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The impact of parents' labor supply shocks (reduction in working time) on their children's schooling outcome

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Abstract

In June 1998 in France, the Aubry Law I implements the legal workweek reduction at 35 hours (keeping earnings constant). Less than two years later, the Aubry law II confirms the reduction of working time. Around 40 percent of the workforce was affected by these laws. This reform was implemented in order to create jobs and reduce the unemployment in France. Until now most of the studies evaluate the impact of the Aubry laws on the labor market conditions, but here we want to look at spillovers effects. In fact, we will investigate the impact of the 35 hours reform on educational outcome of children whose parent have reduced their working time. Indeed, we expect an increase in the schooling outcome trough the fact that parents spend more time with their children. Using the reduction in working time reform as a natural experiment and the fact that some professional categories were not touched by it as the teachers, we will try to capture the effect of parents' labor supply shocks (the 35 hours reform) on their children's schooling outcomes.

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Contents

List of Tables

List of Figures

Introduction

According to OECD data, in 1995 the annual working time for a French worker was about 1 590.7 hours, in 2002 the same figure was about 1 497.3 hours. This reduction in the working time in France is the result of some adopted measures. In fact, the 13 June 1998, the Aubry law I is enacted and roll the reduction in working time (RWT) out in France. Less than two years later, in January 2000, the second Aubry law comes into effect confirming the 35 hours as being the legal working time per week. This reform of the working time of the French worker is done in order to answer at the high level of unemployment and allows firms to have access to more flexibility. These measures are expected to increase the productivity, decrease unemployment and contribute to a better welfare of workers. Until now most of the studies about this reform try to evaluate the effectiveness impact of these laws by focusing their work on the labor demand behavior and on the employment situation. For example, Chemin and al. [1], study the effect of the Aubry laws on the employment situation by comparing the Alsace-Moselle region and the rest of the France. Other authors have been also interested in the impact of the Aubry laws on the labor supply side. For example, Goux and al. in 2014 [2], have studied the effect of the reform on the spousal labor supply within a household and on the direct hour effect. They find that the 35-hours agreements leads to a reduction about two hours in the workweek for husband and wife.

The previous result shows that following the Aubry laws, the workers have indeed decreased their working time and so have benefited from more free time. Therefore, we can suppose that this new surplus of free time could be used in several ways, but that for parent's worker this time could be allocated to their children. This surplus of time share with the children could be beneficial for them. Indeed, many studies have highlighted the beneficial effect of parents' commitment to their children's education (better cognitive skills, grades etc.). So that we can expect an increase in the children educational outcomes, though more time allocated by parent to them.

So far, the existing evaluations of the workweek reduction policy have been focused on this employment effect and don't always take into account its spillover effects as the time spent by parents with their children, which could affect another public concern like education. An overall view of the effects of the 35 hours reform on the different sides of the society is still needed, and we want to contribute to it by studying in this master thesis the impact of the parents' labor working time reduction on their children's schooling outcomes using the 35 hours reform as a natural experiment.

To do this, we will first present some introductory fact. Second, we will explicit the methodological analysis we will do and the data we will use. To begin the study we do first a graphical analysis in the chapter 3 to capture some pertinent evolution. In the last chapter, we implement several's estimation strategies and discuss the results we will find.

Chapter 1

Introductory facts

1.1 The Aubry Laws: implementation of a reduction in the working time

1.1.1 Objective of the laws

In France, since 1982 the legal working time was about 39 hours per week. In 1996, a first action to reduce the working time under the condition to avoid termination or conduct new employment in the same proportion was allowed by the Robien law. Two years later, the government of Lionel Jospin undertakes a reform to pursue this idea. The 13 June 1998, the Aubry law I is enacted and roll the reduction in working time (RWT) out. This law expects 35 hours of being the legal working time for most of the French private sector full time workers. The 19 January 2000, the Aubry law II, confirms the first one and changes some rules relative to the RWT and the bargaining process associated with it.

The objectives of the Aubry laws were about three dimensions: The first concerns the reduction of the unemployment. In fact, in a context of high unemployment rate (about around 10,3% in 1998 according to OECD data), the French government thinks that the RWT allows to reallocate this new time and share it with other workers. The expression which gives this idea is "work less in order to work all". Second, the RWT is expected to permit a reorganization into the firm by more flexibility in the hours. This is expected to allow firms to be more competitive and productive. Finally, the RWT provides better living conditions for workers as they have more free time and so could find a preferable equilibrium in term of private life. On overall, these laws imply better economic efficiency for the firm through less unemployment and productivity gains. Second, it's also referred to workers welfare improvement.

1.1.2 Implementation of the reduction in the working time for the firm

In June 1998, the law numbered (1998-461), untitled the "Aubry law I" proposed through a bargaining process, the reduction in working time at 35 hours per week. The deadline according to the firm to comply with the law are different in function of their size. The firms with more than 20 employees have until the 1st January 2000 whereas the firms with less than 20 employees have until the 1st January 2002. To encourage the firms to reduce the working time of their workers, the Aubry Law I, establishes a system of incentive aid under the condition of an agreement between the social partners: The firm is committed to increase it's total payroll by 6% if the working time has reduced by 10% or avoid in the same proportion the number of layoffs. The target of this incentive helps is to maintain the level of employment or increase it.

In January 2000, a second law, untitled the "Aubry law II" corroborates the reduction in working time. With this law, the incentive help is deleted for firms with more than 20 employees. Concerning the firms with less than 20 employees they have always access to the aid but on the condition to decrease the working time to 35 hours until January 2002. This second law, implements also the "Annualization" of working time.

In the following tables derived from a study "Les modalités de passage à 35 heures en 2000" [3], we will present in more details some figures of the RWT reform. Given the table 1.1 which shows the passage to the 35 hours depending on the date, we can see that at the end of the 1999 year around 39.000 firms have adopted the 35 hours working time and that around 4 millions of workers was employees in these firms. Concerning the second Aubry law, there is around 2.8 other million workers who have adopted the reduction in working time reform. At the end of the year 2000 around 7.000.000 firm's employees was working 35 hours per week.

Table 1.1: Transition to the 35 hours

	Before 13/06/98 (Law Robien)	**13/06/98 - 31/12/99 (Aubry law I)**	**End 2000 (Aubry law II)**
Number of firms	**2 290**	**38 900**	**30 400**
Number of establishments	**8 700**	**138 700**	**84 100**
Number of employees	**347 000**	**4 438 000**	**2 785 000**
Creation of employment planned	**25 800**	**194 000**	**84 500**
Source : base MES-DARES, URSSAF, base des accords DESTIN et bases des conventions Robien et Aubry I . Travail.gouv.fr. "Les modalits de passage 35 heures en 2000". Fevrier 2002-N06.3			

Concerning the sector affected by the RWT reform, we can see in the table (1.2) that the employees of the commerce and services sector have been the more affected. Indeed, 64.2% of this sector employees have been concerned by the Aubry law I. The industry sector employees have also been affected as they were about 43.5% to be concerned by the second Aubry law. Finally, the construction activity sector seems to be less concerned by the RWT as about 8% of employees of this sector were affected. So the different sectors of activities were not touched in the same way by the RWT reform.

Table 1.2: Distribution of affected employees by sector of activity

Sector of activity:	**Employee concerned by the Aubry law I before 2000**	**Employee concerned by the Aubry laws II in 2000**	**Whole of employees**
Commerce and services	**64.2%**	**51.3%**	**64.3%**
Industry	**29.1%**	**43.5%**	**27.8%**
Construction	**5.2%**	**4.8%**	**7.9%**
Source : bases des conventions Aubry1 , enqute modalits de passage 35 heures et base SIRENE (effectifs au 31 dcembre 1999). Travail.gouv.fr.,"Les modalits de passage 35 heures en 2000". Fevrier 2002-N06.3			

Concerning the occupation status, the Aubry laws have affected the different socio-professional categories in a heterogeneous way. The table 1.3 presents the distribution of workers concerned by the RWT given their professional category. We can see that workers have been highly affected by the reduction of working time: 38% of the workers were concerned by the Aubry law II. Intermediary professions employees and executives were also touched. They were concerned by around 20% and 15% respectively. Finally, 32.7% of the employees were affected by the Aubry law I.

We can notice that the executives have a specific regime concerning their working hours. In fact, since the Aubry law II, the working time for some executives workers (not the leaders ones) is regulated by an "annual package by day" which refers to the concept of the "annualization" of the working hours. Now the working time is not longer counted per hours but per day. This allows executives to be independent in their working time organization. The implementation of this "annual package by day" is conditioned by a branch or firm collective agreement. Executives workers, have to work 218 days per year. In order to not overpass this limit they can have supplementary days off: the RWT translate into "RTT" in French. We can notice than for non-executive workers, the "annualization" correspond for the full time worker to 1600 hours worked per year.

However, the Aubry laws account some exceptions. Professors and teachers were not concerned with the reduction in working time. Their working hours and vacancy days remained the same. To be more precise in the teaching profession, the researcher has a right to work 35 hours only from 2002. The other profession which is exempt of the 35 hours reform concerns the military. In fact, they enjoy a specific status, which gives them specifics rights and obligations. Their working hours depend on their missions. They have no holidays but permission 45 days by year. Finally, the judges are also concerned with the 35 hours since 2002. In a global point of view, the Aury laws don't concern all the French workers. Teaching profession workers and military are the two main exceptions.

Table 1.3: Distribution of workers concerned by the RWT by professional categories

	Worker concerned by the Aubry law I before 2000	**Worker concerned by the Aubry laws II in 2000**	**Whole**
Executives	**9.7%**	**20%**	**12.4%**
Intermediaries professions	**18.5%**	**14.8%**	**20.4%**
Employees	**32.7%**	**26.9%**	**29.1%**
Workers	**39.1%**	**38.3%**	**38.1%**
Sources: Source : base des conventions Aubry I , enqute modalits de passage 35 heures et enqute Emploi de lINSEE de mars 2000. Travail.gouv.fr. Study: "Les modalits de passage 35 heures en 2000". Fevrier 2002-N06.3			

1.1.3 Impact for the workers

In a simplest classical point a view, the worker have to maximize his utility under a resource constraint (R) compose by the wage he wins when working and an exogenous component (r). The individual have to make choices and allocated his time (T) into two main components. The first one is the time allocated to a rewarding activity (t), where the remuneration is in general a wage (w). The second component is the leisure time (l). This later have an opportunity cost: The wage that he could have won if it pass his leisure time to work.

Time constraint equation:

$$T = t + l \tag{1.1}$$

Resources constraint equation:

$$R = wt + r \tag{1.2}$$

In a less formal analyse, the leisure time, could be used by the worker in several's ways: spend time at home with his family or meet friends or do sport, etc. The RWT reform allows worker to work less (reduce t) and increase his leisure time (l) without the opportunity cost associated to this fact. Indeed, the Aurby laws permit worker to work less keeping his wage constant. By this way, there is no opportunity cost to work less and this surplus of time could be considered as free. So that a new free surplus of leisure time is according to the worker. This, could change his behaviour, notably as concern his activity outside his work. In this master thesis, we expect this new surplus of free time to be allocated to the worker's family activities, notably an increase in the time spends by parents with their children.

1.2 Existing evaluation of the 35 hours reform

In the literature some researchers have been interested by the French reduction in working time reform. The first approach is to see if these laws have indeed created jobs and if they have improved the labor market efficiency. For example Chemin and al [1] in 2009 in their article, study the effect of the Aubry laws on the employment situation by comparing the Alsace-Moselle region and the rest of the France. To evaluated this impact on the employment, they used the fact that this region was less affected by the RWT reform than the France was. Their main result is that the 35 hours reform implemented in this region don't gives them an evidence of a significant impact on the employment situation. Indeed, they did not find a significant difference in the employment change between the Alsace-Moselle region and the rest of France. Their results goes toward the view which indicated that the RWT reform has no impact on the employment situation. However, according to Askenazy Philippe in 2008 [4], the measure of the impact of the RWT reform is limited by some aspects. First, it's difficult to find real numbers about the change in working hours. Second, the measure ex-post about the impact of the RWT on the employment situation could be bias. For example, the firms which have implemented the RWT have some characteristics which are correlated to their workforce management behavior so that just comparing them to other firms could create a selection bias in the estimation. Crepon et al. (2004) [5], using individual firm data explore the effect of the 35 hours reform on the employment situation and on the productivity of the firm. Taking into account the endogeneity problem we talk about, they found that firm which implements the RWT reform experience an employment growth. This creation of job was allowed because the RWT was associated to aids. So contrary to the results found by Chemin and al. paper they found a positive effect on the employment situation. Other authors have studied the effect of the Aubry laws on the employment situation but in the literature there is no consensus.

Concerning other aspects of this working time change, other authors have been interesting on the labor supply slide behaviors. Goux and al. (2014) [2], study the effect of the laws on the spousal labor supply within a household. They find a direct effect of the 35-hours agreements on working time: a reduction of the working time per week about 2 hours for the husband and the wife. They also study the Cross-hours effects within a household, that is to say, how own working hours response to spouse working hours. They find that cross-hours effects are highly asymmetrical and heterogeneous: Cross-hour effects are significant for husbands but negligible for wives. Its much larger for fathers of young kids, especially highly skilled ones. This study allows to understand in which way spouse reacts when there is an exogenous chock in their working time.

So far the literature studies the impact of a working time policy on labor supply and demand side in order to evaluate its impact on some aspects as employment, welfare of worker or adjustment in their working time.

1.3 Motivations and policies implication

A large part of the existing evaluations of the workweek reduction policies have been focused on its impact on the labor market aspects and don't always take into account the spillover effect that the new regulation can have on other dimensions like some change in the behavior of workers. For example, if we considered that workers could be parents and their work "habitus" have an impact on their family life, like the time they spend with their children, the RWT reform could change these "habitus". This change is notably related to the surplus of leisure time they have after the RWT, that is to say the use of the augmented (l). Consistent with the results found in the Goux and al. paper (father of young kids adjust more their working time), we could think that the RWT reform lets parents who were affected, change their "habitus" and spend more time with their children. This gain of time spends with them could be beneficial in term of educational or schooling outcomes. In the existing research about the factors which play a role in the academic achievement of children it had been shown that the parental involvement is one of theses determinants. Senler and al [6], in their paper, found a direct link between perceived family involvement and school achievements for elementary school children. So that some authors agree about the benefice of the parental involvement in the children educational outcomes. The parental involvement could take many forms as the time spend by parents with their child. For example, Ho Sui-Chi and Willms (1996) [7], show in a U.S study case than the discussion at home between parent and their children about school related topics had a strong effect on academic achievement.

By this way, it could be interesting to study, the impact of parents' labor supply shocks (reduction in working time) on their children's schooling outcomes. In fact, we expect the RWT reform allows parent's workers to have more free time and perhaps allocated it to their children. This new time according to them is so expected to lead to better educational outcomes. Exploiting the data we will use in this master thesis, we present here a pure descriptive regression of the sciences and reading test mean score value of children on the time spend by parents with them. As presented in the following table, the time spend by parents with their child is indeed positively correlated to test mean score value in the topics quoted above.

Table 1.4: Time spend with the child and schooling outcome: Descriptive regression

	Sciences test mean score	**Reading test mean score**
Time spend to the talk with the child	**4.272*** **	**6.334*** **
	(1.21)	(1.02)
constant	**506.116*** **	**510.312*** **
	(1.07)	(0.98)
dfres	*7907.000*	*9460.000*
Nb.observations	*7909*	*9462*
Significance level: p<0.05*, p<0.01** and p<0.001.*** ***Standard errors in parentheses.*** ***Sources: PISA data (survey 2000, 2003, 2006, 2009, 2012 and 2015).***		

These firsts relations motivate our approach which consists to show a positive impact of the RWT of parents on their children's schooling outcome thought the increase in the time they spend with them. This link we want to investigate between parents working hours change and children's schooling outcomes could highlight some spillover effects between labor market policies and educative ones. Being interested in such spillovers effect of this reform allow to try to understand by which mechanism we can have an indirect effect on another domain. If we found significant results of a positive externality of the RWT reform on educational outcome, this could be used by the future policy marker in order to evaluate ex-ante the plausible indirect effect of the policy they want to implement could have.

Chapter 2

Methodology and Data

2.1 Methodology

2.1.1 Basic facts and main hypotheses

As seen in the part (1.1) the Aubry laws were implemented in a way such that professionals categories was touched differently by the new working time regulation. The majority of the workers have been touched but some exceptions exist as teachers or military workers. We can use this fact to see any differential impact of the laws. Our analysis of interest suggests that in the light with the preceding evaluation of the Aubry law, the reduction in working time allows affected workers to have more free time keeping their earnings constant. This surplus of time could be used in several's ways, but we can think that for parents this time is used to pass more time with their children. This new time spend with children could be beneficial for them notably in term of educative or cognitive outcome.

The Aubry laws furnishing a good natural experiment to make the analysis of interest. Indeed the specification of the reduction in working time implementation allows us to make some assumptions needed to conduct our study:

Assumption 1.a: Thank to the fact that the Aubry laws doesn't affect all workers, we can define a treatment group composed by children whose parents are in the professional categories affected by the reduction in working time and a control group composed by children whose parents are not affected.

Assumption 1.b: The Aubry laws had no monetary impact on affected workers as their earnings are kept constant. So that, the reduction in working time doesn't play a role in the economic choice and behaviors of

affected workers (work plus to win more in another job for example). The reduction in working time allows a **surplus of free time** for affected workers.

The last and important hypothesis which need to be fulfilled and checked for our analysis concern the allocation of the surplus of free time.

Assumption 1.c: A part of the new time surplus allows by the reduction in working time is spent with the children. This assumption need to be valid for our analysis as the way by which the reduction in working time is supposed to affect the child's schooling outcomes is by the fact that a parent spends more time with him.

2.1.2 The surplus of time: more time spent with the child?

As explain our main channel by which the 35 hours reform affect the children's schooling outcome is by the fact that parents spend more time with them. This surplus of time is expected to have some positive externalities on schooling results. Before seeing directly at the impact of the laws on schooling outcomes, it's seems to be necessary to look at the evolution of time spent with the child following the Aubry laws. This is needed in order to valid our **assumption 1.c.**

According to a Master thesis, untitled " Synchronisation et temps de travail: Quel impact des 35h sur le temps parental?" [8], a student using data from " Enquete Emploi du Temps" from INSEE, study the impact of the Aubry's laws on parental time. Exploring the fact that the parental time is an important factor in the cultural transmission, he found that the reduction in working time allowed by the Aubry's laws creates a positive chock on the parental time of treated workers defined as executives in comparison to teachers workers not affected by the RWT reform. The main conclusion of this study is that the RWT allows executive's parents "to win 19.7 minutes by day of parental time". The results of this master thesis could valid the hypothesis that the reduction in working time allows parents to spend more time with their children following the 35 hours reform.

Depending on the data we have in our work, we also will try to test this hypothesis. First in the **chapter 3**, we will look graphically at the evolution of time spent by parents with the child. Second, in the **chapter 4**, we will exploit the data and used an Instrumental Variable (IV) estimation strategy. In fact, we will instrument the time spend by parents with their children by the fact to be a parent affected by the 35 hours reform. The IV estimation strategy is used as the effect of time spent by a parent with his child on schooling outcome could be endogenous. Indeed, it's expected to be determined by the reduction in working time reform. More free time allows parents to spend more time with the child. Thought this new surplus of time share with the children, we expect an increase in the value of the schooling outcomes. After to have made a first stage estimation, we will look at the impact of the instrumented time spend by parents with their children on their schooling results.

2.1.3 Reduction in working time and schooling outcomes: A Difference in Differences estimation strategy

The Aubry laws: A treatment

The Aubry laws represent a specific intervention in the labor market of the French government in the 1998s year. The passage of the law change the legal working time of several workers. This change could produce some modifications on the labor market but also on other aspects such as changes in the behaviors of worker. As explained before parents who work less thanks to the laws can now pass more time with their child and so contribute to a better educational outcome like better schooling results.

Wanting to estimate the effect of the Aubry laws on schooling outcomes, a Difference in Differences (DID) estimation strategy seems to be a good point. In fact, the DID estimation strategy is generally used to identify the effect of a specific treatment on a population of interest. Its compare variation in outcomes between two groups over time. Its the difference in outcomes before and after the implementation of the laws between the treatment group (here workers affected by the reduction in working time) and the control group (workers not affected). In this context, the Aubry laws furnishing a good experiment as they didn't touch all workers and so allow us to distinguish a treatment and a control group (**hypothesis 1.a**). Moreover, the reduction in working time was such that we can define a post and a pre-treatment period.

Main assumptions for the groups definition:

To try to capture a causal impact of the parent's labor supply shock (due to the Aubry laws) on schooling outcome of their children we need some specific assumptions to be fulfilled:

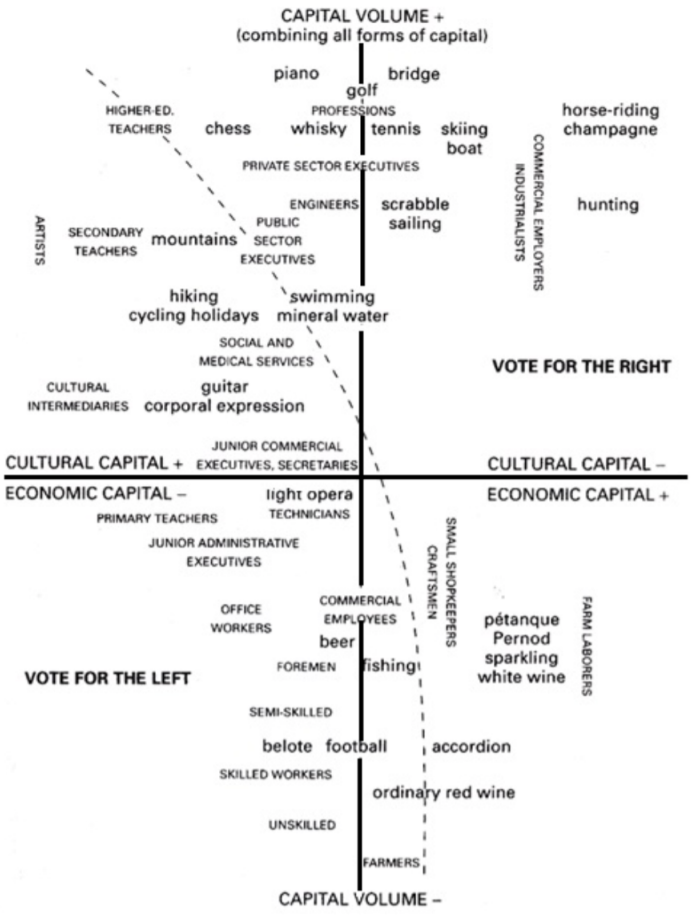
Assumption 2.a: First, we need the treatment to be not determined as a function of the outcomes of interest. In our context, this assumption is respected as the reduction in working time was not implemented in function to schooling result of the child. Indeed the Aubry laws were done in order to stimulate the labor market and reduce unemployment. No educational outcome was taken into account.

Assumption 2.b: Second, we need our group's outcomes evolution to respect the parallel trend assumption. This later requires that if there is no treatment, the difference in outcome between the two groups is constant over time. In other words, we need, that absent the reduction in working time the two groups have followed the same trends. This assumption to be verified, we need first to make our two groups of comparison similar as possible. In addition, we also need to look graphically the evolution of school results before and after the implementation of the labor reform in order to check the parallel trend assumption. We will make this verification in a graphical analysis present in the **chapter 3**.

Definition of the groups: We will distinguish two ways to define our groups of interest.

Approach A: The first approach consists to define our control group as children whose one of the parents is a teacher and our treatment group as children whose one of the parents is an executive. Indeed, teachers are not affected by the reduction in working time contrary to executives workers. In addition, this specification is encouraged by the fact that these two groups have the similar cultural and sociological aspect. In fact, according to Bourdieu Pierre social space representation [9] given in the following picture, the individual is positioned in function of his relative place in term of economic and cultural capital. We can remark than executives workers and teachers are in the same space, so that, they are similar in term of cultural and economic capital. Choosing them to comparison allow us to have our groups which are similar in term of unobservable characteristics. Moreover, due to the cultural similarities between the two groups of parents, the children are expected to have comparable school results. In fact the gap of school results between children of teacher and executive is expected to be less substantial than the one between teacher and workman for example.

Figure 2.1: Bourdieu social space representation



Source: mythsofourtime.wordpress.com

In order to complete our analysis and capture any other impacts we will used a second approach.

Approach B: The second approach consists to define our groups in the following way: A treatment group composed by all children whose parent are in the professional categories touched by the reduction in working time (executives, workers, employees, etc). The control group is composed by the children whose parents are either teachers or military professionals.

In our analysis we will also try some other specifications depending on our results.

2.2 Data

2.2.1 PISA data

PISA evaluation:

In the light with the preceding assumptions and framework, we need data which allow us to have on the one hand the level of school results of children and on the other hand the occupation status of the parents. We also need data which give us the value of schooling results of child in different points of time to analyze the impact of the reduction in working time reform. To make this comparison, we will use data coming from the Program for International Student Assessment (PISA). This program is an international survey done every three years. It has been created and done by the Organization for Economic Co-operation and Development (OECD). The objective is to evaluate the education systems across the world. The survey is implemented in such a way to test the knowledge and skills in several fields of 15-year-old students. The students are assessed in mathematics, sciences and reading. This allows us to have access to schooling outcome data. In addition the PISA program also included survey for schools, for teachers and parents. It provides us some useful information as the occupation status of the parents. By this way, we can see if the parents of children are affected or not by the reduction in working time reform. Moreover, the PISA program integrated a parent and school questionnaires which permit to look at the environment in which the student involved and his knowledge acquisition context. We can see the home living conditions and the specificity of school organization. In plus, the question answer in the student survey given a view of the daily life conditions of the student. This could be useful for our analysis, notably to see the time that parents allocated to their children.

