PARTIAL FISCAL DECENTRALIZATION REFORMS AND EDUCATIONAL OUTCOMES: A DIFFERENCE-IN-DIFFERENCES ANALYSIS FOR SPAIN

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ABSTRACT

Several arguments derived from fiscal federalism theory suggest that decentralization may improve the provision of public goods and services. However, theory remains inconclusive regarding these effects under partial decentralization. The aim of this study is to examine this hypothesis by evaluating the effects on educational outcomes of the partial fiscal decentralization reform that took place in Spain during the 1980s. Since education competences were devolved to the regions at different points in time, we can consistently estimate the effects of this reform by applying the *differences-in-differences* method and by using the non-decentralized regions as the comparison group. We find that the reform had a sizeable impact on the percentage of students dropping out early from school. The effects are much stronger for regions with a high level of revenues. We also find that the effects are concentrated in the high-school program and that the reform was not able to improve educational outcomes in the vocational program. We interpret these results as evidence that decentralization improved the match between education policy and population preferences.

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KEYWORDS: Partial Fiscal Decentralization, Policy Evaluation, Education, differences-in-differences, event-study.

1. INTRODUCTION

In the last three decades Spain has been involved in a far-reaching process of fiscal decentralization, to the extent that today it is one of the most decentralized public sectors in Europe. As a result of this process important areas of expenditure, such as education, health care or social welfare, are nowadays devolved to the regional governments (Solé-Ollé, 2010). Focusing on the education policy area, we find that while regions with a historic regional status were able to accede to the educational powers not specifically assigned to the central government in the Spanish Constitution (1978) at the beginning of the 1980s, the other regions did not receive these powers until the final years of the 1990s. An additional characteristic of the decentralization reform in Spain at the beginning of the 1980s is that it was a *partial decentralization reform*, since subnational governments were not granted any powers to raise tax revenues until the end of the 1990s. Within this context, theory remains inconclusive regarding the effects of decentralization and empirical analyses are required (Weingast, 2009; Brueckner, 2009; Borge *et al.,* 2014). Despite this need, empirical studies on the effects of education decentralization under such setting have, until recently, been non-existent.

Thus, the aim of this study is to evaluate the effects of the Spanish partial fiscal decentralization reform in Spain on educational outcomes. The way in which education policy has been decentralized in Spain provides a unique benchmark against which to identify the effects of a partial decentralization reform in education, since the regions that did not receive educational powers in each time period can be used as a comparison group for the regions that did receive them. Given that the decision to decentralize educational policy to these regions was made on historical grounds, and as part of a broader decentralization process affecting other areas of expenditure policy, we do not expect the implementation of the reform to be endogenous. Despite this, we estimate the effects of the education decentralization reform on educational outcomes with a *difference-in-differences* approach. In this way, we can control for the non-observable characteristics of regions that might have influenced the decision to decentralize and which could result in differences between the treatment and comparison groups before decentralization that determine the evolution of their educational outcomes. Additionally, we conduct an *event-study analysis* that allows us to test the exogeneity assumption by looking at the evolution of the outcome variable in the years before and after decentralization.

There is a long-standing tradition of studies that argue that the decentralized provision of public goods and services should be preferable in terms of social welfare to that of a centralized provision, both because subnational governments have a better knowledge of local preferences and needs than the central government (Oates, 1972), and because they have more incentives than centralized authorities to act in accordance with these preferences (Seabright, 1996; Oates, 2005). However, it has been argued that when subnational governments are highly dependent on intergovernmental grants to finance their expenditures (as it happens under a partial fiscal decentralization setting) they have an unclear perception of hard budget constraints (Wildasin, 1997) and they are not as accountable as they would be if they were financed by their own revenues (Weingast, 2009). Early empirical studies that have sought to test this proposition conclude that such a situation of vertical fiscal imbalance encourages subnational governments to overspend

and generates unsustainable deficits and bailout demands (Rodden 2002, 2003). Despite this evidence, recent studies conclude that the provision of public goods and services in a situation of *partial fiscal decentralization* can be preferable to both full central control and full decentralization, when per capita spending is held fixed (Brueckner, 2009; Borge *et al.*, 2014). These papers suggest that partial fiscal decentralization might improve both the responsiveness of government to the demand of public services and the efficiency in its provision.

There are already several papers in the literature providing evidence on the effects of decentralization on educational outcomes in several countries (see Barankay and Lockwood (2007) for Switzerland; Galiani and Schargrodsky (2002) and Galiani *et al.* (2008) for Argentina, and Brutti (2016) for Colombia). The general conclusion reached by these studies is that decentralization is positively related to educational outcomes, and that it is more beneficial when subnational governments have a good financial situation (Barankay and Lockwood, 2007; Galiani and Schargrodsky, 2002; Brutti (2016)). Falch and Fischer (2012) conduct a similar analysis for a set of countries, for which they also find that the average effect of decentralization on educational outcomes is positive.

However, as noted above, the effects of decentralization are likely to depend on how subnational governments are financed and on the degree of political accountability in each country, so that the effects of decentralization could be heterogeneous between countries. In Spain, subnational governments were not granted powers to raise tax revenues. In addition, democracy in Spain had just been established after a long period of dictatorship. Thus, we might not expect the effects of decentralization to be the same in this country than in Argentina, where a far-reaching process of revenue decentralization was implemented before educational competences were devolved to the provinces, or Switzerland, with a tradition of sub-national tax autonomy and democracy. The effects of the decentralization reform in Spain in the educational sector have only been previously studied in Esteller-Moré and Solé-Ollé (2005), where the focus was specifically on the analysis of its effects on the *allocative efficiency* of education investment policies. That is, the authors analyse whether the decentralization reform in Spain had an impact on investment patterns and the extent to which these changes could be related to objective measures of need. They concluded that the Spanish decentralization reform improved *allocative efficiency* in both education and road investment[1]. Note that this paper is relevant for us because the improvement in the *allocative efficiency* might actually be one of the mechanisms that help improve educational outcomes under decentralization.

We measure educational outcomes using the *dropout rate* in secondary (non-compulsory) education, defined as the proportion of students from a cohort enrolled in a given grade at a given school-year who do not continue their studies in the following school-year (UNESCO, 2009). As there were two alternative pathways upon completion of compulsory education, the high-school program and the vocational program, we measure dropout rates in secondary education for both of them. There are at least two

[1] The effects of decentralization in Spain have been analyzed in other contexts than education. For instance, Carrion-i-Silvestre *et al.* (2008) analyze its effects on economic growth for the period 1965-2000, concluding that the effect was positive for those regions with the highest levels of fiscal decentralization (those that received educational competences at the beginning of the eighties), but negative for those regions with the lowest levels of competencies.

reasons for our interest in the proportion of students who dropout full-time education after finishing compulsory education. First, in a country where enrolment rates in compulsory education are close to 100%, as it was the case in Spain, it seems appropriate to use a variable that focus on students that dropout school after this period to measure educational outcomes. Second and most importantly, still nowadays each year a large number of young people in Spain fail to finish secondary education[2]. As a consequence, upper-secondary graduation rates in Spain remain low in international comparisons and raising them is one of the main objectives facing the educational policy in Spain, as it was during the eighties. Finally, tests score data is not available for the analysed period.

To conduct the analysis, we constructed a panel data set containing information on the 50 provinces of Spain for the period 1977-1991, a period that includes the years before and after the education decentralization reform of the 1980s. The reason to focus our study on this period is that a reform of the educational system that extended compulsory education from the age of 14 until the age of 16 was implemented at the same time that the decentralization reform at the end of the 1990s. In addition, during the 1990s there was also a reform of the regional funding system, which implied a significant increase in the degree of regional tax autonomy (Bosch and Duran, 2005). As a consequence, it is not possible to disentangle the effects of the education decentralization reform during the 1990s from the effects of the education and the funding system reforms.

We find that the reform had a sizeable impact on the percentage of students dropping out early from school. Decentralization cut the *dropout rate* in around one (two and a half) percentage points in the short-run (in the long-run). This represented a reduction of around 13% and 20% with respect to the pre-decentralization *dropout rate*, respectively. However, the effect is concentrated in the *high-school program*, with a reduction in the *dropout rate* of about three (four and a half) percentage points in the short run (in the long run), which represents a reduction of around 22% and 40% with respect to the pre-decentralization *high-school dropout rate*. However, the reform was not able to improve educational outcomes in the *vocational program* on average. Therefore, our results suggest that decentralization had the effect of shifting government priorities both towards education (given that the overall regional budget is fixed) and also towards the education programs most preferred by a majority of the population. Additional results complement this view: the effect of the reform on *vocational dropout rates* increases with either the level of government revenues or with unemployment. This suggest that when revenues are low the priority is the high school program and that education policy priorities shift away from it as unemployment rises. Overall, we interpret this as evidence that decentralization improved preference matching and, as a result, education outcomes.

The rest of this article is organized as follows. Section 2 describes the main features of the educational sector in Spain, with particular reference to the education decentralization reform. Section 3 describes the empirical strategy, and it includes a

[2] In 1978, the average gross enrolment rate in secondary education in Spain was 52.1 per cent, 36.1 per cent in the high-school program and 16 per cent in the vocational program. In 1991, the average gross enrolment rate in secondary education was 89.1 per cent in Spain (61 per cent in the general education program and 28.1 per cent in the vocational program), although differences between regions were quite significant. Thus, during the eighties enrolment rates in secondary education in Spain experienced a significant growth.

description of the variables that we use in the analysis and our data sources. Section 4 presents the different tests conducted to check the validity of our comparison group. Section 5 presents the results. Finally, the last section reports the conclusions.

2. THE MAIN FEATURES OF THE EDUCATION SECTOR IN SPAIN

2.1. DECENTRALIZATION PROCESS

We can trace the process of decentralization in Spain back to 1978, when the Spanish Constitution was enacted. The 1978 Constitution clearly laid down the foundations that would enable Spain to have one of the most decentralized public sectors in Europe. That is, it established the grounds to create regions (17 self-governing regions were formed) and specified the division of powers between the central government and the new regional governments. In the education sector, the Constitution upheld the central government's power to define the main structure of the education system, to regulate the requirements for the obtaining, issuing and standardization of academic degrees and professional qualifications and to establish the basic rules to guarantee the unity of the Spanish education system. In practice, that meant that the central government kept the decision-making power to define the programs of study, the subjects to be taught and most of the course content. All other responsibilities in the sector, however, were provided for being devolved to the regional governments. For instance, decisions about assignment of students to schools, teaching methods and personnel management (except decisions about salary levels) were not specifically assigned to the central government in the Constitution.

