Institute of Education

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Working Paper No. 16-13
October 2016

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School Hours and Maternal Labour Supply: A Natural Experiment from Germany

Nikki Shure[1]

Abstract

This paper examines the recent German reform to increase primary school hours and the effect this has had on maternal labour supply. The introduction of *Ganztagsschulen*, or full day schools, has been one of the largest and most expensive reforms in the German education landscape over the past 15 years, but with little evaluation. While the impetus for the reform came from improving pupils' learning outcomes, it was also motivated by a desire to increase maternal labour supply, which had been traditionally low in Germany as compared to other countries. I exploit the quasi-experimental nature of reform to assess whether or not gaining access to a full day school increases the likelihood that mothers enter into the labor market or extend their working hours if already employed. I use the German Socio-Economic Panel data set (GSOEP) and link it to a school-level data set with geographical information software (GIS). Using a flexible difference-in-difference approach in my estimation of linear probability and logit models, I find that the policy has a statistically significant effect of approximately five percentage points at the extensive margin, drawing more women into the labor market. I find no significant impact of the policy at the intensive margin; women who were already working do not extend their hours and in some cases even shorten them. These results are robust to a variety of checks and comparable to previous findings in the literature on childcare and maternal labor supply. This is one of the few papers, however, to look at the relationship between primary school and maternal labor supply at the level of treatment.

JEL codes: J22, I28, J16

Keywords: Time Allocation and Labor Supply, Education: Government Policy, Economics of Gender.

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Acknowledgements: I would like to thank seminar participants at the University of Oxford, UCL Institute of Education, 2014 International Workshop on Applied Education Economics, and IZA. Brian Bell, Margaret Stevens, Patricia Rice, Sandra McNally, Nick Papageorge, Alex Bryson, Damian Clarke, Federico Torrachi, and Tunde Buraimo provided helpful comments and advice. Thank you to the German Institute of Economic Research for hosting me and especially Jan Goebel for the help in linking my data to the GSOEP. This research was undertaken with the help of a 2014 Santander Travel Grant.

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1 Introduction

The linkage between childcare and female labor supply has received much attention in labor economics and public policy. It has been shown that the costs of childcare affect how women determine their labor force participation and hours worked. As the primary carers of children, women often exit the labor market after having children and only re-enter if childcare becomes available and affordable.[1] When preschool childcare is expensive or limited in supply, primary school may be the first opportunity for families to utilize ``free'' childcare. For many mothers, however, the fact that the length of the primary school day does not correspond to the length of the working day makes combining work and family difficult. This paper examines how extending the length of the primary school day affects maternal labor supply.

I exploit the quasi-experimental nature of the *Ganztagsschulreform*, full day school reform, in Germany and ask whether it caused mothers to enter the labor market if they were not working before or extend their working hours if they were already working. Using the slow and staggered nature of the reform, I am able to exogenously assign treatment, access to a full day school, to women and explore how this impacted their labor market status by estimating an intention to treat (ITT) effect. I find that women who were not working before they gain access to a full day school are nearly five percentage points more likely to enter the labor market once they gain access, but that for women already working, there is no statistically significant effect on the hours they work. This result may be explained by the income and substitution effects underpinning a basic model of labor supply. For mothers previously not working, the implicit childcare subsidy provided by the full day school makes a new portion of their budget constraint available and preferable to not working. For mothers already working, the implicit childcare subsidy has an ambiguous effect, which may cause them to substitute away from labor and towards leisure by decreasing their hours worked.

This identification strategy is stronger than previous research on childcare and maternal labor supply. I am able to measure treatment at the level of the closest primary school unlike previous research which uses regional and time variation in the introduction of implicit childcare subsidies. It is also preferable to previous work in the German context, which has used survey questions on whether or not children attend a full day school, and is thereby unable to disentangle the simultaneous childcare and labor market participation decisions. This is because the extension of the primary school day is still opt-in in many schools in Germany.[2]

Most of the existing evidence on childcare and maternal labor supply comes from studies that focus on

[1] This simplifies the decision to re-enter the labor market, ignoring the implicit costs associated with employment such as the penalty many women may pay for having taken time off for maternity leave.

[2] This is the difference between an *offene* or ``open'' full day school and a *gebundene* ``bound'' full day school. See the Appendix for further discussion on this distinction.

the early years of a child's life. This paper also contributes to the literature by focusing on the length of the primary school day, something which is a source of debate in many countries. In Germany, this debate centered on improving education outcomes, based on the idea that learning is a function of the number of hours spent in the classroom.[3] Impetus to speed up this reform came from the 2001 ``PISA Shock,'' the public reverberation of Germany's rather poor performance on the first Programme for International Student Assessment (PISA) tests administered in 2000.

The other major reason for tackling the issue of school hours, however, was to increase the labor market participation of mothers. Policy makers in many countries continue to weigh the merits of extending the school day to the length of the working day. It is important to note that this was not how the reform was undertaken in Germany. Before the reform, a typical German school day, began around 8am and ended at approximately 1pm. After the reform, the school day now ends at approximately 3pm (Stecher et al. 2008). A priori we might assume that an increase in the length of the school week by approximately ten hours would not be enough to see a dramatic effect. Many jobs are structured on a part time (perhaps 20 hours per week) or full time basis (35-40 hours per week). A woman already working part time might not be able to increase her hours worked per week due to contractual rigidities. For a mother not working, however, this extension of the school day might be enough to induce her into part time employment. The design of the reform may in part be driving the results found in this paper: change at the extensive margin and no change at the intensive margin. This evidence can inform policy debates on proposals to extend the primary school day by smaller increments, which do not coincide with the length of the working day or week.

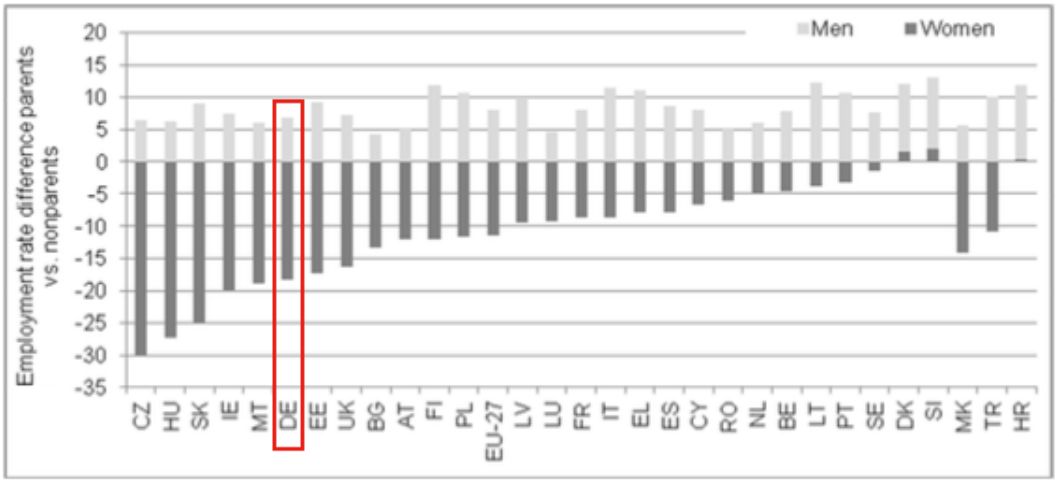


Figure 1: Employment rate differential with and without children under 12, men and women aged 25-49 in 2010

Source: Miani and Hoorens (2014)

[3]This has also been the reasoning in Chicago, where Mayor Rahm Emanuel has unsuccessfully proposed extending the primary school day to 7.5 hours (Neufeld, 2014). See Lavy (2015) for an overview of the literature linking learning time to educational outcomes.

Germany stands out as an industrialized country with low labor market participation of mothers.[4] Apart from the cultural tradition of the nuclear family model with male breadwinner, limited and expensive childcare options have made combining work and family life difficult.[5] In German there is even a pejorative term used to describe mothers who ``neglect'' their children, even as a result of working: *Rabenmutter*.[6] Geyer and Steiner (2007) show that mothers in Germany have longer term negative effects of having children on their employment than mothers in other EU countries. Figure 1 shows the pronounced difference between women with children under the age of 12 and those without; mothers with children under the age of 12 in Germany are nearly 20 percentage points less likely to be employed. This is larger than the average across EU member states (10 percentage points difference). EU Labor Force Survey statistics presented in Figure 2 show that the majority of mothers who work in Germany work part time, which is similar to mothers in the Netherlands, United Kingdom, and Austria. Taken together this shows that not only are mothers in Germany less likely to participate in the labor market, but that if they do participate, it is likely to be on a part time basis.

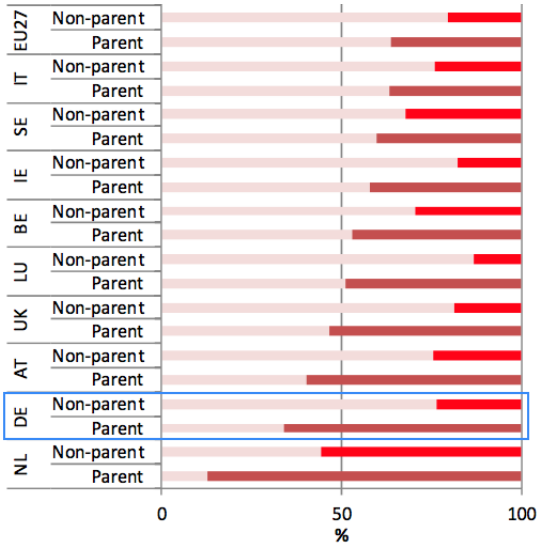


Figure 2: Proportion of female parents and non-parents employed part time and full time, aged 20-49

Source: Miani and Hoorens (2014)

As a result of this and other factors, overall female employment in Germany was considerably lower than in European Union and partner countries at the beginning of the period of the full day school reform. Figure 3 shows how Germany's female employment ratio for women aged 15-64 compares to the Nordic countries, the Netherlands, France, the United Kingdom, and the United States in 2000 and in 2012.[7] In 2000, only 57.8 percent of German women aged 15-64 were employed, either in full time or part time

[4] Of course when we talk about Germany today, we refer to a reunified Germany, which brought together two different traditions and attitudes towards women participating in the labor market. Wenzel (2010) points out that these differences, primarily the result of East Germany having had a stronger tradition of women working and as a result more developed childcare options, still persist today. Even in 2002, more than ten years after German reunification, 51.7 percent of mothers in former East Germany were in full time employment; this is contrasted with only 16.8 percent of mothers in West Germany (Wenzel, 2010).

[5] See the Appendix for statistics on after-school childcare availability in the four states studied in this paper.

[6] The literal translation is ``raven mother'', but its actual meaning is an ``uncaring mother'' who neglects her children.

[7] It should be noted that the data for the United States only contains information on women aged 25 and older due to differences in labor force surveys.

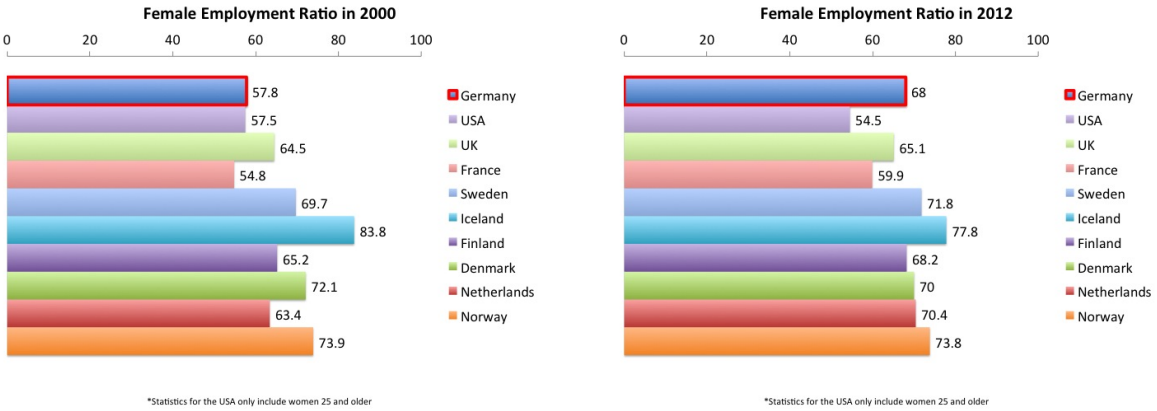


Figure 3: Female Employment Ratio in 2000 and 2012, Source: ILOStat

employment (International Labor Organization Statistics). By 2012, this had increased to 68 percent (ILOStat).[8] The data from both years shows that Germany has a lower female employment ratio than most of the Nordic countries, but that the gap has decreased over time.

