

Does the background of the minister of education influence the performance of the education sector?

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Does the background of the minister of education influences the performance of the education sector?

Jury

Mémoire présenté par

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Executive summary

The aim of my thesis is to analyse if the background of the minister of education influences the performance of the sector. Using an unique panel data set, I try to estimate if certain experiences in an education minister's life has an effect on the performance of the sector. To do this, I use several econometrical models, descriptive statistics, related literature to my research question and theories linked to the topic. With help from all this information, I explain that certain experiences in an education minister's life can improve the sector they govern.

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1. Introduction

Education is a very important sector which is difficult to administer. When we talk about education, we talk about an investment for human and economic development. According to **Ozturk (2001)**, education is one of the fundamental factors of development and no country can achieve sustainable development without a substantial investment in human capital. It has been a while that our society is curious and innovation-oriented and so children have to be prepared to ensure this continuity.

It is a very interesting topic to analyse, because it would be very useful to know what skills are needed to form a good education minister. In almost every country in the world, the education ministry includes decision making for primary and secondary education. These are probably the most important years for a person's development, because it is during these years that we accumulate the most knowledge and that we begin to build our values.

Logically, highly skilled people are needed to administer a such important sector. It is a difficult sector to administer, because there are different aspects that must be taken into consideration. It is not only about finding the best education system for the children and their integration in society. It is for example also necessary to have a good system of hiring teachers, because without qualified teachers there won't be many qualified pupils. These two factors are closely linked, because it is not efficient to have a good education system without performant teachers as it is explained in the paper published by the OECD (**How the world's best-performing school systems come out on top, 2007**). In this paper, they explain that the quality of an education system cannot exceed the quality of a teacher. The opposite is also true even if probably with less amplitude, however these 2 factors must be in tune.

Looking at current society, it is still not clear what makes a good minister. What are the required experiences and knowledges to form a performant minister? Taking the recent elections in France as an example, we notice that almost half of the ministers (11 of 23) composing the government were rather chosen because of their sector-specific experience than their political experience. For example, Jean-Michel Blanquier who is now the minister for education in France has an important experience in tertiary education seen that he has been teacher and rector in university. Even if the secondary and tertiary education are not exactly the same, there are similarities. Frédérique Vidal, who is now minister for higher education taught for a long time in universities, and the same applies for among others Laura Flessel (minister for sports), Nicole Belloubet (minister for justice), Nicolas Hulot (minister for ecology), Agnes Buzyn (minister for health), all of these having a sector-specific experience. In the previous government, it was not the case, all the ministers having been chosen for their high experience in politics. The question that could be asked is what is the best option among these two, or is it better to have a minister with both experiences?

There are arguments in favour of each possibility. A minister for education with an experience as a teacher will have a better understanding about pedagogy and the

current problems education faces. This will facilitate the implementation of efficient reforms that will improve education quality. On the other side, it is possible that an ex-teacher would feel to invested in the role and so forget his objectiveness by for example taking decisions based on emotions or past experiences. However, in my opinion it is quite unlikely that this could happen. As explained above, Jean-Michel Blanquier (minister for education in France) has an experience as a teacher in university, but he is also very interested in fundamental education. He has published two books: **L'école de la vie. Pour que chacun puisse réussir in 2014** and **L'École de demain : Propositions pour une Éducation nationale rénovée in 2016**. In these books, he gives propositions about how improving education. What I want to illustrate with this is that he is really concerned with the problematic and wants to improve the education level and therefore, a sector-specific experience could be very important seen that they are more involved and aware about the weaknesses of the sector.

It is hard to compare different ministers and governments, because times change and all governments face different problems. However, thanks to PISA tests, abilities of students can be compared, and therefore also in a certain way the performance of education sectors among countries. So, the main point that I would like to illustrate with my thesis is that ministers with an experience in primary or secondary education perform better than other ministers without such an experience. This experience should facilitate the implementation of reforms improving the education sector. In the literature, we find some subjects similar to this one. According to **Jones and Olken (2005)**, leaders matter for growth. In other terms, not everyone has the capacity to serve as minister. Other authors (**Besley et al., 2011**, **Diaz-Serrano and Perez, 2013**), explain that the education level of leaders matters for a good performance. More related to my subject, **Moessinger (2014)** and **Jochimson and Thomasius (2014)** find for finance ministers that having a sector-specific experience can lead them to perform better than ministers without such an experience. **Fuchs and Richert (2015)** found that some of the personal characteristics of the development minister matter for a good performance. **Jacqmin and Lefebvre (2016)** found similar results for higher education ministers. They explain in their paper that a past experience in higher education leads to a better performance of the sector.

Using an original panel dataset with the characteristics of European leaders from twenty different countries, I analyse empirically if different ministers' experiences improve the performance of the education sector. Analysing the results, I discuss different explanations behind these. Even if the results are not the expected ones, there are nevertheless certain indications that cannot be overlooked. I employ various static and dynamic panel estimation methods, but the only one which is reliable is the LSDVc dynamic panel data estimator.

My thesis is organized as follows. Section 2 discusses the literature review, illustrates the papers from where I hold the main ideas and presents the hypotheses I created. Section 3 presents the data I collected to do this empirical study and section 4 explains my estimation strategy and the different models I computed. Section 5 shows the results I obtained and section 6 discusses potential explanations to the results I obtained. Finally, section 7 concludes my thesis.

2. Literature review and hypotheses

2.1. Literature review

As **Jones and Olken (2005)** explain in their paper, the quality of leaders matters for growth. In other words, there are leaders who perform better than others. In my study, I analyse the effects of the background and the experiences of the education ministers on the performance of their sector and it would be very interesting to find what skills or experiences form the best ministers. There are many factors that can have an influence on the output of the minister. For example, an important factor I do not analyse is the education level. In my sample, almost all minister is highly educated, given that 58,85 % of the ministers have a PhD degree and 86,73% have at least a master degree. It is important to illustrate this, because **Besley and Montalvo (2011)** explain that a more educated leader performs better than a less educated leader. This comes from the assumption that a more highly educated leader is also a better citizen and is more likely to operate in the broader public interest, as some empirical evidences have shown (**Milligan et al., 2004 or Dee, 2004**). This makes sense, a leader who looks after the public interests rather than his own will make more people happy. **Diaz-Serrano and Perez (2013)** go even further and observe that the educational attainment of the population is negatively impacted when a country transitions from an educated leader to a less educated one. In other words, a highly-educated leader has a positive impact on the education level of the population which can be related to the fact that more highly educated leaders can generate more growth because among other facts, there is an increase in the quality of human capital.

Economics of education literature also try to explain performance in the education sector. For example, **Fucks and Woessmann (2007)** claim that student performance is higher with external exams and budget formulation, but also with school autonomy in textbook choice, hiring teachers and within-school budget allocations which could be an argument in favour of decentralized systems. **Hanushek and Woessmann (2011)**, claim that resources and, most importantly, institutions matter. As in most the literature on educational production, they compute their empirical study using a basic model with the most important factors affecting students' performance at school. These are the family background, school resources, institutional features of schools and education systems and the individual ability which is hard to measure. As already said, they found that resources but above all institutions are important for a good performance of the education sector. This cannot be neglected, seen that ministers are on the head of the sector and also influence the resources available for schools.

Now more related to my research question, a few studies have focused on personal characteristics of leaders and on the effects of sector-specific experience on the output of their sector. **Moessinger (2014)** and **Jochimsen and Thomasius (2014)**, found that it is important taking into consideration the professional background when choosing the finance minister. Indeed, they observe that a finance minister who made studies in finance or economics or who had a professional experience in the finance sector tended to perform better than the other finance ministers without such an experience. This is closely related to the theory of human capital. The on-the-job

experience acquired in the finance sector should improve their skills and knowledge about this sector. This is quite logical, a person who already has an experience or some knowledges in an area will perform better than a person who has less knowledges or none. **Feld and Schaltegger (2010)**, **Moessinger (2014)** and **Jochimsen and Thomasius (2014)** also explain that the longer the tenure of the finance minister, the stronger is his position in cabinet and the lower the deficit will be. This again is related to the on-the-job learning effect: the longer the tenure of a minister, the more experience and abilities he will get in this area, but also the stronger his position will be. In other words, the minister will have more power and influence which could for example facilitate implementation of reforms. **Fuchs and Richert (2015)** also found that some of the personal characteristics of the development minister matter for a good performance. Especially, they find that the tenure at the job is very important, seen that ministers who have been longer in office succeed in getting larger aid budgets.

Furthermore, **Jacqmin and Lefebvre (2016)** found similar results for higher education ministers. They argue that an academic experience as professor, rector, dean or even as a student can increase the ability of higher education ministers in introducing more adequate reforms that makes the sector more performant. However, they find that this result is driven by ministers with both sector-specific and electoral experience. The authors also observe that the tenure at the job and an experience in private sector have a positive effect on the performance of the sector. On the other hand, they show that age has a negative effect on output which is a bit surprising seen that age can be seen as an indicator of life experience. However, the idea remains the same: a sector-specific experience increases the performance of the sector governed by the higher education minister.

Most of these papers observe that personal characteristics and a sector-specific experience can increase performance of the same sector. However, a sector-specific experience is more important than that, because the background of education ministers not only affects the performance of the sector they govern, but also gives a lot of information about them. According to the signalling theory in economics, the background of a minister can convey information about him. The background of a minister can give information about his person, for example, in Michael Spence's job-market signalling model, employees send a signal about their ability level to the employer by acquiring education credentials. The same applies to education ministers, the background can be a signal that a minister has the required knowledge and abilities to be minister, but also to implement the best reforms and so this can increase support by people to get elected and also to implement reforms.

Finally, through time ministers have created a social capital. Social capital is an economic idea that refers to the connections between individuals and entities that can be economically valuable. Social networks that include people who trust and assist each other can be a powerful asset. These relationships between individuals and companies can lead to a state in which each think of the other when something needs to be done. Through their careers, education ministers have made acquaintances with the same social background as them (**Hayo and Neumeier (2012,2014)**) and so the education minister will spend more for the education sector as a way of pleasing all these people having the same social background as the minister and who have given him their support.

2.2. Hypothesis

An experience as a teacher can be very useful for a minister. There are several reasons in favour of this idea. First, a teacher has knowledge about pedagogy and this is very important, because in education it is not enough to have some knowledges in certain areas, it is also important to know how to transmit them and how to deal with children. Second, this experience has given them a certain knowledge about the sector and it is important to know how current education is. By having been teacher in primary and secondary education, ministers have had an overview about it and they are more likely to know what needs to be done to improve education. Both arguments are linked to the theory of human capital which claims that an on-the-job experience increases their skills and their knowledges about the sector. The experience as a teacher permits to see from inside how school is. This experience also permits to know how most teachers are and this can be useful to avoid problems with them seen that they form an important part of education. Teachers also know how parents of children think and these constitute a large part of the people. What I want to illustrate with these arguments is that the experience as a teacher gives the minister very detailed knowledges about the sector.

Hypothesis 1

An experience in primary or secondary education is an asset for the education minister. With an experience in the sector, there is an on-the-job learning effect so results of a minister with an experience in the sector will be better than the results of ministers without this experience.