The PISA data are such that around 34 countries members of the OECD and some other partner countries participate to the survey. According to PISA report about 28 million of 15-year-old's students in 2015 participated to the PISA test across around 70 countries. In each country which participated the number of students who fulfilled the questionnaire are between 4 500 and 10 000.

The students are selected from a random sample of school and fulfilled the following conditions: They have at minimum 15 and 3 month years old and until 16 and 2 month years old. So that the selection of the student is not a function of the class level. This specification is important if we want to compare test scores results across several's countries as the selection of student don't depend on the school organization and on the educational system.

There are several's waves of PISA survey: The first survey dated from the year 2000 and the last available is for the 2015 year. Between the two, we have surveys for the years 2003, 2006, 2009 and 2012. In each evaluation waves some subjects are favour as sciences in 2015 or mathematics in 2003 for example.

2.2.2 Use of Data and descriptive statistics

A) Determination of survey used:

As explained in the first chapter, we remind ourselves that the Aubry laws were implemented in a way such that the majority of the firms have until 2002 to reduce the working time of their workers. Given the years of the PISA surveys we have and the age of students, we will make the analysis in two main ways:

Approach i: A first approach consists to suppose that the surplus of time spend by parents with their child is highly beneficial for them when they are young. In fact, as highlighted by some studies the key stage of child the cognitive development is when they are young (between 0 and 4 years). Indeed, according to Piaget Jean [10], the children have a psychological development which is divided into several stages. To 0 to 2 years old the child is in the "sensorimotor" stage: he takes contact with the world around him by the movement and sensation he has. Second, between 2-6 years old, the child takes the advent of the language and become able to think in term of symbolic terms. He take also the notion of quantity and space.
According to the period of Aurby law's implementation (see chapter 1) and the PISA survey waves, we will focus in this approach (i) on two main surveys: The survey of 2009 as it correspond to children born in 1994, so in the pre-treatment period and PISA survey of 2015 as it correspond to children born in 2000 so in the post treatment period. We will also use the survey of 2012 as in the sample children could be affected when there are young (when they have one year old).

So in this first approach we will focus on the beneficial impact of the reduction of working time of the parents on their young children's cognitive development. The later is supposed to be translated into better school results in the following education of the child. Here, we focus on the long term impact of the increase in the time spend with the child.

Approach ii: In a second approach we will use all the surveys of PISA available and suppose that for the years 2000 and 2003 we are in the pre-treatment period as all the firms have until 2002 to comply with the laws. By this fact, we can suppose that the majority of the firm begins with the 35 hours working time regulation at the beginning of the 2000 or 2002 years. So that after 2003 the firm is supposed to have complied with the Aubry's laws. Concerning the post treatment period, it could be defined by all the other surveys (the year 2006, 2009, 2012 and 2015). For this analysis (ii) we supposed that the more we are far away the year 2002 more people are supposed to be affected and change their behaviors.

In this second approach, we will directly look at the impact of the reduction of working time of the parent on the capacity of a student at the age of the PISA survey (when the child have 15 years old). Here we focus on the direct impact of the time past with the child.

B) Determination of country and population of interest:

Country of interest:

i) In a first part, we will focus mainly in France to make our analysis of interest as we want to evaluate the impact of the French labor regulation change.

ii) In our analysis we also make a comparison with another country to control for differential pattern. For this we will focus notably on Spain. In fact Spain seems to be a good counter factual of France. Indeed, first, in term of labor market conditions there are no labor market reforms in Spain between 1995 and 2005 which allow us to have a country no affected by RWT at the time where France implement this kind of labor reform. In addition, the labor market conditions are similar for the two countries before the RWT reform: the legal working time is about 40 hours per weeks in Spain and the limits of supplementary hours are similar to French ones. Second, in term of size of working age population there are comparable: According to OECD, in 1998 the percentage of working age population was about 68.64% of total population in Spain and 65.22% in France. In 2012 the same figures were about 67.37% and 64.04% respectively.

Population of interest:

As explained before, we will use two ways to define our groups of interest. On the approach A, we will focus on children whose parents are either teacher (non affected) or executive workers (affected). In the approach B, we will use all the professional categories touched by the 35 hours reform as treatment group and the children of teachers and military professionals as a control group. To define these groups in the PISA data, we will use the International Standard Classification of Occupation (ISCO) codes available in the PISA questionnaires. For the survey range from the years 2000 to 2009 the ISCO-88 classification is used and for the last two surveys (2012 and 2015) we used the ISCO-08 classification.

In the Approach A, we define our control group as children whose parent are in teaching professional categories: Primary, secondary and other teaching professional categories. The treatment group is in the first major group of the ISCO classification, including corporate managers, managers of small enterprises and other executive occupations which are concerned by the RWT.

In the Approach B, we define our control group as children whose parents are in the teaching professionals categories (primary, secondary and other teaching professional categories) and in the armed forces categories. The treatment group corresponds to the ISCO classification concern by the reduction in working time: Manager as before, all the professionals except teaching ones (business, health, public services administrative professionals etc), technicians, service and shop workers. We include also the crafts, plants, machine operators, skilled agricultural and other elementary occupations.

To make the analysis more precise, first, we will distinguish between mother and father occupation status. It's seem to be important to differentiate between mother and father in order to capture any differential impact between the two parents. It permits us to see if father or mother plays a more or less important role in the schooling result of their child. Perhaps some difference in their behavior concerning the time they spend with their children exist and this could translate a more or less impact of the RWT on child's schooling outcome. Second, for our analysis, we drop children whom parents are treated and non treated at the same time (for example, children whose the mother is a teacher and the father an executive worker). It's important to avoid them in order to not capture some effects which are not due to the 35 hours reform.

Descriptive statistics of the sample used:

The following tables present the number of observations we have across the PISA survey for our two approach:

Table 2.1: Approach A: descriptive statistics

Year	Father teacher	Father executive	Mother teacher	Mother executive
2000	**75**	**202**	**153**	**101**
2003	**97**	**423**	**177**	**147**
2006	**97**	**563**	**180**	**229**
2009	**71**	**457**	**84**	**217**
2012	**170**	**530**	**284**	**188**
2015	**197**	**493**	**380**	**219**

We can make some remarks: First, the children whose father is an executive worker are in larger numbers comparably to the case when they have a mother executive. Concerning the teaching profession, it's the reverse. Mothers teachers are more important than father ones. This seems to be logic as according to the Word Bank data in 1975, the percentage of women teacher was about 69% and about 83% in 2013. In addition our data confirm this evolution as we can see that the number of mother teacher increase in our sample.

Table 2.2: Approach B: descriptive statistics

Year	Father treated	Father non treated	Mother treated	Mother non treated
2000	**2,380**	**75**	**2,426**	**50**
2003	**4,044**	**95**	**4,099**	**40**
2006	**4,432**	**94**	**4,495**	**31**
2009	**4,156**	**63**	**4,206**	**13**
2012	**4,181**	**163**	**4,291**	**53**
2015	**5,546**	**203**	**5,698**	**51**

In our approach B, we can see that the number of treated workers is much higher than the non treated ones. This fact is logic as the number of profession affected concern the quasi totality of the French workers except for example teacher or military. Due to the drop of children whom parents are at the same time affected and non affected (ie: mother teacher or military and affected father or the reverse) the numbers of non affected observations decrease.

Chapter 3

Graphical analysis

In this chapter, we will present some graphics that we analyze in order to see if our analytic assumptions are valid. All the graphics presented here are drawn using PISA data available online.

3.1 Evolution of the time spent with the children

In order to see if the reduction in working time allows parents to spend more time with their children, we will try to see graphically if there is some different evolution between our two groups of interest. According to the PISA data, we have in the questionnaire an indicator of the time spent with the child. In fact, depending on the year of survey, PISA asks parents or child "how often do you talk with your parent/child?". This question allows us to have an indicator of time spend with the child at home. Nevertheless, for some years of survey there is no observations available for France and for the individuals of interest. The only years which furnishing us this indicator are the years 2000 and 2015. In a general point of view, we can consider that these two periods furnishing us a "pre" and "post" treatment period respectively.

We can notice here that the variable we use to measure the time spent with the child as being the time to talk with them is predicted to have an impact on their schooling outcome in accordance with the existing literature. According to Ralph B and McNeal [11], parent-child discussions are predicted to have an impact on attitudes and academic achievement of the children. It's a factor which dominates in term of parental-child involvement and which have a lasting effect.

Now we will begin our graphical representation. We expect the analysis of our graph to fulfilled some assumptions:

Assumption A: We expect an increase in the time spend to talk with the child between the two years for the treated workers.
Assumption B: We expect to time spend to talk with the child to increase more for the treated group in comparison to the control one. This could be attributed to the reduction in working time which allow them to be more present for their child.

3.1.1 Time spent to talk with the child in France

In the next two pages we analyze graphically the time spent to talking with the child in our two main approaches. The graphs are presented in the page 21.

Approach A: Comparison for children of teacher and executive workers.

A) Mother case:

Assumption A: This assumption is fulfilled as the time spent to talking with the child increase over the two periods for mother executive.

Assumption B: This assumption is no fulfilled as there is a parallel evolution for our two groups. To have an effect of the reduction in working time on time spent to talking with the child, we expect the mother executive to cached-up the mother teacher.

B) Father case:

Assumption A: This assumption is fulfilled as the time spent to talk with the child increase over the two periods for father executive.

Assumption B: As for the mother case, the assumption is no fulfilled as there is a parallel evolution for our two groups.

Approach B : Comparison for children of affected and non affected workers

A) Mother case:

Assumption A: This assumption is fulfilled as the time spent to talk with the child increase over the two periods for treated executive mother.

Assumption B: This assumption is fulfilled as there is an increase in the time spent to talk to the child for treated mother which is more important than the case where the student have a non treated mother.

B) Father case:

Assumption A: This assumption is fulfilled as the time spent to talk with the child increase over the two periods for treated father.

Assumption B: Contrary to the mother case, the assumption is no fulfilled as there is a parallel evolution for our two groups.

On overall, given the graphical analysis, the approach A don't answers in any case the two main assumptions. For the other approach (B), the only case which seems to be relevant is the case where the student has a mother who is affected by the reduction in working time. We can just notice that non affected workers (teachers or teachers and military workers) spend in general more time to talk with their children than the affected workers.

Figure 3.1: Indicator of time spent to talk with the child - mother case (executive/teacher)

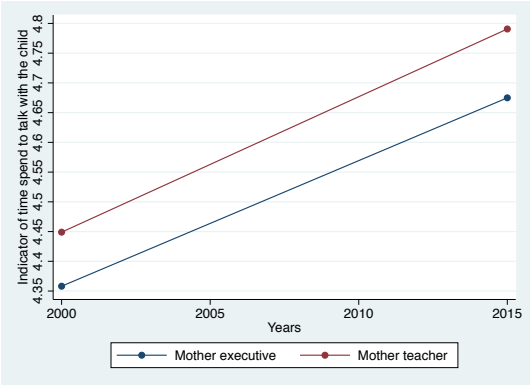


Figure 3.2: Indicator of time spent to talk with the child - father case (executive/teacher)

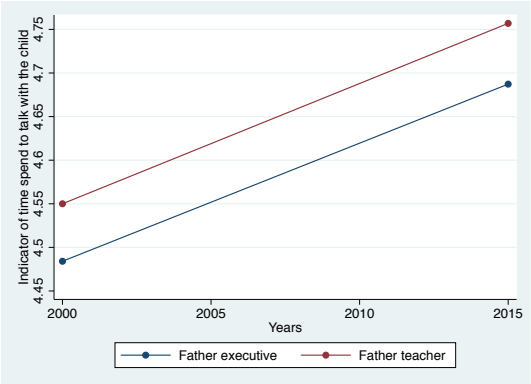


Figure 3.3: Indicator of time spent to talk with the child - mother case (treated/non treated)

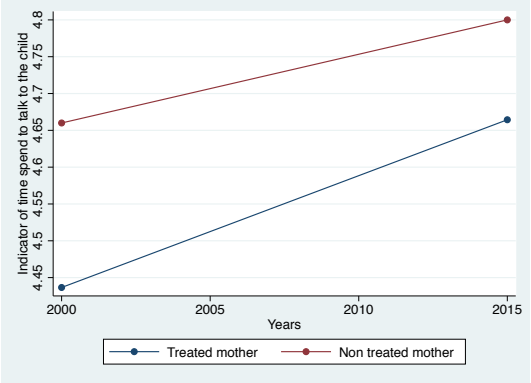
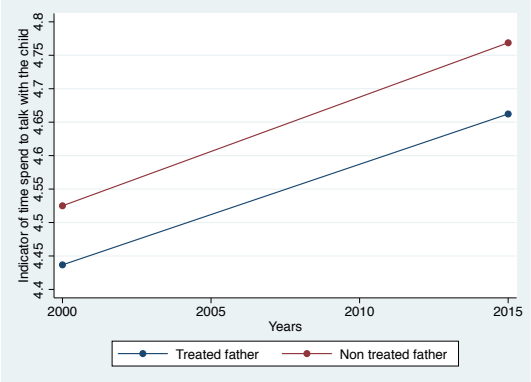


Figure 3.4: Indicator of time spent to talk with the child - father case (treated/non treated)



3.1.2 Comparison with Spain

Here we compare graphically the evolution of time spent by parents to talk with the child in France and in Spain. There is an assumption we need to check:

Assumption C: We expect the French treated parents to increase their time spent with the child relative to their Spanish counterpart.

Approach A: Comparison for children of teacher and executive workers

A) Mother case:

Assumption C: The assumption is not fulfilled as the gap increase between the two countries but is due to an increase of time spent with the child by the Spanish mothers and not the French ones .

B) Father case:

Assumption C: As in the mother case, the assumption is not fulfilled. Indeed, there is a reversal situation. In 2000 it's the French fathers who spent more time to talk with their children than their Spanish counterpart. In 2015, it's the reverse which occurs.

Approach B : Comparison for children of affected and non affected workers

A) Mother case:

Assumption C: The assumption is not fulfilled. Indeed, there is a reversal situation. In 2000 it's the French treated mothers who spent more time to talk with their children than their Spanish counterpart. In 2015, it's the reverse which takes place.

B) Father case:

Assumption C: As in the mother case, the assumption is not fulfilled. This is the same reversal situation. In 2000 it's the French treated fathers who spent more time to talk with the child than their Spanish counterpart. In 2015, it's the reverse which occurs.

On overall, this comparison with Spain is not encouraging as we obtain the reverse of our assumption.

Figure 3.5: Indicator of time spent to talk with the child - mother case (executive/Spain counterpart)

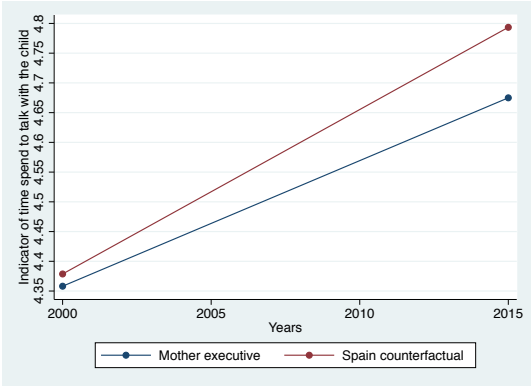


Figure 3.6: Indicator of time spent to talk with the child - father case (executive/Spain counterpart)

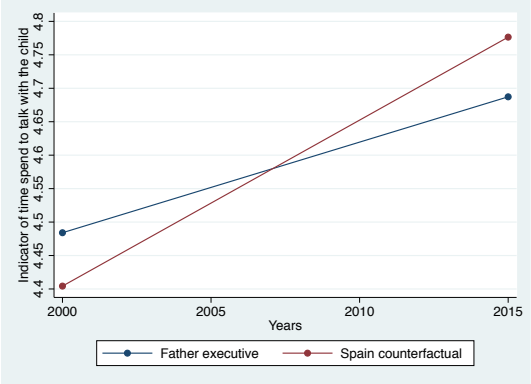


Figure 3.7: Indicator of time spent to talk with the child - mother case (treated/Spain counterpart)

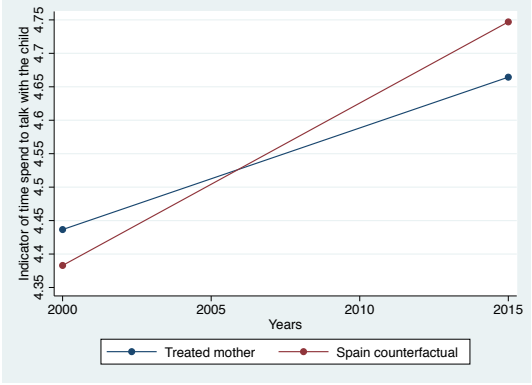
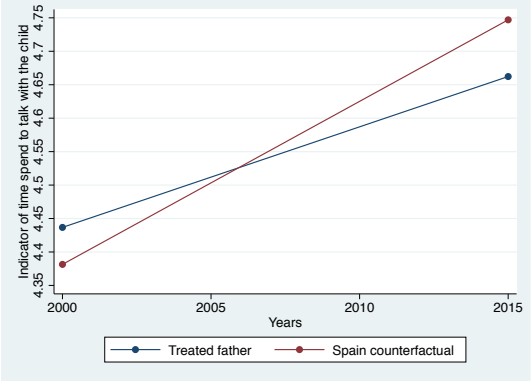


Figure 3.8: Indicator of time spent to talk with the child - father case (treated/Spain counterpart)



General comment: On all the graph analyze, the case which fulfilled the assumptions we made is the approach B notably for the mother case. So, in this graphical analysis, the treated mothers (all professional categories touched by the 35 hours reform) increase their time spent to talk with their children between our two periods of interest (before and after the reform). In addition, the increase in this time spent with the child for mothers treated is more important than the increase in time allocated to children by the non affected mother. So, we can think that the reform allows affected mothers to spend more time with their child. In the **chapter 4**, we will test this assumption by making an instrumental variable estimation strategy.

Nevertheless, this graphical analysis has some limitation notably in term of data availability. Indeed, we just have two years of observations and the measure of time spend by parents with their children is a crude measure. In the following chapter we will use an IV estimation strategy to see the impact of the RWT on the time spend with the children. Given the results of this graphical analysis and the data we use, we don't expect to obtain a causal impact.

3.2 The test mean score evolution of children in France

In a second time, we want to look if there is some remarkable evolution and differences in test mean score values between the two groups of interest and time periods in France. As explained in the last chapter we will make two main comparison: the first among children whose parent are teacher and executive and the second between children whose parent are affected and non-affected by the 35 hours reform. In all the case, we will discuss the evolution of the mean score value of the tests for the three main topics studied in PISA: mathematics, sciences and reading. The mean score value are calculated for all the years from the plausible value of the test given for each student and each topic in the data. In addition, in each case we will use two ways of interpretation for the treatment time period (see chapter 3, determination of survey used).

3.2.1 Approach A: Comparison between children of teacher and executive workers

Here we will first look at the evolution of test mean score values over time between manager and teacher children in France. We draw for each survey between 2000 and 2015, the test mean score value for each group of parent. In each case we distinguish mother and father and use two ways of analysis for the time period as explain before. We expect the analysis of our graph to fulfilled some assumptions:

Approach i: Definition of the pre-treatment period as 2009.

Assumption a: We expect a decrease of the gap between the test mean score value of our two groups, notably between 2009 and 2015. Indeed, this decrease could be attributed to a positive spillover effect due to

the potential surplus of time spend by parents with their children. This decrease should be determined by a catch-up of children whose the parent is affected by the RWT.

Assumption b: We want to look at the pre-trend existing between the two groups. If before the treatment period the evolution seems to follow the same patterns this allow us to valid the parallel trend assumption needed for our difference in difference estimation strategy. So for the approach (i), we need that before 2009 the two groups follow the same pattern of test mean score value.

Approach ii: Definition of the pre-treatment period as 2003.

Assumption b: For the second way of analysis we expect the gap closed up after the years 2003 by an increase in the mean test score value for the affected group. In addition, as the firm has until 2002 to comply with the Aubry laws, we think that more we are far away the year 2003, more we expect worker to be affected by the reduction in working time and adopt a new behavior in the time spend with their children.

Assumption d: For the approach (ii), we need also the parallel trend assumption to be checked. Here the pre-trend is before the year 2003.

1) Look at the evolution of mathematics test mean score value:

A) Mother case: According to the graph presented on the following page, we will see if the preceding assumptions are respected or not.

Approach i: Definition of the pre-treatment period as 2009.

Assumption a: We can see that between 2009 and 2012 the gap between the two groups collapse by around 25 points. Nevertheless, this decrease in not due by a catch-up in the test mean score value of children whose mother have reduced their working time.

Assumption b: Before 2009, the parallel trend assumption is not fulfilled as we have a stabilization for children of executive's mothers after 2006 whereas there is an increase of the test mean score value in mathematics for the other group (children whose mother is a teacher).

Approach ii: Definition of the pre-treatment period as 2003.

Assumption c: As expected the gap after the years 2003 collapse notably for the year 2012. The gap being of 31 points in 2003 it becomes about 5 points in 2012. But as in the approach (i), this is not due to the only drop of mother executive children's test mean score value.

Assumption d: Before 2003 the parallel trend assumption is fulfilled as for the two groups we have an increase in the mathematics test mean score value before 2003.

Figure 3.9: Evolution of mathematics test mean score - mother teacher case

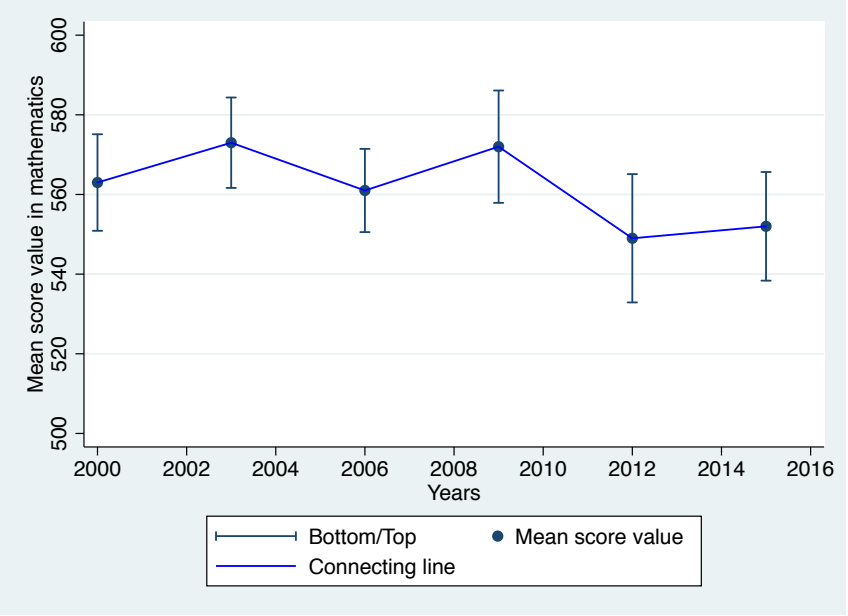


Figure 3.10: Evolution of mathematics test mean score - mother executive case

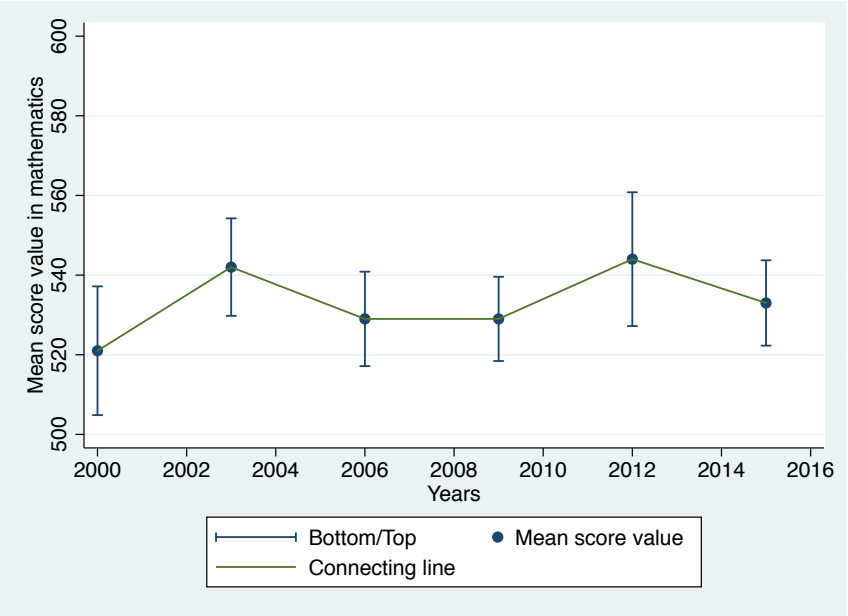
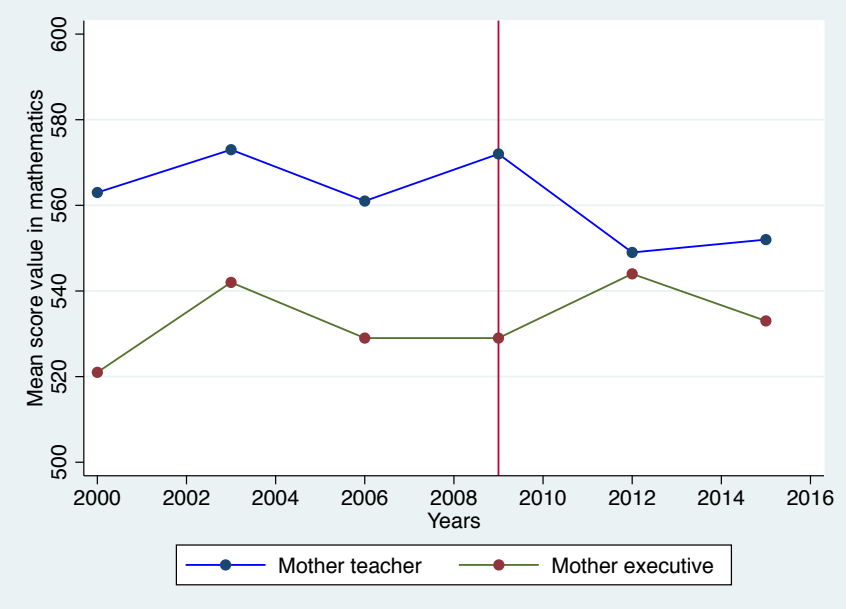


Figure 3.11: Evolution of mathematics test mean score - mother case



B) Father case:

The graphs are presented on the next page.