One of the main features of Spain's process of decentralization was the asymmetrical manner in which it was conducted (García-Milà and McGuire, 2002). While historic regions were able to accede to all the powers not specifically assigned to the central government in the Constitution (section 149) following the approval of their Statutes of Autonomy (that is, País Vasco, Cataluña, Galicia, Andalucía, Canarias and Comunidad Valenciana), the other autonomous regions had to wait five years following the approval of their Statutes of Autonomy to be assigned the same powers. In practice, however, these non-historic regions were not able to receive these educational powers until the approval of the *Acuerdos Autonómicos de Ampliación de Competencias* in 1992, and the transfers were not made effective until the final years of the 1990s. As a result, the decentralization process has taken place over almost two decades, but today all the regions enjoy the same powers in the education sector. Table 1 shows the year in which the individual Statutes of Autonomy were introduced in each region or Autonomous Community and the year in which educational transfers decrees were approved[3].

During the first years following the decentralization reform at the beginning of the 1980s, the central government had to guarantee to the subnational governments the resources that were necessary to provide all the services that had been decentralized with general transfers. In practice, though, the difficulties to compute the level of resources that were needed to provide these services has been argued to lead to a shortage of subnational revenues in some regions, especially in the richer ones, and to the existence of relevant imbalances between territories with regard to their level of government

[3] Educational transfer decrees took effect from 1 January of the year following that during which they were approved.

revenues as compared to their needs. It was not until 1986 when a new regional funding system was defined, which started to be applied in 1987. However, the new funding system did not imply a relevant change in the fiscal autonomy of regional governments and it did not correct the unbalances from the previous period (Bosch and Duran, 2005). Despite the decentralization reform was partial, during all the period we analyse in this study (1977-1991) subnational governments had the decision-making power to freely allocate their resources among the different areas of expenditure.

Table 1. *Statutes of Autonomy and educational transfer decrees.*

Region	*Year of approval of*	
	Statute of Autonomy	*Educational transfers decree*
Decentralized in the 1980s		
País Vasco	1979	1980
Cataluña	1979	1980
Galicia	1981	1982
Andalucía	1981	1982
Canarias	1982	1983
C. Valenciana	1982	1983
Navarra	1982	1990
Decentralized in the 1990s		
Baleares	1983	1997
La Rioja	1982	1998
Aragón	1982	1998
Cantabria	1981	1998
Madrid	1983	1999
Murcia	1982	1999
Castilla y León	1983	1999
Extremadura	1983	1999
Castilla La Mancha	1982	1999
Asturias	1981	1999

Source: Boletín Oficial del Estado (BOE).

2.2. EDUCATION SYSTEM STRUCTURE

When the Spanish Constitution was enacted in 1978, the education system in Spain was regulated by the *Ley General de Educación* (LGE) from the year 1970, which made education free and compulsory until the age of 14. In addition, with the aim of guaranteeing free education, a system of public subsidies to private schools was set in motion. This law also introduced the *vocational program* into the education system as an alternative pathway to the *high-school program* upon completion of compulsory education and to facilitate young people's entry into the labour market. Thus, after compulsory education, there was a secondary education *high-school program,* which was a three years program, plus one year of preparation for the entry to university; and a secondary education *vocational program,* which was a five years program, divided in two stages. After the first stage of the *vocational program* (with a duration of 2 years) it was

possible to change to the first course of the *high-school program*, and after the second stage of the *vocational program* (with a duration of 3 years) it was possible to change to the course of preparation for university.

In 1985, the *Ley Orgánica Reguladora del Derecho a la Educación* regulated the state-funded schools, which combined free education in private schools with parental discretion regarding the school choice, although these schools existed yet before this law. The basic structure of the education system was not altered until 1990, when the *Ley Orgánica de Ordenación General del Sistema Educativo* (LOGSE) extended compulsory education to the age of 16 and created advanced vocational schools. The LOGSE educational reform was approved in 1990, but it was progressively implemented between 1992 and 2003. Since this reform was not implemented at the same time in regions that received educational competences in the 1980s than in regions that received them in the 1990s, an analysis of the effects of decentralization on educational outcomes at the end of the 1990s would confound these effects with those of the educational reform. Thus, we focus our analysis on the period 1977-1991, before the LOGSE educational reform started to be implemented[4].

3. METHODOLOGY

3.1. EMPIRICAL STRATEGY

The aim of this study is to evaluate the effects of the partial fiscal decentralization reform in Spain on the country's educational outcomes, measured as the *dropout rates* in secondary education, both in the *high-school* and in the *vocational programs*. Although we do not have any experimental data, we are fortunate that educational powers in Spain were devolved to the regions at different points in time in base to historical reasons. In addition, since the education decentralization reform in Spain was made within a broader process of decentralization, which implied both the creation of the regional level of government and the devolution of different public policies to the new regional governments, we do not expect its implementation to be determined by the characteristics of the educational sector. Thus, we can use the outcomes in the non-decentralized regions to estimate what would have happened in the decentralized regions had they not been decentralized (Diamond and Robinson, 2010).

Despite these arguments, we estimate the effects of the partial fiscal decentralization reform in Spain with a *difference-in-differences* method, which enables us to control for differences between regions in terms of the observable and non-observable time unvarying characteristics that might be related both to educational outcomes and the selection of regions that were granted powers in the field of education at the beginning of the 1980s. For instance, it might be the case that the importance attached to education was different in historic regions –with a common culture and often with an own language- than in the other regions[5]. Thus, the equation we estimate is:

[4] For an analysis of the effects of the LOGSE educational reform on *dropout rates* see Felgueroso *et al.* (2013).

[5] If such differences were to exist and we did not control for them, a non-zero correlation between the decentralization variable and the error term in the outcome equation would appear, and our

$$Y_{istg} = \Phi_i + \theta_{tg} + \alpha d_{st} + \varepsilon_{istg} \quad (1)$$

where Y_{istg} represents the educational outcomes in province *i* of region *s* in year *t* in grade *g;* Φ_i is a province-specific fixed effect; θ_{tg} is a composite year-grade fixed effect, which allows us to control for the temporary shocks that affect each grade outcomes in all provinces equally (for instance, a central government reform or a common economic shock); d_{st} is the decentralization variable for region *s* in year *t;* and ε_{istg} is an error term with the usual properties. We take first differences to eliminate the province fixed effects, and then apply pooled ordinary least squares (POLS) to the differenced equation to estimate it (Wooldridge, 2002). This model allows any kind of dependence between selection for treatment, d_{st}, and the province-specific component, Φ_i.

We cluster standard errors at the regional level, to account for intra-group correlation (between provinces in the same region) and to obtain a variance covariance matrix which is consistent in the presence of any correlation pattern within regions over time (Bertrand *et al*., 2004). According to Angrist and Pischke (2009), Stata cluster robust variance matrix works well at correcting for serial correlation in panels, even with 10 clusters as Hansen (2007) demonstrates. In our setting, with 17 clusters, 3 grades and 14 periods, we can hope our standard errors not to be downward biased. However, we show the robustness of our results by conducting our estimations by also applying the wild bootstrap method proposed by Cameron *et al.* (2008).

The only assumption that we need so as to identify the effect of decentralization on educational outcomes, α, is that selection into treatment is independent of the temporary individual-specific effect (ε_{istg}). This ensures that the evolution of the outcomes in non-decentralized regions is the same as they would have been in decentralized regions had the latter not been decentralized (Angrist and Pischke, 2009). In section 4.1 we conduct different tests to show that this identifying assumption is accomplished in our setting.

Additionally, we conduct an event-study analysis that allows us to test that assumption by looking at the evolution of the outcome variable in the years before and after decentralization. With this purpose, we define the set of variables d_{st}^k for all integers *k* from -k_0 to k_0. If -$k_0 < k < k_0$, then d_{st}^k takes the value 1 when decentralization in region *s* occurred at time *t-k*. Therefore, d_{st}^1 takes the value 1 if decentralization took place one year before, d_{st}^2 takes the value 1 if decentralization took place two years before, and so on. The variable $d_{st}^{k_0}$ ($d_{st}^{-k_0}$) takes the value 1 if decentralization took place at least k_0 years before (at least k_0 years after). The regression model is:

$$Y_{istg} = \Phi_i + \theta_{tg} + \sum_{k \in K} \alpha_k d_{st}^k + \varepsilon_{istg} \quad (2)$$

Where K includes all integers from -k_0 to k_0, except -1, so that the coefficients $\{\alpha_k\}_{k \in K}$ indicate how the outcome variable changes with respect to the year prior to decentralization, i.e. they show the cumulative effects of decentralization. The best way to present the results of the event-study is by displaying a graph of the coefficients for the

estimates of the impact of decentralization would be affected by a selection bias (Heckman and Hotz, 1989).

years before and after decentralization. However, in addition to this graphical analysis, we present in the main table of results a compact version of the same evidence that is summarized by three parameters, which represent the pre-decentralization, short-term and long-term effects (see Bottan and Pérez-Truglia, 2015, for a similar approach). The regression model is:

$$Y_{istg} = \Phi_i + \theta_{ig} + \alpha^{ST} d_{st}^{Short-term} + \alpha^{LT} d_{st}^{Long-term} + \alpha^{PD} d_{st}^{Pre-dec.} + \varepsilon_{istg} \qquad (3)$$

Where $d_{st}^{Short-term}$ is a dummy variable that takes the values 1 if the region has been decentralized for 3 years or less, and 0 otherwise; $d_{st}^{Long-term}$ is a dummy variable that takes the values 1 if the region has been decentralized for at least 4 years, and 0 otherwise; and $d_{st}^{Pre-dec.}$ is a dummy variable that takes the values 1 when decentralization took place 2 or more years after. This is a falsification test for whether the outcome variable evolves similarly between decentralized and centralized regions prior to decentralization. If decentralization was implemented in regions where a variation in dropout rates was already occurring, the coefficients measuring decentralization effects before treatment should be significant.

In some specifications, we also include a set of variables that control for time varying characteristics of the regions that might be considered as being associated with the dynamics of the outcome variable. In line with previous evidence on education production functions (Hanushek, 1986, 2003), we consider the potential determinants of educational attainment in Spain to be the *Years of education* of the population and the *Family income*, as measures of family background and inputs, and the *Unemployment rate,* as being representative of the broader context of the educational sector. We also control for the level of *Government revenues*, a measure of the fiscal capacity of subnational governments. By including these control variables in the regression, we ensure that we are comparing the outcomes of decentralized regions with the outcomes in non-decentralized regions that have similar observable characteristics, and thus, which would respond in the same way to the decentralization policy.

Moreover, we estimate additional specifications that include province-specific linear trends, intended to capture secular trends in outcomes that are specific to provinces but not related to decentralization. They allow relaxing the assumption that the underlying trends in the outcome variable are the same for both treatment and control group, needed for the *differences-in-differences* estimator to be consistent. Finally, in order to reassure that the results are not driven by shocks that are contemporaneous with the decentralization policy, we estimate our equations by including a dummy variable that indicates when the health policy was decentralized to each region. As the health policy, one of the most important expenditure areas for the regional governments, was also decentralized during the eighties, affecting regional budget constraints, it could be argued that educational outcomes were affected by these non-education policy change, and that this effect is biasing the education decentralization coefficient[6].

