# Universal Preschool and Supply-Side Responses: Evidence from Vermont

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**Abstract**

The United States aims for providing universal access to high-quality pre-kindergarten (Pre-K) to promote holistic child development and long-run education and earning outcomes. However, limited funding has constrained the scope of state-level universal Pre-K (UPK) programs, and therefore little is known about providers' responses to UPK policies. This paper fills in the knowledge gap by examining the supply-side market impacts of Vermont's UPK program, which provides a uniform per-child subsidy for all 3- and 4-year-olds. Exploiting variation in treatment intensity across counties, I estimate two-way fixed effects and event-study models. I find that in more intensely treated counties, UPK increases provider entry and exit, but does not improve the aggregate quality of care. I then estimate a static demand and supply model to simulate the consequences of the UPK policy. I find that the marginal costs and fixed costs for UPK programs are much higher, while families' utility on UPK programs are offset by the higher prices. Therefore, while the policy successfully increased high-quality childcare supply across the state, providers in low-income counties have less incentive to invest in quality improvements, limiting the expansion of high-quality care among low-income regions. These findings highlight the importance of subsidy design for aligning family access with policy goals of expanding high-quality early education.

## 1 Introduction

Research on early childhood education under age 5 has emphasized the importance of high-quality non-parental care in shaping children's short-run health and cognitive outcomes, long-run education attainment and employment success, and female labor force participation (Ludwig and Miller, 2007; Duncan and Sojourner, 2013; Gruber et al., 2023; Baker et al., 2005). The call for high-quality childcare coincides with a growing female labor force participation, further stressing the need for providing non-parental care in the market. Despite the need of high-quality childcare, childcare crisis in the US has pertained for decades, and the US government spends little on early education: in 2019, the US spent about \$2,800 per child for 3-4-year-olds, compare to \$12,800, more than 4 times the mount for childrens aged 5-18 (Davis and Sojourner, 2021). This also implies that the child care market for 3-4-year-olds are largely private provision, which causes several problems, including high price, scarce capacity, and existence of low quality providers. First, supply of high-quality care is scarce in many locations because child care providers usually earn low wages compared to other industries, resulting in high turnover. Second, limited supply pushes up the cost of high-quality care: each full-time preschool child on average costing 8.9% $\sim$ 16% of median income for married families, and $\sim$ 28% of income for low-income parents, widening the inequality gap (Baldiga et al., 2018). The cost of care has been surging over the past few years, with out-of-pocket costs increased by 23% for center care from 2012 to 2016 (Tekin). Finally, child care quality remains an issue. While many states have established child care star rating systems to disclose quality, some families, especially lower-income families, make child care decisions based on practical factors such as distance and price, which may undermine child care quality and result in worse children's outcomes in the long run (Herbst et al., 2020; Baker et al., 2005). With soaring childcare costs and dwindling availability, families are facing unprecedented challenges in securing their children a high-quality childcare slot.

Policy makers have responded to the childcare crisis with increased federal- and state-level interventions through financial assistance programs and public provisions of care, in hope of achieving more equitable access to high-quality childcare. Two major federal fundings for child care are the Child Care Development Fund (CCDF) and Temporary Assistance to Needy Families (TANF) program, both aims to provide financial assistance to low-income families with children. States also contribute through mandatory matching funds to CCDF and additional state funds. Most states have thus implemented means-tested programs that target low-income families, who are more likely to face financial constraints, and therefore less likely to afford high-quality professional childcare. However, a few states have implemented non-means-tested universal preschool (UPK) programs, arguing that UPK is more effective at reaching disadvantaged children by avoiding complicated application and recertification process. Furthermore, UPK programs address the ”doughnut hole” problem, where strict income caps of means-tested programs exclude mid-income families who also struggle with high costs. As of today, there are 5 state-level UPK programs: Oklahoma, Florida, Georgia, DC, and Vermont. Existing research have evaluated the impact of UPK programs on enrollment, children's outcomes and mothers' employment decisions (Cascio, 2017; Gray-Lobe et al., 2022; Humphries et al., 2024). Less attention has been paid to the supply side: Bassok et al. (2014) applies synthetic controls to compare Oklahoma and Georgia to other US states and finds significant increase in public school provision in both states, but accompanied by crowd-out of private care in Georgia and insignificant decrease in private care in Oklahoma. Few research have focus on Vermont UPK, with little evidence on the impact on the market structure.

This paper aims to provide evidence on how the voucher-like Vermont UPK policy affects the structure and dynamics of the local preschool market, with a focus on provider entry, exit, upgrades (in star ratings), and pricing of private preschools. Vermont has several unique features that make it a good case study for UPK policies. The state combines means-tested Child Care Financial Assistant Program (CCFAP) with the UPK policy in order to expand access of care to all families. The UPK policy is not completely universal, as it only subsidizes for part-time care in certain prequalified UPK providers. The intention of the policy is to increase access to high-quality care for all children, as it only covers the tuition for enrolling in prequalified, high-quality providers. Because the policy reduces out-of-pocket cost of prequalified care, especially for lower-income families who face liquidity constraint, this implies increased demand in the market, and therefore should stimulate growth on the supply side. Nevertheless, the policy can also trigger unexpected consequences due to its mixed delivery system of private and public provision, and the fixed subsidy across all families. I exploit the natural variation in treatment intensity across counties, and compare providers in the more-intensely treated counties (lower-income counties) to less-intensely treated counties (higher-income counties). Using annual data on all licensed and registered Vermont childcare providers, I apply Difference-in-difference with inverse probability weighting (Abadie, 2005; Callaway and Sant'Anna, 2020). Descriptive statistics and reduced-form analysis reveal three main findings. First, while the Vermont childcare market is shrinking over time, the number of high-quality UPK prequalified programs have been increasing ever since the policy implementation, suggesting the policy successfully improves the market quality composition. Second, compared to the higher-income counties, lower-income counties do not see more frequent provider upgrades (by star rating), and while lower-income counties have more entries and exits, the new entrants are low-quality and generally do not upgrade to higher-quality in the short term. This deviates from our hypothesis that the policy should encourage more providers to upgrade to high-quality in lower-income counties, where families see a larger growth in demand after the policy relieves their liquidity constraint. Finally, the full-time UPK tuition rate increases faster in higher-income counties compared to lower-income counties. This may suggest that UPK providers have the tendency to increase full-time UPK prices to offset any reduced revenue from the fixed part-time subsidy or the high UPK compliance cost. Families in higher-income counties are more willing to pay for attending full-time UPK than lower-income counties, where the increased demand for UPK is mostly for part-time free UPK.

The reduced-form evidence motivates me to build a static demand and supply model to reveal family choices and providers' costs of operating UPK, using annual data on all licensed and registered Vermont childcare providers. On the demand side, the model allows heterogeneous preferences for child care for families with different income. On the supply side, the model incorporates both the CCFAP and the UPK policy, allowing different prices for families with different income, and reduced price for families enrolling in UPK. I then use the model to compute variable profits and fixed costs of providers with different quality levels. This allows me to construct meaningful counterfactuals that reveals how the Vermont UPK affects market structure and consumer welfare, and whether an alternative policy can improve the market quality structure cost-effectively. My first counterfactual shows the market structure without the UPK policy. Comparing the alternative market structure to the current market structure shows that the UPK policy successfully increases high-quality provider supply for both high-income and low-income counties. However, the average market quality increases more for higher-income counties, suggesting that the UPK policy redistribute more funding toward higher-income counties. The results are crucial in resolving the current policy debates. With many states planning to roll out UPK policies, my research provides guidance on how they should implement the UPK policy if the states are not able to guarantee universal care for all eligible children.

