policy underwriting and to match the frequency of our results on insurance markets to the annual frequency of our PACE and property tax data used in the main analysis. An example of an observational unit in our analysis would then be the average premium charged on all residential homeowners insurance policies in Miami-Dade County in 2010Q1 underwritten by Citizens Property Insurance Corporation, the Florida state-run insurer of last resort.

The underlying source of these data are quarterly commercial and residential property insurance reports submitted to the FLOIR via their Quarterly and Supplemental Reporting System (QUASR).[18] Insurers doing business in Florida are required to comply with data provision according to Florida Statutes §624.424(10). The QUASR data have been used extensively in the literature on the Florida homeowners insurance market. For recent examples, see Eastman et al. (2024) who examine the pass-through of premia to house prices and Sastry et al. (2026) who show underpriced GSE mortgage risk leads to insurance market unraveling. A known issue with the QUASR data is that coverage has deteriorated over time, with a sharp drop in the number of total premia (as determined by regulatory filings) missing post-2018 due to insurers successfully petitioning for filing exemptions related to trade secrets (Sastry et al., 2026). To account for this, we check robustness of our specifications to restricting our sample to the period from 2009 to 2018. Doing so also avoids the post-2020 period during which the legal status of PACE was in flux for several Florida counties.

H Do Counties' Finances Predict PACE Program Adoption?

Table H.1 extends the analysis in Table 1 concerning county-level determinants of PACE program adoption. We include an extensive set of county financial accounting variables to study whether local governments' finances affect PACE program adoption and/or mediate the role of the tax assessor's office. Municipal finance variables include county-level (total) debt, tax revenue, expenditures, interest payments, and holdings of cash and securities. We scale these variables by total revenue. The data come from Willamette University's Government Finance Database and are based on the Census Annual Survey of State and Local Government Finances. In each regression, represented as a separate column in the table, the dependent variable is a dummy equal to one if a county has adopted PACE in a given year, and zero otherwise.

[17] Quarterly market reports from FLOIR aggregated to the company level can be found here: https://floir.com/tools-and-data/residential-market-share-reports.

[18] Custom reports based on QUASR data can be downloaded in non-batch format here: https://apps.fldfs.com/QSRNG/Reports/ReportCriteria.aspx.

We find that a county's financial condition does not predict PACE adoption in the specifications where we control for county and year fixed effects (columns 3–5). This evidence supports the idea that local governments' financial incentives are not the driving factor behind program implementation. As in Table 1, we find that newly elected tax assessors are more likely to pass a PACE program in counties where residents' climate concerns are high, as measured by the Yale Program on Climate Change Communication surveys.

I Additional Results for Homeowners Insurance Market

This appendix presents robustness checks and additional results on homeowners insurance market outcomes in support of our Section 6.1 calculations of the potential capitalization of insurance premia into house prices.

I.1 Results Using Insurers' Exposure to PACE Counties

One possible threat to identification of the causal effect of PACE program adoption is that insurers may expand their policy issuance in a county in response to PACE adoption, perceiving such contracts as becoming relatively safer because homeowners now have access to financing for home-hardening investments. To alleviate this concern, we employ a shift-share design by fixing insurers' county exposure to its initial level in 2009, the year before passage of Florida Statute §163.08 authorizing local PACE programs. For example, suppose that in 2009, insurer A operates in Brevard and Miami-Dade Counties with exposure values of \$30k and \$70k in total contract face values (i.e., the total insured values), respectively. By 2012, insurer A increases its exposure in Miami-Dade to \$80k while maintaining \$30k in Brevard. In 2012, Miami-Dade County has enacted PACE. We calculate insurer A's 2012 PACE exposure share as 70% (= 70/100) using its initial 2009 exposure before PACE adoption as the vector of "shares," and the staggered adoption of PACE across Florida counties as the "shifters."

This logic motivates the following regression estimated at the insurer-year level:

$$\begin{aligned}\log(Premium_{i,c,t}) &= \alpha + \beta_1 \cdot PACE_{c,t} \times ExposureShare_{i,c,t} + \beta_2 \cdot PACE_{c,t} \\ &+ \beta_3 \cdot ExposureShare_{i,c,t} + \gamma' \cdot \mathbf{X_{c,t-1}} + \epsilon_{i,c,t}\end{aligned} \tag{I.1}$$

where $log(Premium_{i,c,t})$ is the log annual insurance premium for contracts underwritten by insurer i in county c. $PACE_{c,t}$ is a dummy variable equal to one if county c has adopted PACE in year t, and zero otherwise. We interact $PACE_{c,t}$ with $ExposureShare_{i,c,t}$, which measures insurer i's 2009 share of dollar value exposure to all PACE counties with an ordinance as of year t. In some specifications, we also experiment with including insurer $\times$ year fixed effects or replacing the time-varying, lagged county demographic controls $\mathbf{X_{c,t-1}}$ with county $\times$ year fixed effects to account for county-specific time trends in the homeowners insurance market.