[6] Also, in order to make sure that the results are not driven by the behavior of any specific region (e.g., Navarra, that got the education competences very late in the period) we repeat the estimation taking out on region at a time and check that the results remain qualitatively the same.

We also test whether the effects of decentralization depended on the characteristics of the regions. More concretely, we estimate our equations by including interaction terms between the decentralization dummy variable and the four control variables mentioned above: *Government revenues*, *Years of education*, *Family income* and *Unemployment*. Previous papers have already shown that the effect of decentralization is stronger for subnational governments with a better financial situation (see e.g., Barankay and Lockwood (2007) and Brutti (2016)). There is some evidence suggesting that in Spain, the education competences transferred to the regions were underfunded, and that there existed relevant imbalances between territories with regard to their level of government revenues as compared to their needs, so that we can expect the effect of decentralization to be different between them. Some papers also suggest that the effectiveness of the decentralization reforms is higher when schools are located in non-poor municipalities (see e.g., Galiani *et al.* (2008)) suggesting it is worth investigating this channel. Finally, unemployment levels differ a lot across the Spanish geography, and determine to a large extent the incentives of young people to remain at school. We also expect the unemployment rate to have an effect on voters' demand of education and, specifically for the demand of vocational training, which is most needed in places with high levels of unemployment.

Finally, we also look at whether the effects of decentralization work in part through decision regarding the allocation of resources to different uses. For this purpose, we use data on the number of teachers, which we have able to obtain only for the *high-school program*. With this data, we investigate whether the decentralization reform had an effect on the *teacher/student ratio*, whether the effect was stronger for regions with a higher level of *Government*

3.2. DATA

We constructed a panel data set containing information on the 50 provinces of Spain for the period 1977-1991, a period that covers the entire process of decentralization of the 1980s[7]. In this way, we include observations for the years before and after the 1980s decentralization process was implemented. The reason we end in 1991 is that a reform of the educational system that extended compulsory education from the age of 14 until the age of 16 was implemented at the same time that the second wave of the decentralization reform at the end of the 1990s. In addition, during the 1990s there was also a reform of the regional funding system, which implied a significant increase in the degree of tax autonomy of regional governments (Bosch and Duran, 2005). Therefore, it is not possible to disentangle the effects of the education decentralization reform during the 1990s from the effects of the education and the funding system reforms.

Several variables have been proposed in the literature to measure educational attainment, including net enrolment rates (Mahal *et al.*, 2000), average test scores in language and maths (Galiani and Schargrodsky, 2002) and the ratio between the number of students obtaining the university entrance qualification and the number of 19 year olds in the population (Barankay and Lockwood, 2007). Here, since test score measures are

[7] Although the educational powers were transferred to the regional governments, our data are measured at the provincial level in order to increase the precision of our estimates.

not available for Spain for the analysed period, we measure educational attainment by using the *dropout rate* in secondary education by grade and educational program (high-school or vocational). This variable is defined as the proportion of students from a cohort enrolled in a given grade at a given school-year who are not enrolled in the next grade and that who not repeating course in the following school-year (UNESCO, 2009). We compute the *dropout rates* in the first, second and third grades in each educational program, including students in public and private schools[8]. Students in private schools are included for two reasons: first, because we can expect decentralization to affect education outcomes in private schools too, since the vast majority of schools in this group are state-funded (though privately managed). Second, if we restrict the measurement of the *dropout rate* to public schools, the variable can be affected by students transferring from private schools to public schools or vice versa.

The *dropout rate* is an indicator commonly used in the public debate in Spain and also by international organizations (e.g., OECD, 2017). A possible criticism of this variable is that one might argue that regions might boost it by simply reducing educational standards. We will provide some evidence that suggests this is not the case. First, we will show that the effect of decentralization on the *dropout rate* is stronger when regional governments have a high level of revenues. Second, we will also show that decentralization has some effect on input choices as the *teacher/student ratio*, and that this effect mediates to some extent its effect on the *dropout rate.* If the reduction in dropout rates was just the effect of reduced educational standards in decentralized regions none of these effects should appear.

Decentralization is defined with a dummy variable that takes the values 1 if the region *s* is decentralized in year *t,* and 0 otherwise. We consider this variable to be appropriate in the case of Spain, where the decentralization of spending in education has also meant devolution in decision-making powers to the regions, and where educational powers were transferred by law at a specific point in time. However, we also define a set of variables d_{st}^{k} for all integers *k* from -k_0 to k_0, to conduct the event analysis. If -k_0 < *k* < k_0, then d_{st}^{k} takes the value 1 when decentralization in region *s* occurred at time *t*-*k*. Therefore, d_{st}^{1} takes the value 1 if decentralization took place one year before, d_{st}^{2} takes the value 1 if decentralization took place two years before, and so on. The variable $d_{st}^{k_0}$ ($d_{st}^{-k_0}$) takes the value 1 if decentralization took place at least k_0 years before (at least k_0 years after). The *decentralization* variables were constructed from the legislative acts providing for the transfer of educational powers from the central to the regional governments, and published in the *Boletín Oficial del Estado* (BOE). In Table 1 above we can see the years in which these legislative acts were enacted.

[8] As explained above, secondary education in Spain during the eighties was a four years program for the *high-school program* and a five years program for the *vocational program*. The theoretical entrance age to secondary education was 14 or 15, depending on the month each student was born, and it was non-compulsory.

Table 2: *Descriptive statistics*

	Obs.	Mean	Std. Dev.	Min	Max
Dropout rate - Secondary education (in %)	2100	12.95	6.89	-1.52	37.76
Dropout rate-High-school program (in %)	2100	8.75	4.98	-4.04	38.74
Dropout rate-Vocational program (in %)	2100	19.22	17.84	-7.21	72.80
Teacher/student Ratio-High-school program (*teachers per 100 students*)	2100	6.44	0.62	3.98	9.61
log(*Family income*)	750	2.07	0.22	1.51	3.02
log (*Years of education*)	750	1.79	0.12	1.51	2.11
Unemployment rate (in %)	750	14.63	7.10	1.41	35.01
Youth unemployment rate (in %)	750	30.75	14.70	1.23	68.27
Government revenues (in % of GDP)	238	7.14	2.36	4.42	11.57

Notes: (1) Obs.=Number of observations and refer to the number of distinct units of observation; in some cases, it is equal to the product of #provinces x #grades x #years (50 x 3 x 14 = 2100), in others is just the product of #provinces #years (50 x 14 = 750), while in others it is just #regions x #years (17 x 14 = 238).

The data describing the number of students enrolled in each grade and of the number of teachers were obtained from the Education Annuals published by the *National Statistics Institute* until 1985 and by the *Ministry of Education and Science* for all years after that date. Additional variables used in the analysis include the *Years of education* variable, defined as the average years of education of the active population, which is calculated from data of the *Labour Force Survey* provided by the *National Statistics Institute;* the *Family income* variable, measured in thousands of euros at 1990, and constructed from data published by the *Fundación BBVA* (period 1978-1986) and from the *Regional Accounts* published by the *National Statistics Institute* (period 1986-1991); the *Unemployment rate* of the population between 25 and 54 years old, which is also obtained from the *Labour Force Survey*; and, finally, the amount of *Government revenues* at the disposal of the regional governments, measured as a percentage of the regional GDP, which includes all the revenues (except transfers for specific services other than education). Table 2 presents the descriptive statistics of all these variables.

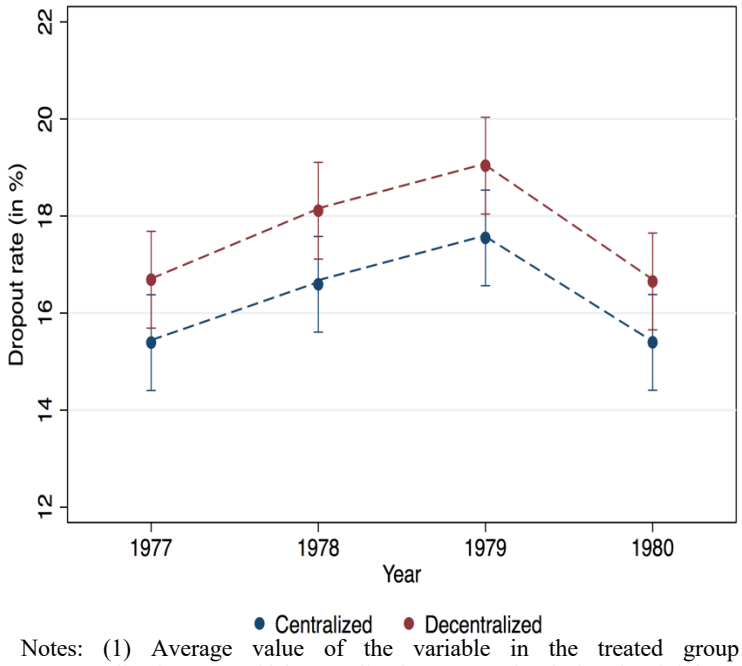
4. COMPARISON GROUP VALIDATION

The advantage of the *difference-in-differences* estimation method is that it accounts for any time unvarying characteristic of the regions which may determine both student outcomes and the desire of regional governments to be granted powers in the field of education. However, differences in the time varying characteristics of the regions might cause the evolution of the outcomes to be different in decentralized and non-decentralized regions. In this section, we test the validity of the identifying assumption, which implies

that absent decentralization the treated group of regions would have experienced similar trends in the outcomes to the comparison ones.

First, we assess the validity of the non-random selection assumption by looking at the evolution of the *dropout rate* in secondary education in the treated and control groups during the period 1977-1980, that is, before the decentralization process was started. Figure 1 shows that the *dropout rate* presents a similar pattern on both groups of regions. Also, we can observe that the differences in levels for any given year are not statistically significant. Similar graphs for the dropout rate in the *high-school* and in the *vocational program* are presented in the appendix. The conclusion is the same in all cases.

Figure 1. *Pre-treatment differences in the Dropout rate.*



Notes: (1) Average value of the variable in the treated group (Decentralization (D)=1 if decentralized at some point during the eighties – in red) and the comparison group (Decentralization (D)=0 – in blue) in the years previous to any decentralization (i.e., 1977 to 1980); (2) The dot indicates the average value of the year/group and the lines the 95% confidence intervals; standard errors clustered at the regional level.

