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Socioeconomic Determinants of the Availability of Kindergartens in the Czech Republic

Bachelor's Thesis

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Prague, July 28, 2022 Zuzana Meteláková

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Abstract

This thesis aims to identify socioeconomic determinants of the availability of places in kindergartens in the Czech Republic which is for the purpose of this thesis expressed as the percentage of rejected kindergarten applications. Additionally, district-level characteristics related to the perceived shortage of places in kindergartens for children from distinct age groups, which indicates whether a child has a legal right to attend a kindergarten and whether pre-primary education is compulsory for them, are inspected. A balanced panel dataset of 76 Czech districts and the Capital City of Prague for the school years 2017/2018, 2018/2019, and 2019/2020 is analysed utilizing panel data estimation methods. The results suggest that an increase in the male unemployment rate and the growth of the average monthly wage correspond to the deterioration of the availability of places in kindergartens. The results are similar for children aged three to four years. On the contrary, the results are substantially different for children from other age groups and imply that an increase in the percentage of the urban population is associated with a lower percentage of rejected kindergarten applications. The population density, the net migration, the percentage of foreigners in the population, the share of young children in the population, and the number of newborn children lagged by three years are other district-level characteristics related to the share of rejected kindergarten applications.

Keywords

preschool education, early childhood care, kindergarten, availability of kindergartens, rejected applications

Title

Socioeconomic Determinants of the Availability of Kindergartens in the Czech Republic

Abstrakt

Cílem této práce je identifikovat socioekonomické faktory dostupnosti míst v mateřských školách v České republice, která je pro účel této práce vyjádřená procentem zamítnutých žádostí o zápis ke vzdělávání v těchto školách. Kromě toho práce zkoumá charakteristiky okresů související s vnímaným nedostatkem míst v mateřských školách pro děti z různých věkových skupin, což indikuje, zda má dítě na předškolní vzdělání v mateřské škole právní nárok a zda je pro něj předškolní vzdělání povinné. Pomocí metod pro panelová data jsou analyzovány školní roky 2017/2018, 2018/2019 a 2019/2020 na úrovni 76 českých okresů a Prahy. Celkové výsledky ukazují, že se dostupnost míst v mateřských školách zhoršuje při zvýšení podílu nezaměstnaných mužů a růstu průměrné měsíční mzdy. Pro děti ve věku tří až čtyř let jsou výsledky podobné. Výsledky se značně odlišují pro děti z ostatních věkových skupin a naznačují, že růst podílu městského obyvatelstva souvisí s nižším procentem zamítnutých žádostí o vzdělávání v mateřských školách. Hustota zalidnění, migrační saldo, procentuální zastoupení cizinců v populaci, podíl dětí v populaci a počet nově narozených dětí tři roky před zkoumanými lety jsou další charakteristiky související s podílem zamítnutých žádostí o vzdělávání v mateřských školách.

Klíčová slova

předškolní vzdělání, péče o děti, mateřské školy, dostupnost mateřských škol, zamítnuté přihlášky

Název práce

Socioekonomické faktory dostupnosti mateřských škol v České republice

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Acronyms

BIC	Bayesian Information Criterion
BLUE	Best Linear Unbiased Estimator
CZSO	Czech Statistical Office
ECEC	Early Childhood Education and Care
EU	European Union
FD	First-differenced/First Differencing
FE	Fixed Effects
FGLS	Feasible Generalized Least Squares
GLS	Generalized Least Squares
LAU	Local Administrative Units
MEYS	Ministry of Education, Youth and Sports
MIT	Ministry of Industry and Trade
MoLSA	Ministry of Labour and Social Affairs
NUTS	Nomenclature of Units for Territorial Statistics
OECD	Organisation for Economic Cooperation and Development
OLS	Ordinary Least Squared
RE	Random Effects
SD	Standard Deviation
UNICEF	United Nations Children's Fund

1. Introduction

In the Czech Republic, preschool education is provided for children aged two to six years preceding compulsory education in primary schools (Act No. 561/2004 Coll., as amended). As stated by Chzhen (2018), assuring high-quality early childhood learning is considered a policy that subdues the unequal conditions of young children because of its propitious effect on acquiring basic knowledge and developing social skills. Preschool education is in the country organized primarily in kindergartens, to which an application must be submitted. Be that as it may, the supply of places in kindergartens does not meet the demand, and a vast number of applications is not accepted (Zykanová & Janhubová, 2020). Zatloukal et al. (2021) confirm that the number of rejected applications for pre-primary education is still climbing.

Consequently, this thesis aims to detect the socioeconomic factors of the availability of places in kindergartens, which is for the purpose of this thesis expressed as the percentage of rejected kindergarten applications. There exist many Czech and international studies inspecting the relationship between distinct regional characteristics and the participation rate in preschool education, e.g., by Zykanová and Janhubová (2020), Hulík et al. (2008), and Kachi et al. (2020). Nonetheless, the question of what the socioeconomic factors of the availability of places in kindergartens are, i.e., the determinants of the rejection rate of kindergarten applications, has not been answered yet.

Together with a general analysis of the availability of places in kindergartens without taking children's age into account, additional analyses are included to find out what are the socioeconomic factors of the perceived shortage of places in kindergartens for children from three distinct age groups. The age of a child impacts whether the child has a legal right to be placed in a kindergarten and whether pre-primary education is compulsory for them (Act No. 561/2004 Coll., as amended).

In the analysis, the same administrative units are observed for three consecutive school years 2017/2018, 2018/2019, and 2019/2020. In concrete, 77 LAU 1, which in the Czech Republic includes 76 districts and the Capital City of Prague, are inspected. Thus, the analysis deals with a panel data structure. Therefore, appropriate panel data estimation methods are implemented. District-level socioeconomic characteristics that are included in the models are the average monthly wage, the male unemployment rate, the percentage of the urban population, the percentage of inhabitants with higher education, and the number of dwellings completed per 1,000 population.

Other than socioeconomic characteristics such as the percentage of foreigners, the number of newborn children per 1,000 population lagged by three years, the share of children aged two to six years, the net migration per 1,000 population, and the population density are also included in the analysis.

The findings of the research in this thesis imply that the male unemployment rate, the average monthly wage, and the percentage of the urban population are associated with the share of rejected kindergarten applications for at least some age groups. The number of dwellings completed per 1,000 population and the percentage of the population with higher education are statistically insignificant for all age groups. On the contrary, all remaining district-level characteristics are statistically significant for at least some age groups.

These results can provide suggestions to local governments on how to plan kindergartens and what characteristics of the population to monitor in order to reduce the perceived shortage of places in kindergartens.

The thesis is structured as follows. Chapter 2 offers the institutional background of ECEC together with the supply-demand framework of places in kindergartens in the Czech Republic. Moreover, a graphical representation of the data is included to provide visual support for the interregional comparison. In Chapter 3, studies examining the participation rate in preschool education are outlined. The data source, the variable selection, and the descriptive statistics of the dependent and independent variables accompanied with map graphs are presented in Chapter 4. Chapter 5 includes the description of the methodology utilized in the analysis, concretely panel data estimation methods. This chapter also provides the assumptions discussion and comparison of the panel data estimation methods. The results of the analysis are stated, interpreted, and discussed in Chapter 6. The thesis is concluded in Chapter 7.

2. Institutional Background

This chapter is dedicated to the description of the care and education of children during their early childhood, known as ECEC, and the operation of the facilities in which the ECEC is organized.

Specifically, this section highlights the importance of preschool education, also known as pre-primary education, and describes the organization of preschool education in the Czech Republic. It includes an explanation of the operation of kindergartens, which are part of the Czech school system and provide pre-primary education for children aged two to six years. Moreover, it presents a brief analysis of the availability of places in kindergartens in the country using a supply-demand framework. Particular attention is placed on this type of facility to deliver a comprehensible background to the research question of this thesis.

Loudová Stralczynská (2017) states that ECEC is in the Czech Republic divided into two separated parts. Early childhood education, i.e., pre-primary education, is provided by public kindergartens, private kindergartens, church kindergartens, and preparatory classes in the last year of pre-primary education and is under the auspices of the MEYS. With respect to early childhood care, the MoLSA supervises the organization of children's groups, and the MIT is responsible for social care institutions that are established as a continuation of the previous day nurseries which no longer exist in the original form (Loudová Stralczynská, 2017).

The ECEC is provided to children before the beginning of their compulsory primary education. In the Czech Republic, the school year starts on the 1st of September and ends the next calendar year on the 31st of August. Unless the postponement of compulsory school attendance is permitted, children start primary school on the 1st of September following their sixth birthday. The postponement by one school year, i.e., the child starts primary school on the 1st of September following their seventh birthday, is possible if the child is not adequately mentally or physically mature and if it is recommended by the relevant school advisory facility or a paediatrician (Act No. 561/2004 Coll., as amended).

2.1. Early Childhood Care in the Czech Republic

Early childhood care contains two organizationally distinct types of childcare. The first part is the individual childcare provided usually by one person to a small group of children. The second part is collective care.

Individual childcare is frequently ensured by parents and the broader family of children aged under three years. Commercial service of individual childcare is scarce in the Czech Republic because of associated high costs (Paloncyová, 2013).

Regarding collective childcare, Janhubová and Zykanová (2020) state that there presently exist predominantly four types of facilities used for the care of children during their early childhood, namely children's day-care in children's groups, nurseries (even though they do not exist in their original form), micro nurseries, and non-governmental organizations operated based on a trade license.

Nurseries were up to the 31st of March 2013 organized as medical facilities under the authority of the Ministry of Health of the Czech Republic and were used for the care of children until three years of age (Act No. 20/1966 Coll., as amended). Nonetheless, nurseries as medical facilities were abolished (Act No. 372/2011 Coll., as amended). Presently, they can be operated as a licensed trade called Daily care of children under three years of age within the purview of the MIT (Act No. 455/1991 Coll., as amended). The accessibility to nurseries is restricted and concentrated in large cities (Kuchařová et al., 2009).

Furthermore, in 2014, a new form of provision of early childhood care in the children's group was established. Children's groups provide care for children from six months of age to the beginning of compulsory school attendance and focus on the development of children's aptitude and cultural, hygienic, and social habits. They can be operated by non-profit institutions, regional and municipal organizations, municipalities, ministries, public universities, endowment funds, and companies. The utmost capacity of a children's group is 24 children, and they must enable children to attend the children's group for at least six hours a day (Act No. 247/2014 Coll., as amended).

2.2. Pre-primary Education in the Czech Republic

Pre-primary education is the second part of the ECEC in the Czech Republic. The benefits of participating in preschool education have been highlighted in many studies. To illustrate, Barnett (2008) in his research concludes that preschool programs produce a positive effect on the development and learning skills of children and suggests that preschool education positively influences long-term improvements in school success.

In a more recent study examining the long-term effects of attending kindergartens in Boston, Gray-Lobe, Pathak, and Walters (2021) argue that preschool education boosts post-secondary and college-preparatory outcomes. They have discovered that a child who participated in preschool education has a higher probability of graduating from high school and is more likely to enrol in a university. Barnett and Belfield (2006) point out that preschool education improves the results in the following education and eliminates the link between parental and children's behaviours in areas such as crime and teen parenting. Similarly, Gray-Lobe, Pathak, and Walters (2021) state that participation in preschool education decreases juvenile incarceration. Ball (1994) concludes that preschool services help to reduce stress on families and children and contribute to lifting children out of poverty because parents are enabled to work.

In the Czech Republic, the organization of preschool education is defined and described within Act No. 561/2004 Coll., on Pre-school, Basic, Secondary, Tertiary Professional and Other Education (the Education Act), as amended. In this act, it is stated that the objective of pre-primary education is helping to develop a young child's personality and support their emotional, cognitive, and physical growth. Furthermore, children benefit from preschool education by obtaining basic rules of conduct and forming interpersonal relations. Moreover, it should partly eliminate inequalities in development among children before their admission to primary schools and create essential prerequisites for continuing education.

Preschool education is in the country organized primarily in kindergartens including schools for pupils with special educational needs. Other possibilities of preschool education are preparatory classes, the preparatory stage of special basic schools, and individual education (Zatloukal et al., 2021).

It is provided for children between two and six years of age. Nevertheless, children who do not reach three years of age as of the beginning of a given school year do not have a legal right to be admitted to kindergartens. Moreover, if not stated otherwise, children must

start compulsory pre-primary school attendance on the 1st of September following their fifth birthday. Children can fulfil this requirement in kindergartens established by municipalities or groups of municipalities, in preparatory classes, preparatory stage of special basic schools, in foreign schools approved by the MEYS, or they can be educated individually at home (Act No. 561/2004 Coll., as amended).

2.2.1. Kindergarten

Socioeconomic characteristics that are related to the availability of places in kindergartens are inspected in this thesis. Thus, particular attention is paid to kindergartens and their operation. In the Czech Republic, kindergartens are established by the MEYS, regions, municipalities, unions of municipalities, registered churches, religious societies, and other natural or legal persons. Kindergartens are listed in the Register of Schools and School Facilities conducted by the MEYS (Act No. 561/2004 Coll., as amended).

Even though there is presently a wide range of kindergarten establishers, all kindergartens were public until 1989. However, together with political, economic, and social reforms, there was a change in the educational system. There appeared new opportunities for the private sector and the church to establish kindergartens, which were first shown in statistics for the school year 1991/1992 (Hůle et al., 2015a). Moreover, more places in kindergartens from the school year 2004/2005 were needed because of high natality at the beginning of the 21st century.

Because of the above-mentioned arguments, there was an incentive to construct new kindergartens and improve their capacity by establishing new classes. As depicted in Table 1, the number of public, private, and church schools is rising. The capacity expansion has been caused especially by the construction of private kindergartens. The highest number of private kindergartens is in the Capital City of Prague and the Central Bohemian Region. Even though the number of newly established public kindergartens has increased insignificantly in comparison to private kindergartens, the number of classes in public kindergartens is on the rise so they can be attended by more children (CZSO, 2021). Moreover, Table 1 shows the number of children and classes in kindergartens in each school year.

As demonstrated in Table 2, the percentage of public kindergartens, i.e., kindergartens established primarily by municipalities, a union of municipalities, regions, and the MEYS, is gradually decreasing. Concretely, from 98.03 % in the school year 2006/2007 to 91.46 % in the school year 2020/2021. On the contrary, the share of private

kindergartens is rapidly increasing from 1.52 % in the school year 2006/2007 to 7.60 % in the school year 2020/2021. The percentage of kindergartens established by registered churches remains stable and below 1 %.

Table 1: Total number of kindergartens, number of public, private, and church kindergartens, number of classes, and number of children in kindergartens from the school year 2006/2007 to 2020/2021, the Czech Republic

School year	Total number of kindergartens	Number of public kindergartens	Number of private kindergartens	Number of church kindergartens	Number of classes	Number of children
2006/2007	4 815	4 720	73	22	12 494	285 419
2007/2008	4 808	4 706	77	25	12 698	291 194
2008/2009	4 809	4 702	82	25	13 035	301 620
2009/2010	4 826	4 702	96	28	13 452	314 008
2010/2011	4 880	4 723	126	31	13 988	328 612
2011/2012	4 931	4 745	150	36	14 481	342 521
2012/2013	5 011	4 778	194	39	14 972	354 340
2013/2014	5 085	4 794	249	42	15 390	363 568
2014/2015	5 158	4 812	300	46	15 729	367 603
2015/2016	5 209	4 828	333	48	15 848	367 361
2016/2017	5 209	4 820	340	49	15 856	362 653
2017/2018	5 269	4 833	386	50	15 969	362 756
2018/2019	5 287	4 838	399	50	16 064	363 776
2019/2020	5 304	4 854	401	49	16 295	364 909
2020/2021	5 317	4 863	404	50	16 526	357 598

Source: CZSO

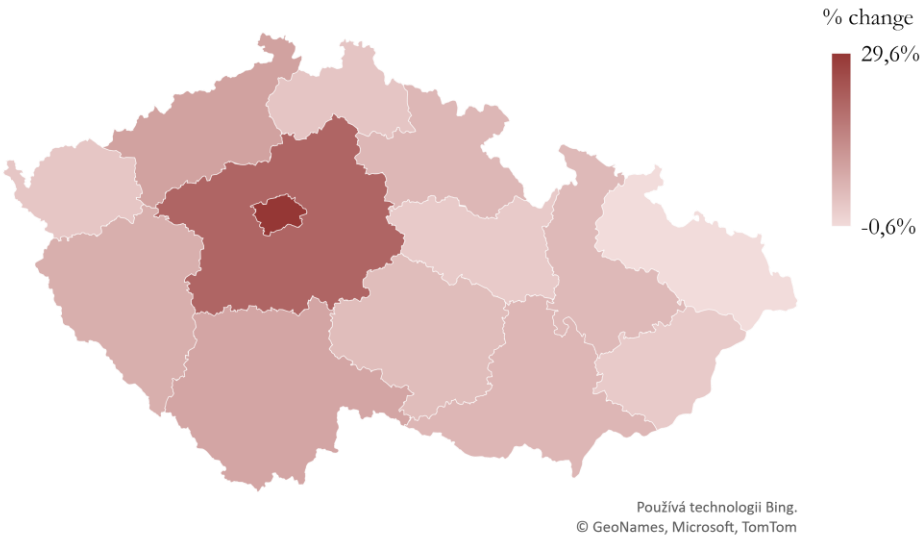
Table 2: Percentage of public, private, and church kindergartens from the school year 2006/2007 to 2020/2021, the Czech Republic

School year	Percentage of public kindergartens	Percentage of private kindergartens	Percentage of church kindergartens
2006/2007	98.03%	1.52%	0.46%
2007/2008	97.88%	1.60%	0.52%
2008/2009	97.78%	1.71%	0.52%
2009/2010	97.43%	1.99%	0.58%
2010/2011	96.78%	2.58%	0.64%
2011/2012	96.23%	3.04%	0.73%
2012/2013	95.35%	3.87%	0.78%
2013/2014	94.28%	4.90%	0.83%
2014/2015	93.29%	5.82%	0.89%
2015/2016	92.69%	6.39%	0.92%
2016/2017	92.53%	6.53%	0.94%
2017/2018	91.73%	7.33%	0.95%
2018/2019	91.51%	7.55%	0.95%
2019/2020	91.52%	7.56%	0.92%
2020/2021	91.46%	7.60%	0.94%

Source: CZSO, own processing

Be that as it may, the process of increasing kindergarten capacity by establishing new kindergartens is not homogenous across the country. The dissimilarity between districts is demonstrated in Figure 1. Inspecting the number of kindergartens in the school years 2010/2011 and 2020/2021, the most prominent ten-year percentual increase of 29,6 % is observable in the Capital City of Prague followed by the Central Bohemian Region with a 21,1% increase. Contrarily, in the Moravian-Silesian Region, the ten-year percentual change is – 0,6 %, i.e., the number of kindergartens has reduced in this region since the school year 2010/2011. In the Zlín Region and the Pardubice Region, the percentual change is positive but below 3 %. The data source of Table 1, Table 2, and Figure 1 is stated in the Appendix.

Figure 1: Percentual change in the number of kindergartens between the school year 2010/2011 and 2020/2021 by regions, the Czech Republic



Source: CZSO, own processing

Kindergartens are divided into classes either homogeneous or heterogeneous in terms of age (Decree No. 14/2005 Coll., as amended). Thus, another indicator of the expansion of kindergarten capacity is the increasing number of classes in kindergartens. The highest percentual change in the number of classes in kindergartens between the school year 2010/2011 and 2020/2021 was in the Central Bohemian Region, the lowest one in the Karlovy Vary Region. The regionally heterogeneous change in the kindergarten capacity is caused primarily by the demographic development in the number of children between two and six years in the regions (CZSO, 2021).

Nonetheless, the supply of places in kindergartens still does not meet the demand (Zykanová & Janhubová, 2020). Kucharová et al. (2009) state that due to the insufficient capacity, kindergartens must implement criteria for the admission of applicants. In their research, they discover that 87 % of monitored kindergartens apply at least one criterion. However, a significant portion of kindergartens utilizes a combination of 4 and more criteria. The dominant criterion of whether a child is accepted for preschool education is age aspect. Specifically, older children are enrolled preferentially. Other admission criteria are the permanent residence in the territory of the municipality or the city district, the employment of both parents, attending kindergarten by a sibling of the child in question,

and the length of attendance. Furthermore, applicants from socially needy families, of Czech nationality and from families with three or more children are accepted preferentially.

To add to that, principles of kindergartens established by municipalities or groups of municipalities are obliged to preferentially admit applications from children who reach three years of age before the start of the given school year, and who have their permanent residence in its territory or are placed in a care home which is situated in its territory (Act No. 561/2004 Coll., as amended) ("spádové mateřské školy"). Moreover, headteachers of these kindergartens must ensure conditions for compulsory preschool education for children who have permanent residence in its territory. If this is not possible, the child is admitted to a kindergarten established by another municipality or union of municipalities. This is ensured by the municipality of the child's permanent residence (Act No. 561/2004 Coll., as amended).

Headteachers of kindergartens can set a fee for attending the kindergarten or decide on its reduction or remission. For attending kindergartens established by the state, region, and municipality or union of municipalities, the fee is regulated by the law (Decree No. 14/2005 Coll., as amended). To add to that, children who have their sixth birthday during the respective school year and children who postpone compulsory school attendance, attend a kindergarten established by the state, region, and municipality or union of municipalities at no cost (Act No. 561/2004 Coll., as amended). The price of private kindergartens is not regulated and therefore, attending these schools tends to be more costly (Kuchařová & Svobodová, 2006).

The last part of this subchapter is dedicated to the age structure of children in kindergartens, which is rather heterogeneous. To illustrate, in the school year 2020/2021, 9.7 % of children who attended a kindergarten were younger than three years in comparison with five-year-old children, who represented 29.7 % of all children in kindergartens. Nonetheless, the number of children below three years of age increased from the school year 2012/2013 to the school year 2017/2018 by 42.3 % (CZSO, 2021).