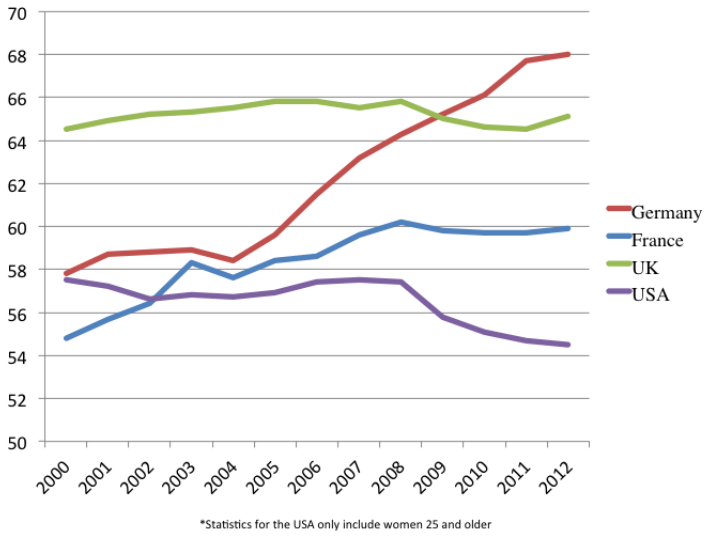


Figure 4: Female Employment Ratio, Source: ILOStat

Similarly, this gap has closed between Germany and other comparable EU and partner countries. Although Germany, France, and the United States started off in similar positions in 2000, Figure 4 shows that Germany's female employment ratio has increased much faster and at a rate that allowed it to overtake the United Kingdom by 2012, a country with a traditionally higher female employment ratio. It is noteworthy that Germany's female employment ratio has increased significantly over the period of the full day school reform, but of course this is not enough to attribute causality. The estimates produced in this paper, however, will begin to explain the role of the full day school reform in increasing maternal

[8] This is still below the European Commission's target of 75 percent by 2020.

labor supply and thereby the overall female employment ratio.

The rest of the paper is structured as follows. In Section 2 I discuss the relevant literature. In Section 3 I present the data used in this paper and present some descriptive statistics. In Section 4 I lay out the empirical strategy and a theoretical framework of labor supply and in Section 5 I present the results obtained. In Section 6 I include several robustness checks. Finally, in Section 7, I conclude.

2 Existing literature

Most of the literature relating chilcare costs and maternal labor supply looks at pre-primary childcare, which makes this paper a more unusual contribution to the field since I examine the extension of the primary school day.[9] Previous work linking a change in the explicit cost of preschool childcare found positive effects on the intensive and extensive margins of maternal labor supply. Lefebvre and Merrigan (2008) and Baker et al. (2008) examine the expansion of universal, highly subsidized preschool childcare in Quebec, using the rest of Canada as a control. Lefebvre and Merrigan (2008) find that the policy increased the participation of mothers who have at least one child under the age of five by eight percentage points. Their findings also show that mothers in Quebec increased their annual hours worked by 231 hours and annual weeks worked by 5.17 weeks. Baker et al. (2008) show that maternal employment rates rose by 7.7 percentage points, approximately 14.5 percent of the baseline employment rate. These studies differ from this paper because they exploit an explicit price change across regions within a country.

Gelbach (2002) is more similar to this paper since he exploits an implicit childcare subsidy as opposed to an observed change in price. He looks at the impact of public kindergarten enrollment in the United States, which varies based on birth month, on maternal labor supply. Enrollment in a public kindergarten the year before primary school begins is an implicit childcare subsidy to the family since there is no formal cost. Gelbach finds that for single mothers, whose youngest child is five, their child's eligibility for free kindergarten increases their labor supply by between 6-24 percent. He notes that there is no significant impact of the policy on single mothers who have both a five year old child and a younger child, but that for married women the effect size is 6-15 percent regardless of whether or not they have an additional child under five.

Gelbach also makes the point that for any families consuming fewer or the same number of hours of childcare as the primary school day, this subsidy is a ``100 percent marginal price subsidy for childcare of fixed quality'' and that if the family consumes more hours of childcare than provided by the length of the school day, then ``the subsidy is entirely inframarginal with respect to childcare costs,'' and leads to

[9] The literature on childcare costs and female labor supply may be divided into structural and quasi-experimental strands. As this paper uses the latter approach, I limit my discussion of the literature to papers that use a policy change, which alters the price or availability across women and time periods to identify the relationship between maternal labor supply and childcare costs. See Blau and Currie (2006) for an overview of the structural literature.

a kink in the budget constraint (Gelbach, 2002: 308). This is something I will return to in my discussion of the theoretical model underpinning the analysis in this paper.

Recently more research has turned to the relationship between primary school hours and maternal labor supply. Contreras, Sepúlveda, and Cabrera (2010) and Berthelon, Kruger, and Oyarzún (2015) also look at the extension of the primary school day in Chile. Contreras et al. (2010) and Berthelon et al. (2015) use survey and administrative data from Chile, which also increased school hours to a full length school day beginning in 1996. This reform was undertaken on the municipal level, which allows the authors to exploit the quasi-experimental nature of the reform across municipalities and time. The reform in Chile was not undertaken in a random way. Municipalities that were classified as ``higher risk'' were also the first to receive full day schools. Similar to this work, Contreras et al. (2010) show that the reform acted as an implicit childcare subsidy, which had a positive effect on female labor supply. Contreras et al. (2010) find that a one percent increase in full day schools causes a three percent increase in the likelihood that a woman works. Their findings show that women already employed actually decrease their working hours. Similarly, Berthelon et al. (2015) find positive effects on participation and longer term labor market attachment.

Methodologically all of these quasi-experimental papers are similar to this paper in their identification strategy; however, I exploit school level variation, which reduces some of the concern surrounding the common time trend assumption and the comparability between states or regions across time. In any empirical work using difference-in-difference, the ensuring the comparability of treatment and control groups should be a priority. I return to this point in Section 4 when I verify the common time trend assumption for my sample of mothers.

This work is also one of the first to assess the *Ganztagsschulreform* in Germany. There has been one major longitudinal study of the reform process, which collected data on a representative sample of children in full day primary and secondary schools in 14 German states (Holtappels et al. 2008). They also surveyed the parents of these pupils as part of the study. Their statistics show that 26 percent of mothers in the sample, whose children attend a full day school, reported being able to extend their working hours and 21.2 percent reported being able to re-enter the labor market (Holtappels et al. 2008). Their study does not differentiate between mothers of children in primary school and secondary school, and it is not clear whether or not the mothers in their sample might be choosing a full day school and as a result, be able to change their labor supply.

Marcus et al. (2013) provide a descriptive overview of the reform using the German Socio-Economic Panel (GSOEP) to show what types of families attend full day schools, but do not identify the causal impact of the reform on female employment. They find that primary school aged children whose mothers work full time and children in single mother households are more likely to attend a full day school, and that children with immigrant parents and children from families that receive social benefits are also more likely to attend a full day school. Marcus et al. also find that over time more children from low socio-

economic households are attending full day schools. This is not a surprising result since the majority of full day schools in Germany are still opt-in, so parents who need to work will choose to send their children to a full day school.

Rainer et al. (2013) also use the GSOEP and propensity score matching to look at the impact of various types of childcare in Germany on female labor supply. They create a matched sample of women who report their child attends a full day school with very similar women whose children do not. They find that the full day school reform caused women who were already working to extend their hours, but did not draw women into the labor market. Rainer et al. find that most of the impact on hours and wages comes from women who were already working in the year before their child started attending a full day school. Their analysis includes all mothers of children aged 6-18 in the GSOEP, which again mixes primary and secondary schooling, and they are also unable to disentangle the endogenous childcare and labor supply decisions.

Nemitz (2015) also uses the GSOEP to assess the impact of the full day school reform on maternal labor supply by exploiting the variation in federal funding at the county level. She finds a large effect at the extensive margin (26 percentage points) and no effect at the intensive margin. The size of this effect at the extensive margin is much larger than previous estimates in this literature examining primary school hours. This paper allows for a more precise estimation of the treatment effect since I know when a mother's closest school became a full day school as opposed to how much money her county spent on converting its primary and secondary schools into full day schools. Nevertheless, even with the different identification strategy and the difference in sample (she excludes Bavaria) our results show agreement.

3 Descriptive statistics and data

In this paper, I combine state-level school data with individual level data from the GSOEP. The school-level data used in this paper is the year in which a given primary school started offering a full school day. Education policy is devolved in Germany, which means that each state has a large amount of autonomy over its education system. The devolution of education policy to the states makes data collection in Germany difficult, but also creates ample regional variation in policy implementation. In this paper I use a self-collected data set to look at the process of the full day school reform in four German[10] states: Hesse, Rhineland Palatinate, Schleswig-Holstein, and Bavaria. These four states were chosen because they were the only states to have the necessary data centrally collected over the period of interest. This data had never been collected across states in this manner because some states do not collect this information centrally, but rather allow school districts to record this information. Although the data

[10]This paper focuses only on West Germany because of the underlying differences between the West and East German education systems. East Germany already had many schools that offered full school days because women were expected to participate in the labor market; childcare was much more developed in East Germany as a result.

Table 1: Summary Statistics By Observations

Variable Name	N	Mean	SD	Minimum	Maximum
Access to a FDS	11,013	0.103	0.304	0	1
Employed or seeking work	11,013	0.636	0.481	0	1
Employed	11,013	0.619	0.485	0	1
Full time	7,152	0.230	0.491	0	1
Part time	7,152	0.770	0.420	0	1
Weekly hours	6,554	25.635	12.997	1	80
Log weekly hours	6,554	3.086	0.616	0	4.382
Labor income	6,797	1,451	1,784	0	99,999
Age	11,013	37.2	9.5	15	64
Number of children 0-2	11,013	0.059	0.240	0	2
Number of children 2-4	11,013	0.206	0.441	0	3
Number of children 5-7	11,013	0.304	0.513	0	3
Number of children 8-10	11,013	0.249	0.554	0	3
Number of children 11-12	11,013	0.249	0.455	0	3
Number of children 13-15	11,013	0.331	0.541	0	3
Number of children 16-18	11,013	0.263	0.504	0	3
Years of education	9,979	12.064	2.591	7	18
Married	11,013	0.711	0.453	0	1
Single mother	10,606	0.114	0.318	0	1

NB: N are person-year observations

collection process proved arduous, I now have a unique data set never before used for this type of analysis.

I link the school-level data to the GSOEP, a longitudinal study of families and individuals in Germany, which includes questions on work and family and was started in 1984 (SOEP, 2013). It includes data on over 11,000 households across Germany. I use the GSOEP because it is a longitudinal study with more than sufficient information about the children in the family and allows me to access to the household's address. Since parents do not report the name of the school their child attends, I use their address to link them to the closest primary school (see Section 4 for further discussion).

Table 1 presents summary statistics for the variables used in the analysis as well as some additional demographic information.[11] My sample includes 1,496 women who are observed at some point during the period 2000-2012 in the four states of interest. I look at these years because this is the period in which

[11] Some of the variables I do not actually include in the analysis, due to the inclusion of individual fixed effects, but they prove interesting for descriptive purposes.

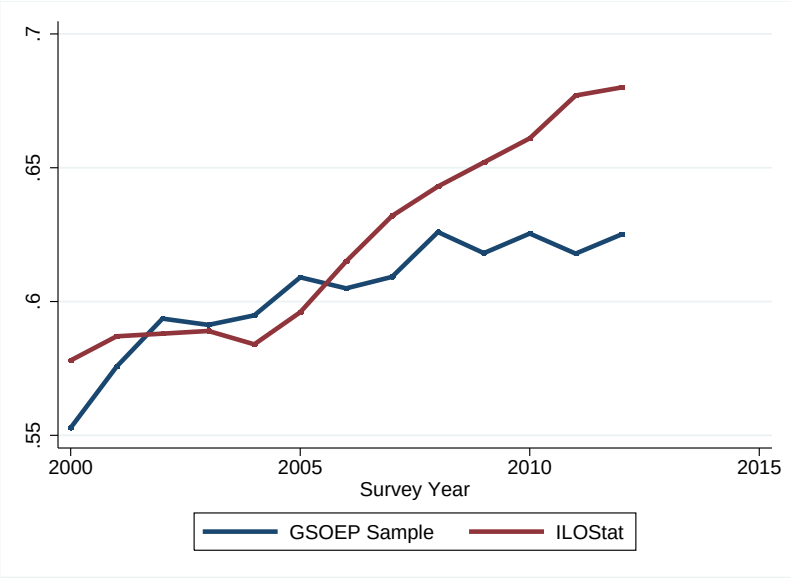


Figure 5: Employment Ratio Within GSOEP and in ILOStat Data By Year

NB: The female employment ratio from the GSOEP includes all women aged 15-64 in the four states of interest since this is comparable to the ILO statistics for all of Germany. The female employment ratio for the women with primary school aged children in these four states has also increased over the period 2000-2012.

the reform is taking place in the states for which I have data. I only include women who have primary school aged children during this period and who are aged 15-64, as this is the working age population as defined by the German Federal Employment Agency. These women are linked to 1,084 primary schools in the four states.