Hypothesis 2

The longer the tenure of the education minister in the cabinet, the better will perform the sector. As it can be seen above in the literature review, the tenure is also linked to an on-the-job learning effect. The more time an education minister will spend in office the better he will know what to do and also the stronger will be his position, which can be an asset in order to improve the performance of the sector.

Hypothesis 3

Seen that in my sample 21,28% of the education ministers have already an experience as minister in a cabinet, I add the hypothesis that an education minister who has already been minister in no matter what sector, will also perform better seen that he has a non-negligible experience in a cabinet.

Hypothesis 4

An electoral experience is also important for an education minister, seen that politics is not a simple sector and so it is possible that the political experience also improves the minister's abilities. It is even possible that electoral experience and an experience in primary or secondary school are linked, as **Jacqmin and Lefebvre (2016)** found for the higher education minister.

3. Data and Descriptive statistics

3.1. Data

Table 1 : Descriptive statistics

	Obs	Mean	Std. Dev.	Min	Max
Performance					
Pisamean	299	496,2307	20,05891	424,3333	552,6667
Pisamaths	299	496,5652	21,7351	420	548
Pisasciences	299	498,7692	22,6403	424	563
Pisareading	299	493,3578	19,19625	428	547
Leader's variables					
Female	296	0,51	0,5	0	1
Age	296	49,02	8,37	30	68
Experience in primary or secondary education	296	0,28	0,45	0	1
Political experience	289	0,94	0,23	0	1
Experience in private sector	287	0,26	0,44	0	1
Tenure at the Job (8 months = 1)	296	3,69	2,87	0,5	17,5
Already minister experience	296	0,21	0,41	0	1
Political and school experience	289	0,25	0,43	0	1
Control variables					
Government spendings in education as % of GDP	233	5,49	1,24	2,86	8,62
Centralization rate in %	245	52,42	0,35	0	100
Real Gdp per capita in euros (chain-linked volumes)	286	32160,84	17529,11	6400	84400
Population size	299	22700000	26300000	281154	82500000
N	299				

To analyse the relationship between the background of the ministers of education and the performance of the sector, I computed a new panel dataset. The dataset contains personal information about education ministers from 20 different countries. I only took European countries, because these are close to each other and there could be some cultural similarities or at least more common points than among countries from different continents. To choose an education minister for a year I simply took the one who has stayed most time in the cabinet during this year. In all, I have 113 ministries from the following countries: Austria, Czech Republic, Denmark, Estonia, Finland, France, Germany, Ireland, Iceland, Italy, Luxembourg, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden and Turkey. I took the countries from the UE25 but due to a lack of information or difficulties in translating information, I left seven countries aside and for compensation I took Turkey and Norway to obtain 20 countries.

The main variables are about personal characteristics of education ministers and can be seen on Table 1. The variable female illustrates the percentage of female ministers in my sample, Age gives the age of the ministers and can be seen as an indicator for life experience of the ministers. Experience in primary or secondary education which is my key variable is a dummy variable which is equal to one if the minister has worked in secondary or primary education as a teacher. I take into consideration if the education minister has already had a political experience, this dummy variable is equal to one if the minister has ever been active in local or national politics. Private sector experience is also a dummy variable which measures if the minister has ever worked in the private sector. Tenure at the Job measures how long ministers have been in place and “already minister” experience shows if the minister has already been minister in no matter what sector. I computed the variable tenure at the job as follows: plus one if the minister has served for at least 8 months. I did this because many ministers have had a short mandate and tenure at the job can be an important variable seen that with an increase in the tenure, there is an increase of the on-the-job experience. The last variable is a cross variable: it measures if the minister has a political experience and an experience in primary or secondary school. With all these variables, I can have a non-negligible overview over the background of the ministers and I expect that most of these variables positively influence my dependent variable. My control variables are the percentage of government spending in education, the centralization rate of these expenses, the real growth domestic product per capita in euros and the population size.

Finally, to measure performance of the education sector of different countries, I took the PISA Tests since 2000. PISA stands for Programme for International Student Assessment and is a worldwide study by the Organisation for Economic Co-operation and Development (OECD) in member and non-member nations of 15-year-old school pupils' scholastic performance on mathematics, science, and reading. It was first performed in 2000 and then repeated every three years. Its aim is to provide comparable data with a view to enabling countries to improve their education policies and outcomes. Some studies have already used the PISA results, for example **Hanushek and Woessmann (2011)** used among other indicators the PISA results to compare international differences in educational achievements.

My dependent variable, Pisamean consists on an average of the 3 indicators (mathematics, science and reading). Seen that Pisa tests are only carried out three in three years and that I probably wouldn't have enough observations, I computed new observations by using the linear approximation approach. At the end, I have 296 observations thanks to this method. To be sure that all information is correct, I tried to collect the same information from two different sources, but it was not always possible. For the personal information, I found most information on Wikipedia, personal websites and parliament websites. The percentage of government spending in education and centralization rate are available on the Worldbank and OECD website, respectively. The Pisa tests and the population size of the countries can also be found on the OECD website. The real gdp per capita in euros is available on the Eurostat website.

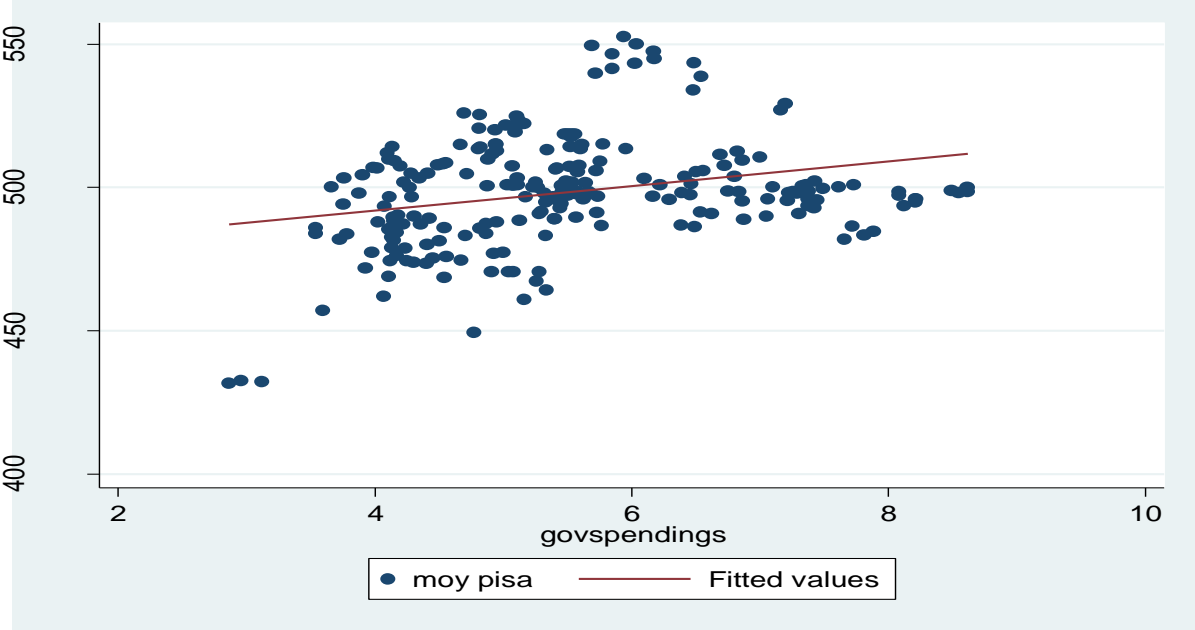
3.2. Descriptive statistics

Table 1 illustrates summary statistics about the ministers: 51% of the ministers are women, the average age is approximately 49 years and 28% of the ministers have had an experience in primary or secondary education. 94 % have an electoral experience (94 % is a very high ratio which means that there is very little variance and could provoke less significance for this variable), 26% have had an experience in the private sector and 21 % have already been minister of a sector. 25% have both experiences: political and primary or secondary education experience. On average, the tenure at the job is 3.69 (8 months = 1), converting this in real time it corresponds to two and a half year. The average percentage of government spending in education of the countries is 5.49% of GDP. We see in Table 1 that approximately 52% of the budget for primary and secondary education comes from central government. Finally, the average real gdp per capita in euros and population size are respectively 32160,84 and 22700000.

I have not integrated anything about years of education and studies ministers have made (it was done in other papers), because it is not easy to collect the exact number of years of education and concerning the studies there is nothing that emerges (12,5% have studied political sciences, 13,85 % education/pedagogy/teacher, 12,16% law and 10,47% economics). On Table 2 (appendix)¹, it can be seen studies ministers have made and the average Pisa results. For example, the 13,85 % of the education ministers having studies education/pedagogy/teacher do a lot better than the average performance. The average Pisa results are about 496,08 and the average of these ministers is 503,55. The 12,16 % who studies political sciences also succeed in doing better than the average by having average results of 501,66. On the other side, education ministers who studies law or economics do worse than the average (493,48 and 492,05 respectively).

¹ Table 2 in the appendix, shows the studies ministers have made and the average Pisa results during their mandates.

Figure 1: PISA results/ government spending in education as % of GDP



This figure illustrates the Pisa results per government spending in education in percentage of GDP. There is a positive relation between both variables.

Figure 2: PISA results/ centralization rate of government spending in education

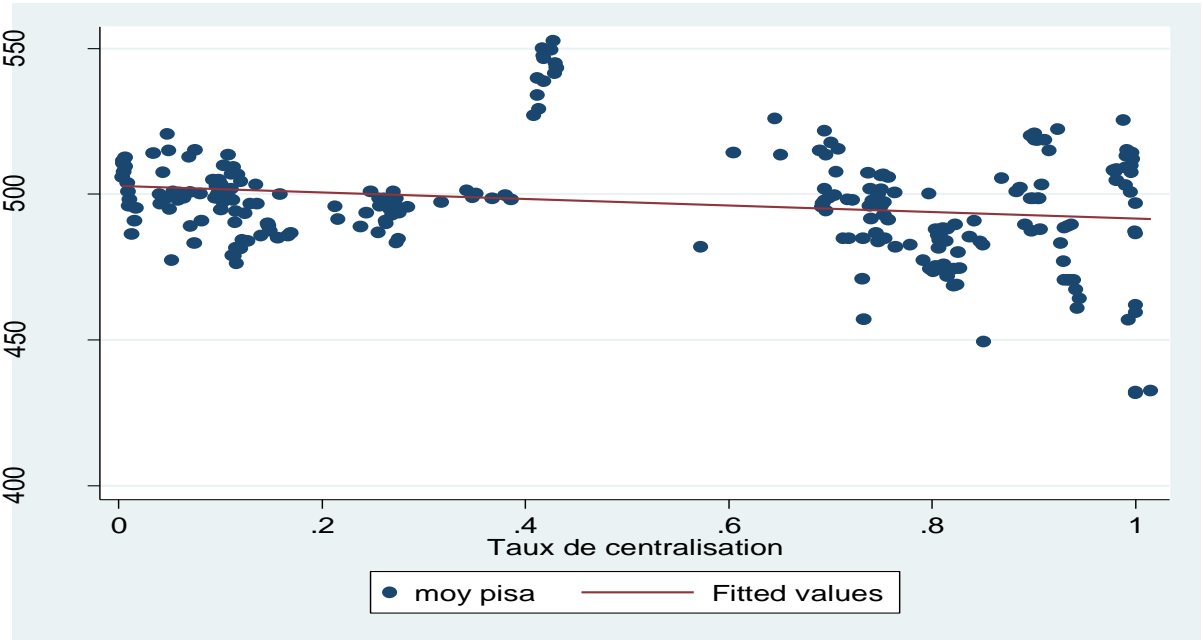


Figure 2 illustrates the PISA results per centralization rate, and it can be seen that countries which are less centralized tend to have better results. So, it seems that there is a negative relation between the centralization rate of government spending in education and the PISA results.