## 1.1 Related Literature

This paper contributes to a growing literature on the intersection of public provision and private sector dynamics in ECE. A large body of evidence documents the high returns to investment in high-quality care, with short-run improvements in children's cognitive development and long-run gains in educational attainment and labor market outcomes (Herbst, 2013, 2018a; Gathmann and Sass, 2018). Evaluation of universal preschool programs in Oklahoma, Georgia, and Boston similarly demonstrate the benefits of extending child care access (Cascio and Schanzenbach, 2013; Gray-Lobe et al., 2021; Durkin et al., 2022). The latest evidence on UPK is more nuanced. Humphries et al. (2024) find that New Haven's UPK program had limited effects on children's long-term academic achievement, with the exception of modest gains among middle-income families. However, the program significantly increased parental earnings, with effects persisting for six years. The largest earnings gains accrued to middle-income households, suggesting that universal preschool filled the "doughnut hole" in the existing policy landscape: families earning too much to qualify for subsidies but too little to afford high-quality private care. Despite these benefits, the implementation of universal child care policies at scale also poses risks. Studies of Quebec's universal child care program in the late 1990s (Baker et al., 2005, 2015) show that the policy induced a large shift into formal care but also led to adverse outcomes. Children exposed to the program exhibited worse behavioral and emotional skills, which extend to worse health, lower life satisfaction, and higher crime rates in adolescence, as well as worse parental mental health and family relationship. The authors hypothesize that these negative effects arose from increased parental stress, and lowered childcare quality due to rapid expansion.

Existing literature that studies the impact of government intervention on the demand side largely overlooks the dynamics on the supply side, therefore risks mis-specifying customer welfare change. Indeed, research on the supply side has shown that government intervention of childcare can have unexpected consequences on market structure: Hotz and Xiao (2011) show that more stringent quality regulation decreases ECE supply in disadvantaged neighborhoods. Brown (2018) studies NYC UPK and find that UPK policy expansion leads to private childcare center's revenue loss, resulting in lower average quality, reduced capacity or exit of existing programs. My research will be the first to provide evidence on the impact of a state-level UPK policy on the providers, and apply structural models to understand how the UPK policy affects consumer surplus through changes in equilibrium.

This paper also contributes to an emerging IO literature on the supply side of ECE. Many recent IO papers study the impact of public school provision or school vouchers on the provision of private schools. Neilson (2021) uses micro data from Chile to study the impact of school voucher on market competition and finds that the voucher leads to inequality in school quality, because of higher market power in poorer areas. Allende (2019) incorporates social interactions in demand estimation and concludes that schools have higher market power in high-SES markets because high-SES families value social interactions (peers) more compared to low-SES families, and are less sensitive to price. Singleton (2019) also studies funding mechanism, and argues that a flat charter school funding causes schools to favor lower-cost students. The paper that is most similar to my research is Bodere (2023), which investigates a tiered reimbursement system in Pennsylvania using aggregate data at the centers' level. My paper studies a different universal PreK policy in a different state, where the flat subsidy rate can cause providers to respond to the policy differently than a tiered reimbursement system. My data also allows me to include family daycare homes in addition to child care centers, so that I can better monitor provider dynamics in the market. Finally, I account for potential capacity constraints by adding a threshold term in the marginal cost specification, allowing the marginal cost to nonlinearly increase as a provider's enrollment approaches its capacity. By shedding light on how Universal PreK affects provider entry and exit and the nature of competition, I can offer important policy insights for governments seeking to expand access without unintentionally undermining preschool quality.

## 2 Universal Preschool in Vermont

Vermont established its Universal Prekindergarten (UPK) program under Act 166 in 2014. The act was Fully implemented in the 2016–2017 school year, and mandates that all public school districts provide access to publicly funded prekindergarten education for every 3-4-year-old child, regardless of family income or child's abilities. The program was designed to promote equitable access to high-quality early education. It guarantees a minimum of 10 hours per week of schooling for 35 weeks annually, which allows families to choose from a range of prequalified providers, including public school programs, Head Start, and private early education centers. The program pays the prequalified providers directly at a flat rate, which was $\$3,092$ per child in 2016/2017 school year, and does not allow providers to charge families any out-of-pocket charge for enrolling in part-time UPK.

To become prequalified for UPK, providers must meet specific criteria, such as employing licensed educators and aligning curricula with the Vermont Early Learning Standards. Additionally, all UPK programs are required to participate in the state's quality rating system, the Step Ahead Recognition System (STARS), achieving at least four out of five stars, or be a 3-star program with detailed plans of progressing into 4+ star in the next 2 years. This criteria further encourages providers to upgrade quality of care. On the other hand, it could push up the price of high-quality care, as providers need additional efforts to meet more stringent requirements to qualify for UPK.

The original goal of the policy is to allow more children to enroll in affordable high-quality preschool, as the policy reduces out-of-pocket cost for high-quality care. It creates more demand for part-time UPK because part-time UPK is completely free for all families. It also potentially create more demand for full-time care from families who originally face financial constraint, and therefore cannot afford high-quality care. Whereas for high-income families who are likely to have already enrolled in high-quality preschool, the policy acts as a pure transfer but does not necessarily induce more demand on the extensive margin. In theory, the increase in demand not only encourages providers to become UPK prequalified, but also allows providers to have more power to raise full-time tuition rates, as the subsidy covers partially the cost of families.

Ever since its implementation, the number of privately operated UPK programs in Vermont has steadily increased, despite the market decline, suggesting that the policy is successful in driving providers to offer high-quality UPK-prequalified preschool care (Figure 1). The policy also encourages new entrants to become UPK prequalified. As shown in Figure 2, new entrants after UPK implementation in 2016-2017 (panel (a)) are more likely to become high-rating (4-5 star) in 2 years, compared to new entrants before UPK implementation in 2013-2014 (panel (b)). Nevertheless, the Vermont UPK policy faces significant challenges, primarily due to its funding structure. The most prominent issue is the mismatch between the subsidy rate and the market rate. UPK subsidy is often lower than the average market rate for part-time care. For instance, in 2019, the average part-time annual tuition was \$5,106, while the UPK payment was only \$3,356 (Figure 2). Since prequalified UPK providers cannot charge additional fees for the 10 hours of part-time UPK, they must either absorb the loss or compensate for it elsewhere. This creates a disincentive for providers to offer part-time UPK, as the revenue is lower than what they could earn from a non-UPK program of similar quality. To make up for this loss, providers may charge higher rates for full-time UPK services. However, this strategy is only viable if the demand for full-time care is price-inelastic. If parents are highly sensitive to price changes, this could lead to a decrease in enrollment in full-time programs, undermining the provider's ability to cover costs and potentially pushing them toward a lower-quality service model to remain profitable.

Furthermore, as is the case with most other states that provide "universal" preK, access to affordable high-quality care remains limited for many three- and four-year-old children in Vermont. This is because either it is costly for states to guarantee truly "universal" preschool, or supply is complicated with a mixed delivery system of public and private programs. As of May 2019, 50% of private UPK programs had reached capacity and could not accept more children, while 39% of public UPK programs had reached capacity. In particular, high-poverty regions faced even tighter constraints, with 60% of UPK programs at full capacity, compared to an average of 43% statewide (Waterman Irwin and Gallo, 2021). These statistics suggest that supply constraints disproportionately bind in economically disadvantaged areas, where demand for subsidized care is likely highest. As a result, children in high-poverty neighborhoods face reduced availability of UPK programs. Moreover, since parents in these regions may be less able to afford high-quality private alternatives or commuting costs, the effective price of access to high-quality care is higher for low-income households. Overall, this implies that in practice, Vermont's UPK policy has not reached its goal of universal access. The underlying reason for scarcity of slots, in particular in high-poverty areas, likely stems from the program's funding structure. Vermont provides a fixed per-child subsidy to all UPK providers, which is far from covering the full cost of operating a UPK part-time program. National Institute for Early Education Research (NIEER) estimates the cost of providing high-quality UPK for 6 hours/day and 180 days/year is \$13,626 per student, and that the cost varies based on program settings. This implies an average cost over \$4,400 per student for required part-time care, which is higher than the paid subsidy rate of \$3,982. This limited funding potentially weakens incentives for existing providers to upgrade their quality, and deters potential entrants from supplying UPK.