Table H.1. Do Municipal Finances Predict PACE Adoption?

Dep. variable: PACE Adopted	(1)	(2)	(3)	(4)	(5)	(6)
County financial variables:						
Municipal debt/Revenue	-0.132	-0.170*	-0.065	-0.109	-0.230	-0.085
	(0.106)	(0.089)	(0.099)	(0.092)	(0.159)	(0.089)
Tax revenue	0.707	0.846*	0.730	0.368	0.515	0.373
	(0.477)	(0.455)	(0.676)	(0.632)	(0.709)	(0.602)
Expenditure ratio	-0.122	-0.095	-0.156	-0.030	-0.075	-0.008
	(0.240)	(0.198)	(0.298)	(0.294)	(0.315)	(0.284)
Interest payment/Revenue	0.115	1.015	0.466	0.471	-0.025	0.409
	(1.758)	(1.437)	(1.842)	(1.828)	(1.285)	(1.797)
Cash/Revenue	0.178	0.160	0.048	0.081	0.261	0.062
	(0.127)	(0.116)	(0.105)	(0.102)	(0.160)	(0.102)
Other county-level factors:						
Population	0.049	0.078	-0.481	-0.086	0.236	0.108
	(0.075)	(0.078)	(1.033)	(1.005)	(1.508)	(1.013)
Household median income	0.654**	0.426	-0.219	-0.228	0.049	-0.143
	(0.308)	(0.357)	(0.357)	(0.351)	(0.435)	(0.349)
% Bachelor degree's or higher	-1.825**	-1.835**	1.521	1.151	1.475	1.243
	(0.813)	(0.754)	(1.263)	(1.193)	(1.387)	(1.158)
% Black	1.429	2.512	1.195	0.987	-0.231	0.175
	(2.394)	(2.110)	(2.543)	(2.429)	(3.797)	(2.429)
% Latino	1.771	2.329	-1.304	-0.802	-4.980	-2.747
	(2.134)	(1.858)	(7.260)	(6.793)	(8.978)	(6.648)
% White	1.056	2.280	-4.513	-1.294	-6.029	-2.993
	(1.985)	(1.710)	(4.781)	(4.973)	(7.038)	(4.906)
Unemployment rate	-4.423***	-3.957***	-1.016	-1.349	-1.017	-0.982
	(1.426)	(1.255)	(1.206)	(1.211)	(1.321)	(1.132)
Democratic leaning	0.734	-0.083	-0.600	-0.853	-1.489	-1.152
	(0.753)	(0.670)	(1.090)	(0.957)	(1.137)	(1.014)
Neighbor PACE	0.036	-0.053	0.053	0.034	-0.005	0.055
	(0.093)	(0.087)	(0.084)	(0.086)	(0.079)	(0.083)
#Declared natural disasters	0.127***	0.088***	-0.008	-0.012	-0.015	-0.022
	(0.025)	(0.029)	(0.027)	(0.028)	(0.037)	(0.026)
Abnormal property damage	0.000	0.000	-0.000	-0.000	-0.001	-0.000
	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Climate concerns		0.042***		0.021	0.028	0.021
		(0.011)		(0.019)	(0.022)	(0.019)
Assessor turnover		0.363		-1.275**	-1.395**	
		(0.610)		(0.509)	(0.686)	
Assessor turnover × Climate concerns		-0.007		0.023**	0.025*	
		(0.011)		(0.009)	(0.013)	
Retirement turnover						-1.720**
						(0.683)
Retirement turnover×Climate concerns						0.031***
						(0.011)
Sample	All	All	All	All	Pre-2020	All
Observations	466	466	466	466	344	466
R-squared	0.379	0.425	0.713	0.728	0.697	0.731
County FE	No	No	Yes	Yes	Yes	Yes
Year FE	No	No	Yes	Yes	Yes	Yes

Notes: This table examines whether a county's government finances, economic, political, or demographic conditions predict the adoption of PACE programs. The dependent variable is an indicator equal to one ($Adopted_{c,t}$) if a county c has adopted PACE in that year t. Standard errors are reported in parentheses and clustered at the county level. County financial accounting data come from Willamette University's Government Finance Database. Variable definitions appear in Table 1. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

