Child Indicators Research (2023) 16:1019–1048
https://doi.org/10.1007/s12187-022-10007-9

The Socio-Economic Status of Neighbourhoods and Access to Early Childhood Education

Eszter Baranyai[1]

Accepted: 7 December 2022 / Published online: 16 February 2023

Abstract
Good-quality early childhood education and care (ECEC) has been shown to benefit children from low socio-economic backgrounds the most, starting from a very early age. Yet in many countries ECEC usage by such children is lower than that of their more fortunate peers. We study inequalities in the availability and affordability of local ECEC services in Hungary across neighbourhoods of different socio-economic status because these factors have been found to be key for ECEC uptake in many settings. Hungary is an interesting case because the potential to reduce child poverty is high. We find that publicly-funded ECEC availability for children under age 3 is lower in poorer areas in Hungary even after controlling for proxies of demand, regional effects and the known issue of low ECEC density in smaller settlements. Formal ECEC through the private sector is also scarcer in poorer areas but we do not find evidence that it is less affordable than in richer areas using a stylised family affordability metric. Our study not only expands the geographical dimension of the literature but also adds particular value by studying the private-sector pricing of ECEC services in the context of demand unsatisfied by the public sector.

Keywords ECEC · Childcare · Socio-economic status · Availability · Affordability · Hungary

1 Introduction

Childcare enables parental employment, and may thus lead to better family finances and lower risks of poverty. Through the development of human and social capital, it produces rates of return to both the individual as well as the society (Conley, 2010). Digging deaper into capital-formation, multiple studies confirm that it is children from low socio-economic status (SES) backgrounds who

✉ Eszter Baranyai
baranyai.eszter@uni-neumann.hu

[1] John Von Neumann University, Kecskemét, Hungary

benefit the most from childcare (Ruhm & Waldfogel, 2012; Yang, 2021). This is also true for the youngest children (often defined as 0–3 years).

Whether and how childcare can reduce social inequality and poverty have been attracting increasing attention from scholars and policy-makers alike (Van Lancker, 2018). Currently, formal ECEC is in short supply in many countries (Kim & Umayahara, 2010; Pavolini & Van Lancker, 2018) despite universal access to ECEC being a key international policy objective (OECD, 2001). And in many countries, childcare services usage is socially stratified: it is the highly-educated and better-off families who are most likely to access childcare (Habibov, 2015; Schober & Spiess, 2013).

One reason for such social stratification may be related to the substantial heterogeneities in the spatial distribution of ECEC services. Location is key to ECEC services due to the geographically small, local nature of these markets (Pennerstorfer and Pennerstorfer, 2020). Another reason identified by the literature is the affordability of ECEC services (Abrassart & Bonoli, 2015; Pavolini & Van Lancker, 2018), in which the combination of public and private providers – hereinafter referred to as the welfare mix – appears to play an important role (Campbell et al., 2018; Lee & Jang, 2017; Ünver et al., 2018; Van Lancker & Ghysels, 2016).

We study ECEC availability and affordability in a Hungarian context. Throughout the study our focus is on spatial inequalities – specifically, spatial differences in ECEC provision that imply that children from lower SES backgrounds are disadvantaged in their access to nurseries. Hungary – together with other Central and Eastern European (CEE) countries – is amongst those furthest away from the Barcelona targets that European policymakers have set (European Commission, 2018). Dating back to 2002, one of the Barcelona objectives for each member state entails providing high quality and affordable childcare facilities to 33% of children under 3 years of age. Hungary is also an interesting case because microsimulations put it amongst the countries where a targeted 10% expansion of nursery slots has the greatest potential to reduce child poverty (Hufkens et al., 2020). Additionally, recent years have seen renewed government focus on improving childcare availability (e.g. Orbán, 2019). Despite the policy relevance, studies of this topic in a CEE context are rare in the international literature.

While nursery fees have been studied in the context of ECEC accessibility, in Europe this has mostly been done for nurseries where fees are set or controlled by the central or local government (Abrassart & Bonoli, 2015). Studies often focus on the country's most common form of ECEC (e.g. OECD, 2017; Vandenbroeck et al., 2008, 2013) which may paint an incomplete or even misleading picture if there is significant unfulfilled demand. In contrast, we focus on the form best able to respond to demand – the legal form of formal ECEC that is most flexible in its ability to follow fluctuations in demand due to ease of establishment, size and type of providers. In Hungary, these are the (typically private non-profit) family nurseries which plug the gap between demand and the limited provision from local government-run, low-fee traditional nurseries. Information on private nursery fees is scarce in many countries and this is certainly true for Hungary (Makay, 2015).

Our research questions are:

(1) What is the relationship between ECEC availability and the prosperity of the area?
(2) What is the relationship between the affordability of family nurseries and the prosperity of the area?
(3) How does the welfare mix affect spatial inequalities in a) ECEC availability and b) the affordability of family nurseries?

ECEC availability refers to the ability of all children to attend a formal ECEC facility in the vicinity of their homes, in line with the underlying concept of local childcare markets (Pennerstorfer and Pennerstorfer, 2020). Prosperity of an area refers to the economic wellbeing of residents and is proxied through three metrics. We define affordability of childcare as the extent to which families are able to pay formal ECEC facilities' fees out of their family income and use proportions as a proxy.

We find that childcare availability in the state-operated traditional nurseries is lower in poorer areas even after controlling for smaller settlements, regional effects and proxies for demand. Consistent with our expectations, this is also the case – to a somewhat larger extent – for the typically privately-run family nurseries. Some of the poorest districts, in fact, have no family nurseries at all. Although we cannot exclude the possibility that family nursery affordability has a role to play in less prosperous areas' low family nursery uptake, our metrics do not indicate lower affordability in poorer areas even after removing public or church support. This suggests other factors, such as local mothers' lower earnings potential, traditional mindsets opposing formal childcare in early years, and the lack of labour opportunities allowing childcare-friendly working patterns, might (also) be important.

To study the relationship between nursery availability and prosperity we run spatial regressions with a number of specifications and controls. To study spatial inequalities in affordability we rely on our hand-collected data sample of family nursery fees and provide out-of-sample estimates for all other nurseries. Thereafter, to compare the cross-country financial burden relative to net income we apply a stylised nursery affordability model for a two-earner couple who work locally and whose two children attend local nurseries (OECD, 2017).

2 Literature Review

2.1 Childcare and Child Development

Childcare can affect the development of children through multiple routes. First, the quality of care may be different at home than in a dedicated childcare arrangement, influencing skill acquision (e.g. social, language and motor skills). Second, in the reduced time spent with the child, the quality of parent–child interactions may change. For example, there is some evidence in Germany of activities such as reading or singing increasing while watching tv and running errands decreasing in frequency (Felfe & Lalive, 2013) while in Quebec the quality of parenting was shown

to have deteriorated (Baker et al., 2008). Third, increased parental employment raises household income which has been shown to have positive effects on child development (e.g. Dahl & Lochner, 2012).

A key conclusion arising from the literature on ECEC in the first few years of life appears to be that high-quality ECEC can have a positive impact on some aspects of child development but the issue of quality is of paramount importance. Comparing children with and without ECEC or examining the impact of hours spent in ECEC, in general a positive effect is reported for cognitive and language development though the size and the persistence of the effect vary across settings (see Melhuish et al., 2015 for overview). The body of evidence on the impact on socio-emotional development is mixed. The cultural context, in particular the age of entry, the quantity of non-parental childcare at an early age and group sizes, appear important. Early US studies suggest non-maternal care in the early years could lead to a higher risk of insecure attachment with the mother (see Friedman & Boyle, 2008 for overview). Other studies, however, suggest this to be the case only if ECEC quantity was high in the first 15 months of life (rare in Hungary) accompanied by low quality childcare or low parental sensitivity (see Melhuish et al., 2015 for overview). High quantity of ECEC particularly from an early age has been associated with increased likelihood of externalising behavioural problems but high quality care has been shown to moderate such effects in the US. Some non-US studies find no link or a less persistent link between childcare and antisocial behaviour or even a positive behavioural effect from high-quality care (see Melhuish et al., 2015 for overview).

Evidence from a number of studies and countries suggest low SES children benefit the most from ECEC. For example, Geoffrey et al. (2010) show significant positive effects on the cognitive trajectory of Canadian children from disadvantaged backgrounds by looking at measures of school readiness, vocabulary, reading and math scores. In a German context, Felfe and Lalive (2013) find lower SES children experience greater benefits from ECEC insofar as their comprehension and independence are concerned. The persistence of positive cognitive effects from ECEC appears particularly marked for disadvantaged students with differences between children with and without ECEC background still reported at age 25 in the US (Herrod, 2007). Scholars argue that a key reason for why low SES children gain more from childcare than the offsprings of more affluent or highly educated parents is because of the less stimulating learning environment in their homes (Van Lancker, 2018). Some studies looking at the youngest, in fact, find cognitive and non-cognitive effects to be significantly positive only for low SES children (Kottelenberg & Lehrer, 2014). In recent years, ECEC is also increasingly recognised as a tool for the social integration of children especially from migrant or minority backgrounds (e.g. Saraceno, 2011).

2.2 Provision and Costs of Childcare

A common theme in the studies of Western countries is that nursery place availability is often lower in lower SES neighbourhoods, with supporting evidence from Vienna (Pennerstorfer and Pennerstorfer, 2020), the Netherlands (Noailly and Visser,

2009) and Australia (Cloney et al., 2016) but not from New York (Small & Stark, 2005). Furthermore, rural areas (e.g. van Ham & Mulder, 2005), especially remote rural communities (Langford et al., 2019) appear to have lower ECEC coverage.

Studies linking ECEC affordability with SES status often do this by examining enrolled children's SES status and the costs of the nursery. Abrassart and Bonoli (2015) show that the extent of progressiveness in the fee structure varies greatly across the Swiss canton of Vaud and has an impact on ECEC usage across socio-economic lines. Pavolini and Van Lancker (2018) find marked differences in structural constraints in ECEC availability and affordability across countries and show this as one of the key reasons for differences in ECEC uptake across socio-economic lines. In contrast, we compare affordability spatially, in line with the concern that lower SES children from low SES areas may be particularly at a disadvantage in their access to ECEC.