Overall, the Vermont UPK system acts like a state-subsidized high-quality child care system. While it does not guarantee universal access to high-quality care, Vermont's UPK policy serves as a compelling case study for examining the effects of the subsidized early education programs on provider responses, including market entry, exit, and quality of care. The flat rate subsidy naturally creates a variation in treatment intensity: $\$3,092$ covers a higher proportion of childcare expenses for lower-income counties with lower tuition rates. This implies that families in lower-income counties have more incentive to respond to the program by enrolling in a preschool, which should create more demand for high-quality care and encourage providers to enter the market and become UPK prequalified. Therefore, one way to demonstrate the impact of UPK on providers is to compare the more intensely treated counties (lower-income counties) to less intensely treated counties (higher-income counties), so that observed differences between the two types of counties represent the treatment effect of the policy. I will discuss this specification in my reduced-form analysis in the following section.

## 3 Data

The main data is provided by Vermont Department for Children and Families, and covers all licensed and registered childcare providers serving child under 5yo in Vermont. The data is collected every December between 2010 and 2019 (I cut off at 2019 to prevent disruption of Covid), and contains detailed information on provider characteristics such as capacity and enrollment (2017-2019 available) breakdown by age group (infant, toddler, preschool), star rating (not-rated, 1-5 star), program type (center/home), physical addresses, whether the program is prequalified for UPK, and whether it is a public program. In addition, the data reports providers' weekly rate for all programs that participate in Child Care Financial Assistance Program (CCFAP), which covers partially the family's cost of care based on family income. The majority of childcare providers in Vermont participate in CCFAP, so only 30% of providers have missing market rates, which I impute using *MissingForest*. All programs report full-time and part-time provider rates for infant, toddler, preschool separately. Table 1 shows summary statistics for year 2012 and 2019. It is worth noting that the average enrollment is higher than the average capacity. This is because the enrollment data reports the pure headcount of enrollment in a program at the time of inspection, which does not distinguish between full-time and part-time children. Thus, if a program operates full-time but have children enrolled part-time, then the enrollment can exceed the capacity. Despite this data limitation, in the static model, I assume all enrollments are full-time as a proxy of the actual full-time equivalent enrollment.

The second set of data is ACS 5-year estimates. This data allows me to construct demographic characteristics of different census block groups, including population, number of children under age 5, income, poverty rate, female education level, and percentage of children under federal poverty line. It also allows me to construct the treatment intensity indicator variable, measured at the county level:

$$T_c = \begin{cases} 1 & \text{county median HH income in 2013} < \text{state median HH income (dark blue)} \\ 0 & \text{otherwise (light blue)} \end{cases}$$

Finally, I use National Survey of Early Care and Education (NSECE) 2019 data to construct additional micro moments in my static model. This survey contains detailed information on households' choices of childcare arrangements, in terms of distance and pricing, given household income.

# 4 Reduced-form evidence

In my reduced-form study, I compare the more-intensely treated counties (lower-income) to less-intensely treated counties (higher-income). The goal is to demonstrate the UPK policy has an impact on provider dynamics, including entry, exit, upgrade (in terms of star ratings), and pricing. To account for differential pretrends between the two types of counties, I employ DiD with Inverse Probability Weighting (IPW) (Abadie 2005; Callaway & Sant'Anna 2020). This allows the parallel trends assumption to hold conditional on covariates:

$$E[Y_t(0) - Y_{t-1}(0)|X, T = 1] = E[Y_t(0) - Y_{t-1}(0)|X, T = 0], \tag{1}$$

where $Y_{i,t}(0)$ is potential outcome at time $t$ if unit remain untreated, and $Y_{i,t}(1)$ is potential outcome at time $t$ if unit becomes treated in 2015.

I aggregate the data at town-year level to create a balanced panel. The outcome variables of interest include # of total provider entries/exits/upgrades per 1,000 children in town; # newly entere/exited slots per 1,000 children in town; and total # of slots per 1,000 children in town. Control variables include local demographics, such as average HH income, % of women with high-school degree, and % of HHs under federal poverty line. In addition, I focus on private programs, and control for total # of public programs and public slots, since public programs have lots of dnamics that are independent of market dynamics.

I choose a binary treatment variable instead of a continuous measure of treatment intensity because family responses to the subsidy are likely nonlinear in household income, and assuming a linear relationship between family income and family responses can generate messy outcomes. While the program was designed to broaden access among disadvantaged children, the very lowest-income families may be less responsive to UPK because they already receive full or nearly full tuition support through the Child Care Financial Assistance Program (CCFAP). For these families, the marginal value of the UPK subsidy is small. On the other hand, high-income families may have already purchased high-quality care since they are more capable of affording expensive preschool care themselves. Thus, UPK operates largely as an transfer that reduces their out-of-pocket costs but generates little additional demand. It follows that UPK policy is most likely to have an impact on the extensive margin among mid-income families who do not benefit from means-tested financial assistance programs, and who face financial constraints. For these families, UPK policy may encourages higher enrollment in prequalified programs.

## 4.1 Reduced-form results

Tables 2 and 3 report provider entries, exits and upgrades using provider-year level unbalanced data. Counties that are more intensely treated show higher rates of provider entry and exit, albeit column (1) in Table 2 suggests the parallel trend assumption for entry is violated. With that caveat in mind, the finding is consistent with the mechanism that UPK increases demand for early childhood education, creating stronger incentives for new providers to enter the market. At the same time, the higher exit rates, particularly among low-rated programs (those with a STARS rating of 2 or below, or unrated). This suggests that the policy increases competitive pressure, potentially crowding out lower-quality providers.

On the other hand, programs in more intensely treated counties are less likely to upgrade to a higher star rating. This raises concerns on the aggregate quality of the provider market after the policy implementation. Indeed 80% of all new entrants during year 2017-2019 entered as low-quality programs with star rating less than 2 star. Taken together, these findings imply that while UPK stimulated entry, the majority of entrants did not meet the standards required to become prequalified UPK providers. As a result, the policy may have expanded the number of providers without meaningfully increasing the supply of high-quality care, thereby undermining its stated goal of improving access to high-quality early education.

The results hold when we normalize outcomes by population. Table 4 reports the number of provider entry/exit/upgrade, along with associated slot changes, at the town-year level per 1,000 children. The results are consistent with Table 2 and 3: more intensely treated counties display more newly opened slots per 1,000 children, more exited slots per 1,000 children, and fewer upgraded slots per 1,000 children. The population-normalized results reinforce the interpretation that UPK increased the overall dynamism of the child care market—through higher entry and exit—but did not translate into a net improvement in access to high-quality slots.

Finally, I run DID using provider-year level data to evaluate the treatment effect on reported tuition rates. The results are presented in Table 4. Overall, there is no significant difference in the full-time/part-time weekly preschool rates across the full sample of private providers. An exception for the "ever-UPK" providers, which are the providers that became UPK-prequalified at some point on or after 2015. For those providers, there is evidence of a significant increase in full-time preschool rates for less-intensely treated counties. One possible explanation is that the demand for high-quality childcare, such as UPK-prequalified childcare, is more inelastic in high-income counties. This enables providers in those counties to increase full-time preschool care price without losing much enrollment. In contrast, there is no observed change in part-time weekly rates, likely because the cost of part-time UPK services is fully covered by a flat government payment, eliminating price-setting discretion on the part of providers. Finally, I find no significant changes in toddler care prices, suggesting that the UPK policy does not generate spillover effects on prices for non-eligible age groups within the same providers.

## 4.2 Discussion

On the demand side, the UPK policy should, in principle, alter parental enrollment decisions by reducing the out-of-pocket cost of formal preschool care. Low-income families, who might otherwise rely on informal arrangements or parental care, face stronger incentives to enroll in preschool once the policy lifts their financial constraints. For higher-income families, who are more likely to already purchase high-quality care, the UPK policy primarily acts as a subsidy that reduces expenditures on care they would have demanded even in the absence of the policy. Thus, we would expect demand responses to be stronger in low-income counties relative to high-income counties, and in equilibrium, we expect increase in high-quality preschool slots in disadvantaged areas.