Second, in Table 3 we formally test whether the average level of the outcomes and their growth is the same for both groups of regions during the period 1977-1980. The differences are not statistically significant. Third, we test whether the inclusion within the decentralization reform was correlated with the *teacher/student ratio* or the covariates for which we were able to assemble data for this period: log(*Family income*), log(*Years of education*), *Unemployment rate* and *Young unemployment rate*. If this were the case, their omission in the outcomes equation might bias the estimated decentralization parameter. In addition, balance in pre-treatment characteristics is always a good feature in this context, since if the treated and non-treated groups look equal, it is more likely that they would behave in a similar way absent decentralization. Table 3 presents the balance tests for these variables and show that no significant differences can be appreciated between

groups, nor in levels or in differences. In the appendix, we also present figures similar to Figure 1 for these variables that confirm this result[9].

Table 3: *Pre-treatment balance in outcomes and covariates*

	Average levels			First Diffs.		
	D=0	D=1	Diff.	D=0	D=1	Diff.
Dropout rate-Secondary education (in %)	16.232 (4.306)	17.622 (4.447)	1.389 (1.021)	1.376 (5.287)	1.566 (4.767)	0.190 (0.504)
Dropout rate-High-school program (in %)	9.947 (4.088)	10.633 (3.960)	0.687 (0.727)	1.019 (5.916)	1.497 (6.271)	0.478 (0.625)
Dropout rate-Vocational program (in %)	29.146 (13.083)	30.446 (13.865)	1.300 (1.634)	-3.057 (7.764)	-2.823 (5.284)	0.214 (1.500)
Teacher/Student Ratio-High-school program	6.324 (0.340)	6.159 (0.430)	-0.165 (0.153)	-0.101 (-0.234)	-0.051 (-1.76)	-0.050 (-2.346)
log (Family income.)	2.014 (0.199)	2.037 (1.644)	0.023 (0.086)	0.001 (0.037)	0.008 (0.017)	0.007 (0.007)
log (*Years of education*)	1.645 (0.076)	1.644 (0.074)	-0.001 (0.033)	0.084 (0.029)	0.083 (0.031)	-0.001 (0.809)
Unemployment rate (in %)	6.341 (2.525)	8.069 (4.427)	1.728 (2.036)	5.045 (2.070)	5.243 (2.670)	0.198 (1.855)
Youth unemployment rate (in %)	17.498 (5.159)	19.326 (8.484)	1.828 (3.613)	13.942 (5.109)	14.041 (6.008)	0.099 (0.012)

Notes: (1) Difference between the Average levels and First-Differences of outcomes and covariates in the Decentralized (D=1) vs. the Centralized (D=0) regions. (2) Average levels of the variable for the years 1977, 1978, 1979 and 1980; First Diffs. = growth of the variable during the period 1977-80. (3) In parenthesis, standard errors; ***, ** & *: coefficient is statistically significant at the 1%, 5% and 10% levels.

These analyses seem to confirm that the identifying assumption is fulfilled in this setting. As the education decentralization reform in Spain was made within a broader process of decentralization, which implied both the creation of the regional level of government and the devolution of different public policies to the new governments, its implementation was not determined by the characteristics of the educational sector or the characteristics which might also influence educational outcomes. In addition, since the selection of the regions that received these competences during the 1980s was made on historical grounds, we do not observe relevant differences between the two groups of regions regarding their observable characteristics. Thus, we can consistently estimate the effects of decentralization by using the *difference-in-differences* estimation method, even without including control variables. With this approach, we are anyway controlling for the time unvarying non-observable characteristics of regions that might have driven the decentralization process. In addition, we will conduct an event-study analysis that allows us to follow the evolution of the outcome variable in the years before and after decentralization, and which can be considered an additional validation test. Finally, we will conduct

[9] There is a small statistically significant difference in the level of unemployment in 1980, although this variable clearly evolves in the same way in both groups of regions. In any case, we will also include this variable as a control in some of the equations.

additional regressions by including observable control variables and/or province-specific time trends, just to show that the results remain unchanged.

5. EMPIRICAL FINDINGS

5.1. EFFECTS OF DECENTRALIZATION ON THE *DROPOUT RATE*

The results of estimating equations (1) and (3) are presented in Table 4. Panel (a) of this table presents the *difference-in-differences* estimator of the effects of decentralization on secondary dropout rates, while Panel (b) presents the summary results of the event-study analysis, showing the short-run effect (from 0 to 3 years after decentralization), the long-run effects (4 and more years after decentralization), and the pre-decentralization effects.

The results in Panel (a) suggest that the decentralization reform in Spain had a negative and significant effect on the *dropout rates* in secondary education. The coefficient is statistically significant at the 90% level[10]. The same conclusion is reached with alternative specifications, that confirm the robustness of this result. First, as it is shown in column (ii), the inclusion of control variables in equation (1) does not change the magnitude and significance of the decentralization coefficient. Second, the inclusion of a province-specific linear trend (columns (iii) and (iv)), which allow us relaxing the assumption that the underlying trends in the outcome variable are the same for both treatment and control group, also does not significantly change the magnitude and significance of the decentralization coefficient. Third, when controlling by other contemporaneous policy shocks to rule out the hypothesis that our estimated results are biased because of other policy changes occurring at the same time, we also corroborate previous results (column (v)). Thus, based on these results, the decentralization reform decreased the dropout rates in secondary education by about 1.5 percentage points after decentralization. This effect is quantitatively meaningful. Taking into account that the mean of the *dropout rate* in the comparison group of regions during the treatment period was about 11.5 percentage points, this implies a 13 percent reduction of the dropout rate in the treated regions as a consequence of decentralization.

In Panel (b) of Table 4 we allow the effects of decentralization to depend on the length of time a region has been decentralized. As observed, the short-term effect (from 0 to 3 years) is not statistically significant. The effect appears to be larger and statistically significant in the long run (after 4 years of decentralization). According with these results, decentralization decreased dropout rates by an average of 1 percentage point in the short run, and about 2.4 percentage points in the long run. When compared to the average *dropout rate* in the control group these results suggest a reduction of around 10% and 20% in the short and in the long-run, respectively.

[10] Note that the coefficient is also statistically significant when we look at wild bootstrap standard errors, as proposed by Cameron *et al.* (2008).

Table 4: *Effects of decentralization on the Dropout rate*

	(i)	(ii)	(iii)	(iv)	(v)
	Panel (a): *Average effect*				
Decentralization	-1.605*	-1.461*	-1.546*	-1.487*	-1.443*
	(9.069)	(0.757)	(0.782)	(0.734)	(0.788)
	[0.091]	[0.081]	[0.087]	[0.073]	[0.066]
R^2-adj.	0.161	0.143	0.190	0.182	0.177
Average effect in %	-13.37				
	Panel (b): *Short vs. Long term effect*				
Short term effect (0 to 3 years)	-1.152	-1.047	-1.101	-1.076	-1.068
	(0.790)	(0.631)	(0.687)	(0.617)	(0.667)
	[0.150]	[0.134]	[0.141]	[0.148]	[0.122]
Long-term effect (4 & more years)	-2.394***	-2.369***	-2.369***	-2.400***	-2.443***
	(1.041)	(0.726)	(0.726)	(0.700)	(0.716)
	[0.022]	[0.008]	[0.008]	[0.005]	[0.006]
Pre-decentralization effect	0.395	0.321	0.343	0.407	0.429
	(0.933)	(0.929)	(0.966)	(1.238)	(1.079)
	[0.807]	[0.775]	[0.786]	[0.760]	[0.747]
R^2-adj.	0.164	0.147	0.198	0.177	0.158
Short term effect in %	-9.77				
Long term effect in %	-20.12				
Province FE	YES	YES	YES	YES	YES
Grade x *Year* FE	YES	YES	YES	YES	YES
Province Trends	--.--	--.--	YES	YES	YES
Control variables	--.--	YES	--.--	YES	YES
Health care dec.	--.--	--.--	--.--	--.--	YES

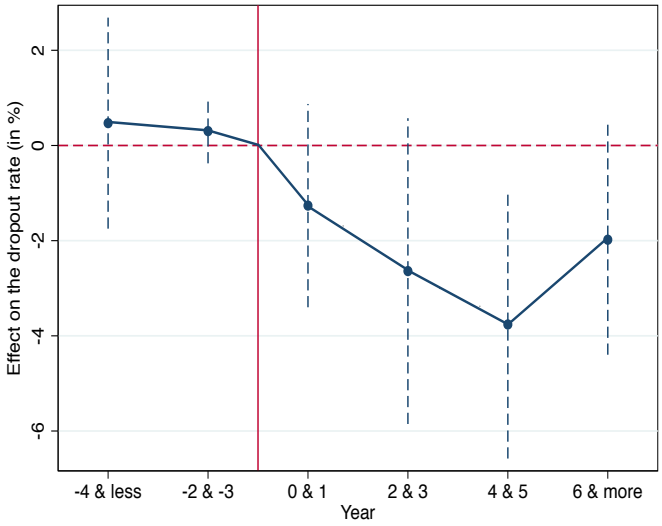
Notes: (1) Dependent variable is Dropout rate (in %) in Secondary education. (2) Observations: p x g x y = 50 x 3 x 14 = 2,100 where p=province, g=grade and y=year. (3) *Average effect in %:* Effect computed as a % of the average dropout of the control group after decentralization, using the results in column (i); *Short and Long run effect in %:* Effect computed as a % of the average dropout of the control group 0 to 3 years and 4 & more years after decentralization, using the results in column (i). (4) In parentheses: standard errors clustered at the regional level (r=17), with ***, ** & * indicating that the coefficient is statistically significant at the 1%, 5% and 10% levels; in brackets: wild-bootstrap p-values.

Panel (b) also presents a falsification exercise, since it includes a lead of the treatment variable, which equals one when a region is at least two years away from being decentralized. If decentralization was implemented in regions where an improvement in dropout rates was already occurring, the coefficients on the placebo variables should be negative and significant. Instead, the estimated placebo coefficients are non-significant.

Figure 2 shows the event-study graph for the effect of decentralization on *dropout rates* in secondary education. As observed, the cumulative effect of decentralization grows over time and becomes statistically significant at the 95% level four years after the decentralization reform, that is, in the long run. The coefficient is very small for the first

two years. Also, it can be observed that the coefficients to the left of the date of decentralization are close to zero, and precisely estimated, corroborating that, prior to the decentralization process, the evolution of the outcome variable is the same in decentralized and non-decentralized regions.

Figure 2. *Graphical event study analysis of the Effect of decentralization on the Dropout rate*



Notes: (1) Dependent variable is the Dropout rate (in %) in Secondary education. (2) The dots indicate the estimated effect for each period (i.e., 0&1: decentralization year + first year after decentralization, 2&3: second and third years after decentralization, and so on. (3) The dashed line indicates the 95% c.i., with standard errors clustered at the regional level. The coefficient for the year prior to decentralization was normalized to zero.