In the context of ECEC availability, affordability and perceived affordability a number of studies have examined the impact of the welfare mix (Campbell et al., 2018; Lee & Jang, 2017; Ünver et al., 2018; Van Lancker & Ghysels, 2016). The introduction of market forces and for-profit service providers have been found to be associated with provision shifting to wealthy neighbourhoods and under-supply in less prosperous areas (Lee & Jang, 2017; Noailly & Visser, 2009). The evidence on the presence of non-profit providers is less universal: in Vienna they are found to increase inequalities (Pennerstorfer and Pennerstorfer, 2020) unlike in the UK (Campbell et al., 2018).

3 The Hungarian Context

We focus on Hungarian ECEC for children under age 3 because participation rates in Hungary for this age group are comparatively low (EPIC, 2019) and attendance is non-compulsory. Participation rates from age 3 rise significantly (EPIC, 2019). The pattern can be attributed to a confluence of factors including compulsory pre-primary education from age 3 and the post-natal leave maximum of 3 years (OECD, 2016a), as well as conservative attitudes towards working mothers of very young children (Pavolini & Van Lancker, 2018). Barring special cases, children need to start pre-primary education (*óvoda*) from the September after they turn 3, though if the *óvoda* has spare capacity it can admit children who are at least 2.5 years old (Public education law, 2011). The younger age group (20 weeks old up to óvoda admittance) is catered for by the various form of nurseries (*bölcsődék*). Throughout the study we proxy the local child population of *bölcsőde* age through the number of 0, 1 and 2 year-olds. ECEC coverage for under 3-s has been growing in recent years but still more than four in five children are not provided for.

Since 2017 formal ECEC is available in four forms for children under age 3 (HCSO, 2019a) (Table 1). Traditional nurseries, which are overwhelmingly operated by local authorities, constitute the dominant form, accounting for 86% of nursery slots in 2018. These are followed by family nurseries (12%), mini nurseries (1%) and workplace nurseries (less than 1%). Hereinafter due to market share considerations, current research does not focus on mini and workplace nurseries. Whereas

Table 1 Overview of formal childcare for under 3-s in Hungary

Type of nursery	Share of operator by no of slots			Slots		Children admitted	
	Public sector	Church	Other	Number	% of Total	Number	% of Total
Traditional nursery	94%	2%	4%	40,648	86%	38,223	86%
Family nursery	13%	10%	77%	5,840	12%	5,680	13%
Mini nursery	61%	12%	27%	625	1%	623	1%
Workplace nursery	88%	0%	13%	56	0%	51	0%
Total nurseries	84%	3%	13%	47,169	100%	44,577	100%

Data as of 2018. Other includes "non−profit" and "other non−state" categories

traditional nurseries represent institutionalised forms of ECEC, family nurseries cater for smaller group sizes and settings and are classified as service providers rather than institutions. As service providers, family nurseries can be established quicker, even in a home, and statutory requirements for the service provider role can be met through a 100-h course (Dudás, 2019a). In contrast to traditional nurseries, family nurseries tend to be operated by the private sector – civilians or non-profit companies. For-profit companies' share is small (5% of family nursery slots). Family nurseries can be seen as plugging the gap between the public sector's institutional provision of ECEC and local demand (HCSO, 2019a).

Traditional nurseries face significantly tighter legal restrictions on their fees than family nurseries (Child protection law, 1997). Traditional nurseries cannot charge more than 20–25% of family income per person, set their fees based on income and a number of exemptions apply – such as for families with three or more children, children with disabilities or poor families (Dudás, 2019a). In practice, monthly fees are typically very low, much lower than the OECD or EU average (OECD, 2016b), and can be as low as zero for disadvantaged groups.

Family nurseries, in contrast, face fewer restrictions on the price element beyond a cap double as high – 50% of family income per person – in accordance with the often private sector nature of these and thus the importance of financial viability. Correspondingly, family nursery fees can extend to many multiples of the fees charged by traditional nurseries. Another source of funding for most family nurseries is from the government: around 30,000 Hungarian forints per child per month can be obtained depending on the number of days the child is present and whether the family nursery is operated jointly amongst local authorities (Budget law, 2018).

Traditional nurseries – unlike family nurseries – are by law required to give priority in their admission to children from disadvantaged backgrounds. Specifically, this category includes children of working parent(s): entitled to child protection allowance (more detail in *Data and Methodology*), from families with 3 or more children, from a single parent household; as well as children removed from families by child welfare agencies irrespective of parents' labour market status (Child protection law, 1997, 42/A §).

Our study is timely because, looking ahead, the government has communicated its intention to increase formal ECEC coverage for the youngest (Orbán, 2019). In

this context, family nurseries appear to be recognised to some extent as part of the solution. For example, government funding through tenders that aim to augment the number of ECEC slots have been made available to family nurseries (Hungarian Government, 2018).

While improvements have been made to ECEC availability in smaller municipalities in recent years, it remains in shorter supply than in larger towns and cities. Since end-2020 local authorities are under obligation to provide nursery slots where more than 40 children live who are under age 3 or demand exists in relation to at least 5 children, though municipalities with a population under 10,000 are not required to provide these ECEC slots in the municipality itself (Makay, 2018). Given the known nursery shortage in and policy focus on smaller municipalities, we control for these.

4 Data and Methodology

Throughout the study we use data at the most granular level possible: nursery, settlement, district or county. Counties – of which there are 20 including Budapest, the capital – correspond to the Eurostat's Nomenclature of Territorial Units for Statistics (NUTS) 3 level. One level below are the 197 districts which have been established with the purpose of optimising the efficiency of local administration. As population density varies greatly across rural and urban areas, districts exhibit significant differences in their population (ranging from 8,000 to 235,000) and area (ranging from 100 to 1600 km2 for non-Budapest districts and 2 to 55 km2 for Budapest districts) (HCSO, 2022). There are over 3000 settlements in Hungary, with Budapest districts included separately in the study.

4.1 Spatial Inequalities in ECEC Availability

We apply multi-variate spatial regressions to gauge the association between population to provider ratios (PPR) – common in the literature (Fransen et al., 2015) – and prosperity, the latter proxied by child poverty rate and local housing conditions. Spatial regressions allow for the spatial context – observations may not be independent and identically distributed, observations near each other may be related. We use the SLX model in which explanatory variables on nearby geographical units are (also) included. For example, a district's nursery coverage ratio may be influenced not only by the prosperity in the district itself but by that in neighbouring districts. We use the SLX model because of its comparatively good performance under realistic conditions (Rüttenauer, 2019) and because the local nature of the childcare market is consistent with the SLX model's local (rather than global) spillover specification. Nonetheless, for robustness, we also run the basic OLS model which disregards the spatial context.

We use a global regression model (the SLX model) on account of its greater simplicity, its ease of interpretation for a wider audience and the objective and breadth of the paper. Global regression models estimate an average parameter for each independent variable. The relationship between the independent variable and the

dependent variable may however exhibit spatial heterogeneities. For example, local regression models could uncover if the relationship is stronger in certain areas and weaker in others. Detailed exploration of such spatial heterogeneities is out of the current paper's scope but could constitute a useful further analysis in addition to the study of other questions outlined in the *Conclusions*. Throughout the study we use the GS2SLS estimator and the Stata and QGIS software packages.

The SLX model takes the form of (Halleck Vega & Elhorst, 2017):

$$Y = \alpha\iota_N + X\beta + WX\theta + \varepsilon \tag{1}$$

where Y is an N×1 vector of nursery coverage ratios for each geographical unit (i = 1,…,N), α is a constant and ι_N is an N×1 vector of ones, X is a N×K matrix of explanatory variables and W is the N×N spatial weights matrix. β and Θ are vectors of response parameters. Explanatory variables in our regressions include: measure of socio-economic status (main variable of interest), proportion of villages and small towns in the area, a proxy for demand for nurseries (proportion of highly educated women or women's labour force participation) and regional dummies.

Key to spatial regressions is the specification of spatial weights matrix, W, which describes how the cross-sectional units are connected to each other (Halleck Vega & Elhorst, 2017). In this respect, Halleck Vega and Elhorst (2017) emphasise the importance of theoretical considerations in determining the exact specification of the matrix. As mentioned, the childcare market is very much a local one and there is little evidence in Hungary to suggest parents use nurseries beyond their settlement or a neighbouring settlement. Our spatial weights matrix allows for spatial spillovers inbetween neighbouring geographical units (which in this paper is most often a district) only:

Contiguity matrix W, where

$$w_{i,j} = \begin{cases} 1 \; if \; i \; and \; j \; share \; a \; common \; border \\ 0 \; otherwise \end{cases} \tag{2}$$

Indeed, Halleck Vega and Elhorst (2017) note that such a contiguity spatial weights matrix is the most commonly applied approach. Halleck Vega and Elhorst (2017) also discuss that although theory should be the driving force behind the functional form of the matrix, another approach could involve using alternative matrices – such as the inverse distance matrix – for robustness. We, therefore, check results assuming spillover effects are proportional to the inverse of the distance between geographical units (inverse distance spatial weights matrix) allowing spillovers within a 20 km limit:

Inverse-distance matrix W, where

$$w_{i,j} = \begin{cases} \frac{1}{D(i,j)} & if \; D(i,j) \; \leq \; 20km \\ 0 & otherwise \end{cases} \tag{3}$$

where D(i,j) equals distance between geographical unit i and j.

We construct nursery coverage ratios as follows at a district-level using data from the Hungarian Central Statistical Office's (HCSO) regional statistics portal

(HCSO, 2019d; HCSO, 2019e). For nursery type $n \in \{traditional\ nurseries,\ family\ nurseries,\ all\ nurseries\}$ and district i:

$$Nursery\ coverage\ ratio^{n}{}_{i} = \frac{ECEC\ slots_{i}^{n}}{0-2\ year\ old\ residents_{i}} \tag{4}$$

The lack of regard for the exact spatial distribution of both supply and demand, a noted shortcoming of the PPR method (Huff, 1963), is mitigated by local authority operated or funded nurseries' (the majority of nurseries) preference to admit children from the local authority's territory. The proportions of villages and small towns in the district are computed using HCSO data (HCSO, 2018).