Figure 3: PISA results/ real gdp per capita in euros

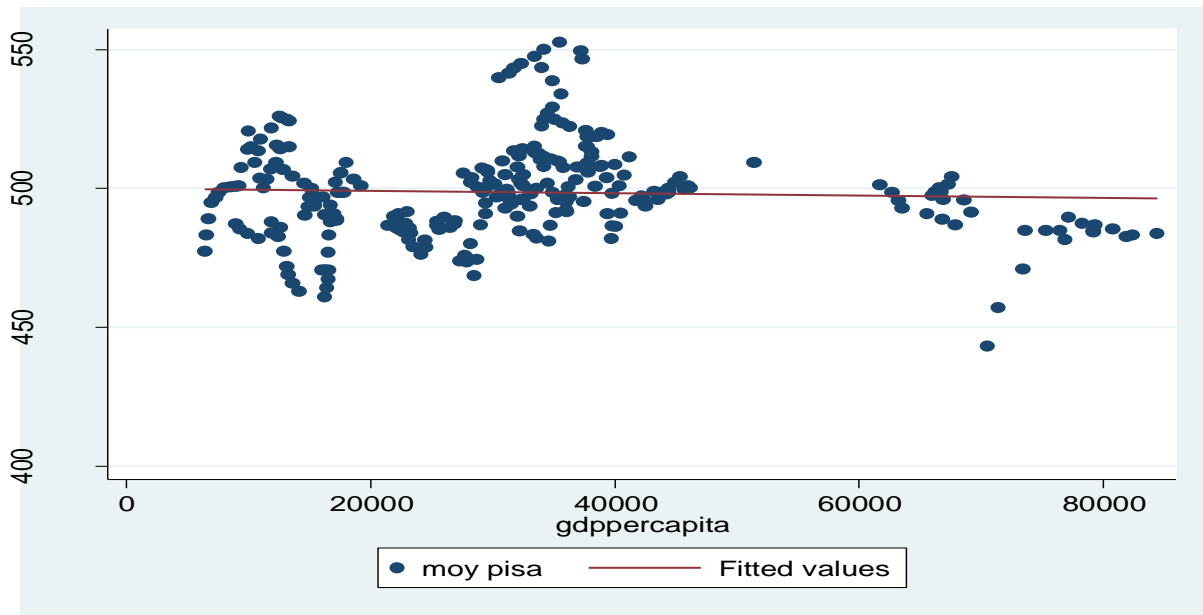
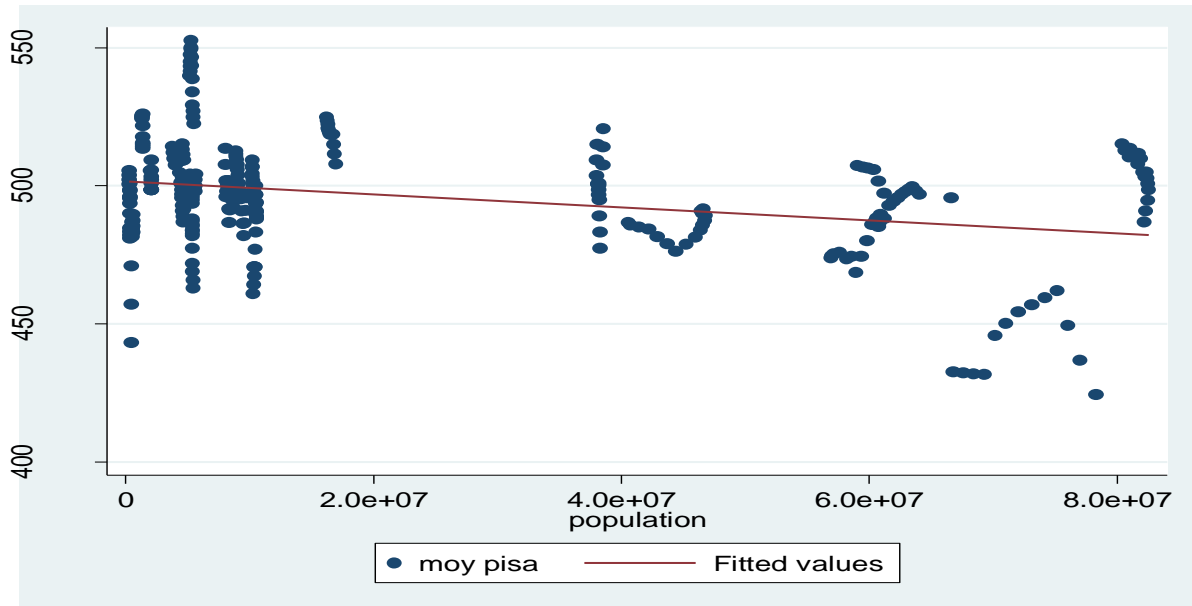


Figure 3 shows the relation between the Pisa results and the real gdp per capita. It can be seen that the slope of the fitted line is slightly negative.

Figure 4: PISA results/ population size²



Here we see the relation between the Pisa results and the population size in the countries. The relation is negative which could mean that countries with a less important population size tends to perform better than other countries with higher population sizes.

² 2.0^e+07 = 20000000
8.0^e+07 = 80000000

Table 3: Average PISA results according to the fact that ministers have an experience in primary or secondary education or not³

exprisecc	Pisamean
0	495.6012
1	497.3347
Total	496.0814

This table shows the average PISA results for ministers having an experience in primary or secondary education and those who do not have this experience. It can be seen that ministers with this experience have a better output than the others.

Table 4: Average PISA results according to the fact that ministers have an experience in politics or not

Political exp	Pisamean
0	486.2986
1	497.14
Total	496.5398

This table shows the average PISA results for ministers having an experience in politics and those who have not this experience. Ministers with an electoral experience have much better results than those who have no electoral experience. However, only 6% of the sample have no political experience as it can be seen in Table 1.

³ 0 always corresponds to the ministers who do not have this experience and 1 to the ministers having this specific experience.

Table 5: Average PISA results according to the fact that ministers have already an experience as minister or not

Already minister	Pisamean
0	494.7329
1	501.0688
Total	496.0814

Table 5 shows the average PISA results for ministers having already an experience as minister regardless of sector and those who have not this experience. It can be seen that ministers who were already minister do a lot better than those without such an experience.

Table 6: Average PISA results according to the fact that ministers have an experience in private sector or not

Private sector	Pisamean
0	495.9705
1	496.709
Total	496.1661

Table 6 shows the average PISA results for ministers having an experience in private sector and those who have not. It can be seen that there is no big difference among those ministers who worked in private sector and those who have not. This can be interpreted as follows: an experience in private sector seems not to have a big effect on performance of the minister.

Figure 5: PISA results/ tenure at the job

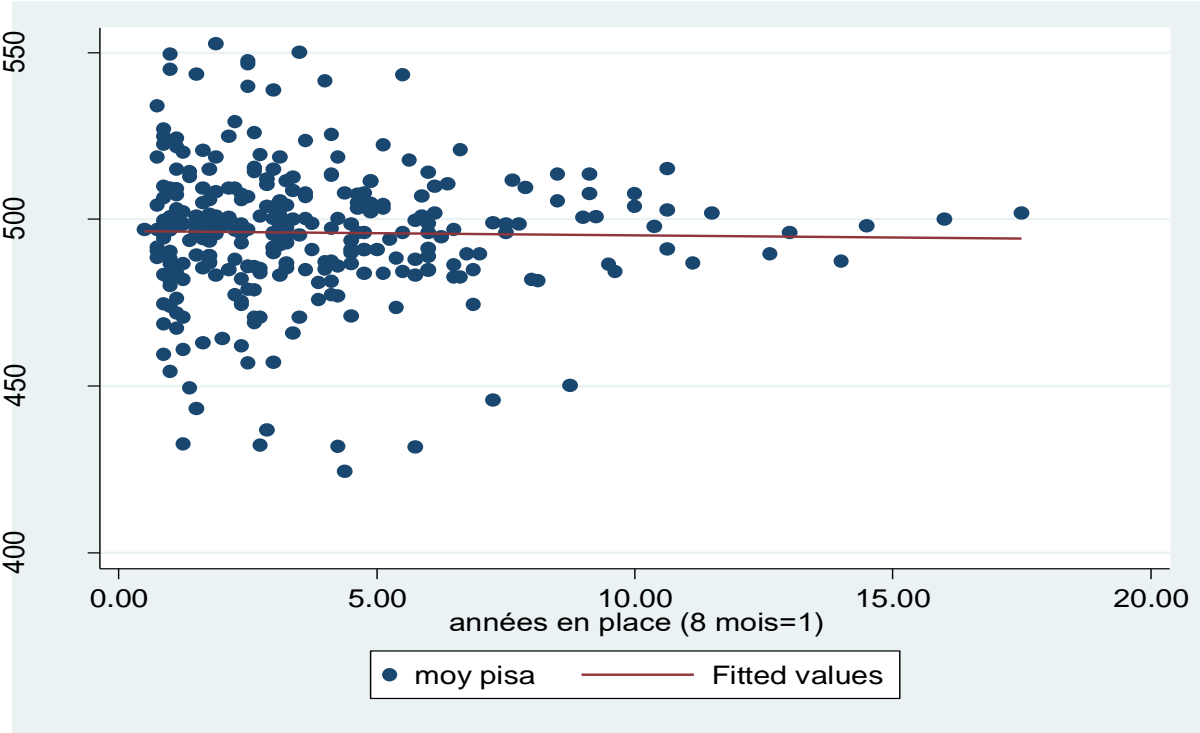


Figure 5 show the relation between the PISA results and the tenure at the job. It seems that the slope is almost 0 which according to this figure would mean that the tenure at the job has no big effect on performance.

4. Estimation strategy

The aim of my thesis is to estimate the impact of the background of the ministers of education on the performance of the education sector. In other words, I would like to illustrate if the different characteristics of the education ministers increase or decrease the PISA results of their country. To do this, I use different models⁴. I first estimate a static panel data model using OLS:

$$\text{pisamean}_{it} = \beta_0 + \beta_1 \text{leaderexp}_{it} + \beta_2 \text{controls}_{it} + E_{it}$$

Here, I have pisamean_{it} which is my dependent variable and measures performance of the education sector. β_0 represents the intercept and gives the value of my dependent variable when my independent variables are equal to 0. leaderexp_{it} is the vector associated to the experiences and characteristics of the education minister, controls_{it} are my control variables that I already presented in the previous section (government spending in education and centralization rate) and E_{it} is the error term.