Because of attrition and sample refreshment, the GSOEP is not a balanced panel, which should be kept in mind when analyzing the descriptive statistics presented in Table 1. Since I only look at women up to age 64, once a woman turns 65, she also drops out of my sample. I only look at women who had primary school aged children during the period 2000-2012, so this type of attrition does not pose a large problem.[12] This means that I have at most 11,013 person-year observations for some variables.[13]

Across all time and person observations, approximately 60 percent are employed. The dynamics of their employment proves similar to the ILO statistics presented earlier; over the period of interest, employment has also increased for the women in the four states in my sample (Figure 5). For the women who work, their average weekly hours worked in Table 1, are approximately 26. This is well below the threshold of 35 hours[14] for a full time job, indicating that many women in the sample are engaged in part time work. Figure 6, a histogram of hours worked by men and women from the data used in this paper shows this clearly. This figure shows that most men in the sample work full time, but that much of the density of hours for women is found towards the left of the distribution. This prevalence of part time work is

[12] A total of 11 women exit the sample for this reason, which is 0.7 percent of the sample.
[13] There are fewer observations for some variables due to missing values.
[14] Here I use the OECD definition of part time work to be anything less than 35 hours per week (OECD Glossary of Statistical Terms).

characteristic of female labor supply in Germany, as discussed in the introduction to this paper, and will help explain the results.

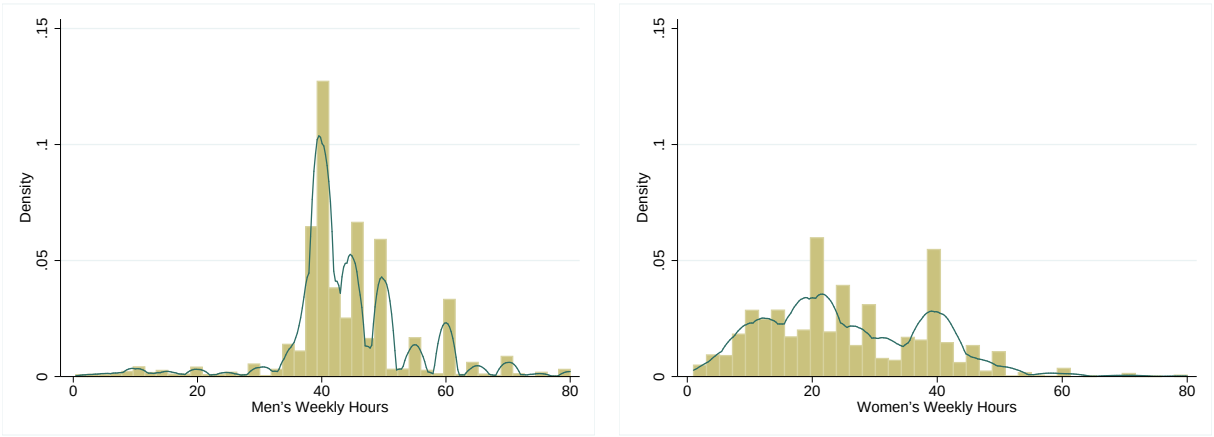


Figure 6: Distribution of Hours Worked For Men and Women

For the women who work, their monthly labor income is reported in Euros. Income in the GSOEP is top coded with 99,999 Euros, which affects the mean value reported in Table 1. The median income for the women working in my sample is 1,200 Euros per month, which is less than the reported mean of approximately 1,450.

As the literature has shown, mothers have different labor force participation patterns as a result of how old their children are. Table 2 shows there is a difference in the participation rate of women in this sample whose youngest child is primary school aged (approximately 65 percent) compared to women whose youngest child is still preschool aged (under 50 percent). Furthermore, the participation rate increases as the age of the youngest child increases. Table 2 shows a similar trend for weekly hours of work: they increase as the age of the youngest child increases, but still never reach an average value above 35 hours per week. The means in each panel of Table 2 are statistically different from each other at the five percent level. This is why I control for the age of other children in the household in all models.

Figure 7 shows what percentage of the sample of 1,496 women has access to a full day facility in any given year and Table 3 shows the exact number of women in the sample in a given year and state that have access. As more schools convert to full day facilities over the period, the number of women gaining access increases; however, the relatively modest rate of gaining access is due to the slow nature of the reform across the four states. Bavaria, the most populous state in the data set, has had the slowest switch-over rate (see Figure 8 in Section 4 for more information), limiting the absolute number of women who gain access to a full day school. Nevertheless, 333 women will still allow me to estimate the impact of the extension of the school day on female labor supply.

Table 2: Labor Market Participation by Age of Youngest Child

	Employed or seeking work		
	N	Mean	Standard Deviation
Age Category of Youngest Child			
0-1	624	0.212	0.409
2-4	1,728	0.481	0.500
5-7	1,929	0.650	0.477
8-10	2,186	0.659	0.474
11-12	1,305	0.701	0.454
13-15	1,205	0.740	0.439
16-18	643	0.757	0.429

	Weekly Hours of Work		
	N	Mean	Standard Deviation
Age Category of Youngest Child			
0-1	116	20.138	14.339
2-4	758	21.1	12.12.422
5-7	1,181	23.585	12.485
8-10	1,360	24.575	12.306
11-12	852	26.153	12.760
13-15	839	27.821	12.871
16-18	462	28.502	13.151

NB: N are person-year observations.

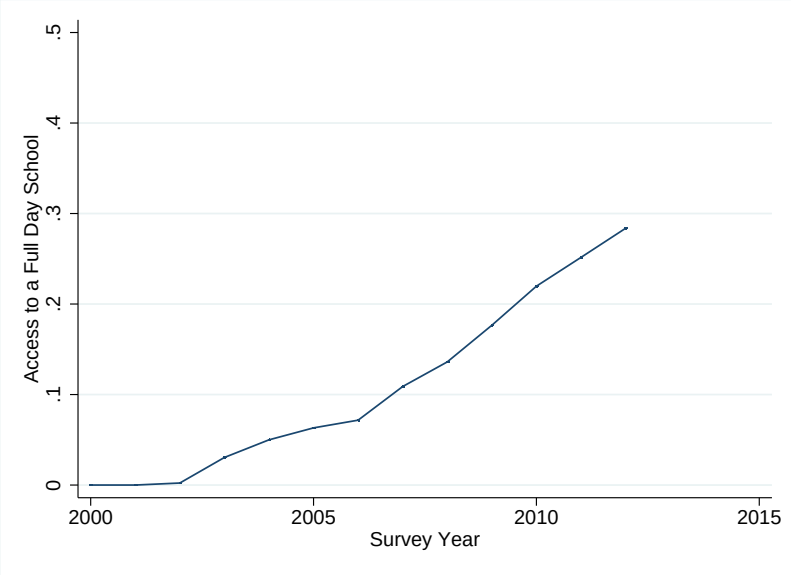


Figure 7: Proportion of Sample with Access to Full Day Schools By Year

Table 3: Number of Women with Access By Survey Year

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Overall
Number of women with access	0	0	2	27	43	54	66	96	114	149	165	206	217	333
...in Bavaria	0	0	0	0	0	0	5	11	14	28	38	56	66	95
...in Hesse	0	0	0	16	20	21	23	27	34	38	56	63	70	103
...in Rhineland-Palatinate	0	0	2	10	17	21	25	31	33	43	37	44	41	66
...as a proportion of sample	0	0	0.002	0.030	0.050	0.063	0.086	0.110	0.136	0.180	0.220	0.252	0.284	0.223
...in Schleswig-Holstein	0	0	0	1	6	12	13	27	33	40	34	43	40	72
Number of women in panel	863	832	896	886	861	855	921	882	838	844	751	819	765	1,496

4 Methodology

In this paper, I identify the causal impact of the extended school day on female labor supply. Usually, the challenge to identification in this type of research lies in disentangling the endogenous work and childcare decisions. In this context, where attending the full day school option is not mandatory, parents have to make this simultaneous labor supply and childcare decision. The advantage of my data on the German reform is that access to a full day school comes exogenously to different women at different times, which means I can estimate an intention to treat (ITT) effect of gaining access to a full day school. I exploit this variation in my identification strategy and verify its validity using several different approaches.

4.1 Identification strategy

The reform to extend the school day has been slow and staggered, which proves useful for identification. Schools did not switch over all at once; in fact, even within a state, district, or city there is substantial variation over a period of almost 10 years as to when schools switched over from half day institutions to full day ones. This means that two mothers who live in the same city may have gained access at different points in time because of the difference in when the primary school closest to their home began operating as a full day school.

As previously mentioned, attending the full day option at these schools is not necessarily mandatory. Because of the constraints in extending the day, some schools offer an extended day option for which parents must enroll their children. This means there is still an element of choice in whether or not a child attends a full day school. This is generally free since the schools are public, but parents may be asked to sign their children up to a lunch option in order to keep the cafeteria running.[15] In this paper I treat all schools offering the full day option the same and estimate an intention to treat effect since I am interested in how gaining access affects labor market outcomes.

Primary school[16] attendance in Germany is decided solely on proximity to school. There are few private primary schools in Germany and homeschooling is prohibited by law. This allows me to use geographic proximity to a full day school to evaluate the effect of the reform on maternal labor supply.[17] The variation in when a school switches over arises because of the costs associated with the reform. One of the main costs of extending the school day arises in the necessity of building cafeterias to provide lunch on site. Very few primary schools in Germany would have had a cafeteria or any kitchen facilities on site since all children went home for lunch when school ended. The costs and time lags associated with constructing cafeterias should not be underestimated when assessing the speed of the reform.

[15] Families who cannot afford this can get the lunch cost fully subsidized by the state.

[16] Here primary school aged children are 6 to 10 years old, as secondary school begins in grade 5 in the four states I analyze.

[17] After speaking to people from the Ministries of Education in these four states, it seems that based on their anecdotal evidence, on average less than one percent of families request that their child attend a primary school that is not the school to which they were assigned, i.e. the school closest to their home. They unfortunately do not collect official statistics on this, but if their estimates are accurate, then using closest school as a measure of access seems valid.

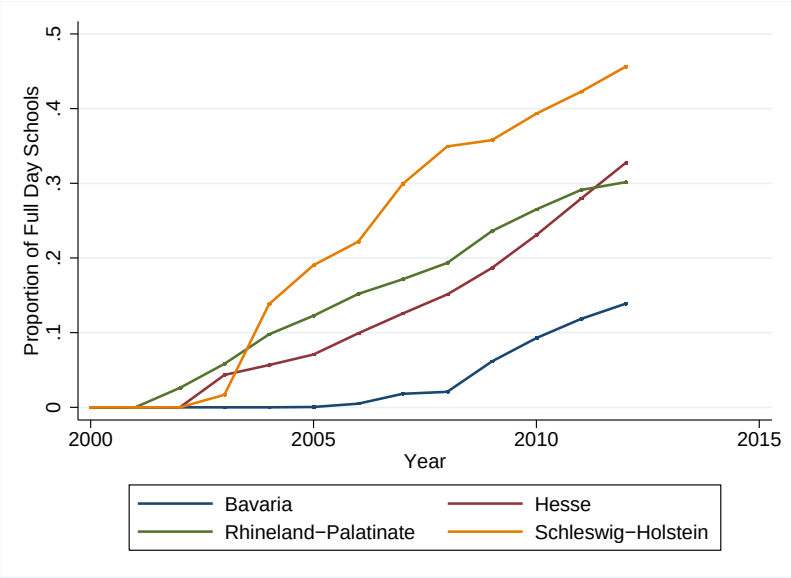


Figure 8: Proportion of Primary Schools Operating as Full Day Facilities By Year

Another cost of the reform is the hiring of additional teachers. Teachers in Germany have a special civil servant status, which means the government cannot simply extend their current working hours. Teachers must be converted from part to full time or additional teachers must be hired. The costs associated with hiring new teachers and building new cafeterias are paid by the federal government[18] and state and not by the individual municipality or district, so it seems reasonable to assume that when a school switches is not correlated with other characteristics of the local area in which the school is located, especially since two schools within a relatively homogenous region (e.g. a small city) may differ in their switch-over years. Nevertheles, this is something I will explicitly test in Section 4.2. Potentially school switch-over year could be correlated with some school specific characteristic, e.g. the seniority of the principal, however, since I do not look at education outcomes of the pupils, this seems less relevant for mothers' labor supply.

For every primary school from the four states in my sample, I have the year in which the reform took effect and the school began operating as a full day facility. I observe the first schools operating as full day schools for the 2002-2003 school year; my data continues until the 2012-2013 school year. The switch-over process is still on-going in Germany, and in Bavaria, for example, there are still many primary schools that have not switched over, while in the other states almost half of all primary schools have since transitioned. Figure 8 shows the percentage of total primary schools in each of the four states of interest that have started operating as full day facilities in each year. As may be seen in this figure, less than 50 percent of total primary schools in each state have switched over as of 2012.