The child poverty rate is used as a proxy for prosperity due to its spatial granularity and is calculated as follows using data from HCSO (HCSO, 2019d; HCSO, 2019e). For geographical unit i:

$$Child\ poverty\ rate_{i} = \frac{Number\ of\ children\ recipient\ of\ regular\ child\ protection\ allowance_{i}}{Number\ of\ children\ aged\ 0-17_{i}} \tag{5}$$

The regular child protection allowance (*rendszeres gyermekvédelmi kedvezmény*) is designed to help underprivileged children in line with the declared public policy aim that no child should be removed from their family on account of the family's low income (Child Protection Law, 1997). Local authorities review allowance applications but criteria on the following are set centrally and are identical (e.g. no difference in forint thresholds) across the country: the family income per person, household status (whether single parent household), serious illness or severe disability of children, and family wealth per person (Kormányablak, 2020). While questions have been raised about the extent of poor families not covered by the allowance (or its predecessor: *rendszeres gyermekvédelmi támogatás*) (Darvas & Mózer, 2004; Farkas, 2016), in the past, at least, the provision was seen to be fairly well targeted at families with children exposed to a high risk of poverty (Darvas & Mózer, 2004). A key shortcoming of child poverty rate as a proxy for prosperity is that it disregards differences in prosperity for the child population not falling into the poor category. Furthermore, childcare avalability may influence fertility rates and, if the effect differs across socio-economic lines, it could have a knock-on impact on child poverty rates.

As an alternative measure of prosperity, we construct a district-level index showing the proportion of housing units with modern conveniences ('*összkomfortos*') using data from the 2016 microcensus. For district i:

$$Housing\ category\ 1\ Index_{i} = \frac{Number of\ 'összkomfortos'\ housing\ units_{i}}{Total\ housing\ units_{i}} \tag{6}$$

'*Összkomfortos*' is the highest of five categories defined by lawmakers and denotes housing units with a room of at least 12 square meters, a kitchen, a bathroom and a toilet, as well as main utilities including central heating (HCSO, 2016). A shortcoming of this housing category 1 index is that it does not differentiate between the other four types of housing categories.

We use two (imperfect) measures to proxy demand for ECEC. First, we use the proportion of women who participate in the labour force. Second, we use the proportion of women with higher education because studies suggest that labour market inactivity due to childbirth is shorter for highly educated women (HSCO, 2015).

4.2 Family Nursery Fees

Hungary's social sector portal contains detailed information on each nursery (SZGYF, 2019) but information on fees is missing. At the time of download on 12 July 2019 the database consisted of 977 family nurseries where the end date of service was a future date or indefinite. Full-time price data were hand-collected from family nursery websites or via phone calls conducted in July 2019 on a stratified random sample. Strata were formed based on the 8 NUTS 2 regions, as defined by Eurostat (Eurostat, 2019). 153 family nurseries were selected into the sample and prices were recorded for 116. The 37 missing values are mostly driven by inability to establish contact (28) and business closure (6). Full-time nursery fees are overwhelmingly flat – we found no evidence of differential pricing in 112 cases. An overview of the characteristics of family nurseries in our sample and the overall population is presented in Table 2.

In order to estimate fees for out-of-sample family nurseries, we fit a regression on in-sample family nurseries *f*:

$$\begin{aligned} &Family\ nursery\ fee_f = \alpha + \beta_1 Prosperity_i + \beta_2 \sum_{j=1}^{n} w_{ij} Prosperity_j + \beta_3 Operator_f \\ &+\beta_4 State\ support_f + \beta_5 Settlement\ type_f + \varepsilon_{fi}, \\ &i = 1, ..., n, \end{aligned} \tag{7}$$

where *i(f)* denotes the county (specification 1), settlement (specification 2) or district (specification 3) of the family nursery. The proxy for prosperity is either the average wage (specification 1), the child povery rate (specification 2) or the housing category 1 index (specification 3). The third term on the right-hand side of the equation corresponds to the spatial lag (the neighbouring areas' proxy for prosperity) as the w_{ij}-s are the elements of the contiguity spatial weights matrix as defined in (1). The operator type of the family nursery is either church, public sector or other. State support indicates whether the private sector family nursery has applied for the 30,000Ft/per child/month state support. Finally, the settlement type in which the family nursery is located can be village, small town, town with county's rank or capital.

Independent variables were chosen by adapting the findings of nursery price studies (Ficano, 2006; Blau, 2001; Helburn & Howes, 1996; Davis and Li, 2009) which use a market framework of supply and demand (Davis & Li, 2009; Ficano, 2006) to the Hungarian family nursery context considering data limitations and relevance as follows. The studies identify family income, cost of labour, regulation, the quality of care, the extent of government childcare support, child population and maternal employment as relevant determinants. In addition, we also take account of the spatial context by including the spatial lags of the proxy of prosperity. Similar to 3.1., we do this for neighbouring geographical units, thereby allowing neighbouring areas' prosperity to influence family nursery fees

Table 2 Overview of family nurseries' characteristics in sample and in total population

	Sample		All family nurseries	
	N	%	N	%
NUTS 2 regions				
Budapest	28	24	242	25
Southern Great Plain	13	11	125	13
Northern Great Plain	8	7	80	8
Northern Hungary	14	12	119	12
Central Transdanubia	9	8	87	9
Southern Transdanubia	13	11	89	9
Western Transdanubia	10	9	77	8
Pest	21	18	158	16
Total	116	100	977	100
Legal status of settlement				
village	26	22	193	20
town	29	25	262	27
town with county rights	33	28	280	29
capital	28	24	242	25
Total	116	100	977	100
Type of operator	8	7	126	13
public sector	8	7	126	13
church	12	10	96	10
other	96	83	755	77
Total	116	100	977	100
Receives state support	106	91	878	90
Yes	106	91	878	90
No	10	9	99	10
Total	116	100	977	100

Other includes "non−profit" and "other non−state" categories

in addition to the local area's prosperity – consistent with some cross-administrative boundary usage of nurseries. While results shown in the paper are based on this spatial econometric model, untabulated non-spatial OLS results (without the spatial lags of prosperity) lead to the same overall conclusions.

The first version of our proxy for prosperity indicator – relying on average wage data of full-time employees (HCSO, 2019c) – intends to capture the spatial variation of both family income (demand) as well as staff labour costs (supply) in the absence of granular data on the two factors separately. Wage data are, however, only available at a county level. In an attempt to provide more granularity, dummies for the type of settlement (town, village, capital) are added (HCSO, 2018) as evidence shows that within a county the type of settlement has a material

bearing on the average income (HCSO, 2019b). Each county's average wage is divided by the national average to create an average wage index.

In specification 2, as an alternative to the average wage index, we use the child poverty index – the child poverty rate divided by its average – at a settlement level which on account of its greater granularity allows for robustness checks. Nevertheless, the key shortcoming of the child poverty index is that it can be seen to provide information on the left side of the income distribution whereas due to their fees, family nurseries are often perceived to be used by middle- or high-income families.

In Hungary all family nurseries operate in the same regulatory context thus regulation cannot be seen as a differentiating factor. A notable shortcoming in the data is the lack of information on the quality of care or extra services. Nonetheless, such differences are tempered by a number of minimum quality requirements on, for example, staff to child numbers and floor area (CSONK, 2017). Local authority and church operators of family nurseries may be covering part of the costs of nursery care, therefore dummies for the type of operators are added. Demand for family nurseries is influenced by the number of children who cannot access traditional nurseries. A ratio of non-family nursery slots to the 0–2-year-old population is constructed by district but is omitted in the final version of the model as its coefficient is not found to be statistically significant at the 0.1 level, nor does the variable increase the model's goodness of fit.

4.3 Spatial Inequalities in the Affordability of Family Nurseries

Equipped with data on family nursery fees, we create stylised examples of how average family nursery fees in each of the 20 counties compare to the area's average family net income, relying on a methodology used to compare nursery fees across countries (OECD, 2017). For each county we divide the average family nursery fee with the average net family income. The latter is calculated as follows:

$$\begin{aligned} \textit{Average net family income (HUF)} = {} & 167\%\ \textit{average wage} - \textit{social contributions} - \textit{tax} \\ & + \textit{family allowance} + \textit{net maternity benefit} \end{aligned} \tag{8}$$

A two-earner couple with two children, aged 2 and 3, is assumed. One parent's gross earnings equals the average wage of the area while the other parent is assumed to earn 67% of this average. In addition to the wages, families receive cash benefits, family allowance (családi pótlék) and maternity benefit (GYES), which latter is a fixed amount the family receives until the child turns 3 (GOCCB, 2019; Dudás, 2019b). Parents pay tax and social contributions but also benefit from the tax relief on account of their two children (NAV, 2019).

In the current study, unlike the OECD study, the 2-year-old is assumed to access (full-time) family nursery services, rather than using the most typical form of ECEC which would be the traditional nursery, and the 3-year-old's (low) kindergarten fees are disregarded. Also disregarded is the return-to-work subsidy (HST, 2019) because, importantly, this did not apply to mothers already in work and paying family nursery fees at the time of the data collection. Assuming the younger child is

Table 3 Descriptive statistics

Variable	level	N	mean	median	min	max	st.dev
all nursery coverage ratio	district	197	0.129	0.109	0.000	0.374	0.085
family nursery coverage ratio	district	197	0.016	0.012	0.000	0.074	0.017
traditional nursery coverage ratio	district	197	0.112	0.097	0.000	0.356	0.079
z_family nursery coverage ratio	district	197	0.000	-0.252	-0.953	3.516	1.000
z_traditional nursery coverage ratio	district	197	0.000	-0.185	-1.423	3.110	1.000
child poverty rate	district	197	0.251	0.203	0.010	0.745	0.183
village proportion	district	197	0.394	0.416	0.000	0.898	0.239
small town proportion	district	197	0.410	0.425	0.000	1.000	0.268
Housing Category 1 Index	district	197	0.566	0.549	0.211	0.915	0.160
Proportion of women with HE	district	197	0.161	0.131	0.058	0.549	0.094
Women labour force participation	district	197	0.412	0.411	0.333	0.526	0.034
average wage	county	20	308,448	297,954	243,489	442,590	44,960
average wage index	county	20	0.876	0.846	0.691	1.257	0.128
average net family income	county	20	434,796	423,141	362,656	583,767	49,930
child poverty index	settlement	3172	1.00	0.80	0.00	3.18	0.80

2 years old, as in the OECD's methodology, is reinforced in a Hungarian family nursery context by the fact that a minority of children accessing these services are under age 2 (Makay, 2018).