Seen that OLS estimator is more appropriate for Cross-sectional data⁵, this model might be vulnerable to omitted variable bias, since that the variables in my model might be correlated with the error term. In other words, there is unobserved heterogeneity (some unobserved factors that affect my dependent variable). This also means that it is possible that my variables are linked/correlated to other facts or experiences, or that they only affect my dependent variable through other variables which are not in my model. Therefore, in my case I must use fixed effects seen that OLS is inconsistent. By using fixed effects, I ensure that there is no confusion between my variable of interest and country-specific omitted variables that are constant across time or time-specific omitted variables which are constant across countries and so I include a series of year (ψ_t) and country fixed dummies (λ_i). It is important to do this, because first there can be differences across countries. For example, countries have all different spatial dimensions or cultural differences which cannot be neglected. Second, it is also important to check for time-specific omitted variables bias because there can be different phenomena which can have an influence like for example the subprime crisis in 2007 which affected the economic situation of many countries. I therefore consider a second model:

$$\text{pisamean}_{it} = \beta_0 + \beta_1 \text{leaderexp}_{it} + \beta_2 \text{controls}_{it} + \psi_t + \lambda_i + E_{it}$$

⁴ In all the models I computed, I used the option robust to avoid heteroskedasticity problems.

⁵ Cross-sectional data is a type of data collected by observing many subjects at the same point of time. Panel data is a type of data collected by observing several subject at several points of time.

To estimate this model, I use a two-way fixed effects approach⁶. However, the two models estimated until now are static panel data models. Static panel data models respond exclusively to current events and seen that there is a lag effect in my model, I have to use a dynamic panel data model. By adding a lag variable of my dependent variable, I can not only check for current events but also for past events having still effects on the present. This allows to see if an improvement of the education sector comes truly from the change of the minister and not because the system was already performant. So, I add a lagged dependent variable of one year to create a dynamic panel data model:

$$\text{pisamean}_{it} = \beta_0 + \beta_1 \text{pisamean}_{it-1} + \beta_2 \text{leaderexp}_{it} + \beta_3 \text{controls}_{it} + \psi_t + \lambda_i + E_{it}$$

Here again, this model can be estimated with a standard two-way fixed effects approach. However, using the fixed effect approach with a lagged dependent variable might be problematic, because in a dynamic panel data model the lagged dependent variable correlates with the error term which causes biased coefficients. Moreover, seen that I have a small T (16 years) and lower than my N (20 countries), my model is likely to suffer from the Nickell bias (**Nickell 1987**). If I would have large T in my sample and much greater than my N, the bias would be small, but unfortunately it is not the case. So, a solution to this could be a General Method of Moments approach. In the literature, the GMM approach is one of the most commonly tools used when there is endogeneity between the dependent variables and when the goal is to instrument them with a lagged dependent variable. However, also in General Method of Moments there are different methods.

The Arellano-Bond estimator (**Arellano and Bond, 1991**) is one of the most commonly used general method moments estimator for dynamic panel data models. In this model, first difference of the regression equation is taken to remove the fixed effects. Then, deeper lags of the dependent variable are used as instruments for differenced lags of the dependent variable which are endogenous. Nevertheless, the AB approach requires small T and large N and seen that I have 16 years (T) and 20 countries (N), this estimator would not be consistent with my sample. When the sample is not large, GMM estimators tend to underestimate the coefficients of the exogenous repressors.

The most suitable approach for my sample is the LSDVc estimator (**Bruno, 2005**). This approach relies on a standard fixed-effect estimator but uses an approximation of its bias to obtain a consistent estimator. The correction procedure of the LSDVc estimator requires an initial consistent estimate of the coefficients, which I can obtain through my fixed-effects estimator. It has been showed by using simulations, that this approach generates more accurate coefficients and lower standard errors than the GMM approach, especially with small panels. Given that my sample is a small panel, the LSDVc estimator is the most appropriated. Then, seen that the performance of the education sector does not drastically change from one year to the next, this indicator corresponds more to a stock than to a flow. It is not like interest rates which are highly volatile and fluctuate a lot. PISA results do not vary as much from year to year which

⁶ By using two-way fixed effects, I check for country and time fixed effects, while the one-way fixed-effects approach only checks for country fixed effects.

is a second argument in favour of the Bruno approach. Finally, a last argument in favour of this approach is that in most literature I read with a sample similar to mine, most of the authors also used the LSDVc approach. **(Jacqmin and Lefebvre, 2016 and Jochimsen and Thomasius, 2012)**

Finally, I did a last fixed effects regression taking the government spending in education as a dependent variable. The goal of this model is for example to illustrate if ministers with specific experiences spend more money on education than others and if ministers get better results due to an increase in government spending in education or due to their skills.

$$\text{government spending}_{it} = \beta_0 + \beta_1 \text{leaderexp}_{it} + \beta_2 \text{controls}_{it} + \psi_t + \lambda_i + E_{it}$$

This model can also be estimated by a two-way fixed effects approach.

5. Results

5.1. Multicollinearity

Table 7: Correlation Table⁷

	pisamean	exppri~c	tenure~b	age	alread~n	polexp	privat~r	govspe~s	centra~e	polsch~p	lag1
pisamean	1.0000										
expprisec	0.1065	1.0000									
tenurejob	-0.0050	0.1990	1.0000								
age	-0.0594	-0.0332	-0.0799	1.0000							
alreadymn	0.1883	0.0548	-0.0967	0.2279	1.0000						
polexp	0.1982	-0.0012	0.0641	-0.1987	0.1311	1.0000					
privatsector	-0.0398	-0.1379	-0.0946	0.0795	0.0976	0.0196	1.0000				
govspending	0.2830	-0.0596	0.0581	-0.2255	0.2559	0.1269	0.0954	1.0000			
centraliza~e	-0.1620	0.0759	0.0339	0.2237	0.0846	-0.0768	0.0051	-0.2802	1.0000		
polschoolexp	0.1277	0.9576	0.2217	-0.0788	0.0742	0.1372	-0.2021	-0.0509	0.0386	1.0000	
lag1	0.9852	0.0851	-0.0151	-0.0571	0.1862	0.2245	-0.0221	0.2899	-0.1538	0.1067	1.0000

Before illustrating the results of the regressions, it is important to see if there is multicollinearity among my variables. Seen that we talk about collinearity only if there is a correlation of at least 0.6, there are only a few variables which are correlated. Logically, there is a correlation between my dependent variable (pisamean at time t) and my lag variable (lag1 = pisamean t-1). There is also a correlation between the variable polschoolexp (experience in politics and in school) and the variable expprisec (experience in primary or secondary school). I have to check for this because if there would be a high correlation among two or more explanatory variables in my multiple regression model, this would mean that one can be linearly predicted with a certain degree of accuracy. When this happens, the estimated coefficients may change wrongly in response to small changes in my model. It is also probable that if two variables are highly correlated, that the coefficient of one of them may be statistically insignificant, seen that the effect of this variable can be absorbed by the other variable.

⁷ The definition of the variables is available in the appendix.

5.2. OLS estimator

Table 8

Dep. var.: Pisamean	(1)	(2)	(3)	(4)	(5)
Exp. in primary/sec education	1.733 (2.2694)	3.970 (2.1316)	5.148* (2.3478)	4.248 (2.4152)	9.996* (4.3912)
Political exp.		11.05*** (2.0694)	9.164*** (2.6388)	14.32*** (2.8491)	15.64*** (3.2392)
Tenure at the job			-0.286 (0.3328)	-0.359 (0.3733)	-0.340 (0.3784)
Already minister			4.423 (2.7304)	5.244 (3.0716)	5.397 (3.0911)
Private sector			0.458 (2.4348)	-4.002 (2.6433)	-4.459 (2.9382)
Age			-0.165 (0.1398)	0.0634 (0.1524)	0.0571 (0.1538)
Gov. sp. in edu. as % of GDP				1.209 (1.0625)	1.112 (1.1070)
Centralization rate				-5.438 (2.8653)	-5.615 (2.9248)
Real gdp per capita in eur.				0.0000258 (0.0001)	0.0000323 (0.0001)
Population size				-0.00001** (0.0000)	-0.00001** (0.0000)
Pol. and school exp.					-6.250 (5.8288)
_cons	495.6*** (1.4745)	485.1*** (1.8448)	494.8*** (8.1754)	481.8*** (9.7121)	481.3*** (9.7089)
N	296	289	280	211	211
R-sq	0,001	0.023	0.040	0.160	0.161

Standard errors in parentheses

* p<0.05, ** p<0.01, ***p<0.001

Table 8 represents simple OLS regressions. In the first column, I only regressed the experience in primary or secondary education over the PISA results. The coefficient is positive but not statistically significant. In the second column, I added the electoral experience. The coefficient for experience in primary or secondary remains insignificant but the coefficient for the electoral experience is positive and highly significant. This means that the fact of having an electoral experience increases the performance of the education sector. In the third column, I added the rest of the variables about the leader's characteristics, the only change is that now the coefficient of the variable experience in primary/secondary education is positive and statistically significant. In the fourth regression, I added my control variables and only the coefficient for the population size is negative and significant. Even if the coefficient for the government spending in education is not significant, it is nevertheless positive and fits to what can be seen on Table 1. The same applies for the centralization rate which is negative and not significant, which means that the less the spending's are centralized, the better the results. This corresponds to Figure 2 in section 3. The experience in primary and secondary school and the electoral experience keep the same signs but only the political experience is significant. In the last regression, I added the variable political and school experience which represents the ministers who have an experience in primary or secondary school and an electoral experience. This cross variable permits me to check if the experience in primary or/secondary education is conditional to a political experience. The coefficient is not statistically significant which is logical since in my sample there are 94% ministers who already have a political experience.

It can be observed that for the two last regressions the sample is less important. This happens because two variables (government spending and centralization rate) are not complete. At the end, only the observations are taken where the information is available for all the variables. This will also happen in the next models⁸.

Even, if OLS is not consistent for panel data seen that there is unobserved heterogeneity (Section 4), nevertheless it can be useful to analyse some coefficients. For example, the signs of the coefficients of the government spending in education and the centralization rate correspond to the figure 1 and 2 in section 3, which could mean that there is a positive effect of the government spending in education on the performance of the education sector across countries. However, this does not mean that within a country the government spending has the same effect on performance, but this will be analysed later with help of more adapted models. The next model I use, is a two-way fixed-effects estimator which is more suitable for panel data.

⁸ In my sample, I almost not have observations for the variables government spending and centralization rate for the years 2014 and 2015. Therefore, when I use Lsdv regressions to check for the year and country fixed effects, I will not have observations for the year dummies 2014 and 2015, seen that information is not complete for these years.