However, reduced-form results suggest a different story, where low-income counties did not observe significantly larger increases in high-quality slots relative to higher-income counties. There are two potential mechanisms. First, the flat per-child subsidy does not adjust for differences in provider operating costs, weakening the incentive for providers to upgrade. Low-quality entrants are willing to serve additional demand generated by UPK, but upgrading to UPK-prequalified levels entails fixed and recurring costs that the flat subsidy does not cover. As a result, many new providers remain low quality. Similarly, low-quality incumbents also lack the incentive to upgrade. Increased competition among low-quality providers, as well as increased preference for subsidized lower-cost, higher-quality care, eventually caused some of the low-quality providers to exit the market.

Second, family responses to the subsidy are likely nonlinear in household income, as I detailed in the previous paragraphs. Low-income families already benefit from near-full subsidies through CCFAP, so the additional value of UPK is limited. High-income families are largely inframarginal, as they likely already purchased high-quality care. Thus, mid-income families benefit the most from UPK policy, since they may suffer from financial constraints because they are not eligible for means-tested CCFAP financial assistance, making them the group most likely to adjust enrollment decisions in response to the policy.

Overall, my reduced-form results suggest heterogeneous responses to the UPK policy based on regional income. Although I classify the impact of UPK policy on Vermont families by low- and high- income counties, the reduced-form evidence does not consistently imply stronger responses in low-income areas, and therefore does not unpack the underlying reason for changes in quantity, price, and quality. Instead, it raises an interesting question: if UPK increases demand for high-quality professional care, why do we not observe more providers upgrading to high-quality in more intensely treated counties? Also, why do we observe many entries and exits of low-quality programs who do not benefit from the UPK subsidy at all? A reasonable guess is that while UPK attracts many providers to enter the market to capture the excess demand, new entrants have largely underestimated the cost of upgrading to UPK-prequalified. Therefore, new entrants do not upgrade and remain at low quality, which increases the competition among low-quality care, which in turn causes more exits of low-quality providers. To answer these questions, in the next section, I develop a static demand and supply model that reveals family choices and providers' operating costs at different quality levels, allowing me to assess whether the UPK subsidy effectively promotes the expansion of high-quality care as intended.

# 5 Modeling the Preschool Market

I specify an empirical model of families' choice in preschool (demand), and school entry, exit, upgrade and pricing (supply). I explicitly model the UPK subsidy and the CCFAP tiered-reimbursement to examine how demand and supply respond to child care policies. While UPK is a subsidy on the demand side, it creates heterogeneity in consumer prices across markets, and therefore could generate distortions in equilibrium through interacting with market power on the supply side.

I define a market $m \times t$, where $m$ is defined to minimize cross-border school choices. I define a total of 4 markets in Vermont, based on a proposed consolidated school district to reduce administrative cost. I assume parents residing in market $m$ can send the child to any preschool program in the region. Because families can choose schools in a neighboring market, I create a 5km buffer surrounding each market following Allende (2019) paper when account for family child care choices. This means that for each market, the set of schools will be the ones within the market boundary, but I assume demand can come from all families within the market plus the buffer zone. Geographically, I divide each market $m$ into multiple regions $l$ (e.g. defined by census block group) that is characterized by the number of 3-5 age children $N_{lmt}$, HH income distribution $F^y_{lmt}$, family education collected from ACS 5-year estimates, and assume characteristics of each family with a

3-5 yo child is randomly drawn from the distribution of region $l$'s distribution.

## 5.1 Static Model

The market rate for each provider is $p_{jt}$, and parents sending their child to a pre-qualified UPK program pays $p_{jt} - subsidy_t$.

Each provider $j$ offering child care for 3-5 yo child (pre-qualified for UPK or not) belongs to $\mathcal{J}_{mt}$ preschools in a market $mt$. Preschool-fixed characteristics $\xi_j$, time-fixed demand shock $\xi_t$, and transitory demand shock $\Delta\xi_{jt}$ are unobserved but known to parents. I use $sr_{jt}$ to denote the star rating of provider $j$. Thus, family $i$ derives utility from choosing preschool $j$:

$$u_{iljt} = \underbrace{\beta^{sr}\mathbb{1}\{sr_{jt} = sr\} + \beta^{UPK}\mathbb{1}\{UPK_{jt} = 1\} + \xi_t + \xi_j + \Delta\xi_{jt}}_{\delta_{jt}} + \underbrace{(\alpha_1 + \frac{\alpha_2}{y_{it}})p'_{ijt} + \lambda_d d_{lj}}_{\mu_{iljt}} + \epsilon_{ijt}. \quad (2)$$

I allow price tradeoffs to depend on family income. $p'_{ijt}$ takes into account UPK subsidy for pre-qualified programs. I assume all children enrolled in an UPK program receives UPK subsidy, since the transparency of this UPK program is relatively high. $d_{lj}$ measures the distance between the centroid of region $l$ and program $j$, so that utility takes into account distance from school. I assume all shocks are Extreme Value Type I distributed. The outside option is not attending licensed/registered child care (parental care, relatives care, non-professional care).

Then, the share of households in area $l$ choosing program $j$ is:

$$s_{ljt} = \int_0^\infty \frac{exp(\delta_{jt} + \mu_{lj}(y_{it}))}{1 + \sum_{k \in \mathcal{J}_{mt}} exp(\delta_{kt} + \mu_{lk}(y_{it}))}, \quad (3)$$

and the market share of program $j$ is then computed by summing $s_{ljt}$ over all regions $l$, and income $n$ drawn from distribution $F^y_{lmt}$:

$$s_{jt} = \sum_{l \in \mathcal{L}_m} \sum_{n \in y(.)} w_{lnt} s_{lnjt}. \quad (4)$$

A caveat of this analysis is I do not take into account program wait lists, because I don't have the precise data on which provider have reached its capacity. Instead, I follow the literature's common practice to add an increasing term in the marginal cost, such that marginal cost increases as a provider reaches its capacity (Fowlie et al., 2012; Ryan, 2012). Based on 2017-2019 data, only 30% percentage of programs have enrollment $\geq$ capacity, suggesting capacity is not often a restricting factor of family choices, so my specification should not significantly affect the demand estimation. In addition, because the enrollment is pure headcount of enrolled children instead of full-time equivalent enrollment, this can bias our results if the part-time/full-time enrollment differs across provider types.

**Marginal Cost:** Preschool program chooses market rate $p_{jt}$ to maximize profits in Bertrand competition. Although there are programs that are not for-profit (e.g. public programs), the majority of preschools in my data are for-profit. We thus have the usual setting of supply side, with variable profit:

$$\pi(p_{jt}, s_{jt}, sr_{jt}) = N_{mt} s_{jt}(p_{jt} - mc_{jt}), \tag{5}$$

The first order condition is:

$$s_{jt} + \frac{\delta s_{jt}}{\delta p_{jt}}(p_{jt} - mc_{jt}) = 0. \tag{6}$$

We can rewrite marginal cost as:

$$mc_{jt} = p_{jt} - \underbrace{[\Delta_t(p_{jt})^{-1} s_{jt}]}_{\eta_{jt}}, \tag{7}$$

where $\Delta_t(p_j t)$ is the matrix of $\frac{\delta s_{jt}}{\delta p_{jt}}$. $\eta_{jt}$ is the markup.

The parameters in the static model will be estimated jointly using GMM. The cost-shifters are public school teachers' wages, and measures of local competition.

## 5.2 Supply

I model the supply side using a two-stage static game. The goal is to obtain an estimate for fixed costs associated with different actions, such that I can conclude whether the current UPK subsidy covers the cost of operating at a high quality level, and how an alternative policy can incentivize more high-quality child care provision. I assume different fixed costs for operating at different quality levels $\{Star0, Star1-2, Star3, Star4-5\ non-UPK, Star4-5\ UPK\}$, and impose a common entry cost for all potential entrants because over 70% of all new entrants in years 2017-2019 entered as low-rating, therefore have similar fixed cost.