Descriptive statistics for all variables are included in Tables 2 and 3. Most variables are available at a district-level, the exceptions are the income data (county) and child poverty data (district and settlement).

5 Results and Discussion

5.1 Spatial Inequalities in ECEC Availability

Figures 1 and 2 show maps of district-level nursery coverage ratios and child poverty rates. Across the country nursery slots are only available to a minority of nursery-aged children. Noticeable is that nursery coverage ratios are comparatively higher around Budapest and its agglomeration. Child poverty rates, in contrast, are the highest in the Eastern part of the country.

Regression results suggest that ECEC availability is lower in districts with a higher child poverty rate (Table 4 Specification 1). This holds true even after controlling for the population of villages and towns without a county rank (Specification 2) or taking into consideration the demand for ECEC through two proxies – the proportion of women with higher education (Specifications 3 and 4) or women in the labour force as a proportion of the women population (Specifications 5 and 6). The finding is not simply the result of differences across regions: even after controlling for regions by adding dummies at the NUTS2 level (8 regions), there are fewer nursery slots per child in poorer areas (Specifications 4 to 6). Finally, instead

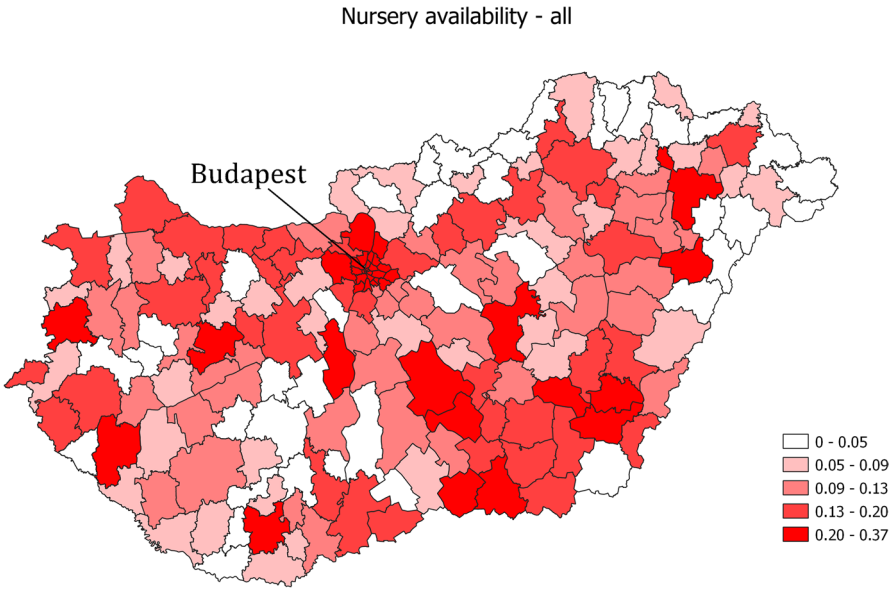

Fig. 1 Nursery coverage ratios – all forms of nursery. Nursery coverage ratio defined as ECEC slot per 0–2 year old permanent resident, by district

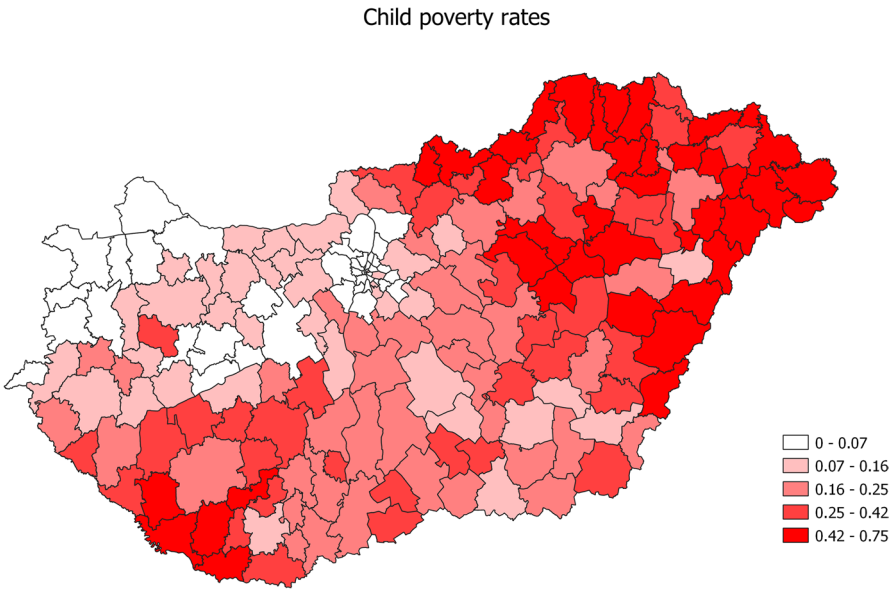

Fig. 2 Child poverty rate. Child poverty rate defined as the number of children recipient of regular child protection allowance divided by the number of children aged 0–17, by district

Table 4 ECEC availability

Variable	(1)		(2)		(3)		(4)		(5)		(6)	
	Child poverty rate		Child poverty rate		Child poverty rate		Child poverty rate		Child poverty rate		Housing Category 1	
	Coeff	Prob	Coeff	Prob	Coeff	Prob	Coeff	Prob	Coeff	Prob	Coeff	Prob
Measure of SES	-0.31	***	-0.17	***	-0.15	***	-0.17	***	-0.14	***	0.15	***
	(0.03)		(0.03)		(0.03)		(0.04)		(0.03)		(0.04)	
Village proportion			-0.18	***	-0.16	***	-0.15	***	-0.15	***	-0.13	***
			(0.02)		(0.03)		(0.02)		(0.02)		(0.02)	
Small town proportion			-0.10	***	-0.08	***	-0.09	***	-0.09	***	-0.08	***
			(0.01)		(0.02)		(0.02)		(0.02)		(0.02)	
HE Women proportion					0.12		0.02					
					(0.08)		(0.09)					
Women labour force participation									0.32	**	0.38	**
									(0.16)		(0.16)	
Constant	0.19	***	0.29	***	0.25	***	0.25	***	0.11		-0.04	
	(0.01)		(0.01)		(0.03)		(0.04)		(0.07)		(0.07)	
Includes NUTS2 dummies	No		No		No		Yes		Yes		Yes	
N	197		197		197		197		197		197	
Wald chi2	146		480		481		692		688		680	
Prob (> chi2)	0.00		0.00		0.00		0.00		0.00		0.00	
Pseudo R^2	0.38		0.72		0.72		0.75		0.76		0.76	
Shapiro–Wilk (res)	0.04		0.21		0.41		0.45		0.12		0.04	
Measure of SES direct impact	-0.31	***	-0.17	***	-0.15	***	-0.17	***	-0.14	***	0.15	***
	(0.03)		(0.03)		(0.03)		(0.04)		(0.03)		(0.04)	
Measure of SES indirect impact	0.05		0.10	**	0.09	**	0.05		0.00		-0.02	
	(0.03)		(0.04)		(0.04)		(0.06)		(0.06)		(0.07)	

Table 4 (continued)

Variable	(1)		(2)		(3)		(4)		(5)		(6)	
	Child poverty rate		Child poverty rate		Child poverty rate		Child poverty rate		Child poverty rate		Housing Category 1	
	Coeff	Prob	Coeff	Prob	Coeff	Prob	Coeff	Prob	Coeff	Prob	Coeff	Prob
Measure of SES total impact	-0.26	***	-0.07	***	-0.06	**	-0.11	**	-0.13	**	0.12	*
	(0.03)		(0.02)		(0.03)		(0.06)		(0.05)		(0.06)	

Dependent variable: all forms of nursery slots as a proportion of 0–2 year old permanent residents. Specifications 1–5 use child poverty rate as the measure of prosperity while specification 6 uses the Housing Category 1 Index. Results are robust to heteroskedasticity. All specifications apply the SPX model which includes the spatial lags of the exogenous covariates – these lags are ommitted from the table. ***, **, and * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively. Standard errors in parenthesis

of the child poverty rate we apply an alternative measure of prosperity, the Housing category 1 index (Specification 6), and arrive at the same conclusion. Results are robust to heteroskedasticity and to the removal of districts with the highest and the lowest nursery availability rates or to the removal of districts with the highest and lowest child poverty rates. Throughout this section we present results pertaining to the SLX model but the OLS model yields broadly similar results (untabulated). Our main specifications are also rerun using the inverse distance spatial weights matrix (Supplementary Table 1) instead of the contiguity spatial weights matrix, leading us to the same the broad overall conclusions.

The own-county direct effect of a 10 percentage point higher child poverty rate is a 2 percentage point lower ECEC availability ratio (10*-0.17) (Specification 2). Additionally, there is a spillover effect across neighbouring counties: a 10 percentage point higher child poverty rate across neighbours on average results in a 1 percentage point higher ECEC availability ratio (10*0.1). The total impact is therefore a 1 percentage point lower ECEC availability ratio. The effect is far from insignificant in light of the low nursery coverage ratios (average of 13% across districts) and the wide range of child poverty ratios (from 0.01 to 0.74 across districts). Findings are directionally in line with fundings for a number of European countries (Cloney et al., 2016; Noailly and Visser, 2009; Pennerstorfer and Pennerstorfer, 2020).