Approach i: Definition of the pre-treatment period as 2009

Assumption a: In mathematics for the father case, we can see that between 2009 and 2015 the difference in test mean score is no significant (no differences) between our two groups of children. Indeed the gap was about 24 points for the two year survey.

Assumption b: Concerning the pretend evolution, its seems to be the same. Indeed, the two groups experience an increase in the test mean score value since 2006.

Approach ii: Definition of the pre-treatment period as 2003.

Assumption c: As expected the difference in mean score value after the years 2003 collapses. Indeed, it was about 42 points in 2003 to pass to 19 points in 2006. Nevertheless, as in the mother case this is not due to a catch-up for the affected children.

Assumption d: Contrary to the analysis (i), here the parallel trend assumption is not fulfilled. Indeed, there are variation presents for children whose father is a teacher and not for the executive ones. In fact, we have a slow decrease in test mean score value for children whose father are executive before 2003 whereas there is an increase in the test mean score value for teacher's children.

Figure 3.12: Evolution of mathematics test mean score - father teacher case

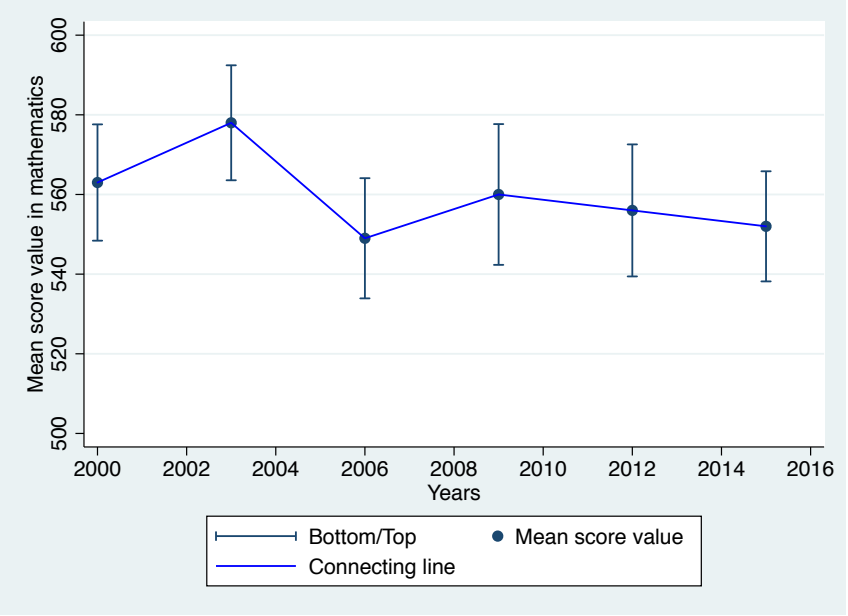


Figure 3.13: Evolution of mathematics test mean score - father executive case

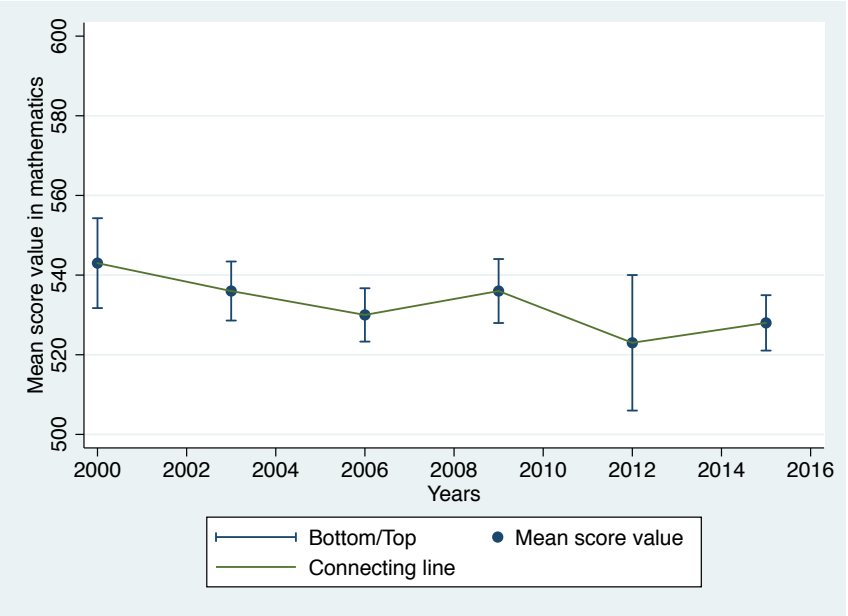
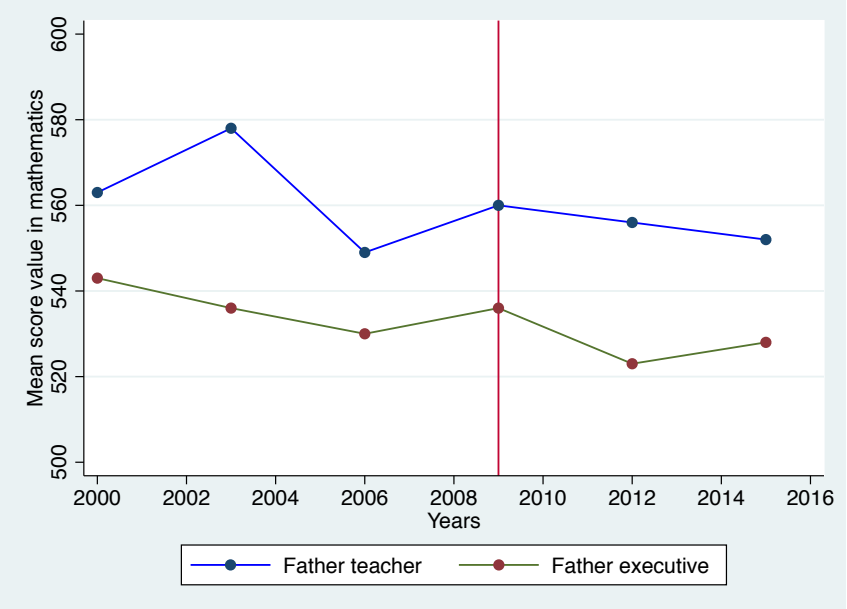


Figure 3.14: Evolution of mathematics test mean score - father case



2) Look at the evolution of sciences mean score value:

A) Mother case:

The graphs are presented on the next page.

Approach i: Definition of the pre-treatment period as 2009

Assumption a: We can see that the gap between the two years of interest and between our two groups decreases clearly (by one half point). The difference in test means score value was about 44 points in 2009 to collapse to 20 points in 2015. But the decrease of the gap is not due to an advantage of affected children compare to the non affected ones.

Assumption b: Concerning the pretend evolution, we can say that the two groups follow the same patterns: a decrease for the years 2003 until 2006 and after an increase in the test mean score value until 2009.

Approach ii: Definition of the pre-treatment period as 2003.

Assumption c: As expected the gap after the years 2003 collapses notably in comparison with the years 2012. Indeed, the difference in test mean score value in 2012 was about 6 points. Nevertheless the gap increase in the year 2006 (it reaches 43 points).

Assumption d: Concerned the parallel trend assumption, it's seems to be fulfilled as before 2003 we have an increase in science test mean score value for our two groups.

Figure 3.15: Evolution of sciences test mean score - mother teacher case

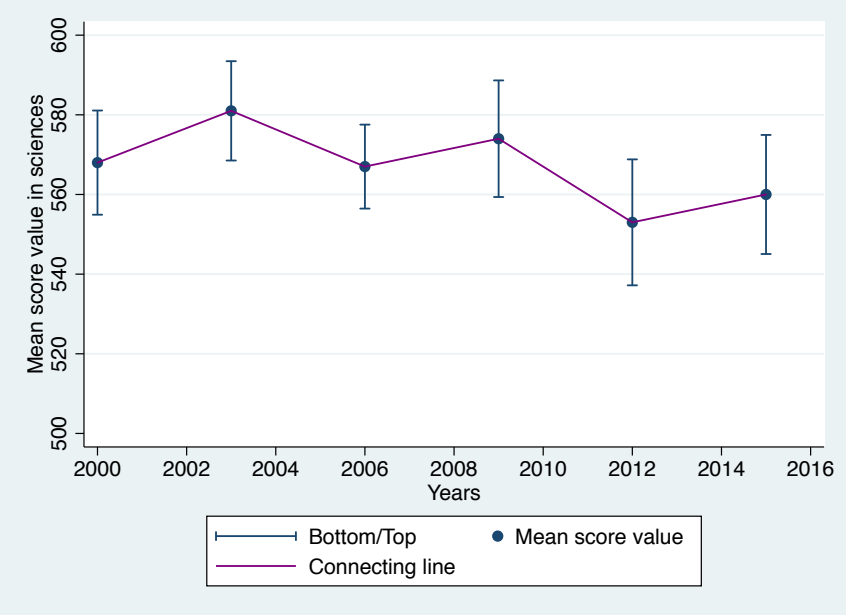


Figure 3.16: Evolution of sciences test mean score - mother executive case

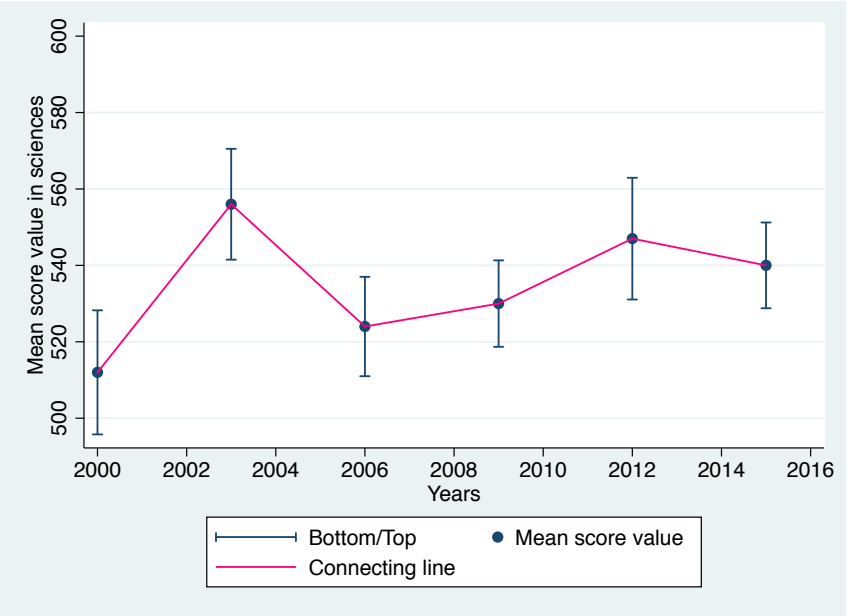
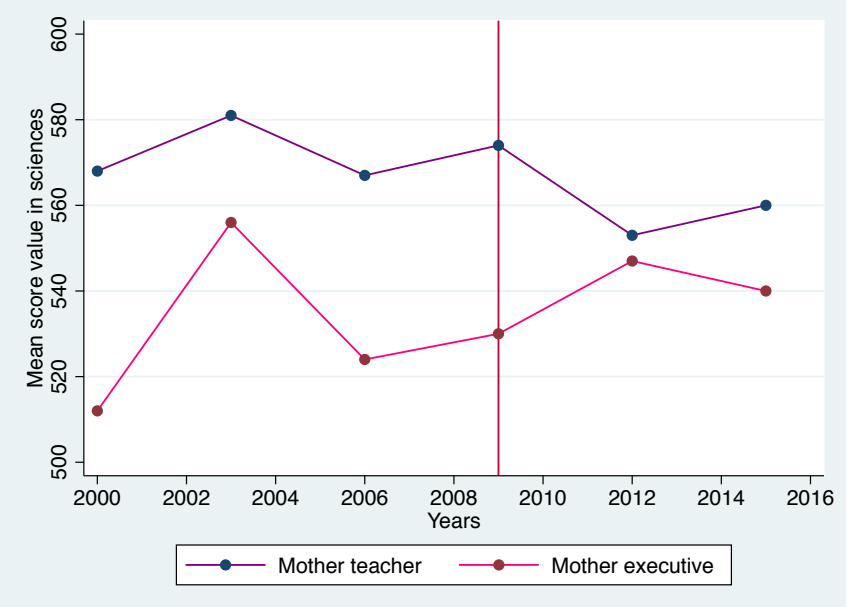


Figure 3.17: Evolution of sciences test mean score - mother case



B) Father case:

The graphs are presented on the next page.

Approach i: Definition of the pre-treatment period as 2009

Assumption a: We can see that the gap between the two periods of interest decreases. Indeed the difference in test mean score value passes from 33 points in 2009 to 27 points in 2015. But is not due to a catch-up coming from the children whose father is an executive.

Assumption b: Concerning the pretend evolution we can say that the two groups follow the same patterns: a decrease for the years 2003 until 2006 and after an increase in the science test mean score value.

Approach ii: Definition of the pre-treatment period as 2003.

Assumption c: As expected the gap after the years 2003 collapses. It was about 41 points in 2003 and passes to 28 points in 2006. But as in the approach (i) this is not due to the only drop of father executive children's test mean score value.

Assumption d: Before the year 2003 the parallel trend assumption is also fulfilled. Indeed, we have an increase in the mean score value for the two groups of children.

Figure 3.18: Evolution of sciences test mean score - father teacher case

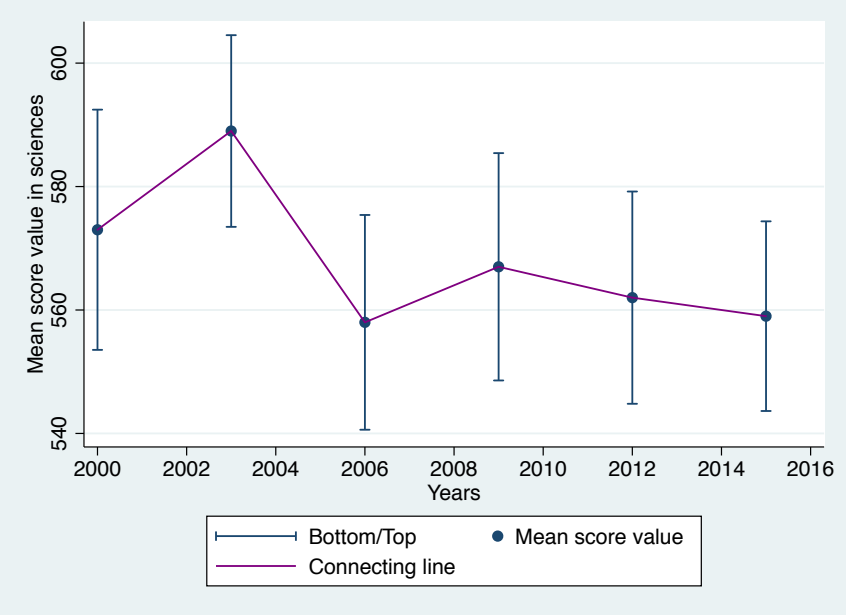


Figure 3.19: Evolution of sciences test mean score - father executive case

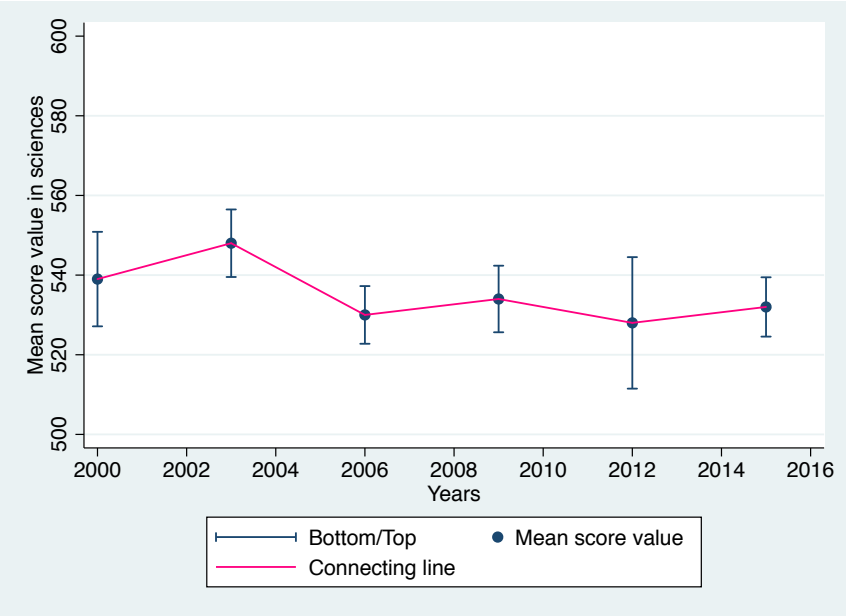
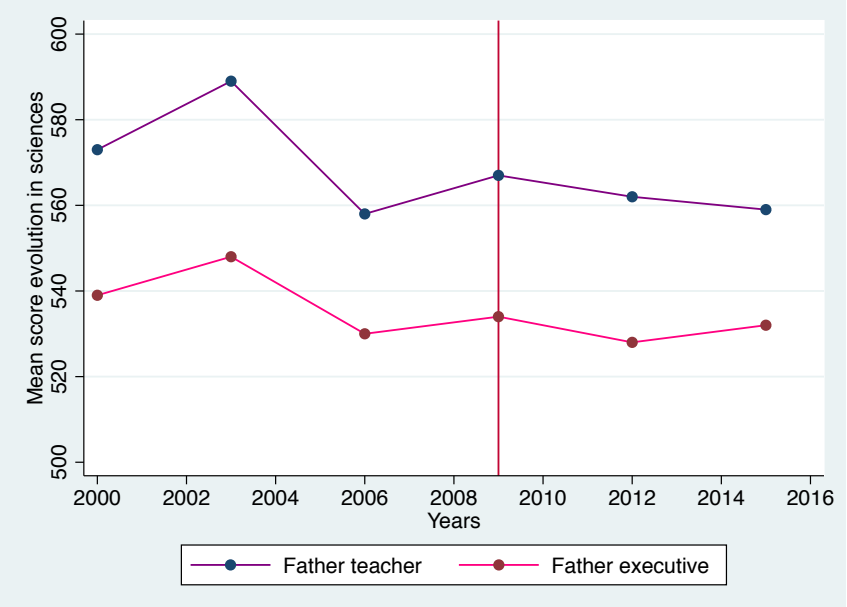


Figure 3.20: Evolution of sciences test mean score - father case



3) Look at the evolution of reading mean score value:

Approach A: Comparison for children of teacher and executive

A) Mother case:

The graphs are presented on the next page.

Approach i: Definition of the pre-treatment period as 2009

Assumption a: We can see that the gap for all the groups and for the two periods of interest decreases. The difference in reading test score value passes from 38 points in 2009 to 20 points in 2015. Moreover, this gap decrease is caused by a catch-up from the children whose mother are executive.

Assumption b: Before 2009, the parallel trend assumption is fulfilled as we have an increase in the test mean score value for the two groups after 2006.

Approach ii: Definition of the pre-treatment period as 2003.

Assumption c: The gap was little for the years 2003 (16 points) and it has attained an inferior value just in the 2012 year survey (10 points). But contrary to the above approach, this is not only due to an increase of mean score value by children affected.

Assumption 2.2: Before 2003, the parallel trend assumption is not fulfilled. Indeed, we have an increase in the test mean score value in reading for children whose mother is an executive and not for the teacher ones.

Figure 3.21: Evolution of reading test mean score - mother teacher case

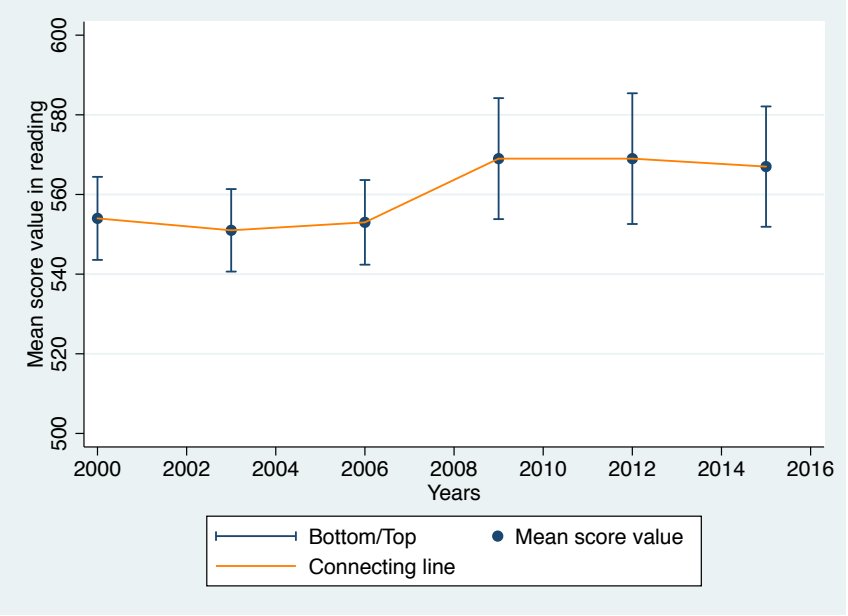


Figure 3.22: Evolution of reading test mean score - mother executive case

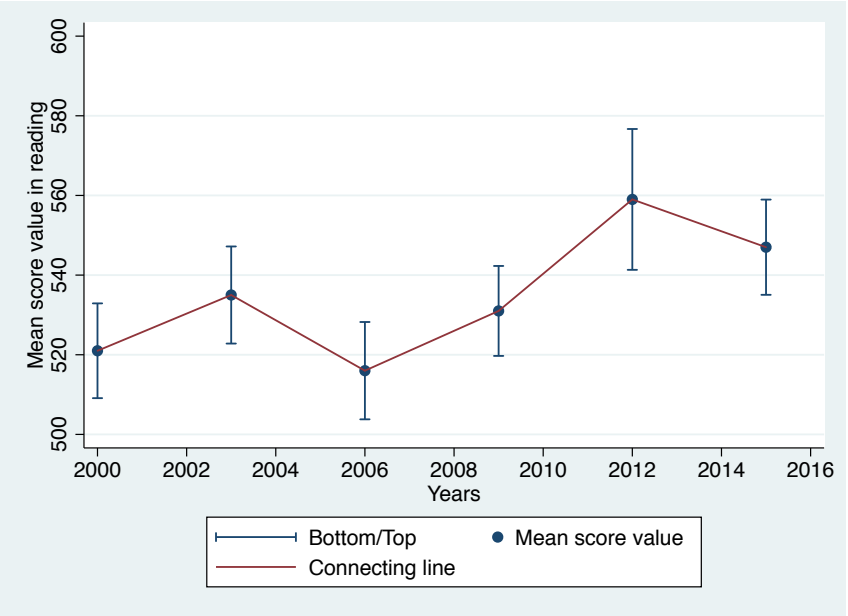
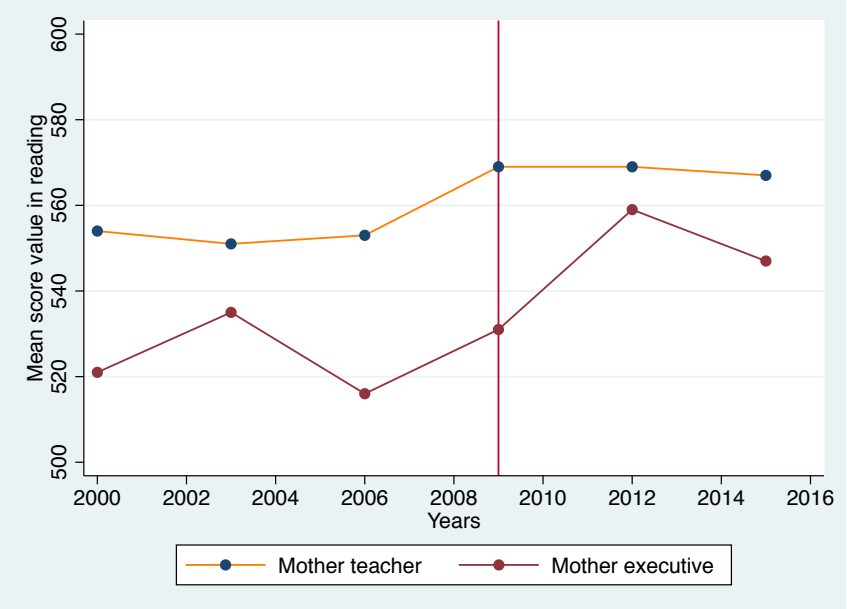


Figure 3.23: Evolution of reading test mean score - mother case



B) Father case:

The graphs are presented on the next page.

Approach i: Definition of the pre-treatment period as 2009

Assumption a: The gap decreases between the years 2009 and 2015. The difference in the test mean score value passes from 32 points in 2009 to 27 points in 2015. As in the mother case, this is due to an increase in the test mean score value of children whose father are executive.

Assumption b: Concerning the parallel trend assumption, its seems to be fulfilled as for the two groups we have the same evolution before 2009. In fact, we have a little decline in the reading test mean score value until 2006 and after an increase.

Approach ii: Definition of the pre-treatment period as 2003.

Assumption c: The gap after the years 2003 is relatively stable. It decreases in 2006 (21 points) in comparison with the year 2003 (24 points) but not for the other years. Indeed the difference in mean score value was about 31 points in 2012.

Assumption d: Before the year 2003, the parallel trend assumption is also fulfilled. We have a slow decline in reading test mean score value for our two groups between 2000 and 2003.