Thus, all the results presented in this section are highly robust to alternative specifications and point in the same direction; they suggest that the Spanish partial decentralization reform did have an impact on the *dropout rate* in secondary education, and that this effect increased with time.

5.2. EFFECTS BY PROGRAM

In this section, we allow the effects of decentralization to vary by educational program. In Table 4 above we observed that the effect of the decentralization reform on the *dropout rates* in secondary education was significantly negative on average. In Table 5, we observe that these results are driven by students in the high-school program. Thus, based on the results shown in Panel (a) of Table 5, the decentralization reform decreased the dropout rate by an average of 3.9 percentage points in the *high-school program*. That is, as a result of the decentralization reform, the dropout rate in the *high-school program* decreased by about 28.5 percent in the treated relative to the control regions.

Table 5: *Effect of decentralization on the Dropout rate by program.*

	High-school program			*Vocational program*		
	(i)	(ii)	(iii)	(iv)	(v)	(vi)
	Panel (a): *Average effect*					
Decentralization	-3.930***	-3.901***	-3.920***	1.863	1.607	1.603
	(1.326)	(1.261)	(1.308)	(0.869)	(1.800)	(1.804)
	[0.027]	[0.030]	[0.025]	[0.002]	[0.374]	[0.370]
R^2-adj.	0.234	0.202	0.208	0.110	0.072	0.085
Average effect in %	-28.53			8.33		
	Panel (b): *Short vs. Long term effect*					
Short term effect	-3.131***	-3.075***	-3.115***	2.915	3.042	3.062
(0 to 3 years)	(1.316)	(1.355)	(1.415)	(2.054)	(2.015)	(2.097)
	[0.019]	[0.023]	[0.021]	[0.265]	[0.238]	[0.242]
Long-run effect	-4.555*	-4.426*	-4.515*	0.938	0.909	0.844
(4 & more years)	(2.297)	(2.233)	(2.371)	(3.043)	(3.165)	(2.342)
	[0.097]	[0.092]	[0.075]	[0.707]	[0.728]	[0.739]
Pre-decentralization effect	-0.351	-0.362	-0.107	0.395	0.321	0.429
	(0.751)	(0.648)	(0.787)	(0.933)	(0.929)	(1.079)
	[0.481]	[0.599]	[0.891]	[0.807]	[0.775]	[0.747]
R^2-adj.	0.217	0.193	0.199	0.113	0.085	0.099
Short term effect in %	-22.23			9.07		
Long term effect in %	-39.70			5.91		
Province FE	YES	YES	YES	YES	YES	YES
Grade x *Year* FE	YES	YES	YES	YES	YES	YES
Control variables	--.--	YES	YES	--.--	YES	YES
Province trends	--.--	--.--	YES	--.--	--.--	YES

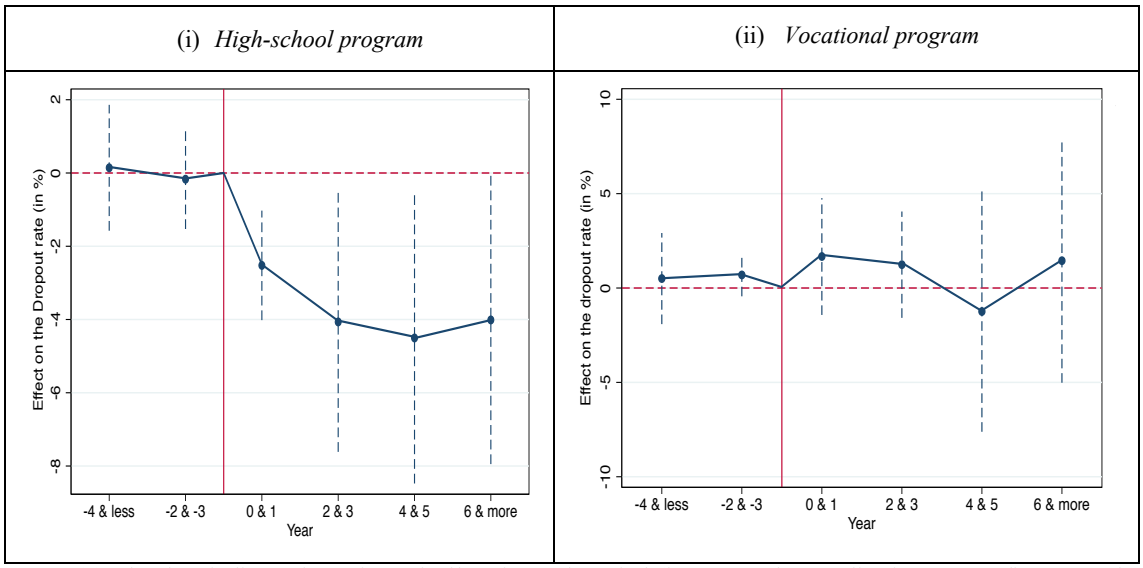
Notes: (1) Dependent variable is Dropout (in %) in the High-school program or in the Vocational program. (2) Observations: p x g x y = 50 x 3 x 14 = 2,100, where p=province, g=grade and y=year. (3) *Effect in % of Average:* Effect computed as a % of the average dropout of the centralized regions after 1982. (4) In parentheses: standard error clustered at the regional level (r=17), where ***, ** & * means that the coefficient is statistically significant at the 1%, 5% and 10% levels; in brackets: wild-bootstrap p-values.

In Panel (b) we show the effects in the short and in the long-run. The *dropout rate* in the *high-school program* significantly decreased following decentralization, by around 3 percentage points in the short-run, and 4.5 percentage points in the long-run. These are quite important effects: when compared to the control group, the dropout rate in the high-school program decreased by about 22 percent in the short-run and almost 40 percent in the long-run, due to the decentralization reform. The results are different in the *vocational program*. In this case, decentralization seems to have increased the dropout rate, although this effect is not statistically significant, and it disappears over time.

Figure 3 shows the event-study graph for the effect of decentralization on *dropout rates* in secondary education, differentiating between the *high-school* and the *vocational programs*. As observed, for the *high-school program* the effects of decentralization were felt immediately after decentralization, and increased over time. The event study graph

suggests that the effect of decentralization gradually intensifies over the first five years after decentralization, and then stabilizes. For the vocational program, the coefficients to the right of decentralization are small, oscillate between positive and negative, and are not statistically significant, thus confirming previous findings. The estimated coefficients to the left of the date of decentralization are close to zero and precisely estimated in both cases, suggesting that, prior to the decentralization, the evolution of the outcome variable is the same in decentralized and non-decentralized regions.

Figure 3. *Graphical event study analysis of the effect of decentralization on the Dropout rate by program.*



Notes: (1) The dots indicate the estimated effect for each period (i.e., 0&1: decentralization year + first year after decentralization, 2&3: second and third years after decentralization, and so on. (2) The dots indicate the estimated effect for each period (i.e., 0&1: decentralization year + first year after decentralization, 2&3: second and third years after decentralization, and so on. (3) The dashed line indicates the 95% c.i., with standard errors clustered at the regional level.

These results confirm once more that the decentralization reform had a relevant effect on educational outcomes. However, they also show that the effects were concentrated in the high-school program. Why was that the case? We believe that these results might be interpreted as evidence of a better match between the preferences of the population and educational policies under a partial fiscal decentralization reform, where subnational resources were scarce and subnational governments faced a trade-off in the allocation of these resources. Given that the *high-school program* is the chosen avenue into university for most students, and that the attractiveness of *vocational* education in Spain is much lower than that of the *high-school program*, regional governments might have concentrated their initial efforts and resources on improving the outcomes in the *high-school program*. In the next section, we do analyse whether the effects of decentralization were determined by the availability of public resources, which will inform us about whether this hypothesis is a plausible explanation.

5.3. HETEROGENEOUS EFFECTS

We should bear in mind that the effects of the decentralization reform in Spain estimated in the previous sections represent the average impact across regions, while decentralization may have had heterogeneous effects. As discussed above, following decentralization

regional governments might have had different levels of government revenues to respond to their needs and demands. Since the regions had not been granted with tax autonomy, these revenues were basically determined by the central government. Although we cannot identify the effects of the decentralization reform in every region, in this section we do analyse whether the effects of decentralization are influenced by the level of *Government revenues,* the *Unemployment rate, Family income* or the number of *Years of education* of the population, by including interaction terms between *decentralization* and these variables in the estimated equation, along with the covariates themselves.

In general terms, the effects of decentralization on the secondary education *dropout rates* are expected to be higher in regions with a higher level of *Government revenues*, just because these governments have more resources to mobilize. The effect might also be larger in regions with a high *Unemployment rate* if spending on education is considered useful to help young people to find a job and/or to keep out young people out of the streets. The effect of *Family income* and *Years of education* is less clear; on the one hand, the effect could be larger because the demand of education might be larger in regions with a higher level of these variables, but it could be smaller if public inputs and family inputs are substitutes.

Table 6 presents the results for the *dropout rate* in secondary education (that is, without disentangling the effects by program). The first four columns introduce each interaction at a time, while column (v) introduces the four interactions together. In all cases we include *Province* and *Year-grade* fixed effects and control variables. The coefficient of the decentralization dummy is around -1.5 –which indicates the effect at the mean value of the interacting variables, since all of them have been demeaned-, and is similar in size to the one presented in Table 4. The only interaction term which is statistically significant is the one with *Government revenues*. The reduction in the dropout rate is much larger the higher the level of regional revenues. Note that the size of the interaction coefficient and the level of statistical significance remains the same when we control at the same time for the interactions with the other covariates.

Of course, one might argue that the level of *Government revenues* might be correlated with other omitted variables (besides those considered in the other interactions included in the equation), introducing some doubts regarding whether the interaction effect is genuinely due to differences in revenue levels. Column (vi) performs a more demanding test on this by including *Decentralization* x *Region* fixed effects. That is, we allow the coefficient of the decentralization dummy to be different for each of the regions. In this way, the coefficient on the interaction term can be interpreted as the change in the effect of the decentralization reform due to changes in the level of revenues in each region, that is, due to the within region variation in the level of government revenues. Since results in column (vi) show that the coefficient is still statistically significant at the 95% level and that it is even larger, the effect of the interaction term between decentralization and government revenues cannot be explained by any fixed characteristics of the regions with a high level of revenues which might influence the impact of the reform (see Curto *et al*., 2018, for a similar approach).