Table I.1 reports the results from estimating (I.1), showing a robust effect of PACE adoption on negative pass-through into insurance premia from the estimated coefficient of interest ($\beta_1 < 0$). This effect qualitatively holds regardless of whether we use OLS or a stacked DiD estimator (Cengiz et al., 2019) to account for heterogeneous treatment effects by cohort of adoption. We also observe a similar, slightly attenuated effect if we restrict the estimation sample to contracts only insuring against wind-based damages to the property (columns 6 and 7). Based on our preferred specification in column 5, which uses the stacked estimator and includes all policies in the sample, a one standard deviation increase in an insurer's exposure to PACE counties generates a 5.2% decrease in annual insurance premia after PACE adoption.[19]

I.2 Effects on Local Market Share of State-Run Insurer (Citizens)

The preceding evidence shows that PACE adoption passes through to lower insurance premia at the county level, the insurer-county level, and at an individual level, as suggested by house price capitalization. Based on Table A.2, pass-through occurs for both the private and public homeowners insurance market segments. Since its creation in 2002, Citizens Property Insurance Corporation (Citizens for short) acts as the state-run insurer-of-last-resort, offering contracts to Florida homeowners who otherwise cannot obtain a policy from the private market. Citizens periodically engages in a "Depopulation Program" when its market share rises, which most recently occurred after Hurricane Ian in 2022 (Citizens Property Insurance Corporation, 2024).

A natural question arises of whether the home-hardening projects that PACE loans finance help homeowners remain in the private segment of the market. This can occur either because homeowners are less likely to be dropped by their insurer or because they are not priced out of the private market. Homeowners are eligible for Citizens coverage if all private insurer quotes are more than 20% higher than Citizens' comparable coverage premium.[20] We show in Table A.2 that the pass-through of PACE to premia is of a similar magnitude across Citizens and non-Citizens policies, indicating that any drop in Citizens' market share is more likely due to PACE preventing unraveling from insurers exiting the market altogether, dropping policies, or refusing policies for PACE customers who are currently enrolled with Citizens.

Since Citizens' market share is volatile both at the county level and in aggregate over our sample time period, and thus likely non-stationary, we use the year-on-year county-level growth rate in the market share as our outcome variable and estimate stacked difference-in-differences regressions. In Figure I.1 we plot the dynamic event study coefficients. Consistent with the hypothesis that PACE helps prevent insurance market

[19] Given that the standard deviation of $ExposureShare$ is 0.333 and the standard deviation of $\log(Premium)$ is 0.567, the calculation is $0.333 \times 0.088/0.567 = 0.052$.

[20] See discussion of the Citizens 20% rule in the context of the Depopulation Program here: https://www.citizensfla.com/-/new-rules-for-citizens-depopulation-program.

TABLE I.1. Insurer Exposure Share Design: PACE Adoption Effects on Insurance Pricing

Dep. variable: $\log(Premium_{i,c,t})$	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$PACE_{c,t} \times ExposureShare_{i,c,t}$	-0.075***	-0.094***	-0.076***	-0.082***	-0.088***	-0.046*	-0.058***
	(0.021)	(0.024)	(0.025)	(0.024)	(0.017)	(0.025)	(0.017)
$ExposureShare_{i,c,t}$	0.179***	0.208***	0.181***		0.055***	0.128***	0.032*
	(0.045)	(0.047)	(0.047)		(0.017)	(0.047)	(0.017)
$PACE_{c,t}$	0.020	0.027**					
	(0.012)	(0.013)					
Population		0.041					
		(0.196)					
% Black		0.541					
		(0.799)					
% Hispanic		0.778					
		(0.761)					
Unemployment rate		-0.131					
		(0.224)					
% Bachelor's degree or higher		0.139					
		(0.211)					
Abnormal property damage		-0.000					
		(0.000)					
Sample	All	All	All	All	All	Wind	Wind
Estimator	OLS	OLS	OLS	OLS	Stacked	OLS	Stacked
Observations	40,614	23,087	40,614	40,593	214,823	39,959	212,278
Adj. R-squared	0.764	0.771	0.762	0.794	0.782	0.801	0.814
Insurer FE	Yes	Yes	Yes	–	Yes	Yes	Yes
Year FE	Yes	Yes	–	–	–	–	–
County FE	Yes	Yes	–	–	–	–	–
County × Year FE	No	No	Yes	Yes	Yes	Yes	Yes
Insurer × Year FE	No	No	No	Yes	No	No	No