As expected (Abrassart & Bonoli, 2015; Makay, 2018), ECEC availability for the youngest is lower in districts with a larger proportion of their population living in villages and less central towns (Specification 2's total impact measure for village and town proportion are untabulated).

Turning to the effect of the welfare mix, the pattern of lower ECEC availability for the youngest in areas with higher child poverty, controlling for small settlements, demand and regional effects, is true for both the public sector-operated traditional nurseries (Table 5 specification 1) and the largely private sector-run family nurseries (specification 2). A one percentage point higher child poverty rate is associated with a 0.09 (0.06) percentage point lower ECEC coverage ratio for traditional (family) nurseries (including the impact of spatial spillovers). The smaller total impact measure for family nurseries (0.06 versus 0.09) largely reflects family nurseries' smaller market share. In order to see whether family nursery or traditional nursery provision reacts more to child poverty rates irrespective of differences in market share, we standardize the traditional and family nursery availability ratio (deduct mean and divide by standard deviation) and rerun specifications 1 and 2. The child poverty ratio's total impact measure is larger in absolute terms for family nurseries (-3.5 in specification 4) than traditional nurseries (-1.10 in specification 3), suggesting private sector provision (proxied by family nursery availability) responds slightly more to poverty levels than does public sector provision (proxied by traditional nursery availability).

A clear conclusion thus is that children in poorer areas have less access to ECEC. With local children in such areas more likely to come from low SES families, one concern could be that this translates to lower accessibility for children from

Table 5 ECEC availability: traditional versus family nurseries

Variable	(1)		(2)		(3)		(4)	
	Traditional nurseries		Family nurseries		Z_traditional nurseries		Z_family nurseries	
	Coeff	Prob	Coeff	Prob	Coeff	Prob	Coeff	Prob
Child poverty rate	-0.12	***	-0.02		-1.48	***	-1.34	
	(0.03)		(0.01)		(0.41)		(0.91)	
Village proportion	-0.14	***	-0.01	*	-1.75	***	-0.88	*
	(0.02)		(0.01)		(0.28)		(0.50)	
Small town proportion	-0.07	***	-0.02	***	-0.86	***	-1.18	***
	(0.02)		(0.01)		(0.20)		(0.34)	
Women labour force participation	0.28	*	0.03		3.53	*	1.56	
	(0.16)		(0.05)		(2.09)		(3.30)	
Constant	0.11		0.00		-0.01		-0.81	
	(0.07)		(0.03)		(0.95)		(1.58)	
Includes NUTS2 dummies	Yes		Yes		Yes		Yes	
N	197		197		197		197	
Wald chi2	616		112		616		112	
Prob (> chi2)	0.00		0.00		0.00		0.00	
Pseudo R^2	0.74		0.30		0.74		0.30	
Shapiro–Wilk (res)	0.85		0.00		0.85		0.00	
Measure of SES direct impact	-0.12	***	-0.02		-1.48	***	-1.34	
	(0.03)		(0.01)		(0.41)		(0.91)	
Measure of SES indirect impact	0.03		-0.04		0.38		-2.16	
	(0.06)		(0.02)		(0.72)		(1.37)	
Measure of SES total impact	-0.09	*	-0.06	**	-1.10	*	-3.50	**
	(0.05)		(0.02)		(0.66)		(1.39)	

Dependent variable: nursery slots as a proportion of 0–2 year old permanent residents. Specifications 1 and 3 include traditional nurseries only, specifications 2 and 4 family nurseries only. Specifications 3 and 4 use standardised nursery coverage ratios. All specifications apply the SPX model which includes the spatial lags of the exogenous covariates – these lags are ommitted from the table. ***, **, and * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively. Results are robust to heteroskedasticity. Standard errors in parenthesis

underprivileged backgrounds – precisely the children who would benefit the most from ECEC for the reasons mentioned in the *Introduction*.[1] This is consistent with Van Lancker and Ghysels's (2016) finding for Hungary showing lower usage of ECEC for children with low-educated mothers and with data on income quintiles and ECEC usage from the Hungarian Central Statistical Office (HCSO, 2012). In contrast to these, Pavolini and Van Lancker (2018) fails to find evidence of lower

[1] The correlation between ECEC availability and socio-economic inequality in ECEC usage is not necessarily positive, and we get back to this issue when discussing policy implications.

Table 6 Districts with and without family nurseries

Districts with family nurseries:	Yes			No		
	Mean	Median	sd	Mean	Median	sd
Child poverty rate	0.21	0.16	0.18	0.33	0.32	0.17
Housing Category 1 Index	0.60	0.61	0.16	0.50	0.47	0.15
Village proportion	0.34	0.34	0.24	0.49	0.53	0.20
Small town proportion	0.37	0.39	0.29	0.50	0.56	0.20
HE Women proportion	0.19	0.15	0.11	0.11	0.11	0.28
Women labour force participation	0.42	0.042	0.03	0.40	0.40	0.03
N		130			67	

usage in low SES households for Hungary, though only three very broad categories are studied (managers and professionals, white-collar workers and blue-collar workers). Pavolini and Van Lancker's (2018) results may also be influenced by the admission criteria of traditional nurseries in Hungary that gives priority to disadvantaged children. With such criteria in place, it may not be the lowest SES children who are affected the most but children from families with limited means who do not fall into the priority category. The families of these children may not be able to afford private childcare or such arrangements may place a significant burden on family finances.

In any case, the admission criteria only partly mitigates the impact of low ECEC coverage on the most disadvantaged. First, admission is mostly conditional on parents' active labour market status. Second, nursery coverage ratios are much lower than child poverty rates in many areas. Third, studies show that ECEC achieves maximum benefit for low SES children if they are mingled with other children (Reid & Ready, 2013), in other words low supply in these areas may even be suboptimal for the admitted.

A clear policy implication thus is to increase ECEC supply targeting the poorest areas first. Increasing supply, however, does not automatically translate into higher proportions of disadvantaged children going to nursery (e.g. Schober and Stahl, 2014) though it can have a positive impact (Van Lancker, 2018). In Hungary – as in many other countries – highly educated mothers tend to return to work earlier than others (HSCO, 2015), translating to a greater demand for childcare. Key to the expansion of childcare, therefore, is to ensure that alongside higher SES children low SES children are also admitted to an adequate extent.

5.2 Spatial Inequalities in the Affordability of Family Nurseries

Given the shortage of favourably-priced traditional nursery places across the country, the affordability of family nurseries may play a pivotal role in the usage of childcare. If fees are comparatively less affordable in poorer areas, this may result in less local children benefiting from such services.

At the time of the data collection family nurseries were present in 130 of the 197 districts. These districts had lower rates of child poverty, higher proportions

Table 7 Studying family nursery fees

	(1) Average wage index			(2) Child poverty index			(3) Housing Cat 1 index		
Variable	Coeff	SE	Prob	Coeff	SE	Prob	Coeff	SE	Prob
Proxy for prosperity	98,967	24,823	0.00	-13,273	6,051	0.03	74,706	13,995	0.00
Neighbours' prosperity	18,296	6,841	0.01	-11,963	2,810	0.00	19,461	7,692	0.01
Operator (base: Other)									
Church	-43,232	8,297	0.00	-46,461	8,536	0.00	-47,169	8,580	0.00
Public sector	-61,584	8,570	0.00	-60,134	9,021	0.00	-60,951	8,487	0.00
Receives state support (for private sector nurseries)	-28,915	7,658	0.00	-31,291	7,947	0.00	-30,294	8,062	0.00
Type of settlement (Base: village)									
Small town	6,288	5,745	0.28	10,101	6,824	0.14	10,525	5,652	0.07
Town with county's rank	18,336	4,664	0.00	19,342	6,871	0.01	12,150	5,440	0.03
Capital	14,418	15,026	0.34	29,307	7,313	0.00	28,806	6,965	0.00
Constant	-23,112	18,772	0.22	95,195	7,654	0.00	18,181	11,825	0.13
N	116			116			116		
Prob (F-statistic)	0.00			0.00			0.00		
R^2	0.71			0.67			0.67		
Shapiro–Wilk W test (Prob > z)	0.09			0.30			0.41		
Pseudo-R^2 LOOCV	0.66			0.62			0.63		
Pseudo-R^2 crossfold k = 5	0.55, 0.64, 0.72, 0.75, 0.75			0.55, 0.62, 0.62, 0.66, 0.67			0.49, 0.59, 0.61, 0.68, 0.73		

Dependent variable: Full-time family nursery fee including meals excluding discounts.Proxy for prosperity is the average wage index, the child poverty index and the housing category 1 index in specifications 1, 2 and 3, respectively. The base case is a private sector-operated nursery in a village. Standard errors are clustered at the level of the treatment variable: county for (1), settlement for (2) and district for (3). LOOCV denotes the leave-one-out cross-validation procedure. Crossfold k=5 denotes k-fold cross-validation where the number of subsamples (k) is set at 5; results are reported for each fold. Pseudo-R2 refers to the square correlation coefficient of the predicted and observed values of the dependent variable

of housing with modern conveniences and lower proportions of small settlements (Table 6).

In line with the literature on market-based nursery fees (e.g. Davis & Li, 2009), our sample data suggest higher nursery fees *in forint terms* in counties with higher average wages (Table 7). This, in itself, is no surprise as families living in better-off areas are presumably more able to afford higher fees and, simultaneously, nursery staff in the area is able to negotiate higher wages. Ignoring the spillover effects from neighbouring counties' prosperity, specification 1 suggests that fees are 30,680 forint higher in a family nursery located in a county where the average wage corresponds to the cross-county average compared to an otherwise identical nursery in the poorest county where the average wage is 69% of the cross-county average (98,967*100%-98,967*69%). The difference in fees (30,680 forints) amounts to 9% of the country-wide average gross wage. The explanatory variables explain over 70% of the variation in family nursery fees in our sample of 116 (Table 7, specification 1).