The low representation of two-year-old children in kindergartens is partially caused by the fact that children who do not reach two years of age as of the beginning of a given school year do not have a legal right to attend kindergarten (Act No. 561/2004). Furthermore, Hůle et al. (2015a) explain that parents prefer to take care of children up to three years of age by themselves because of the possibility of taking parental leave. The employee should be granted a parental leave when applied for, but only until the child reaches three years of age (Act No. 262/2006 Coll., as amended).

Taking parental leave is supported by the possibility of simultaneously collecting parental allowance. The collecting of parental allowance is flexible, i.e., in optionally monthly repayments, but at maximum up to four years of age of the child or when having drawn 300,000 CZK (Act No. 117/1995 Coll., as amended). In this thesis, the years 2017, 2018, and 2019 are analysed. Thus, it is essential to mention that until the 31st of December 2019, the parental allowance was 220,000 CZK in total (Act No. 200/2017). The increase of parental allowance on the 1st of January 2020 together with the COVID-19 pandemic and the consequent fear of parents from sending their child to a kindergarten caused a drop in the percentage of children younger than three years in kindergartens (CZSO, 2021).

Even while one of the parents is collecting a parental allowance, children can attend kindergarten regularly but no more than four hours a day (Act No. 117/1995 Coll., as amended). Thus, mothers tend to be motivated to place their two-year-old children in a kindergarten so that they can return to the labour market immediately after their child's third birthday. Furthermore, institutionalized childcare for children under three years of age might be financially unavailable for a vast number of families.

At the end of this subchapter, it is essential to mention that since the school year 2020/2021, there have been set rules for providing distance education when schools must be closed, or children are prohibited to attend schools in person. Kindergartens are now obliged to provide distant classes for children with compulsory preschool attendance (Act No. 349/2020 Coll., as amended). This is another impact of the COVID-19 pandemic on the Czech school system. Consequently, pre-COVID data are utilized in the analysis.

2.2.2. Supply and Demand for Places in Kindergartens

In this subchapter, the relationship between the supply and demand for places in kindergartens is commented on to rationalize the adequacy of inspecting the determinants of kindergarten availability in the Czech Republic. Kuchařová et al. (2007) specify the difference between kindergarten accessibility, which means the existence of childcare service nearby the place of residence of the family, and availability, which is defined as the existence of sufficient places in kindergartens to meet the demand. The availability assesses the real relationship between the supply, i.e., the capacity of kindergartens, and demand for preschool education, i.e., the number of submitted kindergarten applications.

There was a significant decrease in the number of newborn children in the 1990s which led to the reduction of kindergarten capacity. Consequently, these measures caused

a problem in 2004, when the demand for places in kindergartens increased due to high natality and migration flows at the beginning of the 21st century (Hulík et al., 2008).

Since then, the supply of places in kindergartens has not met the demand in the Czech Republic (Janhubová & Zykanová, 2020). Nonetheless, Hůle et al. (2015a) declare that the demand for places in kindergartens is predicted to stagnate or even decline. Headteachers of relatively small kindergartens claim that the number of both lodged and rejected applications is constant, on the other hand, relatively large kindergartens observe a decrease in the demand for places in kindergartens and associated count of rejected children. Contrarily, Zatloukal et al. (2021) argue that the number of rejected applications for preschool education is still on the rise. From the school year 2019/2020 to the school year 2020/2021, the percentage of rejected applications grew in all age categories, altogether by two percentage points to 25 % (Zatloukal et al., 20201). This development indicates that many localities suffer from insufficient kindergarten capacity, which can be also caused by the regionally heterogeneous construction of new kindergartens.

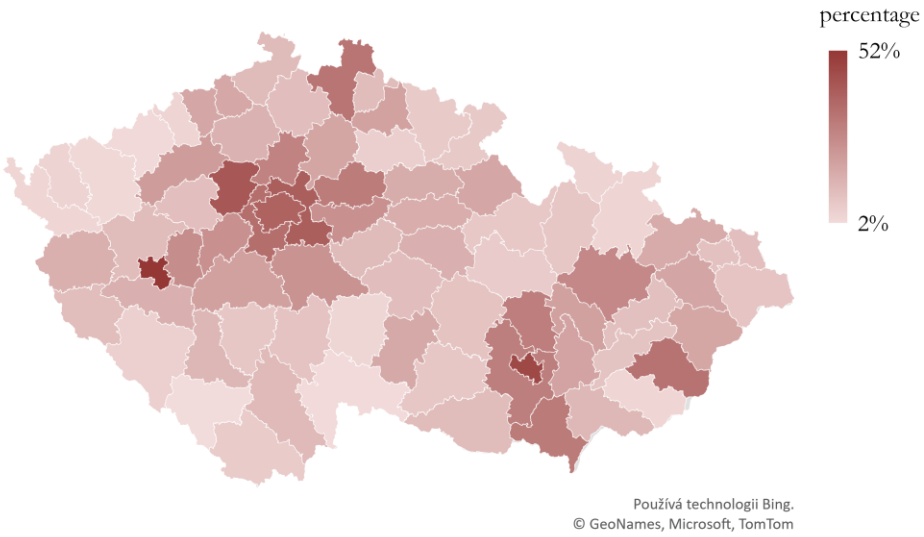
Official statistics register only one indicator of the unmet demand for places in kindergartens and that is the number of rejected kindergarten applications. The number of rejected applications for a place in a kindergarten is six times higher than at the beginning of the century (Hůle et al., 2015a). Nonetheless, this indicator is only approximate because parents can submit more applications simultaneously.

The unfavourable situation of unsatisfactory kindergarten capacity is present predominantly in the surroundings of large cities. There is a lower probability of getting a place in a kindergarten in municipalities with more than 50,000 inhabitants because of higher demand for preschool education together with an inadequate supply of places in kindergartens measured as the number of kindergartens for 1,000 children. This is most probably caused by the construction of satellite cities during which the establishment of kindergartens lags (Kuchařová et al., 2009). Hůle et al. (2015a) have also discovered a strong linear correlation between the share of rejected applications and the strength of affiliation to the core city.

Therefore, the percentage of rejected kindergarten applications significantly varies among districts as shown in Figure 2. Figure 2 reveals the differences between districts in the percentage of rejected kindergarten applications for the school year 2017/2018, which is the first year analysed in this thesis.

In districts with large cities such as Prague, Brno, Liberec, and Plzeň the share of rejected kindergarten applications reaches 50 %. The most homogenous situation is in the Central Bohemian Region, which follows the results of the analysis provided by Hůle et al. (2015a).

Figure 2: Percentage of rejected applications to kindergartens by districts, the Czech Republic, the school year 2017/2018

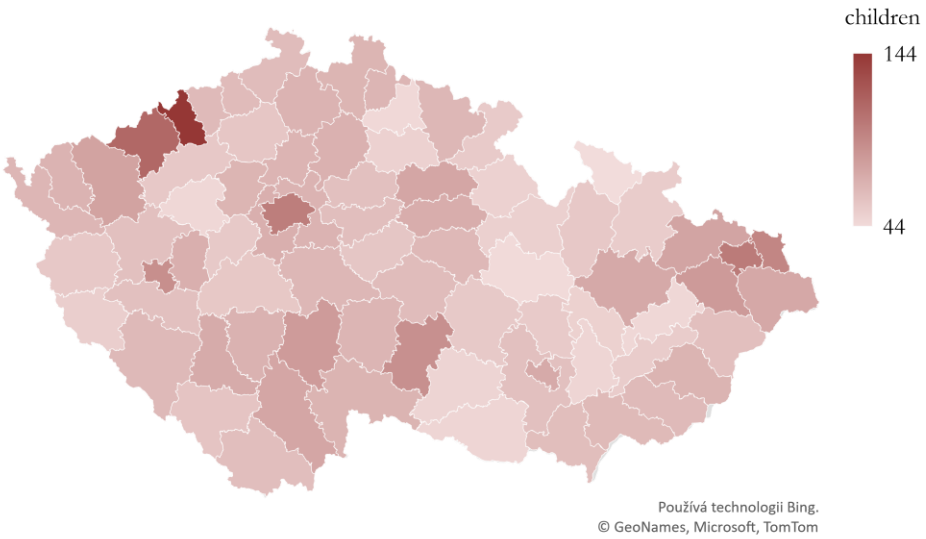


Source: MEYS, own processing

The supply of places in kindergartens can be expressed as the number of kindergartens per 1,000 children as done by Kuchařová et al. (2009) or the average number of children in one school by Hůle et al. (2015a). Figure 3 serves to illustrate the district differences between the average number of children per kindergarten in the school year 2017/2018. The situation is analogous in the school years 2018/2019 and 2019/2020.

From Figure 3 we can observe that the kindergartens are in general of similar size in all districts. Kindergartens with a notably higher average number of children are situated in the Most district and the Chomutov district. Hůle et al. (2015b) claim that the cause of these extreme cases is that Most was destroyed as a result of mining and built in a different place. The capacity of newly constructed kindergartens was substantially higher.

Figure 3: Average number of children per kindergarten by districts, Czech Republic, the school year 2017/2018



Source: MEYS, own processing

Data on Figure 2 and Figure 3 were obtained on request from the official register of the MEYS called *S 51-01 Výkaz o zápisu k předškolnímu vzdělávání v mateřské škole (S 51-01 Report on enrolment to preschool education in kindergartens).*

To conclude this chapter, a national comparison is presented. Research from 2018 conducted by UNICEF comparing 41 developed OECD and EU countries shows that the childcare enrolment rate of children under three years of age in the Czech Republic in 2016 was the second lowest, just after Slovakia. This shows that Czech parents do not use childcare for the youngest children as much as in other OECD and EU countries. On the other spectrum are countries such as Denmark and the Netherlands. To illustrate, in Denmark, the participation rate in childcare of children up to two years of age was 70 %. To add to that, the percentage of all children participating in preschool education in 2015 was 88,6 % in the Czech Republic which put the country in 38th place. The highest enrolment rate of 99,9 % was in Lithuania (Chzhen et al., 2018).

3. Literature Review

This section aims to introduce and summarize literature examining the determinants of the relationship between the demand and supply of places in kindergartens. The results of different empirical studies and analyses are to be discussed as they help to discover what regional characteristics are associated with the availability of places in kindergartens in the Czech Republic.

The objective of the research in this thesis is to identify what socioeconomic characteristics are associated with the availability of places in kindergartens in the Czech Republic. Therefore, the first subchapter is dedicated to the socioeconomic predictors of the relationship between the supply and demand for places in kindergartens. Other factors are discussed in the second subchapter. In the third subchapter, the contribution of the analysis in this thesis is highlighted.

The relationship between the supply and demand for a place in kindergartens has been a subject of extensive research in the Czech Republic primarily since the beginning of the 21st century. The up-to-date Czech studies including a statistical or econometric approach to examine the situation of preschool education focus on inspecting the participation rate in pre-primary education which is represented by the share of young children attending kindergarten (Hulík et al., 2008; Janhubová & Zykanová, 2020).

Be that as it may, in this thesis, socioeconomic characteristics of districts that are related to the level of meeting the demand for places in kindergartens are examined, i.e., socioeconomic factors of the chance of having a kindergarten application admitted. To the knowledge of the author of this thesis, there is no existing literature implementing the same procedure. For this reason, literature investigating influences on the participation rate in preschool education using econometric methods or elementary statistics is enumerated even though the inspected dependent variables in the up-to-date research differ from the one chosen for the analysis in this thesis.

In most cases, analyses of aggregated data for regions, districts, and municipalities have been done, for example by Hulík et al. (2008), Kuchařová and Svobodová (2006), Kuchařová et al. (2007), or Janhubová and Zykanová (2020). Research utilizing censuses and questionnaires has been performed by Hůle et al. (2015a) and by Kolaříková and Janiš (2015). However, not only the whole-county research has been done, but there also exist analyses focused on a single region, for example, the case study in the Capital City of Prague by Navrátil (2019) or Plzeň Region by Hůle et al. (2015a). Nonetheless, the author of this thesis

is aware of only two analyses by Hulík et al. (2008) and by Janhubová and Zykanová (2020) that statistically and econometrically quantify the relationship between the supply and demand for places in kindergartens in the Czech Republic.

Hulík et al. (2008) state that interregional differences in pre-primary education participation rate can be caused by both the supply of places in kindergartens and the demand side. The reasons for inconsistent preschool education participation between regions can be direct which is the capacity of kindergartens and indirect which is the decision-making of parents. In their analysis, they implement the Pearson correlation coefficient which measures how strongly two variables are linearly related. From the group of 26 variables of their choice, those significant at a 95 % significance level are utilized in factor analysis using a varimax rotation. This approach enables them to execute a cluster analysis to identify regions and districts with similar determinants of the participation rate in preschool education. The most significant determinants are divided into four groups, concretely socioeconomic factors, sociodemographic factors, sociocultural factors, and the factor of accessibility.

Following this division, socioeconomic and other than socioeconomic determinants of the participation rate in preschool education are discussed in the next two subchapters 3.1. and 3.2., respectively.

3.1. Socioeconomic Predictors

Socioeconomic characteristics such as the unemployment rate, the rate of economically inactive inhabitants, the average monthly wage, the percentage of the urban population, the sector where mothers work, and the education of parents are the frequently mentioned predictors of the equilibrium between the supply and demand for pre-primary education.

Hulík et al. (2008) specify the significant socioeconomic factors of the participation rate in preschool education as the average monthly wage, the unemployment rate, the percentage of economically active women, the share of women working in the primary sector, the percentage of the urban population, and the number of kindergartens per 1,000 children between three and five years old. According to Hulík et al. (2008), socioeconomic determinants explain over 13 % of the variability among all inspected variables.

Moreover, by executing a cluster analysis, Hulík et al. (2008) discovered that in economically strong LAU 1 such as the Capital City of Prague, Plzeň-město, Brno-město,

Ostrava-město, and Mladá Boleslav, the socioeconomic predictors are more important than other factors.

When inspecting the relationship between the work activity of the population and the participation in pre-primary education, the employment rate and the rate of economic activity can be inspected. Contrarily, the unemployment rate reflects primarily the financial burden of attending a kindergarten and its impact is discussed later in this subchapter (Hůle et al., 2015b).

Kuchařová (2009) states that women are less employed than men and work part-time more often. Caregiving responsibilities limit women more than men when integrating into the labour market. An analysis executed by European Commission (2008) reveals a significant positive correlation between the number of children attending childcare facilities and the female employment rate. The same relationship has been discovered by Kuchařová and Svobodová (2006). Furthermore, they have discovered that the demand for places in kindergartens is significant in regions with high employment.

This positive correlation might be explained such that when parents voluntarily do not work, they have more time for taking care of their child, and thus sending their child to a kindergarten is not necessary for them. Another possible explanation may be that due to insufficient kindergarten capacity, women cannot work and take care of their children.

Moreover, Hulík et al. (2008) have concluded that there is a negative linear relationship between the proportion of economically active women and the participation rate in pre-primary education among children aged three to five years.

Socioeconomic factors that represent the financial burden of attending a kindergarten are the unemployment rate, the average monthly wage, and the share of women working in the primary sector of the economy.

A greater unemployment rate among women than among men is partially caused by an insufficient supply of childcare facilities and the preferences of employers (Kuchařová et al., 2007). By implementing a regression analysis, Zykanová and Janhubová (2020) conclude that when the unemployment rate increases, the ratio of children attending a kindergarten to the total number of children in respective age groups lowers. They have discovered that the effect of the unemployment rate is significant at a 5 % significant level and is of the greatest magnitude for children aged three to five years. Analogously, Kuchařová and Svobodová (2006) claim that a relatively low participation rate in pre-primary education is observable in regions with a high level of unemployment. Using a different approach, Hulík

et al. (2008) examine the correlation between the unemployment rate and the rate of preschool participation using the Pearson correlation coefficient. The coefficient is negative, but the dependence is statistically insignificant.

Additionally, Hulík et al. (2008) detect a strong negative correlation between the average monthly wage and the participation rate in preschool education. On the contrary, the ratio of women working in a primary sector and the rate of participation in pre-primary education are positively correlated. By employing a questionnaire survey, Hůle et al. (2015b) have discovered that attending a kindergarten is a significant burden for socially disadvantaged families. The financial burden was the reason for not sending their children to kindergartens for about 82 % of respondents.

The same aspect of kindergarten availability is mentioned in the analysis by Prokop and Dvořák (2019). They argue that the reasons for a low participation rate in preschool education of children from unfavourable socioeconomic backgrounds are the associated costs of attending a kindergarten and the fact that there is usually an economically inactive family member who can provide the childcare. Therefore, there is a low percentage of children attending a kindergarten in economically backward areas, where the average monthly wage is below average, and a great part of women work in the primary sector.

The level of education of parents is also an important indicator of whether a child participates in preschool education. Hůle et al. (2015b) confirm that the level of education of parents is the key determinant of the education of their children and claim that women with higher education send their children to kindergartens less often. Be that as it may, there is no significant difference between the participation rate in kindergartens of children of mothers with primary education and mothers with secondary education (Hůle et al., 2015b).

Analogously, Hulík et al. (2008) have found in their district analysis a negative relationship between the percentage of inhabitants with higher education and the participation rate in pre-primary education. The correlation coefficient between the share of inhabitants with low education and the participation rate in preschool education is positive. However, these dependencies are not statistically significant.

In contrary with the results of the analyses elaborated by Hulík et al. (2008) and Hůle et al. (2015b), Su et al. (2020) state that children of mothers with low education participate less in pre-primary education.

Moreover, Hulík et al. (2008) identify the percentage of the urban population as another socioeconomic variable related to the preschool enrolment rate. With a higher

percentage of the urban population, the participation rate in preschool education decreases. Hůle et al. (2015b) suggest that there is sufficient capacity in regions with a low percentage of the urban population.

Based on a consultation with the author's thesis supervisor, housing construction is also considered a socioeconomic factor. Navrátil (2015) in his analysis argues that in the Capital City of Prague where the housing construction is substantial, the availability of places in kindergartens worsens.

In the second part of this subchapter, there are presented foreign papers assessing the socioeconomic factors of the relationship between the demand and supply of preschool education. Although many foreign studies inspect the predictors of the participation rate in preschool education, only several are mentioned in this thesis. This is because the school system varies between countries and therefore these studies do not have to be relevant to the Czech Republic.

Kachi et al. (2020) examined the disbalance in institutionalized childcare in Japan by using longitudinal data on Japanese children and their families followed by implementing a logistic regression with the binary dependent variable being the use or non-use of centre-based childcare. The microdata were obtained via a survey, in which respondents were asked for one of five reasons for not using institutionalized childcare. According to their research, the household income, the mother's education, and the employment status of the mother are the significant socioeconomic characteristics related to the enrolment rate in childcare facilities. These predictors of use or non-use of institutionalized childcare were assessed by adjusted odds ratios on 95 % confidence.

Longitudinal data on Nordic children were inspected by Zachrisson et al. (2013). They implemented three sets of analyses focusing on the mother's level of education which was found an important factor in whether children receive ECEC before they reach 18 months of age.

Sylva et al. (2007) explicitly state that in England, the education of the parents, their profession, and income level are the most essential factors affecting the amount of center-based childcare. Crosnoe et al. (2016) have concluded that children from low-income families participate in pre-school education less frequently. They add that employment among mothers of preschool-age children and the level of maternal education consistently predict the enrolment in kindergarten of children from low-income families.

Fuller et al. (1997) in their research in the United States found out that there is a strong link between family income and the availability of places in kindergartens in all states except for San Francisco. Moreover, Latino children face the lowest supply of places in kindergartens. Fuller and Liang (1996) conducted two studies to assess the effect of characteristics varying among states and locals on kindergarten availability. Both studies confirmed that these characteristics are the household income, the level of education of the parents, and the family structure.

The enrolment rate in preschool education by children from low-income, middle-income, and low-income families has been inspected by Magnuson and Waldfogel (2016) and Bassok et al. (2016). They concluded that even though the gap has narrowed, the lowest participation rate is among children from low-income families.

At the end of this subchapter, three studies from China are mentioned. Gong et al. (2014) have conducted an analysis using the probit model and have discovered a positive relationship between the preschool participation rate and the household income per capita in families both from urban and rural backgrounds. Furthermore, Wang and Gong (2019) have utilized a logit model in their analysis and have concluded that the preschool participation of children living in urban areas is less likely to be affected by family income.

Moreover, the results of the analysis of panel data employed by Su et al. (2020) imply that preschool attendance is predicted by the age of children, education level of mothers, the income of the family, and the wealth of the region when these children live.

3.2. Other Predictors

In this subchapter, other than socioeconomic predictors of the participation rate in preschool education are commented on.

The structure and placement of kindergartens are important determinants of the participation rate in preschool education in the Czech Republic. The results of the study conducted by Janhubová and Zykanová (2020) indicate that the share of municipalities with at least one kindergarten is significant at a 1 % significance level for the participation rate of the youngest children, i.e., children aged up to two years and eight months. However, the effect is insignificant for other age groups. They also state that the estimated effect of the average size of the kindergarten class on the participation rate of the youngest children is negative and statistically significant at a 1 % significance level. Similarly, they conclude that

an increasing number of rejected kindergarten applications per 100 children in kindergartens reduces the participation rate in preschool education.

Analogously, Hulík et al. (2008) confirm that there is a strong negative correlation between the preschool participation rate and the share of rejected kindergarten applications. The importance of the size of the kindergarten has been highlighted by Hůle et al. (2015a) who have discovered that large kindergartens are obliged to reject a higher percentage of filed applications.

The results of the research conducted by Hulík et al. (2008) suggest that the number of kindergartens per 1,000 children between three and five years old positively correlates with the participation rate in pre-primary education. Hůle et al. (2015a) in their analysis of the introduction of preschool education in the last year of attendance came to a similar conclusion, i.e., that capacity problems are in large cities because of the high concentration of children in kindergartens.