In order to analyze the geographic distribution of full day schools and link school-level data to individual-level data, I use geographic information system (GIS) software to link a woman to her closest primary school using her geocoded address and geocoded addresses of all primary schools in her state. Unfor-

[18] Much of the funding for the reform has come out of the *Investitionsprogramms ``Zukunft Bildung und Betreuung''* (Investment Program: The Future of Education and Childcare), which committed 4 billion Euros of federal money to the reform during the period 2003-2009 (Rainer et al., 2010).

tunately, the GSOEP does not identify the name of the school a child attends, only the type of school (i.e. “primary school”). However, because children attend their closest primary school, I can determine in which year a woman gained access to a full day school based on the status of her closest primary school. Panel (a) of Figure 9 shows all the primary schools in the four states and panel (b) of Figure 9 shows the geographical distribution of full day primary schools in these states. This allows me to observe a woman before and after gaining access and estimate a difference-in-difference model (see Section 4.3 for a complete discussion of the empirical strategy).

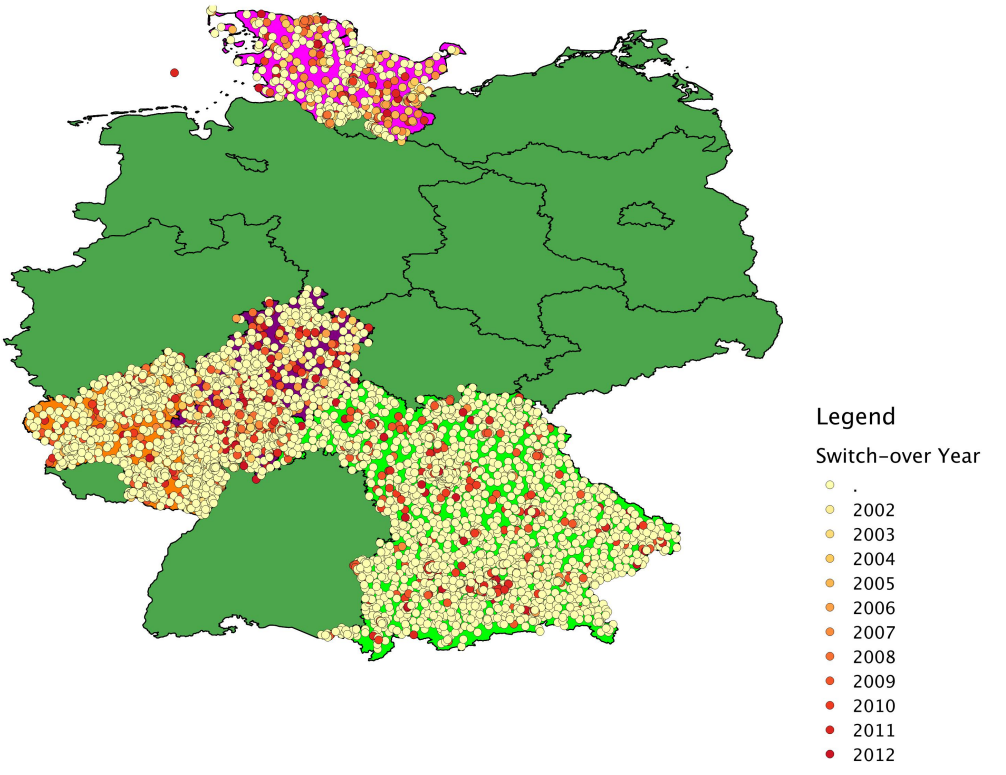
4.2 Verification

This identification strategy relies on women who gain access to a full day school having the same pre-treatment trends as women who do not gain access. This is commonly referred to as the ``common time trend assumption'' underpinning difference-in-difference. The control group and the treated group should have been following the same trends in labor market participation before the treated group gained access to a full day primary school. Since I only look at women who have primary school aged children during the period 2000-2012, it is reasonable to assume that these women follow a parallel trend. I am able to explicitly test this assumption using an event study design similar to Autor (2003). The results from the event study specification are presented in Figure 10.

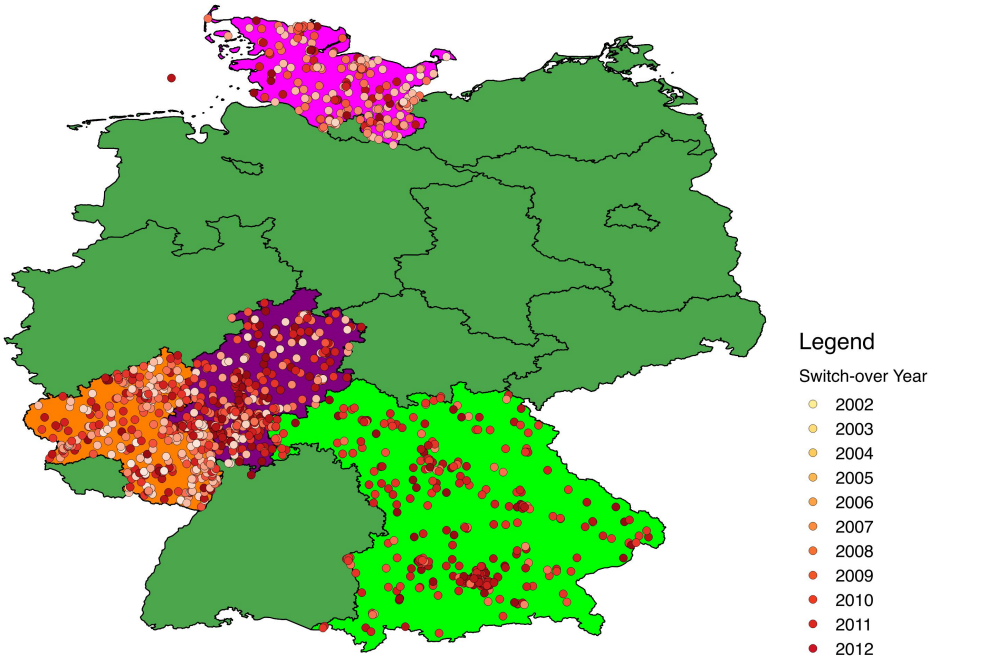
Figure 10 plots the coefficients obtained from a regression of the outcome of interest, labor market participation, on pre- and post-treatment dummies, state-year fixed effects, state trends, and individual fixed effects. The red vertical line indicates the year before a woman gains access to a full day school. If women who gain access are no different from women who do not gain access in terms of pre-treatment participation, we would expect all of the pre-access parameters to be equal to zero, which is what we observe in Figure 10. The 95 percent confidence intervals are such that we cannot claim these parameters are different from zero. Mothers who gain access to a full day school do not exhibit different pre-access trends in labor market participation than mothers who do not gain access.

Because I am using difference-in-difference for my estimation, we do not need to worry about the switch-over year of a given school being correlated with location specific factors that would affect female employment. In order to explicitly test this exogeneity, I look at the correlation between district-level[19] unemployment, land prices, and GDP per capita with switch-over intensity, the percentage of schools in a given district in a given year that have already converted to full day schools. Here these land prices are collected by the *Statistisches Bundesamt* and reflect the actual sale price of undeveloped land that may be developed for commercial or private use in a given year averaged at the district level. These prices are measured in Euro value of land per square meter. The results of this analysis are presented in Table 5. To check the correlation, I run three simple linear regressions of the district level switch-over

[19]Here district refers to *Kreis*, of which there are 173 in the four states of interest.



(a) All Primary Schools



(b) All Full Day Schools

Figure 9: Geographical Distribution of Primary Schools

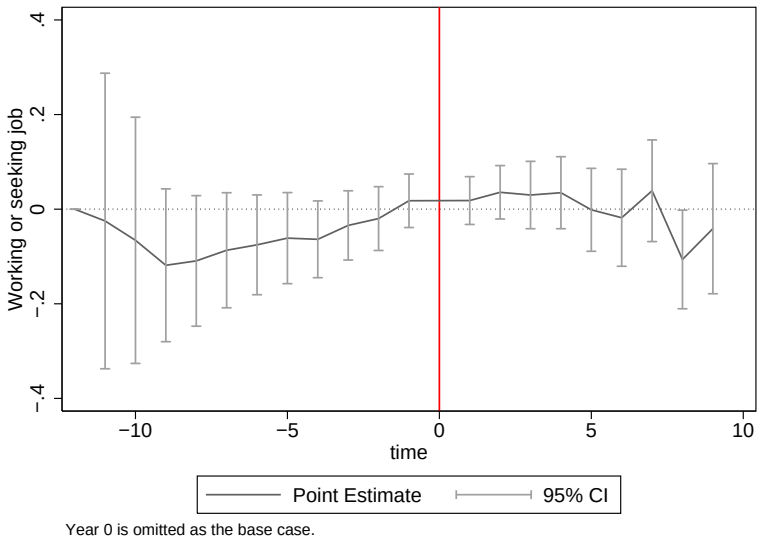


Figure 10: Event study: verifying the common time trend assumption

rate on district level economic factors, including state-year dummies, linear trends for each state, and district fixed effects. I cluster the standard errors at the district level.

We might be concerned that districts with low unemployment would be more likely to have a faster switch-over rate, since they require more childcare and are potentially more affluent; however, this is not observed. Column (1) in Table 5 shows that there is no observable correlation between the unemployment at the district level and the rate of switch-over. The coefficient on unemployment is not statistically different from zero and very small. At the same time, we might think that districts with high land prices might be economically booming and again require more childcare or have faster switch-over since they are more affluent, which is observed in Table 5. Column (2) shows no correlation between land prices and switch-over intensity; the estimated coefficient is not different from zero. Column (3) shows that including both unemployment at the district level and land prices does not change the correlations. In all three specifications, there is no statistically significant relationship between the switch-over rate of primary schools and GDP per capita, which also indicates that more affluent areas are not more likely to have a higher proportion of full day schools. Given this analysis, it seems plausible that the switch-over rate of primary schools in these four states is not being driven by economic factors at the district level.

The exogeneity of the reform means that women cannot affect when they gain access to a full day school because their children must attend the closest primary school. There is still the possibility that some families may send their children to a private school that offers extended hours or potentially move house to live closer to a full day primary school. Unfortunately I am not able to identify reasons for moving house, however, it does not appear to pose a serious problem to identification. I observe 40 women in the data set who have moved house from a home where the closest primary school was not a full day school to a home where the closest primary school is a full day school. This is something I will address in the Robustness section.

Table 5: Economic Factors Affecting Switch-over

	(1)	(2)	(3)
	ols	ols	ols
VARIABLES	switch-over rate	switch-over rate	switch-over rate
Unemployment	-0.004		-0.004
	(0.004)		(0.004)
Undeveloped land price		0.000	0.000
		(0.000)	(0.000)
Log GDP per capita	-0.061	-0.059	-0.074
	(0.077)	(0.073)	(0.075)
Constant	-0.013	-0.018	-0.031
	(0.046)	(0.012)	(0.048)
District FE	Yes	Yes	Yes
State-Year dummies	Yes	Yes	Yes
State trend terms	Yes	Yes	Yes
Observations	2,076	2,206	2,036
Districts	173	173	173
R-squared	0.829	0.820	0.829

Clustered standard errors in parentheses

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

NB: Undeveloped land price is the average per square meter sale price of land for construction purposes in each year in each district. Unemployment is average for each year in each district. All data is from the Statistical Offices of the German Länder and Federal Statistical Office.

4.3 Empirical strategy

In this section, I describe the models used to estimate the effect of the policy on maternal labor supply. I estimate two main models: one looking at changes in labor market participation status (employment or actively seeking a job versus not working) and one looking at changes in hours worked. This allows me to explore the impact of the policy on the extensive and intensive margins. My variable of interest is access to a full day school.

All of the participation models are estimated as linear probability and conditional logit models because of the binary outcome measure. This model does not take into account whether or not the woman is working part or full time, but rather pure, binary labor market participation status. The model for labor market participation status, whether or not the woman is employed or actively seeking employment, takes

the following form, where E_{it} is a binary variable that takes the value ``1" when the woman is employed or seeking employment and ``0" otherwise:

$$E_{it} = \alpha_0 + D_{it}\delta + \eta_i + \phi_{st} + t_s + X_{it}\beta + \varepsilon_{it} \quad (1)$$

In all models, ``i" signifies ``individual," ``s" signifies ``state," and ``t" signifies ``year." This specification allows for the inclusion of the treatment variable, D_{it}, which switches to one once a woman's closest school becomes a full day school. These regressions also include an individual fixed effect, η_i, state-year dummies, ϕ_{st}, state trend terms, t_s, as well as standard errors, ε_{it}, clustered at the individual level. The individual fixed effects pick up any individual specific, time invariant characteristics that could explain participation. Similarly, the state-year dummies should explain any variance in participation status caused by events occurring in a specific year in the state of residence, i.e. larger macroeconomic events or state specific labor market policies, and the state trend terms should account for any linear trends in a given state's macroeconomic situation. Since individual decisions to supply labor could be correlated over time, I cluster the standard errors at the individual level even though the treatment is occurring at the school level.

The vector X_{it} includes a set of variables that account for whether or not the woman has children in a set of age categories. These include the number of children under the age of two, children aged two to four, children aged five to seven, children aged eight to ten, children aged 11-12, children aged 13-15, and children aged 16-18. These variables are included in order to disentangle the general effects of being a mother on labor supply and are summarized in Table 1.