Alternative specifications using the more granular child poverty index (specification 2) or the housing category 1 index (specification 3) instead of the county-level average income ratio as a proxy for the area's SES arrive at similar results, though with a somewhat worse model fit.

Results in all three specifications are robust to heteroskedasticity. Dropping observations pertaining to fees or proxies for prosperity with a few of the largest and smallest values does not modify conclusions. Shapiro–Wilk test results suggest that at 0.05 significance level we cannot reject the hypothesis that residuals are normally distributed. Finally, we use two cross-validation methods frequently used in the literature, K-fold cross-validation and leave-one-out cross-validation (Arlot & Celisse, 2010) to test our models' out-of-sample prediction power. Results suggest that the correlation between the observed values of family nursery fees and those predicted by our models is strong.

While results indicate that family nursery fees are lower in financial terms in lower SES counties, we next analyse the financial burden to families these translate into. We estimate fees for the 861 out-of-sample family nurseries. We use specification 1 because of its goodness of fit and its prediction power. Table 8 shows nusery fee statistics in forint terms. The average family nursery fee for all nurseries is estimated at 64,437 forints inclusive of meals. For the nurseries with private operators this is 74,312 forints. While we lack granular data on traditional nursery fees, one estimate for these establishments at the time of our data collection puts the average excluding meals at 8,000 forints and the average fee for meals at around 8–10,000 forints with 60–70% of children receiving free meals (Dudás, 2019a). As expected, family nursery fees thus appear significantly higher than traditional nursery fees.

Table 8 Family nursery fees in sample and in total population

	Sample						All nurseries (including imputed values)					
	N	Fee characteristics					N	Fee characteristics				
		mean	median	min	max	st.dev		mean	median	min	max	st.dev
NUTS 2 regions												
Budapest	28	96,520	92,250	52,500	157,500	26,066	242	94,886	90,323	52,500	157,500	17,129
Southern Great Plain	13	44,451	50,000	11,340	79,000	20,794	125	52,650	58,717	7,795	87,714	16,071
Northern Great Plain	14	38,245	33,500	10,500	72,850	20,195	119	41,315	45,344	0	88,668	22,510
Northern Hungary	9	34,890	40,000	0	75,000	25,151	87	38,552	40,000	0	87,077	18,486
Central Transdanubia	13	69,452	70,000	46,296	120,650	19,009	89	71,407	70,000	26,807	120,650	17,765
Southern Transdanubia	8	35,419	33,500	8,400	58,600	15,777	80	41,234	52,099	5,539	85,459	22,908
Western Transdanubia	10	65,586	63,000	15,351	112,350	34,343	77	53,131	54,226	9,543	112,350	22,640
Pest	21	77,683	77,700	31,090	107,100	20,613	158	72,123	70,736	31,090	111,699	16,692
Total	116	65,545	65,000	0	157,500	32,461	977	64,437	64,448	0	157,500	28,162
Legal status of settlement												
village	26	41,647	27,620	0	106,000	34,489	193	34,711	28,047	0	106,000	25,421
town	29	58,844	64,700	28,500	107,100	20,479	262	59,742	58,717	0	107,100	18,390
town with county's rights	33	63,982	58,600	30,000	120,650	23,889	280	63,002	59,752	23,875	120,650	17,936
capital	28	96,520	92,250	52,500	157,500	26,066	242	94,886	90,323	52,500	157,500	17,129
Total	116	65,545	65,000	0	157,500	32,461	977	64,437	64,448	0	157,500	28,162
Type of operator												
public sector	8	12,002	10,574	0	24,150	8,434	126	23,513	23,875	0	57,655	16,979
church	12	39,583	35,920	10,500	70,053	19,286	96	40,481	44,868	8,174	75,916	16,290
other	96	73,253	72,925	14,000	157,500	28,994	755	74,312	70,736	14,000	157,500	22,244
Total	116	65,545	65,000	0	157,500	32,461	977	64,437	64,448	0	157,500	28,162
Receives state support												
Yes	106	61,253	60,060	0	135,000	29,984	878	59,672	59,752	0	135,000	24,791

Table 8 (continued)

	Sample						All nurseries (including imputed values)					
	N	Fee characteristics					N	Fee characteristics				
		mean	median	min	max	st.dev		mean	median	min	max	st.dev
No	10	111,045	107,750	80,000	157,500	21,415	99	106,691	119,239	23,875	157,500	19,794
Total	116	65,545	65,000	0	157,500	32,461	977	64,437	64,448	0	157,500	28,162

Other includes "non-profit" and "other non-state" categories. Out-of-sample fees imputed using specification 1 (shown in Table 7)

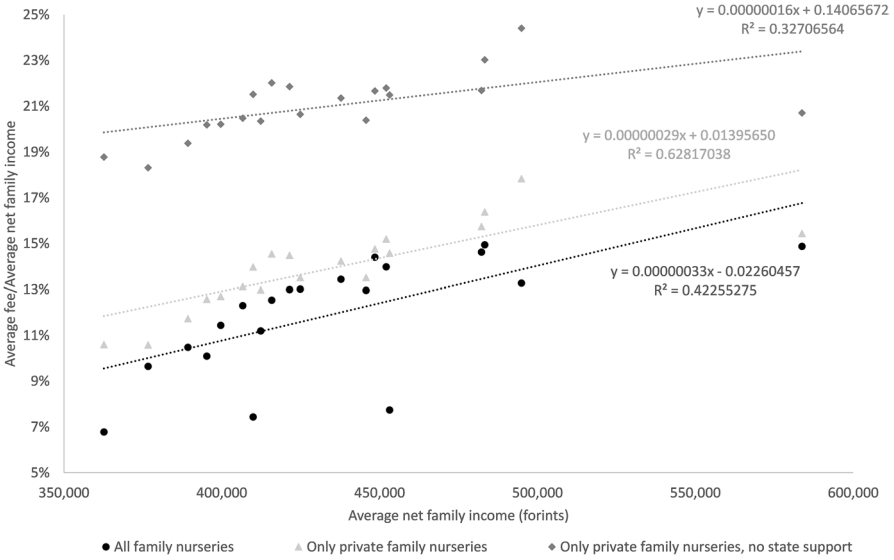

Fig. 3 Family nursery affordability across counties. Each mark represents a county's family nursery affordability metric for one of the three models: including all family nurseries (dark black dot), only private family nurseries (light grey triangle), only private family nurseries with the removal of state support (grey diamond). Dotted lines are the fitted regression lines for each of the three models showing the relationship between family nursery affordability and the county's average net family income

The average family nursery fee accounts for between 6 and 15% of the average net family income across counties (Fig. 3, black circles), using a stylised family affordability metric as outlined in *Data and Methodology*.[2] Interestingly, the proportion is lower in poorer counties, as evidenced by the positive slope of the black trendline in Fig. 3 and the high statistical significance of the corresponding regression coefficient (untabulated).

Turning to the effect of the welfare mix, we next seek to understand whether average family nursery affordability in poorer counties still compares favourably to that in richer counties absent state and church support.

As a first step, we remove family nurseries from our sample with state or church operators. We rerun the fee model to estimate fees for out-of-sample privately-operated family nurseries and then recreate the stylised examples of family nursery fees in the context of net family income. On average family nursery affordability using this metric continues to be more favourable in counties with a lower average net family income, as illustrated by the positive slope of the light grey line in Fig. 3 and the high statistical significance of the corresponding regression coefficient (untabulated). This suggests that even amongst privately-run family nurseries, the average family nursery fee makes up a smaller proportion of the

[2] Note that almost all of these proportions exceed the legal threshold of 20–25% of per person family income applicable to the (public) traditional nurseries, referred to in the Hungarian context section, as – for example – the 7% family nursery fee/net family income corresponds to a 28% family nursery fee/ per person family income (7/(100/4)) for a family of four.

net average family income in poorer counties than in richer ones. The slope is only slightly less positive than when all nurseries were included.

The state normative support of about 30,000 forints is a flat amount across the country, regardless of the family nursery fee. Proportionately, therefore, this translates to a higher subsidy in poorer areas where family nursery fees tend to be lower. Consequently, as a second step, we seek to uncover whether this form of government involvement might be driving the aforementioned positive relationship. As a thought experiment, where family nurseries have applied for state support, we increase fees by this amount. This is not to say that absent government support, fees would indeed increase by this amount as market forces, not least the ability and willingness of parents to cover this extra cost, would also be at play. Nevertheless, one could assume that in poorer areas, family nurseries might be able to pass on less of the increase in costs than family nurseries in richer areas. According to this line of reasoning, and repeating the steps in the first part of this section, we would be underestimating the steepness of the slope (Fig. 3 dark gray line). Even so, the slope remains positive, though somewhat less steep than in the first two scenarios. Again, this provides further confirmation that the average family nursery fee as a proportion of the average net family income in poorer counties compares favourably to that in richer counties, even after government and church support is removed.

6 Limitations

Conclusions regarding ECEC availability relative to demand should be interpreted with caution on account of the shortcomings of our two proxies for demand: the proportion of women who participate in the labour force and the proportion of women with higher education. Neither of these take into account whether the woman has nursery-aged children and is actively seeking childcare.

The OECD proxy we use to measure ECEC affordability is imperfect. Indeed, it is plausible that even though fees account for a smaller proportion of net family income in poorer areas, the net family income is so low that fees are not affordable. Moreover, income averages may mask important differences in the distribution of income – such data for families with young children would be particularly useful. Also, we do not have spatial information on the income distribution of parents whose children go to traditional nurseries. Despite traditional nurseries' legal obligation to prioritise disadvantaged children, it is conceivable that in some areas proportionately more children are admitted from higher socio-economic background (relative to the non-prioritised low SES group) and thus family nursery fees constitute a comparatively higher burden for the average family looking for childcare in the area.

7 Conclusions

A dominant way of viewing childcare is as an investment in human and social capital. Multiple studies confirm that it is low SES children who benefit the most from ECEC (e.g. Van Lancker & Ghysels, 2016), including from a very young age.