Demographic features of the population are described in publications as important factors associated with participation in preschool education. Kuchařová et al. (2007) confirm that a gradual decrease in the natality since the mid-1990s caused the closure of many kindergartens and other childcare facilities which resulted in insufficient capacity when the natality increased at the beginning of the 21st century.

Similarly, Hůle et al. (2015a) state that both the number of newborn children and migration flows are fundamental predictors of the participation rate in preschool education. Analogously, Zykanová and Janhubová (2020) confirm that the participation rate is negatively related to the increasing population balance measured by the population index. Hulík et al. (2008) suggest that both the total fertility and the crude rate of migration balance are negatively correlated with the pre-primary participation rate.

Furthermore, according to Jahubová and Zykanová (2020), the estimated effect of the population density on the ratio of children in kindergartens is negative and statistically significant at a 5 % significance level. Kuchařová et al. (2009) confirm that the population density is meaningful for explaining kindergarten availability, because in areas with high population density the discrepancy between the demand and supply increases. Concretely, a higher participation rate in preschool education is in regions with decreasing population.

Hulík et al. (2008) have detected other demographic characteristics of the population correlated with the participation rate: the crude rate of marriage, the crude rate of divorce, the share of illegitimate children, the ratio of newborn children with a weight under 2.5

kilograms, the crude rate of abortion, and the life expectancy of women as of the childbirth. The last demographic variable and the participation rate are positively correlated. However, the correlation between the participation rate and the other factors mentioned is negative.

Furthermore, Hulík et al. (2008) have examined the relationship between the nationality structure and children's participation in preschool education. They have concluded that the percentage of the Romany people in the population and the share of dwellers of Czech, Moravian, and Silesian nationality are related to the participation rate, the former negatively and the latter positively while both factors are statistically significant.

The participation rate in pre-primary education of socially disadvantaged children has been inspected by Hůle et al. (2015b) and Kolaříková (2015). Kolaříková (2015) divided the factors that cause a lower participation rate in pre-primary education of children from socially disadvantaged families into two categories – external and internal influences. The external influences are the insufficient capacity in kindergartens, admission criteria, which are often not met, financial burden, and transportation accessibility. The fear of abuse and bullying, and the underestimation of preschool education are the internal factors of the low participation rate in preschool education of children from socially disadvantaged families.

3.3. Contribution of the Research

In this subchapter, the contribution of the research in this thesis is highlighted and the possible problems in the existing analyses are discussed. Research on the detection of the determinants of the unmet demand for places in kindergartens, i.e., the percentage of rejected kindergarten applications, has not been done in the Czech Republic yet.

Therefore, the results of this thesis reveal determinants of the perceived shortage of places in kindergartens which might help policymakers optimally spatially establish kindergartens to meet the demand for places in them. Even though the participation rate in preschool education can be high, children might be placed in a kindergarten that is far away from their residence or in a kindergarten that does not meet the requirements of the parents such as the study programs or the price.

In the following paragraphs, the problems in the up-to-date literature on the participation rate in pre-primary education are enumerated. There are two main studies by Janhubová and Zykanová (2020) and Hulík et al. (2008) that use an advanced statistical

approach to quantitatively assess the relationship between distinct independent variables and the participation rate in pre-primary education in the Czech Republic.

Janhubová and Zykanová (2020) employ a regression analysis using cross-sectional data. However, they do not examine the presence of heteroscedasticity in the errors nor the endogeneity problem and perfect collinearity among the independent variables. The endogeneity might emerge by including in their regression the unemployment rate among together men and women due to the reverse causality. The effect of kindergarten availability on the labour market of mothers has been inspected for example by Pianta et al. (2009). Therefore, the reported estimates are likely to be biased.

Hulík et al. (2008) inspect the correlation between regional characteristics and the participation rate in preschool education through the Pearson correlation coefficient. Utilizing the same characteristics would likely lead to endogeneity in our model because Hulík et al. (2008) use the economic activity among women and the unemployment rate among women which might again result in the reverse causality problem.

4. Data

This chapter introduces the data that are used for the analysis. In the beginning, the data source is stated. Subsequently, the structure of the dataset is characterized. Furthermore, the following subchapters 4.1. and 4.2. offer a detailed description of the dependent and independent variables, accompanied by graphic representations of the data.

District-level data are employed in the analysis for three consecutive school years 2017/2018, 2018/2019, and 2019/2020. The cross-sectional units are defined as LAU 1, which in the Czech Republic stands for 76 districts (in Czech "okresy") and the Capital City of Prague. The Capital City of Prague is included in the dataset although it is not a district. Be that as it may, the Capital City of Prague is an independent LAU 1 and in this thesis is referred to as a district as well. Thus, there are altogether 77 LAU 1 in the Czech Republic and consequently, the dimension of the data is 77 entities.

Aggregated variables for each LAU 1 are used because of the nature of the available data. When independent variables are solely available on the regional level defined by the Czech NUTS 3 division (in Czech "kraj"), corresponding values of independent variables are applied to all districts from the given region.

The data on the dependent variable, i.e., the number of submitted applications to kindergarten, the total sum of rejected applications together with gender, district, and age specifics were obtained on request from the official register of the MEYS called *S 51-01 Výkaz o zápisu k předškolnímu vzdělávání v mateřské škole (S 51-01 Report on enrolment to preschool education in kindergartens)*. The data on the control variables were collected from publicly accessible databases of the CZSO. The concrete databases are enumerated in the Appendix.

The time dimension ranges from the school year 2017/2018 to the school year 2019/2020. Zatloukal et al. (2021) argue that the education in kindergartens in the school years 2019/2020 and 2020/2021 was significantly influenced by the COVID-19 pandemic. Although the data on the count of submitted applications from the 31st of May 2019 are for the school year 2019/2020, the first case of COVID-19 in the Czech Republic was discovered on the 1st of March 2020, so the data used in the analysis are not likely to be influenced by the pandemic (Česká televize, 2021). Consequently, the last three pre-COVID years were chosen for the analysis of kindergarten availability.

To summarize, a balanced panel dataset containing 231 observations is used for the analysis, i.e., a data set with the same number of time periods for each cross-sectional unit (Wooldridge, 2013).

4.1. Dependent Variable

In the up-to-date Czech empirical literature, the discrepancy between the supply and demand for places in kindergartens is represented by the participation rate in kindergartens (Kuchařová & Svobodová, 2006; Zykanová & Janhubová, 2020). Be that as it may, Kuchařová and Svobodová (2006) state that the data on the percentage of children attending kindergartens do not directly reflect kindergarten availability. A more direct indicator of kindergarten availability is the relationship between the number of rejected applications to kindergarten and the number of accepted children, i.e., new children that are in kindergartens as of a certain date (Kuchařová & Svobodová, 2006).

The data on the number of places in kindergartens demanded are approximated by the total number of lodged applications. Therefore, in this thesis, the dependent variable is defined as the ratio of the total sum of rejected applications to the total number of applications to kindergartens in each LAU 1.

The author of this thesis is aware that the number of rejected applications is not equal to the number of children that did not get a place in a kindergarten because many parents submit several applications at the same time. This inconsistency notwithstanding, it is assumed that parents are not forced to submit more applications in regions with a sufficient kindergarten capacity (Zykanová & Janhubová, 2020). Hůle et al. (2015a) add that parents file more requests concurrently when they are aware of the inadequate capacity of kindergartens in the district of their residence. Thus, the share of applications that are rejected represents the perceived shortage of places in kindergartens.

The data on the dependent variable are valid as of the 31st of May in the corresponding years 2017, 2018, and 2019. Regarding the collection of the data, kindergartens established by the MEYS, regions, municipalities, unions of municipalities, registered churches, religious societies, and other natural or legal persons are obliged to fill in the form of the register until the middle of June. School-based health clinics, kindergartens established for institutional care and protective education, and kindergartens where

the enrolment was cancelled (for instance kindergartens to which no applicants arrived or kindergartens that are to be shut down), are excluded from the register.

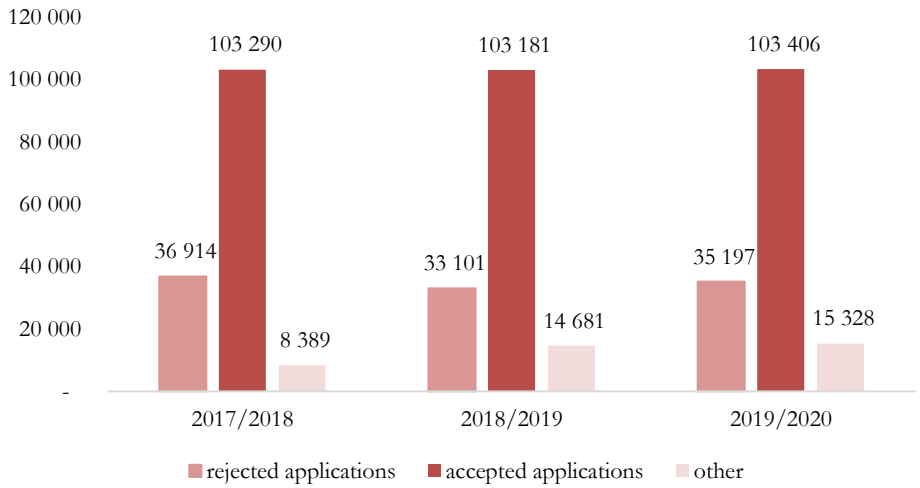
Furthermore, complementary analyses are employed in this thesis. Concretely, the predictors of the availability of places in kindergartens for three separated age groups are inspected. The first group includes children up to two years of age, ones who do not have a legal right to attend a kindergarten. Secondly, we analyse the availability of places in kindergartens for children who have a legal right to attend a kindergarten but it is not compulsory for them, i.e., for three-year-old and four-year-old children. Finally, factors related to the percentage of rejected applications of children having compulsory preschool education, i.e., five-year-old and older children, are inspected (Act No. 561/2004 Coll., as amended). Analogously, the dependent variables for the complementary analyses are represented by the percentage of rejected kindergarten applications for each of the age groups.

This division of children into age groups is limited by the possibility of postponement of compulsory primary school attendance i.e., five-year-old children do not have compulsory preschool education. However, we do not consider these exceptions and follow the most probable scenario.

Figure 4 demonstrates the distribution of applications for a place in a kindergarten in absolute values. Even though the total number of admitted applications remains relatively unchanged, there is a notable decrease in rejected applications in 2018 compared to 2017 from 36,914 to 33,101. In 2019, the number of rejected applications increased again. The "other" section is the sum of applications with open records and with suspended administrative proceedings.

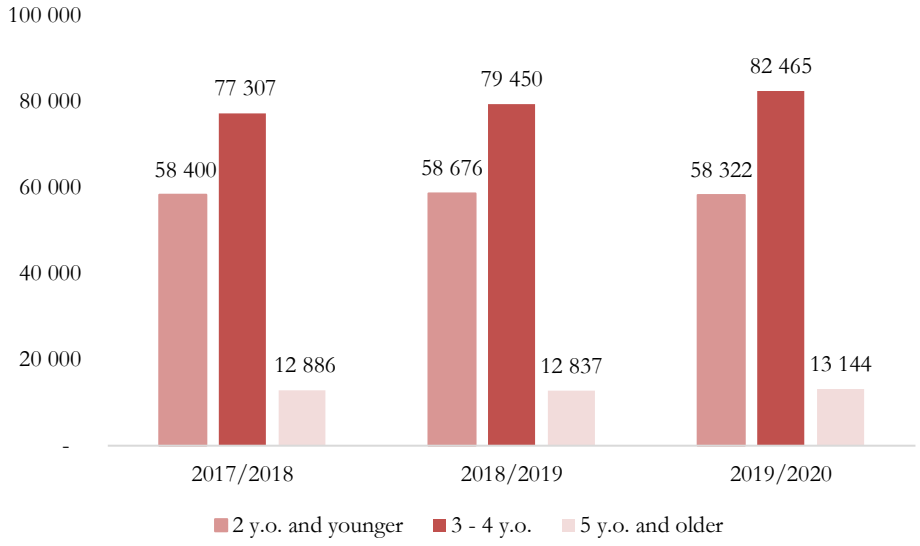
Moreover, as shown in Figure 5, the highest and continuingly increasing number of lodged kindergarten applications is from three-year-old and four-year-old children.

Figure 4: Results of submitted applications to kindergartens, the Czech Republic, school years 2017/2018 to 2019/2020



Source: MEYS, own processing

Figure 5: Submitted applications to kindergartens grouped by children's age, the Czech Republic, school years 2017/2018 to 2019/2020



Source: MEYS, own processing

The descriptive statistics of the dependent variables (mean, SD, median, maximum, minimum, 1st quantile, and 3rd quantile) are depicted in Table 3. The dependent variable *Reject* refers to the percentage of rejected kindergarten applications without age distinction, *Reject_under* represents the percentage of rejected applications of children up to two years of age, *Reject_legal* is the percentage of rejected applications of three-year-old and four-year-old children and *Reject_comp* is the percentage of rejected applications of children of five years of age and older.

Table 3: Descriptive statistics of the dependent variables

	Mean	SD	Min.	1 st Qu.	Median	3rd Qu.	Max.
Reject	16,15	10,19	0,58	8,40	13,89	21,12	52,43
Reject_under	26,81	17,68	1,08	12,76	23,25	36,32	79,07
Reject_legal	9,92	8,18	0,00	4,24	6,94	14,10	43,26
Reject_comp	4,43	3,83	0,00	1,63	3,60	6,16	20,36

Source: MEYS, own processing

Table 3 reveals that the average percentage of rejected kindergarten applications varies substantially depending on the age of the children. The greatest average percentage of rejected applications on the total number of applications, concretely 26.81 %, is among the youngest children. The average percentage of rejected applications decreases with increasing children's age. This result is rather expected because children who reach three years of age before the beginning of a given school year have a legal right to attend a kindergarten, and children in their last year of preschool education, i.e., usually five-year-old children, have a compulsory pre-primary school attendance (Act No. 561/2004 Coll., as amended).

Moreover, in all four cases, the percentage of rejected applications suffers from a great SD, the most prominent being among the percentage of rejected applications of the youngest children and the lowest among the oldest pre-schoolers. This can be again explained by the effect of the Czech legislative mentioned in the previous paragraph.

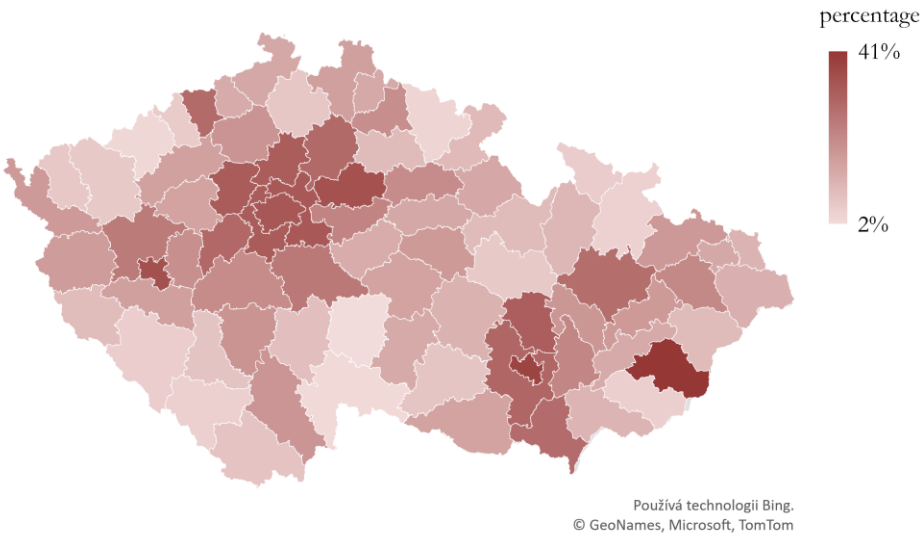
In all age groups, the mean is larger than the median. Moreover, the mean is much closer to the minimum value than to the maximum value which implies that the mean is influenced by particularly high values of rejected applications in some LAU 1. Therefore, district differences are further inspected in this subchapter. Additionally, the share of rejected

applications ranges between 0 and 100, therefore, the *Reject_legal* and *Reject_comp* variables reached their minimum value.

The perceived shortage of places in kindergartens is not homogenous across the country. In concrete, in Figure 6, the district differences in the percentage of rejected applications for the school year 2019/2020 are depicted. The greatest share of rejected applications was in the surroundings of large cities. This supports the findings of Kuchařová et al. (2009) that there is a lower probability of getting into a kindergarten in highly populated municipalities because of the high demand for preschool education exceeding the capacity of kindergartens.

In the Zlín district, the percentage reached 41%. More than 30 % of rejected applications were in the Brno-město district, Plzeň-město district, Praha-východ district, Praha-západ district, Nymburk district, and in the Capital City of Prague. Contrarily, in the Jindřichův Hradec district and the Pelhřimov district, only 2 % of applications were rejected, which is the lowest percentage in the country.

Figure 6: Percentage of rejected applications to kindergartens by districts, the Czech Republic, the school year 2019/2020



Source: MEYS, own processing

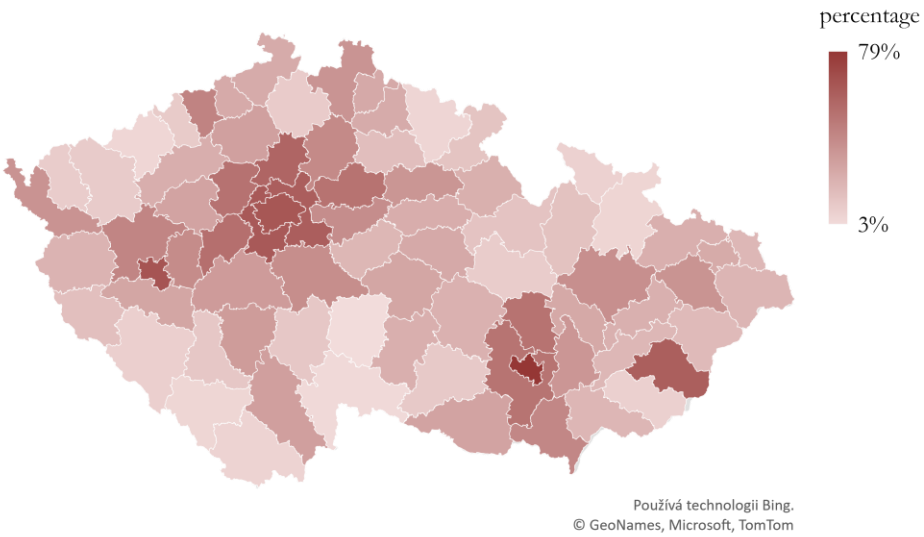
As mentioned, in this thesis, complementary analyses of the predictors of kindergarten availability for three different age groups are employed. Table 2 demonstrates

that a substantial dissimilarity in the percentage of rejected applications to kindergartens exists among the age groups. Therefore, Figures 7 – 9 provide a detailed analysis portraying the district differences in the percentage of rejected applications for a given age group. The age of children is valid as of the 1st of September 2019.

The unfavourable situation of a high percentage of rejected applications follows the same pattern as in Figure 6 when not taking children's age into account. In districts with highly populated cities, especially districts from the Central Bohemian Region, the South Moravia Region, the Zlín Region, and the Capital City of Prague, the unavailability of places in kindergartens is the most conspicuous. Despite the Capital City of Prague being LAU 1 with a striking percentage of rejected applications of children for whom pre-primary education is not compulsory, the situation improves for older children as the share of rejected applications of these applicants is below the country average.

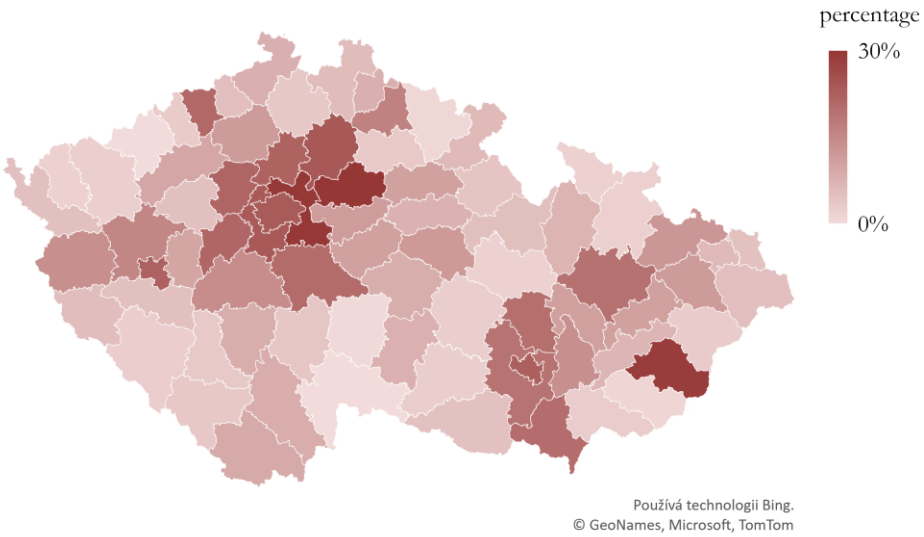
On the contrary, in the Brno-město district, Plzeň-město district, Praha-západ district, and Zlín district, there is a high share of rejected kindergarten applications in all age categories. There shall be highlighted that in Figure 9, for five-year-old children and older, the district distribution varies significantly in comparison with other age categories. This is caused by a relatively low number of applicants and the fact that in a vast majority of districts, applications of none of these children were rejected.