Table 6. *Heterogeneous effects of decentralization on the Dropout rate.*

	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Decentralization	-1.477** (0.752) [0.012]	-1.448* (0.791) [0.055]	-1.432* (0.771) [0.062]	-1.455* (0.798) [0.072]	-1.197* (0.760) [0.014]	--.--
x *Government Revenues*	-0.697** (0.266) [0.030]	--.--	--.--	--.--	-0.678** (0.249) [0.022]	-0.815** (0.320) [0.016]
x *Unemployment rate*	--.--	0.066 (0.145) [0.754]	--.--	--.--	0.052 (0.115) [0.661]	--.--
x log(*Family income*)	--.--	--.--	0.072 (0.067) [0.886]	--.--	0.091 (0.370) [0.858]	--.--
x log(*Years of education*)	--.--	--.--	--.--	-2.256 (2.776) [0.531]	-2.190 (3.480) [0.622]	--.--
R^2-adj.	0.189	0.170	0.165	0.160	0.159	0.134
Province FE	YES	YES	YES	YES	YES	YES
Grade x *Year FE*	YES	YES	YES	YES	YES	YES
Control variables	YES	YES	YES	YES	YES	YES
Dec. x *Region FE*	NO	NO	NO	NO	NO	YES

Notes: (1) Dependent variable is Dropout rate (in %) in Secondary Education. (2) Observations: p x g x y = 50 x 3 x 14 = 2,100, where p=province, g=grade and y=year. (3) In parentheses: standard error clustered at the regional level (r=17), with ***, ** & * meaning that the coefficient is statistically significant at the 1%, 5% and 10% levels; in brackets: wild-bootstrap p-values.

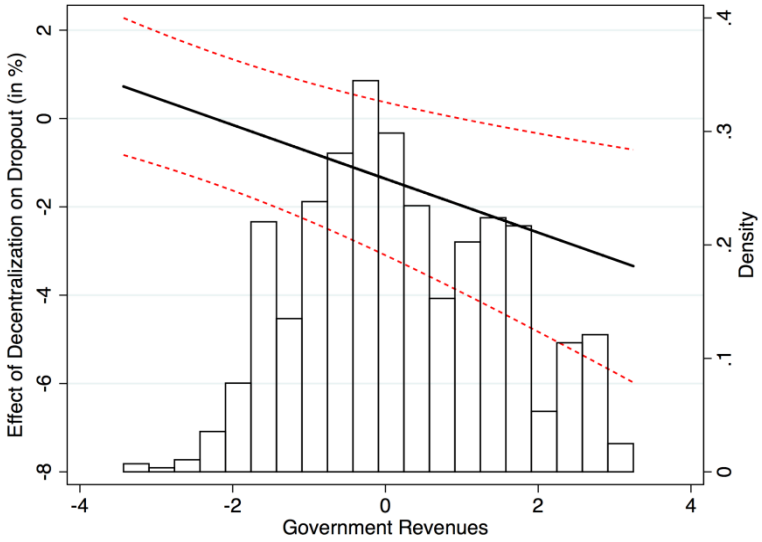
To better gauge the effect of the level of *Government revenues* on the effect of the decentralization reform we plot the marginal effects in Figure 4[11]. In the x-axis we represent the level of *Government revenues* demeaned and in the y-axis the effect of *decentralization* on the dropout rate, considering that the level of the other variables are equal to their mean. As it can be observed, the effect goes from zero in regions with a level of revenues below the mean, to nearly minus 4 percentage points in regions with a higher level of revenues. In regions with the average level of revenues the partial decentralization reform decrease dropout rates by an average of 1.5 percentage points.

As an additional evidence that *Government revenues* do matter, Figure A.3 in the appendix shows the event-study graph for the effect of decentralization on *dropout rates* in secondary education, differentiating between regions with a high level of government revenues (above the median) and regions with a low level of government revenues (below the median). As it can be observed, in regions with a high level of government revenues decentralization decreased the dropout rates immediately after decentralization, while in

[11] We are not presenting the marginal effects on the other interactions because they are not statistically significant. Moreover, the effects are also very small and so the graph of the marginal effects looks quite flat. Complete results are available upon request.

regions with a low level of government revenues the effects of decentralization started to be noticed only in the long run (four years after decentralization).

Figure 4. *Marginal effect of Government Revenues*



Notes: (1) Effect of decentralization on the Dropout rate (in %) in Secondary Education as a function of the level of Government Revenues (as a % of regional GDP). (2) The solid line indicates the prediction and the dashed lines the 95% confidence intervals (standard errors clustered at the regional level); the histogram of Government Revenues is shown behind.

Overall, these results show that the impact of the decentralization reform clearly depends on the amount of revenues at the disposal of the regional government and it is in line with the findings of previous papers (Galiani *et al.* (2008) and Brutti (2016)).

4.6. HETEROGENEOUS EFFECTS BY PROGRAM

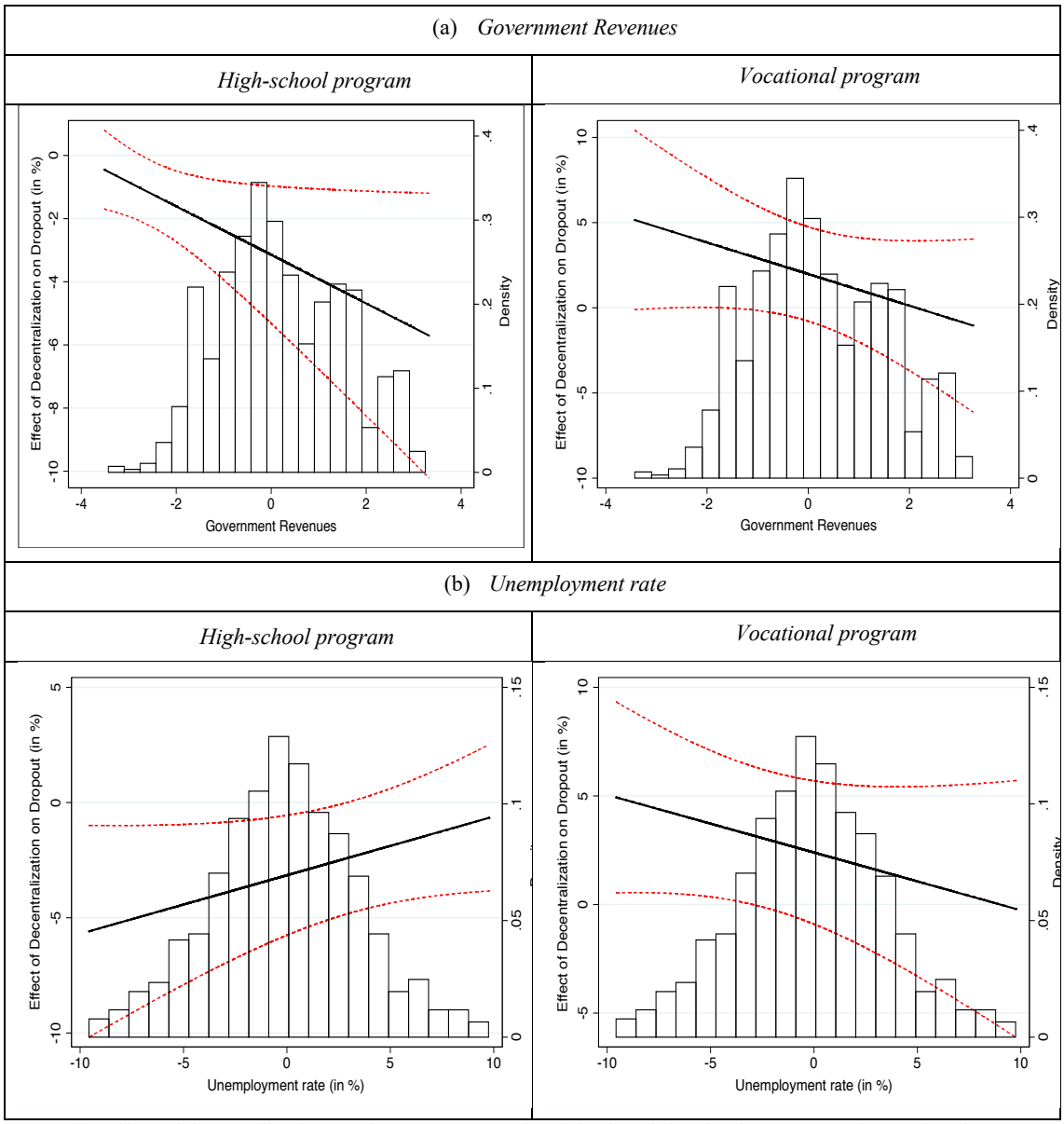
In this section we do analyse the heterogeneous effects of decentralization in the different educational programs. In Table A.1 in the appendix we show the full results of the analysis for the *high-school program* and the *vocational program*, and in Figure 5 we plot the effect of decentralization on the dropout rate for students in the *high-school program* (left) and the vocational program (right), as a function of the regional government revenues and the unemployment rate.

As it can be observed in Figure 5, the effect of decentralization highly depended on the level of government revenues in both programs. As we can observe, the effect of the decentralization reform on the dropout rate in the *high-school program* goes from zero (when government revenues are 4 points below the mean) to minus 6 percentage points (when government revenues are 4 points above the mean). For the *vocational program*, we observe that in regions with a level of government revenues 4 points below the mean, decentralization might even increase the dropout rates by 5 percentage points, although this effect is not significant at the 95% confidence level. In regions with a high level of government revenues, the effect of decentralization is zero, and not significant.

These results might be indicative of politicians giving a higher priority to the *high-school program* over the *vocational* one, which happens especially when resources are

scarce. This could be also indicative of the higher difficulty of improving the outcomes in the *vocational program*, which is only feasible when there is abundancy of resources. The evidence does not seem compatible, though, with a reduction of educational standards in the *high-school program*, since the reduction in the *dropout rate* in this case seems to happen thanks to the availability of resources, and revenues would have not been required if the *dropout rate* was cut simply by reducing standards.

Figure 5. *Marginal effects by program.*



Notes: (1) Effect of decentralization on the Dropout rate (in %) in the High-school program and Vocational program as a function of the level of Government Revenues (as a % of regional GDP) (panel (a)) and as a function of the unemployment rate (panel (b)). (2) The solid line indicates the prediction and the dashed lines the 95% confidence intervals (standard errors clustered at the regional level); the histogram of interacted variable is show behind.

Panel (b) of Figure 5 presents the marginal effects with respect the *Unemployment rate*. Contrary to what happened with the effect of decentralization on the global *dropout rate* in secondary education (which was not affected by unemployment, recall Table 6), the *Unemployment rate* does have an effect on the *dropout rate* by program. Interestingly,

the sign of the effect differs by program and the magnitude is (in absolute value) very similar between them (see the appendix). Specifically, we find that the effect of the decentralization reform on the *dropout rate* in the *high-school* and the *vocational program* goes down (in absolute value) as the *Unemployment rate* increases. As a consequence, in the *high-school program*, the decentralization reform reduces the dropout rate more than 5 percentage points in regions where the unemployment rate is very low, and the effect becomes non significant at the 95% confidence level when the unemployment rate is 2 points above the mean. In the *vocational program,* the *dropout rate* increases after the decentralization reform when the unemployment rate is very low and the effect decreases as the unemployment rate increases, so that it becomes non significant at the 95% confidence level when the unemployment rate is 3 percentage points below the mean.[12] This suggests that the higher priority given to the *high-school program* happens more often when resources are scarce but also when the unemployment rate is low. This provides evidence that regional governments start caring (relatively) more about the *vocational program* –and so abandoning the bias in favour of the *high-school program*- in situations of high unemployment, suggesting that they understand that the *vocational program* might be a more effective way to fight unemployment that the *high-school program*. We think this provides additional evidence that the effect of the decentralization reform on the *dropout rate* was (at least partly) due to a better match between government policies and preferences.