The two-stage game is as follows:

1. Providers observe realizations of shocks to fixed costs of quality $F_j$. The shocks are unobserved to economists. They then simultaneously choose the quality of care or exit to maximize expected profits, and incur fixed costs.

$$\max_{quality} \{\{\mathbb{E}_{(\xi_t,\eta_t)}\pi_{jt}(quality, \Theta_t, \xi_t, \eta_t) - F_t^{quality}\}_{quality\in\{star1,\ldots,star5-UPK\}}, 0\} \tag{8}$$

   Potential entrants also decide whether to enter the market. I allow free entry at all locations in the market, such that each location $l$ has a potential entrant every year. The potential entrant's decision is:

$$\mathbb{E}_{(\xi_t,\eta_t)}\pi_{jt}(\Theta_t, \xi_t, \eta_t) - F_{jt}^{enter} \geq 0 \tag{9}$$

2. Providers observe realizations of demand and MC shocks unobserved to economists. They then simultaneously set prices.

At stage 1, providers know the distribution of shocks to demand and MC, but observe their realizations only at stage 2. In equilibrium, $F_t^{quality}$ solves eqn (8) for each provider $j$. $F_t^{enter}$ solves eqn (9) for each potential entrant $j$. The idea is that deviation (entry, exit, upgrade) of one provider from equilibrium should not lead to higher expected profit for that provider, with the expectation taken over demand and MC shocks. If a provider upgrades to a new quality level, this implies an upper bound for the fixed cost of operating at the new quality level the provider upgrade to. If provider choose to exit the market from a quality level, this imposes a lower bound on the FC of operating at the quality level. For new entrants, I obtain an upper bound of the fixed cost of entry. From potential new entrants that do not enter the market, I obtain a lower bound of the FC of entry.

### 5.3 Estimation

I use 2017-2019 data to estimate the static model. This allows me to use the enrollment data (only available after 2017) instead of capacity data to calculate the market share. The static parameters to be estimated in the demand model are:

- mean utility parameter: $\beta^{sr}$,$\beta^{UPK}$
- family type specific parameters (nonlinear): $\alpha_1$, $\alpha_2$, $\lambda_d$
- fixed unobservables $\xi_t$, $\xi_j$, $\Delta\xi_{jt}$

For the supply model, I assume marginal cost depends linearly on observed preschool characteristics $X_{jt}$ (star rating, demographics), unobserved cost shocks ($w_t$, $w_j$, $\Delta w_{jt}$), and increasing as enrollment approaches the capacity:

$$\begin{aligned} mc_{jt} = {} & X_{jt}\eta' + \gamma_c center_j(Enrollment - \theta_{jt})\mathbb{1}[(Enrollment - \theta_{jt}) > 0] \\ & + \gamma_h(1 - center_j)(Enrollment - \theta_{jt})\mathbb{1}[(Enrollment - \theta_{jt}) > 0] + \omega_t + \omega_j + \Delta\omega_{jt}, \end{aligned} \tag{10}$$

where $\theta_{jt}$ is the threshold at which the MC binds, assuming programs have to increase marginal cost beyond the threshold.

I estimate using GMM. To deal with endogeneity of prices, I include instruments of cost-shifters (average preschool teacher wage for public schools) and differentiation instruments following Gandhi and Houde (2020).

To compute the fixed costs, I will first obtain the expected variable profit by drawing $n$ demand and MC shocks from the estimated distributions and recompute the equilibrium. The average variable profits obtained from the simulation will allow me to estimate the fixed cost bounds that supports the observed provider deviation.

### 5.4 Results

Demand and marginal cost estimates are in Table 7 and Table 8. On the demand side, families significantly value star 4-5 UPK programs, suggesting that the UPK prequalification is a strong signal for high-quality preschool care. Families do not significantly value star3-5 star non-UPK programs higher than low-rating (star 1-2) programs, which may be due to our data limitation that prevents us from accurately capturing the true market share of all programs. Families also have significantly lower utility for programs with long distance and higher prices. In terms of preference heterogeneity, families with lower income have a taste for less costly programs.

On the supply side, I find considerable variation in marginal cost for different qualities of care, with star 4-5 UPK programs costing \$42.6 more per child than low-rating programs. Fixed cost estimation suggests that on average, the upper bound for fixed cost for operating at 4-5 Star UPK is \$1,138 higher than operating as a 4-5 Star non-UPK. This implies extremely high cost of maintaining UPK prequalification. Using 232 exited providers in 2017-2019, I compute a lower bound for operating at different quality levels. The lower bound for Not rated (average \$360) is slightly higher than 1-2 star, 3-star or 4-5 star non-UPK providers (\$195, \$174, \$208, respectively). The lower bound for 4-5 star UPK is much higher (\$774). Overall, given the higher fixed cost of maintaining UPK status and the capped tuition received from part-time UPK subsidy, it seems reasonable that current UPK providers increase full-time prices to become more profitable.

# 6 Counterfactuals

With the demand and supply model, I can run several counterfactuals to understand the true impact of UPK policy, and how alternative policies may shape the market of supply.

The first counterfactual would be completely without the UPK policy, but with the CCFAP tiered-reimbursement subsidy. This allows me to compare the market quality component change of the UPK policy. The second counterfactual is a budget neutral policy that reallocates funding from CCFAP to UPK subsidy, such that lower-income families value the UPK policies more. For each counterfactual, I follow the steps below to collect a set of potential equilibrium:

1. Simulate a counterfactual $\mathcal{A}$ where programs remain the same state as in data $\rightarrow$ variable profits may change due to different policy

2. Loop through every incumbent and potential entrant, note all providers that have a profitable deviation given the estimated range of fixed cost for different quality levels. Call the deviated state $\mathcal{A}'$

3. For every possible $\mathcal{A}'$, compute an interval of fixed cost for each provider s.t. the provider has no incentive to deviate from $\mathcal{A}'$. If the fixed cost interval for all providers overlap with the estimated fixed cost interval for corresponding quality level, then consider $\mathcal{A}'$ a potential equilibrium

4. Start from $\mathcal{A}'$, repeat step 2 and 3, until no profitable deviation can be made by a unilateral provider

This requires me to know the variable profit of each provider $j$ in every possible state. This is an infeasible task as there could be over $3^3 00$ possible states in one market. Therefore, I need to predict the variable profits of providers in different states. I will need neural network or lasso

### 6.1 No UPK Policy

Figure 6 shows the simulated market without UPK policy, with two additional plots that shows the market structure changes for high-income and low-income counties separately. Comparison of the current (original) market structure to the counterfactual suggests that UPK policy encourages more supply of 4-5 star providers, consistent with the policy's intention of expanding high-quality child care. It is worth noting that the counterfactual market structure for high-income and low-income counties have similar levels of star 2-5 providers, but low-income counties have fewer star 1 providers than high-income counties. This implies we estimate that child care in low-income counties have higher average quality compared to high-income counties. The structure makes sense, as the CCFAP policy pays higher subsidies to higher-rating providers in lower-income families, such that providers are more likely to upgrade in low-income counties. Overall, this implies the current UPK policy successfully encourages slightly more upgrades to 4-5 stars in the high-income counties compared to the low-income counties. The underlying mechanism is lightly the lower variable profits from UPK providers in low-income counties due to fewer families willing to pay for higher UPK prices.

## 7 Conclusion

This paper contributes to the current policy debate on extending UPK policy to all states. Using a static demand and supply model, I show that the Vermont UPK policy successfully improves the market structure for both high-income and low-income counties, through encouraging providers to upgrade to become higher quality. The impact is heterogeneous across counties, with higher-income counties observing slightly more improvement, likely because higher-income families are more willing to attend full-time UPK programs by paying a higher out-of-pocket cost. This suggests that policymakers who want to implement a similar voucher-based UPK policy may want to closely examine its potential impact on different population to ensure that the policy does not disproportionally redistribute subsidy to high-income families from low-income families.