5.3. Two-way fixed effects estimator (LSDV)

Table 9

Dep.var.: Pisamean	(1)	(2)	(3)	(4)	(5)
Exp. in primary/sec. education	2.051 (2.4455)	2.048 (2.4017)	2.905 (2.6088)	5.054** (1.7415)	11.73** (3.8234)
Political experience		-6.662 (5.9864)	-6.415 (5.3399)	-5.506 (3.2800)	-4.248 (3.5548)
Tenure at the job			0.371 (0.2325)	0.379* (0.1802)	0.412 (0.2051)
Already minister			3.073 (2.7101)	3.000 (1.6012)	3.216* (1.5285)
Private sector			0.519 (2.0169)	-0.712 (1.6537)	-1.358 (1.7348)
Age			-0.0382 (0.0927)	-0.116 (0.0636)	-0.127 (0.0624)
Gov. sp. in edu. as % of GDP				-6.403* (2.7076)	-6.163* (2.7210)
Centralization rate				-10.14 (4.9938)	-10.08 (5.0955)
Real gdp per capita in eur.				-0.00236** (0.0006)	-0.00223** (0.0006)
Population size				-0.0001 (0.0000)	-0.0001 (0.0000)
Political and school experience					-7.508 (5.5676)
_cons	492.7*** (4.1821)	502.6*** (6.9499)	501.9*** (8.2134)	654.7*** (39.9339)	645.9*** (41.3139)
year/country fixed effects	yes	yes	yes	yes	yes
N	296	289	280	211	211
R-sq	0.038	0.057	0.107	0.388	0.398

Standard errors in parentheses : * p<0.05, ** p<0.01, *** p<0.001

Table 9 represents two-way fixed effects regressions. I did the 5 same regressions as in the OLS model but now, I check for country and time fixed effects. The results in this model are a bit different from the results in the simple OLS model. In the first three regressions, no variable is statistically significant. In regression 4, where I added my control variables, the variables experience in primary or secondary education, tenure at the job, government spending and gdp per capita are significant and for the two first, the coefficients are the expected ones seen that they are positive. This means that an experience in primary or secondary education and the fact of being longer in place are two positive experiences in a minister's life for a better performance of the education sector. The government spending is now negative and significant which means that countries with less spending in education performs better. This contradicts figure 1 but I will explain later why it is negative. In the last regression estimated, I added the variable pol. and school exp. which is negative but not significant. As I explained in section 3, seen that there is almost no variance in the variable political experience, it is quite unlikely that this variable and the cross variable will be significant. The coefficients for the variables experience in primary and secondary education, already minister, government spending and population size keep the same sign and are all significant. Finally, even if not many coefficients are statistically significant, nevertheless some of them correspond to what I expected. For example, the coefficients for exp. primary/sec education, tenure at the job and already minister are always positive.

However, the two previous models were static panel data models and they are not suitable with what I pretend to analyse, because seen that I am talking about politics, I have to use a dynamic panel data. As already explained in section 4, a static panel data does not take into account the past and I need a dynamic panel data model to ensure that the change in performance comes from the minister and not because the system was already performant.

5.4. Two-way fixed effects estimator (LSDV) with lagged dependent variable

Table 10

Dep. Var.: Pisamean t	(6)	(7)	(8)	(9)	(10)
Exp. in primary/sec. education	0.734 (0.3981)	0.675 (0.3455)	0.497 (0.3905)	0.126 (0.5489)	0.196 (1.1981)
Pisamean t-1	0.847*** (0.0454)	0.886*** (0.0300)	0.879*** (0.0358)	0.849*** (0.0564)	0.849*** (0.0584)
Political experience		-0.799 (0.7835)	-0.918 (0.6941)	-0.499 (0.8587)	-0.488 (0.8830)
Tenure at the job			0.281** (0.0757)	0.324*** (0.0794)	0.324*** (0.0811)
Already minister			0.550 (1.2698)	0.797 (0.9725)	0.800 (0.9528)
Private sector			-0.209 (0.6700)	-0.607 (0.6796)	-0.614 (0.7616)
Age			-0.0633 (0.0484)	-0.0234 (0.0325)	-0.0235 (0.0328)
Gov. sp. in edu. as % of GDP				-0.860 (1.0898)	-0.859 (1.0809)
Centralization rate				-0.478 (2.2414)	-0.482 (2.2450)
Real gdp per capita in eur.				-0.000206 (0.0002)	-0.000205 (0.0002)
Population size				0.000001 (0.0000)	0.000001 (0.0000)
Political and school experience					-0.0783 (1.3133)
_cons	76.01** (22.6011)	57.20*** (14.5407)	62.55** (17.5622)	77.62* (35.0854)	77.69* (35.7280)
year/country fixed effects	yes	yes	yes	yes	yes
N	276	270	261	197	197
R-sq	0.814	0.823	0.834	0.834	0.834

Standard errors in parentheses: * p<0.05, ** p<0.01, *** p<0.001

These five regressions (the same as the ones in the previous models except the addition of a lag variable) correspond to dynamic panel data models estimated using two-way fixed effects. The results indicate a rather strong path dependency of the performance, seen that the estimated coefficient of the lagged performance is positive, larger than 0.5, and highly significant. Here again, there are not many coefficients which are statistically significant. However, it is interesting that the variable tenure at the job is always positive and significant which means that the longer a minister is in office the better will be the results. This can be explained by an on-the-job learning effect. As already explained, the more time a minister spends in office the more skills and knowledges he will acquire and so the better he will be at his job. Apart from these variables, none are significant. However, these models probably suffer from diverse bias. In a dynamic panel data model the lagged dependent variable suffers from endogeneity. My lagged dependent variable might be correlated with the error term and this provokes downward bias of the coefficients. According to **Nickel (1987)**, in the case of small panels the coefficients are biased when T (years) is small so I have to use a different approach. In section 4, I explain that the AB approach also does not work for my sample. The most suitable estimator for my sample is the LSDVc estimator (**Bruno 2005**). This approach relies on the standard fixed-effects estimator, but uses an approximation of its bias to obtain a bias-corrected estimator.

5.5. LSDVc estimator

Table 11

Dep. Var.: Pisamean	(11)	(12)	(13)	(14)	(15)
L.pisamean	0.971*** (0.0495)	1.002*** (0.0465)	0.972*** (0.0502)	0.856*** (0.0763)	0.854*** (0.0766)
Exp. in primary/sec. education	0.647 (1.4729)	0.611 (1.2576)	0.516 (1.7757)	0.0960 (1.9123)	0.403 (3.9925)
Political experience		-0.943 (2.7459)	-1.687 (3.7688)	-0.910 (3.9676)	-0.864 (2.0865)
Already minister			0.443 (1.5992)	0.563 (2.0736)	0.575*** (0.1133)
Age			-0.0763 (0.0762)	-0.0249 (0.1126)	-0.0256 (0.3155)
Tenure at the job			0.285 (0.2135)	0.311 (0.3135)	0.313 (2.1053)
Private sector			-0.0902 (1.7797)	-0.166 (2.0922)	-0.200 (1.7249)
Gov. sp. in edu. as % of GDP				-0.493 (1.7143)	-0.492 (7.3367)
Centralization rate				-0.954 (7.2896)	-0.977*** (0.0006)
Real gdp per capita in eur.				-0.0001 (0.0006)	-0.0001*** (0.0000)
Population size				0.000001 (0.0000)	0.000001 (1.9242)
Political and school experience					-0.339 (0.0000)
country fixed effects	yes	yes	yes	yes	yes
N	276	270	261	197	197
R-sq					

Standard errors in parentheses: * p<0.05, ** p<0.01, *** p<0.001

These LSDVc regressions are my final models. According to the literature, this approach is the most appropriated for my sample and so coefficients should be consistent and reliable. Again, the results indicate a rather strong path dependency of the performance, as the estimated coefficient of the lagged performance is always positive, higher than 0.5 and highly significant. So, regression 11 consists of a basic regression. The coefficient for experience in primary or secondary education is positive but not significant. In the next regression, I integrate the political experience whose coefficient is negative but not significant. The coefficient for the primary or secondary experience remains positive and not significant. Regression 13 consists of all the leaders' variables. The coefficients for the variables seen in the previous regressions kept the same sign, the coefficient for already minister and tenure at the job are positive and age and the experience in private sector seem to have a negative effect on performance. However, also in this regression there is no coefficient which is statistically significant. In the fourth model, I add my control variables (government spending in education as % of GDP, centralization rate, real gdp per capita and population size). Some leaders' variables coefficients change but all of them keep the same sign. Government spending and centralization rate have a negative impact on performance. Here, again no coefficient is significant. Finally, in the last regression I add the cross variable political and education experience. The coefficient for this variable is negative and not significant. For the other variables, there are only three changes. An experience as minister is still positive but highly significant. The centralization rate keeps negative, but now it is significant. According to this, an experience as minister would lead to a better performance of the education sector and a decentralised system tends to be more performant than a high centralized system. The last change is that now the coefficient for the real gdp per capita is now significant, but the coefficient is very low so that there is almost no effect.

The changes in regression 14 and 15 could at least in part be explained due to a decrease of the sample. As explained before, due to the control variables government spending and centralization rate, the sample for the two last regressions is less important. This decrease in the sample may be responsible for the changes in the results, because seen that I almost do not have observations for two of my control variables (government spending and centralization rate) for the years 2014 and 2015, the effect decreases. If I would not integrate the very last years, it would not happen because the sample would keep the same.

However, when looking at the coefficients the signs are in most of the cases the expected ones. In the five regressions, the coefficient for the experience in primary or secondary education is always positive which corresponds to the hypothesis I set in section 3. The coefficient for the political experience is always negative. The coefficients for already having been minister are also always positive and even statistically significant in the fifth model as already said above. The coefficients for age are always negative and corresponds to what I saw in the literature. In **Jacqmin and lefebvre (2016)** and **Jochimson and Thomasius' (2012)** papers, the coefficients for the variable age are always negative and significant. The coefficients for the tenure at the job are also the expected ones, seen that they are in all the models positive. The government spending in education has a negative sign in the last two models. This does not correspond to figure 1 where it is possible to see that for the sample I used

there is a positive relation across countries between government spending and the PISA results, but I will discuss this in the next section. Finally, the coefficient for the centralization rate is always negative and even significant in the last regression. The coefficients for the gdp per capita and population size are very weak, the coefficients for the gdp rate being positive and those for the population size negative. Political and school experience is also negative.