Similarly, the regressions exploring weekly hours worked, take the following general form:

$$H_{it} = \alpha_0 + D_{it}\delta + \eta_i + \phi_{st} + t_s + X_{it}\beta + \epsilon_{it} \quad (2)$$

Here H_{it} is a continuous variable representing either level hours worked or the logarithm of hours worked. As before, this model also includes an individual fixed effect, η_i, state-year dummies, ϕ_{st}, state trend terms, t_s, as well as standard errors, ϵ_{it}, clustered at the individual level. The vector X_{it} includes the same covariates as in the participation regressions.

I estimate the participation and hours worked models separately as opposed to in a joint participation-hours framework because I am not working in the standard censored context. In my data set, all of the hours worked are positive values; any woman who does not work receives a missing value instead of a zero for her hours. This allows me to estimate the impact of the policy on hours conditional on employment before gaining access, which is the intensive margin. I still look at how the extension of the school day affects the extensive margin by looking at the dummy variable for being employed or seeking employment. By separating the two, however, I am able to disentangle the extensive from the intensive margin.

This empirical strategy, however, does not take potential spillover effects into account. There are a limited number of jobs available in the labor market and in order for these mothers to enter the labor market, vacancies must be created at a fast enough rate or some other workers must be squeezed out or have their hours reduced. The workers who exit the labor market could be women who do not have children or men. I include mothers who are actively seeking a job in the participation model to capture part of this, but other aspects of labor demand may also change as a result of the policy. Since this reform was widely discussed in Germany, it is likely that endogenous job creation took place as firms created new jobs in response to the reform. One example of this is teaching jobs. I will exclude women who work as teachers from my estimation of these models as a robustness check. All of these general equilibrium concerns should be keep in mind when thinking about the policy implications of this type of reform.

4.4 Theoretical predictions

Models of labor supply include an agent maximizing her utility function subject to a budget constraint. Often the budget constraint is piecewise linear due to complexities in the fiscal system as well as costs to entering the labor market. For the purposes of this paper, I consider a simple, static labor supply model, with a piecewise linear budget constraint. I allow childcare beyond the hours provided by primary schooling to serve as a variable cost to entering the labor market.[20] I present the results of the model graphically to focus on the basic intuition, although of course they could also be solved mathematically.

The model shows the effect of variable costs on labor supply and is similar to the static model in Pencavel (1987): the women in this model want to maximize their utility function $U(x,\ h)$, where x represents consumption and h represents hours of work. This utility function is increasing in x and decreasing in h and is well-behaved (real valued, continuous, and quasi-concave).

As the women face a fixed cost to entering the labor market, childcare, the budget constraint will be piecewise linear. This is because I assume that once a woman decides to work any number of hours beyond $\hat{h}$, the length of the primary school day, she must pay for childcare. We may think of this as the hourly rate a nanny or daycare facility charges for after-school childcare. The woman solves the following maximization problem for each segment of the budget constraint to determine her participation and her hours:

$$max_{x,h} \quad U(x,\ h) \quad s.t.\ \ px \leq \begin{cases} y & if\ h = 0 \\ w_1 h + \tilde{y}, & if\ 0 < h \leq \hat{h} \\ w_2 h + \tilde{y}, & if\ h > \hat{h} \end{cases} \tag{3}$$

[20] See the Appendix for how the same results may be derived by treating childcare costs as fixed, which also gives rise to a piecewise linear budget constraint. Regardless of which model is chosen, however, they make very similar predictions and both unambiguously predict that women will never leave the labor market as a result of this policy change.

Here the cost of childcare beyond $\hat{h}$ hours is deducted from the woman's wage, which means w_2 is less than w_1. This will create a kink in the budget constraint as the relative price ratios change. I normalize $p = 1$. There is a fixed cost to working, z, such that non-labor income is y when the woman does not work at all and $\tilde{y} = y - z$, when she works more than zero hours. This is a necessary cost to impose, and standard in most models, because without it, women who are not working might never be drawn into the labor market as a result of the school day extension. The size of this fixed cost could vary, however, for the purposes of this discussion, I have left it as relatively small and the same across all graphs.

There are three different cases to consider: women who do not work, women who work $\hat{h}$ hours, and women who work more than $\hat{h}$. I do not consider the case of women who work less than $\hat{h}$ hours or who work exactly $\hat{h}$ hours at an interior solution because provided they have well-behaved preferences, they will not be affected by the reform.

The first case is that of a woman who is not working before the school day gets extended. This may be seen in Figure 11. Here the woman was choosing not to work at a corner solution, point A, because her highest possible indifference curve was not tangent with an attainable portion of her budget constraint. Once school hours were increased, however, she is able to choose point B on a higher indifference curve, thereby entering the labor market and increasing her utility.

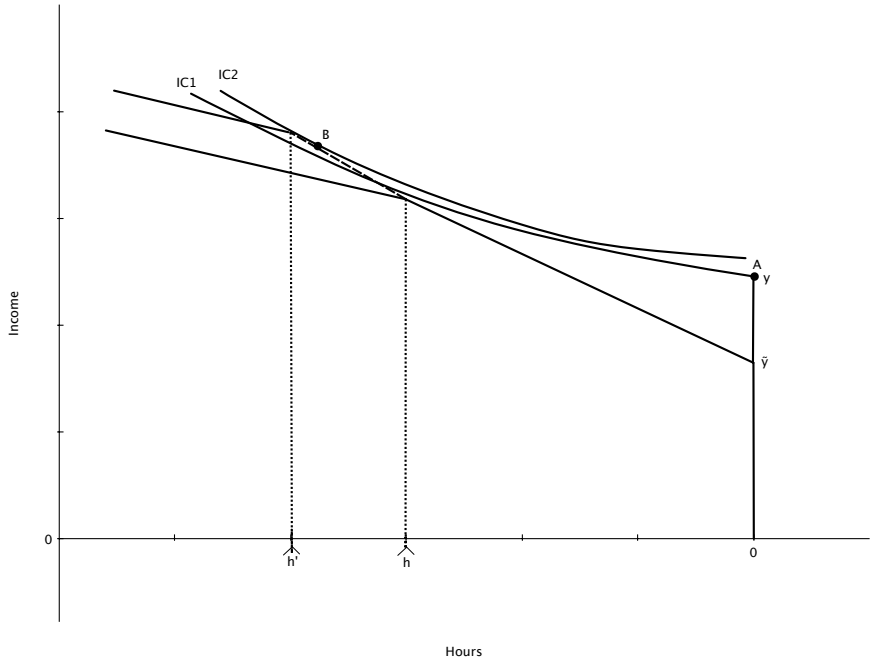


Figure 11: Case 1: Woman not working

The second case of a woman working exactly $\hat{h}$ hours has two possible outcomes, which depend on her preferences. The first outcome is the less interesting one. Here the woman's indifference curve is tangent to her budget constraint at the kink point, but the shape of the indifference curve is such that when school hours are extended and the budget set gets larger, her initial choice is still her optimal choice. In this case the woman does not extend hours and her utility does not change. This is the same scenario

for a woman who is initially working less than $\hat{h}$ hours, given that her preferences are well-behaved.

Figure 12 shows what happens when she has a different indifference curve and the policy change causes her to change her working hours. Initially this woman is also at point A, at the kink point, however, once school hours increase and her budget set gets larger, she can move onto a higher indifference curve. This new tangency point, at point B, is possible because of the increased budget set. This woman is now working more hours and has higher utility.

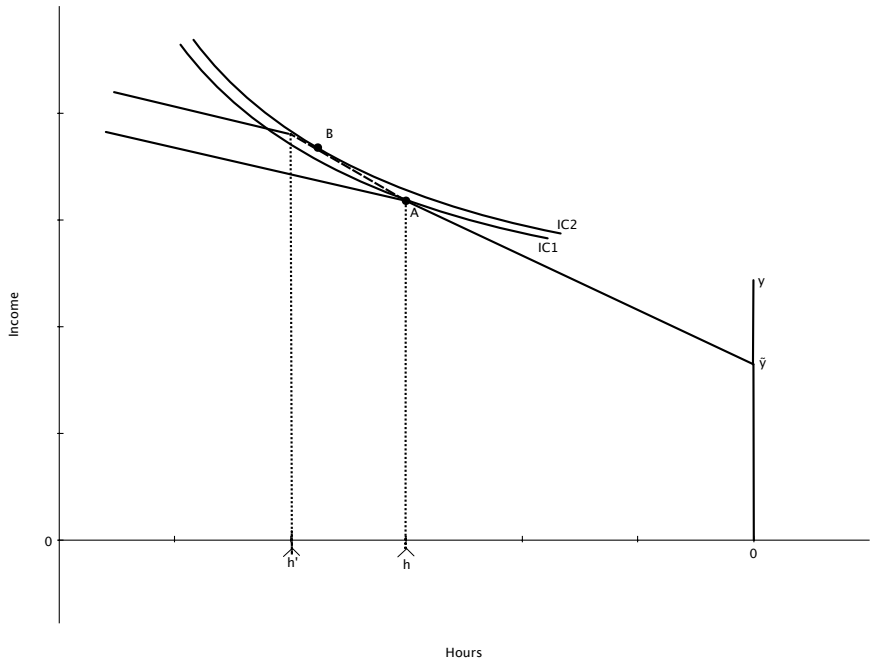


Figure 12: Case 2: Woman working exactly primary school hours

The third and final case is that of a woman working hours above $\hat{h}$. This situation is depicted in Figure 13. This woman was working some number of hours beyond the length of the primary school day. When the school day was extended, her budget set also expanded due to the income effect. This resulted in her being able to choose a point on a higher indifference curve, point B in Figure 13. As a result of moving from point A to point B, this woman has decreased her hours, but increased her utility. This decrease in hours is a direct result of the income effect being the only effect coupled with labor being a normal good.

The same decrease in hours and increase in utility may be shown for values of h greater than, but closer to $\hat{h}$ in magnitude, as seen in Figure 14. However, in this case we observe both an income and a substitution effect, which work in opposite directions. This is the only case where the woman will experience a substitution effect as the wage rate has changed on this portion of the budget constraint. In Figure 14, the income effect dominates the substitution effect and the woman decreases her hours worked. The opposite would also be possible if the substitution effect dominated.

This model predicts that as a result of the extension of the primary school day, mothers who were not working before will be drawn into the labor market. The effect of the reform on women already working is unclear. They will either increase, decrease, or remain at the same number of hours. This intensive

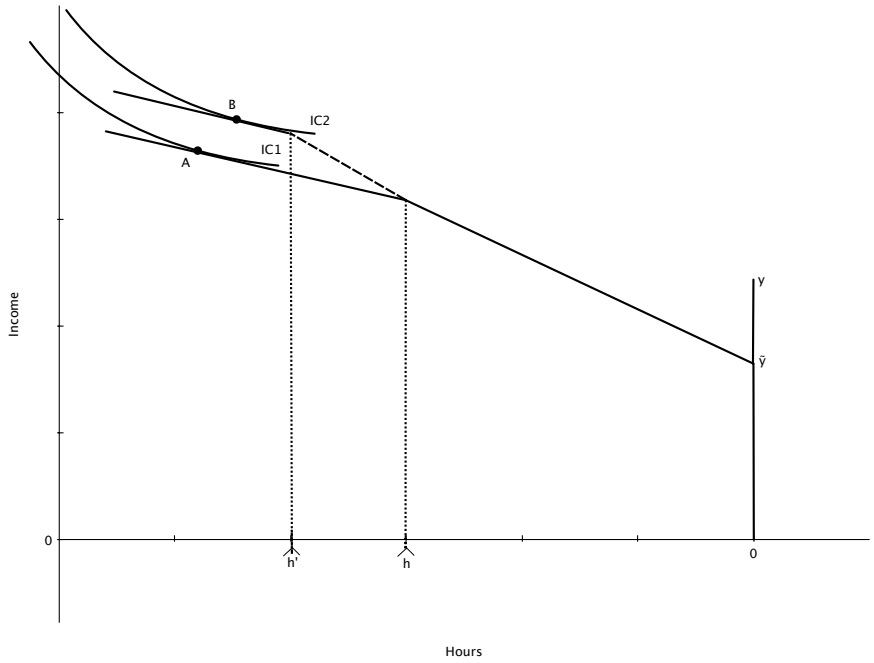


Figure 13: Case 3a: Woman working beyond primary school hours

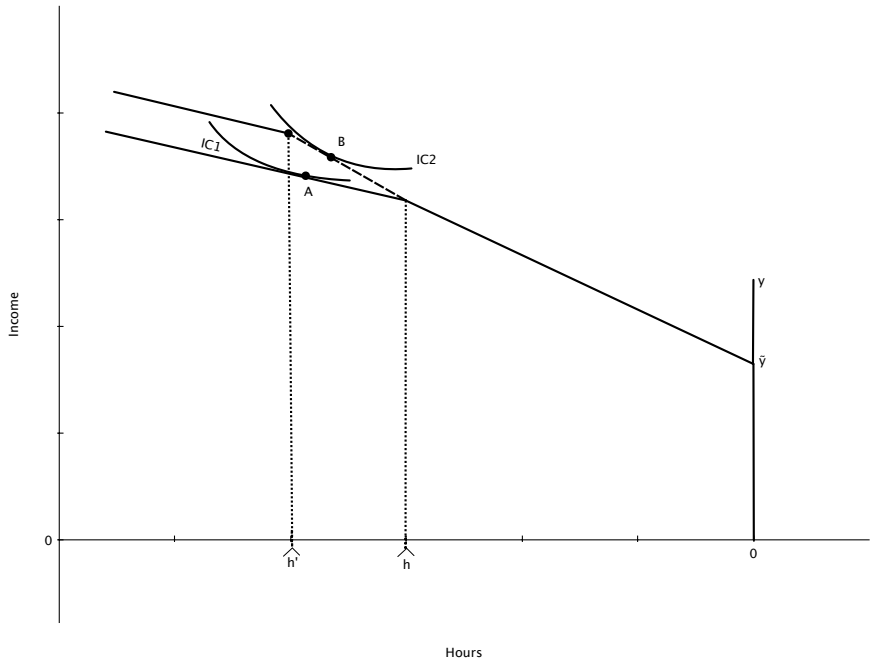


Figure 14: Case 3b: Woman working beyond primary school hours

margin change is unclear due to the different responses of individuals depending on the number of hours they work and their preferences. In almost all cases, however, the policy change allows women to reach a new utility maximizing choice on a higher indifference curve, making them better off than they were before.