Figure 3.24: Evolution of reading test mean score - father teacher case

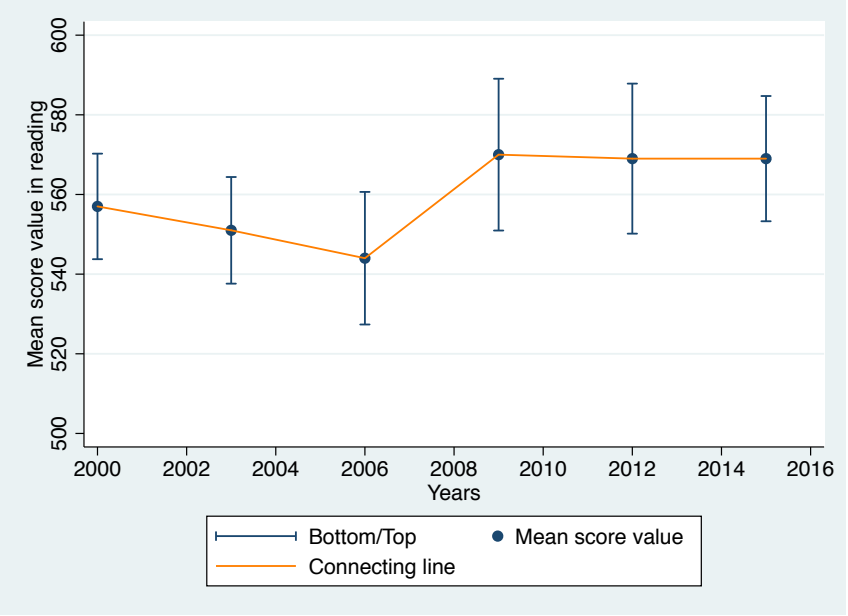


Figure 3.25: Evolution of reading test mean score - father executive case

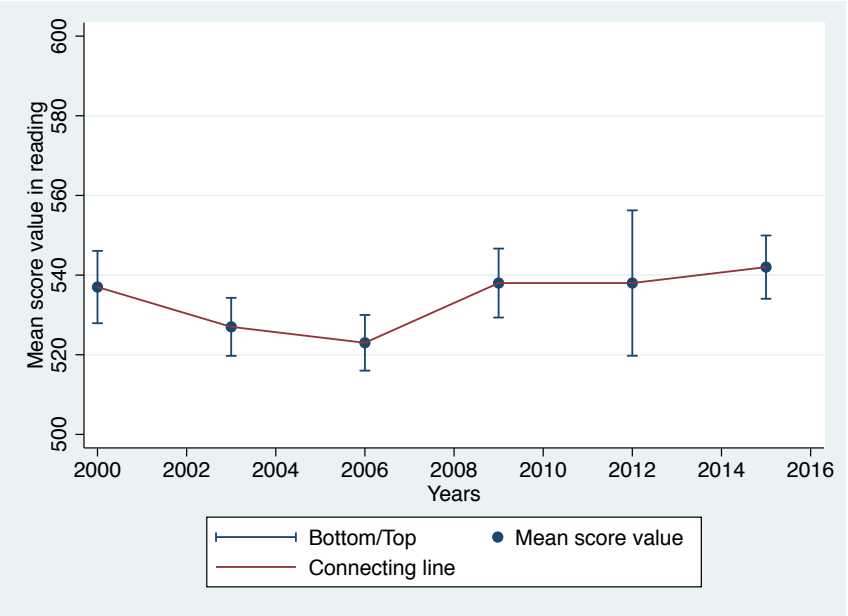
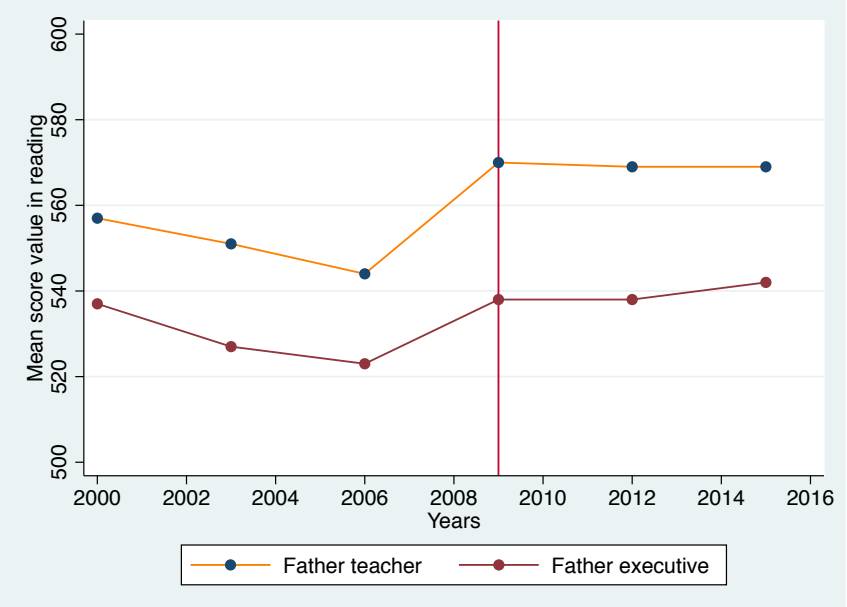


Figure 3.26: Evolution of reading test mean score - father case



General conclusion:

Given the graphical analysis we have done, we can say that for the approach A, on all the school's topics we look at, the one which seems to be relevant for our analysis (i) that is to say which fulfill our hypotheses (a) and (b) is the reading topic for the mother and the father case. Indeed, we see that after 2009 the reading test mean score value for teacher children look like stable contrary to manager's children who experience an increase in their test mean scores. This could translate a catch-up from the children of executive workers on the teacher ones. So for our approach (i) we will notably focus on the reading topic.

Concerning the approach (ii), there are no topics which seem to be relevant. In fact, in all the graphs we look at, the assumptions (c) and (d) are not validated.

In a general point a view, a remarkable evolution is the decrease in test mean score value for the two groups in all the topics between the years 2003 and 2006. It could be interesting to understand why we have a such decrease. This fact merits further research.

3.2.2 Comparison with Spain

In order to observe an effect of the French labor market regulation on schooling outcomes; we want to look at the evolution of the test mean score value over time between manager and teacher children in France and in another country. As explained in the preceding chapter, we choose Spain as a comparison country. So here, we want to look at some remarkable evolution and differences in test scores mean values between the two groups of interest and the time periods in Spain and in France.

There is two mains hypotheses:

Assumption e: For the first way of analysis (i), we expect an increase of the test mean score value for the executive children in France after 2009 compared to their counter factual in Spain.

Assumption f: For the analysis (ii), we expect the test mean score value in a given topic to increase for French children compare to their Spanish counterpart after the year 2003.

1) Look at the evolution of mathematics test mean score value:

The graph are presented on the next page.

A) Mother case:

Approach i: Definition of the pre-treatment period as 2009

Assumption e: We see that as expected, after the year 2009, the mother managers's children have a test mean score which increase in France compared to their Spanish counterpart. This could be attributed to the 35 hours reform which allows French parents to spend more time with their child when they were young and this could have produce an increase in their cognitive skills.

Approach ii: Definition of the pre-treatment period as 2003.

Assumption f: Here, the graphical evolution don't valid our assumption. Indeed, the French students have a test mean score value which decreases after the year 2003 whereas it increase for the Spain students.

B) Father case:

Approach i: Definition of the pre-treatment period as 2009

Assumption e: We see that contrary to what we expected, after the year 2009 the father managerss children have a test mean score which decreases while it increases for their Spanish counterpart.

Approach ii: Definition of the pre-treatment period as 2003.

Assumption f: For the analysis (ii), as in the mother case, the French students have a test mean score value which decreases after the year 2003 whereas it increases for the Spain students in mathematics. This is not in favour of our assumption.

C) Teaching profession case:

In the last graph, we have the representation of the evolution of the test mean score value for children whose parent (mother or father) is teacher in France and in Spain. We can see that after the year 2003, the test mean score value of mathematics decreases for French students in the mother and the father case whereas it increases for the Spain ones. After the year 2009, the mean score value decreases in all the cases. A last general comment is that French student do better in general than their Spain counterpart.

Figure 3.27: Evolution of mathematics test mean score - mother case comparison with Spain

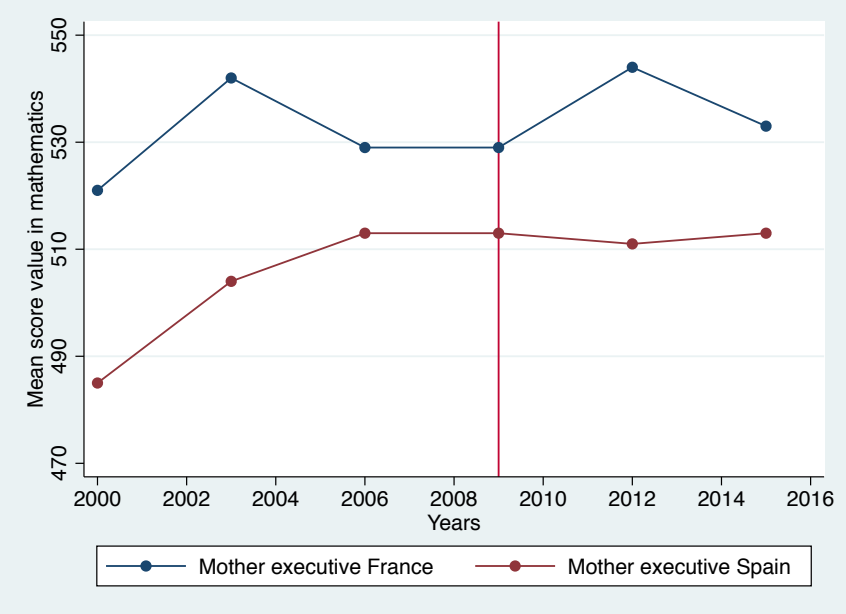


Figure 3.28: Evolution of mathematics test mean score - father case comparison with Spain

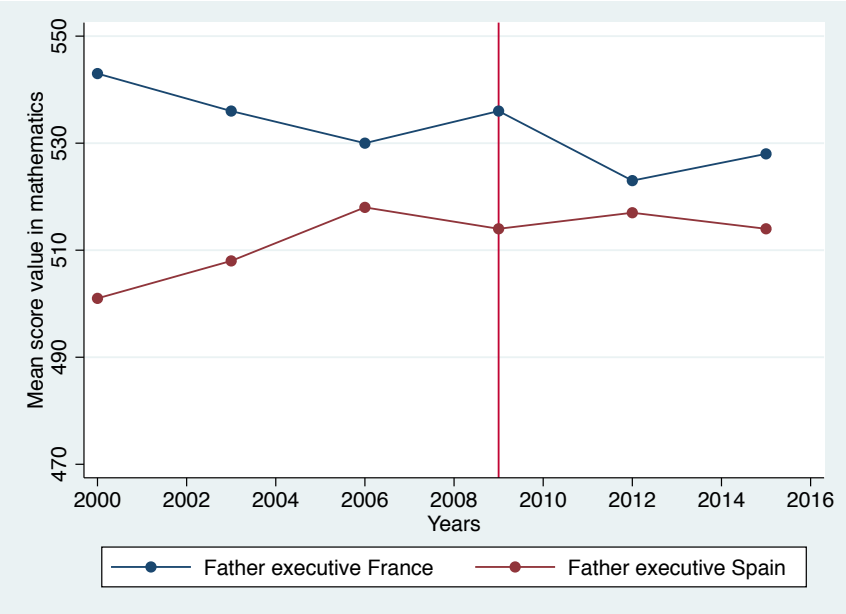
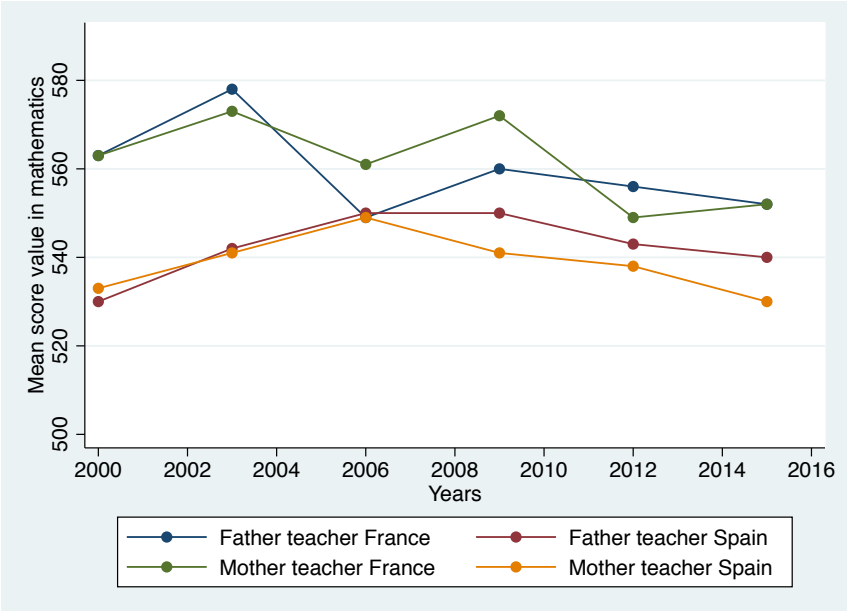


Figure 3.29: Evolution of mathematics test mean score - teacher case comparison with Spain



2) Look at the evolution of sciences test mean score value:

The graph are presented on the next page.

A) Mother case:

Approach i: Definition of the pre-treatment period as 2009

Assumption e: We see that as we expected, after the year 2009, the mother managers children have a test mean score value in science which increases whereas it's stables for their Spanish counterpart.

Approach ii: Definition of the pre-treatment period as 2003.

Assumption f: Here the graphical evolution don't valid our assumption as in the mathematical case. Indeed, the French students have a test mean score value which decreases after the year 2003 whereas it increase for the Spain students.

B) Father case:

Approach i: Definition of the pre-treatment period as 2009

Assumption e: We see that contrary to what we expected, after the year 2009 the father managers children have a test mean score value which decreases while it increases for their Spanish counterpart.

Approach ii: Definition of the pre-treatment period as 2003.

Assumption f: For the analysis (ii), as in the mother case, the French students have a test mean score value which decreases after the year 2003 whereas it increase for the Spain students in the sciences. This is not in favour of our assumption.

C)Teaching profession case:

In the last graph, we have the representation of the evolution of the test mean score value for children whose parent (mother or father) is teacher in France and Spain. We can see that after 2003 the mean score value in sciences decreases for French students in the mother and the father case whereas it increases for the Spain ones. After the year 2009, the mean score value decreases in the French case but increase slowly for Spain students. A last general comment is that French student do better in general than their Spain counterpart as in mathematics.

Figure 3.30: Evolution of science test mean score - mother case comparison with Spain

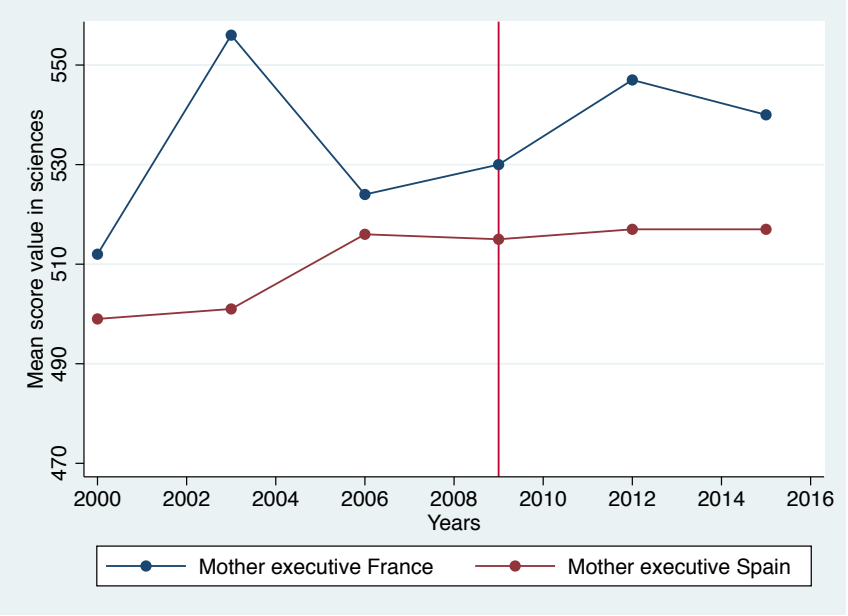


Figure 3.31: Evolution of science test mean score - father case comparison with Spain

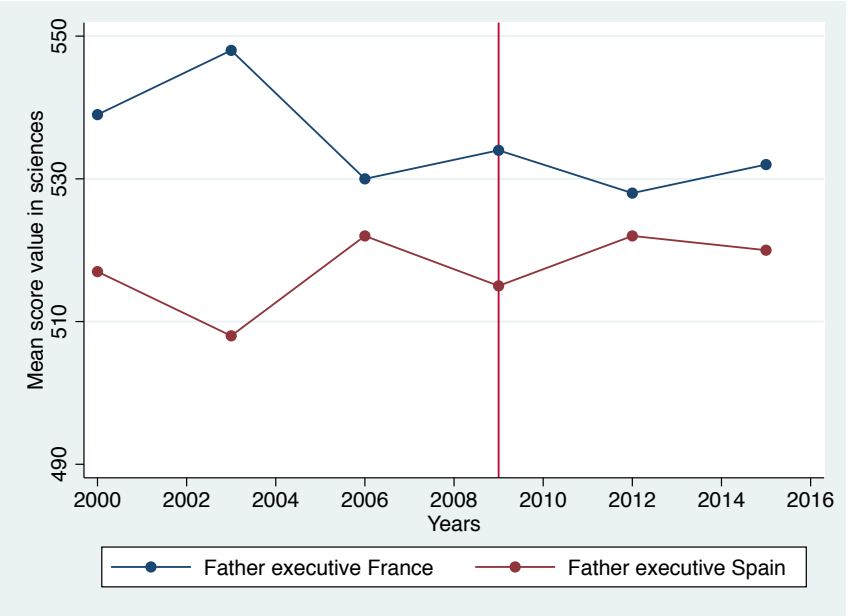
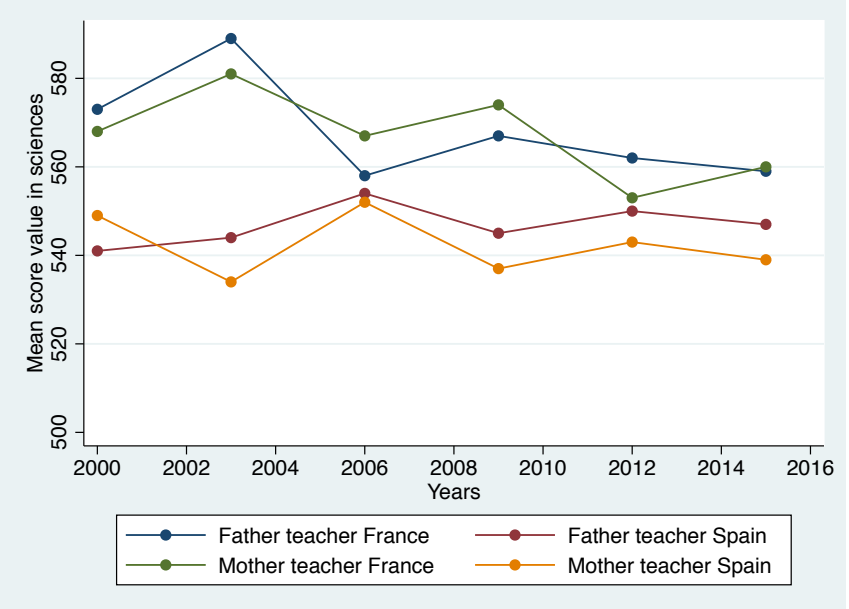


Figure 3.32: Evolution of science test mean score - teacher case comparison with Spain



3) Look at the evolution of the reading test mean score value:

The graph are presented on the next page.

A) Mother case:

Approach i: Definition of the pre-treatment period as 2009

Assumption e: We see that as we expected, after the year 2009 the mother managerss children have a test mean score value in reading which increases, whereas it's stable for their Spanish counterpart.

Approach ii: Definition of the pre-treatment period as 2003.

Assumption f: Here the graphical evolution don't valid our assumption also as in the mathematics and sciences case. Indeed, the French students have a test mean score value which decreases after the year 2003. Here, Spain students have also a test mean score value which decreases after 2003.

B) Father case:

Approach i: Definition of the pre-treatment period as 2009

Assumption e: We see that contrary to what we expected, after the year 2009 the father managerss children have a test mean score which looks like stable whereas it increases for their Spanish counterpart.

Approach ii: Definition of the pre-treatment period as 2003.

Assumption f: For the analysis (ii), as in the mother case, the French students have a test mean score value which decreases after the year 2003. As in the mother case, the mean score value decreases also for Spain students.

C)Teaching profession case:

In the last graph, we have the representation of the test reading mean score value evolution for children whose parent (mother or father) is teacher in France and Spain. We can see that after 2003 the test mean score value in reading decreases for French student in the mother and father case. It decreases also for Spain students. After the year 2009, the mean score value is stable for French and increases a little for Spain children. A last general comment is that French student do better in general than their Spain counterpart in the reading topic.

Figure 3.33: Evolution of reading test mean score - mother case comparison with Spain

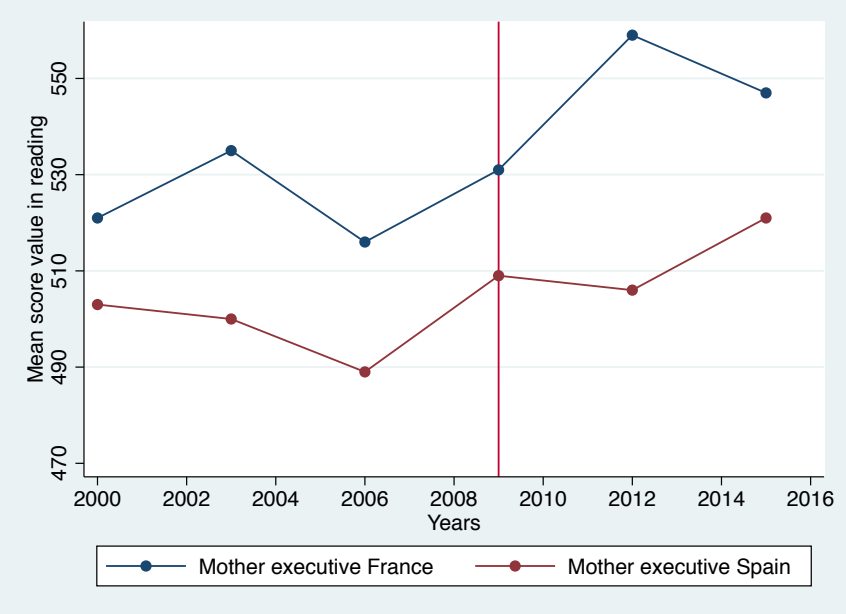


Figure 3.34: Evolution of reading test mean score - father case comparison with Spain

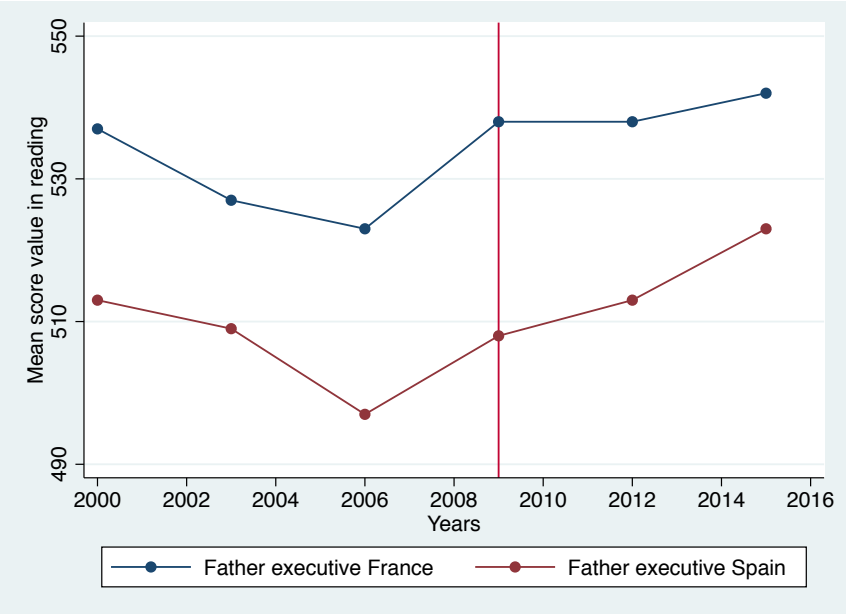
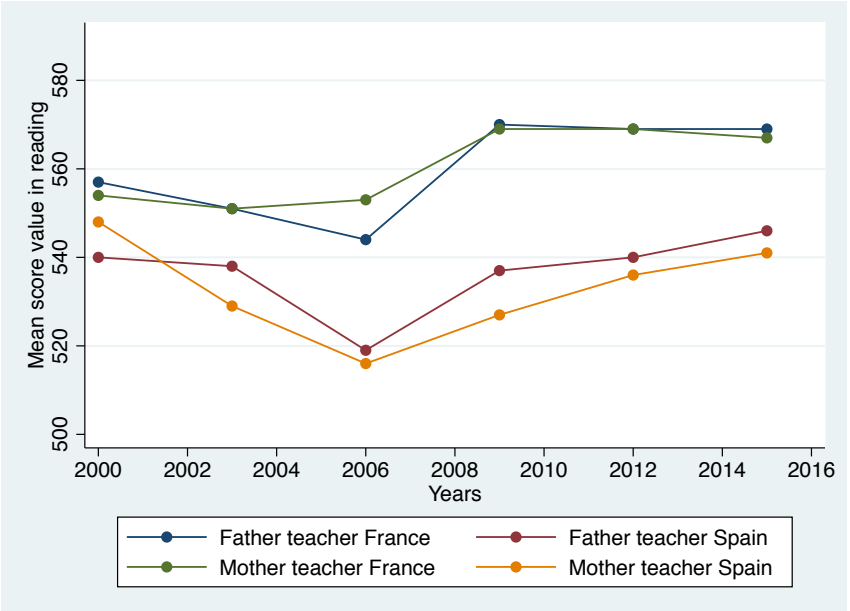


Figure 3.35: Evolution of reading test mean score - teacher case comparison with Spain



General comment:

On all the specifications we have for the approach (i) only the mother case in all the topics fulfilled the assumption (e). Nevertheless, for the approach (ii), none of the graphs we analyze confirm the assumption (f). This fact seems logic as we have seen that after 2003 we have a huge decline in test mean score value in France in all the topics. The general decline of the test score in France seems to invalid our approach which consist to consider our post treatment period as being after the year 2003.