4.7. EFFECTS ON RESOURCE ALLOCATION

Finally, in this section we provide some additional evidence which suggests that the effects of decentralization work partly through decisions related to the allocation of public resources to different uses. There is not a lot of data available for the period of analysis than can be used with this purpose. However, we have been able to assemble data on the number of teachers, albeit only for the *high-school program*. With this data, we investigate: (i) whether the decentralization reform had an effect on the *teacher/student ratio*, (ii) whether the effect was stronger for regions with a higher level of *Government revenues*, and (iii) to which extent the effect of the decentralization reform on the *teacher/student ratio* accounts for the overall effect of the reform on the *dropout rate* in the *high-school program*.

The effects are presented in Table A.2 in the appendix and just summarized here. The results suggest, first, that decentralization also increases the *teacher/student ratio* (column (i)), providing thus evidence that regions with devolved education responsibilities felt pressured to improve the amount of inputs allocated to education, at least in the *high-school program*. Second, the results also suggest that this effect is higher the higher the amount of *Government revenues* (column (ii)), and it is only significant in regions with a level of Government revenues above the mean. Figure A.4 plots the marginal effects: the effect of the reform is zero when the level of revenues is below the mean and around 0.3 at higher levels. Note that the mean (standard deviation) of the

[12] Note that these results are robust to the inclusion all the interactions at the same time and also to the inclusion of *Region* x *decentralization* fixed effects (see appendix).

teacher/student ratio (measured as teacher per 100 students) in the sample is 6.44 (0.62), so that these effects are significant.

In columns (iii) to (vi) the results show that an increase in the *teacher/student ratio* helps reducing the *dropout rate* in the *high-school program* (although the effect is small) and that after controlling for the *teacher/student ratio* the effect of the decentralization reform on the *dropout rate* slightly decreases. That is, the results point to the conclusion that decentralization effects on dropout rates in the *high-school program* (in regions with a level of revenues above the mean) is partly explained by an increase in the level of resources devoted to education following decentralization, and particularly to the *high-school program*. Note, however, that the low explanatory power of that channel suggests that the reform might also have affected the efficiency in the use of the existing resources.

5. CONCLUSION

Does decentralization improve the provision of outcomes of public goods and services? The answer to this question remains unclear in the theoretical literature, which emphasises the trade-offs between potential benefits and drawbacks. However, until recently, very few empirical studies had attempted to examine these trade-offs, specially in the case of partial decentralization (that is, decentralization of expenditures responsibilities but not of tax powers). At a time when decentralization policies are on the agenda of many countries and figure among the main recommendations emanating from international organizations, we considered it timely to offer some insights into this problem. Specifically, we have focused on analysing the impact on educational outcomes of the partial fiscal decentralization reform in Spain at the beginning of the 1980s.

As we have seen, the Spanish decentralization reform in education started at the beginning of the 1980s, when educational powers were devolved to País Vasco, Cataluña, Galicia, Andalucía, Canarias, Comunidad Valenciana and Navarra. The fact that the other regions had to wait until the end of the 1990s to receive the same powers enables us to use these non-decentralized regions as the comparison group and so estimate the effects of decentralization. Although it is our belief that the selection process was not influenced by regional characteristics which in turn might also have influenced the evolution of educational outcomes, we use the *difference-in-differences* method to estimate the effects of decentralization. In this way, we are able to control not only for the temporary shocks that affect the outcomes of all regions equally, but also for the non-observable characteristics of the regions that may influence the evolution of their educational outcomes and which could result in differences between the treatment and comparison groups before decentralization. We also conduct an event-study analysis that allow us to estimate yearly decentralization effects.

According to our analysis, the decentralization reform in Spain reduced the *dropout rate* in secondary education by around 1.5 percentage point on average. The effect is about 1 percentage points in the short-run (from 0 to 3 years after the reform) and around 2.5 points in the long-run (4 years or more after the reform). This implies a substantial reduction in the *dropout rate* of the treated regions (around -13% relative to the control ones). This effect is concentrated in the *high-school program*, which is the main path towards university education, enrols most of the secondary education students, and is the

most popular one amongst the Spanish population. In this case, the long-run reduction in the *dropout rate* is close to 4.5 percentage points (nearly -40% relative to the control group). Contrasting with this result, the *vocational program* did not seem to benefit much from the reform. We also find that the impact of decentralization is much affected by the level of *Government revenues* enjoyed by the regions, both in the *high-school* and in the *vocational program*. Additionally, we find that the impact of decentralization on the *dropout rate* in the two programs is affected by the *Unemployment rate*: the higher the unemployment rate the lower the reduction in the *high-school program dropout rate* after decentralization and the lower the increase on the *vocational program dropout rate*. All this suggest that the regions that received education competences tended to prioritize the *high-school program* over the *vocational* one, especially when revenues were scarce and the unemployment rate low.

These results might be interpreted as evidence of a better match between the preferences of the population and educational policies under a partial fiscal decentralization reform than under centralization, given the situation of scarcity of subnational resources. Given that the *high-school program* is the chosen avenue into university for most students, and that the attractiveness of *vocational* education in Spain is much lower than that of this *high-school program*, regional governments might have concentrated their efforts and resources on improving the outcomes in the *high-school program*.

ACKNOWLEDGEMENTS

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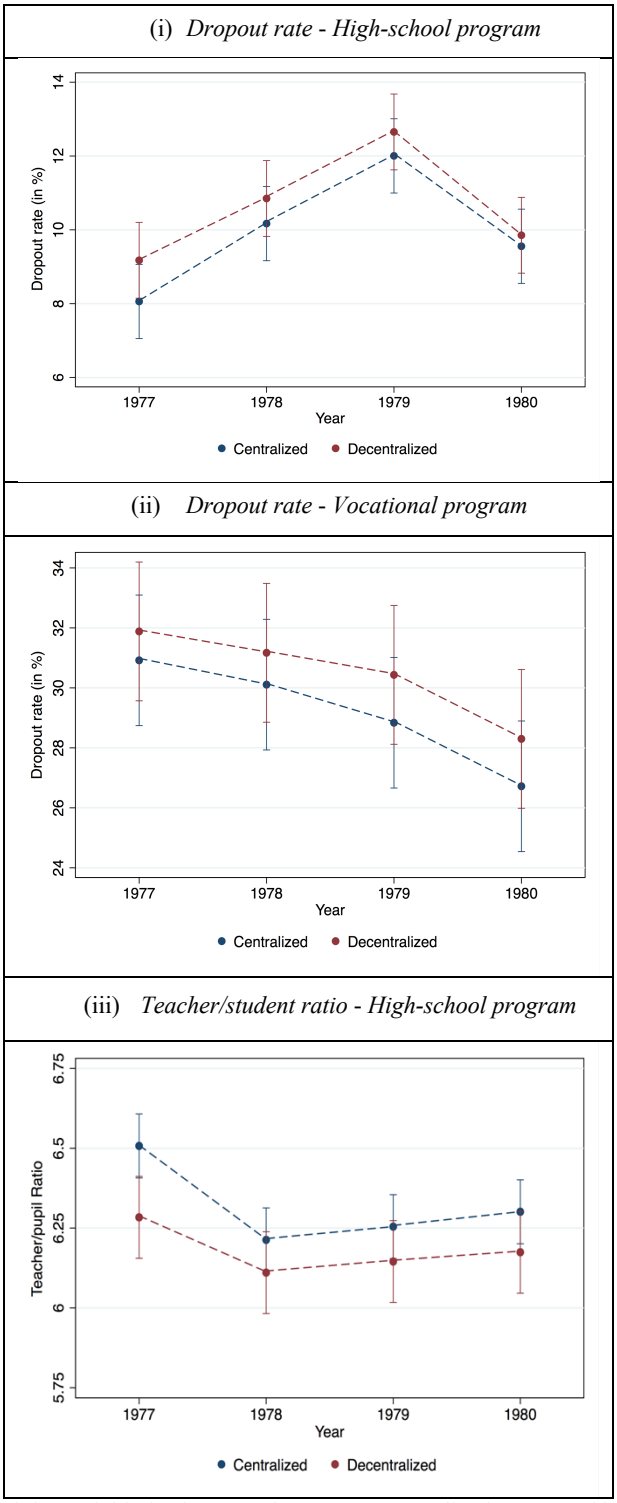
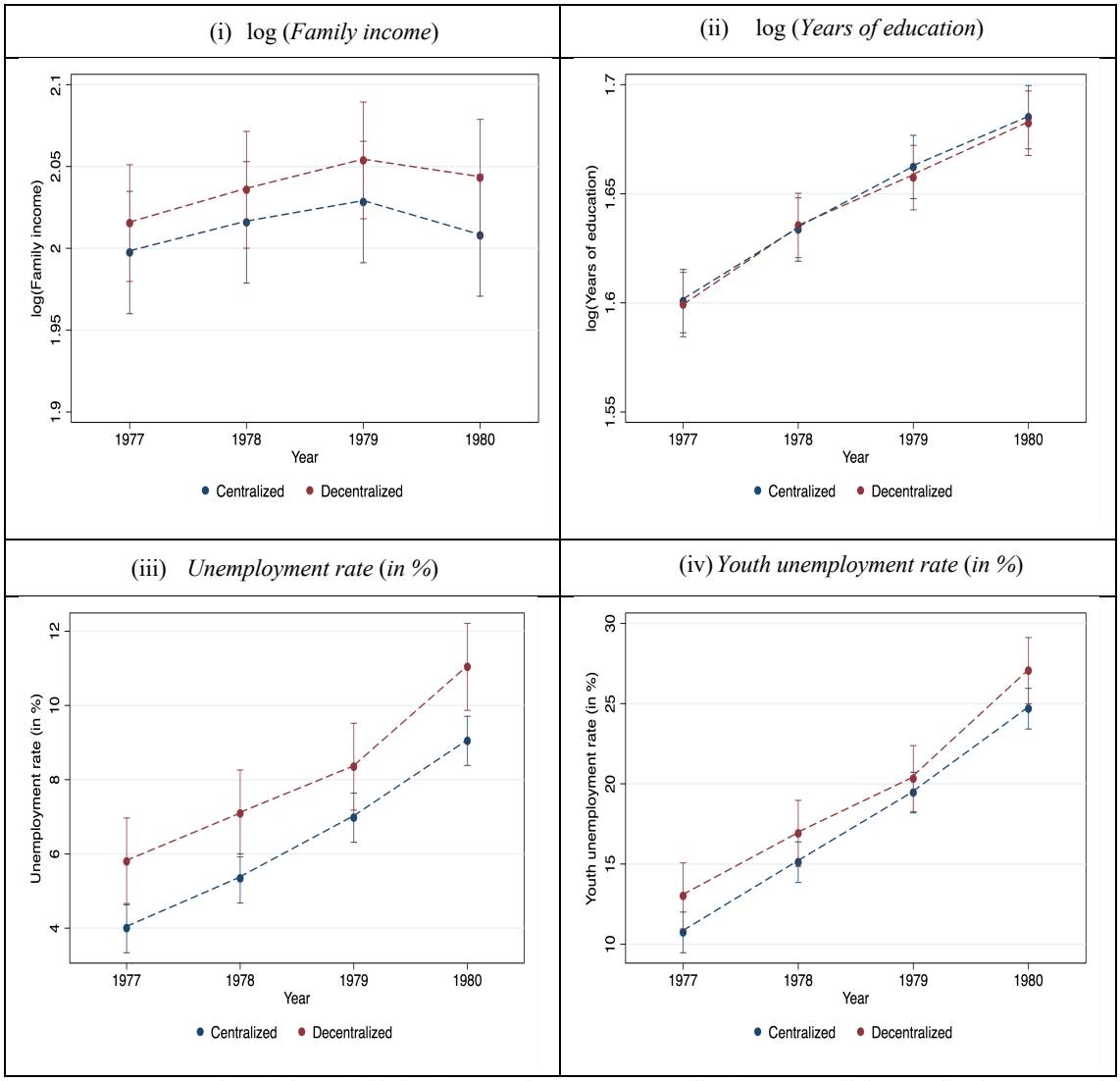
APPENDIX. ADDITIONAL FIGURES AND TABLES

