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# Understanding Day Care Enrolment Gaps

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#### IMPRESSUM

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# Understanding Day Care Enrolment Gaps\*

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## Abstract

We document day care enrolment gaps by family background for children under 3 in Germany. Research demonstrates that children of less-educated or foreign-born parents benefit most from day care, making it important to understand the causes of such enrolment gaps. Using a unique data set that records both actual and preferred day care usage, we demonstrate that differences in demand cannot fully explain the enrolment gaps. Investigating supply-side factors using quasi-experimental designs, we find that reducing both parental fees and scarcity of places significantly decreases enrolment gaps by parental education but not by parental country of birth. We discuss implications.

**Keywords** Child care · Early education · Inequality · Socio-economic status · Discrimination · Synthetic control

**JEL Classification** I24 · J13

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# 1 Introduction

By school starting age, children of less-educated or foreign-born parents are often behind their peers on measures of child development (e.g. Bradbury et al., 2015; Carneiro and Heckman, 2003). In many cases, these inequalities are already so deeply ingrained that they are difficult to address through the school system. Day care is considered an effective means of influencing child development in pre-school years, especially for children of less-educated or foreign-born parents.<sup>1</sup> As a result, day care is increasingly seen as an opportunity to “level the playing field” for children of different family backgrounds (e.g. Cornelissen et al., 2018; Felfe and Lalive, 2018; Havnes and Mogstad, 2011, 2015). However, despite expanding access to day care, there remain enrolment gaps across many OECD countries (e.g. OECD, 2018).

In countries with universal day care, enrolment gaps by family background may be explained by different preferences for day care (i.e. demand) or different barriers to access (i.e. supply). On the demand side, less-educated or foreign-born parents may be less likely to want a day care spot if they prefer informal care arrangements, have more critical attitudes toward day care, expect lower returns to investment in their children, or expect lower returns to working (Boneva and Rauh, 2018; Cunha et al., 2013). On the supply side, those parents may be disproportionately affected by barriers such as a shortage of places or day care fees (parental contributions).<sup>2</sup> Shortages may disproportionately affect less-educated or foreign-born parents if they have fewer resources (e.g. financial, social, information) to secure scarce slots, or if the combination of higher workloads and excess demand results in greater applicant discrimination by day care centers.<sup>3</sup> Finally, the presence of day care fees,

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<sup>1</sup>Payoffs exist in general because many skills develop early in life (e.g. Phillips et al., 2000) and because longer payoff periods make early learning more productive (Becker, 1975). There may also be important “dynamic complementarities” since early inputs strongly affect the productivity of later inputs (e.g. Cunha and Heckman, 2007).

<sup>2</sup>Many OECD countries are characterized by severe day care shortages and high parental fees (OECD, 2017).

<sup>3</sup>In a randomized controlled trial, Andersen and Guul (2019) show that discrimination by public school teachers is most acute when workloads are high.

even if income-adjusted, may discourage lower-income parents from enrolling in day care. The existence of any such mechanisms, in particular those on the supply-side, would have important policy consequences.

In order to investigate demand- and supply-side causes of day care enrolment gaps, we use a large representative survey data set of more than 62,000 children younger than three in Germany. Using this data, we start out documenting gaps in day care enrolment by parental education and parental country of birth.<sup>4</sup> We then explore the demand side as an explanation for observed gaps by making use of the fact that our data set reports stated preferences for day care irrespective of actual enrolment. To examine the role of scarcity of places, we create a measure of local shortages that is the difference between demand and supply at the county level. We estimate the effect on shortages on the enrolment gap in a panel fixed effects model. As such we make use of within-county changes in shortages over time that largely reflect differences in the timing of the roll-out of places across Germany. Finally, to examine the role of parental fees, we use the synthetic control method to estimate the impact of a substantial reduction of fees due to a policy change in one German federal state.

We find enrolment gaps of 14 percentage points by parental education and 12 percentage points by parental country of birth—corresponding to gaps of around 37 percent in each case. We show that the demand gaps for these family backgrounds are much smaller than the enrolment gaps. In fact, for children with migrant family backgrounds there is hardly any demand gap at all. Overall, the enrolment gaps cannot be (fully) explained by differences in demand. On the supply-side, we find that reducing day care shortages significantly decreases the enrolment gap by parental education but has no effect on the migrant-native gap. Similarly for parental fees, a large reduction in one state significantly reduced the enrolment gap by parental education but had no impact on the gap by parental country of birth.

In terms of policy implications, the results suggest that the enrolment gap for less-

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<sup>4</sup>These factors are more fixed than income or employment, which are endogenous with day care enrolment.

educated parents may be reduced either by reducing fees or through increasing availability. However, the enrolment gap by parental country of birth does not seem to be affected by changes to these supply constraints. Our results imply that the gap for foreign parents reflect barriers to access that remain even when day care is available and affordable. We suggest two possibilities: (i) that foreign-born parents face strong discrimination even where shortages of places is less acute, or (ii) that foreign-born parents do not find the quality of care to be adequate. The latter possibility could be the case if the quality of care is lower in the areas where foreign parents typically live, or if foreign parents are more greatly affected by quality issues that affect everyone such as group size, or if foreign born parents are affected by specific quality concerns such as a lack of multilingual teachers or consideration of different cultures and religions.

This paper is closely related to the literature on the evolution and causes of educational inequalities and intergenerational educational mobility (see e.g. Björklund and Salvanes, 2011, for an overview). The existing economic literature mainly focuses on exploring socioeconomic status gradients in educational attainment or achievement, with a particular focus on higher education (e.g. Boneva and Rauh, 2017; Machin and Vignoles, 2004; Hanushek et al., 2019). Such gaps are both well documented and well understood in terms of their major determining factors. Conversely, gaps in early educational settings are less well understood, despite the crucial importance of this early phase of life for later outcomes. Large and persistent gaps in enrolment in early education and care are well documented across different institutional settings (e.g. Greenberg, 2011; Magnuson and Waldfogel, 2016; Stahl and Schober, 2018; Zachrisson et al., 2013). However, the literature on the underlying drivers of such gaps is thin. In particular, it lacks good data capturing demand and regional supply side factors, thus failing to answer convincingly why gaps in enrolment in day care exist. Most previous research on the different demand and supply side factors is purely descriptive and based on cross-country variation (e.g. Pavolini and Van Lancker, 2018) or time varia-

tion within a single country or region (e.g. Sibley et al., 2015).<sup>5</sup> The evidence from these studies is mixed. There is some suggestive evidence that supply-side factors, for example, the availability of day care or its fees, are important for explaining the large gaps in day care enrolment (e.g. Abrassart and Bonoli, 2015; Bainbridge et al., 2005; Sibley et al., 2015; Pavolini and Van Lancker, 2018). Others find the fee structure and the level of provision to be less important (Van Lancker, 2018; Van Lancke and Ghysels, 2012). Regarding demand side factors, previous studies show that less educated or foreign-born parents of children who are not in day care are somewhat more likely to state that they want to raise their child themselves (e.g. Schober and Spieß, 2013).

We address this gap in the literature by using a large and representative data set of children below the age of three in Germany that allows us to not only observe actual day care enrolment but also demand for day care. Thus, we can provide evidence on whether gaps in enrolment in early education and care simply reflect differences in demand between groups. In addition, we use different empirical methods to investigate the role of regional availability of day care spots and fees in explaining gaps by family background. The paper proceeds as follows: Section 2 outlines the institutional background, Section 3 describes the data used and our empirical strategy. Section 4 presents the results, where we start by examining the role of demand, followed by an analysis of day care shortages and day care fees. Section 5 concludes.

## 2 Institutional Background

In recent years, there has been a strong political effort to increase the provision of publicly subsidized day care in Germany. Thanks in part to a legal claim for children older than three, in place since 1996, enrolment rates have consistently been above 90 percent in the 2010s for this age group. For under threes, enrolment rates were persistently low until around

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<sup>5</sup>In addition, many previous studies define low-socioeconomic status by household income, a problematic approach since the labor supply decision of women on the intensive and extensive margin is likely to be endogenous to day care enrolment.

2005. In 2005, (*TAG*), and, in 2008, (*KiföG*), two laws, came into effect on the federal level, committing the federal states and counties to gradually expand day care supply for children under the age of three. From August 2013 onward, every child above the age of one has a legal claim to a place in day care. The reforms lead to a large increase in enrolment rates of children under three. Whereas in 2006 the fraction of children under the age of three enrolled day care was about 12 percent, the enrolment rates in 2018 were just under 34 percent. Despite this increase, there are large and persistent day care shortages; i.e. demand for day care far exceeds its supply (Alt et al., 2017). In addition, the expansion has happened heterogeneously across states and counties, resulting in large variation in day care shortages across regions.

In Germany, day care is provided within a universal and strongly subsidized system. Almost all day care places are publicly subsidized and provided by the municipalities themselves or by non-profit organizations, including churches and welfare associations. For example in 2017, 33% of day care institutions were public providers, 59.2% other non-profit organizations, and only 2.6% of institutions were private and non-charitable (Statistisches Bundesamt, 2017). On average, public subsidies cover about 70% of day care costs (Spieß, 2013), with some states covering 100% for certain age groups and households.

The remaining proportion of day care costs is partly covered by parental fees. The fees parents pay are usually income-dependent with a progressive fee structure.<sup>6</sup> In some states and municipalities, it also depends on other factors, such as the number of siblings, hours of day care, and type of provision (Autorengruppe Bildungsberichterstattung, 2018). Some low income parents, particularly all welfare recipient families,<sup>7</sup> are exempted from paying fees. Overall, parental fees amount to about 5-10% of average earnings. Thus, they are lower than the OECD average and much lower than in countries with low public subsidies like the US

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<sup>6</sup>Parental fees are not paid to the individual day care institution. Thus, day care centers usually have no financial incentive to take in children from families with higher income. However, they get larger subsidies when they take in children with special needs.