3.2.3 Approach B: Comparison between children of affected and non affected workers

Here, we will now look at the evolution of the test mean score values over time between affected and non affected children in France. As defined in the chapter 2, the affected group is composed by all children whose parents are concerned by the reduction in working time (manager, executive, craft etc). The control group is composed by children whose parents are either teachers or in a military profession. As done before, we draw for each survey between 2000 and 2015, the test mean score value for each group of parent. In each case we distinguish mother and father and used two ways of analysis for the time period. We expect the analysis of our graph to fulfilled the same assumptions as before (catch-up in test mean score value for affected children and parallel trend assumption).

1) Look at the evolution of mathematics test mean score value:

A) Mother case:

According to the graph presented in the following page we will see if the later assumptions are respected or not.

Approach i: Definition of the pre-treatment period as 2009.

Assumption a: We can see that between 2009 and 2012 the gap between the two groups collapses. In 2009 the gap was about 81 points and becomes 76 in 2012. But the decrease of the gap is due to a decrease in mathematics test mean score value of the non treated mother.

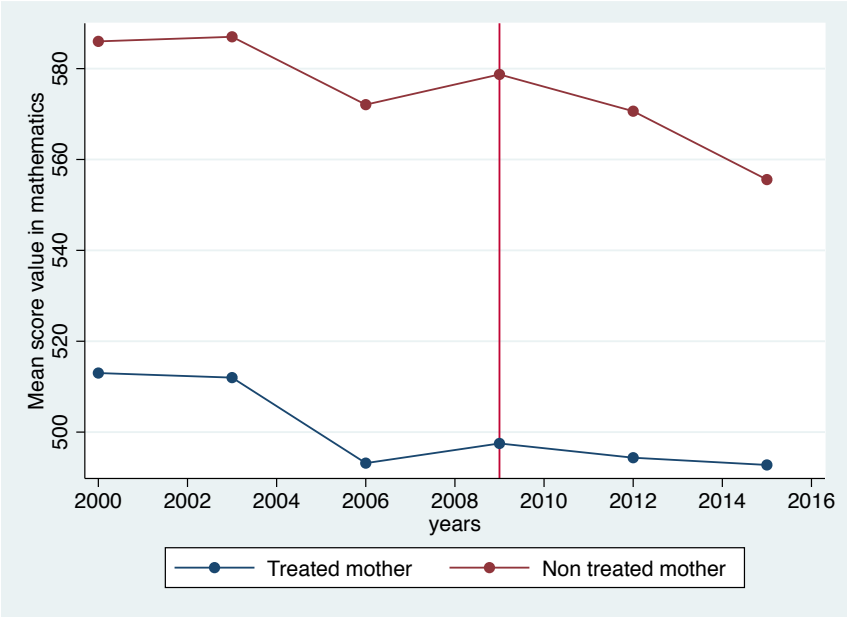
Assumption b: Before 2009, the parallel trend assumption is fulfilled as we have an increase in mean score value for the two groups before 2009.

Approach ii: Definition of the pre-treatment period as 2003.

Assumption c: Contrary to what we expect, the gap after the year 2003 don't collapse. The difference between the two groups increases from 75 points in 2003 to 78 points in 2006. It attains 81 points of difference in mean score value in 2009.

Assumption d: Before 2003 the parallel trend assumption is fulfilled as for the two groups we have a stagnation in the mathematics test mean score value before 2003.

Figure 3.36: Evolution of the mathematics test mean score - mother treated/non treated



A) Father case:

Approach i: Definition of the pre-treatment period as 2009.

Assumption a: We can see that between 2009 and 2012 the gap between the two groups collapses a little. In 2009 the gap was about 53 points and becomes 52 points in 2012. But there is no catch-up coming from the fact to have an affected father.

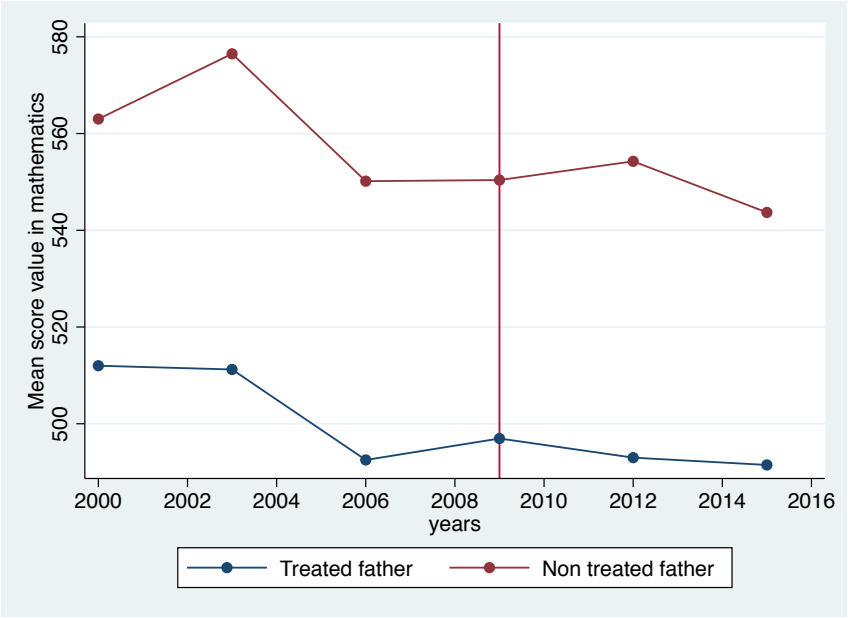
Assumption b: Before 2009, the parallel trend assumption is not well fulfilled as we have a slow increase in mean score value for the non treated groups before 2009 and a stagnation for the control group.

Approach ii: Definition of the pre-treatment period as 2003.

Assumption c: As we expect the gap after the year 2003 collapses in the next years. The difference between the two groups increases from 65 points in 2003 to 57 points in 2006. It attains 52 points of difference in test mean score value in 2009. But the variation of the two groups invalid the assumption.

Assumption d: Before 2003 the parallel trend assumption is not fulfilled as we have an increase in the test mean score value of mathematics before 2003 for the control group.

Figure 3.37: Evolution of mathematics test mean score - father treated/non treated



2) Look at the evolution of the sciences test mean score value:

A) Mother case:

Approach i: Definition of the pre-treatment period as 2009.

Assumption a: We can see that between 2009 and 2012 the gap between the two groups collapse. In 2009 the gap was about 87 points and becomes about 63 points in 2015. Nevertheless, as in the mathematics topic case this is due to a decline in the test mean score value of children whose mother are non affected.

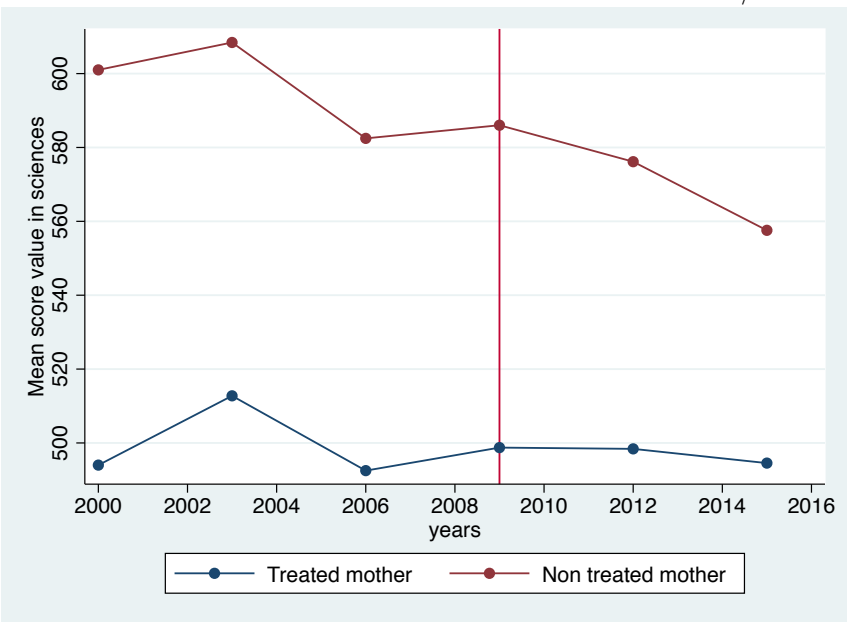
Assumption b: Before 2009, the parallel trend assumption is fulfilled as we have an increase in test mean score value for the two groups before 2009.

Approach ii: Definition of the pre-treatment period as 2003.

Assumption c: As we expect the gap after the year 2003 collapses. The difference between the two groups increase from 95 points in 2003 to 89 points in 2006. It attains 87 points of difference in test mean score value in 2009.

Assumption d: Before 2003, the parallel trend assumption is fulfilled as for the two groups we have an increase in the test mean score value in sciences before 2003.

Figure 3.38: Evolution of sciences test mean score - mother treated/non treated



A) Father case:

Approach i: Definition of the pre-treatment period as 2009.

Assumption a: We can see that between 2009 and 2012 the gap between the two groups collapses. In 2009 the gap was about 61 points and becomes 57 points in 2015. But the way by which the gap close up is non relevant for our analysis.

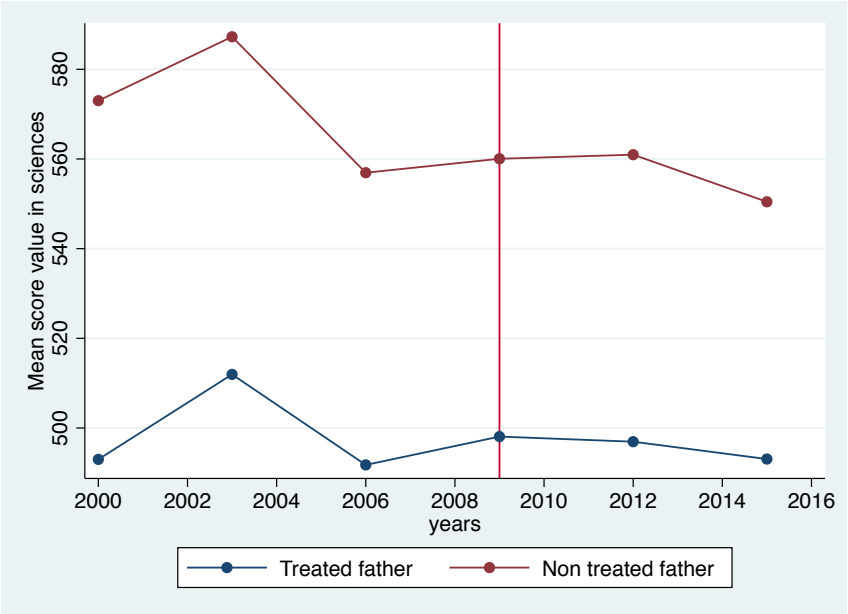
Assumption b: Before 2009, the parallel trend assumption is not fulfilled as we have a slow increase in the test mean score value for the control groups before 2009 whereas it increases is more important for our treatment group.

Approach ii: Definition of the pre-treatment period as 2003.

Assumption c: As we expect the gap after the year 2003 collapse in the next years. The difference between the two groups increases from 75 points in 2003 to 65 points in 2006. It attains 61 points of difference in test mean score value in 2009. But on overall, the variation in mean score value is not translated into an increase for the treatment group compared to the control one.

Assumption d: Before 2003 the parallel trend assumption is fulfilled as we have an increase in the test mean score value of mathematics before 2003 for the two groups.

Figure 3.39: Evolution of sciences test mean score - father treated/non treated



3) Look at the evolution of the reading test mean score value:

A) Mother case:

Approach i: Definition of the pre-treatment period as 2009.

Assumption a: We can see that between 2009 and 2012 the gap between the two groups collapse. In 2009 the gap was about 98 points and becomes about 69 points in 2015. But there is at the same time an increase of the test mean score value for children whose mother is treated and a decrease for the other children so that we cannot valid our assumption for the years 2015.

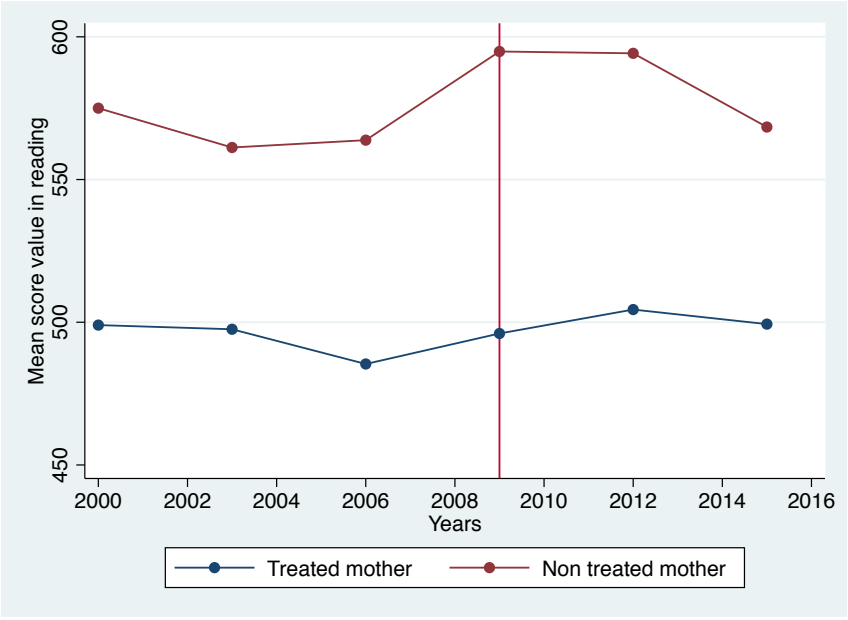
Assumption b: Before 2009, the parallel trend assumption is not fulfilled as we have a slow increase in mean score value for the treatment groups before 2009 whereas this increase is more important for our control group.

Approach ii: Definition of the pre-treatment period as 2003.

Assumption c: Contrary to what we expect the gap after the year 2003 don't collapse. The difference between the two groups increases from 64 points of difference to 78 points in 2006.

Assumption d: Before 2003, the parallel trend assumption is not fulfilled as we have a decrease in the test mean score value for the control group before 2003 whereas there is a stagnation for our treatment group.

Figure 3.40: Evolution of reading test mean score - mother treated/non treated



A) Father case:

Approach i: Definition of the pre-treatment period as 2009.

Assumption a: We can see that between 2009 and 2012 the gap between the two groups collapses. But as in the mother case the variation are not in perfect fulfillment with our assumption.

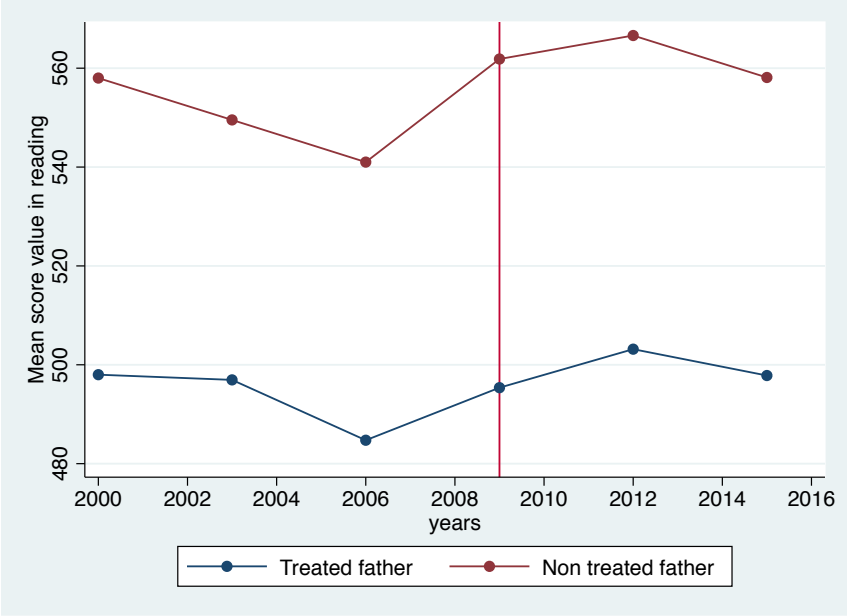
Assumption b: Before 2009, the parallel trend assumption fulfilled as we have an increase in the test mean score value for the control and treatment group before 2009.

Approach ii: Definition of the pre-treatment period as 2003.

Assumption c: Contrary to what we expect the gap after the year 2003 don't collapse in the next years. The difference between the two groups increases from 52 points in 2003 to 56 points in 2006. It attains 66 points of difference in mean score value in 2009.

Assumption d: Before 2003 the parallel trend assumption is not fulfilled as we have a decrease in the mean score value of reading before 2003 for the control group and a stagnation for the treated one.

Figure 3.41: Evolution of reading test mean score - father treated/non treated



General comment:

In all the cases we describe above we remark that in all the topics the children whose parents are non treated do better. Concerning our analysis we remark that for the approach (i) and (ii) none of the cases we observe fulfilled the assumptions we made.

3.2.4 Comparison with Spain

As done in the approach A, we will now compare graphically the evolution of the test mean score value over time between treated and non treated children in another country. As before, we will use Spain for comparison. So we want now look at some remarkable evolution and differences in the test scores mean values between the two groups of interest and the time period in Spain and in France.

There is two mains hypothesis as the ones used before:

Assumption e: For the first way of analysis (i) we expect an increase of the test mean score value for the treated children after 2009 compared to their counter factual in Spain.

Assumption f: For the analysis (ii), we expect the test mean score value in a given topic to increase for French children compare to their Spanish counterpart after the year 2003.

1) Look at the evolution of the mathematics test mean score value:

The graph are presented in the following page.

A) Mother case:

Approach i: Definition of the pre-treatment period as 2009

Assumption e: We see that as expected after 2009 the mother treated children have a test mean score which increases in France compared to their Spain counterpart. This could be attributed to the 35 hours reform which allows French parents to spend more time with their child when they were young and this could have produced an increase in their cognitive skills.

Approach ii: Definition of the pre-treatment period as 2003.

Assumption f: Here the graphical evolution don't valid our assumption. Indeed, the French students have a test mean score value which decreases after the year 2003 whereas it increases for the Spain students.

B) Father case:

Approach i: Definition of the pre-treatment period as 2009

Assumption e: We see that contrary to what we expected, after the year 2009 the children whose father are treated have a test mean score which decreases while it increase for their Spanish counterpart.

Approach ii: Definition of the pre-treatment period as 2003.

Assumption f: For the analysis (ii), as in the mother case, the French students have a test mean score value which decreases after the year 2003 whereas it increases for the Spain students in mathematics. This is not in favour of our assumption.

Figure 3.42: Evolution of mathematics test mean score - mother treated case comparison with Spain

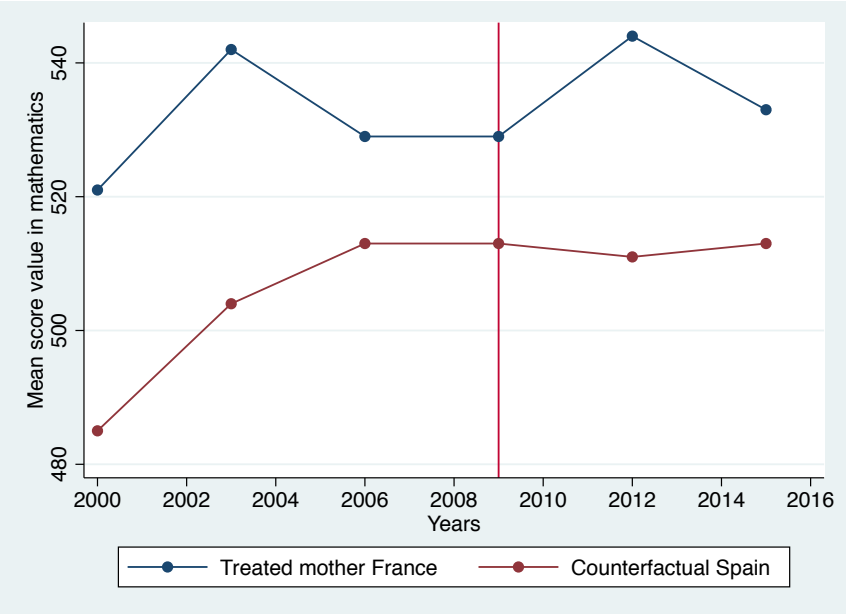
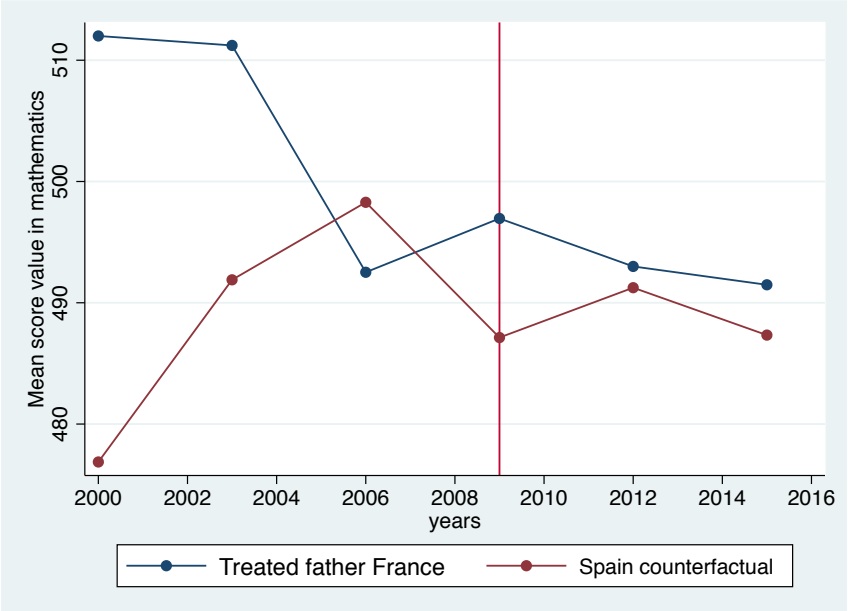


Figure 3.43: Evolution of mathematics test mean score - father treated case comparison with Spain



2) Look at the evolution of the sciences test mean score value:

The graphs are presented in the following page.

A) Mother case:

Approach i: Definition of the pre-treatment period as 2009

Assumption e: We see that as expected after 2009 the mother treated children have a test mean score which increases in France compared to their Spanish counterpart. This could be attributed to the 35 hours reform which allows French parents to spend more time with their child when they were young and this could have produced an increase in their cognitive skills.

Approach ii: Definition of the pre-treatment period as 2003.

Assumption f: Here the graphical evolution don't valid our assumption. Indeed, the French students have a test mean score value which decreases after the year 2003 whereas it increases for the Spain students.

B) Father case:

Approach i: Definition of the pre-treatment period as 2009

Assumption e: We see that contrary to what we expected, after the year 2009 the children whose father are treated have a mean score which decreases compared to while it increases for their Spanish counterpart.

Approach ii: Definition of the pre-treatment period as 2003.

Assumption f: For the analysis (ii), as in the mother case, the French students have a test mean score value which decreases after the year 2003 whereas it increases for the Spain students in the sciences. This is not in favour of our assumption.

Figure 3.44: Evolution of sciences test mean score - mother treated case comparison with Spain

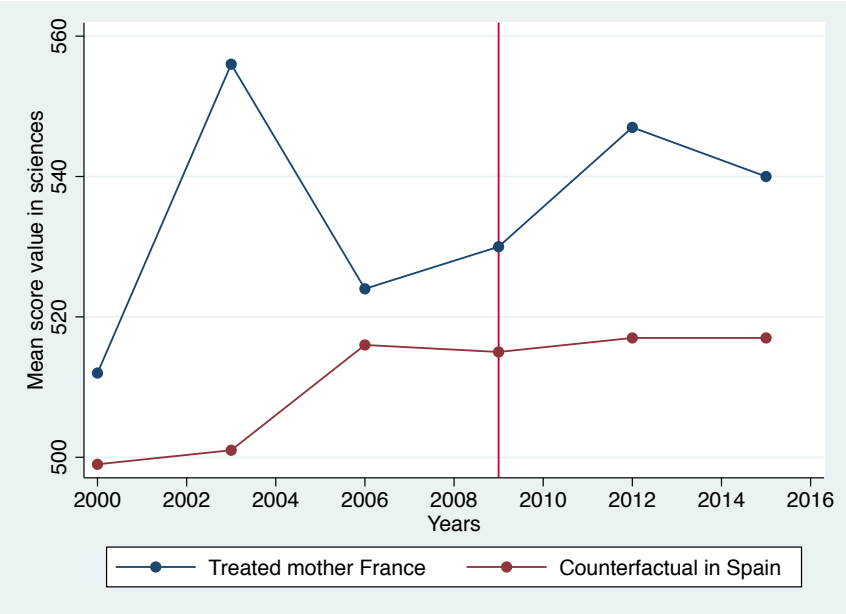
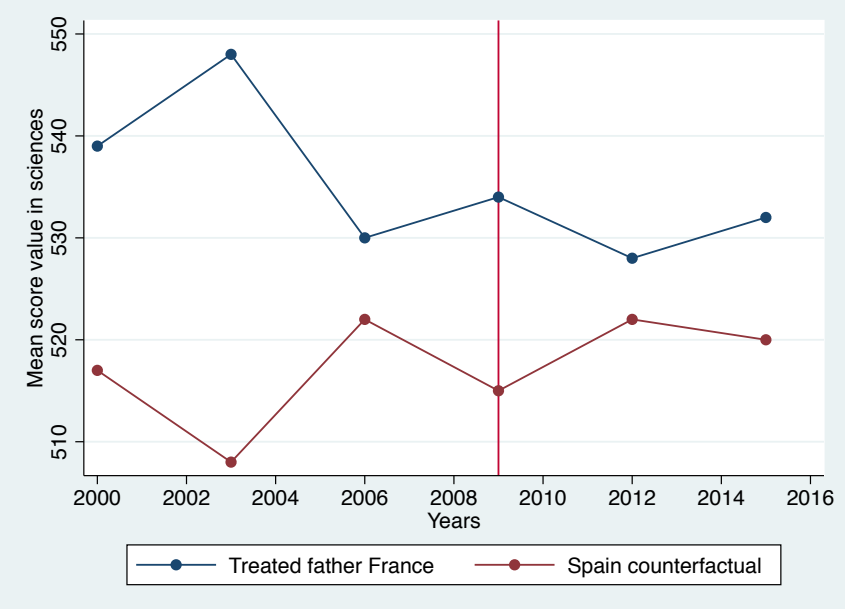


Figure 3.45: Evolution of sciences test mean score - father treated case comparison with Spain



3) Look at the evolution of the reading test mean score value:

The graphs are presented in the following page.