Notes: This table presents results from estimating exposure share difference-in-differences regressions according to (I.1). The dependent variable in each column is the log annual home insurance premium for owner-occupied residences at the insurer-county level. PACE is a dummy variable that takes the value of one if county c has adopted PACE in year t, and zero otherwise. $ExposureShare$ measures the percentage of insurer i's dollar exposure to PACE counties in year t; we fix the vector of insurers' county-level exposure shares to the baseline year of 2009 prior to the statewide enactment of PACE in Florida. We use dates that official PACE ordinances or the first interlocal agreements are enacted to assign treatment timing across counties. In each regression, we weight observations by their lagged county-level population. Columns 1 through 4 report OLS regressions; columns 5 and 7 use the stacked event study estimator (Cengiz et al., 2019). In columns 6 and 7 we restrict the sample to policies covering wind damages only. In column 2, the lagged county-level controls include population, proportion of Black, proportion of Hispanic, proportion of population with a Bachelor's degree or higher, unemployment rate (all from the one-year American Community Survey estimates), and abnormal property damage caused by natural disasters, as reported by SHELDUS. Robust standard errors clustered at the insurer-year level in parentheses. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

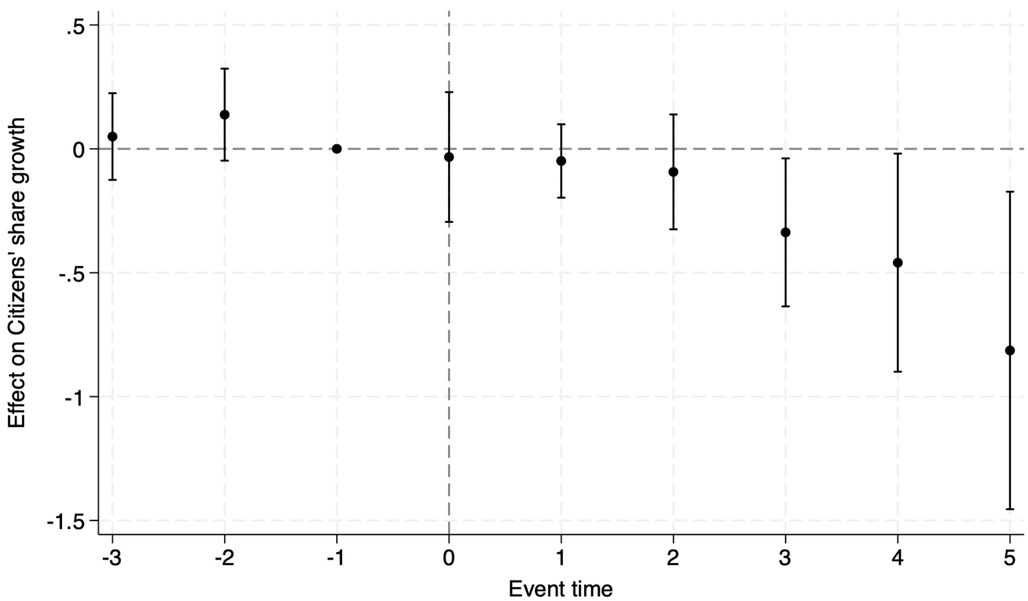
TABLE I.2. PACE Adoption Effects on Citizens' Local Market Share

	(1)	(2)
PACE	-0.298**	-0.372***
	(0.124)	(0.140)
Observations	4,005	1,184
Adj. R-squared	0.704	0.763
County controls	No	Yes
Cohort × Year FE	Yes	Yes
Cohort × County FE	Yes	Yes

Notes: This table presents the county-year level difference-in-differences regressions. The dependent variable is the growth in county-level market share of the public insurance provider, Citizens Property Insurance Corporation. PACE is a dummy variable that takes the value of one if county c has adopted PACE in year t, and zero otherwise. We use the stacked event study estimator (Cengiz et al., 2019). Lagged county-level controls in column 2 include population, proportion of Black, proportion of Hispanic, proportion of population with a Bachelor's degree or higher, unemployment rate (all from the one-year American Community Survey estimates), and abnormal property damage caused by natural disasters, as reported by SHELDUS. We weight observations by their lagged county-level population. All fixed effects are interacted with cohort stack. Robust standard errors (in parentheses) are clustered at the county level. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

unraveling, we find a negative effect in Table I.2 on the local growth rate of Citizens' market share. Comparing PACE counties to non-PACE counties, the average PACE adoption event results in a 37.2 percentage point drop in the market share growth rate. We find no clear evidence of a pre-trend in local market shares, supporting our interpretation based on Table 1 and Table H.1 that selection of counties into PACE is not driven by historical claims payouts from property damages.

FIGURE I.1. Event Study: County-Level PACE Adoption Effects on Citizens Property Insurance Corporation's Local Market Share



Notes: This figure plots the dynamic treatment effects from stacked specifications as in Table I.2, estimated via the stacked estimator of Cengiz et al. (2019) and Baker et al. (2022). The dependent variable is the growth in county-level market share of the public insurance provider, Citizens Property Insurance Corporation. We weight observations by their lagged county-level population. Time on the x-axis is measured in years relative to PACE program adoption ($t = 0$). Bars indicate 95% confidence intervals with standard errors clustered by county.