Figure 7: Percentage of rejected applications to kindergartens of two-year-old children and younger by districts, the Czech Republic, the school year 2019/2020



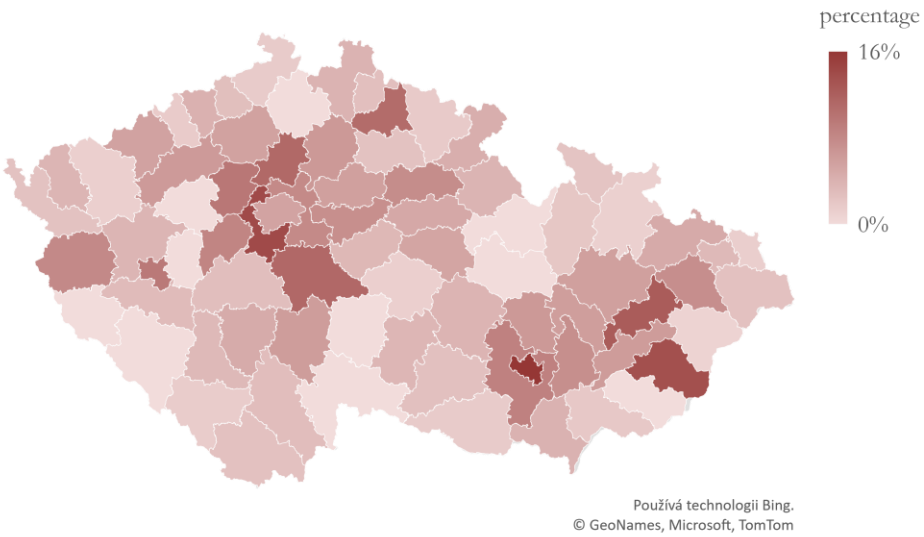
Source: MEYS, own processing

Figure 8: Percentage of rejected applications to kindergartens of three-year-old and four-year-old children by districts, the Czech Republic, the school year 2019/2020



Source: MEYS, own processing

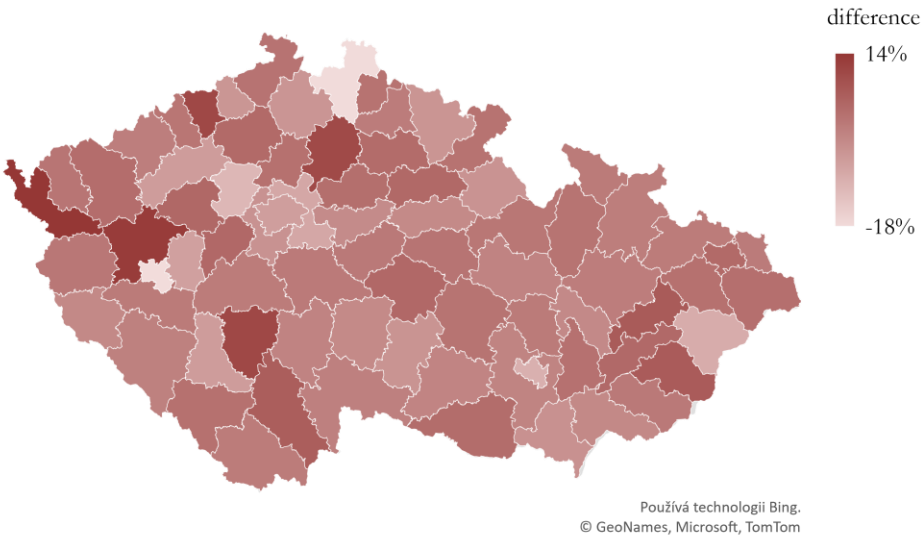
Figure 9: Percentage of rejected applications to kindergartens of five-year-old children and older by districts, the Czech Republic, the school year 2019/2020



Source: MEYS, own processing

Moreover, it is also essential to demonstrate the change in the percentage of rejected applications. Thus, Figure 10 serves to demonstrate in which districts the percentage of rejected applications increased and in which decreased from the school year 2017/2018 to 2019/2020. We do not consider children's age in Figure 9. We can see that in the Plzeň-město district and the Liberec district, the percentage of rejected applications decreased by about 18 percentage points. On the contrary, in the Cheb district, the percentage of rejected applications increased by 14 percentage points.

Figure 10: Change in the percentage of rejected applications to kindergartens between school years 2017/2018 and 2019/2020, the Czech Republic



Source: MEYS, own processing

4.2. Independent Variables

In this subchapter, the process of the selection of independent variables and their description is presented. Even though there exists research on the discrepancy between the supply and demand for places in kindergartens, to the author's best knowledge, in none of the analyses is the dependent variable defined as the ratio of rejected applications to all applications to kindergartens.

Thus, it is not known in advance what independent variables should be included in the model for explaining the percentage of kindergarten rejected applications in the Czech Republic. Consequently, the method of BIC is implemented to select the explanatory variables which are later utilized in the panel data estimation.

Even though the control variables in the true model of kindergarten availability are not known in advance, a great number of control variables has been collected for the analysis. These control variables have been chosen based on economic intuition and the general literature on the dissimilarity between the demand and supply of places in kindergartens.

Firstly, Hůle et al. (2015a) define migration and natality flows as essential regional characteristics related to the participation rate of children in kindergartens. Hulík et al. (2008) measure the migration flows by the crude rate of migration whereas Janhubová and

Zykanová (2020) utilized the population index. A negative relationship between migration inflow and the participation rate has been discovered. Thus, the variables on the net migration per 1,000 population and the number of newborn children per 1,000 population lagged by three years have been added to the dataset.

Additionally, based on the analysis performed by Navrátil (2019), the number of completed dwellings has been obtained.

Furthermore, Hulík et al. (2008) found a significant correlation between the average monthly wage and the participation rate of children in preschool education. Consequently, the data on the average gross monthly wage are included in the dataset.

A slightly different approach is chosen concerning the factors of employment and unemployment. Hulík et al. (2008) conclude that there is a significant correlation between the unemployment rate among women and the participation rate of children in pre-primary education. Similarly, Kuchařová and Svobodová (2006) confirm a positive correlation between the employment rate among women and the participation rate of children in preschool education. Be that as it may, in this thesis, data on the male unemployment rate and the male employment rate are inspected. This approach is implemented to eliminate reverse causality because e.g., Pianta et al. (2009) state that attending childcare increases maternal employment.

Further, the population density of each LAU 1 is included in the dataset following Janhubová and Zykanová (2020). Hulík et al. (2008) argue that there is a significant correlation between the nationality structure and the children's participation rate in pre-primary education. To add to this, Kuchařová et al. (2009) state that being of Czech nationality is one of the most common selection criteria for whether a child gets a place in a kindergarten. As the nationality structure is not observable, it is approximated by the number of foreigners.

The dataset was expanded by the number of dwellers above 15 years of age with higher education because Hůle et al. (2015b) have highlighted that mothers with higher education send their children to kindergartens less frequently.

Additionally, the share of the urban population and the number of children between two and six years of age in the total district population to capture the age structure have been added to the dataset. Hulík et al. (2008) state that the percentage of the urban population is correlated with the participation of children in pre-primary education.

For the analysis, several control variables must have been altered. Concretely, the number of foreigners and the number of children aged two to six years have been divided by the total LAU 1 population as of the end of the calendar year. This approach resulted in percentages. Similarly, the number of dwellings completed has been divided by the total LAU 1 population and multiplied by 1,000. The number of inhabitants over 15 years of age with higher education has been divided by the total district population above 15 years of age. Furthermore, the nominal average gross monthly wage has been divided by the basic index and multiplied by 100 to obtain real values and not to distort the results of the analysis. The real wage is expressed in 2015 CZK. Finally, some ratios have been multiplied by 100 for easier work with the variables.

The data on the explanatory variables were all obtained from the CZSO and are valid as of the 31st of December of the previous year, i.e., are lagged by one year except for the percentage of children of two to six years of age in the district population and the number of newborn children per 1,000 population.

The intuition behind this approach is that the data on the rejected applications are from the 31st of May of each year and therefore, district characteristics preceding the results of the submission of the application are relevant for the decision-making of the parents and the creation of the relationship between the demand and supply of places in kindergartens. Moreover, this approach helps to eliminate reverse causality and consequently endogeneity.

Data on the number of newborn children per 1,000 district population are lagged by three years because, in the inspected years, these children reach two years of age. Moreover, data on the percentage of two- to six-year-old children in the district population are valid as of the 31st of December of the respective year, i.e., are not lagged. This is because they start school on the 1st of September and the time difference between September and December is more acceptable than between January and September.

Followingly, the independent variables are enumerated and briefly described.

- *Wage* – the average real gross monthly wage expressed in 2015 CZK (thousands) in the NUTS 3
- *Unempl_men* – the unemployment rate among men in the LAU 1
- *Empl_men* – the employment rate among men in the NUTS 3
- *Net_migr* – the net migration per 1,000 population in the LAU 1
- *Newborn* – the number of newborn children per 1,000 population in the LAU 1, lagged by 3 years
- *Dwellings* – the number of dwellings completed per 1,000 population in the LAU 1
- *Foreign_ratio* – the percentage of foreigners in the total LAU 1 population
- *Density* – the LAU 1 population per square kilometre
- *Urban* – the percentage of the urban population in the LAU 1
- *Uni_ratio* – the percentage of the population above 15 years of age with higher education in the NUTS 3
- *Age_ratio* – the percentage of children aged two to six years in the total LAU 1 population

The control variables representing district-level socioeconomic characteristics are based on the literature mentioned in the third chapter the male employment rate, the male unemployment rate, the average real gross monthly wage expressed in 2015 CZK, the percentage of the urban population, the percentage of population aged above 15 years with the higher education, and the number of dwellings completed per 1,000 population.

As mentioned, to the author's best knowledge, there is no existing literature inspecting determinants of the percentage of rejected applications to kindergartens. Therefore, the BIC is implemented to eliminate the manually collected control variables that are not in the true model.

The BIC is one of the tools that can be utilized to select a suitable model based on the empirical log-likelihood. It serves to asymptotically approximate a transformation of

the Bayesian posterior probability of each possible model. The model with the lowest BIC is optimally a posteriori the most probable (Neath & Cavanaugh, 2011).

The most suitable control variables were selected based on analysing the cross-sectional data for the years 2017, 2018, and 2019. The methods of analysing panel data differ from those utilized for cross-sectional data. For that reason, explanatory variables that appear in the five best models based on the lowest BIC are utilized in the analysis of the panel data.

The male employment rate and the male unemployment rate appear separately in the models selected by the lowest BIC with the same frequency. Both variables represent similar information and thus, only the variable on the unemployment rate among men is utilized in the panel data analysis. This is because the male unemployment rate is on the LAU1 level and the male employment rate on the NUTS 3 level so the variable on the unemployment among men is more precise.

Although the independent variables selected based on the BIC are not identical for all four defined dependent variables, in all four regressions included in the analysis, the same collection of control variables is used. This approach allows us to compare the results of the analysis between age groups.

Followingly, the descriptive statistics of the selected independent variables are presented and briefly commented on. Table 4 demonstrates results from the complete dataset of all 77 LAU 1 in all three consecutive years, i.e., of 231 observations.

Table 4: Descriptive statistics of the independent variables

	Mean	SD	Min.	1 st Qu.	Median	3rd Qu.	Max.
Wage	27,39	2,45	23,60	25,61	27,35	28,10	38,13
Unempl_men	3,94	1,80	1,06	2,65	3,58	4,78	10,61
Urban	58,99	15,64	28,96	47,73	56,36	67,81	100,00
Uni_ratio	16,42	3,67	11,24	14,74	15,77	17,13	38,34
Dwellings	2,49	1,36	0,75	1,51	2,15	3,10	8,25
Age_ratio	5,15	0,48	4,09	4,90	5,06	5,30	7,46
Foreign_ratio	3,58	2,37	0,97	2,10	2,93	4,48	15,71
Density	196,69	356,74	36,82	74,81	115,60	153,90	2637,27
Newborn	10,29	0,78	8,48	9,76	10,23	10,72	12,61
Net_migr	2,04	4,47	-6,14	-0,89	1,11	3,84	22,53

Source: CZSO, own processing

The mean and median of the real average gross monthly wage expressed in 2015 CZK are almost identical. The real average gross monthly wage is bounded from below by zero, therefore, extremes appear on the upper bound. Consequently, the minimum is closer to the mean value than the maximum.

Concerning the explanatory variables on the percentage of the urban population and the male unemployment rate, there is a notable difference between the mean and median. Again, the minimum value is closer to the mean than the maximum value and the mean is greater than the median because even though the values of both explanatory variables range between 0 and 100, extreme values emerge closer to the upper bound. The percentage of the urban population reaches its maximum possible value of 100 % in the Capital City of Prague and the Brno-město district.

As illustrated in Table 4, the net migration is the only control variable taking negative values. Despite the values of net migration not being bounded, the difference between the mean and the maximum value is more than two times larger than between the mean and the minimum value. In the presence of extreme positive values of the net migration especially in Praha-východ and Praha-západ, the mean is greater than the median.

Further, as shown in Table 4, the mean and median of the population density considerably vary due to the maximum value in the Capital City of Prague and the non-existence of the upper limit of the values.

The SD of the net migration and the population density are twice as large as their mean values. This indicates great dissimilarities in net migration and population density among districts.

Furthermore, the mean and the median of the number of newborn children per 1,000 population lagged by three years take similar values and are placed approximately in the middle of the distance between the minimum and the maximum. Contrarily, there is a conspicuous difference between the mean and the median of the number of dwellings completed per 1,000 population. This discrepancy is caused by the emergence of extreme values close to the maximum because this variable is bounded from the bottom by zero. The highest values are in the districts Praha-východ and Praha-západ.

The descriptive statistics of the percentage of foreigners and the percentage of the population with higher education are greatly affected by the Capital City of Prague, which represents the maximum value. The mean values are therefore greater than the median values.

Lastly, the mean and median of the percentage of children aged two to six years in the district population are similar as well as the 75th quantile. This means that the percentage does not vary significantly between districts except for the maximum value of 7,46 % in Praha-východ

From the preceding paragraphs, it is evident that the Capital City of Prague, Praha-východ, and Praha-západ represent extreme values of various independent variables. Descriptive statistics of the dependent and independent variables without these districts are summarized in the Appendix in Table A. 4 and Table A. 5, respectively. The most obvious difference that emerged is a substantial decrease in the maximum value and the SD of the district-level population density and the net migration per 1,000 population. Similarly, the maximum value of the percentage of foreigners lowered as well.

Consequently, the models without the Capital City of Prague and the two nearest districts Praha-východ and Praha-západ were estimated to check whether the results are driven by these very specific districts with high population density, the net migration per 1,000 population, and the dwellings completed per 1,000 population. The results of this supplementary sensitivity analysis are presented in the Appendix in Tables A. 6 – A. 9.

At the end of this chapter, the pairwise correlation between all control variables used in the regression is inspected. The results are presented by the correlation matrix in Figure 11. There is no perfect correlation among the explanatory variables, i.e., the correlation does not equal one in absolute value. The highest positive correlation of 0.82 is between the number of newborn children per 1,000 population lagged by three years and the share of young children in the population, which is intuitive.

Moreover, the correlation coefficient between the number of completed dwellings per 1,000 population and the net migration per 1,000 population is 0.81. This result is rather expected as net migration is defined as the difference between inhabitants who have moved to the district and those who have moved away to another district. The reason for positive net migration may be the extensive housing construction, i.e., the number of dwellings completed.

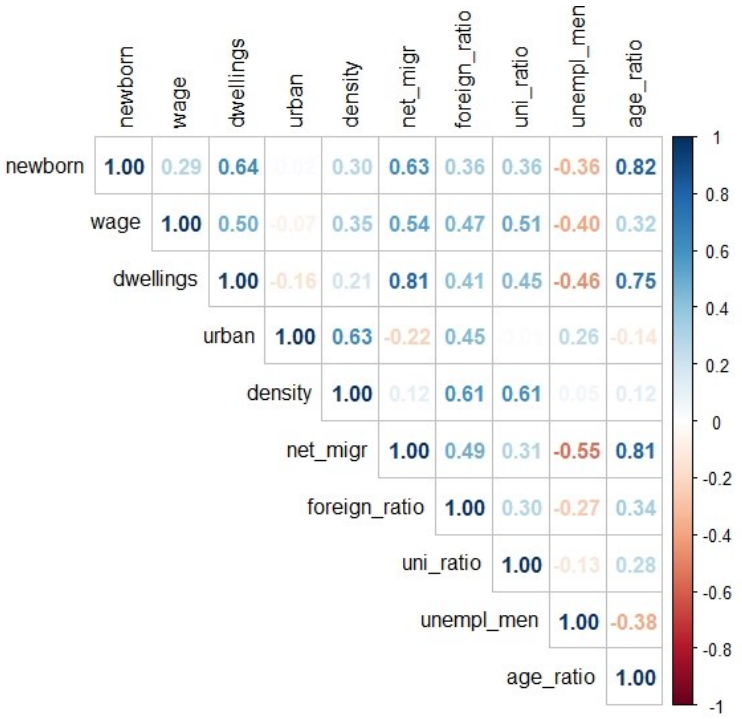
Furthermore, net migration is high in large cities and their suburbs, which are frequent destinations for families with young children (Hulík et al., 2008). This may cause the high correlation of 0.81 between the net migration and the share of children aged two to six years.

Generally, when the correlation between two variables is strong, we use only one of them in the regression to prevent violation of the multicollinearity assumption which is further discussed in subchapter 5.4.

We observe a high correlation between the number of dwellings completed per 1,000 population and the net migration. On the other hand, BIC indicates that both variables transmit important information because they appear together in the models selected by the BIC. Therefore, in the main analysis, both variables are included in the specification. Net migration is excluded from the set of explanatory variables in a sensitivity analysis reported in the Appendix.

The same approach is implemented regarding the correlation between the share of young children in the population and the number of newborn children per 1,000 population. Both appeared in the same model using BIC and thus, both variables are included in the main model. Furthermore, the share of young children is also excluded from the sensitivity analysis demonstrated in the Appendix. Lastly, both net migration per 1,000 population and the share of young children are omitted together from the specification as a part of the sensitivity analysis.

Figure 11: Correlation matrix



Source: CZSO, own processing

5. Methodology

This chapter presents econometric methods which are applied in the analysis of the data presented in the previous chapter to answer the research question of this thesis, i.e., what the socioeconomic determinants of the availability of places in kindergartens in the Czech Republic are. Concretely, the FD approach, the FE estimation method, and the RE estimation method are explained in subchapters 5.1., 5.2., and 5.3., respectively. The assumptions are discussed in subchapter 5.4. and the comparison of the panel data estimation methods is provided in subchapter 5.5. The description of the methodology is inspired by Wooldridge (2013).

We observe the percentage of rejected applications to kindergartens in all 77 LAU 1 for the consecutive school years 2017/2018, 2018/2019, and 2019/2020. As the same cross-sectional units appear in all time periods, the data are structured as panel data. For this reason, the panel data estimation methods are discussed in this chapter. In the analysis, we assume that parents place their children in a kindergarten in the district of their residence and that the district characteristics relate to the percentage of rejected applications in the given district.

To estimate the effect of socioeconomic characteristics on the availability of places in kindergartens, i.e., the percentage of rejected applications to pre-primary education in kindergartens, the approach captured by equation (1) is implemented.

$$\begin{aligned} Reject_{it} = \beta_0 + \beta_1 Log(Wage_{it}) + \beta_2 Unempl\_men_{it} + \beta_3 Urban_{it} + \beta_4 Uni\_ratio_{it} \\ + \beta_5 Dwellings_{it} + \beta_6 Age\_ratio_{it} + \beta_7 Foreign\_ratio_{it} + \beta_8 Density_{it} \\ + \beta_9 Newborn_{it} + \beta_{10} Net\_migr_{it} + a_i + u_{it} \end{aligned} \quad (1)$$

$Reject_{it}$ is the dependent variable denoting the ratio of rejected applications to the total number of lodged kindergarten applications in LAU 1 i in period t. The control variables, i.e., characteristics of the i-th LAU 1 in period t are described in the fourth chapter. We use the natural logarithm of the average monthly real wage expressed in 2015 CZK to obtain the growth rate so that changes in this variable can be interpreted as growth rate and to ensure the normal distribution of this variable. $\beta_n, n = 1, \dots, 6$ are the respective slope coefficients of the control variables and β_0 is the intercept. Moreover, u_{it} is the district and time-specific idiosyncratic error and a_i includes all factors that affect the dependent variable,

that are unobserved and do not vary within districts over time. This error can also be referred to as unobserved district heterogeneity or the district fixed effect.

To simplify the notation, equation (2) captures the same model as equation (1). X_{it} is a row vector of included independent variables. The average monthly real wage expressed in 2015 CZK is still in logarithm. The column vector of the slope coefficients of respective explanatory variables is denoted by β. The dependent variable is represented by y_{it} for simplicity.

$$y_{it} = \beta_0 + X_{it}\beta + a_i + u_{it} \quad (2)$$

For the percentage of rejected applications to kindergartens of children from different age groups, the model and methodology are analogous. $Reject\_under_{it}$ refers to the percentage of rejected applications of children up to two years of age, $Reject\_legal_{it}$ to the share of rejected applications of children aged three to four years and $Reject\_comp_{it}$ to the percentage of rejected applications of five-year-old and older children.

The same approach is used in the regressions in the sensitivity analysis, only some independent variables are excluded from the complete set of control variables or some districts are eliminated from the sample.

The unobserved effect a_i represents unobserved attributes of each LAU 1 which are the same across all three time periods and affect the share of rejected applications to kindergartens, such as the distance to the Capital City of Prague, the traditions in childcare, or the transportation infrastructure which are assumed to be constant as only three years are inspected in the analysis.