5 Results

In this section of the paper, I present the regression results of the models discussed in Section 4 on the full sample of all women who live in the four states of interest during the period 2000-2012 and have primary school aged children. I examine the extensive margin first by looking at whether a woman is working or actively seeking a job or not. I then turn my attention to the intensive margin by looking at hours worked conditional on working.

5.1 Full sample results

In Table 6 I present the results from the regressions on employment using the full sample of women with primary school aged children. I first run a linear probability model on the binary outcome variable in Column (1), followed by a conditional logit in Column (2). Column (1) shows that gaining access to a full day school increases the probability of being employed or actively seeking a job by 4.8 percentage points. This effect is statistically significant at the five percent significance level. The sign and significance of this coefficient do not change when I move from the linear probability model to the logit regression. In Column (2) we observe a small, yet statistically significant effect of providing women with an implicit childcare subsidy on their labor supply. Both of these regressions include individual fixed effects, state-year dummies, and linear state trend terms with standard errors clustered at the individual level. The marginal effect associated with the odds ratio reported in Column (2) is 0.045, which is comparable to the estimate obtained through OLS.

As might be expected, having children of any age decreases participation and as children get older, this gets smaller. There is clearly a negative effect of being a mother on employment, which matches the previously discussed statistics of West German mothers' employment.

I estimate that this 4.8 percentage point increase in the probability of being employed or seeking employment translates into a less than one percentage point increase in overall participation over this period[21]. This is rather small in terms of a change at the extensive margin in the macro picture since over the period 2000-2012, the female employment ratio in Germany increased by approximately 10 percentage points (ILOStat). The potential of this 4.8 percentage point effect, however, should be considered. As my data on primary schools shows, only 50 percent of primary schools in these four states have switched over to full day schools. If this treatment effect remains constant, switching over all primary schools could increase overall maternal participation by nearly five percentage points, which would be very significant in the German context.

[21] I calculate this using the total population of mothers in these four states in 2012 (ILOStat).

Table 6: Estimates on Participation

VARIABLES	(1) participation	(2) participation
Access to FDS	0.048**	0.539**
	(0.023)	(0.234)
Children aged 0-1	-0.434***	-3.376***
	(0.025)	(0.228)
Children aged 2-4	-0.219***	-1.745***
	(0.019)	(0.146)
Children aged 5-7	-0.063***	-0.590***
	(0.014)	(0.115)
Children aged 8-10	-0.059***	-0.519***
	(0.013)	(0.111)
Children aged 11-12	-0.031**	-0.259**
	(0.013)	(0.119)
Children aged 13-15	-0.030**	-0.285**
	(0.012)	(0.117)
Children aged 16-18	-0.019	-0.108
	(0.012)	(0.111)
Individual FE	Yes	Yes
State-year dummies	Yes	Yes
State trend terms	Yes	Yes
Observations	6,216	6,216
Individuals	702	702
(Pseudo) R-squared	0.599	0.220

Clustered standard errors in parentheses

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

NB: Outcome "participation" includes those employed and actively seeking employment.

Table 7: Estimates on Hours Worked

	(1)	(2)
VARIABLES	ln(weekly hours)	weekly hours
Access to FDS	-1.004	-0.033
	(0.675)	(0.036)
Children aged 0-1	-10.441***	-0.515***
	(1.165)	(0.062)
Children aged 2-4	-8.541***	-0.391***
	(0.665)	(0.032)
Children aged 5-7	-4.878***	-0.199***
	(0.523)	(0.025)
Children aged 8-10	-4.169***	-0.168***
	(0.434)	(0.021)
Children aged 11-12	-2.958***	-0.114***
	(0.415)	(0.019)
Children aged 13-15	-2.019***	-0.075***
	(0.402)	(0.018)
Children aged 16-18	-1.091***	-0.030*
	(0.408)	(0.017)
Individual FE	Yes	Yes
State-year dummies	Yes	Yes
State trend terms	Yes	Yes
Observations	1,135	1,135
Individuals	4,614	4,614
R-squared	0.754	0.724

Clustered standard errors in parentheses

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

All of these results are being estimated on the ``switchers,'' women who changed their labor market status as a result of the treatment. This is because of the nature of the difference-in-difference estimation; we are interested in how the treated individuals' employment status changes across periods compared to the non-treated sample's changes. In the case of the conditional logit model, women whose employment status does not change across periods are actually dropped in the estimation. This is why both the number of observations and the number of individuals are lower than the numbers reported in the Descriptive Statistics in Table 1. This reinforces the point that women are being drawn into the labor market and there is actually a change at the extensive margin as a result of this reform.

Turning to the intensive margin, I find no impact of the reform on hours worked. These regressions are only being estimated on women who report a positive number of hours worked with zero hours being treated as missing. This means that any changes in hours will reflect changes at the intensive margin. As the coefficients on the treatment variable in Table 7 show, the effect on both level and log hours is small and not statistically different from zero. For women who were already working before getting treated, their treatment did not cause them to change their working hours. This could be driven by rigidities in the labor market that do not allow workers to easily increase their hours of work by small increments. As the stylized facts from Germany and the data showed, many women are working part time. An increase of the school day by a few hours per day might not provide enough childcare to allow women already working to transition from part time to full time work.

Another explanation could be a positive income effect as a result of this implicit childcare subsidy. As the women in the sample become wealthier as a result of the free childcare, they could be substituting away from labor to leisure. If women have heterogeneous preferences, then some women could increase their hours as a result of the policy change and some women could decrease them. On average this effect will appear as zero, which could explain the coefficients in these regressions as they estimate the average effect on hours. The effect could also be heterogeneous depending on the number of hours women worked before the reform and the gradient of their budget constraints. This fits with the predictions of the static labor supply model.

5.2 Heterogeneous Treatment Effects

I explore the possibility of heterogeneous treatment effects by interacting the access variable with a demographic control variable since the effects of the treatment may differ for different women. I look at single mothers since they could have fundamentally different responses to being treated. I do not conduct any heterogeneous treatment analysis along other interesting dimensions (e.g. state of residence) because dividing the sample into so many sub-groups significantly decreases the number of women in any group, decreasing the reliability of the estimates.

Table 8: Heterogeneous Treatment Effects: Single Mothers

	(1)	(2)	(3)
	ols	ols	ols
VARIABLES	participation	ln(weekly hours)	weekly hours
Access to FDS	0.039	-0.024	-0.896
	(0.024)	(0.042)	(0.684)
Single mother	0.033	0.115**	2.955***
	(0.029)	(0.047)	(0.962)
Access*Single mother	-0.000	-0.038	-0.335
	(0.068)	(0.078)	(1.844)
Children aged 0-1	-0.410***	-0.403***	-6.917***
	(0.026)	(0.069)	(1.276)
Children aged 2-4	-0.197***	-0.304***	-5.647***
	(0.019)	(0.043)	(0.823)
Children aged 5-7	-0.045***	-0.137***	-2.849***
	(0.015)	(0.032)	(0.603)
Children aged 8-10	-0.044***	-0.125***	-2.748***
	(0.014)	(0.026)	(0.502)
Children aged 11-12	-0.017	-0.082***	-1.891***
	(0.013)	(0.023)	(0.474)
Children aged 13-15	-0.018	-0.055***	-1.300***
	(0.012)	(0.020)	(0.444)
Children aged 16-18	-0.008	-0.022	-0.742*
	(0.012)	(0.019)	(0.451)
Individual FE	Yes	Yes	Yes
State-year dummies	Yes	Yes	Yes
State trend terms	Yes	Yes	Yes
Observations	10,606	6,222	6,222
Individuals	1,496	1,126	1,126
R-squared	0.604	0.730	0.769

Clustered standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

NB: Outcome "participation" includes those employed and actively seeking employment.

In Table 8, I present the results from the interaction of the access variable with a binary variable for whether or not the woman is a single mother. If we think that single mothers are more likely to work due to economic concerns, then their response to the treatment may differ in a key way. The results in this table, however, do not show a statistically significant heterogeneous treatment effect for single mothers versus the rest of the sample. The coefficient on the interaction term of access and single mother is small and negative in all three regressions, but it is not statistically different from zero.

6 Robustness

6.1 Estimation without teachers

In the previous analysis, I have ignored any possible impacts the extension of the school day may have had on the labor market. This might not be reasonable given how large the reform is and the impact it has had on the labor market for teachers. Since schools needed to hire many new teachers as a result of extending the school day, there has been increased demand for teachers across Germany.

Statistics from the Federal Statistical Office show that in the 2012-2013 school year, 88 percent of all primary school teachers were women (Statistisches Bundesamt). Since teaching is a traditionally female dominated career in Germany, the large increase in demand for teachers could affect the mothers in my sample. Teaching is also a career that allows women to combine work with childcare in a relatively straightforward fashion since their working hours do not extend beyond school hours. Additionally, many teachers in Germany also work part time. Of all teachers working in primary schools in the 2012-2013 school year, 38.65 percent of them were employed on a part time basis (Statistisches Bundesamt).

In order to disentangle the increased demand for teachers from the implicit childcare subsidy the mothers receive as a result of the extended school day, I drop all women from my sample who ever worked as teachers.[22] I observe 64 women in my sample who worked as teachers during the period 2000-2012, who I exclude and then run the same regressions on employment status and hours on this sub-sample. These results may be seen in Table 9.

These results are similar to those on the full sample in terms of the employment regressions. Columns (1) and (2) in this table show that women who gain access to a full day schol and have never worked as teachers are still 4.8 percent more likely to be employed. The marginal effect associated with the logit coefficient in Column (2) is 0.046. These results indicate that the increased demand for teachers is not driving the change at the extensive margin.

When we turn our attention to Columns (3) and (4), the results differ from those using the full sample. Now the negative effect of being treated on hours worked is statistically significant at the 10 percent level.

[22] I drop any woman who has worked as a teacher at any type of school, not just primary, because the reform to extend the school day has also occurred at the secondary schooling level.

Table 9: Estimates Without Teachers

	(1)	(2)	(3)	(4)
	ols	logit	ols	ols
VARIABLES	participation	participation	ln(weekly hours)	weekly hours
Access to FDS	0.048**	0.539**	-0.055	-1.163*
	(0.023)	(0.234)	(0.035)	(0.699)
Children aged 0-1	-0.434***	-3.376***	-0.510***	-10.459***
	(0.025)	(0.228)	(0.065)	(1.198)
Children aged 2-4	-0.219***	-1.745***	-0.388***	-8.393***
	(0.019)	(0.146)	(0.033)	(0.671)
Children aged 5-7	-0.063***	-0.590***	-0.194***	-4.861***
	(0.014)	(0.115)	(0.025)	(0.537)
Children aged 8-10	-0.059***	-0.519***	-0.163***	-4.026***
	(0.013)	(0.111)	(0.021)	(0.445)
Children aged 11-12	-0.031**	-0.259**	-0.106***	-2.809***
	(0.013)	(0.119)	(0.019)	(0.420)
Children aged 13-15	-0.030**	-0.285**	-0.066***	-1.843***
	(0.012)	(0.117)	(0.018)	(0.388)
Children aged 16-18	-0.019	-0.108	-0.023	-0.866**
	(0.012)	(0.111)	(0.016)	(0.379)
Individual FE	Yes	Yes	Yes	Yes
State-year dummies	Yes	Yes	Yes	Yes
Observations	6,216	6,216	6,176	6,176
Individuals	666	666	1,071	1,071
(Pseudo) R-squared	0.599	0.214	0.726	0.761

Clustered standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

NB: Outcome "participation" includes those employed and actively seeking employment.

The size of the coefficients is larger than those obtained from the full sample. This would reinforce the idea that extending the school day has made mothers who were already working decrease their hours due to the income effect of the implicit childcare subsidy.