Similar to other countries, the public provision of ECEC for the under 3-s is in short supply in Hungary. We find that the shortage of the (publicly-funded) traditional nurseries is greater in poorer areas even after controlling for small settlements, regional effects and proxies of demand. Our regressions suggest that, on average, a 10 percentage points higher child poverty rate is associated with a one percentage point lower traditional nursery coverage ratio (slots per 0–2 year-old residents), after controls and considering spillover effects. The one percentage point difference is far from marginal in a country where formal ECEC arrangements cover less than 20% of children pertaining to this age group and child poverty rates range from 1 to 74%.

Lower access to ECEC in poorer areas is suboptimal because it may translate into many underprivileged children forgoing the potential benefits of ECEC – precisely the children who could gain the most. Local availability is highly relevant in childcare with geographical proximity essential in allowing parents to manage daily logistics (Pennerstorfer and Pennerstorfer, 2020).

In the the context of traditional nursery shortage, family nurseries are the legal form through which the private market steps in to supply formal ECEC. Privately-run family nurseries' market share is at c. 10% and are widely seen to be used by better-off families (e.g. Keller, 2018). Unsurprisingly, we also find lower availability of this form of ECEC in poorer areas. We do not, however, uncover evidence suggesting that family nursery fees are less affordable in poorer compared to richer areas areas using a stylised family affordability metric.

To maximise the benefit of early childcare at the level of society, it is important to ensure that less advantaged children have access to ECEC services but in settings that are not purely limited to such children. One possible policy direction that accomodates for the local nature of ECEC is expanding public ECEC in poorer areas with policies ensuring that the proportion of lower SES children does not decrease. The country-wide expansion of ECEC services has been a policy objective in Hungary in recent years, current paper suggests targeting underprivileged areas first.

Further studies could usefully build on our results and inform a holistic policy approach aimed at increasing ECEC usage for disadvantaged children. To this end, one useful line of enquiry would entail a thorough exploration spatially and across socio-economic lines of factors that have been identified as important to ECEC demand beyond the affordability of private ECEC – which we did not find to be inferior in poorer compared to richer areas. Such factors include inadequate labour market opportunitities, the perceived value of maternity benefit and conservative attitudes in favour of young children staying with their mothers (HSCO, 2015).

Abbreviations *CEE*: Central and Eastern Europe; *ECEC*: Early Childhood Education and Care; *HCSO*: Hungarian Central Statistical Office; *NUTS*: Nomenclature of Territorial Units for Statistics; *OLS*: Ordinary Least Squares; *PPR*: Population to Provider Ratio; *SES*: Socio-Economic Status

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s12187-022-10007-9.

Funding Open access funding provided by John von Neumann University.

Data Availability All data analysed in this study are referenced and links are provided in the References section. The one exception is the data on family nursery fees which are available from the corresponding author on reasonable request.

Declarations

Other Declarations Not applicable.

Competing Interests The authors have no competing interests to declare that are relevant to the content of this article.

References

Abrassart, A., & Bonoli, G. (2015). Availability, Cost or Culture? Obstacles to Childcare Services for Low-income Families. *Journal of Social Policy, 44*(4), 787–806.

Arlot, S., & Celisse, A. (2010). A survey of cross-validation prodecures for model selection. *Statistics Surveys, 4*, 40–79.

Baker, M., Gruber, J., & Milligan, K. (2008). Universal Child Care, Maternal Labor Supply, and Family Well-Being. *Journal of Political Economy, 116*(4), 709–745. https://doi.org/10.1086/591908

Blau, D. M. (2001). *The Child Care Problem*. Russell Sage Foundation.

Budget law (2018). Law 2018.L. *Hungary's Central Budget 2019*. Retrieved January 7, 2021, from https://net.jogtar.hu/jogszabaly?docid=A1800050.TVHungary.

Campbell, T., Gambaro, L., & Stewart, K. (2018). Universal Early Education: Who Benefits? Patterns in Take-up of the Entitlement to Free Early Education among Three-year-olds in England. *British Educational Research Journal, 44*(3), 515–538.

Child Protection Law (1997). *Lax 1997.XXXI. Child Protection. Hungary.* Retrieved November 30, 2020, from https://net.jogtar.hu/jogszabaly?docid=99700031.tv.

CSONK Kft (2017). *Családi bölcsőde tájékoztató [Information on Family Nurseries].* Resource Document. Retrieved January 8, 2021, from http://www.efop311.hu/wp-content/uploads/2018/05/Csaladi_bolcsode_Tajekoztato.pdf.

Cloney, D., Cleveland, G., Hattie, J., & Tayler, C. (2016). Variations in the Availability and Quality of Early Childhood Education and Care by Socioeconomic Status of Neighborhoods. *Early Education and Development, 27*(3), 384–401.

Dahl, G. B., & Lochner, L. (2012). The impact of family income on child achievement: Evidence from the earned income tax credit. *American Economic Review, 102*, 1927–1956.

Darvas, Á., & Mózer, P. (2004). Kit támogassunk? [Whom Should We Support?]. *Esély, 2004*(6), 66–99.

Davis, E., & Li, N. (2009). Regional Variation in Child Care Prices: A Cross-State Analysis. *Journal of Regional Analysis and Policy, 39*(1), 40–54.

Dudás, Á. (2019a). *Bölcsődei ellátás [Nursery Provision].* Retrieved June 22, 2020, from https://csalad.hu/cikk/bolcsodei-ellatas .

Dudás, Á. (2019b). *Gyermekgondozást segítő ellátás (GYES) [Maternity Benefit].* Retrieved September 22, 2020, from https://www.csalad.hu/cikk/gyes-gyermekgondozast-segito-ellatas .

European Commission (2018). *Barcelona Objectives.* Retrieved June 22, 2020, from https://ec.europa.eu/info/sites/info/files/bcn_objectives-report2018_web_en.pdf .

EPIC (European Platform for Investing in Children) (2019). *Country Profiles – Hungary: Policies and Progress towards Investing in Children.* Retrieved November 23, 2020, from https://ec.europa.eu/social/main.jsp?catId=1248&langId=en&intPageId=3644 .

Eurostat (2019). *NUTS – Nomenclature of Territorial Units for Statistics.* Retrieved November 26, 2020, from https://ec.europa.eu/eurostat/web/nuts/background.

Farkas, Zs. (2016). *A rendszeres gyermekvédelmi kedvezményre jogosult gyermekek, fiatal felnőttek számának csökkenése mögött húzódó okok vizsgálata [Factors behind the Reduction in Children and Young Adults Entitled to Regular Child Protection Allowance].* Resource document. Retrieved September 8, 2020, from http://old.tarki.hu/hu/news/2016/kitekint/szocpol/.

Felfe, C., Lalive, R. (2013). Early Child Care and Child Development: For Whom it Works and Why. S*OEPpapers on Multidisciplinary Panel Data Research, No. 536, Deutsches Institut für Wirtschaftsforschung (DIW), Berlin*. Retrieved 5 September, 2022 from https://www.econstor.eu/bitstream/10419/69908/1/736675108.pdf.

Ficano, C. K. C. (2006). Child-Care Market Mechanisms: Does Policy Affect the Quantity of Care? *Social Service Review, 80*(3), 453–484.

Fransen, K., Neutens, T., De Maeyer, P., & Deruyter, G. (2015). A Commuter-based Two-step Floating Catchment Area Method for Measuring Spatial Accessibility of Daycare Centers. *Health & Place, 32*, 65–73.

Friedman, S. L., & Boyle, D. E. (2008). Attachment in US children experiencing nonmaternal care in the early 1990s. *Attachment & Human Development, 10*(3), 225–261.

Geoffroy, M.-C., Coté, S. M., Giguère, C. -É., et al. (2010). Closing the gap in academic readiness and achievement: The role of early childcare. *The Journal of Child Psychology and Psychiatry, 51*(12), 1359–1367.

GOCCB (Government Office of the Capital City Budapest) (2019). *Tájékoztató Családi pótlék – nevelési ellátás, iskoláztatási támogatás [Information on Family Allowance – Support for Upbringing and Education].* Retrieved February 21, 2021, from http://www.kormanyhivatal.hu/download/4/9d/24000/Családi%20pótlék.pdf.

Habibov, N. (2015). On Individual, Household, and Community Factors Explaining Enrollment to Early Childhood Education and Care in Post-Soviet Transitional Countries. *Child Indicators Research, 8*, 825–843.

Halleck Vega, S. M., & Elhorst, J. P. (2017). The SLX model: Extensions and the sensitivity of spatial spillovers. *Papeles De Economia Espanola, 152*, 34–50.

HCSO (Hungarian Central Statistical Office) (2012). *Gyermekvállalás és gyermeknevelés [Having children and raising children]* Report, Hungary. Retrieved February 21, 2021, from https://www.ksh.hu/docs/hun/xftp/idoszaki/pdf/gyemekvallalasneveles.pdf

HCSO (Hungarian Central Statistical Office) (2015). *A kisgyermeket nevelő nők és a munkaerőpiac [Women with Young Children and the Labour Market].* Report, *Statisztikai tükör*, Hungary, December.

HCSO (Hungarian Central Statistical Office) (2016). *Comments on methodology and definitions 2016 Microcensus*. Retrieved December 1, 2021, from https://www.ksh.hu/mikrocenzus2016/docs/mikrocenzus_2016_modszertan_fogalmak.pdf.

HCSO (Hungarian Central Statistical Office) (2018). *Gazetteer of Hungary 1 January 2018* . Retrieved February 21, 2021, from http://www.ksh.hu/docs/hun/hnk/hnk_2018.xlsx .

HCSO (Hungarian Central Statistical Office) (2019a). *A gyermekek napközbeni ellátása 2018 [Childcare 2018].* Report, *Statisztikai tükör*, Hungary, April.

HCSO (Hungarian Central Statistical Office) (2019b). *All Households' Data by Income Decile, Region and Type of Settlement* . Retrieved September 15, 2020, from https://www.ksh.hu/docs/hun/xstadat/xstadat_eves/i_zhc014d.html?down=2433.63623046875 .