The sum of the idiosyncratic error u_{it} and the time-invariant unobserved effect a_i is the so-called composite error which is denoted as v_{it}. To obtain consistent or even unbiased OLS estimates, v_{it} must be uncorrelated with the explanatory variables. Even if it is assumed that the idiosyncratic error u_{it} is uncorrelated with the control variables, OLS estimates are biased and inconsistent unless the fixed effect a_i is uncorrelated with all the control variables.

The heterogeneity bias often arises when many control variables are included in the model and some of them are correlated with a_i. Thus, one possibility to solve this problem is not to include the endogenous variable in the regression equation. Nonetheless, omitting the endogenous variable from the model would lead to the successful elimination of the bias only if the unobserved effect a_i and the remaining control variables in the regression equation were uncorrelated.

Therefore, the reason for collecting panel data is primarily to deal with the heterogeneity bias. Panel data estimation methods such as the FD and the FE transformation are other ways to eliminate the unobserved effects that do not vary over time. However, other explanatory variables that are constant over time (or change very little over time) are also eliminated (or their variation is greatly limited) using these estimation methods. Contrarily, when the heterogeneity bias is not present, the RE estimator should be utilized because it would be more efficient than FE and FD estimators and it allows retaining in the model time constant regressors.

All three above-mentioned panel data estimation methods are based on transforming the data and the application of pooled OLS to the transformed data. The FD estimator is the OLS estimator applied to the first-differenced equation, the FE estimator is a pooled OLS estimator which is based on the time-demeaned variables and the RE estimator is obtained by estimating the quasi-demeaned variables by pooled OLS. These data transformations are described in the following subchapters.

It shall be noted that there exist other panel data estimation methods, such as the dummy variable regression, the correlated random effects approach, or the between estimator can be obtained. Nonetheless, these approaches are not discussed in the following subchapters nor used for estimation in this thesis.

5.1. First Differencing

The first estimation method for panel data discussed in this chapter is the FD, which is based on differencing the data in adjacent time periods t and $t-1$:

$$y_{it} = \beta_0 + X_{it}\beta + a_i + u_{it}$$

$$y_{it-1} = \beta_0 + X_{it-1}\beta + a_i + u_{it-1}$$

When we subtract the second equation from the first one, we obtain the FD equation. The final form of the FD equation, where each variable is differenced over time is

$$y_{it} - y_{it-1} = (X_{it} - X_{it-1})\beta + u_{it} - u_{it-1}$$

or

$$\Delta y_{it} = \Delta X_{it}\beta + \Delta u_{it},$$

where Δ stands for the change between two adjacent periods, concretely from period $t-1$ to period t. Consequently, the intercept, time-constant control variables, and the unobserved effect a_i are eliminated.

FD is a useful tool for eliminating the unobserved effect a_i and the consequent heterogeneity bias. Nonetheless, the problem with this estimation method appears when key control variables do not vary or do not vary much over time because they are eliminated as well.

To get the FD estimator, we estimate the FD model by pooled OLS. Even after removing the unobserved heterogeneity, the following properties must be assumed for the inference to be at least asymptotically valid.

The first assumption is that for each cross-sectional unit, the model is

$$\mathrm{y}_{it} = \beta_0 + \mathrm{X}_{it}\beta + a_i + u_{it},$$

where β is the column vector of slope parameters, and a_i is the unobserved fixed effect, and u_{it} the idiosyncratic error. The second assumption states that we observe the same random sample of cross-sectional units. Thirdly, no perfect linear relationships exist among the control variables and each explanatory variable varies over time for at least some cross-sectional units.

The fourth assumption is the so-called strict exogeneity assumption. It assumes that the expected value of the idiosyncratic error conditional on the explanatory variables in all time periods and the unobserved effect equals zero:

$$E(u_{it}|X_i, a_i) = 0.$$

However, this assumption is stronger than necessary for the FD estimator to be unbiased and consistent. The following implication of the strict exogeneity assumption is sufficient:

$$E(\Delta u_{it}|X_i) = 0, t = 2, \dots, T.$$

The FD estimator is unbiased under these four assumptions. To add to this, when the same properties are assumed, the FD estimator is consistent when we observe many cross-sectional units for a fixed number of time periods.

The fifth and sixth assumptions are necessary for the standard errors and test statistics to be at least asymptotically valid. The homoscedasticity assumption is the fifth

assumption which states that the variance of the differenced errors conditional on all control variables is constant:

$$Var(\Delta u_{it}|X_i) = \sigma^2, t = 2, \dots, T.$$

The sixth assumption is on no serial correlation. This means that the differences in the idiosyncratic error in two different time periods should be uncorrelated when conditioning on all explanatory variables:

$$Cov(\Delta u_{it}, \Delta u_{is}|X_i) = 0, t \neq \text{s}.$$

Under the six assumptions, the FD estimator of the slope parameters is BLUE, conditional on all explanatory variables. The last assumption, i.e., that conditional on the explanatory variables, the differenced error terms are independent and identically distributed random variables with normal distribution, ensures that the FD estimators are normally distributed and that the t statistics and F statistics from the pooled OLS on the differenced data have exact t and F distribution. Nonetheless, the usually asymptotic approximations are reliable even without the seventh assumption, which is also the case in this thesis.

5.2. Fixed Effects Estimation

An alternative method of eliminating the unobserved heterogeneity is the FE transformation. This transformation consists of subtracting the equation averaged over time from the unobserved effects model:

$$y_{it} = \beta_0 + X_{it}\beta + a_i + u_{it}, \quad t = 1, \dots, T, i = 1, \dots, n.$$

The equation averaged over time is for all i:

$$\bar{y}_{it} = \beta_0 + \bar{X}_{it}\beta + a_i + \bar{u}_{it},$$

where $\bar{y}_{it} = \frac{1}{T}\sum_{t=1}^{T} y_{it}$, $\bar{X}_{it} = \frac{1}{T}\sum_{t=1}^{T} X_{it}$ and $\bar{u}_{it} = \frac{1}{T}\sum_{t=1}^{T} u_{it}$. By subtracting the equation averaged over time from the unobserved effects model, we get the time-demeaned model:

$$\underbrace{y_{it} - \bar{y}_{it}}_{\ddot{y}_{it}} = \underbrace{\beta_0 - \beta_0}_{0} + \underbrace{(X_{it} - \bar{X}_{it})}_{\ddot{X}_{it}}\beta + \underbrace{a_i - a_i}_{0} + \underbrace{u_{it} - \bar{u}_{it}}_{\ddot{u}_{it}},$$

$$\ddot{y}_{it} = \ddot{X}_{it}\beta + \ddot{u}_{it}, t = 1, \dots, t, i = 1, \dots, n.$$

The unobserved effect a_i is successfully eliminated, together with the intercept. If there were any, time-constant control variables are also eliminated.

The FE estimator is the pooled OLS estimator based on the time-demeaned data and is unbiased and consistent under the same assumptions necessary for the unbiasedness and consistency of the FD estimator. For the FE estimator to be BLUE, two additional assumptions on homoscedasticity of the idiosyncratic error and on the uncorrelation of the idiosyncratic errors in two distinct time periods must be stated.

The fifth and the sixth assumptions are:

$$Var(u_{it}|X_i, a_i) = \sigma_u^2, t = 1, .., T,$$

$$Cov(u_{it}, u_{is}|X_i, a_i) = 0, t \neq s.$$

The seventh assumption states that the idiosyncratic errors are independent and identically distributed with normal distribution when conditional on the control variables and the unobserved effect a_i. Consequently, when the seven assumptions are satisfied, the FE estimator is normally distributed, and t and F statistics are exactly t and F distributed.

5.3. Random Effects Estimation

The last panel data estimation method described in this chapter is the RE estimation method. Unlike the FE estimation method and FD, RE estimation assumes that a_i is uncorrelated with each control variable in all time periods.

The composite error v_{it} is the sum of the idiosyncratic error u_{it} and the unobserved effect a_i. Since a_i appears in the composite errors in all time periods, the serial correlation in the composite errors across time arises:

$$Corr(v_{it}, v_{is}) = \frac{\sigma_a^2}{\sigma_a^2 + \sigma_u^2}, t \neq s,$$

where $Var(a_i) = \sigma_a^2, Var(u_{it}) = \sigma_u^2$. Due to the positive correlation of the error terms, the usual inference would not be correct, and the resulting pooled OLS estimator would be inefficient. Therefore, GLS transformation is used to solve the problem of the serial correlation of the error terms.

The GLS transformation, i.e., the RE transformation, consists of subtracting a fraction of time averages from the respective variables, i.e., the time averages of variables

are multiplied by the term θ ranging from zero to one which depends on the number of time periods, T, the variance of the unobserved effect, σ_a^2, and variance of the idiosyncratic error, σ_u^2:

$$\theta = 1 - \sqrt{\frac{\sigma_u^2}{\sigma_u^2 + T\sigma_a^2}}.$$

Consequently, the errors are uncorrelated in the transformed equation that involves quasi-demeaned data:

$$y_{it} - \theta\bar{y}_{it} = \beta_0(1-\theta) + (X_{it} - \theta\bar{X}_{it})\beta + \nu_{it} - \theta\bar{\nu}_{it}.$$

Compared to the FD and FE estimation, the intercept, unobserved effect, and the time-constant independent variables are not eliminated. Pooled OLS estimator of the quasi-demeaned equation is the GLS estimator. Nonetheless, the parameter θ is unknown in practice, therefore, is estimated such that:

$$\hat{\theta} = 1 - \sqrt{\frac{\hat{\sigma}_u^2}{\hat{\sigma}_u^2 + T\hat{\sigma}_a^2}},$$

where $\hat{\sigma}_u^2$ and $\hat{\sigma}_a^2$ are consistent estimators of σ_u^2 and σ_a^2, respectively. The RE estimator is the FGLS estimator, which uses $\widehat{\theta}$ instead of θ.

For the RE estimator to be consistent, we must assume linearity in parameters, having the same random sample of cross-sectional units, no perfect linear relationship among the control variables, and the expected value of the idiosyncratic error conditional on the explanatory variables being zero. Furthermore, the expected value of the unobserved effect given all explanatory variables must be constant, i.e.,

$$E(a_{it}|X_i) = \beta_0.$$

Additional assumptions are necessary to obtain valid RE standard errors. Concretely, the homoscedasticity of the idiosyncratic error u_{it} conditional on the explanatory variables and the unobserved effect a_i, and the homoscedasticity of the unobserved effect a_i given all control variables:

$$Var(a_i|X_i) = \sigma_a^2.$$

Lastly, we assume no serial correlation in the idiosyncratic errors. Under the above-described assumptions, the RE estimator is asymptotically efficient, asymptotically normally distributed and the RE standard errors and test statistics are valid.

5.4. Assumptions Discussion

In this subchapter, the satisfaction of the assumptions mentioned in the previous sections is discussed. In the case of violation of any assumptions, there are suggested appropriate methods to solve the problem.

The linearity in parameters is satisfied by the construction of the regression model, represented by equation (1), which is utilized for analysing the effect of the socioeconomic characteristics of districts on the availability of places in kindergartens. We observe the whole population of LAU 1 in the Czech Republic in all three consecutive years 2017, 2018, and 2019. Thus, the assumption of random sampling is also satisfied.

Based on the results of the correlation matrix depicted in Figure 11, there is no perfect correlation between the control variables, and no perfect collinearity is assumed. In two cases, the correlation is strong and greater than 0.8. In general, one of the strongly correlated variables would be excluded from the set of control variables. Nonetheless, the highly correlated variables appeared both in the models selected by BIC. Thus, they separately transmit a piece of important information and are therefore both included in the main analysis. However, the sensitivity analysis without one of the highly correlated variables is provided in the Appendix. This serves to inspect any differences that may emerge by excluding these variables from the model. Additionally, all included independent variables vary over time for at least some LAU 1.

The satisfaction of the strict exogeneity assumption is debatable. However, the author of this thesis did her best to satisfy this assumption. Some of the factors that may influence kindergarten availability are the transportation infrastructure or the nationality structure of the population. Developed transportation infrastructure can positively influence the accessibility to jobs and consequently the unemployment rate among men. Moreover, in districts with advanced transportation infrastructure, the ratio of rejected applications may be higher, because parents can prefer these kindergartens due to their convenient location. The impact of the nationality structure on the participation rate in pre-primary education is mentioned by Hulík et al. (2008). The nationality and the unemployment rate can also be correlated.

Be that as it may, we observe only three years. Thus, these characteristics are not likely to change over this short period of time and are included in the fixed effect term, which is eliminated using FE and FD.

Furthermore, even if the idea of the unchanged nationality structure was incorrect, the percentage of foreigners has been added to the analysis to approximate the nationality structure of the population which is unobservable to prevent the emergence of the endogeneity problem. The percentage of foreigners varies over time because foreigners can change their residence, e.g., because of job opportunities. People of different nationalities may live for generations in the same specific regions of the Czech Republic and their residence is not likely to change.

Moreover, the unemployment rate among men instead of the unemployment rate among women is utilized to eliminate the reverse causality and the consequent endogeneity problem. The reverse causality is also prevented by the choice of lagged independent variables.

In the case of RE estimation, the additional zero expected value of the unobserved effect given all explanatory variables shall be tested using the Hausman test. Stationarity is not tested due to the time range of the data which is only three years.

The homoscedasticity in errors is tested by the Breusch-Pagan test for panel data. When the null hypothesis of homoscedasticity in errors is rejected, we conclude that there is heteroscedasticity present in the error terms. If heteroscedasticity in the errors is detected, we can use heteroscedasticity-robust standard errors.

Furthermore, we test the presence of serial correlation of the errors by the Breusch-Godfrey test for panel data. The null hypothesis of this test is no serial correlation of the errors. If the null hypothesis is rejected, we can correct for heteroscedasticity and serial correlation in the errors by obtaining heteroscedasticity- and autocorrelation-robust standard errors. The seventh assumption was not tested as we analyse a large sample and large sample properties are sufficient.

5.5. Comparison of the Panel Data Estimation Methods

In the analysis of the socioeconomic determinants of the availability of places in kindergartens, the most appropriate panel data estimation method is selected. During the FD and the FE transformation, the unobserved heterogeneity a_i is eliminated. Supposing a_i is uncorrelated with each control variable in all time periods, then both FE and FD estimators are inefficient. The RE estimator would be more efficient than FE and FD estimators.

Thus, the Hausman test can be implemented to test whether use the FE or RE estimator. The null hypothesis in the Hausman test is the zero covariance between the unobserved effect a_i and each of the control variables in all time periods. Under the null hypothesis, both FE and RE estimators are consistent, but the RE estimator is more asymptotically efficient. Nevertheless, under the alternative hypothesis, the FE estimator is consistent and the RE estimator is not (Hausman, 1978).

The choice between the employment of the FD or the FE transformation is based on the serial correlation in the idiosyncratic errors, which implies the relative efficiency of the estimators. If the idiosyncratic errors are serially uncorrelated, the FE estimator is more efficient than the FD estimator. Contrarily, if the serial correlation in the idiosyncratic errors is detected and the differenced idiosyncratic error terms are serially uncorrelated, the FD estimator is preferred.

6. Results

In this section, the results of the analysis described in the previous chapters are presented and interpreted in subchapters 6.1. and 6.2., respectively. The comments on the sensitivity analysis reported in the Appendix are provided in subchapter 6.3. Discussion of the results is in subchapter 6.4.

6.1. Regression Results

This subchapter is dedicated to the presentation of the results of the main regressions. To estimate the effect of district-level socioeconomic characteristics on the percentage of rejected applications of children from distinct age groups, FE, FD, and RE estimation methods were utilized. The results are depicted in Tables 5 – 8.

It must be highlighted that the tests mentioned in this section were performed at a 95 % significance level. All models were tested for serial correlation and heteroscedasticity in the disturbance terms using the Breusch-Godfrey test and Breusch-Pagan test for panel data, respectively. Both the null hypothesis of no serial correlation and the null hypothesis of homoscedasticity of the errors were rejected in all four models using the FE estimation method. Thus, heteroscedasticity- and autocorrelation-robust standard errors were calculated. The same test results emerged when using FD on the model with the dependent variable being the percentage of rejected kindergarten applications of five-year-old and older children. The same procedure to correct for the presence of heteroscedasticity and autocorrelation in the error terms was employed.

Heteroskedasticity-robust standard errors were computed when using FD in the model with children aged up to two years because the null hypothesis of the Breusch-Pagan test was rejected but the serial correlation was not detected.

Furthermore, the Hausman test was employed for testing the consistency of RE estimates versus FE estimates. The null hypothesis of this test, i.e., that both the RE and FE estimates are consistent, was not rejected only in one case: the model for the percentage of rejected applications of three-year-old and four-year-old children. In this model, the null hypotheses of the Breusch-Pagan and the Breusch-Godfrey test for panel data were not rejected. In the remaining cases, the null hypothesis of the Hausman test was rejected, meaning that RE estimates were not consistent. Under these circumstances, heteroscedasticity- and/or autocorrelation-robust standard errors were not calculated.

In Tables 5 – 8, the preferred models are in bold. The decision-making process was based on the presence of serially correlated errors and the results of the Hausman test. The RE model was preferred for children aged three to four years because in this case, both the FE and the RE estimator are consistent and the RE estimator is more efficient than the FE estimator. In cases where RE estimates appear to be inconsistent, FE estimation is more suitable when errors are well-behaved, i.e., are not serially correlated, and the FD estimation approach is preferred otherwise. Standard errors were found to be correlated in all relevant cases. Consequently, when RE models were inconsistent, FD models were preferred.

As in most cases, the FD proved to be the preferred estimation technique, the FD model was chosen also for the percentage of rejected applications of the oldest children, even though the serial correlation of the errors was not eliminated using FD. This is to provide results that can be compared between age groups. For the same reason, FD estimates are interpreted even when the RE model is preferred.

Using FD, the adjusted R-squared is 0.118 in the model without age distinction which is satisfactory because the decision-making of people is likely to be affected by a great number of other observable and unobservable factors. In the model with the percentage of rejected kindergarten applications of children aged three to four years, the adjusted R-squared is 0.139, which is slightly higher and implies that variation in the control variables included in the model explains about 13.9 % of the variation in the percentage of rejected applications.

The adjusted R-squared is much lower in the models with the dependent variables being the share of rejected kindergarten applications of the youngest and oldest children., i.e., the included control variables have minor explanatory power. Thus, the results of the analyses could serve policymakers especially when not taking children's age into account and for children aged three to four years.

The results of the supplementary sensitivity analysis are presented in the Appendix in Tables A. 6 – A. 21. The decision-making regarding the preferred model was identical to the above-mentioned process.

Table 5: Regression results, the percentage of rejected kindergarten applications without age differentiation being the dependent variable

	Dependent variable:			
	Reject			
	FE	FE robust	**FD**	RE
Log(Wage)	14.356**	14.356	**16.825*** **	12.001**
	(5.553)	(10.442)	**(5.826)**	(5.208)
Unempl_men	0.791**	0.791*	**1.545** **	0.763***
	(0.365)	(0.436)	**(0.645)**	(0.293)
Urban	-0.790	-0.790***	**-0.673**	0.019
	(0.554)	(0.284)	**(0.516)**	(0.079)
Uni_ratio	0.416	0.416	**0.327**	0.226
	(0.465)	(0.439)	**(0.480)**	(0.287)
Dwellings	-0.222	-0.222	**-0.270**	-0.136
	(0.495)	(0.436)	**(0.474)**	(0.454)
Age_ratio	3.276	3.276	**1.949**	8.150***
	(3.347)	(3.239)	**(2.832)**	(2.014)
Foreign_ratio	-1.007	-1.007	**-0.675**	-0.542
	(1.584)	(1.931)	**(2.134)**	(0.485)
Density	-0.192**	-0.192	**-0.208** **	0.008*
	(0.086)	(0.141)	**(0.104)**	(0.004)
Newborn	0.569	0.569	**1.242***	0.789
	(0.732)	(0.723)	**(0.649)**	(0.708)
Net_migr	0.398	0.398	**0.458** **	0.467**
	(0.258)	(0.257)	**(0.225)**	(0.210)
Constant			**0.630**	-81.733***
			(1.117)	(22.381)
Observations	231	231	**154**	231
R^2	0.136	0.136	**0.176**	0.305
Adjusted R^2	-0.380	-0.380	**0.118**	0.274

Note: Standard errors are in parentheses. *** is significance at 1 % significance level, ** at 5 % significance level, and * at 10 % significance level. Robust stands for heteroscedasticity- and/or autocorrelation-robust standard errors. The dependent variable Reject is the percentage of rejected kindergarten applications. The control variable Log(Wage) is the natural logarithm of the real average monthly wage expressed in 2015 CZK. The preferred model is in bold.

Table 6: Regression results, the percentage of rejected kindergarten applications of two-year-old and younger children being the dependent variable

	Dependent variable:				
	Reject_under				
	FE	FE robust	FD	**FD robust**	RE
Log(Wage)	7.692	7.692	9.872	**9.872**	8.404
	(8.879)	(10.929)	(9.067)	**(11.663)**	(8.179)
Unempl_men	0.281	0.281	1.727*	**1.727***	0.661
	(0.584)	(0.537)	(1.004)	**(0.885)**	(0.458)
Urban	-1.442	-1.442***	-1.390*	**-1.390*****	0.005
	(0.886)	(0.547)	(0.803)	**(0.505)**	(0.121)
Uni_ratio	0.236	0.236	-0.128	**-0.128**	0.340
	(0.743)	(0.692)	(0.747)	**(0.555)**	(0.442)
Dwellings	-0.207	-0.207	0.140	**0.140**	-0.115
	(0.791)	(0.640)	(0.738)	**(0.583)**	(0.713)
Age_ratio	6.219	6.219	2.985	**2.985**	15.910***
	(5.352)	(6.453)	(4.408)	**(3.882)**	(3.125)
Foreign_ratio	-0.757	-0.757	-2.111	**-2.111**	-0.211
	(2.533)	(2.870)	(3.321)	**(2.901)**	(0.740)
Density	-0.048	-0.048	-0.040	**-0.040**	0.015**
	(0.137)	(0.114)	(0.162)	**(0.100)**	(0.007)
Newborn	0.558	0.558	1.812*	**1.812***	1.146
	(1.171)	(1.347)	(1.010)	**(1.001)**	(1.114)
Net_migr	0.372	0.372	0.538	**0.538**	0.672**
	(0.413)	(0.426)	(0.350)	**(0.430)**	(0.328)
Constant			1.650	**1.650**	-106.481***
			(1.738)	**(1.714)**	(34.872)
Observations	231	231	154	**154**	231
R^2	0.061	0.061	0.092	**0.092**	0.391
Adjusted R^2	-0.500	-0.500	0.029	**0.029**	0.364

Note: Standard errors are in parentheses. *** is significance at 1 % significance level, ** at 5 % significance level, and * at 10 % significance level. Robust stands for heteroscedasticity- and/or autocorrelation-robust standard errors. The dependent variable Reject_under is the percentage of rejected kindergarten applications of two-year-old and younger children. The control variable Log(Wage) is the natural logarithm of the real average monthly wage expressed in 2015 CZK. The preferred model is in bold.