5.6. Two-way fixed effects (LSDV) estimator with Gov. sp. in edu. as % of GDP as dependent variable

Table 12

Dep. Var.: govspending	(1)	(2)	(3)	(4)	(5)
Exp. in primary/sec. education	-0.0152 (0.0776)	-0.0160 (0.0790)	-0.0274 (0.0895)	0.0671 (0.0799)	-0.105 (0.1457)
2000bn.year
2001.year	0.112* (0.0509)	0.120* (0.0520)	0.129* (0.0579)	0.144* (0.0652)	0.144* (0.0648)
2002.year	0.253* (0.0951)	0.253* (0.0956)	0.258* (0.0906)	0.253* (0.1114)	0.251* (0.1112)
2003.year	0.248* (0.0994)	0.249* (0.0998)	0.256* (0.0961)	0.330* (0.1555)	0.331* (0.1549)
2004.year	0.212* (0.0960)	0.213* (0.0964)	0.220* (0.1014)	0.329 (0.2120)	0.336 (0.2125)
2005.year	0.148 (0.0954)	0.151 (0.0989)	0.155 (0.1149)	0.234 (0.2581)	0.235 (0.2585)
2006.year	0.0609 (0.1109)	0.0635 (0.1148)	0.0654 (0.1329)	0.224 (0.3120)	0.231 (0.3146)
2007.year	-0.0628 (0.1037)	-0.0602 (0.1092)	-0.0667 (0.1253)	0.140 (0.3459)	0.149 (0.3509)
2008.year	0.0773 (0.1407)	0.0799 (0.1446)	0.0879 (0.1596)	0.280 (0.3713)	0.288 (0.3770)
2009.year	0.549*** (0.1393)	0.555** (0.1584)	0.581** (0.1805)	0.676* (0.3170)	0.676* (0.3184)
2010.year	0.472** (0.1384)	0.475** (0.1599)	0.502* (0.2005)	0.616 (0.3694)	0.621 (0.3728)
2011.year	0.325* (0.1383)	0.330* (0.1490)	0.357 (0.1829)	0.534 (0.3658)	0.545 (0.3699)

2012.year	0.455*	0.451*	0.432*	0.604	0.616
	(0.1816)	(0.1906)	(0.1852)	(0.3731)	(0.3797)
2013.year	0.550**	0.552**	0.542**	0.654	0.669
	(0.1562)	(0.1612)	(0.1667)	(0.3379)	(0.3431)
Political experience		0.0341	0.0507	-0.0835	-0.113
		(0.2022)	(0.2218)	(0.2265)	(0.2230)
Tenure at the job			-0.00556	0.00510	0.00408
			(0.0115)	(0.0085)	(0.0083)
Already minister			0.0406	0.0604	0.0534
			(0.1416)	(0.1468)	(0.1477)
Private sector			-0.0138	0.0489	0.0654
			(0.0884)	(0.0631)	(0.0717)
Age			0.000718	-0.00154	-0.00123
			(0.0064)	(0.0057)	(0.0058)
Pisamean				-0.0179**	-0.0174**
				(0.0058)	(0.0057)
Centralization rate				0.372	0.373
				(0.2886)	(0.2941)
Real gdp per capita in eur.				-0.0000612	-0.0000634
				(0.0000)	(0.0000)
Population size				-3.24e-08	-3.55e-08
				(0.0000)	(0.0000)
Political and school experience					0.191
					(0.1906)
_cons	5.242***	5.216***	5.145***	16.45**	16.35**
	(0.0955)	(0.2477)	(0.5023)	(4.3339)	(4.3723)
N	232	230	224	211	211
R-sq	0.301	0.297	0.297	0.403	0.405

Standard errors in parentheses

* p<0.05, ** p<0.01, ***p<0.001

In this models, I used the government spending in education in percentage of GDP as dependent variable and estimated it by using a two-way fixed-effects approach. This model is very useful, because it shows if ministers with certain characteristics or experiences spend more than others. In the five regressions, except for the year dummies and the variable *pisamean*, no coefficient is statistically significant. There are a lot of year dummies coefficients which are significant and all of them are positive. This might be due to the fact that over the years most of the countries increased their spending in education. Seen that the reference year is 2000 and that for example 10 years later the spending in education is more important for most of the countries, it is logical that most of the year dummies are positive and significant. The coefficients for the variable which measure performance (*pisamean*) is always slightly negative and significant. This means that better results are achieved with less expenses in education.

Looking at the coefficients in table 12, it can be seen that the signs of the coefficients change according to the regressions and so it is hard to draw any conclusions. However, looking at them we note that the coefficients for the variable *experience* in primary or secondary education is most of the times negative. This would mean that ministers with such an experience would tend to spend less than the average. On the other hand, the coefficient for the variables *already minister* and *private sector* are almost always positive which means that ministers with these experiences spend more in education than the average. Finally, the *centralization rate* and the *condition variable* (political and education experience) are always positive. The first indicates that more centralized countries tend to spend more in education than countries which are more decentralized. In contrary, the *real gdp per capita* and the *population size* have negative signs, which could mean that expenses in education are more important in countries with lower population sizes. The coefficients for the *gdp per capita* are almost 0 so there is almost no difference between countries having a higher or a lower gdp per capita.

6. Discussion

Unfortunately, in my LSDVc model which should be consistent, apart from my lagged dependent variable and the coefficient for the variable already minister in the fifth model, no coefficients of the leader variables are statistically significant. So, the computed results are not the expected ones, seen that they are not significant. This could be due to several reasons: there can be a problem with my sample or maybe I have not enough observations. The problem could also come from the linear approximation approach I used, or maybe given that it is always different students who write the PISA tests, this can lead to difficulties in having the expected results. Perhaps it only means that for the sample I computed the background has not a big effect on performance, but this is hard to believe when looking at the literature and descriptive statistics. However, looking at the final results, the coefficient for already minister is significant in the fifth model. This cannot be neglected, seen that it is also an on-the-job experience and maybe even the most important one, seen that it is the same work or almost the same work if the minister has already had an experience as minister.

Even if there are not many coefficients which are statistically significant, by observing all the models I computed, there are still interesting results. Analysing all the variables individually through all the models, the signs of the coefficients are in most of the cases always the same. The sign of the coefficient for the experience in primary or secondary education is positive in all the models I computed. In section 3, I built my hypotheses and explained that I was expecting the experience in primary or secondary education to have a positive effect on the performance of the education sector. Even if they are not significant, nevertheless the signs of the coefficients correspond to what I expected. The coefficients for the tenure at the job are in three of four approaches positive. It is only negative in the OLS approach, but these one is also the less reliable. In all the other models (LSDV, LSDV with lagged dependent variable and LSDVc), the coefficients are positive which again corresponds to what I explained in section 3. The same applies to the experience already minister. The coefficients are positive in all the models and so, it also corresponds to what I expected. It is logical that these experiences have a positive impact on performance, seen that in each of these experiences there is an on-the-job learning effect. With an experience in primary or secondary education, a minister has already had an overview on this sector, he can see what does not work and what has to be improved. A minister who has been teacher, has probably more knowledge in pedagogy and also on how the school subjects should be taught. Therefore, it is more likely that the reforms of a minister with such an experience are more appropriate.

The same applies to the tenure at the job and the experience as minister. With the years in office, a minister can improve his skills, he can learn from his mistakes and improve the performance of the sector over time. An experience as minister can also be a very positive point for the performance, because a minister who already has a mandate as minister, even in a different sector, will know better than anyone the tasks of a minister and what people will expect from him. An experience in the private sector has in all my regressions except two, a negative effect on PISA results. This means

that ministers that have worked in private sector perform worse than the average. It is hard to find an explanation to this. In my opinion, one potential explanation could be that these ministers may be less public-oriented and may focus more on numbers. In other words, they rather may be focused on a positive output for the country than a positive output for the people. These two factors may appear to be similar, but actually are not. A minister who only looks at the good performance of the country, will for example focus more on growth and not on satisfaction of the people and that is what I mean with a less public-oriented minister. Finally, to finish with the leaders' variables, the coefficients for age is always negative, except in the OLS models. As already explained in the previous sections, this corresponds to what I read in the literature. This tends to illustrate that older ministers are less performant. However, the reasons for this phenomenon are not clear. It may be due to the fact that reforms of older ministers are outdated. Society is constantly evolving with time and so education has also to evolve. Therefore, there may be necessary to implement innovative or more adapted reforms and so, age may have a negative impact on Pisa results because of this constant evolution of the education. Because if we look at current education and education 20 years ago, we notice big changes.

Analysing now my control variables, there are also interesting information behind the results. The coefficient for government spending in education as percentage of GDP is only positive in the regression estimated using the OLS approach, in the other approaches used the coefficients are negative. This change of the sign using the fixed-effects approach is logical. Observing figure 1 in section 3, it can be seen the positive relation between government spending in education and performance of the education sector. It can be understood from it, that countries with higher expenses in education perform better than countries with less expenses. That is what the OLS approach tells us, seen that this approach is only suitable for cross-sectional data. In other words, the OLS approach compares countries and does not analyses the evolution between the government spending and performance within the countries. The pooled model does not make difference between period and cross section and it is mostly not appropriate for panel data analysis. It is at this point that the fixed effects method becomes interesting. Seen that it is suitable for panel data, the fixed-effects approach also analyses the relation between spending and performance within the countries. In all the models where I used the LSDV approach the sign of the government spending is negative, and therefore I did a more detailed analysis and looked at the relation between the government spending and the PISA results within all the countries. The relation between government spending and performance in the twenty countries is in 13 of 20 countries negative⁹ (Figures are available on the Appendix p.44). Moreover, in 8 of the 10 countries having the biggest spending rate in education, the relation between these two variables is negative. So, there must be other reasons for the good performance of these countries. I believe that government spending in education can help improving the performance of the sector, but table 13 (appendix p.48) illustrates that it is not the most important factor. On this table, it can be seen that countries with high government spending in education do not necessarily have the best results and

⁹ The relation between the government spending in education in % of GDP and PISA results is negative in: Denmark, Iceland, Sweden, Finland, Austria, Slovenia, Netherlands, Estonia, Poland, Ireland, Italy, Czech Republic and Slovakia. It is positive in: Norway, France, Portugal, Germany, Spain, Luxembourg, Turkey.

the fact that in 8 of 10 countries with the highest government spending in education there is a negative relation between the two variables, shows that there are other factors which are responsible for the results.

Looking now at the coefficients of the centralization rate of the government spending in education, they are negative in all the regressions and even statistically significant in regression 15 in the LSDVc model. This corresponds to what similar papers found. The negative relation between these two variables mean that a more decentralized system of the government spending is more performant. Local authorities govern over a smaller territory and this may facilitate the task. **Hanushek and Woessmann (2011)**, explain that local decision-makers tend to have superior information. They can focus more on the real problems, unlike the centralized systems who have to take decisions considering the country as a whole, even if problems across regions turn out to be different. This may link to a greater autonomy of local governments and maybe also schools as **Fuchs and Woessmann** explain in their paper in 2007.

The coefficients of the other control variables (real gdp per capita and population size) are always close to 0 and almost always not significant, so that there is not much to explain when looking at the regressions. However, when looking at figure 4 in section 3, It can be seen that countries with a smaller population tend to perform better than countries with an important population size. This could be linked to the fact that decentralized systems perform better. It might be easier for countries with a smaller population to be informed about the real problems in education and ameliorate the situation.

Focusing now on the following tables, I compare the results and the government spending in education of ministers having different experiences.