A) Mother case:

Approach i: Definition of the pre-treatment period as 2009

Assumption e: Contrary to what we expected, there is an increase in the test mean score value after 2009 for the French and Spanish case.

Approach ii: Definition of the pre-treatment period as 2003.

Assumption f: Here the graphical evolution don't valid our assumption. Indeed, the French students have a test mean score value which decreases after the year 2003 as the Spain students. In the two cases the two countries follow the same pattern.

B) Father case:

Approach i: Definition of the pre-treatment period as 2009

Assumption e: As in the mother case, there is an increase in test mean score value after 2009 for the two countries.

Approach ii: Definition of the pre-treatment period as 2003.

Assumption f: For the analysis (ii), as in the mother case, the French students have a test mean score value which decreases after the year 2003 as their Spanish counterpart. This invalid our assumption.

Figure 3.46: Evolution in reading test mean score - mother treated case comparison with Spain

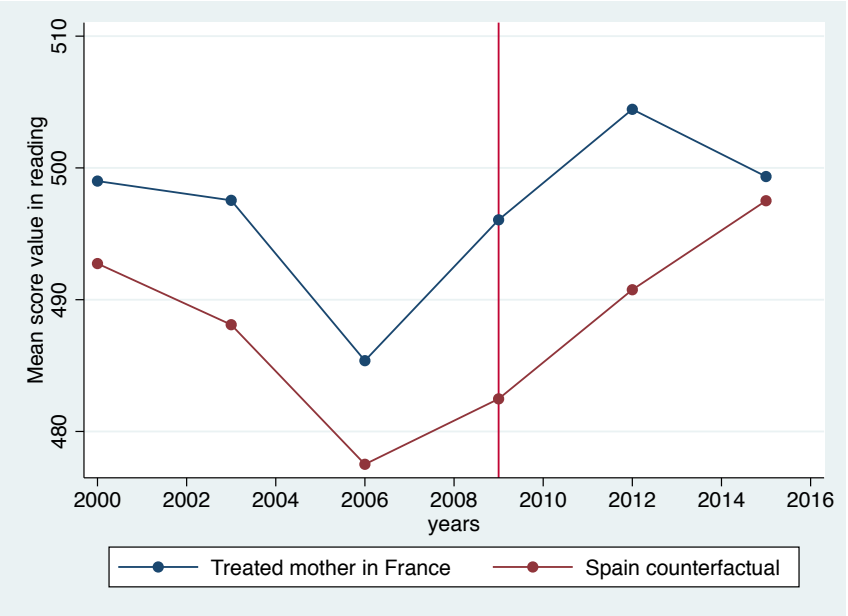
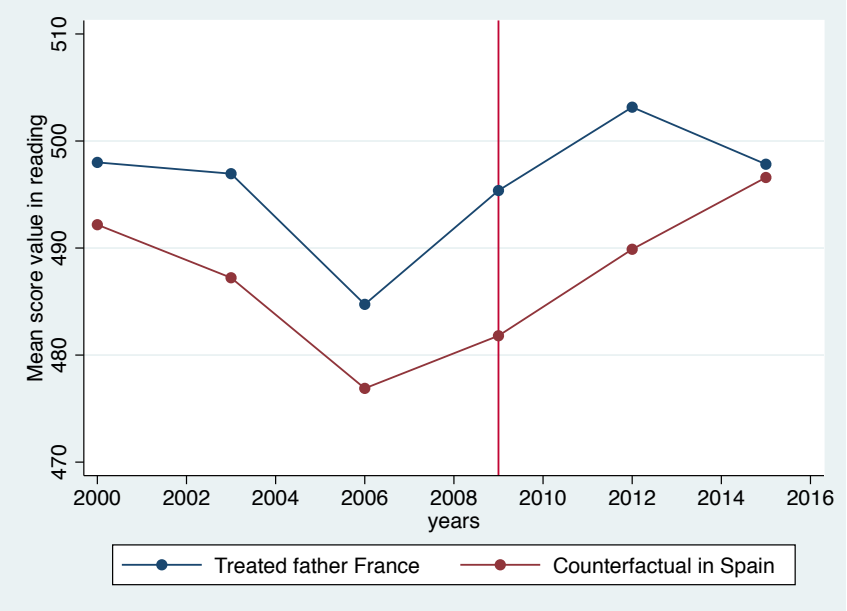


Figure 3.47: Evolution in reading test mean score - father treated case comparison with Spain



General comment:

In all the cases, none of the graphics are compelling for our analysis (ii). Concerning the analysis (i) that is to say, considering the pre-treatment period as 2009, the case which fulfilled our assumptions is for the mother case in the mathematics and science topics.

Conclusion for the graphical analysis:

First for the approach A, with the time specification (i) that is to say when using the year 2009 as pre-treatment period, the assumptions we made are fulfilled only for the reading topic (in the mother and father cases). In fact, in reading, there is catch-up in the test mean score value for student having a mother/father executive in comparison to the one having a teacher parent after the year 2009. Moreover, the reading case valid the parallel trend hypothesis. When comparing to Spain counter-factual children, the topics where French student increase their test mean score value in comparison to Spain, are in the sciences, mathematics and reading for the mother case. Given these results, the approach A seems to be a good begin for our analyze, notably for the mother case in the reading topic. So in the future DID estimation strategy, we will focus on this case. However, having a such evolution for the mother case and not for father seems to contradict an effect of the RWT on schooling outcome as the reform affect mother and father in the same way. But we can think that mother change their behaviors corresponding to the time they pass with their children and that father do not. Concerning the approach (ii), the graphics invalid the assumptions we have.

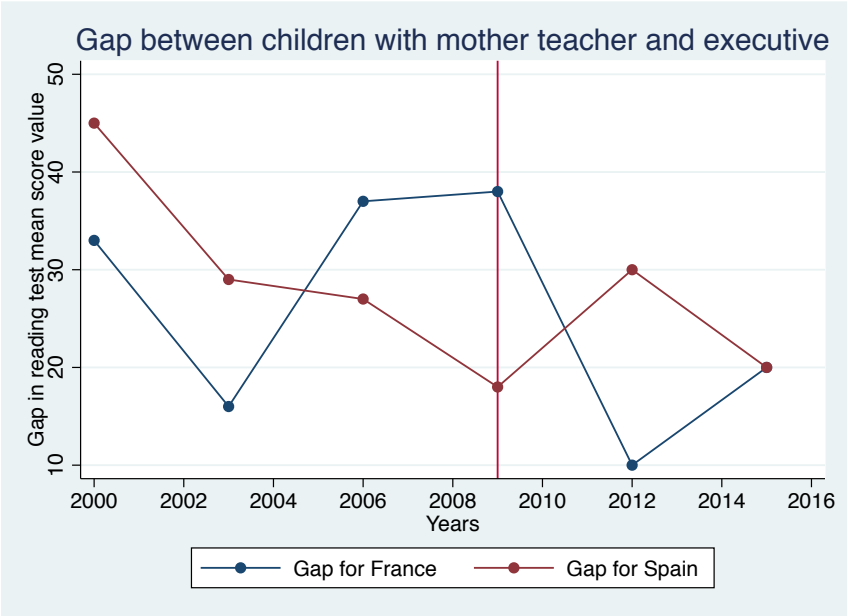
Second, keeping a look at the approach B, the graphics reveal that none of the cases are relevant for the analysis when we compare test mean score value of children whose parents are affected or not (in the two time approach we have). In addition, our future DID estimation strategy required that our groups of comparison are much similar as possible. Here in this approach the treatment group is composed by much more professional categories than in the approach A, so that the difference between our two groups could be driven by some unobservable characteristics and not by the RWT reform. In fact, these differences in characteristics could drive differences in behavior of the parents, in the test mean score of the children etc. In addition, the fact that our numbers of observations are unbalanced between the two groups could be also a limit.

So finally, given this graphical analysis, in our future DID estimation strategy, we will focus on the approach A and on the reading topics case. The mother case seems to be the more relevant given the comparison to Spain counter factual. Nevertheless, in order to confirm the graphical analysis, we will do the estimations for mother and father.

Before to go to the estimation chapter we will just look at a last graph which can help us to see any impact of the Aubry laws on children schooling outcome. We will compare the gap in test mean score value

between children whose mother is a teacher and an executive in France and the same gap for their children counterpart in Spain. We expect the gap in reading test mean score value to decrease in France relative to the one in Spain. Here we will focus on the change in gap after 2009 as we considered this year as a pre-treatment period. We also expect in accordance with the parallel trend assumption that the evolution of the gap to be the same between the two countries before 2009. According to the conclusion draws above, we will focus on mother case and reading topics.

Figure 3.48: Gap in the reading test mean score value between children with mother teacher/executive in France and in Spain



As shown by the Graph (3.48), we seen than the two main assumptions we made are not respected. Indeed, on the one hand the gap between children whose mother is a teacher and an executive in France decrease clearly after 2009 but this same gap increase in Spain or we expected it to be constant. On the other hand, concerning the pre-trend (before 2009) it's not the same for France and Spain. In fact the gap decreases in Spain and remains stable in France. So, it's seems to be difficult given this graph to see an impact of the RWT on reading test mean score value. This graph refers to the idea of a triple difference in difference (3DID) estimation strategy between children whose mother is a teacher and an executive between France and Spain. Nonetheless, given the corresponding graphical analysis the effect of the Aubry law seems to be not effective. By this way implemented a 3DID estimation strategy seems to not convincing us given the graphical analysis. Nevertheless, in the Appendix we provide the results of this estimation strategy and comment it.

Chapter 4

Estimation and main results

4.1 The impact of the time spent by parents with the children on their schooling outcomes

4.1.1 Instrumental variable estimation strategy

In order to see if the reduction in working time allows better schooling results we need first to see if the 35 hours reform allows parents to spend more time with their child and by this way increase their schooling's results (Assumption 1.c).

First, to measure the time spent by the parent with the child we will use as in the graphical analysis, the variable which indicated the time spent to talk with the child at home by parents. Due to the lack in the PISA data of observations for some years and some specifications, we will use as before the survey of the year 2000 and the year 2015. We considered the years 2000 as a pre-treatment period and 2015 as a post treatment period. To allow comparison across the surveys, we normalize our variable which indicates the time spent to talking with the child.

Second, as we expect the reduction in working time increases the child's schooling results thought an increase in the time spent with the child we need to instrument this later. Indeed, the time spent to talk with the child variable could be endogenous.

In fact, if we want to estimate the direct effect of the increase in time spent with the child on schooling results by an OLS estimation (equation 4.1), the results found could be inconsistent. Indeed, the change in the time spend with the child is not only associated to change in the schooling results but also with change on the working time contain in the errors terms u_i.

$$Meanscorevalue_i = \alpha + \beta * Timechild_i + u_i \tag{4.1}$$

Where $Meanscorevalue_i$ is our outcome variable: the test mean score value of the $child_i$ on a given topic (mathematics, reading or sciences). $Timechild_i$ is the normalized variable which gives us the time spend to talk with the child. It's expected to be an endogenous variable. u_i, is the error term (here we expect the error term to be correlated with our explanatory variable).

Actually, we expect the time spent to talk with the child to be correlated to the new French labor legislation. More free time admit by the reduction in working time, could allow parents to spend more time with their children. To avoid an omitted variable bias in our estimated results of the equation (4.1) due to the endogenity of our explanatory variable, we will use an instrumental variable (IV) estimation strategy. We will instrument the variable indicating the time spend to talk with the child by the fact to be a treated parent. Using this method, we try to isolate the part of our endogenous variable which is uncorrelated to the unobservable terms. In fact, we capture the part of the time spent to talk with the child which is correlated with the reduction in working time reform.

IV estimation strategy: System of estimated equations.

To estimate the following system of equations, we will use a 2SLS estimation procedure.

First stage equation: The effect of the 35 hours reform on the time spend with the child.

$$\widehat{Timechild}_i = \alpha + \beta_1 Z_i + \theta G_i + \epsilon_i \tag{4.2}$$

Where $\widehat{Timechild}_i$ is the endogenous variable which gives us the time spend to talk with the child.
*Z_i is our instrumental variable, it's the interaction term between the post treatment period and the parent treated occupation status (Post reform period * Treated parent). It gives us the variable which indicate if the children i have a parent who is affected by the 35 hours reform.*
G_i is a demographic control variable. It's refers to the gender of the student. It allows us to see any test mean score difference between boys and girls. Here, we don't control for the age of the student as the PISA data implements its survey only for students who have between 15 years and 3 month year old and until 16 years and 2 month year old. As the gap of the age is minimal it don't seem to be useful to control for the age.
ϵ_i is the error term (all the unobserved factors which explain our outcome variable but which are uncorrelated to the explanatory ones).

Reduced form equation: The effect of the time spent with the child on schooling outcomes.

$$Meanscorevalue_i = \alpha + \beta_2 \widehat{Timechild}_i + \theta G_i + v_i \tag{4.3}$$

Where $Meanscorevalue_i$ is our outcome of interest: the test mean score value of the child$_i$ on a given topic (mathematics, reading or sciences).

$\widehat{Timechild}_i$ is the instrumented variable which gives us the time spend to talk with the child. Now, this variable is supposed to be exogenous. It's the predicted value.

G_i is the same control variable as in the above equation (the gender of the child).

v_i is the error term (all the unobserved factors which explain our outcome variable and which are uncorrelated to the explanatory ones).

We notice than in our estimation we make the co-variance estimator robust to hereroscedasticity (we use the robust estimator of the variance).

Instrumental variable estimation strategy assumption:

To be a good and valid instrument Z need to answers two main assumptions.

Assumption A.1: The relevance condition: Our instrumental variable needs to be correlated with our endogenous variable. In fact, we need the correlation between the two to be different from zero.

$$\text{Corr}(Z_i, \text{Timechild}_i) \neq 0$$

This condition is expected to be valid as the reduction in working time is supposed to allow parents to spend more time with the child. Nevertheless, if we remember the graphical analysis we do, the relevance condition is not fulfilled in the majority of the approach we use. But we will try here to see if by the IV estimation strategy, we find some consistent results. Next, we will check in the next part the relevance condition by making some tests.

Assumption A.2: The instrument exogeneity condition : The instrument explains the outcome variable only thought the time spend to talk with the child variable. The part of the variation in time spend with the child captured by the instrument is exogenous.

$$\text{Corr}(Z_i, \text{u}_i / W_i) = 0$$

With W_i our control variables.

This condition is expected to be valid as the reduction in working time is supposed to increase the test mean score value through more allocation of time by parents to children. In fact, by having a surplus of free time allocated to children, this is expected to be beneficial for them (see explanation in the preceding chapter).

4.1.2 Results

In this first section, we will estimate by a two stage least squared (2SLS) estimation strategy the system of equations presented above. We will do this for our two approaches and for the three topics we have in the PISA data. Second, we will check the validity of our instrument, notably its relevance condition. In the following tables we will present the results of the 2SLS estimation procedure for the equation (4.3) which gives us the reduced form equation estimated results.

1) Approach A

On the next page there is the table which presents the results of our 2SLS estimation for the approach A and all the school topics. Where the treated parents are executive workers and the non affected by the reduction in working time are teacher ones. This table gives us the results of the reduce form equation (4.3). Where the variable indicating the time spend to talk with the child is supposed exogenous as instrumented.

A) Outcome variable: Mathematics test mean score value.

First, we remark that the coefficients of interest associated to the variable "timechild" are negative. It's significant in the father case but non significant in the mother one. These results don't confirm the sign we have expected: an increase in time spent with the child is supposed to increase their schooling results. Perhaps our model is not well specified or our instrument is non relevant in the explanation of the time spend to talk with the child. These results are not surprising as given the graphical analysis we don't have see an increase in the time spend with the child between the two periods with our measure.

The coefficients associated with the gender control variable are negative. It's significant in the mother case. For example, when instrumenting the time spent with the child by the fact to have a mother executive, we have the test mean score value in mathematics which decrease by around 21 points when the student is a girl compared to the case where it's a boy. Generally, being a girl decreases the mean score value in mathematics test compared to the case where the student is a boy.

B) Outcome variable: Sciences test mean score value.

For the sciences results, first, we remark that all the coefficients associated to the variable "timechild" are non significant and negative. As before, this could come from the structure of the data we have or the fact that our instrument variable is not relevant in the explanation of the time spend with the child by the parents.

The coefficients associated with the gender control variable are negative. The only significant coefficient at the 0.001% level is for the mother case. It's meant that the fact to be a girl when having a mother executive is predicted to decrease the test mean score value by around 25 points compared to being a boy.

C) Outcome variable: Reading test mean score value.

For the reading results, we notice that here, the coefficient associated to the variable "timechild" is positive for the mother executive case but negative for the father case. As before, the non significance of our coefficients could come from the structure of data we have or the fact that our instrument is not relevant in the explanation of time spend with the child.

The coefficients associated with the gender control variable are here positive and significant. The fact to be a girl is predicted to increase the reading test mean score value compared to being a boy.

General comment:

On overall, the coefficient of interest, that is to say, the ones associated with the instrumented variable (the time spend to talking with the child) are in almost all the case non significant and don't have the expected sign. These results could come from a problem in the relevance condition of our instrument or the specification we do. In the graphical analysis present in the chapter 3, the approach A did not convince us. Perhaps our measure of the time spends with the children by the parent is not representative.

However, some results appear to be significant. In fact the gender status of the students plays a role in the test mean score. Being a girl is predicted to decrease the test mean score value in the sciences and mathematics in comparison to being a boy. For the reading test it's the reverse which occurs.

Table 4.1: Impact of the time spent by parents with the child on the test mean score - in a 2SLS estimation - Approach A

	Approach A					
	Mathematics test mean score		**Sciences test mean score**		**Reading test mean score**	
	Mother executive	**Father executive**	**Mother executive**	**Father executive**	**Mother executive**	**Father executive**
Timechild	**-80.777**	**-73.430***	**-33.674**	**-160.877**	**30.596**	**-15.128**
	(107.98)	*(37.07)*	*(101.50)*	*(133.17)*	*(67.57)*	*(40.71)*
Gender	**-21.633****	**-2.871**	**-25.008*****	**4.841**	**18.207****	**26.128*****
	(8.24)	*(7.89)*	*(6.85)*	*(16.93)*	*(6.46)*	*(7.34)*
constant	**567.175*****	**547.274*****	**569.674*****	**559.246*****	**544.133*****	**536.943*****
	(12.24)	*(5.50)*	*(11.22)*	*(12.36)*	*(6.40)*	*(4.44)*
dfres	*626.000*	*728.000*	*636.000*	*724.000*	*733.000*	*843.000*
Nb.obs	***629***	***731***	***639***	***727***	***736***	***846***

Significance level: p<0.05 , p<0.01** and p<0.001***.*
Standard errors in parentheses.
Sources: PISA data

2) Approach B:

On the next page there is the table which presents the results of our 2SLS estimation procedure for the approach B and all the school topics. Where the treated parents are composed by all the professional categories affected by the Aubry laws and the non treated parent are composed by parents who are teachers or military workers. This table gives us the result of the reduced form equation (4.3).

A) Outcome variable: Mathematics test mean score value.

First, we remark that all the coefficients for the mother and the father cases, associated with the variable "timechild" are positive and significant. These results confirm the sign we have expected: an increase in time spends with the child is supposed to increase their schooling results. Nevertheless, our coefficients are quite some high in their value. This could come from our measure of the time spend to talk with the child, which is not representative and which creates a measurement error bias in the estimation. It could also be explained by the fact that our instrument doesn't be relevant in the explanation of the time spend with the child leading to an overestimation bias.

The coefficients associated with the gender control are negative and significant. Being a girl is predicted to decrease the mathematics test mean score value compared to being a boy.

B) Outcome variable: Sciences test mean score value.

For the sciences results, first, we remark that as in the mathematics case, the coefficients associated with the variable "timechild" are positive. But once again the coefficients are high in their value.

The coefficients associated with the gender control variable are negative. It's meant that the fact to be a girl is predicted to decrease the test mean score value in sciences comparable to being a boy.

C) Outcome variable: Reading test mean score value:

For the reading results, we notice that here the coefficients associated to the variable "timechild" are positive for the mother and the father case and are significant. Nevertheless, as in the other topics the coefficients seem to be high in their value.

Concerning the coefficients associated with the gender control, they are positive but non significant.

General comment:

On overall, the approach B, didn't convince us. Despite the fact that our coefficients are of the expected sign and in some case significant, their high value makes us think that we can have a bias in our estimation. This bias could come from our measure of explanatory variable or the validity of our instrument leading to an overestimation bias. In the following section we will test and discuss this.

General conclusion on the 2SLS estimation procedure:

We have done a 2SLS estimation procedure, by instrumented the time spend to talk with the child by the fact to have a parent whose working time has reduced. In the approach (A) the results of the reduce form equation estimates show that none of the coefficient associate to the instrumented variable are significant in the explanation of the test mean score value for the three topics and don't have the expected sign. Given the graphical analysis we did, we did not expect to have a significant impact of the time spend by the parent with the child on their schooling results.

In the approach (B) the results of the reduce form equation estimates are sometimes significant and with the correct sign but their values are quite high. Theses results let us think that by our measure of the explanatory variable or the instrument we used, we can have a bias in our estimation.

On overall, these results don't allow us to confirm an impact of the RWT reform on the schooling outcome trough more time pass by the parent with the children. The non significance of the coefficients or their high magnitude could come from the fact that our instrument is not relevant in the explanation of the time spend to talk with the child, a miss specification in our model or by the used of data we do. These facts need to be discus. We will do this in the next section.

Table 4.2: Impact of the time spend with the child by parents on the test mean score - in a 2SLS estimation - Approach B

	Approach B					
	Mathematics test mean score		**Sciences test mean score**		**Reading test mean score**	
	Mother executive	**Father executive**	**Mother executive**	**Father executive**	**Mother executive**	**Father executive**
Timechild	**345.078***	**235.786*****	**560.122**	**357.851*****	**402.893***	**299.097*****
	(171.34)	*(63.97)*	*(319.18)*	*(105.92)*	*(163.28)*	*(68.41)*
gender	**-31.602***	**-24.796*****	**-35.505**	**-23.982***	**5.970**	**11.819**
	(13.06)	*(6.64)*	*(21.49)*	*(9.62)*	*(12.44)*	*(7.40)*
constant	**514.655*****	**513.975*****	**497.263*****	**499.961*****	**501.499*****	**499.176*****
	(5.68)	*(3.98)*	*(10.05)*	*(6.07)*	*(7.02)*	*(4.81)*
dfres	*7405.000*	*7405.000*	*7399.000*	*7399.000*	*8847.000*	*8847.000*
Nb.obs	***7408***	***7408***	***7402***	***7402***	***8850***	***8850***

Significance level: p<0.05 , p<0.01** and p<0.001***.*
Standard errors in parentheses.
Source: PISA data.

4.2 Check of the validity of the IV procedure and limits

4.2.1 Check of the instrument relevance condition

In this section, we will test the validity of our instrument. As the results obtained before are not convincing, we will notably focus on the relevance condition of our instrument. In all the tests we do, we describe here the method we used and the main results. The tables containing details results are presented in the appendix.

Assumption A.1: The relevance condition: Our instrumental variable needs to be correlated with our endogenous variable. In fact, we need the correlation between the two to be different from zero.

$$\text{Corr}(Z_i, \text{Timechild}_i) \neq 0$$

To see if the relevance condition is fulfilled we need to see if $\text{Corr}(Z_i, Timechild_i) \neq 0$. For that we will explicit the first stage regression summary statistics corresponding to the estimation of the equation (4.2) in each specification case (see Appendix to have the corresponding tables).

Concerning the approach A, first, for the mother case, in all the topics, the partial auto-correlation coefficient between our instrumental variable and our endogenous variable is null or very low. So that, the non significance of our coefficients estimates could come from the fact that our instrument is not relevant in the explanation of our endogenous variable. For the father case the only topic which shows a partial auto correlation which is not low or null is for the mathematics topics case where its value have attained (0.014).

Second, when conducting a Wald test statistic where the hypothesis to test is $H0$ = the instrument is weak, we don't reject in all the cases $H0$, except for the father case in the mathematics topics. This means that in almost all the specifications that we have done in our approach A, our instrument is weak in the explanation of our potential endogenous variable. The only case where we cannot reject that our instrument is weak is in the mathematics case where the instrument is the fact to have a father executive. But, as the sign associated to this specific case is negative we failed to capture the effect of interest. **In a general point of view for our approach A, we can conclude that our instrument is not valid as it's non relevant in the explanation of our endogenous variable. This fact could explain the non significance of our estimates results.**

Concerning the approach B, we remember that the majority of our coefficients were significant but quite high. We will try to see if this fact could come from the validity of our instrument. First, in the mother case in all the topics, the partial auto-correlation coefficient between our instrumental variable and our endogenous

variable is very low. So that our instrument seems to be not relevant in the explanation of our endogenous variable. In addition, when conducting the Wald test statistic to capture the weakness of our instrument, we don't reject $H0$ in all the case at the 10% level. By these facts, the instrument could be considered as non valid.