HCSO (Hungarian Central Statistical Office) (2019c). *Gross Average Earnings of Full-time Workers by Employer Location* . Retrieved September 15, 2021, from https://www.ksh.hu/docs/hun/xstadat/xstadat_evkozi/e_qli029b.html .

HCSO (Hungarian Central Statistical Office) (2019d). *Data on Budapest Districts* . Retrieved September 15, 2020, http://statinfo.ksh.hu/Statinfo/QueryServlet?ha=TK1001_W .

HCSO (Hungarian Central Statistical Office) (2019e). *Annual Statistical Data on Settlements Using 2018 Settlement Structure* . Retrieved January 15, 2020, from http://statinfo.ksh.hu/Statinfo/QueryServlet?ha=TA2018_W .

HCSO (Hungarian Central Statistical Office) (2022). *Regional Atlas – Districts*. Retrieved January 20, 2021, from https://www.ksh.hu/regionalatlas_districts.

Herrod, H. G. (2007). Do first years really last a lifetime? *Clinical Pediatrics, 46*(3), 199–205.

Huff, D. L. (1963). A Probabilistic Analysis of Shopping-center Trade Areas. *Land Economics, 39*(1), 81–90.
Helburn, S. W., & Howes, C. (1996). Child Care Cost and Quality. *The Future of Children, 6*(2), 62–82.
HST (Hungarian State Treasury) (2019). *A Magyar Államkincstár tájékoztatója a kisgyermeket nevelő szülők munkaerőpiaci visszatérését ösztönző továbbadott támogatási konstrukciókról [Information from the Hungarian Treasury on the Support Designed to Incentivise the Labour Market Return of Parents of Young Children].* Retrieved September 1, 2021, from https://tcs.allamkincstar.gov.hu/images/documents/ginop/Kincstar_Kozlemeny_blcsde_07.16.pdf
Hufkens, T., Figari, F., Vandelannoote, D., & Verbist, G. (2020). Investing in Subsidized Childcare to Reduce Poverty. *Journal of European Social Policy, 30*(3), 306–319.
Hungarian Government (2018). *"Húszmilliárd forinttal támogatja a kormány a bölcsődei férőhelyek létrehozását" [Twenty Billion Forint Government Subsidy towards the Creation of New Nursery Places].* Retrieved September 5, 2020, from https://www.kormany.hu/hu/emberi-eroforrasok-miniszteriuma/csalad-es-ifjusagugyert-felelos-allamtitkarsag/hirek/huszmilliard-forinttal-tamogatja-a-kormany-bolcsodei-ferohelyek-letrehozasat .
Keller, J. (2018). As esélykiegyenlítés egyenlőtlen feltételei: A koragyerekkori szolgáltatások intézményi asszimetriái [Unequal conditions to equalisation: Institutional asymmetries of early childhood services]. *Esély, 2018*(5), 48–75.
Kim, G. J., & Umayahara, M. (2010). Early Childhood Care and Education: Building the Foundation for Lifelong Learning and the Future of the Nations of Asia and the Pacific. *International Journal of Child Care and Education Policy, 4*(2), 1–13.
Kormányablak (2020). *Rendszeres gyermekvédelmi kedvezményre való jogosultság megállapítása iránti kérelem [Application for Entitlement to Regular Child Protection Allowance].* Retrieved September 8, 2020, from http://kormanyablak.hu/hu/feladatkorok/100/JEGYZ30000 .
Kottelenberg, M. J., & Lehrer, S. F. (2014). Do the Perils of Universal Childcare Depend on the Child's Age? *Cesifo Economic Studies, 60*(2), 338–365.
Langford, M., Higgs, G., & Dallimore, D. J. (2019). Investigating Spatial Variations in Access to Childcare Provision Using Network-based Geographic Information System Models. *Social Policy & Administration, 53*(5), 661–677.
Lee, J., & Jang, Y. J. (2017). Equal Access to Early Childhood Education in South Korea Using the Geographic Information System. *International Journal of Early Years Education, 25*(2), 171–189.
Makay, Zs. (2015). Családtámogatás, gyermeknevelés, munkavállalás [Support for Families, Parenting and Work]. In: J. Monostori, P. Őri & Zs. Spéder (Eds.), *Demográfiai portré* [Demographic Portrait] (pp.57–74). Budapest: KSH NKI.
Makay, Zs. (2018). Családtámogatás, női munkavállalás [Support for Families, Female employment]. In: J. Monostori, P. Őri & Zs. Spéder (Eds.), *Demográfiai portré* [Demographic Portrait] (pp.83–102). Budapest: KSH NKI.
Melhuish, E., Ereky-Stevens, K., Petrogiannis, K. et al. (2015). Curriculum Quality Analysis and Impact Review of European Early Childhood Education and Care upon child development. CARE 613318. Retrieved September 7, 2022, from https://ecec-care.org/fileadmin/careproject/Publications/reports/new_version_CARE_WP4_D4_1_Review_on_the_effects_of_ECEC.pdf
NAV (Nemzeti Adó- és Vámhivatal) (2019). *A családi kedvezmény változásai [Changes to Family Allowance].* Retrieved October 15, 2020, from https://www.nav.gov.hu/nav/ado/szja/A_csaladi_kedvezmeny_20190131.html .
Noailly, J., & Visser, S. (2009). The Impact of Market Forces on Child Care Provision: Insights from the 2005 Child Care Act in the Netherlands. *Journal of Social Policy, 38*(3), 477–498.
OECD. (2001). *Starting Strong: Early Childhood Education and Care*. OECD Publishing.
OECD (2016a). *Starting Strong IV Early Childhood Education and Care Data Country Note Hungary.* Retrieved December 15, 2019, from http://www.oecd.org/education/school/ECECDCN-Hungary.pdf .
OECD. (2016b). *Society at a glance 2016: OECD Social Indicators*. OECD Publishing.
OECD (2017). *PF3.4: Childcare Support.* Retrieved October 27, 2020, https://www.oecd.org/els/soc/PF3_4_Childcare_support.pdf .
Orbán, V. (2019). *Évértékelő beszéd [Speech Evaluating the Year.* Retrieved September 15, 2021, from https://www.kormany.hu/hu/a-miniszterelnok/beszedek-publikaciok-interjuk/orban-viktor-evertekelo-beszede-2019 .
Pavolini, E., & Van Lancker, W. (2018). The Matthew Effect in Childcare Use: A Matter of Policies or Preferences? *Journal of European Public Policy, 25*(6), 878–893.
Pennerstorfer, A., & Pennerstorfer, D. (2020). Inequalities in Spatial Accessibility of Childcare: The Role of Non-profit Providers. *Journal of Social Policy, 50*(1), 122–147.

Public Education Law, (2011). *CXC. Law of public education.* Retrieved January 18, 2022, from https://net.jogtar.hu/jogszabaly?docid=a1100190.tv.

Reid, J. L., & Ready, D. D. (2013). High-Quality Preschool: The Socioeconomic Composition of Preschool Classrooms and Children's Learning. *Early Education and Development, 24*(8), 1082–1111.

Ruhm, C., & Waldfogel, J. (2012). Long-term Effects of Early Childhood Care and Education, in: *Nordic Council of Ministers Nordic Economic Policy Review: Economics of Education*, 23–51. Copenhagen: Nordic Council of Ministers.

Rüttenauer, T. (2019). Spatial Regression Models: A Systematic Comparison of Different Model Specifications Using Monte Carlo Experiments. *Sociological Methods & Research, 51*(2), 728–759.

Saraceno, C. (2011). Childcare needs and childcare policies: A multidimensional issue. *Current Sociology, 59*(1), 78–96.

Schober, P. S., & Spiess, K. (2013). Early Childhood Education Activities and Care Arrangements of Disadvantaged Children in Germany. *Child Indicators Research, 6*, 709–735.

Schober, P. S., & Stahl, J. F. (2014). Trends in der Kinderbetreuung: Sozioökonomische Unterschiede verstärken sich in Ost und West, *DIW-Wochenbericht*, ISSN 1860–8787, 81 (40), 986–994.

Small, M., & Stark, L. (2005). Are Poor Neighborhoods Resource Dep rived? A Case Study of Childcare Centers in New York. *Social Science Quarterly, 86*(5), 1013–1036.

SZGYF (Szociális és Gyermekvédelmi Főigazgatóság) (2019). *Social Services Portal* . Retrieved July 12, 2019, from http://szocialisportal.hu/intezmenykereso .

Ünver, Ö., Bircan, T., & Nicaise, I. (2018). Perceived accessibility of childcare in Europe: A cross-country multilevel study. *International Journal of Child Care and Education Policy, 12*, 5.

Vandenbroeck, M., De Visscher, S., Van Nuffel, K., & Ferla, J. (2008). Mothers' Search for Infant Child Care: The Dynamic Relationship between Availability and Desirability in a Continental European Welfare State. *Early Childhood Research Quarterly, 23*(2), 245–258.

Vandenbroeck, M., Geens, N., & Berten, H. (2013). The Impact of Policy Measures and Coaching on the Availability and Accessibility of Early Child Care: A Longitudinal Study. *International Journal of Social Welfare, 23*(1), 69–79.

van Ham, M., & Mulder, C. H. (2005). Geographical Access to Childcare and Mothers' Labour Force Participation. *Journal of Economic and Social Geography, 96*(1), 63–74.

Van Lancker, W., & Ghysels, J. (2016). Explaining Patterns of Inequality in Childcare Service Use across 31 Developed Economies: A Welfare State Perspective. *International Journal of Comparative Sociology, 57*(5), 310–337.

Van Lancker, W. (2018). Reducing Inequality in Childcare Service Use across European Countries: What (if any) Is the role of Social Spending? *Social Policy & Administration, 52*(1), 271–292.

Yang, S. (2021). The Long-Run Effects of Early Childhood Education and Care— An Empirical Analysis Based on the China Family Panel Studies Survey. *Child Indicators Resesarch, 14*, 2021–2044. https://doi.org/10.1007/s12187-021-09839-8