<sup>7</sup>Children from welfare recipient families are in principle entitled to free day care. However, the law is not binding.

(OECD, 2016, 2019). However, fees vary widely across regions, income, and family structure (Schmitz et al., 2017).

Before the introduction of the legal claim to day care for all children above the age of one in August 2013, the federal law (*KiföG*) stipulated that children whose parents (or the single parent) are employed, in education, or receive unemployment benefits (*Leistungen zu Eingliederung in Arbeit im Sinne des Zweiten Buches*) must be granted access to day care.<sup>8</sup> Ultimately, these regulations provided preferential access to households without a stay-at-home parent.

Generally, families can freely decide which day care institution they choose. However, due to severe day care shortages, the number of applications is typically much larger than the number of available spots.<sup>9</sup> The allocation of scarce slots is largely uncoordinated (e.g. Fugger et al., 2017) and varies by region and the type of provider. Some providers and counties have transparent selection criteria and a centralized application system, many others do not. For example, public providers sometimes prioritize children who already have or had a sibling in the same facility or live close by. Day care provided by churches might in addition select families based on their religious affiliation (e.g. Herzog and Klein, 2018).

## 3 Data and empirical strategy

### 3.1 Data

In our empirical analysis, we use a unique representative data set, the German Child Care Study (*KiBS*) of the German Youth Institute (DJI).<sup>10</sup> The KiBS is an annual survey of

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<sup>8</sup>Some states and municipalities had additional regulations. For example, they gave priority in access to single parent families or families who do not speak German at home (e.g. Spieß, 2008).

<sup>9</sup>Despite the legal entitlement for all children above the age of one, there are few cases of legal action. According to KiBS data, less than 1% of parents who state having demanded a slot but not receiving one, report having undertaken legal action already.

<sup>10</sup>The KiBS samples the same number of children (approx. 800) in each of the 16 federal states per wave. This disproportional sampling design leads to smaller states being oversampled. Survey weights, calculated on the state level, account for this. A comparison of the weighted share of children under the age of three in day care with administrative statistics in Appendix Table A1 shows that they resemble each other closely.

children and their households with a specific focus on children’s care arrangements (Alt et al., 2018). The survey was first conducted in 2012 and we use information from all available waves, covering 2012 through 2016. We focus on children in the under three age group, where there is still considerable variation in day care enrolment. In total, we observe 62,437 children below the age of three, making the data set the largest available to analyze day care enrolment in Germany.

**Demand and supply side factors.** A unique feature of the data is that parents report whether or not they would like to have a day care place for their child irrespective of actual enrolment. This feature of the data provides us with a convenient measure of day care demand. Given pervasive shortages in the German context, we use actual enrolment as a measure of day care supply.<sup>11</sup> Using these measures, we can calculate day care demand, supply, and shortages (i.e. excess demand) for any given group of children, e.g. in a specific county or of a specific age. Figure 1 plots day care demand, supply, and shortages aggregated by the child’s age *in months*. Below the age of one, both demand and enrolment rates are very low, but demand jumps when the child turns one.<sup>12</sup> Day care enrolment exhibits a much smaller jump, which results in a substantial increase in shortages at this age. Afterwards, both demand and enrolment increase continuously with a slightly steeper slope in enrolment. Overall, in our sample, 31% of children below three years are in day care. The fraction of parents stating a demand for a place in day care amounts to about 44%. This implies that only 71% of demand is met, thus describing a situation of severe day care shortages.

In our analysis, we consider county level shortages as one main explanatory variable for the existence of enrolment gaps. County-specific day care shortages are defined as the fraction of parents who state that they have demand for a slot in day care but whose children

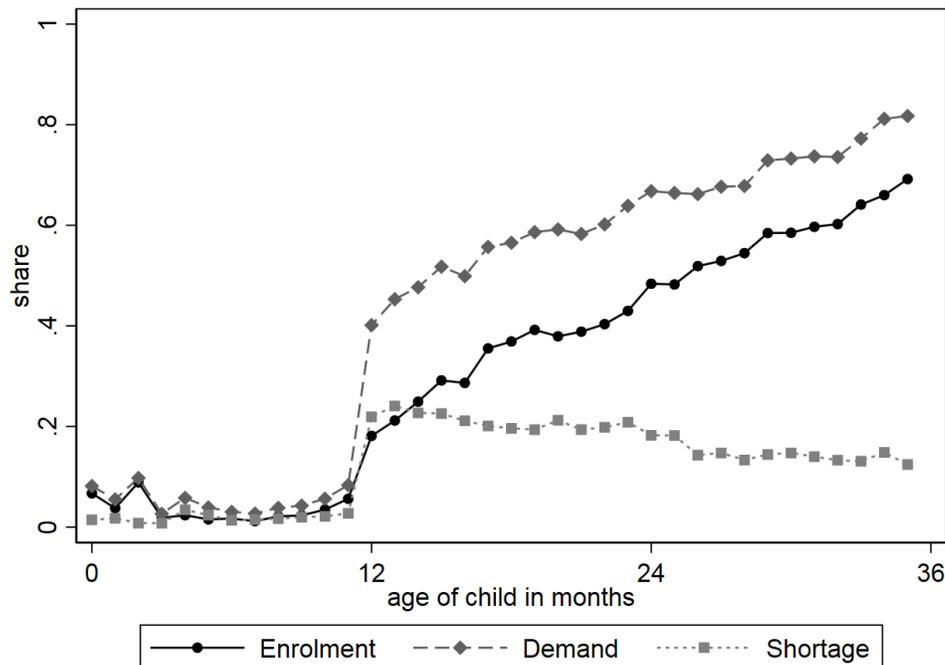
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All figures and tables in this paper are based on weighted calculations using the KiBS data unless indicated otherwise.

<sup>11</sup>Official day care statistics in Germany take the same approach, based on the (reasonable) assumption that the number of free spaces is negligible.

<sup>12</sup>The sudden jump in demand between the 11th and 12th months is likely due to the end of paid parental leave (e.g. Kluve and Schmitz, 2018) and the start of the legal claim to day care (introduced in 2013).

Figure 1: Day care enrolment, demand and shortage by age



Notes: Figure shows day care enrolment, demand and shortages by age of the child.

are not enrolled in day care (see Figure A2 for the distribution of county-level shortages and the deviations from state averages — the effective variation used for our first specification).<sup>13</sup> County shortages range from 0 to 39.2%.

For our analysis of shortages, we make use of two types of variation: (i) across counties within states, and (ii) within counties over time. Since we aggregate individual data points to create county measures, we restrict the sample to have a minimum of 50 observations per county and year to reduce measurement error. This reduces the sample size from 62,473 to 43,691 (and the number of counties from 252 to 95), which has implications for the external validity of our results that we explore in Appendix Table A2. In short, our results are a little more relevant for larger, wealthier, and more urban counties. While our restricted sample is no longer perfectly representative of Germany, it remains a significant advancement on

<sup>13</sup>When calculating shortages for an individual  $i$  in county  $c$  and time period  $t$ , we always leave individual  $i$  out of the calculation, i.e.  $S_{-ict} = \frac{1}{N-1} \sum_{n \neq i}^N Shortage_{nct}$ .

previous studies that focus on individual regions or highly selective groups. Furthermore, the results are robust to the removal of this sample restriction.

The data also contains information on day care fees, as reported by parents in one of the study years (2015). As described in the institutional context, fees vary by household income and other characteristics. For those already in day care, average fees are just below 240 Euros a month. Note that this number is larger than hypothetical average monthly fees if *all* children were enrolled in day care, as fees are progressive.

We also have information on a number of other demand side factors, including the number of applications submitted to day care institutions and hours of day care demanded. Furthermore, the respondents are asked about reasons for not enrolling in day care. They are discussed in more detail in section 4.1.

**Family background.** The data sets contains various socio-economic characteristics of the main respondent and the household. We focus on two main indicators to measure enrolment gaps: parental education and parental country of birth. The less-educated parents indicator is equal to one for children where the respondent parent has no university entrance qualification (Abitur) and zero otherwise.<sup>14</sup> The foreign-born parents indicator is defined as being equal to one for children where both parents (or the single parent) are born in a non-Western European and non-North American country. We make this distinction since Western European and North American countries are in many ways similar to Germany.<sup>15</sup> As a result immigrants from these countries should be affected by shortages and fees similarly to Germans. Overall 48% of children are defined as being from a less-educated household and 14% are defined as having foreign-born parents. Our selection of these indicators is based on several factors. Firstly, these are the sub-groups for which enrolment gaps are

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<sup>14</sup>Educational differences by Abitur vs. no-Abitur are reflected in financial resources of the household and tertiary education obtained, making it a variable that captures socio-economic status. Another common distinction made in the literature is whether parents have obtained tertiary education. As this information is not available in all waves, we do not use this measure in our main specification, but report results in the appendix.

<sup>15</sup>There are no parents from Australia or New Zealand in our data.

often documented in research and in the public debate. Secondly, these are the sub-groups most commonly found in the literature to have greater child development benefits from day care enrolment. Thirdly, these indicators are thought to be more fixed (exogenous) with respect to day care enrolment compared with alternatives such as household income. Fourthly, it is plausible that both of these groups face barriers to accessing public services, with each exploring a slightly different dimension. For example, the foreign-born group may be more exposed to discrimination, have a smaller network of German acquaintances, be less knowledgeable of the (application) system and have lower level of German-language skills things that may give an edge in securing a spot in a competitive environment. In the appendix, we investigate enrolment gaps by alternative indicators: no university degree (57% of our sample), main language at home not German (16%), welfare recipients (19%) and below median pre-birth income (the last two measures are only available in wave 4, and waves 4 and 5, respectively).