When looking at the father case, the partial auto-correlation coefficient between our instrumental variable and our endogenous variable are low. However, when conducting a Wald test statistic where the hypothesis to test is $H0 =$ the instrument is weak, we can reject in theses cases $H0$. This means that in almost all the specifications, we cannot reject that our instrument is not weak in the explanation of our potential endogenous variable. But the fact that the partial auto-correlation coefficient is not high and that our F-Test statistic values are not very high compared to the Wald test critical values we cannot conclude that our instrument is relevant and valid. **In a general point of view for our approach B, we can conclude that our instrument is not valid.**

Given the estimates results we have in the above section, the non relevance of our instrument is not a surprise. Our basic assumption 1.c was that the time spend with the child increase following the reduction in working time reform as parent have more free time. Theoretically, we think this assumption to be fulfilled and this hypothesis had been checked in a Master thesis using another kind of data than the ones we use. So perhaps the non significance of our estimate (approach A) or their high magnitude (approach B) comes from the use of the data we do. In fact, with our PISA data, we have some limitations. First, our measure of the time spends with the child is through the measure of the time spend to talk with them. This kind of measure is probably bias as we cannot distinguish the time pass with the child for educative activities. So that our measure probably under measure the real time spend by parents with the children. This could lead to a bias in our estimation. Second, some observations are missing depending on the year of the survey, so that we cannot use other survey than the one of the years 2000 and 2015. This limit also our analyze. Finally, the limits of our measure quoted just before could explain why our instrument is not valid. Indeed, if we have a bad/limited measure of the endogenous variable our instrument could fail to explain it. According to the graphical analysis we have done before, the measure we used don't seem to be relevant.

To conclude, the IV regression results and the graphical analysis we have done in the preceding chapter, allows us to conclude that we cannot have a causal link between the reduction of working time reform and the time spend by the parents with the child in this framework. This could be due to the kind of information we have access to. Nevertheless, in order to pursue our analysis we implicitly assume that the parent who work less thanks to the Aubry's laws are allowed to help more their children than they do before and by this way increase their schooling outcome. Having a causal impact seems to be difficult to obtain given our graphical analysis and the IV estimation we have just done here, but in the following part we will pursue our analyze and implement a Difference in Differences estimation strategy. In addition, as for the graphical analysis the approach A seems to be the more relevant we will focus on it in the next part.

4.3 The impact of the reduction in the working time on schooling outcomes: DID estimation strategy

In the preceding section, we have concluded that with our PISA data we are unable to obtain a causal link between the reduction in working time reform and the increase in schooling results of their children through an increase in time spend with them.

Willing to investigate in another way the impact of the 35 hours reform, we can assume here that trough the results of the master thesis "Synchronisation et temps de travail: Quel impact des 35h sur le temps parental?", we can agree that our assumption (1.c) is fulfilled. Indeed, keeping confidences that with other data we can show that the RWT allow parents to spend more time with their children we want now use another estimation strategy.

As explain in the chapter 2, we will notably use a DID estimation strategy to see if before and after the implementation of the reduction in the working time (which define a treatment period) there is test mean score difference between children whose mother/father are an executive (treatment group) and those whose mother/father are a teacher (control group). This method corresponds to our approach A.

Here, we will focus on the reading topics case as the graph analysis of this topic answers the assumption that we did: there is catch-up in the reading test mean score value by the children whose parent are affected in comparison to the one whose parents are not. In plus, the parallel trend assumption is also fulfilled. To defined our treatment period we will used several's specifications. First we will use the year 2009 as a pre-treatment period (approach i). Second, we will use the years before 2003 as a pre-treatment period (approach ii). This estimation strategy allows us to try to evaluate the impact of the Aubry's laws on the reading test mean score value of PISA student.

The equation of interest that we want to estimate is the following:

$$Y_i = \alpha + \beta 1 T_i + \beta 2 (T_i * t_i) + \mu t_i + \epsilon_i \tag{4.4}$$

Where Y_i is our outcome variable: The reading test mean score value of the student $_i$. With $i = 1, ...N$.
α is our constant term. $\beta 1$, is the coefficient associated with the treatment group specific effect. It allows us to obtain the average permanent differences between our control and treatment group.
$\beta 2$, It's the coefficient associated with the treatment effect (the passage to the 35 hours). With T_i, the treatment status of student i (his mother/father is an executive) and t_i the treatment time period (dummy variable equal 1 if the year t is considered to belong to the post-treatment period). μ, is the coefficient associated to the time trend which is common for our two groups. ϵ_i is the error term.

4.3.1 Survey of the year 2009 as a pre-treatment period and 2015 survey as a post-treatment period

In a first way, we will notably assume that before the year 2009 we are in the pre-treatment period and the year 2015 is the post-treatment period. In fact, we remember than PISA students in 2009 are born in 1994 so before the implementation of the Aubry's laws and than the one in the 2015 survey are born in 2000 so just after. So, in this first approach we will focus on the beneficial impact of the reduction of working time on young child cognitive development (having an impact on their future schooling outcome).

1) Mother executive case:

The equation we want to estimate is the following:

$$MeanScoreR_i = \alpha + \beta_1 Mexecutive_i + \beta 2 Mexecutivey_i t + \mu year_t + \delta X + \epsilon_i \tag{4.5}$$

Where $MeanScoreR_i$ is the test reading mean score value obtain by the student$_i$. With $i = 1, ...N$.

α is the constant term (it give us the mean score value if the explanatory variable are equal to zero).

β_1, the coefficient associated to the variable $Mexecutive_i$ captures the permanent average differential in reading test mean score value between manager and teacher children.

β_2, the coefficient associated to the interaction term $Mexecutivey_i t$ is the coefficient of interest. The interaction term correspond to the fact to have a mother who is affected and to be in the post treatment period. It captures the differential of the test mean score between children of a manager and the teacher ones. Its the effect of the treatment.

$\mu year_t$ capture the year fixed effect. Here t=2015.

X, is a set of control variables: the gender of the student, the fact to have a father executive. We made several estimations and include controls in different ways.

ϵ_i Is the error term which represented all the unobserved factors which are uncorrelated with the explanatory variable and plays a role in the reading test score.

2) Father executive case:

The equation we want to estimate is the following:

$$MeanScoreR_i = \alpha + \beta_1 Fexecutive_i + \beta_2 Fexecutivey_i t + \mu year_t + \delta X + \epsilon_i \tag{4.6}$$

Where $MeanScoreR_i$ is the test reading mean score value obtain by the student$_i$. With $i = 1, ...N$
α is the constant term (it gives us the mean score value if the explanatory variable are equal to zero).
β_1, is the coefficient associated to the variable $Fexecutive_i$. It captures the permanent difference in test mean score value between children of manager and teacher father.
β_2, is the coefficient associated to the interaction term $Fexecutivey_i t$. It's the coefficient of interest. The interaction term corresponds to the fact to have a father affected and to be in the post treatment period. It captures the differential of test mean score between children of an executive and the teacher ones. Its the effect of the treatment. Here t=2015.
$\mu * year_t$ capture the year fixed effect with t=2015. X, is a set of control variables: the gender of the student, the fact to have a mother executive.
ϵ_i, is the error term which represents all the unobserved factors which are uncorrelated with the explanatory variable and plays a role on the reading score.

4.3.2 Results

The results of the two preceding estimated equations (Equation (4.5) and (4.6)) are presented in the next two pages. For each case, we explicit the results in three ways: the first estimation is without controls (1), the second one includes the control for the fact to have the other parent who is an executive worker (2) and the last specification includes in plus the student gender status control (3).

Mother executive case: Estimated equation (4.5)

Considering the coefficient β_1 associated to the variable $Mexecutive_i$, **there is a permanent negative difference of 22 points in the test mean score value between children whose mother in an executive compare to the case where she is a teacher**. The coefficient is significant at the 0.01% level when including controls relative to the gender of the student and the occupation status of the father (model 2 and 3).

The coefficient of interest β_2, which translates the effect of the treatment is positive but non significant in all the specifications we do. When looking at the control variables, for the occupation status of the father, there is a negative and significant reading test mean score differential about 19 points between students whose

father is an executive and the one whose father is a teacher. The coefficients are significant at the 0.001% level. In the model (3) where we control for the gender status of the student, the associated coefficient is significant at 0.001% level. It translates the idea that **the fact to be a student girl is predicted to increase the reading test mean score value by around 23 points compared to being a student boy**.

Father executive case: Estimated equation (4.6)

Considering the coefficient β_1 associated to the variable $Executive_i$, **there is a permanent negative difference of 13 points in the test mean score value between children whose father in an executive compare to the case where he is a teacher**. The coefficient is significant at the 0.01% level when including control relative to the gender of the student and the occupation status of the mother (model 3).

When looking at the coefficient of interest β_2, which translate the effect of the treatment, it's negative and non significant in all the specifications we do (with and without control). The time fixed effect associated with the year 2015 is positive and significant. Being in 2015 is predicted to increase the reading test mean score value in comparison to the being in 2009.

Finally, the variable controlling for the occupation status of the mother is negative and significant. There is a reading test mean score value differential about 16 points between student whose mother is an executive and the one whose mother is a teacher. As in the mother case, **being a student girl is predicted to increase the reading test mean score value compared to being a boy.**

Conclusion on the estimated results:

Given the graphical analysis we have done in the chapter 3, we were expecting that there is an effect for the mother case in the reading topics for the approach (i) that is to say considering the year 2009 as a pre-treatment period and the year 2015 as a post-treatment period. But, here given the DID estimation we do, **we cannot conclude that the RWT reform has a causal impact on the schooling outcome**. In fact, in all the specifications we do, the coefficients associated with the treatment effect are positive but non significant.

In addition, as discuss in the graphical analysis, the assumptions are fulfilled for mother case but not father one. Here the results estimated confirms this fact as the sign of the coefficient is positive for the mother case and negative for father one. If the RWT reform has an impact on schooling outcome, the coefficient associated with the treatment effect is expected to be positive for both mother and father executive as the reform touched them in the same way. Perhaps mother change their behavior and the father do not. In all the case, here with this time specification, the non significance of our coefficient don't valid an effect of the treatment. Nonetheless, we arrive to capture two effects. The first effect is the one associated with the occupation status

of the parents: there is a permanent negative reading test mean score value difference between children whose mother/father is an executive and the one whose mother/father is a teacher. This test mean score difference is about 22.4 and 13.65 points respectively (for the specification (3)). The second effect concern the gender status of the student. The fact to be a student girl is predicted to increase the reading test mean score value by around 23 points in comparison to being a boy.

Table 4.3: Diff-Diff results for mother case in reading. (Post treatment period: Year 2009).

	Mother executive case		
	Test mean score value in reading		
Model	**(1)**	**(2)**	**(3)**
Mexecutive	**-13.661**	**-21.629****	**-22.442****
	(7.07)	*(7.26)*	*(7.20)*
Mexecutiveyt	**5.712**	**10.180**	**10.189**
	(9.66)	*(9.66)*	*(9.58)*
year15	**9.964***	**4.657**	**5.060**
	(4.77)	*(4.89)*	*(4.85)*
Fexecutive		**-19.051*****	**-19.709*****
		(4.22)	*(4.18)*
Gender			**23.320*****
			(3.98)
Constant	**544.855*****	**558.881*****	**546.578*****
	(3.82)	*(4.91)*	*(5.30)*
dfres	***1905.000***	***1904.000***	***1903.000***
Nb.observations	***1909***	***1909***	***1909***

*Significance level: p<0.05 *, p<0.01** and p<0.001***.*
**Standard errors in parentheses.*
Source: PISA data.

Table 4.4: Diff-Diff results for father case in reading. (Post treatment period: Year 2009).

	Father executive case		
	Test mean score value in reading		
Model	**(1)**	**(2)**	**(3)**
Fexecutive	**-7.101**	**-12.652**	**-13.665***
	(6.59)	*(6.82)*	*(6.76)*
Fexecutiveyt	**-13.152**	**-9.350**	**-8.789**
	(8.38)	*(8.46)*	*(8.39)*
year15	**16.662****	**12.415***	**12.508***
	(6.17)	*(6.31)*	*(6.26)*
Mexecutive		**-15.219****	**-16.074****
		(5.00)	*(4.96)*
Gender			**23.272*****
			(3.98)
Constant	**545.233*****	**553.081*****	**541.034*****
	(5.16)	*(5.76)*	*(6.07)*
dfres	*1905.000*	*1904.000*	*1903.000*
Nb.observations	***1909***	***1909***	***1909***

*Significance level: p<0.05 *, p<0.01** and p<0.001***.*
Standard errors in parentheses.
Source: PISA data.

4.3.3 Survey 2000 - 2003 as a pre-treatment period and other years as a post-treatment period

In a second way, we will notably assume that before the year 2003 we are in the post-treatment period and the other years (2006, 2009, 2012 and 2015) are considered to be the post-treatment period. For this we will do a regression including all the Diff-Diff coefficients associated with theses years in comparison with the years 2000 and 2003 (before the Aubry's laws). More we are far away from 2003 more the probability that people are affected is considered to be high. We will notably think than giving our graph analysis the years 2012 and 2015 are the more relevant as the gap decrease in reading test mean score value is caused by a catch-up from student whose parents are executives. In this estimation strategy, we will look at the impact of the 35 hours reform on the reading test mean score value, to evaluate his impact on the cognitive skills of a student at the age of the PISA survey.

1) Mother executive case:

The equation we want to estimate is the following:

$$MeanScoreR_i = \alpha + \beta_1 Mexecutive_i + \beta_2 Mexecutivey_i t + \mu year_t + \delta X + \epsilon_i \tag{4.7}$$

Where $MeanScoreR_i$ is the reading test mean score value obtain by the $student_i$. With $i = 1, ...N$

α is the constant term (it gives us the test mean score value if the explanatory variable are equal to zero).

β_1, is the coefficient associated with the variable $Mexecutive_i$. It captures the permanent differential of reading test mean score value between manager and teacher children.

β_2, associated to the interactive term $Mexecutivey_i t$ is the coefficient of interest. The interactive term corresponds to the fact to have a mother affected and to be in the post treatment period. It captures the differential of test mean score between children of a manager and the teacher ones. Its the effect of the treatment.

Here, t=2006, 2009, 2012 and 2015.

$\mu year_t$ capture the year fixed effect. Here t=2015, 2012, 2009, 2006, 2003 and 2000.

X is a set of control variables: the gender of the student, the fact to have a father executive.

ϵ_i, is the error term.

2) Father executive case:

The equation we want to estimate is the following:

$$MeanScoreR_i = \alpha + \beta_1 Fexecutive_i + \beta_2 Fexecutivey_i t + \mu year_t + \delta X + \epsilon_i \tag{4.8}$$

Where $MeanScoreR_i$ is the reading test mean score value obtain by the student$_i$. With $i = 1, ...N$
α is the constant term (it gives us the mean score value if the explanatory variable are equal to zero).
β_1 is the coefficient associated to the variable $Fexecutive_i$. It captures the average permanent differential of the test mean score between children of manager and teacher's father. β_2, associated to the interactive term $Fexecutivey_i t$, is the coefficient of interest. The interactive term corresponds to the fact to have a father affected and to be in the post treatment period. It captures the differential of the test mean score between children of a manager and the teacher ones. Its the effect of the treatment. Here t=2006, 2009, 2012 and 2015.
$\mu * year_t$ capture the year fixed effect. With t=2015, 2012, 2009, 2006, 2000 and 2003.
X is a set of control variables: the gender of the student, the fact to have a mother executive.
ϵ_i, Is the error term which represent all the unobserved factors which are uncorrelated with the explanatory variable and plays a role on the reading test score.

4.3.4 Results

The results of the two preceding estimated equations (Equation (4.7) and (4.8)) are presented in the next pages. For each case, we explicit the results in three ways: the first estimation is without control (1), the second one includes the control for the fact to have the other parent who is an executive (2) and the last estimation includes in plus the student gender control (3).

Mother executive case: Estimated equation (4.7)

Concerning the mother executive case: The coefficients β_1 associated to the variable $Mexecutive_i$ are negative and significant in all the three estimations (with or without controls). **This results translates the fact that there is a negative permanent difference in reading test mean score value between children whose mother is an executive in comparison to the case where she is a teacher.** For example, when adding all the controls (specification 3), the fact to have a mother executive is predicted to decrease the reading test mean score value by 17.7 points compared to having a mother teacher. The coefficient is significant at the 0.01% level.

The coefficient of interest β_2, gives us the diff-diff coefficients results for four cases. In all the case the pre-treatment period is considered as being the years 2000 and 2003. When considering the year 2015 as a post treatment period the effect of the treatment is positive (around 5 points in plus for children whose mother are affected by the 35 hours reform) but non significant. But **when looking at the year 2012 as a post treatment period the effect of the treatment is positive and significant at the 0.01% level. Indeed the passage to the 35 hours increases the reading test mean score value by around 25 points for the treatment group in comparison to the control one.** Concerning the other years (2006 and 2009) the coefficients are negative and non significant.

The time trend effect as highlighted by our graphical analysis the years after 2003 that is to say 2006 is associated with a decrease in test mean score value by around 13 points for all students in the model (1). The year 2015 is predicted to increase the reading test mean score value by around 10 points in comparison to the other years. Concerning the other years the coefficient are non significant.

In terms of control variable, the fact to have a father executive is expected to decrease the reading test mean score value by around 18 points in comparison to the case where the student has father who is a teacher. Finally, the coefficient associated with the control variable gender is significant at the 0.001% level. **The fact to be a girl is expected to increase the mean score value in reading by 30 points in comparison the case of being of boy.**

Father executive case: Estimated equation (4.8)

Concerning the father executive case: The coefficients β_1 associated to the variable $Fexecutive_i$ are negative and significant in all the three estimations (with or without controls). **These results translate the fact that there is a negative permanent difference in reading test mean score value between children whose father is an executive in comparison to the case where he is a teacher.** For example, when adding all the control, the fact to have a father executive is predicted to decrease the reading test mean score value by 15.3 points compared to having a father teacher. The coefficient is significant at the 0.001% level.

The coefficient of interest β_2, gives us the diff-diff coefficients results in four cases. In all the case the pre-treatment period is considered as being the years 2000 and 2003. Contrary to mother case none of the treatment effect is significant. When considering the year 2015 as a post treatment period the effect of the treatment is negative (around 7 points in minus for children whose father is affected by the 35 hours reform) . When looking at the year 2012 as a post treatment period, the effect of the treatment is also negative and non significant. Indeed the passage to the 35 hours decreases the reading test mean score value by around 9 points for the treatment group in comparison to the control one. Concerning the other years (2006 and 2009)

the coefficients are positive and non significant.

However, in our table (4.6), we remark that the time trend effect as highlighted by our graphical analysis the years after 2003 that is to say 2006 is associated with a decrease in mean score value by around 12-13 points for all students. The years 2015 and 2012 are predicted to increase the reading test mean score value by around 14 points and 12 points respectively in comparison to the other years. Concerning the other years the coefficients are non significant. In terms of control variable, the fact to have a mother executive is expected to decrease the reading test mean score value by around 12 points in comparison to the case where the student have teacher mother. This result is in the same sense as the one presented in the table (4.5).

As before, the coefficient associated to the dummy variable indicating the gender is significant at the 0.001% level. **The fact to be a girl is expected to increase the test mean score value in reading by 29 points in comparison the case of being of boy.**

Conclusion on the estimated results:

On overall, concerning the occupation status of parents, there is a negative and significant permanent difference in reading test mean score value between children whose mother/father is an executive in comparison to the case where she/he is a teacher. This mean score difference is about around 17 and 15 points respectively. We think that we can trust in theses results as it's corroborate our graphical analysis. In plus, being a student girl is expected to increase the reading test mean score value compared to being a boy by around 30 points.

Concerning the coefficient of our interest that is to say the effect of a the treatment. There is only a significant (at the 0.01% level) and positive result in the mother case for the year 2012. According to the estimation of the equation (4.7), the passage to the 35 hours, increase the reading test mean score value by around 25 points for the treatment group in comparison to the control one.

But, here we need to discuss this result. First in this section, we considered that the pre-treatment period is for the years 2000 and 2003 and that more we are away from theses years more people have probability to be affected. But which seem to contradict a real impact of the Aubry's laws on schooling outcome is that for the year before 2012 (ie: 2009 and 2006) the effect is negative and non significant. Perhaps people take time to assimilate the behavior change following the reduction in working time and so increase the mean score value of their children trough more time pass with them. But here it's seem difficult to believe that we have obtain a causal impact of the Aubry's laws for the year 2012. In addition the father case estimation results don't confirm a positive impact of the RWT reform for the year 2012 as we obtain negative coefficient. Perhaps it's due to differences in behavior between the two parents as explain before but we need to have a proof of a such difference. So here with this time specification, we think that we cannot conclude that we have obtained a positive causal impact of the RWT reform on children's schooling outcome.

Table 4.5: Diff-Diff results for mother case in reading.(Post treatment period: Year 2000-2003)

	Mother executive case		
	Test mean score value in reading		
Model	**(1)**	**(2)**	**(3)**
Mexecutive	**-12.920***	**-16.113****	**-17.774****
	(5.57)	*(5.56)*	*(5.48)*
Mexecutivy15	**4.971**	**4.889**	**5.541**
	(8.50)	*(8.46)*	*(8.33)*
Mexecutivy12	**25.220****	**24.406****	**27.690****
	(8.86)	*(8.82)*	*(8.68)*
Mexecutivy09	**-0.741**	**-5.003**	**-4.326**
	(8.87)	*(8.85)*	*(8.71)*
Mexecutivy06	**-2.147**	**-5.305**	**-3.768**
	(8.55)	*(8.52)*	*(8.38)*
year15	**10.445***	**10.185***	**9.723***
	(4.38)	*(4.36)*	*(4.29)*
year12	**2.353**	**3.631**	**2.952**
	(4.47)	*(4.45)*	*(4.38)*
year09	**0.481**	**5.185**	**4.158**
	(5.04)	*(5.05)*	*(4.97)*
year06	**-12.980****	**-9.443***	**-8.850**
	(4.63)	*(4.64)*	*(4.56)*
year03	**-7.509**	**-5.263**	**-4.565**
	(4.46)	*(4.45)*	*(4.38)*
year00	**0**	**0**	**0**
	(.)	*(.)*	*(.)*
Fexecutive		**-17.822*****	**-18.515*****
		(2.41)	*(2.37)*
Gender			**30.152*****
			(2.29)
Constant	**544.374*****	**552.791*****	**537.793*****
	(3.39)	*(3.56)*	*(3.68)*
dfres	*5383.000*	*5382.000*	*5381.000*
Nb.observations	***5394***	***5394***	***5394***

*Significance level: p<0.05 *, p<0.01** and p<0.001***.*
Standard errors in parentheses.
Source: PISA data.

Table 4.6: Diff-Diff results for father case in reading. (Post treatment period: Year 2000-2003).

	Father executive case		
	Test mean score value in reading		
Model	**(1)**	**(2)**	**(3)**
Fexecutive	**-12.886****	**-14.326****	**-15.339*****
	(4.49)	*(4.49)*	*(4.43)*
Fexecutivy15	**-7.366**	**-7.344**	**-6.851**
	(6.77)	*(6.75)*	*(6.65)*
Fexecutivy12	**-9.366**	**-9.554**	**-8.890**
	(6.92)	*(6.91)*	*(6.80)*
Fexecutivy09	**5.785**	**2.726**	**2.633**
	(7.84)	*(7.86)*	*(7.74)*
Fexecutivy06	**2.048**	**0.199**	**0.691**
	(7.17)	*(7.17)*	*(7.06)*
year15	**14.561****	**14.320****	**13.789****
	(4.98)	*(4.97)*	*(4.89)*
year12	**12.801***	**12.667***	**12.293***
	(5.28)	*(5.27)*	*(5.19)*
year09	**-2.101**	**1.101**	**0.300**
	(6.27)	*(6.31)*	*(6.21)*
year06	**-13.181***	**-11.474***	**-10.798**
	(5.68)	*(5.68)*	*(5.60)*
year03	**-5.740**	**-5.673**	**-4.930**
	(4.49)	*(4.48)*	*(4.41)*
year00	**0**	**0**	**0**
	(.)	*(.)*	*(.)*
Mexecutive		**-12.336*****	**-12.897*****
		(2.94)	*(2.89)*
Gender			**29.901*****
			(2.29)
Constant	**547.334*****	**550.494*****	**535.539*****
	(3.73)	*(3.80)*	*(3.91)*
dfres	*5383.000*	*5382.000*	*5381.000*
Nb.observations	***5394***	***5394***	***5394***

Significance level: p<0.05 *, p<0.01** and p<0.001***.
Standard errors in parentheses.
Source: PISA data.

4.3.5 Last specification and discussion

Last specification: In the preceding section we have a positive and significant effect of the treatment for the year 2012 but as explain the time hypotheses beyond and the results associated with the other years don't go in the sense of a real effect of the RWT reform. Here, if we consider the approach (i) we have implement in the part (4.3.1), that is to say, considering the year 2009 as a pre-treatment period, we examine the RWT reform as a way by which parents are allow to pass more time with their child when there are young (0-4 years) and this surplus of time is supposed to have a beneficial impact in their future schooling outcome.