The current study has several limitations. Because I cannot distinguish full-time enrollment from part-time enrollment, I cannot measure the direct impact of UPK on full-time/part-time enrollment to examine whether providers indeed offer part-time UPK, or they overwhelmingly offer full-time UPK, where they can set price at their discretion. It also potentially biases my demand estimates, as the market share depends on the enrollment data. In addition, I do not observe the wait list for each provider. In reality, a lot of families find it difficult to enroll in their first choice child care, so the observed enrollment may not fully reveal families' preferences. Future research can consider studying a state that reports full-time equivalent enrollment, or has individual survey data that reveals families' first and second choices.

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Table 1: Summary Statistics of Provider Data

| | 2012 | | 2019 | |
|---|---|---|---|---|
| | mean | sd | mean | sd |
| *Panel A: Program Characteristics* | | | | |
| 5 Star | 0.11 | 0.31 | 0.24 | 0.43 |
| Star Accredited | 0.41 | 0.49 | 0.99 | 0.11 |
| UPK Prequalified | | | 0.38 | 0.49 |
| Publicly Provided | 0.11 | 0.32 | 0.16 | 0.37 |
| *Panel B: Capacity and Enrollment* | | | | |
| Preschool Capacity | 8.29 | 11.66 | 12.01 | 14.13 |
| Preschool Enrollment | | | 12.44 | 15.16 |
| Toddler | 2.77 | 4.04 | 3.19 | 4.81 |
| Infant | 2.57 | 4.11 | 3.30 | 5.69 |
| *Panel C: Market Dynamics* | | | | |
| # New Entrants | 132 | | 63 | |
| # Exits | 187 | | 118 | |
| # Upgrades | 192 | | 200 | |
| *Panel D: Provider Rates (Listed Price)* | | | | |
| Full-time Weekly Preschool | 151.12 | 43.78 | 203.33 | 68.18 |
| Part-time Weekly Preschool | 104.06 | 41.00 | 145.45 | 56.22 |
| Full-time Weekly Toddler | 154.52 | 45.46 | 207.84 | 69.56 |
| Full-time Weekly Infant | 161.42 | 47.38 | 212.23 | 65.91 |
| Observations | 1,416 | | 995 | |

Table 2: Treatment Effect on Entry/Exits

| | Entry | Exit | Exit High-rating | Exit Low-rating |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| T | 0.0862*** | 0.1081*** | -0.0664* | 0.1415*** |
| | (0.0329) | (0.0373) | (0.0345) | (0.0434) |
| p-value for pretrend test | 0.0392 | 0.8980 | 0.2100 | 0.7044 |
| *N* | 9,800 | 10,307 | 2,129 | 8,178 |

Note: Treatment effects of treatment indicator estimated using Callaway-Sant'Anna Difference-in-difference. Outcome variables are dummy variables indicating whether the provider is a new entrant, or whether the provider exits the market the following year. Specifications control for demographics such as county population, number of 3-4-year-old children, percentage of women with high-school diploma, percentage of families under federal poverty line, and percentage of children under 5 years old living in poverty.

Table 3: Treatment Effect on Upgrades

| | Any Upgrade<br>(1) | Any Upgrade from Low-rating<br>(2) | Any Upgrade to High-rating<br>(3) | Average Star Rating<br>(4) |
|---|---|---|---|---|
| T | -0.1464*** | -0.0806* | -0.0228 | 0.2091** |
| | (0.0359) | (0.0406) | (0.0225) | (0.0797) |
| p-value for pretrend test | 0.0633 | 0.0329 | 0.1011 | 0.0377 |
| *N* | 10,307 | 6,831 | 8,178 | 10,307 |

Note: Treatment effects of treatment indicator estimated using Callaway-Sant'Anna Difference-in-difference. Outcome variables in columns (1)-(3) are dummy variables indicating whether the provider upgrades on star rating the following year. Outcome variable in column (4) is the star rating. Specifications control for demographics such as county population, number of 3-4-year-old children, percentage of women with high-school diploma, percentage of families under federal poverty line, and percentage of children under 5 years old living in poverty.

Table 4: Treatment Effect on Entry/Exit/Upgrade per 1,000 population

| | # Entry<br>(1) | # Entry Slots<br>(2) | # Exit<br>(3) | # Exit Slots<br>(4) | # Upgrade<br>(5) | # Upgrade Slots<br>(6) |
|---|---|---|---|---|---|---|
| T | 0.3268** | 1.3742* | 0.2019** | 0.5456* | -0.2833** | -1.2432** |
| | (0.1645) | (0.8351) | (0.0792) | (0.3048) | (0.1448) | (0.6273) |
| p-value for pretrend test | 0.0759 | 0.2132 | 0.4810 | 0.8122 | 0.1028 | 0.2384 |
| *N* | 2,450 | 2,450 | 2,450 | 2,450 | 2,450 | 2,450 |

Note: Treatment effects of treatment indicator estimated using Callaway-Sant'Anna Difference-in-difference. Outcome variables are number of program entries/exits/upgrades per 1,000 population in town. Specifications control for demographics such as county population, number of 3-4-year-old children, percentage of women with high-school diploma, percentage of families under federal poverty line, and percentage of children under 5 years old living in poverty.

Table 5: Treatment Effect on Slots per 1,000 Children

| | PreK, private<br>(1) | PreK, private High-rating<br>(2) | Toddler, private<br>(3) | Toddler, private High-rating<br>(4) | PreK, total<br>(5) | PreK, total High-rating<br>(6) |
|---|---|---|---|---|---|---|
| T | -69.7072*** | -11.7088 | -32.9861 | -3.9064 | -46.0316 | -5.9629 |
| | (33.1147) | (17.2783) | (31.6501) | (12.7391) | (32.9897) | (28.0392) |
| p-value for pretrend test | 0.5737 | 0.9177 | 0.2363 | 0.2229 | 0.9385 | 0.8753 |
| *N* | 2,450 | 2,450 | 2,450 | 2,450 | 2,450 | 2,450 |

Note: Treatment effects of treatment indicator estimated using Callaway-Sant'Anna Difference-in-difference. Outcome variables are preschool/toddler capacity. Specifications control for demographics such as county population, number of 3-4-year-old children, percentage of women with high-school diploma, percentage of families under federal poverty line, and percentage of children under 5 years old living in poverty.

Table 6: Treatment Effect on Provider Rates

| | FT weekly PreK (1) | PT weekly PreK (2) | FT weekly Toddler (3) | PT weekly Toddler (4) |
|---|---|---|---|---|
| | | *Panel A. Full Sample* | | |
| T | 1.5057 | 5.1099 | -0.5969 | 0.074 |
| | (3.0758) | (2.8071) | (3.2192) | (3.2333) |
| p-value for pretrend test | 0.6075 | 0.8926 | 0.3211 | 0.2053 |
| $N$ | 7,035 | 7,035 | 7,035 | 7,035 |
| | | *Panel B. High-rating* | | |
| T | -3.6655 | 8.7248 | 3.8752 | 12.9486 |
| | (8.8485) | (9.9648) | (9.3095) | (9.8721) |
| p-value for pretrend test | 0.3987 | 0.4631 | 0.1008 | 0.1689 |
| $N$ | 1,789 | 1,789 | 1,789 | 1,789 |
| | | *Panel C. Low-rating* | | |
| T | 0.2353 | 1.1443 | -2.0746 | -3.037 |
| | (3.1789) | (3.3542) | (3.4714) | (3.8906) |
| p-value for pretrend test | 0.4977 | 0.7156 | 0.1823 | 0.1217 |
| $N$ | 5,246 | 5,246 | 5,246 | 5,246 |
| | | *Panel D. Ever-UPK* | | |
| T | -23.337*** | -7.1046 | -10.3708 | 6.3708 |
| | (9.7289) | (6.8665) | (10.3363) | (9.8564) |
| p-value for pretrend test | 0.3123 | 0.7469 | 0.8652 | 0.2687 |
| $N$ | 1,487 | 1,487 | 1,487 | 1,487 |
| | | *Panel E. Never-UPK* | | |
| T | 3.0215 | 3.6066 | 0.0452 | -1.3364 |
| | (2.8295) | (2.7508) | (3.5262) | (3.4118) |
| p-value for pretrend test | 0.7993 | 0.8586 | 0.4125 | 0.2792 |
| $N$ | 5,548 | 5,548 | 5,548 | 5,548 |

Note: Treatment effects of treatment indicator estimated using Callaway-Sant'Anna Difference-in-difference. Outcome variables are reported market rates, normalized to 2019 dollars. Specifications control for demographics such as county population, number of 3-4-year-old children, percentage of women with high-school diploma, percentage of families under federal poverty line, and percentage of children under 5 years old living in poverty.