Table 1 presents summary statistics of our sample. Observation numbers differ between the variables, as not all questions are asked in each wave and some are conditional on day care enrolment.

### 3.2 Empirical strategy

To investigate possible differential impacts of county-level supply-side factors on day care enrolment, we start out running simple pooled OLS estimation:

$$Y_{icst} = \alpha_0 + \alpha_1 L_i + \alpha_2 S_{-ict} + \alpha_3 (L_i * S_{-ict}) + X'_{it} \alpha_4 + \lambda_{st} + \epsilon_{icst} \quad (1)$$

where  $Y_{icst}$  is day care enrolment of child  $i$  from county  $c$  in state  $s$  in year  $t$ ,  $L_i$  is an indicator of either less-educated or foreign-born parents,  $S_{-ict}$  are regional shortages,  $X'_{it}$  is a vector of exogenous household controls (i.e. the age of the child in three categories and its gender as well as the marital status of the respondent) and an indicator for urban

Table 1: Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
<i>Day care enrolment and demand</i>					
Day care enrolment	62473	.31	.463	0	1
Day care demand	62435	.436	.496	0	1
Day care shortage	62435	.125	.331	0	1
Total monthly fees	6149	238.363	137.622	0	730
Hours of day care demanded	57970	13.499	18.002	0	60
Number of applications	35710	2.417	3.718	0	25
<i>Family background</i>					
Lower education (no Abitur)	62473	.48	.5	0	1
No university degree	49664	.571	.495	0	1
German not main language at home	62287	.162	.369	0	1
One foreign-born parent	62473	.028	.164	0	1
Two foreign-born parents (& non-Western)	61338	.151	.358	0	1
Welfare recipient	23758	.185	.388	0	1
<i>Other household and child characteristics</i>					
Age of child (months)	62473	18.294	9.326	0	35
Female child	62473	.483	.5	0	1
Nbr. children in household	61993	1.812	.859	1	5
Respondent has a partner	62271	.969	.173	0	1
Married	62473	.789	.408	0	1

Notes: Summary statistics pooled over all waves. Questions on fees are only asked in wave 4 for those enrolled. Questions on pre-birth income only in wave 4, on number of applications in waves 3 to 5, on welfare payments in wave 4 and 5. Low education denotes that the respondent's highest school degree is not *Abitur*, which qualifies for university entrance. Monthly fees, number of applications, pre-birth income and number of children in household are winsorised at the 99th percentile.

counties, while  $\lambda_{st}$  are state-year fixed effects. The state-year effects control for time-varying unobservables at the state level that might differentially affect day care enrolment, such as educational reforms, economic shocks, or labor market conditions. Our coefficient of interest,  $\alpha_3$ , indicates whether gaps in enrolment differ by the level of shortage in a county. However, the parameter is inconsistently estimated if changes in supply-side factors within state-year cells are correlated with determinants of the enrolment gap conditional on controls. This seems plausible since county-level shortages (i.e. enrolment and demand) may reflect local labor market conditions or attitudes and norms that certainly affect day care enrolment, potentially with different impacts based on family background.

Our preferred specification is one that includes county fixed-effects:

$$Y_{icst} = \beta_0 + \beta_1 L_i + \beta_2 S_{-ict} + \beta_3 (L_i * S_{-ict}) + X'_{ist} \beta_4 + \mu_c + \theta_t + \varepsilon_{icst} \quad (2)$$

where  $S_{-ict}$  are county level shortages in year  $t$ ,  $\mu_c$  and  $\theta_t$  are county and year fixed effects, and  $X_{ist}$  is the same vector of exogenous controls but including in addition time-varying controls at the state level (unemployment, population density, GDP per capita, and migration share). Here the identifying assumption is that time-variation in shortages within a county is uncorrelated with unobservables that impact day care enrolment differently by family background. This assumption holds if time-variation in shortages within counties arises from exogenous changes in demand or supply. This is plausible if supply changes reflect county-level differences in the timing of roll-out of day care spots in response to the federal level introduction of a legal entitlement to day care. Such differences in speed or timing of roll-out are used in several previous studies as a source of exogenous variation in day care supply (e.g. Cornelissen et al., 2018; Felfe and Lalive, 2018). Furthermore, demand side factors such as norms are likely to be relatively fixed within counties over a short time-frame. Conditional on state-level labor market conditions, local time-variation in demand most likely reflects random fluctuation in birth cohort sizes. Nevertheless, despite the plausibility of the

identifying assumption, the variation we exploit is not fully random.

We further examine alternative specifications to investigate potential non-linear effects of shortages and fees estimating a model with shortages as a binomial:

$$Y_{icst} = \gamma_0 + \gamma_1 L_{it} + \gamma_2 S_{-ict} + \gamma_3 S_{-ict}^2 + \gamma_4 (L_{ict} * S_{-ict}) + \gamma_5 (L_{ict} * S_{-ict}^2) + X'_{ist} \gamma_6 + \mu_c + \theta_t + u_{icst} \quad (3)$$

We also estimate a semi-parametric model:

$$Y_{icst} = \sum_b \delta_b S_{b,-ict} + \sum_b \pi_b (L_{ict} * S_{b,-ict}) + X'_{ist} \sigma + \mu_c + \theta_t + e_{icst} \quad (4)$$

where  $S_b$  are bins for shortages 5 percentage points in width. The advantage of the non-linear specifications is to gain insight into the effect size at different initial levels of shortages. For example, the non-linear specification might reveal that marginal changes have little effect on the enrolment gap at high levels of shortages, suggesting that only a large change would be effective.

In the second part of our analysis, we estimate the impact on the enrolment gaps of a significant reduction of fees in one federal state in Germany using the synthetic control method; further detail is provided in that section.

## 4 Results

We present our results in three sections. In the first section, we provide descriptive evidence on the size of the enrolment gap by family background. In addition, we explore the role of demand as an explanation for this gap. The exploration of demand as a driving factor relies on our data set's unique feature that day care wishes are directly reported. In the second section, we investigate the impact of regional day care shortages on the enrolment gaps using the empirical approaches outlined in the previous section. Finally, the third section examines the role of day care fees. We analyze a policy that eliminated day care fees for the under

three age group in one German state, Hamburg. Since this is the only state to experience such a policy shift in our time window, we make use of the synthetic control method to explore the effect.

## 4.1 Enrolment gaps and the role of demand

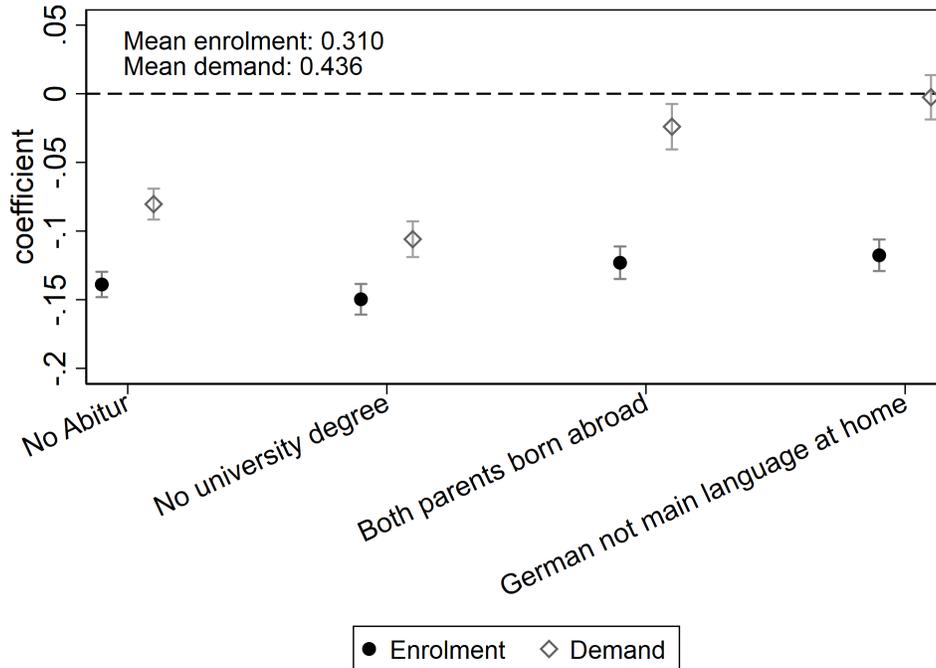
Figure 2 plots the gaps in enrolment and demand for our two main categories (no Abitur and both parents born abroad) plus two alternative categories (no university degree and German not main language at home).<sup>16</sup> Children from less-educated parents have on average about 14 percentage points (ppt) lower enrolment rates than children from more-educated parents (about 37% lower) but only about 8 ppt lower demand (17% lower). Comparing the gaps in relative terms, demand would not seem to be able to explain much more than one half of the gap. Children with both parents born abroad also have a significant enrolment gap of about 12 ppt (37% lower) but have almost no demand gap (2 ppt, or 5% lower). Thus, the demand-side does not seem to be an explanation for the migrant-native gap. The gaps for our two alternative categories are quite consistent with our main categories.

Appendix Table A4 provides potential explanations for the different levels of stated demand in Figure 2. It shows the share of respondents by family background who would enroll in day care under hypothetical scenarios and who agree with reasons for not enrolling in day care. About 15-20% of families state that they would enrol in day care if was free, the registration and application was easier, and if some quality measures, like group size and opening hours, were improved. The most commonly stated reasons by parents for not enrolling in day care is that the child is too young (85%) and that parents want to raise the child themselves (75%). Almost all stated reasons and hypothetical scenarios under which parents would like to enrol in day care differ by our measures of parental education and parental country of birth, whereby the differences are more pronounced for the latter group.