Table 7: Regression results, the percentage of rejected kindergarten applications of three-year-old and four-year-old children being the dependent variable

	Dependent variable:			
	Reject_legal			
	FE	FE robust	FD	**RE**
Log(Wage)	16.682***	16.682	22.847***	**11.800****
	(5.587)	(11.608)	(5.967)	**(5.057)**
Unempl_men	1.159***	1.159***	1.204*	**0.895*****
	(0.367)	(0.449)	(0.660)	**(0.274)**
Urban	-0.486	-0.486**	-0.241	**0.021**
	(0.557)	(0.238)	(0.528)	**(0.064)**
Uni_ratio	0.226	0.226	0.394	**0.060**
	(0.468)	(0.588)	(0.492)	**(0.246)**
Dwellings	-0.025	-0.025	-0.256	**0.197**
	(0.498)	(0.545)	(0.486)	**(0.442)**
Age_ratio	1.711	1.711	0.870	**6.527*****
	(3.368)	(2.920)	(2.901)	**(1.829)**
Foreign_ratio	0.240	0.240	2.318	**-0.254**
	(1.594)	(2.138)	(2.185)	**(0.394)**
Density	-0.277***	-0.277	-0.313***	**0.006**
	(0.086)	(0.192)	(0.107)	**(0.004)**
Newborn	0.044	0.044	0.424	**0.094**
	(0.737)	(0.623)	(0.665)	**(0.698)**
Net_migr	0.381	0.381	0.432*	**0.454****
	(0.260)	(0.234)	(0.231)	**(0.198)**
Constant			-0.721	**-71.094*****
			(1.144)	**(20.802)**
Observations	231	231	154	**231**
R^2	0.162	0.162	0.196	**0.317**
Adjusted R^2	-0.339	-0.339	0.139	**0.285**

Note: Standard errors are in parentheses. *** is significance at 1 % significance level, ** at 5 % significance level, and * at 10 % significance level. Robust stands for heteroscedasticity- and/or autocorrelation-robust standard errors. The dependent variable Reject_legal is the percentage of rejected kindergarten applications of children aged three to four years. The control variable Log(Wage) is the natural logarithm of the real average monthly wage expressed in 2015 CZK. The preferred model is in bold.

Table 8: Regression results, the percentage of rejected kindergarten applications of five-year-old and older children being the dependent variable

	Dependent variable:				
	Reject_comp				
	FE	FE robust	FD	**FD robust**	RE
Log(Wage)	15.274***	15.274*	10.476**	**10.476**	11.867***
	(4.345)	(8.672)	(5.183)	**(12.551)**	(3.489)
Unempl_men	0.228	0.228	0.568	**0.568**	0.216
	(0.286)	(0.341)	(0.574)	**(0.571)**	(0.171)
Urban	-0.274	-0.274	-0.405	**-0.405***	0.0002
	(0.433)	(0.210)	(0.459)	**(0.241)**	(0.032)
Uni_ratio	-0.152	-0.152	-0.286	**-0.286**	-0.150
	(0.364)	(0.318)	(0.427)	**(0.366)**	(0.131)
Dwellings	-0.126	-0.126	-0.158	**-0.158**	0.206
	(0.387)	(0.359)	(0.422)	**(0.429)**	(0.303)
Age_ratio	1.697	1.697	2.209	**2.209***	2.211*
	(2.619)	(1.842)	(2.520)	**(1.224)**	(1.154)
Foreign_ratio	-2.624**	-2.624***	-3.689*	**-3.689*****	-0.218
	(1.240)	(0.937)	(1.898)	**(1.315)**	(0.198)
Density	0.023	0.023	0.046	**0.046**	0.003
	(0.067)	(0.056)	(0.093)	**(0.067)**	(0.002)
Newborn	0.622	0.622	0.881	**0.881**	0.765
	(0.573)	(0.637)	(0.577)	**(0.755)**	(0.497)
Net_migr	0.177	0.177	0.297	**0.297**	-0.005
	(0.202)	(0.192)	(0.200)	**(0.232)**	(0.128)
Constant			0.738	**0.738**	-52.739***
			(0.994)	**(1.066)**	(13.529)
Observations	231	231	154	**154**	231
R^2	0.135	0.135	0.096	**0.096**	0.220
Adjusted R^2	-0.382	-0.382	0.033	**0.033**	0.184

Note: Standard errors are in parentheses. *** is significance at 1 % significance level, ** at 5 % significance level, and * at 10 % significance level. Robust stands for heteroscedasticity- and/or autocorrelation-robust standard errors. The dependent variable Reject_comp is the percentage of rejected kindergarten applications of children aged five and more years. The control variable Log(Wage) is the natural logarithm of the real average monthly wage expressed in 2015 CZK. The preferred model is in bold.

6.2. Interpretation of the Results

In this subchapter, the regression results of the main analysis are interpreted. The sensitivity analysis is commented on in the following subchapter 6.3.

Given that for most specifications FD proved to be the preferred estimation technique, FD estimates are discussed in detail to provide a comparison of the effects of district-level socioeconomic characteristics on the percentage of rejected applications to kindergartens among children from different age groups. Even though the coefficients in FD, FE, and RE models are the same from the mathematical point of view if the assumptions are satisfied, a different source of variation is used to identify these coefficients. In the FD models, we work with changes in time, thus, the interpretation slightly differs from the one when utilizing the RE. When the RE model is preferred, the RE estimates are briefly compared to the FD estimates.

The interpretation of the obtained estimates is often related to the descriptive statistics of the differenced variables shown in the Appendix. Concretely, the descriptive statistics of the differenced dependent variables are summarized in Table A. 2 and of the independent variables in Table A. 3.

6.2.1. Percentage of Rejected Applications (without Age Distinction)

As demonstrated in Table 5, the district-level average real monthly wage expressed in 2015 CZK, and the male unemployment rate are the two statistically significant socioeconomic determinants of the share of rejected kindergarten applications when not taking children's age into account. Other significant independent variables are the number of newborn children per 1,000 population lagged by 3 years, the net migration per 1,000 population, and the district population density. The remaining independent variables included in the regression are not statistically significant.

The FD estimate of the effect of the district-level male unemployment rate on the share of rejected kindergarten applications is positive. It suggests that a one percentage point increase in the district-level male unemployment rate is associated with a 1.545 percentage point increase in the percentage of rejected applications. Thus, moving from the 1st quantile to the median in a district-level change in the male unemployment rate, i.e., by 0.27 percentage points, corresponds to a shift in the change of the percentage of

rejected applications of about 1/5 of the distance between the 1st quantile and the median, i.e., by about 0.42 percentage points, which is a moderate effect.

Regarding the district-level average monthly real wage expressed in 2015 CZK, the FD estimate is also positive. It can be interpreted such that one log-point change in the district-level average monthly real wage, i.e., roughly 1 % growth rate, is related to a 16.8 percentage points change in the share of rejected kindergarten applications. This is a substantial effect given the mean value of the percentage of rejected applications is 16.15 %. It is likely to be caused by the high SD of the percentage of rejected applications and the change in the share of rejected kindergarten applications.

As expected, the FD estimate of the effect of the net migration per 1000 population is positive. The result suggests that a shift by the mean value of change in the net migration (1.00) corresponds to a change in the percentage of rejected applications by about 4 times the mean value which is a considerable effect.

The effect of the number of newborn children per 1,000 population on the percentage of rejected applications is also positive. Contrarily, increasing population density is associated with a drop in the share of rejected kindergarten applications.

6.2.2. Percentage of Rejected Applications (with Age Distinction)

This subchapter includes the interpretation of the results of the three additional analyses inspecting which district-level characteristics are related to the satisfaction of the demand for places in kindergartens of children from distinct age groups. To add to that, a comparison between the FD estimates of the coefficients among age groups is provided.

The results for children aged up to two years are presented in Table 6. Compared to the results without age distinction, the same statistically significant variables are the male unemployment rate, and the number of newborn children per 1,000 population, i.e., the average monthly wage is no longer statistically significant. On the contrary, the percentage of the urban population became statistically significant.

The FD estimates of the male unemployment rate and the number of newborn children are of the same sign and larger in magnitude than without taking children's age into account which suggests that identical change in these district-level characteristics is associated with a greater change in the percentage of rejected kindergarten applications.

The FD estimate of the percentage of the urban population is negative. It implies that a one percentage point increase in the percentage of the urban population is estimated to decrease the percentage of rejected applications by about 1.39 percentage points.

When inspecting the district-level factors associated with the share of rejected kindergarten applications of children aged three to four years, the average monthly wage, the male unemployment rate, the net migration, and the population density are statistically significant using FD as demonstrated in Table 7. The signs of the coefficients of these variables are of the same sign and greater magnitude than the coefficients when not taking children's age into account.

The most striking result to emerge is that one log-point change in the district-level average monthly wage corresponds to the change of the share of rejected applications by 22.8 percentage points which is more than twice the mean value of the percentage of rejected applications of these children. This effect is rather substantial and greater than when not taking children's age into account.

Furthermore, for this age group, RE is consistent and thus preferred, but it would not allow us to compare the results between models. The RE estimate of the monthly wage growth is half the effect estimated by FD. Utilizing RE, the district population density lost its statistical significance. Contrarily, the ratio of children aged two to six years to the total district population became significant.

Finally, the interpretation of the regression results for children with obligatory pre-primary education is provided. In general, the effects of the district-level socioeconomic characteristics vary substantially compared to other age groups. The average monthly wage and the male unemployment rate, i.e., the key socioeconomic characteristics, are no longer statistically significant. The only socioeconomic determinant of the percentage of rejected kindergarten applications of the oldest children is the district-level percentage of the urban population.

Concretely, a one percentage point increase in the percentage of the urban population is related to a decrease in the share of rejected kindergarten applications of children with compulsory pre-primary by 0.405 percentage points. This effect is minor to the effect of the percentage of the urban population on the percentage of rejected kindergarten applications of the youngest children.

Other statistically significant variables for explaining the share of rejected kindergarten application of the children for whom preschool education is compulsory, is

the district-level percentage of foreigners and the share of children aged two to six years. The FD estimate of the effect of the percentage of foreigners is negative and suggests that the availability of places in kindergartens for the children for whom preschool education is compulsory improves when the percentage of foreigners, who are not likely to send their children to kindergartens, increases.

On the contrary, an increase in the share of children aged two to six years in the district population is estimated to increase the percentage of rejected kindergarten applications of five-year-old and older children. One interesting finding is that the FD estimate of the effect of the district-level population density is not statistically significant but is positive in comparison with the other three regressions.

6.3. Sensitivity Analysis

This subsection aims to summarize the main findings from the sensitivity analysis referred to in the previous chapters and reported in the Appendix.

Due to the frequent occurrence of the extreme values of the independent variables in the Capital City of Prague and the two nearest districts Praha-východ and Praha-západ, these districts were excluded from the sample to check whether the effects are in some manner drawn by these specific districts. The regression results are shown in the Appendix in Tables A. 6 – A. 9.

Furthermore, based on the high correlation between the net migration per 1,000 population and the dwellings completed per 1,000 population, the net migration was eliminated from the set of control variables. The regression results are demonstrated in the Appendix in Tables A. 10 – A. 13.

For its strong positive correlation with the number of newborn children per 1,000 population, the share of children aged two to six years was also excluded for the next part of the sensitivity analysis. The regression results are in Tables A. 14 – A. 17. Lastly, both net migration and the percentage of young children in the population were omitted from the supplementary analysis. Again, the results are shown in the Appendix, concretely in Tables A. 18 – A. 21.

Firstly, we removed the Capital City of Prague, the Praha-východ district, and the Praha-západ district from the sample. Except for the model for children aged up to two years, the adjusted R-squared increased, so the variables included have greater explanatory

power. To illustrate, the variation in the explanatory variables included in the model explains about 12.7 % of the variation in the percentage of rejected kindergarten applications without taking children's age into account compared to 11.8 % when all districts were included.

The most striking difference is the much higher effect of the population density on the percentage of rejected kindergarten applications of the children without age distinction and of the children aged three to four years. For children aged between three and four years, the magnitude of the FD estimate of the effect of population density raised more than threefold.

This disparity emerged due to the extreme maximum value in the Capital City of Prague and the consequent great SD. This result is rather intuitive because after excluding the three districts from the analysis, the maximum value and the SD of the district-level population density substantially lowered.

Furthermore, when the male unemployment rate was significant, its effect moderately increased. The percentage of the urban population became statistically insignificant for the youngest children. However, the estimate of the effect of this variable became greater in magnitude for the oldest children. The overall effect of the net migration increased as well, which is another reason for excluding this variable from the analysis. This implies that some effects are driven by these three districts, but not in an extreme manner. In general, the determinants of the availability of places in kindergartens found in the main analysis are related to the percentage of rejected kindergarten applications in the whole county.

When we excluded the net migration from the analysis, the adjusted R-squared of all models decreased which means that the remaining independent variables have lower explanatory power. The control variables that were statistically significant in the models for children without age distinction and for the youngest children kept their statistical significance and no substantial changes in the effects emerged. The effect of the male unemployment rate, the number of newborn children, and the percentage of the urban population slightly decreased. The opposite can be concluded about the effect of the average monthly wage and the population density. Moreover, for three-year-old and four-year-old children, the male unemployment rate lost its statistical significance. On the other hand, the percentage of foreigners became statistically significant. The percentage of the urban population became statistically insignificant in the model for the oldest children.

Next, the percentage of children aged two to six years was omitted from the model. The adjusted R-squared increased in all models which suggests that this variable was

redundant in the model. For example, without taking children's age into account, the adjusted R-squared increased from 0.118 to 0.121. After excluding this variable, only slight changes appeared. To illustrate, the effect of the male unemployment rate on the percentage of rejected applications to kindergartens of the youngest children and children aged three to four years became greater. Moreover, the magnitude of the coefficient of the percentage of the urban population and the percentage of foreigners increased in the regression for the oldest children.

After excluding both the net migration per 1,000 population and the share of young children in the population, the adjusted R-squared decreased in all four models. In the model without age distinction, the effect of the percentage of foreigners changed its sign. Nonetheless, this effect is not statistically significant. Furthermore, in general, the estimate of the effect of the male unemployment rate was lesser. The percentage of the urban population became statistically insignificant in all models. Moreover, the percentage of foreigners became statistically significant for children aged three to four years.

To conclude, after omitting the share of young children in the population from the set of independent variables, the explanatory power of the remaining variables measured by the adjusted R-squared increased. The estimates of the effects of the included variables on the percentage of rejected applications did not change substantially. When excluding the net migration per 1,000 population, the changes were more noticeable. In concrete, the percentage of the urban population lost its statistical significance in most cases. Moreover, the percentage of foreigners became statistically significant in the model for children aged between three and four years. However, after omitting the net migration, the explanatory power of the remaining control variables lowered in all models. Lastly, the removal of the Capital City of Prague, the Praha-východ district, and the Praha-západ district from the sample is associated with a greater magnitude of the coefficients of the population density and the net migration.

6.4. Discussion

This subchapter includes the discussion of the results of the main analysis which are presented and interpreted in subchapters 6.1 and 6.2. The results of the sensitivity analysis are not discussed because it serves only as a supplementary analysis.

As mentioned in the literature review, very little was found in the literature on the question of the determinants of the availability of places in kindergartens in the Czech Republic. Consequently, this research offers the answer to the research question of what the district-level socioeconomic characteristics related to the percentage of rejected kindergarten applications are. All results were obtained using FD to compare the effects between the models.

The findings of this study indicate that when not taking children's age into account, the district-level socioeconomic determinants of meeting the demand for a place in a kindergarten are the male unemployment rate and the average monthly real wage expressed in 2015 CZK. On the contrary, the percentage of the urban population, the number of dwellings completed, and the percentage of the population with higher education are not statistically significant.

The resulted effect of the monthly wage is somewhat counterintuitive. One could say that when the wage increases, parents are likely to pay for individual care or a private kindergarten, for which the fee is greater than for a public kindergarten. Hůle et al. (2015b) argue that women from economically developed regions are willing to pay much higher sums of money for the preschool education of their children. It would lead to a lower share of rejected kindergarten applications.

The outcome of the analysis in this thesis suggests the opposite effect of the average monthly wage. One possible explanation might be that when the labour market increases its attractiveness due to higher wages, parents could be more incentivized to place their children in a kindergarten and work. Another possible explanation could be that when the wage increases more than public kindergarten fees, parents can afford to place their child in a kindergarten. As a consequence, a greater number of applications is submitted. Be that as it may, due to a relatively inelastic supply of places in kindergartens, a greater share of applications must be rejected.

Furthermore, when the average monthly wage grows, the people working in kindergartens might prefer to change their profession, where they can earn more money. This would again correspond to a higher percentage of rejected applications due to an insufficient number of teachers in kindergartens.

A higher male unemployment rate is associated with a greater percentage of rejected applications. The positive relationship between the unemployment rate among men and the percentage of rejected applications to kindergartens may be partly explained by the need

for mothers to work instead of taking care of the child at home and consequently demand a place in a kindergarten. Possibly, due to the financial burden, parents might prefer kindergartens closer to their residence because of the associated transportation costs. Thus, they lodge more applications to place their child in the most affordable kindergarten.

Another possible explanation might be that when the male unemployment rate increases, women working in kindergartens choose a more profitable occupation to financially secure their families, and due to insufficient teachers in kindergartens, the percentage of rejected applications rises.

The percentage of the urban population, the share of inhabitants aged above 15 years, and the number of dwellings completed per 1,000 population are not statistically significant.

Other factors that are related to the availability of places in kindergartens are the population density, net migration, and the number of newborn children lagged by three years. One unanticipated finding was that the percentage of two- to six-year-old children in the district population is not statistically significant. This variable turns out to be irrelevant, as the sensitivity analysis revealed. Apparently, it is enough to control for the number of newborn children.

The number of newborn children per 1,000 population lagged by three years is not included to predict the percentage of rejected applications, but to control for demographic conditions. When it is included, other coefficients can be interpreted by the ceteris-paribus manner that is keeping (among others) the demographic conditions the same across districts. The results suggest that when more children were born three years before the given school years, the availability worsens. The district population density has the opposite effect.

Furthermore, increasing net migration is related to a greater percentage of rejected kindergarten applications. This result may be explained by the fact that the supply of places in kindergartens is relatively inelastic and does not react to newcomers. Moreover, families with preschool-age children move to suburbs of large cities, where the infrastructure is not developed, and these areas suffer from a high share of rejected kindergarten applications (Hulík et al., 2008).

An interesting finding is that the district-level determinants of meeting the demand for a place in a kindergarten of three- to four-year-old children, i.e., children who have a legal right to attend a kindergarten, but pre-primary education is not compulsory for them, are more or less parallel to the results when not taking children's age into account. Concretely,

the signs of the effects are identical except for the percentage of foreigners in the district population. Be that as it may, this variable is statistically insignificant in both regressions.

Nonetheless, this finding is somewhat expected because these children have a legal right to attend a kindergarten and do not represent extremes such as children for whom preschool education is compulsory, and children who do not have a legal right to attend a kindergarten. The only difference is no significant effect of the number of newborn children lagged by three years.

The results for the youngest children differ substantially from the results of the regression without age distinction. In concrete, even though the male unemployment rate remains statistically significant, the average monthly wage lost its significance. This result suggests that even though parents can afford preschool education for their children, the applications of older children are accepted preferentially, and thus, the wage is not relevant. Moreover, an increasing percentage of the urban population improves the kindergarten availability for these children which is contrary to the suggestion of Hůle et al. (2015b) who argue that there is sufficient capacity in regions with a low percentage of the urban population compared to regions where the percentage of the urban population is high.

The most obvious finding to emerge from the analysis is that the effect of the district-level characteristics differs significantly for the children for whom preschool education is compulsory. District-level male unemployment rate and the average monthly wage are no longer statistically significant for predicting the percentage of rejected applications. The percentage of the urban population is the only socioeconomic factor related to the percentage of rejected applications to kindergartens.

Regarding other predictors, the share of foreigners, and the percentage of two- to six-year-old children in the district population emerged as statistically significant for some age groups.

7. Conclusion

The purpose of this thesis was to determine what district-level socioeconomic characteristics are associated with the availability of places in kindergartens in the Czech Republic expressed as the percentage of rejected applications to kindergartens. The socioeconomic characteristics of districts chosen for the analysis in this thesis were the average monthly real wage expressed in 2015 CZK, the male unemployment rate, the percentage of inhabitants aged above 15 years with higher education, the number of dwellings completed per 1,000 population, and the percentage of the urban population.

Other than socioeconomic characteristics that were included in the analysis were the population density, the number of newborn children per 1,000 district population lagged by three years, the percentage of foreigners, the net migration per 1,000 population, and the share of children from two to six years old in the district population.