Table 7: Demand Estimates

| Coefficients | Parameters | Estimates | Std.Errors |
|---|---|---|---|
| | | Linear Demand Estimates | |
| Star 0 | $\beta^{star0}$ | -0.088 | (0.064) |
| Star 3 | $\beta^{star3}$ | 0.138 | (0.115) |
| Star 4 & 5, non-UPK | $\beta^{star4\&5,non-UPK}$ | 0.120 | (0.168) |
| Star 4 & 5, UPK | $\beta^{star4\&5,UPK}$ | 0.423 | (0.213) |
| | | Non Linear Demand Estimates | |
| Price | $\alpha_1$ | -0.015 | (0.004) |
| Price / log income | $\alpha_2$ | -3.480 | (1.170) |
| Distance | $\lambda_d$ | -0.323 | (0.041) |

Estimates of the demand side coefficients include year and preschool fixed effects. Prices are in dollars per week, adjusted for CCFAP subsidies, and distance in km.

Table 8: Marginal Cost Estimates

| | | |
|---|---|---|
| Star 0 | -0.721 | (2.583) |
| Star 3 | 4.889 | (2.040) |
| Star 4 & 5, non-UPK | 21.434 | (3.281) |
| Star 4 & 5, UPK | 42.618 | (3.329) |
| Center | 40.540 | (4.278) |
| Fraction PreK among All Capacity | -24.358 | (6.832) |
| Age | -0.830 | (0.175) |
| % over threshold (Home) | -0.468 | (0.675) |
| % over threshold (Center) | 11.230 | (2.802) |

Estimates of coefficients of programs' marginal costs include program and year fixed effects.

Table 9: Treatment Effect on Entry/Exit/Upgrade per 1,000 population

| | # Entry (1) | # Entry Slots (2) | # Exit (3) | # Exit Slots (4) | # Upgrade (5) | # Upgrade Slots (6) |
|---|---|---|---|---|---|---|
| T | 0.3268** | 1.3742* | 0.2019** | 0.5456* | -0.2833** | -1.2432** |
| | (0.1645) | (0.8351) | (0.0792) | (0.3048) | (0.1448) | (0.6273) |
| p-value for pretrend test | 0.0759 | 0.2132 | 0.4810 | 0.8122 | 0.1028 | 0.2384 |
| $N$ | 2,450 | 2,450 | 2,450 | 2,450 | 2,450 | 2,450 |

Table 10: Demand Estimates

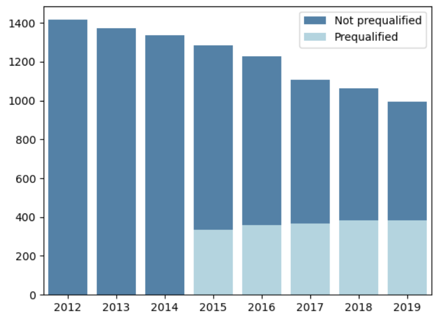
| Coefficients | Parameters | Estimates | Std.Errors |
|---|---|---|---|
| | Linear Demand Estimates | | |
| Star 0 | $\beta^{star0}$ | -0.088 | (0.064) |
| Star 3 | $\beta^{star3}$ | 0.138 | (0.115) |
| Star 4 & 5, non-UPK | $\beta^{star4\&5,non-UPK}$ | 0.120 | (0.168) |
| Star 4 & 5, UPK | $\beta^{star4\&5,UPK}$ | 0.423 | (0.213) |
| | Non Linear Demand Estimates | | |
| Price | $\alpha_1$ | -0.015 | (0.004) |
| Price / log income | $\alpha_2$ | -3.480 | (1.170) |
| Distance | $\lambda_d$ | -0.323 | (0.041) |

Estimates of the demand side coefficients include year and preschool fixed effects. Prices are in dollars per week, adjusted for CCFAP subsidies, and distance in km.

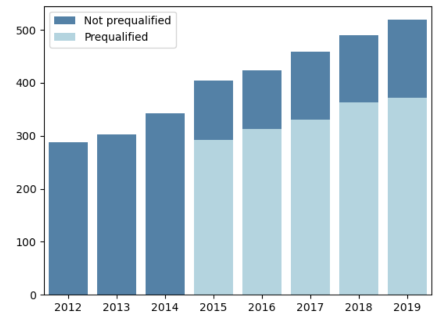
Table 11: Marginal Cost Estimates

| | | |
|---|---|---|
| Star 0 | -0.721 | (2.583) |
| Star 3 | 4.889 | (2.040) |
| Star 4 & 5, non-UPK | 21.434 | (3.281) |
| Star 4 & 5, UPK | 42.618 | (3.329) |
| Center | 40.540 | (4.278) |
| Fraction PreK among All Capacity | -24.358 | (6.832) |
| Age | -0.830 | (0.175) |
| % over threshold (Home) | -0.468 | (0.675) |
| % over threshold (Center) | 11.230 | (2.802) |

Estimates of coefficients of programs' marginal costs include program and year fixed effects.




(a) # Programs




(b) # 4-5 Star Programs

Figure 1

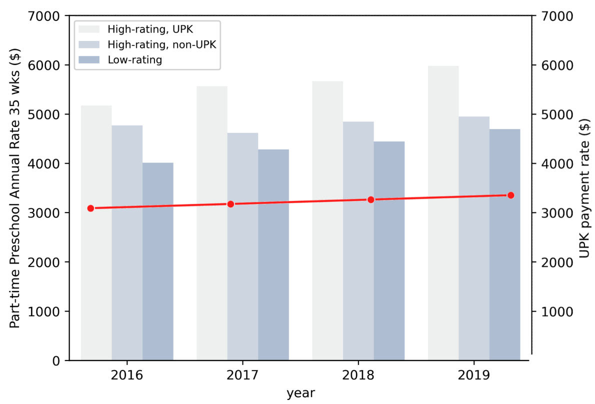
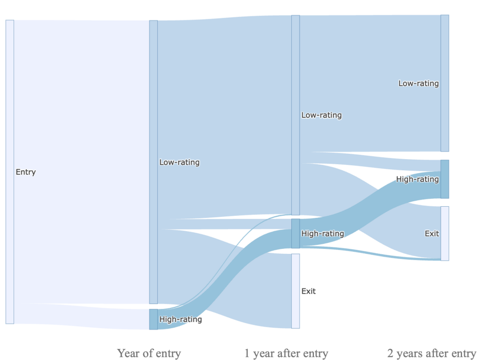
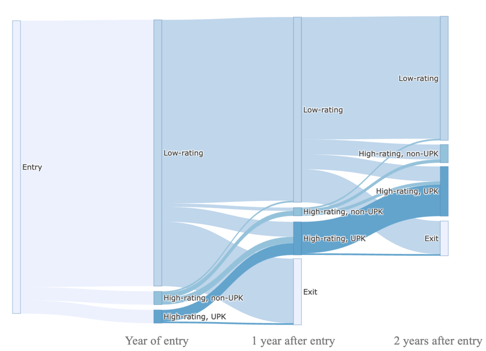