6.2 Estimations without women who move

One way that women may be able to change their treatment status is by moving house so that their new closest primary school is a full day school. These women would undermine my identification strategy because their assignment to treatment is no longer random, which would make me unable to disentangle the childcare and labor supply decisions. These women might have a strong preference to work, which would overstate the importance of access to a full day school. This is why I run the same participation and hours worked models on a sub-sample of women that excludes the 40 women who have moved house from a home where the closest school was not a full day school to a home where the closest school is a full day school. Although I do not know whether or not this is the reason these women have moved (this is not explicitly asked in the GSOEP), I still drop these women as an additional robustness check.

The results of this analysis may be seen in Table 10. As this table shows, dropping the women who moved house and thereby changed their access status does not greatly impact the results. I still find a positive and statistically significant impact of the policy at the extensive margin, although this effect is now only statistically significant at the 10 percent significance level and only in the conditional logit model, and no effect at the intensive margin. The marginal effect associated with the odds ratio estimated in Column (2) is 0.042, which is similar in magnitude to the estimate from the full sample.

Table 10: Estimates Without Women Who Move

	(1)	(2)	(3)	(4)
	ols	logit	ols	ols
VARIABLES	participation	participation	ln(weekly hours)	weekly hours
Access to FDS	0.035	0.497*	-0.035	-1.066
	(0.025)	(0.259)	(0.039)	(0.705)
Children aged 0-1	-0.435***	-3.332***	-0.517***	-10.320***
	(0.025)	(0.228)	(0.064)	(1.188)
Children aged 2-4	-0.217***	-1.732***	-0.387***	-8.341***
	(0.019)	(0.148)	(0.033)	(0.693)
Children aged 5-7	-0.062***	-0.607***	-0.197***	-4.755***
	(0.015)	(0.115)	(0.026)	(0.544)
Children aged 8-10	-0.056***	-0.531***	-0.165***	-4.064***
	(0.013)	(0.112)	(0.021)	(0.446)
Children aged 11-12	-0.029**	-0.278**	-0.112***	-2.887***
	(0.013)	(0.120)	(0.020)	(0.428)
Children aged 13-15	-0.026**	-0.279**	-0.074***	-1.954***
	(0.013)	(0.122)	(0.019)	(0.416)
Children aged 16-18	-0.015	-0.087	-0.029*	-1.036**
	(0.012)	(0.114)	(0.018)	(0.424)
Individual FE	Yes	Yes	Yes	Yes
State-year dummies	Yes	Yes	Yes	Yes
Observations	6,295	6,295	6,332	6,332
Individuals	673	673	1,100	1,100
(Pseudo) R-squared	0.656	0.083	0.756	0.784

Clustered standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

7 Conclusion

The reform to extend the school day in Germany has been one of the largest reforms ever undertaken in their school system. As shown in the descriptive statistics of this paper, the reform is far from complete as many primary schools still have to switch-over to an extended school day. This entails building cafeterias and hiring new teachers. This lag in the reform has created a unique natural experiment, which allows me to look at how extending school hours affects maternal labor supply in a way few other studies have previously been able to do. Because there is still an element of choice in having your child attend a full day school in Germany, this identification strategy allows me to separate the endogenous childcare and labor supply decisions. I am also able to use a more precise measure of treatment than other studies which exploit regional variation by focusing on the school.

I find robust effects of the extension of the primary school day on maternal labor supply. Mothers of primary school aged children are roughly five percentage points more likely to enter the labor market once they are given access to a full day primary school. This result is robust to excluding teachers and to dropping women who may have moved house in order to live near a full day school. It is a large effect that shows this policy has been successful at drawing mothers into the labor market.

At the intensive margin, I find less robust evidence. In most specifications, the effect of the reform on hours worked is small, negative, and statistically insignificant. In the few specifications where the coefficient is statistically significant, its magnitude is still small and negative. This result of mothers decreasing their working hours when given an implicit childcare subsidy can be explained by the income effect of the implicit childcare subsidy dominating the substitution effect when leisure is a normal good. The unintended consequence of mothers potentially reducing working hours is something of which policymakers should be aware.

Childcare policies may be used to draw mothers into the labor market after having children or extend their working hours if already working; however, childcare costs and the length of the school day must be taken into consideration by policymakers. In a country such as Germany, where female labor supply is dominated by part time work and stay-at-home mothers, such policies can enact fundamental change to the labor market if implemented appropriately.

A After-school Childcare in Germany

Before the school day was extended in Germany, there was the option of after-school care, known as a *Hort*, most often provided by non-profit organizations, but often physically located at the primary school (Riedel, 2005). Parents had to sign their children up for a place at the *Hort* and pay for this service, which would often end at 4pm unless they also signed them up for an extended programme (Riedel, 2005). *Hort* still operate at many primary schools in Germany and even at full day schools since working parents may require additional childcare. Table 11 shows that places at such facilities were extremely limited in the states studied during the period of the reform. Note that "PA" in Table 11 refers to place availability, which is the ratio of places to children.

Table 11: After-school Childcare Place Availability Age 6-10

	2006			2009			2012		
State	**Places**	**Children**	**PA**	**Places**	**Children**	**PA**	**Places**	**Children**	**PA**
Bavaria	103,613	639,815	16.2	108,121	592,139	18.3	117,255	556,147	21.1
Hesse	56,004	301,950	18.6	58,927	280,988	21.0	59,138	268,690	22.0
Rhineland-Palatinate	29,302	205,163	14.3	24,803	185,738	13.4	23,544	171,342	13.7
Schleswig-Holstein	21,330	148,701	14.3	23,736	136,583	17.4	21,809	125,084	17.4

Source: *Statistisches Bundesamt, Statistik der Kindertagesbetreuung*

B *The Ganztagsschulreform* (Full Day School Reform)

The reform to extend the primary school day in Germany has been an on-going process over the last 10-15 years, born out of the motivation to not only improve educational outcomes, but also to make work and family more manageable for women. The *Ganztagsschulreform* or full day school reform is the reform process to extend the length of the school day at both the primary and secondary schooling levels. In 2006, the *Kultusministerkonferenz*, a regular assembly of all Ministers of Education from the federal states, defined a *Ganztagsschule* as a school that offers at least seven hours of instruction per day for a minimum of three days out of the school week and offers lunch to its pupils (Holtappels et al. 2008). Since education is a federal issue, states agree to have their schools extend the length of the school day according to a timeline they develop. This timeline is based on discussions with the Ministry of Education

in each state and the feasibility of transitioning to a full day school. This feasibility is determined in part by the speed at which new teachers may be hired and cafeterias may be built since lunch must now be available, which was not the case under the old system. States also have the flexibility to determine the model of full day schools they wish to implement.

Because Germany has a federal system, the education system and the reform process in the four states analyzed in this paper are not identical. The *Kultusministerkonferenz* ensures, however, that many elements of the education systems are standardized. These four states all have a similar structure to their education system, where children attend primary school from age six until the end of fourth grade, when they are ten year old. At this point, the children are then placed into one of three tracks: the university track secondary school (*Gymnasium*), a higher vocational track secondary school (*Realschule*), and a lower vocational track secondary school (*Hauptschule*) (Robelen, 2005). Because there are no national standardized tests in Germany, it is difficult, and not encouraged, to compare the education systems across states.

There is one key difference in the reform between the four states, which has to do with whether or not every class at a given school switches to a full day or just a certain percentage of classes switch (in German this is the difference between an *offene Ganztagsschule*, open full day school, and a *gebundene Ganztagsschule*, complete full day school). An *offene Ganztagsschule* might only have one or two classes per grade level that offer the extended school day option and parents would have to choose to sign their child up for this option whereas at a *gebundene Ganztagsschule*, all children automatically receive the longer school day. Regardless of the type of full day school, they still may offer only three days of extended instruction per week; however, in the data collection and contacting of Ministries of Education for this project, it seems that many schools offer the extended instruction every day of the week.

In Bavaria, for example, all primary schools that have switched to the full day are *gebundene Ganztagsschule*, while in the other states, this has not been the case. Some schools in some of the other states may have switched all classes while others may only have switched one class. The main difference between these two models of switch-over is the cost: switching all classes at the same time means even more teachers must be hired. This accounts for the slower rate of reform in Bavaria as opposed to the other states. For the purposes of the analysis in this paper, I treat all full day primary schools in the same manner because I assume that having the availability of a full school day is enough for the mother to be treated and allows me to estimate an intention to treat (ITT) effect. In discussions with the Ministries of Education for this paper, they confirmed that there has not been massive over-subscription or issues of shortage surrounding full day school places, which makes me confident in combining these two types of full day schools in my analysis.

C Basic Labor Supply Model with Childcare as a Fixed Cost

This model shows the effect of fixed costs on labor supply and is similar to the static model in Pencavel (1987): the women in this model want to maximize their utility function $U(x,\ h)$, where x represents consumption and h represents hours of work. This utility function is increasing in x and decreasing in h and is well-behaved (real valued, continuous, and quasi-concave).

As the women face a fixed cost to entering the labor market, childcare, the budget constraint will be piecewise linear. This is because I assume that once a woman decides to work any number of hours beyond $\hat{h}$, she must pay for childcare. We may think of this fixed cost as the money paid to a childminder or nanny, or the set amount of money that a childcare programme charges per week or month. The woman solves the following maximization problem for each segment of the budget constraint to determine her participation and her hours:

$$max_{x,h} \quad U(x,\ h) \quad s.t.\ \ px \leq \begin{cases} y & if\, h = 0 \\ wh + \tilde{y}, & if\, 0 < h \leq \hat{h} \\ wh + \tilde{y} - F, & if\, h > \hat{h} \end{cases} \tag{4}$$

Solving this maximization problem yields tangency conditions, which is how the woman will determine her participation and hours. There are three different cases to consider: women who do not work, women who work $\hat{h}$ hours, and women who work more than $\hat{h}$. I do not consider the case of women who work less than $\hat{h}$ hours or who work exactly $\hat{h}$ hours at an interior solution because provided they have well-behaved preferences, they will not be affected by the reform.

Where p is the price of consumption, which may be normalised to 1, w is the wage the woman receives for working, which I assume to be the same across hours worked, $h > 0$ are the hours she works, $\tilde{y}$ is her non-labor income minus the general fixed cost to working ($\tilde{y} = y - z$), and F is the fixed cost of childcare needed outside of the primary school day. Combining these two budget constraints gives us a piecewise linear budget constraint. If the woman does not work at all, her income will be composed of non-labor income, y, only. If she works any hours less than $\hat{h}$, she has to pay a small fixed cost of working, z, e.g. transport costs, which explains why the first linear segment of the budget constraint begins below the full amount of non-labor income y. If she works any hours above $\hat{h}$, however, not only does she have to pay the fixed cost of working at all, but she must also pay the fixed cost of childcare beyond the hours in which the child is at primary school.

The first case is that of a woman who was not working before the extension of the primary school day. This scenario may be seen in Figure 15. The woman is initially working zero hours at point A, which is a corner solution, because this same indifference curve is not tangent to any attainable point on her budget constraint. By not working, this woman is on her highest attainable indifference curve. Once the

school day is extended and $\hat{h}$ increases to $\hat{h}'$, the woman is able to move onto a higher indifference curve at the newly attainable portion of her budget constraint, which changes her employment status from not working to working. This is shown by the new tangency point B. This result relies on the general fixed cost to working, e.g. the commuting cost, because without it, no women would be drawn into the labor market as a result of the decrease in childcare costs. The second case is a woman who was working

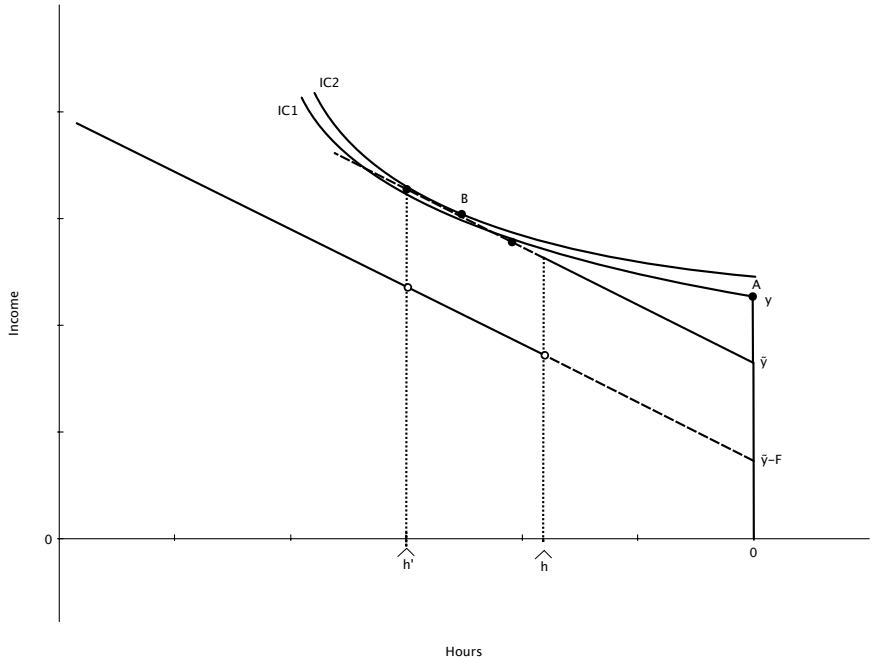


Figure 15: Case 1: Woman not working

exactly $\hat{h}$ hours before the reform. In this case, the woman has coordinated her work schedule exactly with that of the primary school. Figure 16 shows the budget constraint and indifference curves for the woman who is at a corner solution at $\hat{h}$. Initially she is working $\hat{h}$ hours, at point A. The discontinuity in the budget constraint coupled with her preferences brings about this corner solution. Once school hours are extended to from $\hat{h}$ to $\hat{h}'$, this woman is able to move onto a higher indifference curve on the newly extended portion of her budget constraint, at the tangency point B. This woman is now working more hours than before. The third case, shown in Figure 17 is a woman who is working more than $\hat{h}$ hours. This would include all mothers who work full time and some mothers who work part time, provided their hours go beyond the length of the primary school day. Before the reform, this woman determined her participation and hours by selecting point A, where her highest indifference curve is tangent to her budget constraint. Once school hours are extended to from $\hat{h}$ to $\hat{h}'$, this woman has an extended portion of the budget constraint at which the fixed cost of childcare is not deducted. As a result, she can move onto a higher indifference curve, which is tangent to her newly extended budget constraint at point B. In this case she has decreased her working hours, but is still better off than before. The outcome in this third case depends on several factors. First, the size of the fixed cost to working. If the fixed cost to working is very small, which is probably not the case with childcare, and the wage rate is high, meaning the budget