Table 14: Government spending in education in percentage of GDP and PISA results for ministers having an experience in primary or secondary education

Exp. In pri./sec. Edu.	Gov. Sp. In edu. In % of GDP	Pisamean
0	5,535012	495,6012
1	5,350658	497,3347
Total	5,490513	496,0814

Table 15: Gov. sp. in education in % of GDP and PISA results for ministers having a political experience

Political exp.	Gov. Sp. In edu. In % of GDP	Pisamean
0	4,870612	486,2986
1	5,536797	497,14
Total	5,499144	496,5398

Table 16: Gov. sp. in education in % of GDP and PISA results for ministers having an experience in private sector

Private sector exp.	Gov. Sp. In edu. In % of GDP	Pisamean
0	5.388333	495.9705
1	5.653528	496.709
Total	5.454045	496.1661

Table 17: Gov. sp. in education in % of GDP and PISA results for ministers having already in experience as minister

Already minister	Gov. Sp. In edu. In % of GDP	Pisamean
0	5.375484	494.7329
1	6.01088	501.0688
Total	5.490513	496.0814

In the tables 14-17, 0 represents ministers who do not have the experience and 1 the minister having the experience¹⁰. Analysing all this tables, it is possible to compare the spending in education and the performance of the sector according to the experiences. The ministers having already an experience as minister are those who have the best results, but are also those who spend most in education. The ministers having an experience in primary or secondary education, have the second-best results with the least expenses. This cannot be neglected, because this could mean that they achieve

¹⁰ It is possible that ministers have several of these experiences, but here I only analyse the differences among the ministers having a specific experience and those who haven't this experience.

to perform well due to their characteristic and not expenses. It can also be interpreted otherwise: a minister with this experience may perform as well as others but spend less money for it, which can also be seen as an indicator of good performance. Ministers who have worked in the private sector are second in terms of spending in education, but have the worst results. Finally, there is a big difference in the PISA results for the ministers having a political experience (94%) and those who have not this experience (6%). This illustrates that an electoral experience is still very important. Nevertheless, these tables indicate that there can be a link between government spending and certain life experience to achieve a better performance. Table 17, shows that ministers who already have had a mandate, spend more in education but also succeed in having better results, unlike others who spend a lot on education and do not have good results. In my opinion, this tends to show that ministers with certain experiences and characteristics are more prone to implement reforms that improve the performance of the education sector. In other words, certain experiences give the ministers the abilities to use efficiently the state's funds to be performant.

There are surely other experiences or characteristics that influence the performance of the sector, but it is not always easy to find all the information. The fact of being active in an union could be interesting to analyse, maybe there is a difference between people who are active in an union and those who are not. The number of children ministers have can also be interesting to analyse or the political party. For example, **Jacqmin and Lefebvre (2016)** found that leftists tend to spend more in education than ministers of a right-wing party. There are probably other variables that I did not integer in my study, which might be interesting to analyse.

7. Conclusion

Thus, I do not succeed in finding empirical evidence that the background of the education minister influences the performance of the education sector, seen that the coefficients in my regressions are not statistically significant. Nevertheless, there are interesting results that cannot be neglected. Of course, I cannot assure that some specific experiences in ministers' life improve the performance of the sector, but there are indications who tend to demonstrate that it is possible that certain experiences in a minister's life can improve the performance of the sector. I draw these conclusions not only from my regressions, but also from descriptive statistics and all the literature related to my research question.

When looking at the tables analysed in the previous section (Tables 14-17), it can be seen that ministers with an experience in primary or secondary education tend to use less funding than the average and achieve to have the same or even better results than the average. This is an indication for good performance. The same applies to ministers who have already a mandate as minister. Even if they tend to increase the funding received by the education ministry, nevertheless they succeed in obtaining very good results, which means that the funds have been very well spent. For the political and the private sector experience, it is a bit different. These spent more than the average and only achieve average results. In my opinion, this tends to show that ministers with certain experiences and characteristics are more prone to implement reforms that improve the performance of the education sector.

Taking all this information and the papers who have been written on similar subjects (**Jacqmin and Lefebvre, 2016 and Moessinger, 2014, Jochimsen and Thomasius, 2014**), I believe that the background of the education minister has an influence on the performance of the sector. Above all, I believe that a sector-specific experience can improve the performance of the sector. This is also in agreement with what is said in the human capital theory: the on-the-job learning effect of having been active in education before becoming minister is a big advantage. Not only because of a positive influence on the performance, but also for the signal that this experience gives about the abilities of the person and which can ease their election by the people.

Unfortunately, I am not able to do a deeper and more detailed analysis. It is for example very hard to compare reforms among countries. Moreover, it is very hard to analyse the effects of the reforms on the long run, seen that in a lot of countries the mandates are of short duration. It can also be possible that the PISA results are not the most appropriated indicator of performance. However, I believe that my thesis gives some interesting indications about the topic which can be useful.ⁱ

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Appendix

Table 2

Studies	Frequency	Percentage	Pisamean
.	1	0.34	498.3333
Architecture	4	1.35	512.3055
Arts	8	2.70	504.2361
Biology	3	1.01	519.4444
Business/management	9	3.04	487.3456
Chemistry	1	0.34	477.3333
Communication sciences	3	1.01	436.8889
Construction informatics	1	0.34	498.6667
Economics	31	10.47	492.0501
Education/pedagogy/teacher	41	13.85	503.5501
Engineering	3	1.01	487.037
Financial mathematics	2	0.68	484.3889
Health	2	0.68	548.1666
History	10	3.38	497.7778
Human resources	1	0.34	493.7778
Human sciences	2	0.68	494.9998
Journalism	3	1.01	502.8889
Languages/literature	29	9.80	479.0881
Law	36	12.16	493.4784
Mathematics	14	4.73	502.2301
Medicine	2	0.68	471.5555
Military	8	2.70	491.4583
Nurse	5	1.69	532.4666
Philosophy	8	2.70	504.3333
Physics	5	1.69	513.7333
Political sciences	37	12.50	501.6636
Psychology	5	1.69	468.3333
Sciences	2	0.68	513.2222
Social sciences/sociology	12	4.05	493.1759
Sports	1	0.34	552.6667
Transports	5	1.69	484.5333
Typography	2	0.68	489.2222
Total/mean	296	100.00	496.0814

Table 5: Correlation table

Meaning of variables

Pisamean: Mean of the 3 Pisa results (mathematics, science, reading)

Exprisec: experience in primary or secondary education

Tenurejob: tenure at the job

Age: age of minister

Alreadymin: already an experience as minister

Polexp: political experience

Privatesector: experience in private sector

Govspending: government spending in education in percentage of GDP

Centralization rate: centralization rate of spending in education

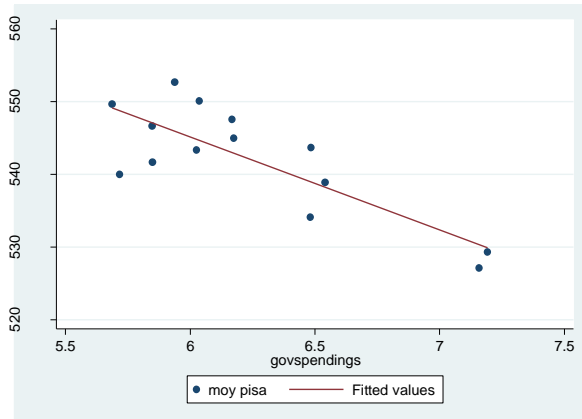
Polschoolexp: experience in politics and in primary or secondary education

Lag1: lagged dependent variable

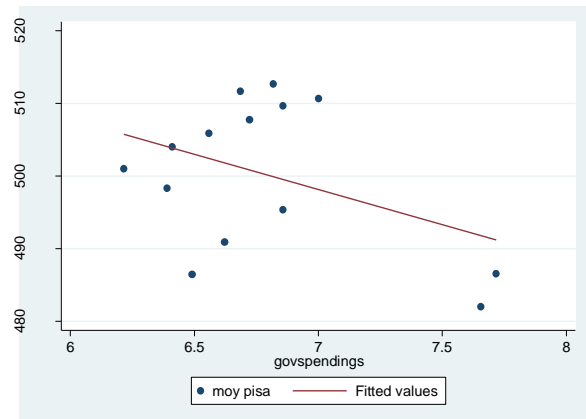
Relation between government spending in education in % of GDP and PISA results within the 20 countries