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<sup>16</sup>These plots show the coefficients obtained from regressing enrolment and demand on the binary categories. Appendix Figure A1 shows these gaps specifically by parents' country of origin, Appendix Table A3 compares the distribution of birth countries in our data with official statistics and characterizes the sample by country of origin.

Figure 2: Gaps in day care enrolment and demand



*Notes:* Figures show differences in day care enrolment and demand by four measures of family background. Coefficients stem from regressing the dependent variable on the indicator for family background in separate regressions. The mean value among all respondents is indicated in the figure. Whiskers indicate 95% confidence intervals.

## 4.2 Supply-side: Day care shortages

Table 2 presents results from pooled OLS regressions based on equation (1) and county fixed effects regression based on equation (2). Column (2) reports a negative and highly significant relationship between regional day care shortages and the enrolment gap for children from less-educated parents using the pooled OLS model. Specifically, an increase in shortages by 10 ppt is associated with a decrease in day care enrolment gap by parental education of about 5 ppt. Column (4) reports the results with county fixed effects where the identifying variation comes from changes in shortages within counties over time. The results are very similar to the pooled OLS estimates and indicate that regional day care shortages have a significant impact on the enrolment gap by parental education. As shown in Appendix Table A5, very similar patterns emerge when differentiating by whether the respondent parent has a university degree.

Table 2: Day care enrolment, family background and regional shortages

	Day care enrolment							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Mean of dep. var	0.375	0.375	0.375	0.375	0.376	0.376	0.376	0.376
Less-educated	-0.131*** (0.006)	-0.055*** (0.014)	-0.123*** (0.006)	-0.065*** (0.014)				
Less-educated $\times$ shortage		-0.005*** (0.001)		-0.004*** (0.001)				
Migration background					-0.114*** (0.008)	-0.114*** (0.023)	-0.112*** (0.008)	-0.121*** (0.024)
Migration $\times$ shortage						-0.000 (0.001)		0.001 (0.001)
Shortage	-0.001 (0.001)	0.002* (0.001)	0.001 (0.001)	0.002*** (0.001)	-0.001 (0.001)	-0.001 (0.001)	0.001 (0.001)	0.001 (0.001)
State $\times$ wave FEs	Y	Y			Y	Y		
County FEs			Y	Y			Y	Y
Wave FEs			Y	Y			Y	Y
Observations	43,668	43,668	43,668	43,668	42,845	42,845	42,845	42,845

*Notes:* County level correlates based on equations (1) and (2). Migration background indicates that both parents are born abroad and non-Western. The sample is restricted to a minimum of 50 observations per county (Appendix Figure A3 shows robustness to different cut-offs). All estimates control for the sex and age of the child, marital status of the respondent and an indicator for urban counties. The county fixed effects estimates include regional controls at the state by year level (unemployment, population density, GDP per capita and migration share). Standard errors, clustered at the individual level, in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

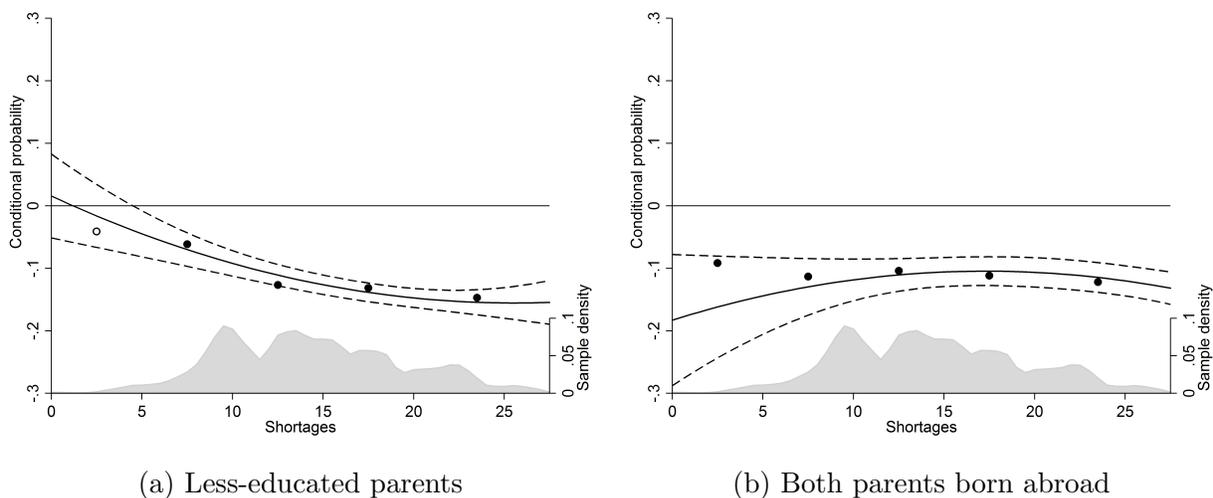
Columns (5)-(8) of Table 2 examine the role of regional shortages for enrolment gaps by parental country of birth. In contrast to the estimates by educational background, the results suggest that regional shortages play a minor role in explaining the foreign-born parents enrolment gap. The foreign-born interaction with regional shortages is not significant and very close to zero in both empirical specifications (with and without county fixed effects). Appendix Table A5 shows estimates based on the indicator "German not main language at home." Again, results are robust to using this alternative measure of migrant family background.<sup>17</sup>

Next, we examine if there is a non-linear relationship between shortages and the enrolment gap in alternative specifications. Figure 3 presents the results of the estimation of equation (3) and equation (4). For the less-educated parents group, there appears to be a

<sup>17</sup>Additionally, results are also robust to imposing the restriction that both parents have to be non-European (in contrast to the current definition of parents being non-Western European and non-North American). These results are available upon request.

clear non-linear relationship between day care enrolment and regional shortages. Specifically, the enrolment gap is close to zero and not statistically significant when shortages are very low and then quickly increases to around 10 ppt before effectively flattening out at higher levels of shortages (above about 20 ppt). The binomial specification finds a zero intercept (in contrast to the less flexible linear specification) and the enrolment gap in the first shortages bin (0 ppt–5 ppt) is insignificant. This implies that the enrolment gap may be substantially reduced when shortages are zero. For the foreign-born parents background category, a very different picture emerges: the enrolment gap is fairly flat at about 10 ppt at all levels of shortages. This is consistent with findings from the linear model in Table 2.

Figure 3: Non-linear effects of shortages on the enrolment gap



*Notes:* Graphical illustrations of the results of the estimation equation (3) and equation (4). The solid line plots the probability of being enrolled in day care conditional on being in the less-educated or foreign-born parents group at different levels of shortages. The solid line plots the estimates retrieved from the binomial specification and equals  $E[Y_{i}^{cst}|Lit = 1] = \gamma_1 + \gamma_4 \times Short_{ct} + \gamma_5 \times Short_{ct}^2$ . The dashed lines represent the 10% confidence intervals reflecting meaningful standard errors computed for marginal effects following Aiken and West (1991). The markers plot the enrolment gap in each shortages bin  $b$ , i.e. the parameters  $\delta_{1b}$ . The filled markers are significant at the 10% level whereas the empty markers are insignificant. The grey area represents a kernel density plot of the sample distribution.

Overall the findings suggest that reducing regional day care shortages lowers the enrolment gap for children of less-educated parents substantially, but it does not help to reduce the migrant-native enrolment gap. We discuss interpretations of these results further down.

### 4.3 Supply-side: Day care fees

In this section, we focus on the role of day care fees as a determinant of the enrolment gap. Due to the lack of time variation in the fee data we analyze the effect of a substantial reduction in fees using the synthetic control method. Specifically, we examine the case of the federal state of Hamburg, where fees were abolished for the first five hours of care per day in August 2014.<sup>18</sup> Hamburg was the only state to change its fees regulation during our sample window of 2012–2016.<sup>19</sup> For those enrolled in half-day care, fees were eliminated completely, and for those enrolled in more than half-day care, fees were reduced by an amount equal to the half-day fee they would have paid previously (depending on the household income and number of persons in the household). Thus, all parents of children 0-2 had a significant fee reduction. Since Hamburg has a fixed fee regulation, only dependent on net household income and household size (which we have in our data), we are able to compute the theoretical reduction in fees for all Hamburg children in our sample (including those not in day care). Monthly fees for the average household were reduced by a total of 178 Euros (63% of the pre-reform fees). For the children of less-educated parents in our sample, fees are reduced by 162 Euros and for the children of better-educated parents, the reduction amounts to 184 Euros. Thus, the magnitude of the reduction was roughly comparable for both groups.<sup>20</sup>

The large reduction of fees in Hamburg provides a quasi-random treatment that we use to estimate the impact of fees on the enrolment gap using the synthetic control method of Abadie et al. (2010). Specifically, we examine the evolution of the enrolment gap for Hamburg ( $N = 3,724$  for Hamburg) before and after the reduction of fees, comparing it to

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<sup>18</sup>Each German federal state independently sets broad regulations for day care fees, e.g. which types of households are exempted from fees. The detailed fee structure itself is set by counties or the individual institutions. Typically, fees vary by hours of day care enrolment, household income and other household characteristics (see Section 2 for more details). Beginning in 2005, some states started abolishing childcare fees, initially for older children, subsequently for younger children.

<sup>19</sup>Before 2012, three states had abolished fees for the last day care year (6 years old), two states (Berlin and Hamburg) had abolished fees for the last three years (3–6 years old), and Rhineland-Palatinate had abolished fees for the last five years (1–6 years old). For Hamburg, fees were abolished for the first five hours of daily care only, while the other states abolished fees for all-day care.