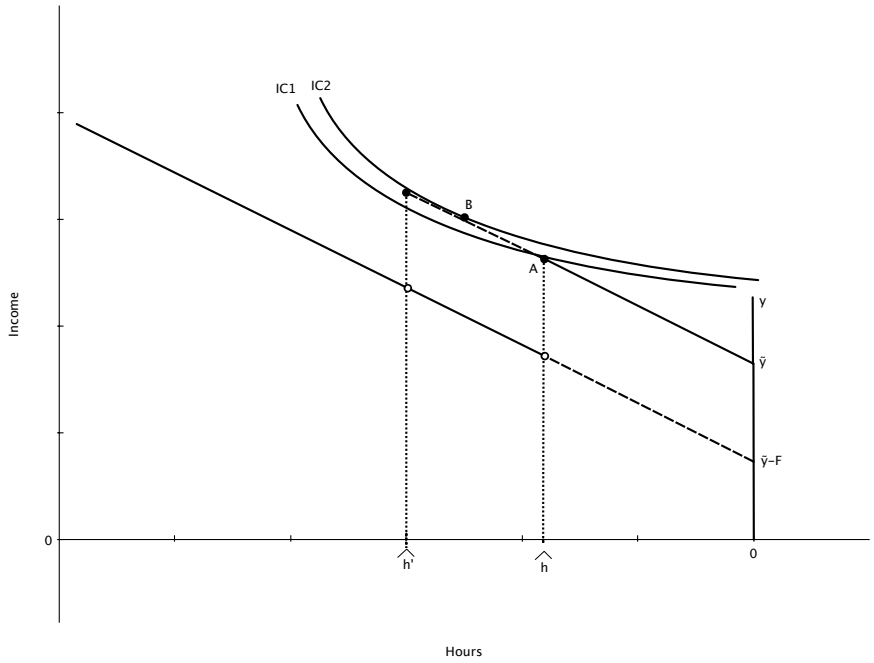


Figure 16: Case 2: Woman working exactly primary school hours

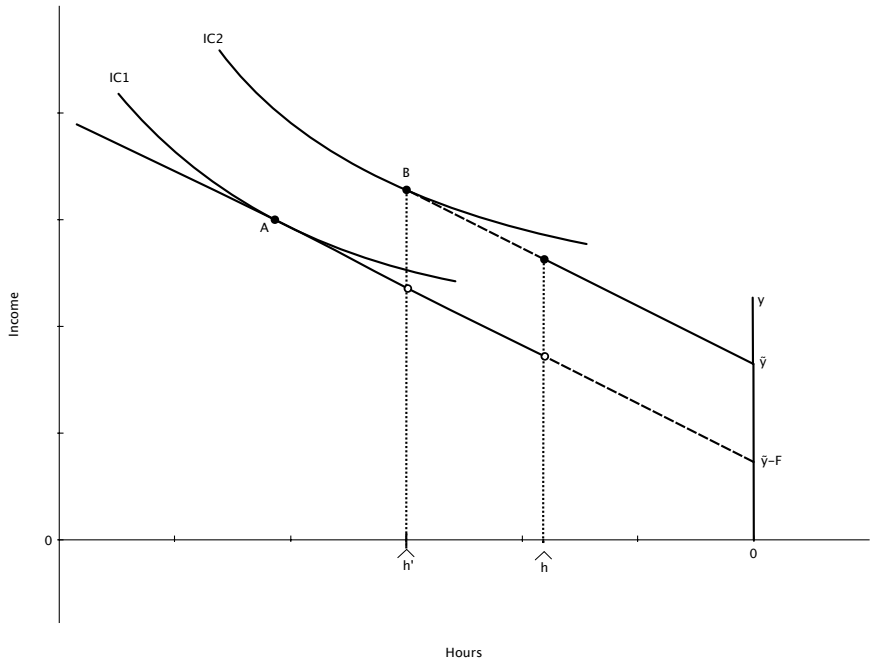


Figure 17: Case 3: Woman working beyond primary school hours

constraint is steep, then the woman may not experience an income effect as a result of the reform. This would apply to women working a lot of hours in this case. The woman who does not experience an income effect as a result of the reform has no reason to change her working hours. Second, whether or not leisure is a normal good. If leisure is a normal good, then the woman facing this labor supply problem must stay at the same hours or decrease her hours as a result of the reform because she only faces an income effect in this case. This model predicts that as a result of the extension of the primary

school day, mothers who were not working before will be drawn into the labor market, but that for women who were already working before the reform, they will either increase or decrease their working hours. The sign of this change depends on how many hours they were working before and their preferences. If we observe mothers setting their working hours exactly to match the length of the primary school day, then we would expect them to increase their hours as a result of the reform. For women working more hours than the length of the school day, this model predicts that they will shorten their working hours. In all cases, women are able to reach a higher indifference curve as a result of the policy change, making them better off than they were before.

D Additional verification of identification strategy

The GSOEP includes a limited number of variables related to child level outcomes, which may have been affected by this reform. It does not include enough information on grades or other academic outcomes to assess the impact of the reform on learning outcomes; however, there are some limited time use variables, which will allow me to verify the validity of my identification strategy. My goal is to show that the children of the woman I am assigning treatment to have actually experienced a change due to the treatment and therefore, assigning treatment to their mothers is a valid approach.

Table 13: Estimates on Child's School Hours

VARIABLES	hrsschool
FDS	16.268***
	(2.095)
Constant	14.665***
	(0.532)
Individual FE	Yes
Year dummies	Yes
Observations	181
R-squared	0.189
Number of children	152

Clustered standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The GSOEP collects information on how many hours primary school aged children spent in various types of childcare, including hours spent at school, when the children start primary school (age six) and again shortly before they transition to secondary school (at age ten). These questions are answered by parents, and the data is only available for a rather small sample of children, 152, who live in the four states of interest.If the identification strategy is working, we would expect that having access to a full day primary school would increase the number of hours a child spends at primary school. I use the same variable, access to a full day school, as determined by proximity to closest primary school, to estimate the following model:

$$SHours_{it} = \alpha_0 + \beta FDS_{it} + \gamma_i + \theta_t + e_{it} \quad (5)$$

Here the subscript ``i'' denotes the child and the subscript ``t'' denotes the year. The variable $SHours_{it}$ is the number of hours the child spends in school and FDS_{it} is the binary indicator for whether the child's

closest primary school is a full day school.

Indeed, as the results in Table 13 show, having access to a full day school increased the number of hours a child spent per week at primary school by approximately 16 hours. Given the confidence interval on this coefficient, this result is in line with an extension of the school day by 2.5 hours per day. Based on this analysis, it seems as though the strategy of using the closest primary school to determine access to a full day facility is a valid method for determining treatment status of mothers.

References

[1] Autor, David H. "Outsourcing at will: The contribution of unjust dismissal doctrine to the growth of employment outsourcing." Journal of Labor Economics, January (2003).

[2] Baker, Michael, Jonathan Gruber, and Kevin Milligan. "Universal Child Care, Maternal Labor Supply, and Family Well-Being," Journal of Political Economy, University of Chicago Press, 116.4 (2008): 709-745.

[3] Berthelon, Matias, Diana Kruger, and Melanie Oyarzún. ``The Effects of Longer School Days on Mothers' Labor Force Participation." IZA Discussion Paper No. 9212, (2015).

[4] Brewer, Mike, and Claire Crawford. Starting school and leaving welfare: the impact of public education on lone parents' welfare receipt. No. 10, 19. IFS working papers, 2010.

[5] Cameron, Adrian Colin, and P. K. Trivedi. Microeconometrics: Methods and Applications. Cambridge: Cambridge UP, 2005.

[6] Card, David and Krueger, Alan. "Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania", American Economic Review, 84.4 (1994): 772-793.

[7] Contreras, Dante, Paulina Sepúlveda, and Soledad Cabrera. "The effects of lengthening the school day on female labor supply: Evidence from a quasi-experiment in Chile." Centro de Microdatos, Departamento de Economía. Universidad de Chile (2010).

[8] Gelbach, Jonah B. "Public schooling for young children and maternal labor supply." American Economic Review (2002): 307-322.

[9] Germany. Statistisches Bundesamt. Statistik Der Kindertagesbetreuung. N.p., 2014. Web. 13 Nov. 2014.

[10] Germany. Statistisches Bundesamt. Allgemeinbildende und berufliche Schulen: Lehrkräfte insgesamt sowie Anteil der weiblichen Lehrkräfte nach Schularten und Beschäftigungsumfang. N.p., 2014. Web. 3 Dec. 2014.

[11] Geyer, Johannes, and Viktor Steiner. "Short-run and long-term effects of childbirth on mothers' employment and working hours across institutional regimes: an empirical analysis based on the European Community Household Panel." IZA Discussion Paper No. 2693 (2007).

[12] Heckman, James J., Lance J. Lochner, and Petra E. Todd. "Earnings Functions, Rates of Return and Treatment Effects: The Mincer Equation and Beyond," Handbook of the Economics of Education. Elsevier, 2006.

[13] Holtappels, Heinz Günter. Ganztagsschule in Deutschland: Ergebnisse Der Ausgangserhebung Der "Studie Zur Entwicklung Von Ganztagsschulen" (StEG). Ed. Eckhard Klieme, Thomas Rauschenbach, and Ludwig Stecher. Weinheim: Juventa Verl., 2008. Print.

[14] International Labor Organization Statistics (ILOStat). ``Employment-to-population ratio by sex and age (%)." <http://www.ilo.org/ilostat>

[15] Lefebvre, Pierre, and Philip Merrigan. "Childcare policy and the labor supply of mothers with young children: A natural experiment from Canada." Journal of Labor Economics 26.3 (2008): 519-548.

[16] Marcus, Jan, Janina Nemitz, and C. Katharina Spieß. ``Ausbau der Ganztagsschule: Kinder aus einkommensschwachen Haushalten im Westen nutzen Angebote verstärkt" DIW Wochenbericht, 27(2013): 11-23.

[17] Meghir, Costas, and Marten Palme. "Educational Reform, Ability, and Family Background." American Economic Review. 95.1 (2005): 414-24.

[18] Miani, Celine, and Stijn Hoorens. "Parents at work: men and women participating in the labour force." European Commission Short Statistical Report No. 2 (2014).

[19] Nemitz, Janina. ``The Effect of All-Day Primary School Programs on Maternal Labor Supply." University of Zurich, Department of Economics Working Paper No. 213, (2015).

[20] Neufeld, Sara. "Extending the School Day Is a Lot Harder Than It Seems." The Atlantic. Atlantic Media Company, 21 Jan. 2014. Web. 29 Sept. 2016.

[21] Rainer, Helmut, et al. "Kinderbetreuung." ifo Forschungsberichte 59 (2013).

[22] Riedel, Birgit. "Das institutionelle Angebot für Kinder ab 6 Jahren (Grundschulalter)." Deutsches Jugendinstitut eV/Dortmunder Arbeitsstelle Kinder-und Jugendhilfestatistik: Zahlenspiegel (2005): 143-155.

[23] Robelen, Erik W. "The Great Divide." Education Week (2005): 31-35.

[24] Socio-economic Panel (SOEP), Data for years 1984-2012, Version 29, 2013.

[25] Wenzel, Stefanie. "Konvergenz oder Divergenz? Einstellungen zur Erwerbstätigkeit von Müttern in Ost-und Westdeutschland." GENDER–Zeitschrift für Geschlecht, Kultur und Gesellschaft 2.3 (2010).