To answer the research question, panel data obtained from the CZSO and the MEYS were utilized. Three consecutive school years 2017/2018, 2017/2018, and 2018/2019 were inspected for all 77 LAU 1 in the Czech Republic, i.e., 76 districts and the Capital City of Prague. The initial data analysis consisted predominantly of a graphical representation of the supply and demand of places in kindergartens in Czech districts. Furthermore, panel data estimation methods were used to identify the key factors of the availability of places in kindergartens. In concrete, in this analysis, the FD estimates were utilized for interpreting the effects of district-level characteristics on the percentage of rejected kindergarten applications because FD was the preferred estimation method in most models. This enabled us to compare the effects between the models.

Together with the detection of the determinants of the percentage of rejected kindergarten applications without age distinction, additional analyses for three distinct age groups were employed to identify what district-level characteristics are associated with the availability of places in kindergartens for each of the age groups and how the determinants and their effects differ depending on children's age. The children's age indicates whether a child has a legal right to get a place in a kindergarten and whether pre-primary education is compulsory for them.

The results are somewhat heterogeneous. According to the reported estimates, the district-level average monthly real wage expressed in 2015 CZK and the share of unemployed men in the district population are the key socioeconomic predictors of meeting the demand for a place in a kindergarten when not taking children's age into account and for

the children for whom the pre-primary education is not compulsory but have a legal right to be placed in a kindergarten. The effect of these control variables is positive in both regressions. The percentage of the urban population is statistically significant for explaining the percentage of rejected applications for the children who do not have a legal right to attend a kindergarten, and for children with compulsory preschool attendance.

The effects of the number of dwellings completed per 1,000 district population and the share of inhabitants with a university degree on the share of rejected kindergarten applications were statistically insignificant in all four regressions in the main analysis. All other than socioeconomic characteristics were statistically significant for at least some age groups.

Furthermore, the Capital City of Prague, the Praha-východ district, and the Praha-západ district were excluded from the analysis to detect possible disparities between the effects. On the whole, the explanatory power of the included variables improved. The most striking result to emerge from this additional analysis was the substantially higher effect of the population density on the percentage of rejected kindergarten applications of children aged three to four years and when not taking children's age into account. Additionally, models without the net migration per 1,000 population and the percentage of children aged two to six years were estimated. Omitting the share of young children did not substantially impact the results. Contrarily, by excluding the net migration, the percentage of the urban population lost its statistical significance in most cases.

In conclusion, some district-level socioeconomic characteristics are related to the percentage of rejected applications to kindergartens. Nonetheless, there are also other predictors of the perceived shortage of places in kindergartens. Mostly, these determinants can be classified as demographic factors.

The findings from these analyses make several contributions to the current literature. First, this study appears to be the first study to examine the effect of socioeconomic characteristics on the percentage of rejected kindergarten applications in the Czech Republic. The existing literature investigates the relationship between the regional characteristics and the participation rate in pre-primary education but does not primarily reflect the perception of the shortage of places in kindergartens. Second, the setup for this research is in the Czech Republic, which is more useful for local policymaking because the education systems vary between countries. Third, in this thesis, the data on the latest pre-COVID school years were utilized.

The results presented in this thesis clearly indicate that the rejection rate of kindergarten applications is related to demographic characteristics of districts and labour market characteristics. This implies that local governments should closely monitor demographic structure in their districts – not only new births but also expected migration – to plan kindergartens. It is also important to note that labour market characteristics are closely associated with the availability of places in kindergartens. The analysis presented in this thesis does not allow us to tell in which direction the causality goes. Nonetheless, the link between the labour market and the placement of children in kindergartens is clear and it should not be overlooked by policymakers.

The scope for this study was limited in terms of the explanations behind the regression results which are rather suggestions than conclusions based on any evidence. Therefore, a natural progression of this work is to analyse the research question using microdata obtained by questionnaire survey from parents or persons in charge of the upbringing of preschool-aged children about how they perceive the shortage of places in kindergartens.

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Appendix

Table A. 1: Data sources on the independent variables

CZSO. Indexy spotřebitelských cen - inflace - časové řady. https://www.czso.cz/csu/czso/isc_cr	Basic index
CZSO. Ročenky. https://www.czso.cz/csu/czso/rocenky_souhrn	Number of foreigners Number of dwellings completed Number of inhabitants with higher education
CZSO. Školy a školská zařízení - školní rok 2010/2011. https://www.czso.cz/csu/czso/skoly-a-skolska-zarizeni-v-cr-ve-skolnim-roce-ve-skolnim-roce-20102011-jfq3quwupp	Number of kindergartens
CZSO. Školy a školská zařízení - školní rok 2020/2021. https://www.czso.cz/csu/czso/skoly-a-skolska-zarizeni-tjp3wpnyep	Number of children in kindergartens Number of classes in kindergartens Number of kindergartens (private, church, public)
CZSO. Veřejná databáze. Statistiky. https://vdb.czso.cz/vdbvo2/faces/cs/index.jsf?page=statistiky	Employment rate among men Unemployment rate among men Population density Percentage of urban population Net migration Nominal gross monthly wage Live births (number of newborn children) Distribution of the population by age Population

Table A. 2: Descriptive statistics of the differenced dependent variables

	Mean	SD	Min.	1 st Qu.	Median	3rd Qu.	Max.
Δ *Reject*	0,12	4,29	-22,62	-1,60	0,32	2,28	11,52
Δ *Reject_under*	0,71	6,37	-25,01	-2,56	0,69	4,67	23,21
Δ *Reject_legal*	-0,12	4,45	-26,96	-1,66	0,19	1,78	15,20
Δ *Reject_comp*	0,02	3,65	-13,87	-1,65	0,00	2,21	9,89

Source: CZSO, own processing

Table A. 3: Descriptive statistics of the differenced independent variables

	Mean	SD	Min.	1 st Qu.	Median	3rd Qu.	Max.
Δ *Wage*	1,05	1,79	-7,00	1,10	1,47	1,61	2,02
Δ *Unempl_men*	-1,05	0,58	-2,82	-1,29	-1,02	-0,62	-0,06
Δ *Urban*	-0,13	0,66	-3,60	-0,19	-0,12	-0,06	2,61
Δ *Uni_ratio*	0,33	0,72	-1,24	0,09	0,36	0,90	2,20
Δ *Dwellings*	0,39	0,74	-1,92	-0,02	0,28	0,73	3,18
Δ *Age_ratio*	0,03	0,12	-0,87	0,01	0,04	0,07	0,91
Δ *Foreign_ratio*	0,26	0,20	-0,10	0,12	0,21	0,35	1,01
Δ *Density*	0,73	3,51	-5,59	-0,12	0,13	0,43	28,45
Δ *Newborn*	0,12	0,51	-1,29	-0,16	0,12	0,41	1,64
Δ *Net_migr*	1,00	1,62	-3,61	-0,03	0,89	2,05	6,04

Source: CZSO, own processing

Table A. 4: Descriptive statistics of the dependent variables; without the Capital City of Prague, Praha-východ district, and Praha-západ district

	Mean	SD	Min.	1 st Qu.	Median	3rd Qu.	Max.
Reject	15,39	9,64	0,58	8,26	13,51	19,91	52,43
Reject_under	25,27	14,89	1,08	12,24	22,35	34,31	79,07
Reject_legal	9,18	7,42	0,00	4,10	6,48	12,46	43,26
Reject_comp	4,26	3,78	0,00	1,55	3,36	5,81	20,36

Source: CZSO, own processing

Table A. 5: Descriptive statistics of the independent variables; without the Capital City of Prague, Praha-východ district, and Praha-západ district

	Mean	SD	Min.	1 st Qu.	Median	3rd Qu.	Max.
Wage	27,21	2,22	23,60	25,58	27,14	28,10	35,10
Unempl_men	4,03	1,78	1,10	2,75	3,69	4,98	10,61
Urban	58,65	15,16	28,96	47,61	56,43	67,78	100,00
Uni_ratio	16,11	2,82	11,24	14,69	15,67	17,13	23,71
Dwellings	2,35	1,14	0,75	1,50	2,09	3,00	6,27
Age_ratio	5,09	0,34	4,09	4,89	5,05	5,26	6,27
Foreign_ratio	3,32	1,89	0,97	2,01	2,80	4,26	9,39
Density	162,92	228,58	36,82	74,70	110,14	146,69	1653,82
Newborn	10,22	0,70	8,48	9,75	10,20	10,63	12,10
Net_migr	1,53	3,58	-6,14	-0,98	1,01	3,17	14,53

Source: CZSO, own processing

Table A. 6: Regression results, the percentage of rejected kindergarten applications without age differentiation being the dependent variable; without the Capital City of Prague, Praha-východ district, and Praha-západ district

	Dependent variable:			
	Reject			
	FE	FE robust	**FD**	RE
Log(Wage)	14.416**	14.416	**16.014*** **	12.637**
	(5.530)	(9.681)	**(5.842)**	(5.245)
Unempl_men	1.044***	1.044**	**1.840*** **	0.793***
	(0.375)	(0.470)	**(0.662)**	(0.294)
Urban	-0.736	-0.736**	**-0.664**	-0.043
	(0.573)	(0.301)	**(0.542)**	(0.082)
Uni_ratio	0.092	0.092	**0.094**	0.396
	(0.480)	(0.424)	**(0.499)**	(0.292)
Dwellings	-0.030	-0.030	**-0.251**	-0.326
	(0.530)	(0.444)	**(0.499)**	(0.490)
Age_ratio	2.418	2.418	**0.930**	9.189***
	(3.463)	(3.381)	**(2.918)**	(2.410)
Foreign_ratio	0.652	0.652	**0.358**	-0.002
	(1.696)	(1.928)	**(2.275)**	(0.503)
Density	-0.815***	-0.815***	**-0.740** **	0.014***
	(0.256)	(0.316)	**(0.312)**	(0.005)
Newborn	0.464	0.464	**1.098***	0.533
	(0.727)	(0.727)	**(0.653)**	(0.715)
Net_migr	0.455*	0.455*	**0.509** **	0.473**
	(0.257)	(0.268)	**(0.227)**	(0.213)
Constant			**0.936**	-87.874***
			(1.154)	(22.564)
Observations	222	222	**148**	222
R^2	0.161	0.161	**0.186**	0.292
Adjusted R^2	-0.344	-0.344	**0.127**	0.258

Note: Standard errors are in parentheses. *** is significance at 1 % significance level, ** at 5 % significance level, and * at 10 % significance level. Robust stands for heteroscedasticity- and/or autocorrelation-robust standard errors. The dependent variable Reject is the percentage of rejected kindergarten applications. The control variable Log(Wage) is the natural logarithm of the real average monthly wage expressed in 2015 CZK. The preferred model is in bold.

Table A. 7: Regression results, the percentage of rejected kindergarten applications of two-year-old and younger children being the dependent variable; without the Capital City of Prague, Praha-východ district, and Praha-západ district

	Dependent variable:			
	Reject_under			
	FE	FE robust	**FD**	RE
Log(Wage)	9.662	9.662	**10.205**	9.301
	(8.952)	(11.042)	**(9.118)**	(8.189)
Unempl_men	0.351	0.351	**2.090****	0.728
	(0.607)	(0.582)	**(1.033)**	(0.455)
Urban	-1.277	-1.277***	**-1.199**	-0.118
	(0.927)	(0.453)	**(0.846)**	(0.121)
Uni_ratio	0.245	0.245	**-0.170**	0.613
	(0.777)	(0.672)	**(0.779)**	(0.440)
Dwellings	-0.371	-0.371	**0.006**	-0.525
	(0.858)	(0.749)	**(0.779)**	(0.766)
Age_ratio	4.643	4.643	**1.300**	17.922***
	(5.606)	(5.809)	**(4.555)**	(3.686)
Foreign_ratio	-0.103	-0.103	**-2.422**	0.689
	(2.746)	(2.979)	**(3.550)**	(0.744)
Density	-0.061	-0.061	**-0.007**	0.028***
	(0.414)	(0.481)	**(0.487)**	(0.008)
Newborn	0.396	0.396	**1.611**	0.690
	(1.176)	(1.365)	**(1.019)**	(1.123)
Net_migr	0.401	0.401	**0.551**	0.709**
	(0.416)	(0.434)	**(0.354)**	(0.330)
Constant			**2.372**	-116.378***
			(1.801)	(34.700)
Observations	222	222	**148**	222
R^2	0.057	0.057	**0.088**	0.379
Adjusted R^2	-0.510	-0.510	**0.022**	0.349

Note: Standard errors are in parentheses. *** is significance at 1 % significance level, ** at 5 % significance level, and * at 10 % significance level. Robust stands for heteroscedasticity- and/or autocorrelation-robust standard errors. The dependent variable Reject_under is the percentage of rejected kindergarten applications of two-year-old and younger children. The control variable Log(Wage) is the natural logarithm of the real average monthly wage expressed in 2015 CZK. The preferred model is in bold.

Table A. 8: Regression results, the percentage of rejected kindergarten applications of three-year-old and four-year-old children being the dependent variable; without the Capital City of Prague, Praha-východ district, and Praha-západ district

	Dependent variable:				
	Reject_legal				
	FE	FE robust	FD	**FD robust**	RE
Log(Wage)	16.376***	16.376	21.553***	**21.553***	13.062***
	(5.392)	(10.256)	(5.921)	**(11.196)**	(5.047)
Unempl_men	1.456***	1.456***	1.539**	**1.539****	0.902***
	(0.366)	(0.504)	(0.671)	**(0.719)**	(0.276)
Urban	-0.311	-0.311	-0.211	**-0.211**	-0.003
	(0.558)	(0.249)	(0.549)	**(0.237)**	(0.069)
Uni_ratio	-0.204	-0.204	0.108	**0.108**	0.202
	(0.468)	(0.465)	(0.506)	**(0.434)**	(0.258)
Dwellings	0.537	0.537	-0.093	**-0.093**	0.225
	(0.516)	(0.484)	(0.506)	**(0.580)**	(0.473)
Age_ratio	-0.107	-0.107	-0.434	**-0.434**	5.784***
	(3.377)	(2.300)	(2.958)	**(1.249)**	(2.217)
Foreign_ratio	1.988	1.988	3.409	**3.409**	-0.013
	(1.654)	(1.924)	(2.306)	**(2.294)**	(0.428)
Density	-1.145***	-1.145**	-1.031***	**-1.031****	0.009**
	(0.249)	(0.461)	(0.316)	**(0.402)**	(0.004)
Newborn	-0.030	-0.030	0.269	**0.269**	-0.035
	(0.708)	(0.617)	(0.662)	**(0.586)**	(0.698)
Net_migr	0.470*	0.470*	0.505**	**0.505***	0.450**
	(0.251)	(0.263)	(0.230)	**(0.275)**	(0.201)
Constant			-0.371	**-0.371**	-72.343***
			(1.170)	**(1.425)**	(21.009)
Observations	222	222	148	**148**	222
R^2	0.223	0.223	0.218	**0.218**	0.239
Adjusted R^2	-0.244	-0.244	0.161	**0.161**	0.203

Note: Standard errors are in parentheses. *** is significance at 1 % significance level, ** at 5 % significance level, and * at 10 % significance level. Robust stands for heteroscedasticity- and/or autocorrelation-robust standard errors. The dependent variable Reject_legal is the percentage of rejected kindergarten applications of children aged three to four years. The control variable Log(Wage) is the natural logarithm of the real average monthly wage expressed in 2015 CZK. The preferred model is in bold.

Table A. 9: Regression results, the percentage of rejected kindergarten applications of five-year-old and older children being the dependent variable; without the Capital City of Prague, Praha-východ district, and Praha-západ district

	Dependent variable:				
	Reject_comp				
	FE	FE robust	FD	**FD robust**	RE
Log(Wage)	14.937***	14.937*	10.823**	**10.823**	11.023***
	(4.419)	(8.748)	(5.274)	**(12.650)**	(3.464)
Unempl_men	0.204	0.204	0.433	**0.433**	0.128
	(0.300)	(0.362)	(0.598)	**(0.602)**	(0.167)
Urban	-0.494	-0.494***	-0.606	**-0.606*** **	-0.034
	(0.458)	(0.157)	(0.489)	**(0.200)**	(0.031)
Uni_ratio	-0.123	-0.123	-0.252	**-0.252**	-0.034
	(0.384)	(0.310)	(0.450)	**(0.369)**	(0.130)
Dwellings	-0.416	-0.416	-0.339	**-0.339**	-0.084
	(0.423)	(0.342)	(0.451)	**(0.464)**	(0.320)
Age_ratio	2.872	2.872*	2.788	**2.788** **	3.256**
	(2.767)	(1.711)	(2.635)	**(1.182)**	(1.357)
Foreign_ratio	-2.587*	-2.587***	-3.534*	**-3.534*** **	0.046
	(1.356)	(0.983)	(2.054)	**(1.368)**	(0.199)
Density	0.139	0.139	0.193	**0.193**	0.006***
	(0.204)	(0.199)	(0.281)	**(0.218)**	(0.002)
Newborn	0.600	0.600	0.900	**0.900**	0.489
	(0.581)	(0.638)	(0.590)	**(0.765)**	(0.510)
Net_migr	0.145	0.145	0.275	**0.275**	-0.017
	(0.205)	(0.197)	(0.205)	**(0.239)**	(0.126)
Constant			0.508	**0.508**	-52.673***
			(1.042)	**(1.070)**	(13.302)
Observations	222	222	148	**148**	222
R^2	0.144	0.144	0.103	**0.103**	0.257
Adjusted R^2	-0.371	-0.371	0.037	**0.037**	0.221

Note: Standard errors are in parentheses. *** is significance at 1 % significance level, ** at 5 % significance level, and * at 10 % significance level. Robust stands for heteroscedasticity- and/or autocorrelation-robust standard errors. The dependent variable Reject_comp is the percentage of rejected kindergarten applications of children aged five and more years. The control variable Log(Wage) is the natural logarithm of the real average monthly wage expressed in 2015 CZK. The preferred model is in bold.

Table A. 10: Regression results, the percentage of rejected kindergarten applications without age differentiation being the dependent variable; without the net migration per 1,000 population

	Dependent variable:			
	Reject			
	FE	FE robust	FD	**RE**
Log(Wage)	15.115***	15.115	17.688***	**12.607****
	(5.557)	(10.773)	(5.874)	**(5.255)**
Unempl_men	0.757**	0.757*	1.429**	**0.646****
	(0.366)	(0.439)	(0.649)	**(0.291)**
Urban	-0.683	-0.683**	-0.480	**-0.005**
	(0.552)	(0.280)	(0.512)	**(0.079)**
Uni_ratio	0.519	0.519	0.432	**0.303**
	(0.462)	(0.446)	(0.483)	**(0.287)**
Dwellings	-0.161	-0.161	-0.224	**0.154**
	(0.496)	(0.412)	(0.479)	**(0.440)**
Age_ratio	3.403	3.403	2.299	**9.678*****
	(3.362)	(3.146)	(2.858)	**(1.909)**
Foreign_ratio	0.198	0.198	1.019	**-0.108**
	(1.384)	(1.626)	(1.986)	**(0.447)**
Density	-0.219**	-0.219	-0.238**	**0.006**
	(0.084)	(0.134)	(0.105)	**(0.004)**
Newborn	0.517	0.517	1.231*	**0.787**
	(0.735)	(0.738)	(0.656)	**(0.715)**
Constant			0.477	**-92.019*****
			(1.127)	**(22.095)**
Observations	231	231	154	**231**
R^2	0.122	0.122	0.152	**0.292**
Adjusted R^2	-0.393	-0.393	0.099	**0.263**

Note: Standard errors are in parentheses. *** is significance at 1 % significance level, ** at 5 % significance level, and * at 10 % significance level. Robust stands for heteroscedasticity- and/or autocorrelation-robust standard errors. The dependent variable Reject is the percentage of rejected kindergarten applications. The control variable Log(Wage) is the natural logarithm of the real average monthly wage expressed in 2015 CZK. The preferred model is in bold.

Table A. 11: Regression results, the percentage of rejected kindergarten applications of two-year-old and younger children being the dependent variable; without the net migration per 1,000 population

	Dependent variable:				
	Reject_under				
	FE	FE robust	FD	**FD robust**	RE
Log(Wage)	8.402	8.402	10.885	**10.885**	9.313
	(8.839)	(11.095)	(9.085)	**(12.614)**	(8.217)
Unempl_men	0.249	0.249	1.589	**1.589***	0.494
	(0.582)	(0.535)	(1.004)	**(0.891)**	(0.454)
Urban	-1.342	-1.342**	-1.162	**-1.162****	-0.031
	(0.878)	(0.542)	(0.793)	**(0.480)**	(0.121)
Uni_ratio	0.332	0.332	-0.006	**-0.006**	0.444
	(0.735)	(0.686)	(0.747)	**(0.576)**	(0.443)
Dwellings	-0.150	-0.150	0.195	**0.195**	0.299
	(0.788)	(0.622)	(0.740)	**(0.563)**	(0.688)
Age_ratio	6.337	6.337	3.396	**3.396**	18.124***
	(5.347)	(6.373)	(4.420)	**(3.915)**	(2.953)
Foreign_ratio	0.370	0.370	-0.121	**-0.121**	0.400
	(2.201)	(2.302)	(3.072)	**(2.634)**	(0.684)
Density	-0.073	-0.073	-0.074	**-0.074**	0.013*
	(0.134)	(0.102)	(0.162)	**(0.088)**	(0.007)
Newborn	0.509	0.509	1.798*	**1.798***	1.135
	(1.169)	(1.365)	(1.015)	**(1.026)**	(1.121)
Constant			1.472	**1.472**	-121.220***
			(1.743)	**(1.794)**	(34.345)
Observations	231	231	154	**154**	231
R^2	0.056	0.056	0.077	**0.077**	0.378
Adjusted R^2	-0.498	-0.498	0.020	**0.020**	0.353

Note: Standard errors are in parentheses. *** is significance at 1 % significance level, ** at 5 % significance level, and * at 10 % significance level. Robust stands for heteroscedasticity- and/or autocorrelation-robust standard errors. The dependent variable Reject_under is the percentage of rejected kindergarten applications of two-year-old and younger children. The control variable Log(Wage) is the natural logarithm of the real average monthly wage expressed in 2015 CZK. The preferred model is in bold.