<sup>20</sup>When expressed as a share of net income, fees are reduced by 0.044 overall, 0.043 for children of less-educated parents and 0.047 for children of better-educated parents.

the evolution for a *synthetic Hamburg* constructed as a weighted average of the remaining federal states, none of which changed their fees in the sample window. The weights for creating synthetic Hamburg are chosen so as to best approximate the real Hamburg based on pre-treatment values of the outcome variable and covariates.<sup>21</sup> Following Kaul et al. (2015), we choose two of the three available pre-treatment outcomes (2012 and 2014) and four covariates (unemployment, population density, GDP per capita, and migration share) to be used in selecting the weights matrix.

Figure 4 shows the results. Panels (a), (b), and (c) plot the evolution of enrolment from less-educated parents, enrolment from better-educated parents, and the enrolment gap, respectively, over time for Hamburg and synthetic Hamburg.<sup>22</sup> The figures show that enrolment of children from less-educated parents increases, while more-education enrolment holds constant, and the enrolment gap decreases relative to the synthetic control. These differences emerge in the first post-intervention period and become statistically significant by the second post-intervention period.<sup>23</sup> Overall, the average of both post-intervention periods suggests a decrease in the enrolment gap by 7.3 ppt. This is an economically significant effect size since and approximately halves the enrolment gap.

To help provide a sense-check for this estimate, we also carry out a pooled OLS regression of equation (1) using the fees information reported for one wave in the place of the shortages variable. We report the results in appendix Table A7. Taking the estimate on the interaction between fees and less-educated parents from column (2) and multiplying it with the average fee reduction in Hamburg provides an expected reduction in the enrolment gap of  $0.06 \times 1.78 = 10.7$ , which is comparable to our synthetic control estimate. Overall, we conclude that reducing fees appears to have large effects on the enrolment gap by parental education, even when fees are income dependent. As the effect is driven by an increase in the number of

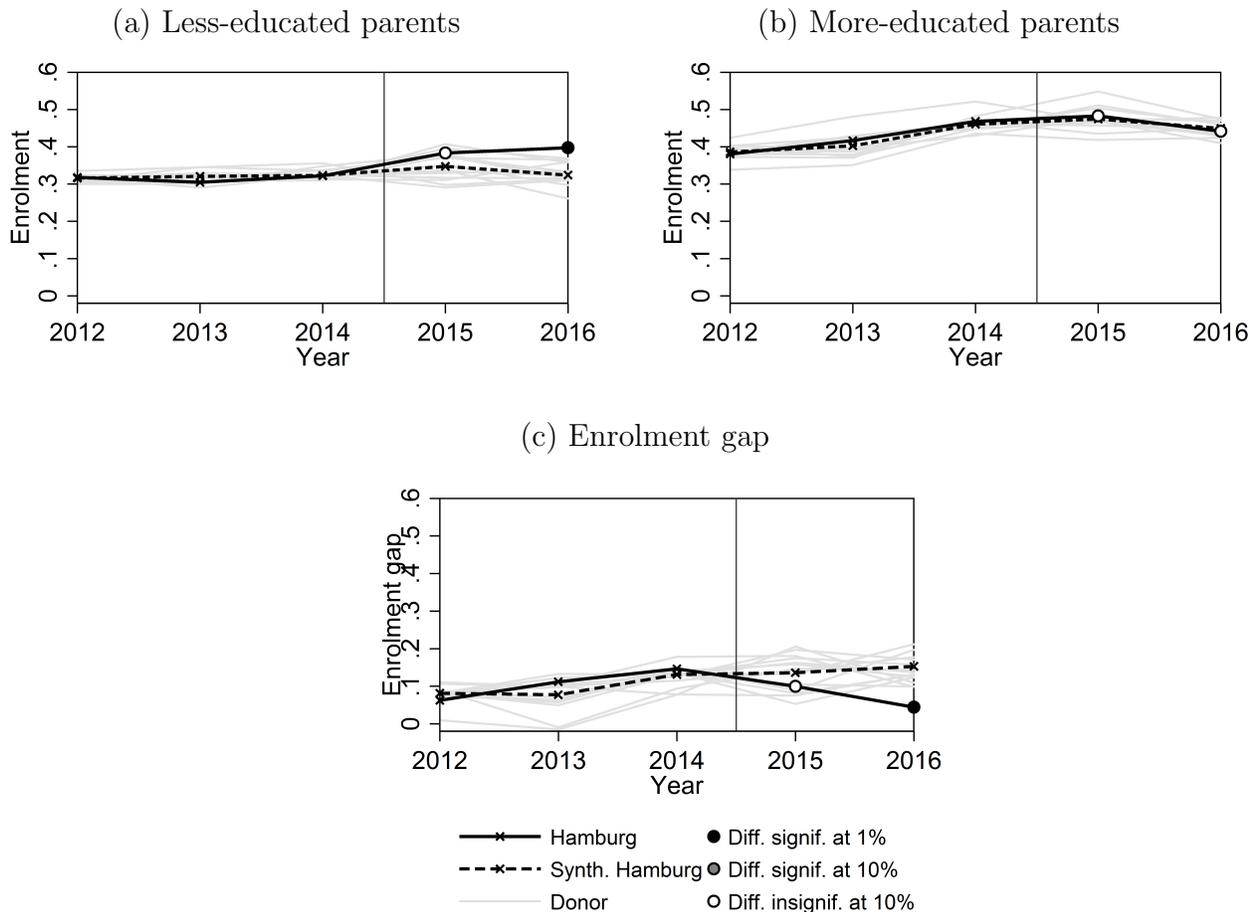
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<sup>21</sup>Weights are chosen to minimize the mean squared prediction error (MSPE) for the outcomes variable over the pre-treatment period. For more detail on the process, see Abadie et al. (2010).

<sup>22</sup>The light grey lines are “donors,” which is an synthetic control method term for non-treated units used as a placebo treatments. In our case, we use the 15 non-treated federal states.

<sup>23</sup>In the synthetic control method, significance levels are based on comparing the deviation between the treated unit and the synthetic control to the typical deviation between the donors and the synthetic control.

Figure 4: The effect of fee elimination in Hamburg on the enrolment gap (by parental education)



*Notes:* Figures show the evolution in Hamburg vs. synthetic Hamburg of (panel a) the enrolment rate of children from less-educated parents; (panel b), the enrolment rate of children from better-educated parents; and (panel c) the enrolment gap. All interviews for the 2014 wave occurred before fees were eliminated, making this the last wave with fees—as indicated by the vertical line. Weights for the synthetic Hamburg were chosen to best approximate the three pre-treatment values for the outcome variable in each case, i.e. for waves 1, 2, and 3. Synthetic Hamburg for panel (a) is 36.3% Bavaria, 5.8% Brandenburg, and 34% Saxony-Anhalt. Synthetic Hamburg for panel (b) is 63.6% Saarland and 36.4% Brandenburg. Synthetic Hamburg for panel (c) 39.3% Bremen, 33.4% Baden-Württemberg, and 27.3% Brandenburg.

children from less-educated parents — rather than a decrease by those from better-educated parents — this may also suggest a more stringent progressive fee structure. We also carry out the synthetic control analysis for the enrolment gap by parental country of birth and present the results in appendix Figure A4. Consistent with our other results, a reduction in

fees does not decrease the enrolment gap for this group.<sup>24</sup>

#### 4.4 Interpretation of the results and policy suggestions

The results for the enrolment gap by parental education are fairly straightforward to interpret. Some of the gap is explained by preferences, as reflected in the demand gap for this type of family background. Some of the gap seems to be explained by financial resources since the gap responds to fees. Finally, the gap gets smaller when places are scarce which is consistent with discrimination and/or differences in search effectiveness/intensity (although it is not possible to distinguish between these).

The results from the enrolment gap by parental country of birth are somewhat less straightforward to interpret. The enrolment gap by country of birth is (a) not reflected in a significant demand gap, (b) still there at low levels of shortages, (c) not bigger or smaller at higher levels of shortages, and (d) not bigger or smaller after a big reduction in fees. Any explanation for the enrolment gap for foreign-born parents needs to be able to fit these four facts.

Firstly, the lack of a significant demand gap allows us to quickly rule out that the enrolment gap is because foreign-born parents do not want a place due to different preferences. One might worry that stated preference reflects parental aspirations and not actual willingness to enrol. However, this does not seem consistent with the fact that foreign-born parents report making multiple application for day care places (two on average).

Secondly, that the enrolment gap exists even with low levels of shortages leads us to effectively rule out lower search intensity/effectiveness by foreign-born parents as an explanation. Beyond making several applications, there is no reason why a high search intensity would be necessary to get a place in an environment with low shortages.

Thirdly, we cannot rule out discrimination. If discrimination against foreign-born par-

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<sup>24</sup>The enrolment of children with migrant family background is unaffected by the change in fees. The native group sees an increase in enrolment; however the effect is small and does not seem to persist, nor is there a significant increase in the enrolment gap in any post-intervention period.

ents is strong enough, then it would result in an enrolment gap that does not necessarily get smaller with marginal increases in the availability of places. Foreign-born parents will struggle to find a place even at relatively low level of shortages if they are at the ‘back of the queue’ for any spot as a result of discrimination. Thus, if discrimination does explain the enrolment gap then it should be of a form stronger than that faced by less-educated parents, on average.<sup>25</sup> This would be consistent with the literature that shows discrimination against ethnic minorities in a wide range of contexts in education, including at day care centers (e.g. Batsaikhan et al., 2019, for Denmark).