Figure A1: *Pre-treatment differences in other outcomes*



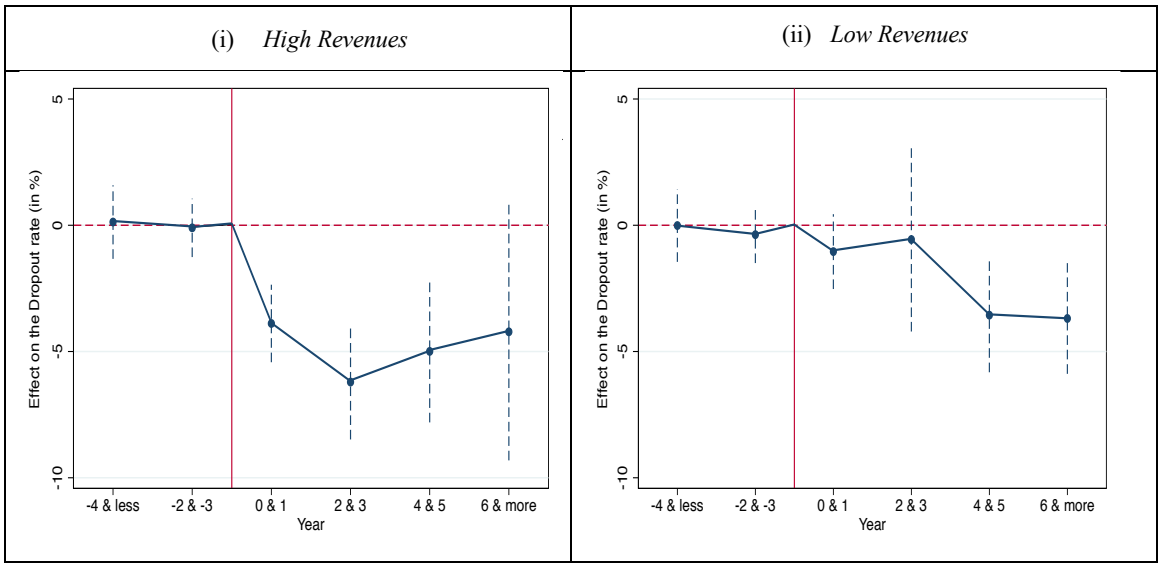
Notes: (1) Average value of the variable in the treated group (Decentralization (D)=1 if decentralized at some point during the eighties – in red) and the comparison group (Decentralization (D=0 – in blue) in the years previous to any decentralization (i.e., 1977 to 1980); (2) The dot indicates the average value of the year/group and the lines the 90% confidence intervals; standard errors clustered at the region level.

Figure A2: *Pre-treatment differences in covariates*



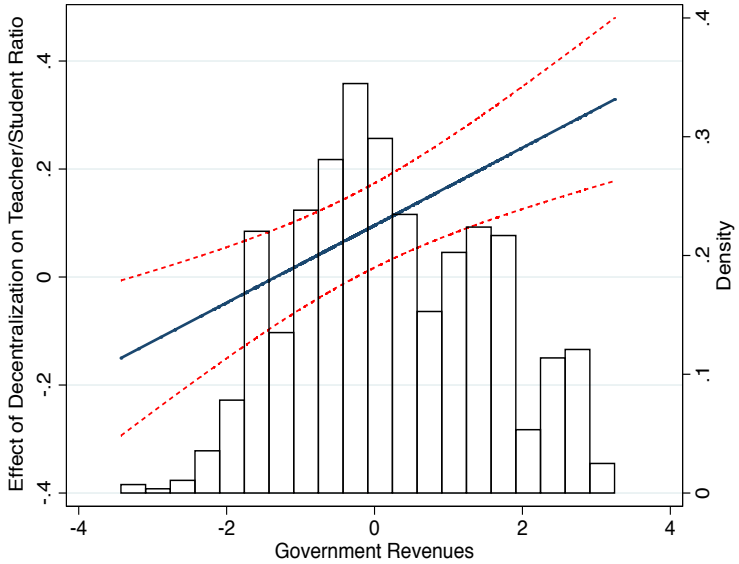
Notes: (1) Average value of the variable in the treated group (Decentralization (D)=1 if decentralized at some point during the eighties – in red) and the comparison group (Decentralization (D=0 – in blue) in the years previous to any decentralization (i.e., 1977 to 1980); (2) The dot indicates the average value of the year/group and the lines the 95% confidence intervals; standard errors clustered at the region level.

Figure A.3. *Graphical event study analysis of the effect of decentralization on the Dropout rate by level of Government Revenues.*



Notes: (1) Dependent variable is the Dropout rate (in %) in Secondary Education. (2) High/Low Revenues = Government Revenues (Taxes + Grants as a % of regional GDP) above/below median; (3) The dots indicate the estimated effect for each period (i.e., 0&1: decentralization year + first year after decentralization, 2&3: second and third years after decentralization, and so on. (2) The dots indicate the estimated effect for each period (i.e., 0&1: decentralization year + first year after decentralization, 2&3: second and third years after decentralization, and so on. (3) The dashed line indicates the 95% c.i., with standard errors clustered at the regional level.

Figure A.4. *Marginal effects of Government Revenues on the Teacher/Student Ratio, High-school program*



Notes: (1) Effect of decentralization on the *Teacher/Student Ratio* (Teachers per 100 students) in the High-school program as a function of the level of Government Revenues (as a % of regional GDP). (2) The solid line indicates the prediction and the dashed lines the 95% confidence intervals (standard errors clustered at the regional level); the histogram of the Revenues variable is show behind.

Table A.1. *Heterogeneous effects of decentralization on the Dropout rate, by program*

	High-school program			*Vocational program*		
	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Decentralization	-3.750**	-3.687**	--.--	1.733	1.838	--.--
	(1.625)	(1.761)		(1.433)	(1.571)	
	[0.042]	[0.049]		[0.350]	[0.568]	
x *Government Revenues*	-0.787*	-0.795**	-0.920***	-0.844	-0.897	-0.927
	(0.463)	(0.320)	(0.340)	(0.501)	(0.566)	(0.676)
	[0.089]	[0.005]	[0.014]	[0.121]	[0.140]	[0.194]
x *Unemployment rate*	0.272*	0.250*	0.242*	-0.301	-0.265	-0.260*
	(0.150)	(0.130)	(0.117)	(0.189)	(0.176)	(0.157)
	[0.098]	[0.094]	[0.051]	[0.123]	[0.135]	[0.086]
x log(*Family income*)	0.089	--.--	--.--	0.088	--.--	--.--
	(0.099)			(0.311)		
	[0.410]			[0.799]		
x log(*Years of education*)	-2.450	--.--	--.--	-1.509	--.--	--.--
	(4.090)			(2.864)		
	[0.552]			[0.622]		
R^2-adj.	0.202	0.175	0.205	0.111	0.086	0.116
Province FE	YES	YES	YES	YES	YES	YES
Grade x *Year FE*	YES	YES	YES	YES	YES	YES
Control variables	YES	YES	YES	YES	YES	YES
Dec. x *Prov. FE*	NO	NO	YES	NO	NO	YES

Notes: (1) Dependent variable is Dropout (in %) in the High-school program or in the Vocational program programs. (2) Observations: p x g x y = 50 x 3 x 14 = 2,100, where p=province, g=grade and y=year. (3) In parentheses: standard error clustered at the regional level (r=17), where ***, ** & *: indicates whether the coefficient is statistically significant at the 1%, 5% and 10% levels; in brackets: wild-bootstrap p-values.

Table A.2: *Teachers' supply mechanism, High-school program*

	Teacher/Student Ratio		*Dropout rate*			
	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Decentralization	0.091*	0.095*	-3.560**	-3.898*	-3.754**	-4.187**
	(0.050)	(0.047)	(1.551)	(1.865)	(1.715)	(1.715)
	[0.087]	[0.070]	[0.049]	[0.055]	[0.044]	[0.044]
x *Government Revenues*	--.--	0.071***	--.--	-0.591*	--.--	-0.795**
		(0.023)		(0.331)		(0.320)
		[0.015]		[0.030]		[0.034]
Teacher/Student Ratio	--.--	--.--	-2.601***	-2.500***	--.--	--.--
			(1.040)	(1.024)		
			[0.030]	[0.028]		
R^2-adj.	0.212	0.220	0.235	0.236	0.214	0.218
Province FE	YES	YES	YES	YES	YES	YES
Grade x *Year* FE	YES	YES	YES	YES	YES	YES

Notes: (1) Observations: p x g x y = 50 x 3 x 14 = 2,250, where p=province, g=grade and y=year. (4) In parentheses: standard error clustered at the regional level (r=17), where ***, ** & * indicates whether the coefficient is statistically significant at the 1%, 5% and 10% levels; in brackets: wild-bootstrap p-values.