Considering this point of view, we can try to legitimate a positive impact of the treatment for the year 2012. In fact, if we considered the year 2009 as a pre-treatment period as children was born in 1994, we can think that the year 2012 could be considered as a post-treatment period. Indeed, the 2012's PISA students were born in 1997 and so could be affected when they had one year old. To see if we can obtain a significant result, we will redo the Difference in Differences estimation strategy when considering the year 2009 and 2012 as a "pre" and "post" treatment period respectively. We will estimate the equation (4.7), for mother case as given our result it's seems to be more relevant. The page 86 presented the table 4.7 which shows the results associated with the estimated equation (4.7).

Results of the table 4.7: We remark that the coefficient of interest, β_2, which translates the effect of the treatment for the year 2012 is positive and significant in all the specification we do. The effect of the treatment was about 30 points in the specification (2). As in the other approach we have, the coefficient β_1 associated to the variable $Mexecutive_i$ shows that there is a permanent negative difference of 22 points in test mean score test value between children whose mother in an executive compare to the case where she is a teacher. The coefficient is significant at the 0.01% level when including control relative to gender of the student and the occupation status of the father (model 3).

In the model (3), where we control for the gender status of the student. The coefficient associated to the gender status is significant at 0.001% level. It translates the fact that being a student girl is predicted to increase the reading test mean score value by around 35 points comparing to being a student boy. Finally, the coefficient associated with the father occupation status is negative and significant. As before there is a negative and significant permanent difference in reading test mean score value between children whose father is an executive in comparison to the case where he is a teacher.

Discussion:

According to the graphical analysis presented in the chapter 3, the expected results were that for our approach A, in the reading topic and mother executive case there could be a positive impact of the RWT reform. Nevertheless, as highlighted by the graph a such link was not obvious concerning the father case (notably when

comparing to Spain counter-factual students). According to the fact that mother and father executives are affected in the same way by the RWT reform, the observation of a differential impact for mother and father case doesn't go toward the validity of an impact of the RWT on students schooling outcome. Nonetheless, this difference between mother and father is perhaps due to difference in parental behaviors. In fact we can think that mother increase their time spend with their children whereas the father do not.

As concern the DID estimation strategy, we try several specifications. The first one consist to make the assumption than the years 2009 and 2015 as a pre and post treatment period respectively. Given this analysis point of view, the impact of the Aubry laws is focused on the fact that parent spend time with their children when they are young (between 0 and 4 years old) and this is beneficial for them in their future schooling outcome detected in the PISA test mean score. When implemented the DID estimation strategy, the sign associated with the treatment effect is positive for mother and negative for father. This confirm our graphical analysis interpretation. Nevertheless, the coefficients are non significant. In this specific case we don't obtain an impact of the RWT on children's schooling outcome.

In the second specification we do, we considered the years 2000 and 2003 as a pre-treatment period and others years as post treatment periods. In this approach we expect to capture the effect of the RWT on present schooling outcome given by PISA test mean score value. The results of this approach are only positive and significant when considering the mother case and the year 2012. But, here it's seems difficult to think in a causal impact of the RWT for the year 2012 as the years before are also considered as a post treatment period and the coefficient associated to theses years are non significant. As explained perhaps mother takes time to assimilate the reduction in their working time and change their behaviors in term of time spend with their children, but the fact that this change takes 12 years illegitimate this hypothesis.

The last specification we have done is in the same way as the first one but we have considered here the year 2012 as a post-treatment period in the place of the year 2015. We obtain a positive and significant treatment effect for mother case. Nevertheless, to prove a causal link between the RWT reform and the increase in the schooling outcome we need to explain why the results for the father case are negative and positive for the mother one. We need to prove that it's comes from a differential in the behaviors of mother and father in their time spend with their children. According to the results of the Master thesis "Synchronisation et temps de travail quel impact des 35 h sur le temps parental?", the parental time is more important for a mother. This result is in favor of the latter assumption concerning our results, but to obtain a causal link we need to prove the same thing with our data. On overall, we fail to demonstrate a causal link between the reduction in working time of parents and the schooling outcome of their children given our data analysis. Nevertheless, some results appear to be consistent with our analysis. First, there is a significant negative test mean score differential between children whose parents are executive and the one whose parent are teachers. In addition, it had been shown that being a girl increases the reading test mean score value compared to being a boy.

Table 4.7: Diff-Diff results for mother case in reading test - Years 2009 and 2012

	Mother executive case		
	Reading test mean score value		
Model	(1)	(2)	(3)
Mexecutive	**-13.661**	**-21.472****	**-22.565****
	(7.37)	*(7.58)*	*(7.43)*
Mexecutivyt	**25.961***	**29.573****	**32.643****
	(10.41)	*(10.40)*	*(10.21)*
year12	**1.872**	**-1.719**	**-1.267**
	(5.05)	*(5.10)*	*(5.00)*
Fexecutive		**-18.674*****	**-19.310*****
		(4.52)	*(4.44)*
Gender			**35.918*****
			(4.23)
constant	**544.855*****	**558.604*****	**539.375*****
	(3.98)	*(5.18)*	*(5.56)*
dfres	*1792.000*	*1791.000*	*1790.000*
Nb.observations	***1796***	***1796***	***1796***

Significance level: p<0.05, p<0.01** and p<0.001***.*
Standard errors in parentheses.
Source: PISA data.

Chapter 5

Conclusion and Appendix

5.1 Conclusion

In this master thesis, we have tried to investigate the impact of the parents' labor supply chocks on the schooling outcome of their children. The labor supply chock used here is the 35 hours reform implemented in France in the early 2000 year. We expected this reduction in the working time reform has allowed parents to allocate more time to their children and by this way increase their schooling outcome. To conduct this analysis, we have used the PISA data which gave us access to school topic's test mean score value for some French students, the occupation status of their parents and some other information. The main approach we used and which was revealed to be the most pertinent for our analyze has been to compare children whose parents are executive (affected by the RWT reform) and those whose parents are teachers (not affected by the RWT reform). In addition, in our analysis we have differentiated the effect for the father and the mother in order to capture any difference between the two.

First, we have conducted a graphical analysis for the two groups of children in France and in Spain countries to see if there is some test mean score evolution which shows a catch-up of the affected children compared to the non affected which could be attributable to the RWT reform. The graphical analysis conclusion was that in the reading topics, there was a such catch-up. When comparing to Spain, it's the fact to have a mother executive which seems to be the more relevant compared to the father case.

Next, we have implemented an IV estimation strategy to see if the RWT reform has allowed better schooling results through the fact that parent have spent more time with their children. Nevertheless, perhaps due to our used of data, this estimation shows non significant results. Nonetheless, trusting in an impact of the RWT reform on the time spend by parents with their child, we have made a DID estimation strategy to try to capture any effect. Our main conclusion is that we cannot demonstrate a causal link between the reduction

in working time of parents and the schooling outcome of their children given our data as the main significant result we have is conditioned by strong assumptions. Indeed, the effect of the RWT is only significant for the year 2012 when we considered this year as a post treatment period and the year 2009 as a pre-treatment period. This result is obtained in reading test for children having an affected executive mother and in the case where we focus on the fact that parent spend more time with their children when they are young (between 0 and 4 years old). We expected this to be beneficial for them in their future schooling outcome detected in the PISA test mean score value. So, to trust in a real impact of the 35 hours reform, we need to prove that the time spend with the children by the affected mother really increase in the year 2012 compared to year 2009. Second, the results are only positive for affected mother and not for a father. This could be due to some difference in behaviors. Perhaps mother spend more time with their child or adjust more their free time toward us than the father do. It's a way which needs to be investigated further notably for the same population studied here, to legitimated an impact of the Aubry's law on schooling results.

5.2 Appendix

5.2.1 Triple Difference in Differences estimation strategy

According to the graphical analysis we have presented here the results of a 3DID estimation strategy comparing reading test mean score value between children whose mother is a teacher and an executive in France in comparison to their Spanish counterpart. This strategy allows us to try to capture the impact of the RWT reform on French children's schooling outcome by comparing them to their Spain counter factual who are not affected by the new french labor legislation. The 3DID estimation strategy allows to take into account for unobservables trends in test mean score value which can exist between on the one hand the children whose mother is a teacher and those whose mother is an executive. On the other hand, the difference in the difference in the difference, control for the unobersables trends between the two groups of children in the two countries. Given the graphical analysis result, we don't expect the coefficient associated to this 3DID to be significant.

The estimate equation is the following:

$$\text{Mean Score R}_i = \alpha + \beta_1 Mexecutive_i + \beta_2 Mexecutive_i T_t + \beta_3 T_t + \beta_4 Countryt + \beta_5 Mexecutive_i * Countryt + \beta_6 T_t Countryt + \beta_7 Mexecutive_i * Tt * Countryt + \delta Gender + \epsilon_i$$

Where $MeanScoreR_i$ is the test reading mean score value obtain by the student$_i$. With $i = 1, ...N$

α is the constant term (it gives us the test mean score value if the explanatories variables are equal to zero).

β_1 is the coefficient associated to the variable $Mexecutive_i$. It captures the permanent differential of reading mean score test between children of mother manager and teacher. Mexecutive is a dummy variable equal 1 if the mother is an executive.

The coefficient β_2, associated to the variable $Mexecutive_i T_t$ which is the interaction term corresponding to the fact to have a mother executive and to be in the post-treatment period. It captures the differential of the test mean score between children of manager and the teacher ones between 2009 and 2015.

T_t, is the time fixed effect. Here T is a dummy variable equal 1 if the year is 2015.

β_4, is the coefficient associated to the country fixed effect. It's a dummy variable equal 1 if the country is France and 0 if it's Spain.

β_5, is the coefficient associated to the variable $Mexecutive_i * Countryt$ which gives the effect of having a mother executive in France.

β_6, is the coefficient which indicates the effect to be in France and in the year 2015.

β_7, is the coefficient of interest. It's the effect of the treatment in France compared to Spain.

Gender, is a control variable. It's a dummy variable equal 1 if the student is a female.

ϵ_i is the error term.

Given the following table (5.1) which provides us the results of the estimated equation we can make some remark: As expected the coefficient of interest (the interactive term $Mexecutive_i * T_t * Countryt$ between the fact to have a mother executive in 2015 (affected by the RWT) in France is non significant. This means that the RWT reform in France had no significant impact on French student reading test mean score value. Nevertheless, some coefficients are significant: the fact to have a mother executive is predicted to decrease the reading mean score value in France and Spain by around 9 points in compared to have a mother teacher. The fact to be in 2015 is predicted to increase the test score by around 14 points compared to the other years. The Fact to be a French student increase the reading test score by around 25 points compared to being a Spanish student. This result is in accordance the graphics analysis which highlight that French student do better than the Spanish one. To conclude as expected the 3DD estimation strategy don't provides us a prove of a positive impact of the 35 hours reform on French student schooling outcome.

Table 5.1: 3DID France and Spain

	Reading test mean score value	
	Mother executive case	
Mexecutive	**-8.751****	**-9.152****
	(2.84)	*(2.81)*
MexecutivT	**-2.825**	**-1.843**
	(6.80)	*(6.72)*
T	**14.730*****	**14.672*****
	(2.95)	*(2.91)*
Countryt	**27.189*****	**25.611*****
	(3.75)	*(3.71)*
Mexecutive*Countryt	**-4.910**	**-5.081**
	(7.08)	*(7.00)*
T*Country	**-4.767**	**-4.084**
	(5.27)	*(5.21)*
Mexecutive*T*Country	**8.537**	**7.401**
	(11.17)	*(11.03)*
Gender		**24.822*****
		(1.81)
constant	**517.666*****	**505.632*****
	(1.34)	*(1.59)*
dfres	*7690.000*	*7689.000*
Nb.obs	***7698***	***7698***

Significance level: p<0.05*, p<0.01** and p<0.001***.
Standart errors in parentheses.
Sources: PISA data.

5.2.2 Checks of the IV procedure: Validity of the instrument test

In this section, we will present the table of the test done in order to see if our instrument is valid. We distinguish all the topics and approach cases. The explanations of the results given in theses tables are presented in the chapter 4, in the section 2.

Approach A and B: relevance conditions check

First, we present the table which gives us the Wald test statistics critical values.

Figure 5.1: Wald test statistics

Critical Values	# of endogenous regressors:	1
Ho: Instruments are weak	# of excluded instruments:	1

	5%	10%	20%	30%
2SLS relative bias	(not available)			

	10%	15%	20%	25%
2SLS Size of nominal 5% Wald test	16.38	8.96	6.66	5.53
LIML Size of nominal 5% Wald test	16.38	8.96	6.66	5.53

Now, we will show the table of the first stage regression summary statistics to see the correlation between our instrument and our potential endogenous variable. Theses tables allow also to see if our instrument is weak or not in the explanation of the instrumented variable.

We look first at the partial auto-correlation coefficient to see if the relevance condition of our instrument is valid. Second using the F-statistics and the Wald test statistic, we test the weakness of our instrument in the explanation of our endogenous variable. We test the following: If the F-test statistic is inferior to our Wald test critical values, we don't reject $H0$. With $H0$ = the instrument is weak.

Figure 5.2: First stage regression results mathematics: Mother executive case

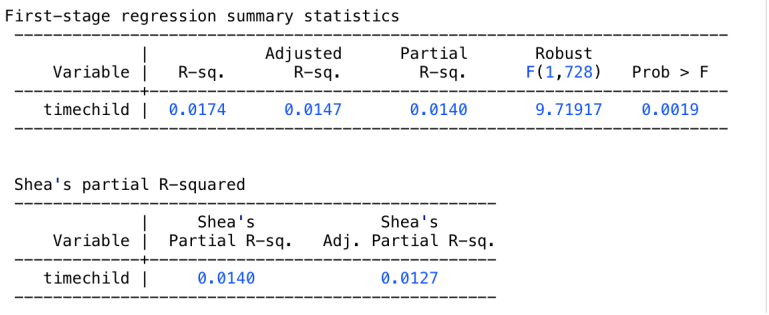
First-stage regression summary statistics

Variable	R-sq.	Adjusted R-sq.	Partial R-sq.	Robust F(1,626)	Prob > F
timechild	0.0015	-0.0017	0.0014	1.36466	0.2432

Shea's partial R-squared

Variable	Shea's Partial R-sq.	Shea's Adj. Partial R-sq.
timechild	0.0014	-0.0002

Figure 5.3: First stage regression results mathematics: Father executive case



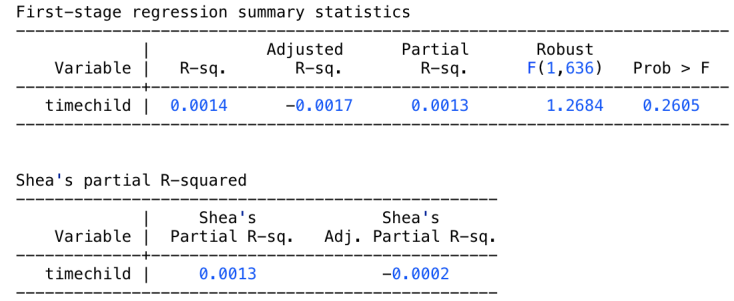
First-stage regression summary statistics

Variable	R-sq.	Adjusted R-sq.	Partial R-sq.	Robust F(1,728)	Prob > F
timechild	0.0174	0.0147	0.0140	9.71917	0.0019

Shea's partial R-squared

Variable	Shea's Partial R-sq.	Shea's Adj. Partial R-sq.
timechild	0.0140	0.0127

Figure 5.4: First stage regression results sciences: Mother executive case



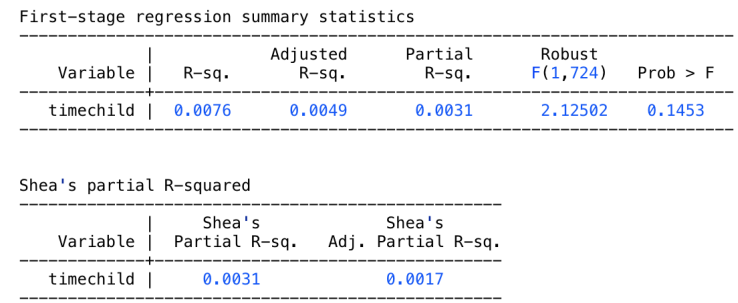
First-stage regression summary statistics

Variable	R-sq.	Adjusted R-sq.	Partial R-sq.	Robust F(1,636)	Prob > F
timechild	0.0014	-0.0017	0.0013	1.2684	0.2605

Shea's partial R-squared

Variable	Shea's Partial R-sq.	Shea's Adj. Partial R-sq.
timechild	0.0013	-0.0002

Figure 5.5: First stage regression results sciences: Father executive case



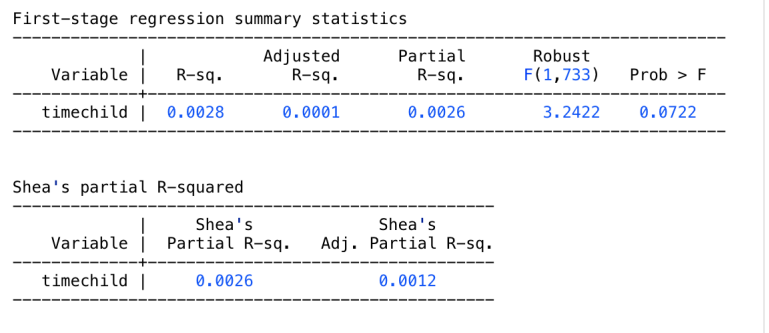
First-stage regression summary statistics

Variable	R-sq.	Adjusted R-sq.	Partial R-sq.	Robust F(1,724)	Prob > F
timechild	0.0076	0.0049	0.0031	2.12502	0.1453

Shea's partial R-squared

Variable	Shea's Partial R-sq.	Shea's Adj. Partial R-sq.
timechild	0.0031	0.0017

Figure 5.6: First stage regression results reading: Mother executive case



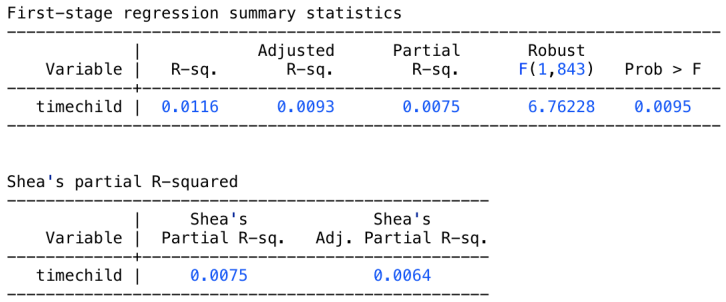
First-stage regression summary statistics

Variable	R-sq.	Adjusted R-sq.	Partial R-sq.	Robust F(1,733)	Prob > F
timechild	0.0028	0.0001	0.0026	3.2422	0.0722

Shea's partial R-squared

Variable	Shea's Partial R-sq.	Shea's Adj. Partial R-sq.
timechild	0.0026	0.0012

Figure 5.7: First stage regression results reading: Father executive case



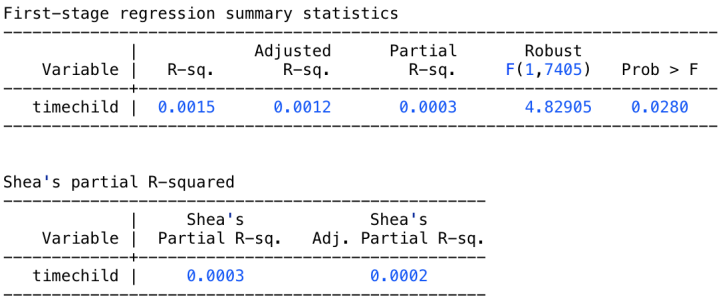
First-stage regression summary statistics

Variable	R-sq.	Adjusted R-sq.	Partial R-sq.	Robust F(1,843)	Prob > F
timechild	0.0116	0.0093	0.0075	6.76228	0.0095

Shea's partial R-squared

Variable	Shea's Partial R-sq.	Shea's Adj. Partial R-sq.
timechild	0.0075	0.0064

Figure 5.8: First stage regression results mathematics: Mother treated case



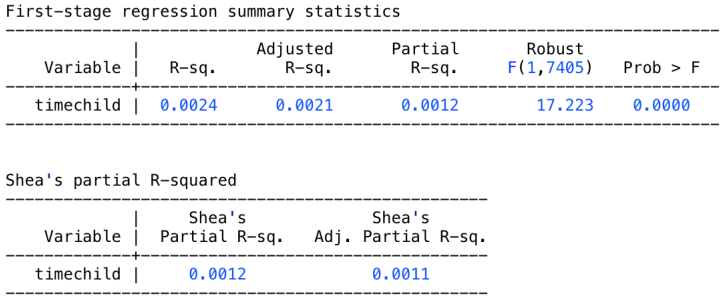
First-stage regression summary statistics

Variable	R-sq.	Adjusted R-sq.	Partial R-sq.	Robust F(1,7405)	Prob > F
timechild	0.0015	0.0012	0.0003	4.82905	0.0280

Shea's partial R-squared

Variable	Shea's Partial R-sq.	Shea's Adj. Partial R-sq.
timechild	0.0003	0.0002

Figure 5.9: First stage regression results mathematics: Father treated case



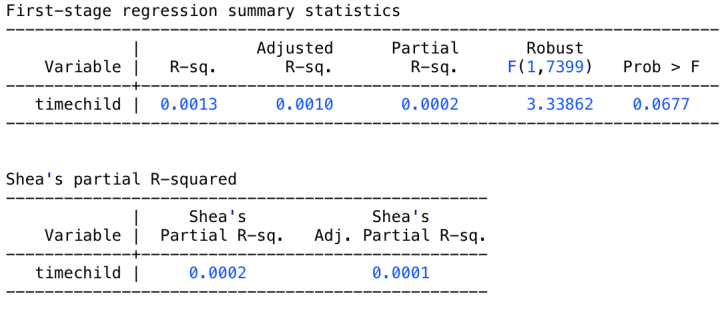
First-stage regression summary statistics

Variable	R-sq.	Adjusted R-sq.	Partial R-sq.	Robust F(1,7405)	Prob > F
timechild	0.0024	0.0021	0.0012	17.223	0.0000

Shea's partial R-squared

Variable	Shea's Partial R-sq.	Shea's Adj. Partial R-sq.
timechild	0.0012	0.0011

Figure 5.10: First stage regression results sciences: Mother treated case



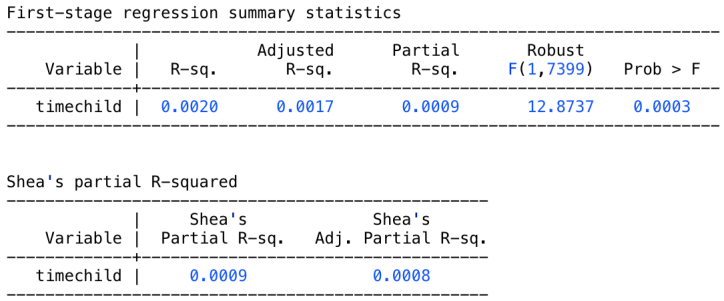
First-stage regression summary statistics

Variable	R-sq.	Adjusted R-sq.	Partial R-sq.	Robust F(1,7399)	Prob > F
timechild	0.0013	0.0010	0.0002	3.33862	0.0677

Shea's partial R-squared

Variable	Shea's Partial R-sq.	Shea's Adj. Partial R-sq.
timechild	0.0002	0.0001

Figure 5.11: First stage regression results sciences: Father treated case



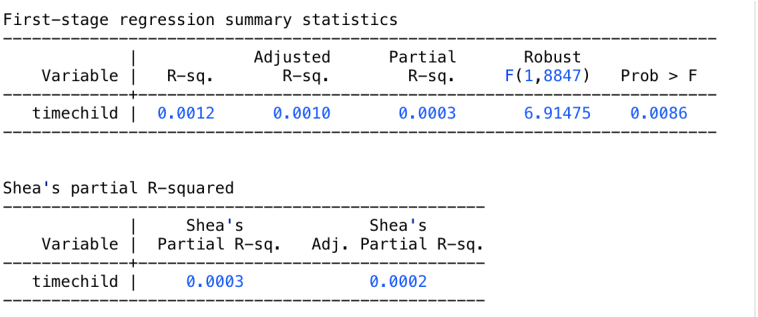
First-stage regression summary statistics

Variable	R-sq.	Adjusted R-sq.	Partial R-sq.	Robust F(1,7399)	Prob > F
timechild	0.0020	0.0017	0.0009	12.8737	0.0003

Shea's partial R-squared

Variable	Shea's Partial R-sq.	Shea's Adj. Partial R-sq.
timechild	0.0009	0.0008

Figure 5.12: First stage regression results reading: Mother treated case



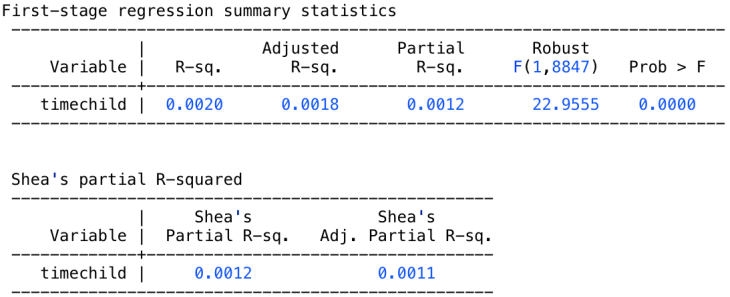
First-stage regression summary statistics

Variable	R-sq.	Adjusted R-sq.	Partial R-sq.	Robust F(1,8847)	Prob > F
timechild	0.0012	0.0010	0.0003	6.91475	0.0086

Shea's partial R-squared

Variable	Shea's Partial R-sq.	Shea's Adj. Partial R-sq.
timechild	0.0003	0.0002

Figure 5.13: First stage regression results reading: Father treated case



First-stage regression summary statistics

Variable	R-sq.	Adjusted R-sq.	Partial R-sq.	Robust F(1,8847)	Prob > F
timechild	0.0020	0.0018	0.0012	22.9555	0.0000

Shea's partial R-squared

Variable	Shea's Partial R-sq.	Shea's Adj. Partial R-sq.
timechild	0.0012	0.0011

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