Fourthly, it appears that financial concerns are no more or less important for foreign parents than other parents, based on the result that eliminating fees does not lower the gap in enrolment. This is somewhat consistent with the fact that the difference in maximum willingness to pay for a day care spot between foreign-born parents and other parents is smaller than the same difference by education (appendix Table A4).

Fifthly, there may be further barriers to access that exist even in areas of low shortages. One possibility is day care quality. Even if parents report wanting a day care spot, and spots are available and affordable, they will not enrol their children if they find the quality to be too low. Appendix Table A4 shows that foreign-born parents are more likely than other parents to report quality indicators such as group size, opening hours, and proximity of care as reasons for not enrolling their children in day care. One potential explanation for these differences is that foreign-born parents place a greater emphasis on quality compared with other parents. However, it could also be that foreign-born parents live in areas with lower day care quality, making these concerns more prevalent. Foreign-born parents may also have specific quality concerns. In fact, foreign parents are three to four times more likely than other parents to cite “if staff were multilingual” and “if culture/religion were considered more” as factors than would lead them to enrol. Notably, citing these quality factors does

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<sup>25</sup>We are not able to distinguish between different reasons for discrimination e.g. if centres make assumptions about workload based on parent characteristics (statistical discrimination), or if they hold implicit or explicit racial bias (taste-based discrimination).

not seem to be related to lower parental demand for day care, suggesting parents see these as supply-side issues.

In terms of policy recommendations, one should expand availability and reduce fees to close the enrolment gap by parental education. But to close to the enrolment gap by parental country of birth, policymakers should ensure that day care centres deliver adequate high-quality care for all children respective of diverse cultures and religions. Finally, a complete elimination of shortages combined with diversity training for staff may be an effective approach to tackle discrimination.

## 5 Conclusion

Despite expansions in day care provision for under three year olds in Germany, there are substantial gaps in day care enrolment by family background. We show that demand for day care cannot fully account for enrolment gaps. Our results suggest that day care fees and local day care shortages play a significant role in explaining gaps by parental education. Reducing day care fees (or a more progressive fee structure) and reducing regional day care shortages can lower enrolment gaps by parental education substantially. However, enrolment gaps by parental country of birth are less affected by changes in local supply-side factors. We interpret our results and discuss policy measures for addressing enrolment gaps in each case.

Given the great potential of high quality day care to reduce inequalities in later life outcomes by family background, it is important to have a thorough understanding of why enrolment gaps in day care exist and how to reduce them. Our study provides a first comprehensive analysis based on large sample data. We capture important supply side factors: the availability of day care slots and parental fees. One factor that we do not observe is the quality of the day care centres. Further, we know little about the magnitude and type of discrimination facing less-educated or foreign-born parents. Our results suggest

that these factors may be important, particularly for the enrolment of children of foreign-born parents. Field experiments could contribute to filling this gap and help to better understand the nature of enrolment gaps in day care, while also proposing solutions to reduce them. We leave this for future research.

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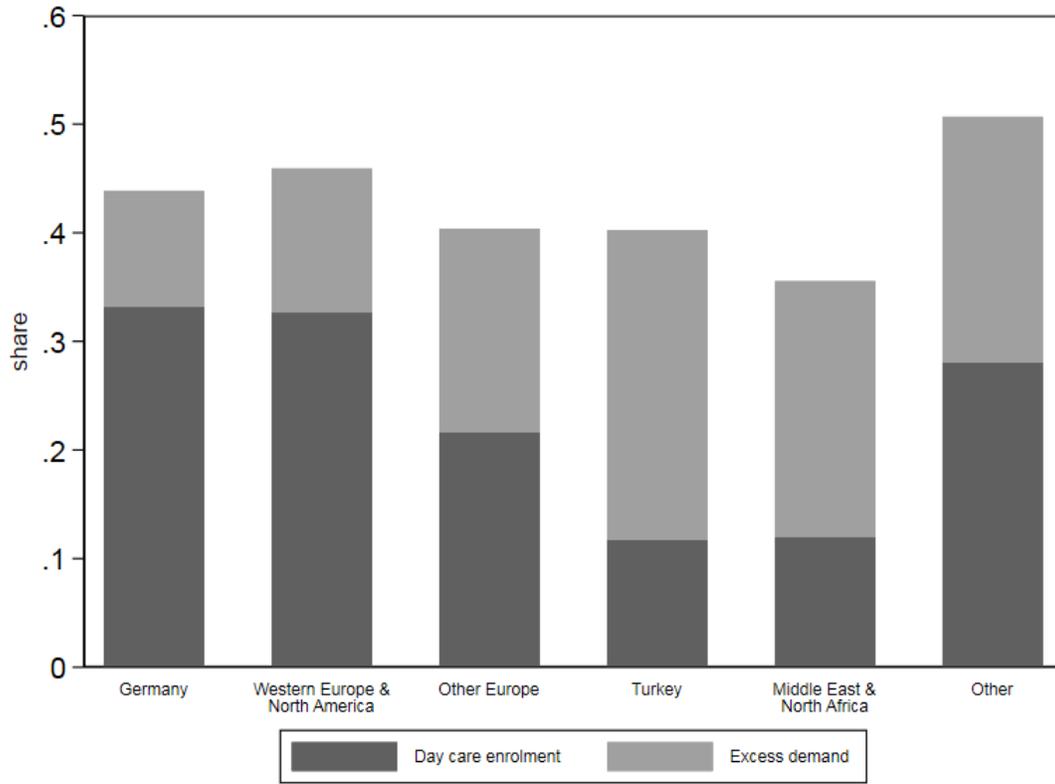
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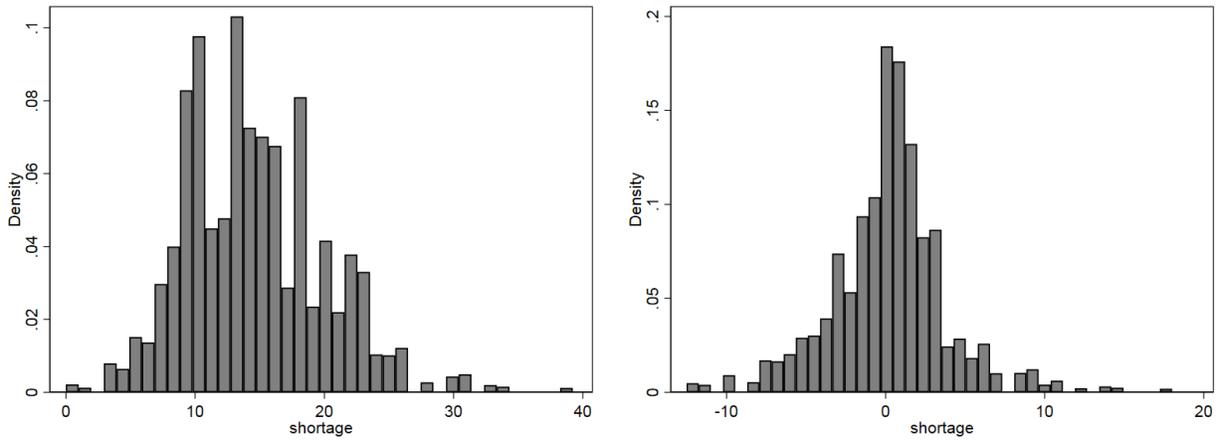
## Appendix (for online publication)

Figure A1: Day care enrolment and demand by birth country of the parents



Notes: Figure shows day care enrolment and demand by birth country of the responding parent.

Figure A2: Shortages in day care

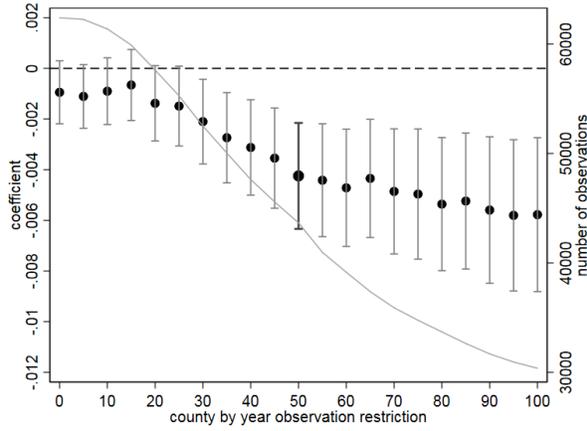


(a) County shortages in percent

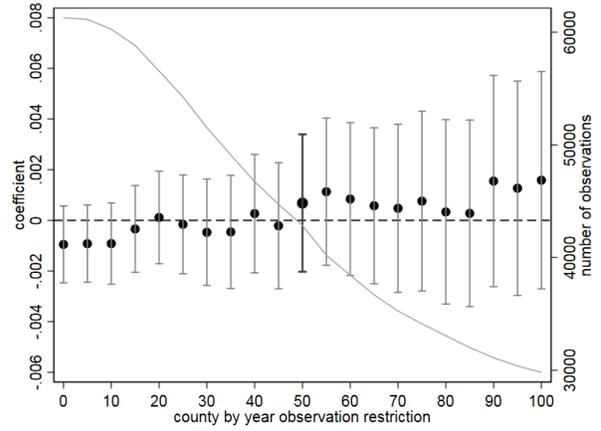
(b) Demeaned county shortages

*Notes:* Figure shows (a) raw shortages in day care at the county level; and (b) demeaned county shortages subtracting the state level average. An individual shortage denotes that a day care spot is desired for the child, but the child is not enrolled. Shortages are calculated at the county by year level. The sample is restricted to 50 county by year observations. Panel (b) omits the city-states of Berlin and Hamburg as these are absorbed in our analysis by state and county fixed effects.