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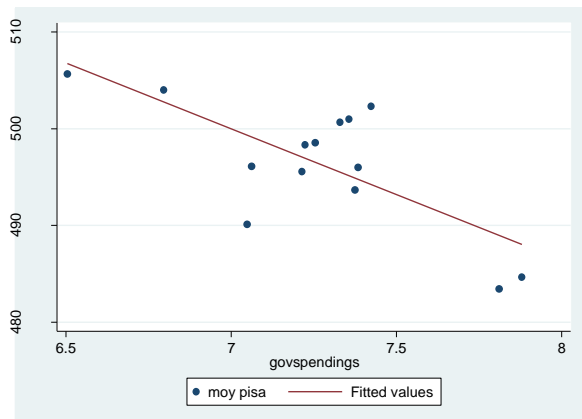
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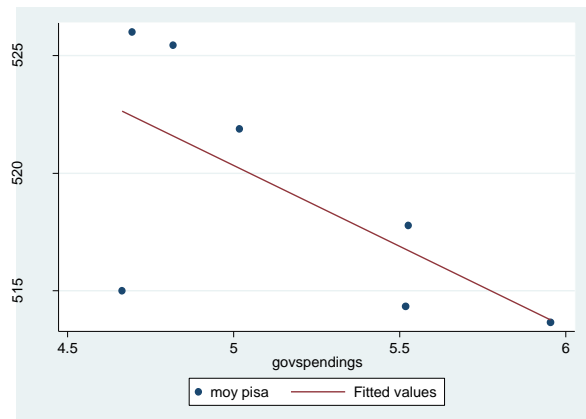
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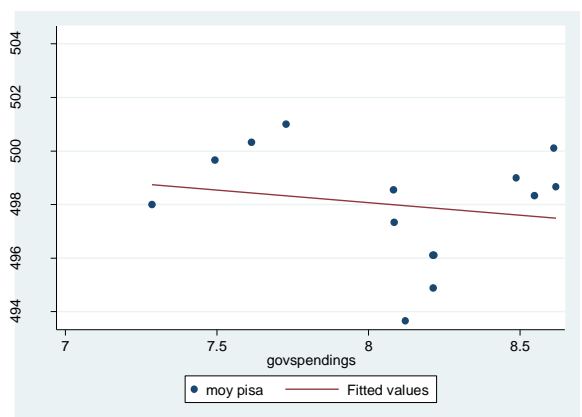
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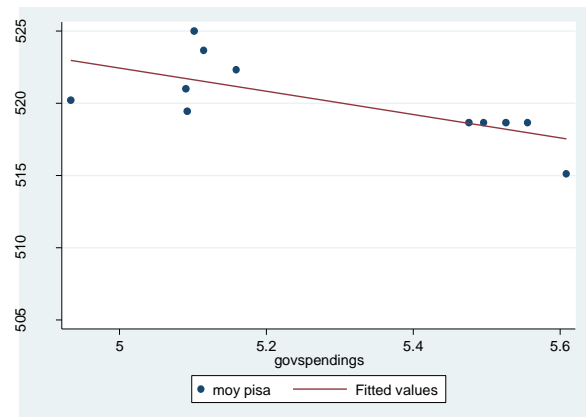
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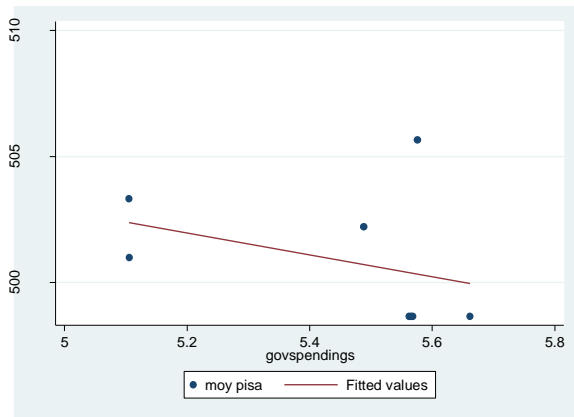
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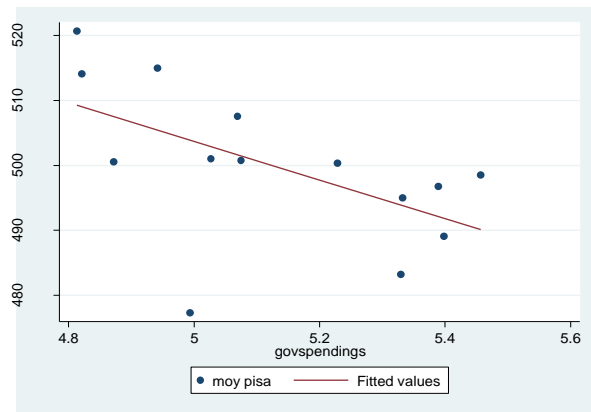
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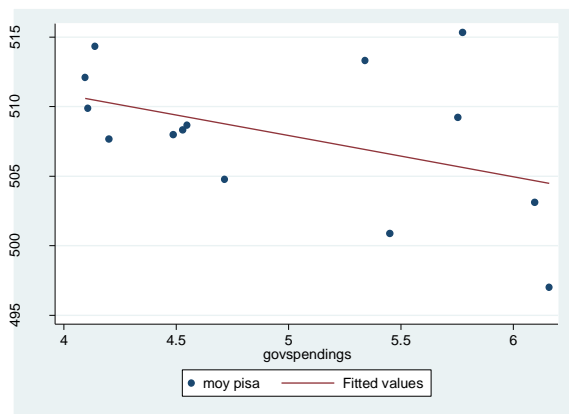
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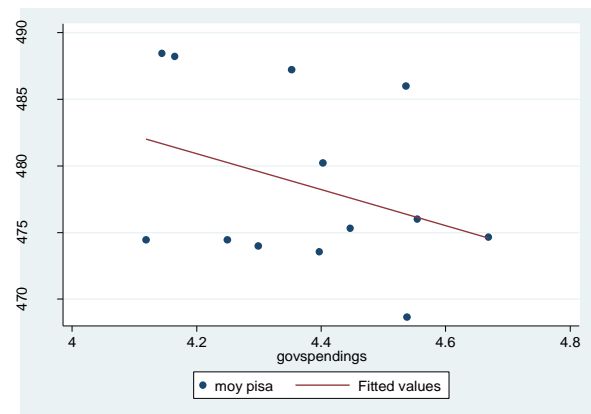
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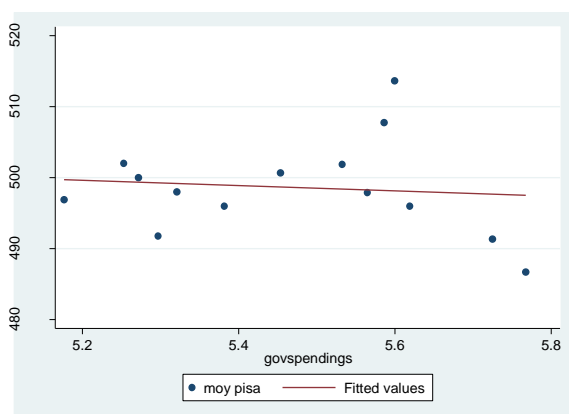
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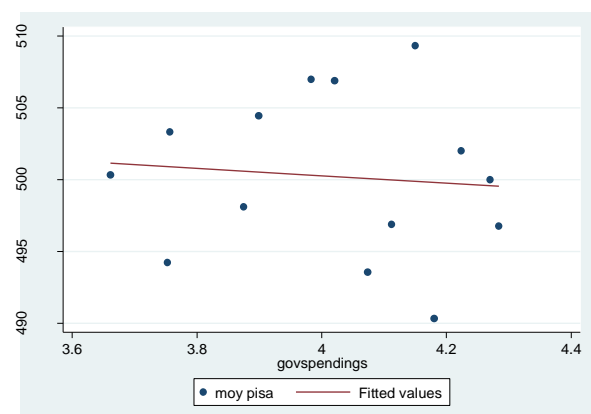
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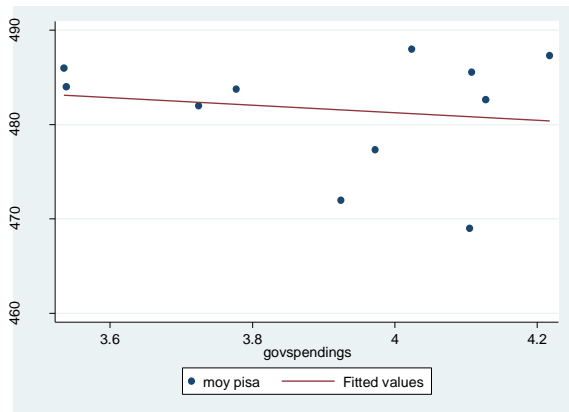
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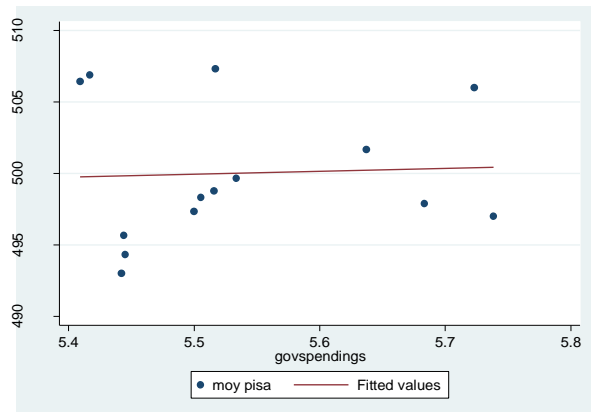
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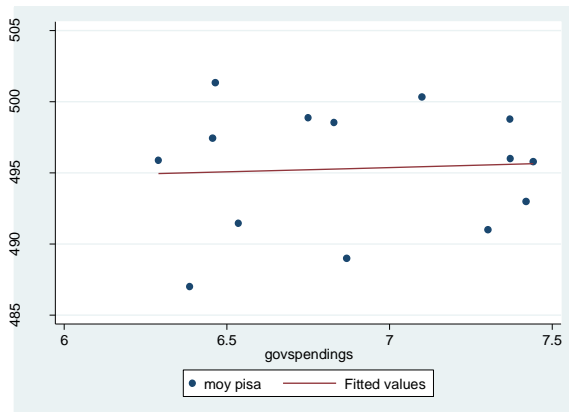
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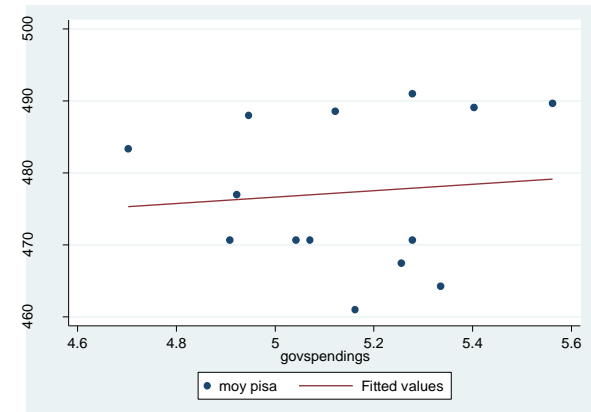
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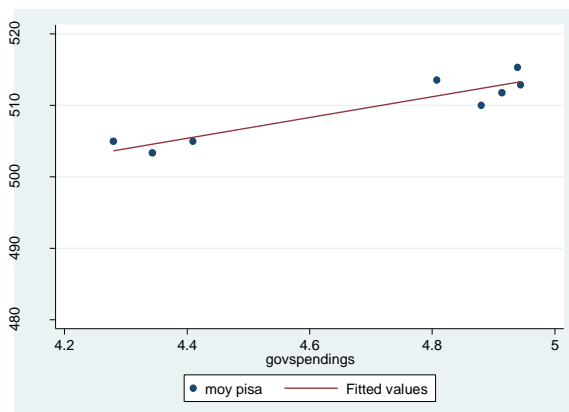
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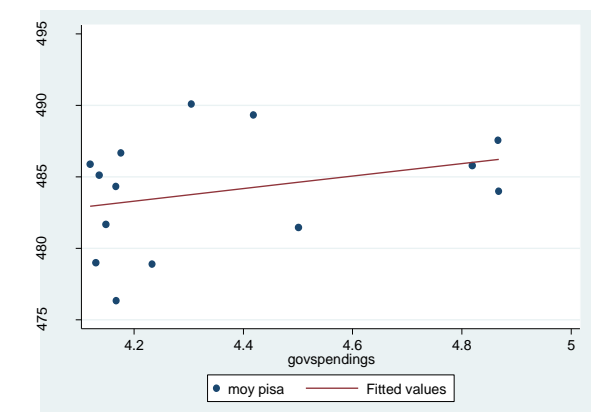
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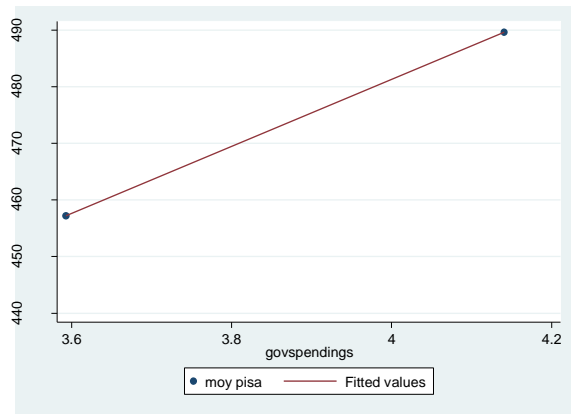
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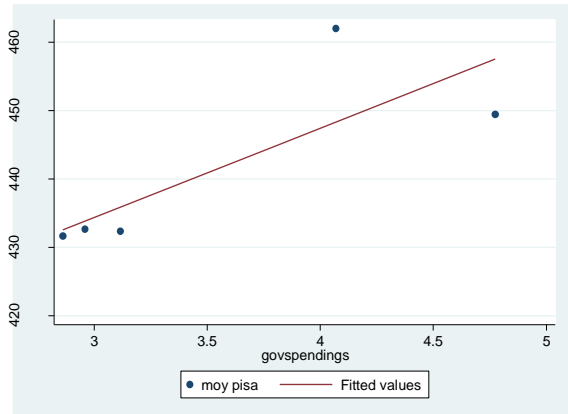


Table 13: Average government expenditure in education in % of GDP and mean of PISA tests per country

Country	Average government expenditure in education in % of GDP	Mean of PISA tests
Finland	6,236	539,83
Estonia	5,170	519,90
Netherlands	5,287	518,54
Ireland	4,956	508,33
Germany	4,690	504,40
Slovenia	5,454	502,20
Poland	5,125	500,81
France	5,536	499,56
Sweden	6,786	499,35
Czech Republic	4,017	499,23
Denmark	8,094	498,65
Austria	5,468	498,00
Norway	6,899	496,27
Iceland	7,262	494,58
Spain	4,361	484,92
Italy	4,375	480,19
Luxembourg	3,867	479,83
Portugal	5,142	479,56
Slovakia	3,914	478,97
Turkey	3,557	443,69
Total	5,491	496,26