Table A. 12: Regression results, the percentage of rejected kindergarten applications of three-year-old and four-year-old children being the dependent variable; without the net migration per 1,000 population

	Dependent variable:			
	Reject_legal			
	FE	FE robust	**FD**	RE
Log(Wage)	17.409***	17.409	**23.661*** **	12.617**
	(5.587)	(11.980)	**(6.003)**	(5.097)
Unempl_men	1.126***	1.126**	**1.094**	0.777***
	(0.368)	(0.452)	**(0.663)**	(0.272)
Urban	-0.383	-0.383	**-0.058**	-0.003
	(0.555)	(0.237)	**(0.524)**	(0.063)
Uni_ratio	0.324	0.324	**0.492**	0.106
	(0.465)	(0.597)	**(0.493)**	(0.246)
Dwellings	0.034	0.034	**-0.212**	0.505
	(0.498)	(0.517)	**(0.489)**	(0.426)
Age_ratio	1.832	1.832	**1.200**	8.196***
	(3.380)	(2.823)	**(2.920)**	(1.692)
Foreign_ratio	1.394	1.394	**3.916***	0.108
	(1.391)	(1.888)	**(2.029)**	(0.362)
Density	-0.302***	-0.302	**-0.340*** **	0.005
	(0.085)	(0.187)	**(0.107)**	(0.004)
Newborn	-0.006	-0.006	**0.413**	0.067
	(0.739)	(0.625)	**(0.671)**	(0.706)
Constant			**-0.864**	-81.936***
			(1.151)	(20.433)
Observations	231	231	**154**	231
R^2	0.149	0.149	**0.176**	0.303
Adjusted R^2	-0.350	-0.350	**0.124**	0.274

Note: Standard errors are in parentheses. *** is significance at 1 % significance level, ** at 5 % significance level, and * at 10 % significance level. Robust stands for heteroscedasticity- and/or autocorrelation-robust standard errors. The dependent variable Reject_legal is the percentage of rejected kindergarten applications of children aged three to four years. The control variable Log(Wage) is the natural logarithm of the real average monthly wage expressed in 2015 CZK. The preferred model is in bold.

Table A. 13: Regression results, the percentage of rejected kindergarten applications of five-year-old and older children being the dependent variable; without the net migration per 1,000 population

	Dependent variable:				
	Reject_comp				
	FE	FE robust	FD	**FD robust**	RE
Log(Wage)	15.611***	15.611*	11.037**	**11.037**	11.822***
	(4.325)	(8.764)	(5.191)	**(12.817)**	(3.443)
Unempl_men	0.213	0.213	0.492	**0.492**	0.215
	(0.285)	(0.340)	(0.574)	**(0.563)**	(0.167)
Urban	-0.227	-0.227	-0.279	**-0.279**	0.001
	(0.430)	(0.208)	(0.453)	**(0.229)**	(0.031)
Uni_ratio	-0.106	-0.106	-0.219	**-0.219**	-0.150
	(0.360)	(0.314)	(0.427)	**(0.359)**	(0.130)
Dwellings	-0.099	-0.099	-0.128	**-0.128**	0.207
	(0.386)	(0.358)	(0.423)	**(0.442)**	(0.286)
Age_ratio	1.754	1.754	2.436	**2.436****	2.175**
	(2.616)	(1.844)	(2.526)	**(1.217)**	(1.011)
Foreign_ratio	-2.089*	-2.089**	-2.589	**-2.589***	-0.221
	(1.077)	(0.891)	(1.755)	**(1.361)**	(0.180)
Density	0.011	0.011	0.027	**0.027**	0.003
	(0.066)	(0.059)	(0.092)	**(0.075)**	(0.002)
Newborn	0.599	0.599	0.873	**0.873**	0.769
	(0.572)	(0.636)	(0.580)	**(0.750)**	(0.495)
Constant			0.640	**0.640**	-52.480***
			(0.996)	**(1.073)**	(12.922)
Observations	231	231	154	**154**	231
R^2	0.130	0.130	0.082	**0.082**	0.221
Adjusted R^2	-0.380	-0.380	0.025	**0.025**	0.189

Note: Standard errors are in parentheses. *** is significance at 1 % significance level, ** at 5 % significance level, and * at 10 % significance level. Robust stands for heteroscedasticity- and/or autocorrelation-robust standard errors. The dependent variable Reject_comp is the percentage of rejected kindergarten applications of children aged five and more years. The control variable Log(Wage) is the natural logarithm of the real average monthly wage expressed in 2015 CZK. The preferred model is in bold.

Table A. 14: Regression results, the percentage of rejected kindergarten applications without age differentiation being the dependent variable; without the percentage of children aged two to six years in the district population

	Dependent variable:			
	Reject			
	FE	FE robust	**FD**	RE
Log(Wage)	14.635***	14.635	**16.753*** **	11.474**
	(5.545)	(10.396)	**(5.814)**	(5.391)
Unempl_men	0.735**	0.735*	**1.609** **	0.861***
	(0.361)	(0.427)	**(0.637)**	(0.302)
Urban	-0.824	-0.824***	**-0.687**	-0.019
	(0.553)	(0.291)	**(0.514)**	(0.081)
Uni_ratio	0.374	0.374	**0.276**	0.136
	(0.463)	(0.432)	**(0.474)**	(0.296)
Dwellings	-0.192	-0.192	**-0.275**	0.170
	(0.494)	(0.433)	**(0.473)**	(0.463)
Foreign_ratio	-0.971	-0.971	**-0.749**	-0.519
	(1.583)	(1.925)	**(2.127)**	(0.501)
Density	-0.198**	-0.198	**-0.213** **	0.009**
	(0.086)	(0.146)	**(0.104)**	(0.004)
Newborn	0.666	0.666	**1.251***	1.934***
	(0.725)	(0.719)	**(0.648)**	(0.672)
Net_migr	0.404	0.404	**0.468** **	0.756***
	(0.258)	(0.256)	**(0.224)**	(0.204)
Constant			**0.793**	-48.105**
			(1.089)	(21.495)
Observations	231	231	**154**	231
R^2	0.131	0.131	**0.173**	0.255
Adjusted R^2	-0.379	-0.379	**0.121**	0.225

Note: Standard errors are in parentheses. *** is significance at 1 % significance level, ** at 5 % significance level, and * at 10 % significance level. Robust stands for heteroscedasticity- and/or autocorrelation-robust standard errors. The dependent variable Reject is the percentage of rejected kindergarten applications. The control variable Log(Wage) is the natural logarithm of the real average monthly wage expressed in 2015 CZK. The preferred model is in bold.

Table A. 15: Regression results, the percentage of rejected kindergarten applications of two-year-old and younger children being the dependent variable; without the percentage of children aged two to six years in the district population

	Dependent variable:				
	Reject_under				
	FE	FE robust	FD	**FD robust**	RE
Log(Wage)	8.221	8.221	9.761	**9.761**	7.245
	(8.878)	(10.877)	(9.048)	**(11.656)**	(8.634)
Unempl_men	0.176	0.176	1.824*	**1.824****	0.871*
	(0.577)	(0.516)	(0.991)	**(0.877)**	(0.481)
Urban	-1.508*	-1.508***	-1.411*	**-1.411*****	-0.066
	(0.885)	(0.559)	(0.800)	**(0.510)**	(0.126)
Uni_ratio	0.155	0.155	-0.206	**-0.206**	0.170
	(0.741)	(0.682)	(0.737)	**(0.548)**	(0.464)
Dwellings	-0.151	-0.151	0.132	**0.132**	0.501
	(0.791)	(0.624)	(0.736)	**(0.581)**	(0.742)
Foreign_ratio	-0.688	-0.688	-2.223	**-2.223**	-0.185
	(2.535)	(2.850)	(3.310)	**(2.925)**	(0.778)
Density	-0.059	-0.059	-0.047	**-0.047**	0.017**
	(0.137)	(0.121)	(0.162)	**(0.104)**	(0.007)
Newborn	0.743	0.743	1.825*	**1.825***	3.469***
	(1.161)	(1.340)	(1.008)	**(1.005)**	(1.074)
Net_migr	0.384	0.384	0.552	**0.552**	1.260***
	(0.414)	(0.425)	(0.349)	**(0.432)**	(0.324)
Constant			1.900	**1.900**	-41.786
			(1.695)	**(1.662)**	(34.254)
Observations	231	231	154	**154**	231
R^2	0.052	0.052	0.089	**0.089**	0.322
Adjusted R^2	-0.504	-0.504	0.032	**0.032**	0.294

Note: Standard errors are in parentheses. *** is significance at 1 % significance level, ** at 5 % significance level, and * at 10 % significance level. Robust stands for heteroscedasticity- and/or autocorrelation-robust standard errors. The dependent variable Reject_under is the percentage of rejected kindergarten applications of two-year-old and younger children. The control variable Log(Wage) is the natural logarithm of the real average monthly wage expressed in 2015 CZK. The preferred model is in bold.

Table A. 16: Regression results, the percentage of rejected kindergarten applications of three-year-old and four-year-old children being the dependent variable; without the percentage of children aged two to six years in the district population

	Dependent variable:			
	Reject_legal			
	FE	FE robust	**FD**	RE
Log(Wage)	16.828***	16.828	**22.815*** **	10.984**
	(5.565)	(11.555)	**(5.947)**	(5.177)
Unempl_men	1.130***	1.130**	**1.233***	1.013***
	(0.362)	(0.443)	**(0.652)**	(0.280)
Urban	-0.504	-0.504**	**-0.247**	0.001
	(0.555)	(0.254)	**(0.526)**	(0.066)
Uni_ratio	0.204	0.204	**0.371**	0.003
	(0.464)	(0.581)	**(0.484)**	(0.253)
Dwellings	-0.009	-0.009	**-0.258**	0.483
	(0.496)	(0.542)	**(0.484)**	(0.445)
Foreign_ratio	0.259	0.259	**2.285**	-0.270
	(1.589)	(2.142)	**(2.176)**	(0.407)
Density	-0.280***	-0.280	**-0.315*** **	0.006*
	(0.086)	(0.194)	**(0.106)**	(0.004)
Newborn	0.095	0.095	**0.428**	1.225*
	(0.728)	(0.628)	**(0.663)**	(0.637)
Net_migr	0.384	0.384*	**0.436***	0.733***
	(0.259)	(0.233)	**(0.229)**	(0.187)
Constant			**-0.648**	-46.097**
			(1.114)	(20.090)
Observations	231	231	**154**	231
R^2	0.160	0.160	**0.195**	0.275
Adjusted R^2	-0.332	-0.332	**0.145**	0.245

Note: Standard errors are in parentheses. *** is significance at 1 % significance level, ** at 5 % significance level, and * at 10 % significance level. Robust stands for heteroscedasticity- and/or autocorrelation-robust standard errors. The dependent variable Reject_legal is the percentage of rejected kindergarten applications of children aged three to four years. The control variable Log(Wage) is the natural logarithm of the real average monthly wage expressed in 2015 CZK. The preferred model is in bold.

Table A. 17: Regression results, the percentage of rejected kindergarten applications of five-year-old and older children being the dependent variable; without the percentage of children aged two to six years in the district population

	Dependent variable:				
	Reject_comp				
	FE	FE robust	FD	**FD robust**	RE
Log(Wage)	15.419***	15.419*	10.394**	**10.394**	11.149***
	(4.331)	(8.660)	(5.178)	**(12.503)**	(3.490)
Unempl_men	0.199	0.199	0.640	**0.640**	0.269
	(0.282)	(0.343)	(0.567)	**(0.547)**	(0.170)
Urban	-0.292	-0.292	-0.421	**-0.421***	-0.0003
	(0.432)	(0.204)	(0.458)	**(0.236)**	(0.032)
Uni_ratio	-0.174	-0.174	-0.344	**-0.344**	-0.159
	(0.361)	(0.319)	(0.422)	**(0.370)**	(0.131)
Dwellings	-0.110	-0.110	-0.164	**-0.164**	0.327
	(0.386)	(0.344)	(0.421)	**(0.426)**	(0.298)
Foreign_ratio	-2.606**	-2.606***	-3.772**	**-3.772*** **	-0.238
	(1.237)	(0.917)	(1.894)	**(1.269)**	(0.198)
Density	0.020	0.020	0.040	**0.040**	0.003
	(0.067)	(0.053)	(0.093)	**(0.060)**	(0.002)
Newborn	0.673	0.673	0.891	**0.891**	1.304***
	(0.566)	(0.634)	(0.577)	**(0.751)**	(0.412)
Net_migr	0.180	0.180	0.308	**0.308**	0.112
	(0.202)	(0.191)	(0.200)	**(0.231)**	(0.113)
Constant			0.923	**0.923**	-45.013***
			(0.970)	**(1.053)**	(12.993)
Observations	231	231	154	**154**	231
R^2	0.132	0.132	0.091	**0.091**	0.207
Adjusted R^2	-0.376	-0.376	0.035	**0.035**	0.175

Note: Standard errors are in parentheses. *** is significance at 1 % significance level, ** at 5 % significance level, and * at 10 % significance level. Robust stands for heteroscedasticity- and/or autocorrelation-robust standard errors. The dependent variable Reject_comp is the percentage of rejected kindergarten applications of children aged five and more years. The control variable Log(Wage) is the natural logarithm of the real average monthly wage expressed in 2015 CZK. The preferred model is in bold.

Table A. 18: Regression results, the percentage of rejected kindergarten applications without age differentiation being the dependent variable; without the percentage of children aged two to six years in the district population and the net migration per 1,000 population

	Dependent variable:			
	Reject			
	FE	FE robust	**FD**	RE
Log(Wage)	15.417***	15.417	**17.624*** **	12.431**
	(5.550)	(10.731)	**(5.866)**	(5.536)
Unempl_men	0.698*	0.698	**1.501** **	0.683**
	(0.362)	(0.432)	**(0.642)**	(0.307)
Urban	-0.717	-0.717**	**-0.491**	-0.078
	(0.551)	(0.288)	**(0.512)**	(0.082)
Uni_ratio	0.476	0.476	**0.374**	0.246
	(0.460)	(0.440)	**(0.477)**	(0.302)
Dwellings	-0.129	-0.129	**-0.229**	0.799*
	(0.495)	(0.406)	**(0.478)**	(0.443)
Foreign_ratio	0.255	0.255	**0.974**	0.280
	(1.383)	(1.613)	**(1.983)**	(0.464)
Density	-0.225***	-0.225	**-0.244** **	0.007
	(0.084)	(0.139)	**(0.104)**	(0.005)
Newborn	0.617	0.617	**1.241***	2.318***
	(0.728)	(0.731)	**(0.655)**	(0.683)
Constant			**0.667**	-55.388**
			(1.100)	(22.008)
Observations	231	231	**154**	231
R^2	0.116	0.116	**0.148**	0.209
Adjusted R^2	-0.393	-0.393	**0.101**	0.180

Note: Standard errors are in parentheses. *** is significance at 1 % significance level, ** at 5 % significance level, and * at 10 % significance level. Robust stands for heteroscedasticity- and/or autocorrelation-robust standard errors. The dependent variable Reject is the percentage of rejected kindergarten applications. The control variable Log(Wage) is the natural logarithm of the real average monthly wage expressed in 2015 CZK. The preferred model is in bold.

Table A. 19: Regression results, the percentage of rejected kindergarten applications of two-year-old and younger children being the dependent variable; without the percentage of children aged two to six years in the district population and the net migration per 1,000 population

	Dependent variable:			
	Reject_under			
	FE	FE robust	**FD**	RE
Log(Wage)	8.965	8.965	**10.790**	8.871
	(8.838)	(11.049)	**(9.072)**	(8.838)
Unempl_men	0.140	0.140	**1.696***	0.567
	(0.576)	(0.515)	**(0.993)**	(0.489)
Urban	-1.406	-1.406**	**-1.179**	-0.167
	(0.878)	(0.553)	**(0.791)**	(0.129)
Uni_ratio	0.253	0.253	**-0.091**	0.340
	(0.733)	(0.678)	**(0.737)**	(0.479)
Dwellings	-0.091	-0.091	**0.188**	1.519**
	(0.788)	(0.602)	**(0.739)**	(0.707)
Foreign_ratio	0.476	0.476	**-0.188**	1.129
	(2.202)	(2.281)	**(3.066)**	(0.732)
Density	-0.085	-0.085	**-0.083**	0.015**
	(0.134)	(0.109)	**(0.161)**	(0.007)
Newborn	0.696	0.696	**1.814***	4.045***
	(1.159)	(1.354)	**(1.013)**	(1.089)
Constant			**1.752**	-52.805
			(1.702)	(35.058)
Observations	231	231	**154**	231
R^2	0.046	0.046	**0.074**	0.268
Adjusted R^2	-0.502	-0.502	**0.022**	0.241

Note: Standard errors are in parentheses. *** is significance at 1 % significance level, ** at 5 % significance level, and * at 10 % significance level. Robust stands for heteroscedasticity- and/or autocorrelation-robust standard errors. The dependent variable Reject_under is the percentage of rejected kindergarten applications of two-year-old and younger children. The control variable Log(Wage) is the natural logarithm of the real average monthly wage expressed in 2015 CZK. The preferred model is in bold.

Table A. 20: Regression results, the percentage of rejected kindergarten applications of three-year-old and four-year-old children being the dependent variable; without the percentage of children aged two to six years in the district population and the net migration per 1,000 population

	Dependent variable:			
	Reject_legal			
	FE	FE robust	**FD**	RE
Log(Wage)	17.571***	17.571	**23.628*** **	12.198**
	(5.565)	(11.930)	**(5.985)**	(5.326)
Unempl_men	1.095***	1.095**	**1.132***	0.852***
	(0.363)	(0.447)	**(0.655)**	(0.285)
Urban	-0.402	-0.402	**-0.064**	-0.056
	(0.553)	(0.254)	**(0.522)**	(0.067)
Uni_ratio	0.301	0.301	**0.462**	0.065
	(0.462)	(0.590)	**(0.486)**	(0.261)
Dwellings	0.051	0.051	**-0.215**	1.192***
	(0.496)	(0.514)	**(0.488)**	(0.419)
Foreign_ratio	1.424	1.424	**3.892***	0.423
	(1.387)	(1.884)	**(2.023)**	(0.380)
Density	-0.306***	-0.306	**-0.344*** **	0.005
	(0.084)	(0.190)	**(0.106)**	(0.004)
Newborn	0.048	0.048	**0.419**	1.717***
	(0.730)	(0.630)	**(0.668)**	(0.643)
Constant			**-0.765**	-54.676***
			(1.123)	(20.598)
Observations	231	231	**154**	231
R^2	0.147	0.147	**0.175**	0.222
Adjusted R^2	-0.343	-0.343	**0.129**	0.194

Note: Standard errors are in parentheses. *** is significance at 1 % significance level, ** at 5 % significance level, and * at 10 % significance level. Robust stands for heteroscedasticity- and/or autocorrelation-robust standard errors. The dependent variable Reject_legal is the percentage of rejected kindergarten applications of children aged three to four years. The control variable Log(Wage) is the natural logarithm of the real average monthly wage expressed in 2015 CZK. The preferred model is in bold.

Table A. 21: Regression results, the percentage of rejected kindergarten applications of five-year-old and older children being the dependent variable; without the percentage of children aged two to six years in the district population and the net migration per 1,000 population

	Dependent variable:				
	Reject_comp				
	FE	FE robust	FD	**FD robust**	RE
Log(Wage)	15.767***	15.767*	10.968**	**10.968**	11.520***
	(4.310)	(8.751)	(5.189)	**(12.773)**	(3.468)
Unempl_men	0.183	0.183	0.568	**0.568**	0.247
	(0.281)	(0.341)	(0.568)	**(0.534)**	(0.168)
Urban	-0.245	-0.245	-0.292	**-0.292**	-0.008
	(0.428)	(0.200)	(0.453)	**(0.223)**	(0.031)
Uni_ratio	-0.128	-0.128	-0.280	**-0.280**	-0.163
	(0.358)	(0.314)	(0.422)	**(0.364)**	(0.131)
Dwellings	-0.082	-0.082	-0.133	**-0.133**	0.473*
	(0.384)	(0.341)	(0.423)	**(0.439)**	(0.260)
Foreign_ratio	-2.059*	-2.059**	-2.637	**-2.637****	-0.154
	(1.074)	(0.875)	(1.754)	**(1.295)**	(0.179)
Density	0.007	0.007	0.020	**0.020**	0.003
	(0.065)	(0.055)	(0.092)	**(0.067)**	(0.002)
Newborn	0.651	0.651	0.884	**0.884**	1.420***
	(0.565)	(0.632)	(0.580)	**(0.744)**	(0.395)
Constant			0.840	**0.840**	-47.215***
			(0.973)	**(1.055)**	(12.793)
Observations	231	231	154	**154**	231
R^2	0.127	0.127	0.076	**0.076**	0.204
Adjusted R^2	-0.375	-0.375	0.025	**0.025**	0.175

Note: Standard errors are in parentheses. *** is significance at 1 % significance level, ** at 5 % significance level, and * at 10 % significance level. Robust stands for heteroscedasticity- and/or autocorrelation-robust standard errors. The dependent variable Reject_comp is the percentage of rejected kindergarten applications of children aged five and more years. The control variable Log(Wage) is the natural logarithm of the real average monthly wage expressed in 2015 CZK. The preferred model is in bold.