Figure A3: Interaction term of Table 2 by sample restriction



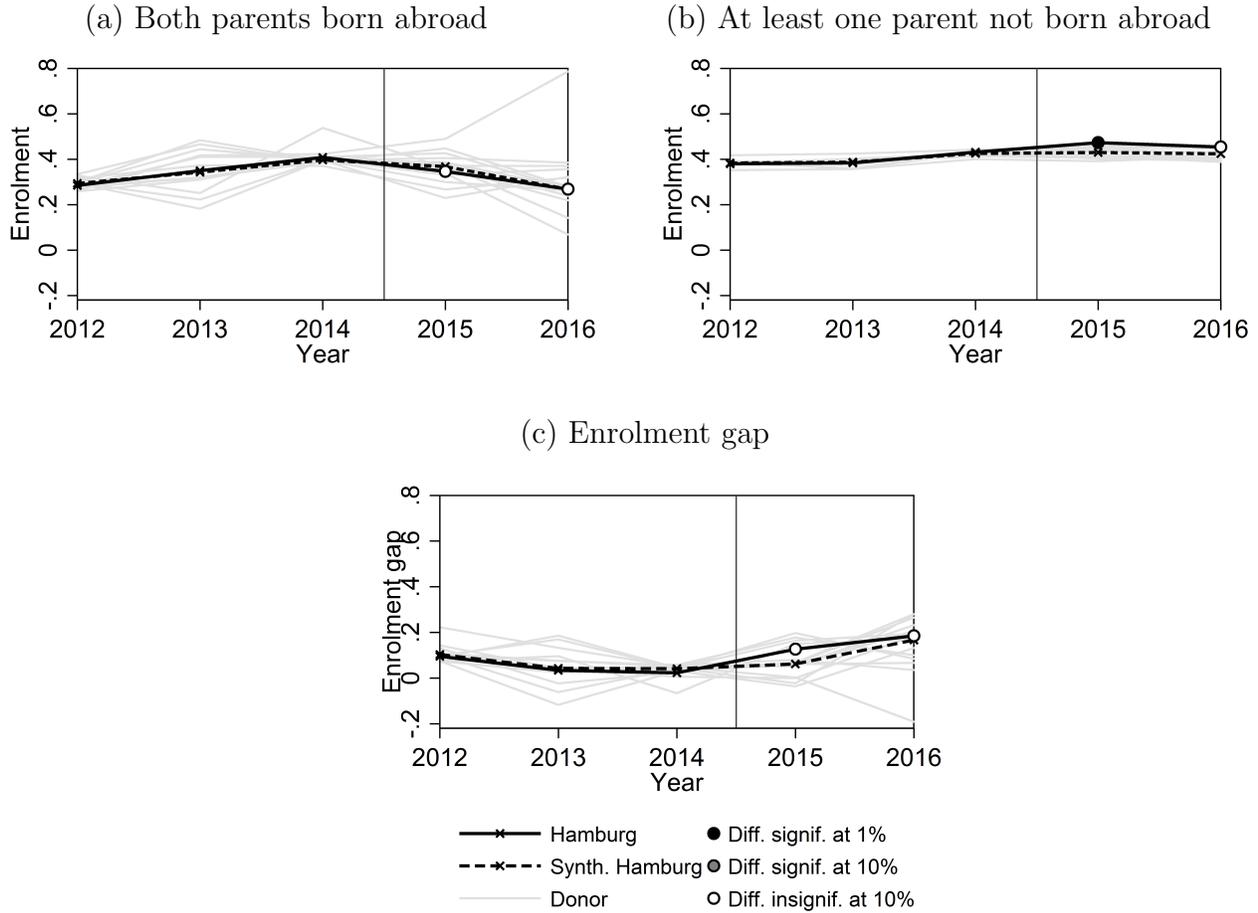
(a) Less-educated parents col (4)



(b) Both parents born abroad, col (8)

*Notes:* Figures show the coefficient of the interaction term of the county fixed effect model in Table 2 for different county by year number of observation restrictions (in intervals of five). The coefficients are obtained from the specification shown in columns (4) and (8) for less-educated parents and foreign-born parents, respectively. The bold markers indicate the coefficients shown in the table. Whiskers present 95 percent confidence intervals. The grey line and the y-axis on the right show the number of observations used in each estimation.

Figure A4: The effect of fee elimination in Hamburg on the enrolment gap (by parental country of birth)



*Notes:* Figures show the evolution in Hamburg vs. synthetic Hamburg of (panel a) the enrolment rate of children with both parents born abroad; (panel b) the enrolment rate of children with at least one parent not born abroad; and (panel c) the enrolment gap. All interviews for the 2014 wave occurred before fees were eliminated, making it the last wave with fees—as indicated by the vertical line. Weights for the synthetic Hamburg were chosen to best approximate the three pre-treatment values for the outcome variable in each case, i.e. for waves 1, 2, and 3. Synthetic Hamburg for panel (a) is 28.8% Baden-Württemberg, 53.9% Berlin, and 17.3% Brandenburg. Synthetic Hamburg for panel (b) is 38.5% Lower Saxony, 45.5% Berlin, and 16.1% Brandenburg. Synthetic Hamburg for panel (c) 28.4% Baden-Württemberg, 17.6% Bavaria, 40.1% Berlin, and 13.9% Brandenburg.

Table A1: Share of children below 3 years in child care -  
comparison of KiBS and official statistics

Federal state	2012		2013		2014		2015		2016	
	KiBS (1)	Difference (2)	KiBS (3)	Difference (4)	KiBS (5)	Difference (6)	KiBS (7)	Difference (8)	KiBS (9)	Difference (10)
Schleswig-Holstein	0.241	-0.001	0.262	-0.001	0.295	-0.008	0.320	0.006	0.311	0.002
Hamburg	0.358	0.000	0.384	0.000	0.427	-0.003	0.453	0.020	0.429	0.000
Lower Saxony	0.220	-0.001	0.244	0.000	0.275	-0.004	0.283	0.000	0.285	0.001
Bremen	0.212	0.000	0.232	0.000	0.264	-0.005	0.281	0.010	0.271	0.001
North Rhein-Westphalia	0.181	0.000	0.198	-0.001	0.233	-0.005	0.266	0.007	0.257	0.000
Hesse	0.236	-0.001	0.256	-0.001	0.283	-0.005	0.306	0.009	0.297	0.000
Rhineland-Palatinate	0.269	-0.001	0.282	0.000	0.304	-0.002	0.312	0.006	0.301	0.002
Baden-Württemberg	0.231	0.000	0.248	-0.001	0.274	-0.004	0.285	0.007	0.279	0.002
Bavaria	0.230	0.000	0.247	-0.001	0.269	-0.002	0.281	0.006	0.272	0.000
Saarland	0.220	-0.001	0.245	-0.001	0.263	-0.007	0.286	0.003	0.287	0.004
Berlin	0.425	-0.001	0.436	-0.001	0.459	-0.001	0.475	0.016	0.459	0.000
Brandenburg	0.534	0.000	0.536	0.000	0.572	-0.006	0.579	0.011	0.572	0.000
Mecklenburg-Vorpommern	0.536	0.000	0.544	-0.001	0.556	-0.005	0.562	0.002	0.560	0.000
Saxony	0.464	0.000	0.472	0.000	0.494	-0.005	0.511	0.005	0.507	0.001
Saxony-Anhalt	0.575	0.000	0.577	0.000	0.577	-0.006	0.583	0.004	0.572	0.002
Thuringia	0.497	-0.001	0.513	-0.001	0.519	-0.005	0.527	0.003	0.524	0.002

Notes: Comparison of the share of children below 3 years in day care as calculated with the KiBS data with official statistics provided by the Federal Statistical Office of Germany.

Table A2: Comparison of analysis sample with dropped observations

	Analysis sample	Dropped observations	Difference
	(1)	(2)	(3)
<i>Panel A: individual characteristics</i>			
Day care enrolment	0.374 (0.003)	0.243 (0.003)	0.131*** (0.005)
Day care demanded	0.490 (0.004)	0.380 (0.004)	0.110*** (0.006)
Day care shortage	0.115 (0.002)	0.136 (0.003)	-0.021*** (0.004)
Lower education (no Abitur)	0.403 (0.004)	0.560 (0.005)	-0.157*** (0.006)
No university degree	0.493 (0.004)	0.660 (0.006)	-0.167*** (0.007)
German not main language at home	0.169 (0.003)	0.155 (0.004)	0.014*** (0.005)
Both parents born abroad (& non-Western)	0.144 (0.003)	0.158 (0.004)	-0.014*** (0.005)
Employed	0.451 (0.004)	0.415 (0.006)	0.036*** (0.007)
Necessity weighted net equivalent income	1984.15 (38.715)	1729.88 (26.626)	254.28* (46.987)
<i>Panel B: county characteristics</i>			
Urban county	0.671 (0.003)	0.216 (0.004)	0.455*** (0.006)
1st GDP tercile	0.042 (0.001)	0.276 (0.004)	-0.234*** (0.004)
2nd GDP tercile	0.273 (0.003)	0.374 (0.005)	-0.101*** (0.006)
3rd GDP tercile	0.685 (0.003)	0.350 (0.005)	0.335*** (0.006)
<i>Panel C: share of federal states</i>			
Schleswig-Holstein	0.046 (0.001)	0.019 (0.001)	0.027*** (0.001)
Hamburg	0.049 (0.001)	-	-
Lower Saxony	0.083 (0.002)	0.103 (0.002)	-0.019*** (0.003)
Bremen	0.016 (0.000)	-	-
North Rhein-Westphalia	0.051 (0.003)	0.389 (0.005)	-0.338*** (0.006)
Hesse	0.078 (0.002)	0.076 (0.002)	0.002 (0.003)
Rhineland-Palatinate	0.063 (0.001)	0.031 (0.001)	0.033*** (0.002)
Baden-Württemberg	0.104 (0.003)	0.166 (0.004)	-0.062*** (0.004)
Bavaria	0.177 (0.003)	0.140 (0.003)	0.037*** (0.005)
Saarland	0.020 (0.000)	0.001 (0.000)	0.019*** (0.000)
Berlin	0.097 (0.002)	-	-
Brandenburg	0.037 (0.001)	0.019 (0.001)	0.019*** (0.001)
Mecklenburg-Vorpommern	0.033 (0.001)	0.004 (0.000)	0.029*** (0.001)
Saxony	0.077 (0.001)	0.024 (0.001)	0.053*** (0.002)
Saxony-Anhalt	0.033 (0.001)	0.017 (0.001)	0.016*** (0.001)
Thuringia	0.036 (0.001)	0.014 (0.000)	0.022*** (0.001)
Observations	43,691	18,782	62,473