Figure 2: Part-time PreK Annual Rate vs. UPK Fund Rate

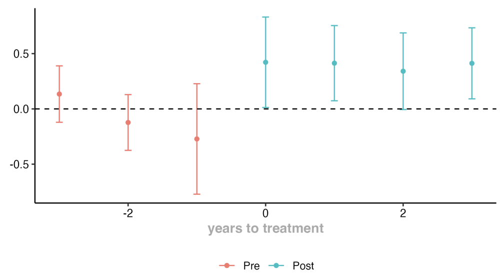



(a) New Entrants in 2013-2014

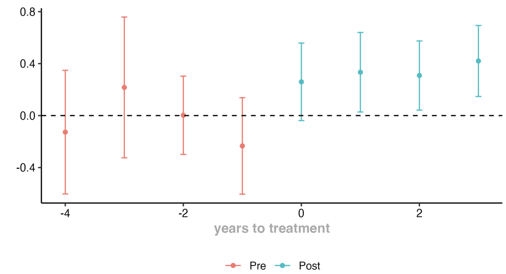



(b) New Entrants in 2016-2017

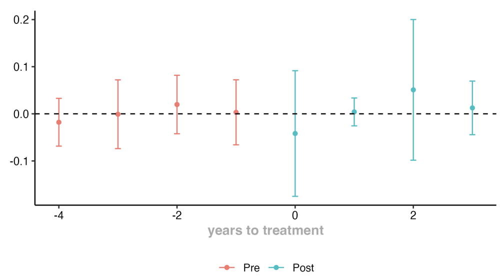
Figure 3: Dynamics of New Entrants



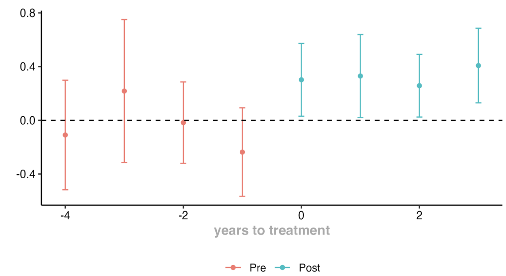

(a) Entry per 1,000 kids



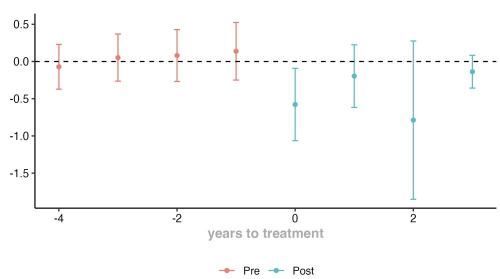

(b) Exit per 1,000 kids



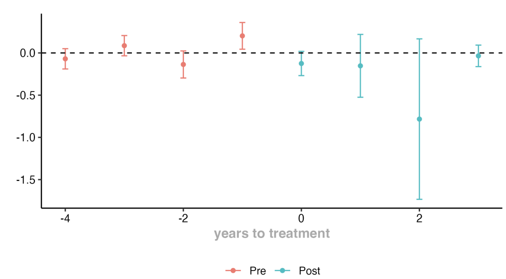

(c) Exit of High-rating per 1,000 kids




(d) Exit of Low-rating per 1,000 kids

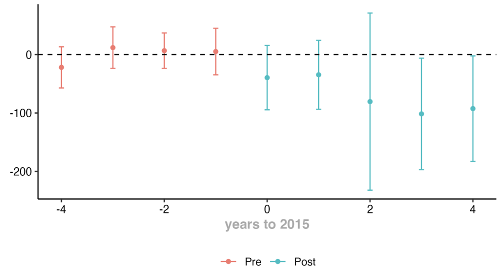



(e) Any Upgrade, per 1,000 kids

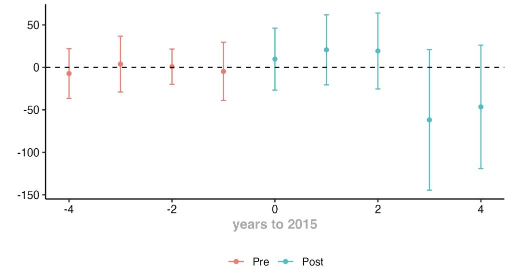



(f) Any Upgrade from Low-rating, per 1,000 kids

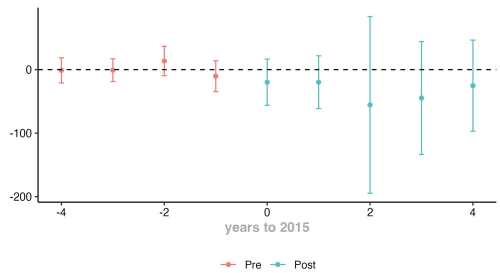
Figure 4: Event Study: Entry, Exit, and Upgrade



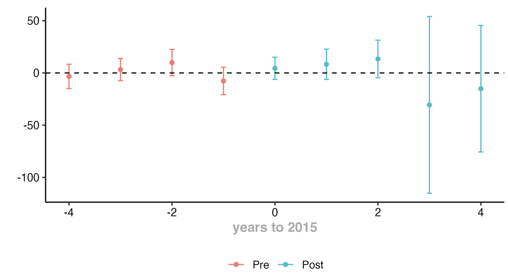

(a) # private PreK slots per 1,000 kids



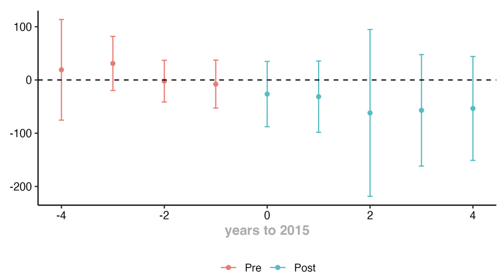

(b) # private high-rating PreK slots per 1,000 kids



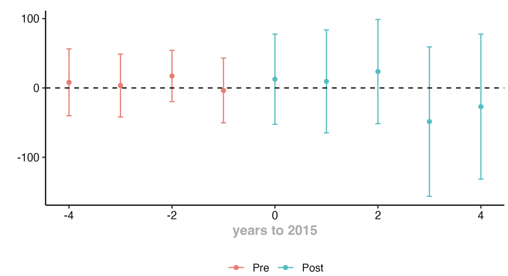

(c) # Toddler slots per 1,000 kids




(d) # High-rating Toddler slots per 1,000 kids




(e) # PreK slots per 1,000 kids




(f) # High-rating PreK slots per 1,000 kids

Figure 5: Event Study: Total Capacity

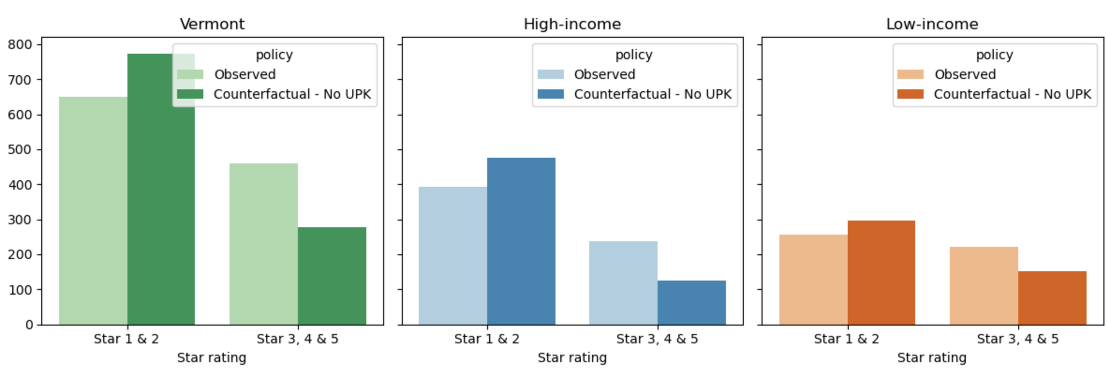



Figure 6: Market Structure of Counterfactual without UPK