Notes: Comparing characteristics of observations used in the analysis sample and observations dropped due to the sample restriction of having at least 50 observations per county and year. Panel A shows individual characteristics, Panel B displays the share of observations coming from each federal state. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

Appendix Table A2 compares the analysis sample with the dropped observations. The sampling design favors observations coming from counties with a *larger* population (especially urban counties) and those from federal states with a *smaller* population as these have fewer counties and every state has roughly the same number of unweighted observations per year. The analysis sample is positively selected; day care enrolment, income, and employment rates are higher, the share with a foreign-born parents and less-educated parents levels is smaller (all differences are significant at the 1 percent level). Although the sample restriction means that our sample is not representative for the whole of Germany, the data used still covers a large fraction of the German population and advances on previous studies looking at specific groups or smaller regions.

Table A3: Characteristics by country of origin

	Share of migration population		Day care			Number of applications (6)	Lower education (7)	Household net income (8)
	Microcensus 2017 (1)	KiBS (2)	Enrolment (3)	Demand (4)	Shortage (5)			
Germany	-	-	0.332	0.439	0.107	2.789	0.457	4084.169
Western Europe and North America	0.091	0.177	0.327	0.461	0.133	2.954	0.393	4063.182
Other Europe	0.360	0.519	0.216	0.404	0.188	2.137	0.589	3122.679
Turkey	0.136	0.090	0.117	0.402	0.285	1.56	0.801	2906.720
Asia	0.221	0.105	0.18	0.438	0.257	2.081	0.64	2985.501
Africa	0.062	0.060	0.257	0.479	0.220	1.957	0.534	2826.919
Others	0.127	0.049	0.321	0.502	0.180	3.159	0.368	3554.822

*Notes:* Table shows characteristics of children with different migration backgrounds. Shares of the Microcensus data refer to children aged 0-5, KiBS data 0-3. For *Western Europe and North America*, and *Other Europe* the composition between Microcensus and KiBS data differs slightly as the Microcensus data only contains the number of children from EU28 and the 12 countries with the largest migrant population share of those. Western European countries not listed are thus assigned to *Other Europe*, leading to an underestimation of the *Western Europe* share in the Microcensus. When countries are assigned to EU28 and residual European countries the share in the Microcensus are 0.291 and 0.286, and 0.344 and 0.386 in the KiBS respectively. In the KiBS data, the country refers to birth country of the responding parent. Microcensus data obtained from the Federal Statistical Office.

Table A4: Reasons for not using day care

Family background	All	Lower educated	Higher educated	Both parents born abroad	≤ 1 parent born abroad	Conditional demand
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Would use day care if ...</i>						
if day care was for free	0.15	0.18	0.12	0.22	0.14	0.54
if the child had a full-day slot	0.09	0.10	0.08	0.14	0.08	0.64
if the child had a half-day slot	0.15	0.17	0.13	0.23	0.13	0.59
if opening hours were more suitable	0.17	0.19	0.14	0.25	0.15	0.48
if staff was multilingual	0.07	0.09	0.05	0.18	0.05	0.47
if groups were smaller	0.18	0.20	0.16	0.27	0.17	0.39
if culture / religion would be considered more	0.05	0.07	0.03	0.13	0.03	0.44
if day care institution was nearby	0.14	0.17	0.10	0.26	0.11	0.53
if registration / application was easier	0.18	0.22	0.14	0.34	0.15	0.48
<i>Reasons for not using day care</i>						
Did not get a spot	0.11	0.12	0.10	0.15	0.10	0.69
Insufficient opening hours	0.07	0.08	0.06	0.07	0.07	0.39
I'm home myself	0.61	0.68	0.53	0.65	0.60	0.14
Want to raise child myself	0.75	0.78	0.72	0.78	0.75	0.13
Child is too young	0.85	0.84	0.86	0.84	0.85	0.12
Child should spent time with siblings	0.36	0.40	0.31	0.45	0.35	0.13
Grandparents can take care of child	0.32	0.37	0.26	0.28	0.33	0.14
Fear of negative influences	0.07	0.09	0.05	0.12	0.06	0.20
Insufficient promotion at instution	0.11	0.11	0.11	0.13	0.10	0.23
Insufficient consideration of culture	0.02	0.03	0.01	0.08	0.01	0.30
<i>Willingness to pay</i>						
Maximum fee for a day care spot	172.63	141.95	224.01	145.28	184.31	

*Notes:* Columns (1)-(5) shows hypothetical scenarios under which parents would use day care and reasons for not using day care. Each cell shows the share of affirmative responses for the corresponding question. Multiple affirmative responses are possible. Column (6) shows the share of parents indicating demand for day care conditional on an affirmative response for the column variables. All questions are only asked if the child is currently not in day care. Number of observations in the first column ranges between 4,527 and 31,375. All but five variables have above 10,000 observations.

Table A5: Day care enrolment, family background and regional shortages - alternative family background definition

	Day care enrolment							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Mean of dep. var	0.379	0.379	0.379	0.379	0.375	0.375	0.375	0.375
No university	-0.137*** (0.006)	-0.059*** (0.016)	-0.129*** (0.006)	-0.069*** (0.016)				
No university $\times$ shortage		-0.005*** (0.001)		-0.004*** (0.001)				
Migration background					-0.110*** (0.008)	-0.113*** (0.022)	-0.110*** (0.008)	-0.121*** (0.023)
Migration $\times$ shortage						0.000 (0.001)		0.001 (0.001)
Shortage	-0.001 (0.001)	0.003** (0.001)	0.002* (0.001)	0.004*** (0.001)	-0.001 (0.001)	-0.001 (0.001)	0.001 (0.001)	0.001 (0.001)
State $\times$ wave FEs	Y	Y			Y	Y		
County FEs			Y	Y			Y	Y
Wave FEs			Y	Y			Y	Y
Observations	35,603	35,603	35,603	35,603	43,536	43,536	43,536	43,536

*Notes:* The sample is restricted to leave-one-out shortages calculated from at least 50 observations per county. Migration background indicates that German is not the main language at home. All estimates control for the sex and age of the child, marital status of the respondent and an indicator for urban counties, the county fixed effects estimates include regional controls at the state by year level (unemployment, population density, GDP per capita and migration share). Standard errors, clustered at the individual level, in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

Table A6: Day care enrolment, family background and regional shortages

	Day care enrolment			
	(1)	(2)	(3)	(4)
Mean of dep. var	0.378	0.378	0.391	0.391
Below median pre-birth income	-0.160*** (0.011)	-0.126*** (0.034)		
Below median income $\times$ shortage		-0.003 (0.002)		
Welfare recipient			-0.202*** (0.013)	-0.253*** (0.032)
Welfare $\times$ shortage				0.003 (0.002)
Shortage	0.001 (0.002)	0.002 (0.002)	-0.003** (0.001)	-0.003*** (0.001)
State $\times$ wave FEs	Y	Y	Y	Y
Observations	8,422	8,422	17,090	17,090

*Notes:* County level correlates based on equation (1) and (2). The sample is restricted to a minimum of 50 observations per county. All estimates control for the sex and age of the child, marital status of the respondent. Information on pre-birth income and welfare recipient status available in wave 4, and wave 4 and 5 respectively. Standard errors, clustered at the individual level, in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

Table A7: Day care enrolment, family background and fees

	Day care enrolment			
	(1)	(2)	(3)	(4)
Mean of dep. var	0.378	0.378	0.377	0.377
Less-educated	-0.141*** (0.011)	-0.027 (0.035)		
Less-educated x fees		-0.062*** (0.019)		
Migration background			-0.095*** (0.016)	-0.081* (0.048)
Migration x fees				-0.008 (0.025)
Day care fees	0.037*** (0.012)	0.060*** (0.014)	0.051*** (0.012)	0.052*** (0.013)
State FEs	Y	Y	Y	Y
Observations	8,987	8,987	8,941	8,941

*Notes:* County level correlates based on equation (1) and (2). The sample is restricted to a minimum of 50 observations per county. All estimates control for the sex and age of the child, marital status of the respondent and indicators for urban counties and terciles for the GDP per capita of the counties. As fees are only available for those in day care, we use our data set to impute hypothetical fees for all children. For this we regress observed day care fees on a number of variables that commonly determine day care fees (number of children in household, 15 household net income bins, age dummies for the children, desired hours corrected by the median gap between desired and actually used hours for those enrolled in day care, and a binary indicator for welfare recipient). Regressions are run by state and include county fixed effects to allow for regional variation in fee structure. In a second step, we predict hypothetical fees for each child based on the coefficients obtained above and then compute the county average. Standard errors, clustered at the individual level, in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .