ESSAYS ON HUMAN CAPITAL

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Dipòsit Legal: T.74-2014

Universitat Rovira I Virgili

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ESSAYS ON HUMAN CAPITAL

Ph.D. Dissertation

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2013

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ESSAYS ON HUMAN CAPITAL

DOCTORAL THESIS

Submitted to the Department of Economics
in partial fulfillment of the requirements for the degrees of

Doctor of Philosophy

at the

Universitat Rovira i Virgili

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Reus, 2013

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WE STATE that the present study, entitled "Essays on Human Capital", presented by Jessica Helen Pérez Reynosa for the award of the degree of Doctor, has been carried out under our supervision at the Department of Economics of this university, and that it fulfills all the requirements to be eligible for the International Doctorate Award.

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Acknowledgment

First, thank God for letting me get here and for being surrounded by great people to achieve this goal. It has been a great four-year project that finally comes to an end. I appreciate all the support, patience and guidance of the following people who have contributed directly and indirectly to the completion of this thesis.

I would like to express my deepest appreciation and gratitude to my advisors, Prof. Luis Díaz-Serrano and Prof. Susana Iranzo, for their invaluable guidance and encouragement that helped me to carry out this thesis. I am truly in debt and thankful to Prof. Díaz-Serrano, for his constant support, patience and help. Without his guidance I could not have concluded this work. I owe my deepest gratitude to Prof. Susana Iranzo for giving me at the first step the opportunity to pursue my doctoral studies under her guidance and direction. Their wide knowledge, commitment and enthusiasm were always a motivation for me. I cannot say thank you enough for their support, advice and encouragement.

I would like to thank the Department of Economics of Universitat Rovira I Virgili, for providing the support and equipment I have needed to produce and complete my thesis. Specially, I thank to Prof. Bernd Theilen, Director, Department of Economics and Prof. Miquel Manjón Antolin, Master coordinator (2009-2010), for giving me the opportunity to undertake doctoral studies through a predoctoral fellowship. I also thank to all the administrative staff of the Department of Economics, for their cooperation and guide in all administrative issues during my stay.

We also want to thank to Prof. Joop Hartog, University of Amsterdam; Prof. Ferrán Mañé, Universitat Rovira I Virgili and Prof. Maite Blázquez, Universidad Autónoma de Madrid, for agreeing to be members of the dissertation committee. I also thank to Prof. Hernando Zuleta, Universidad de los Andes, and Prof. Galina Zudenkova, University of Manheim, for being the

referees of my thesis dissertation.

I am grateful to Prof. Mario Jametti, University of Lugano, for giving me the opportunity to stay in the Institute of Economics (IdEP). Thanks to IdEP for providing me an office space, access to their resources and the opportunity to present my work in an internal Brown Bag seminar. The stay in Lugano was very helpful since I was able to attend seminars and share with students and faculty members of the department.

I would like to acknowledge to Prof. Ferrán Mañé for providing the access to the database used in the first chapter. I wish to thank Prof. Timothy Besley and Prof. Marta Reynal-Querol for generously agreeing to make the data in Besley and Reynal-Querol (2011) available for carrying out the second chapter.

This thesis has also been made possible by external funding. Prof. Díaz-Serrano and I acknowledge the financial support from the Spanish Ministry of Education and Science through Grant ECO2010-20829 for carrying out the last two chapters. I also had the financial support of the SGR Program (2009-SGR-322) of the Regional Government of Catalonia.

I would like to offer my special thanks to Prof. Miquel Àngel Bové Sans for being there in the first moments of adaptation to a new culture and for his personal support during first months. I am still waiting for the book "100 motivos para ser del barça"!.

The whole process of the thesis has been a rollercoaster of emotions and personally I have been blessed of always having support of the following people: Shirley Triana, Carlos Hurtado, Paula Alvarado, Judit Albiol, Marina Bannikova, Guiomar Ibañez, Sergi Bosque and Judit Martinez. Thank you all for being there when I needed them the most. I also thank my cheerful group of fellow students: Patricia Esteve, Jordi Teixidó, Judit Albiol, Enric Meix and Guiomar Ibañez for all the experience shared together and the fun we have had in the last four years. Special thanks to my fellow and partner, Jilber Urbina, for his love and support, especially when Stata did not give me the answer, he was there with R to help me.

Last but not the least, I would like to thank my beloved ones, who have supported me throughout entire process: my family. My parents, Angelita Reinosa and Carlos Pérez; my brother and sisters, Jose Carlos, Elizabeth and Angie. Likewise, to my uncle Hugo Silva Reyes (r.i.p) without whose initial support, this trip would not have been possible.

Contents

List of Tables

List of Figures

Introduction

"Education is the most powerful weapon which you can use to change the world".

Nelson Mandela

This thesis includes three essays on topics related to human capital, particularly that attained through education. Chapter 1 considers the human capital as an important factor which determines the allocation of decision rights within the firm. The last two chapters carry out an empirical analysis on the link between institutions, governance and education. Each chapter can be considered independently of the rest.

The first chapter is aimed at the enterprise level. *Chapter 1* examines empirically the determinants of delegation of decision-making in small and medium-sized enterprises (SMEs). An important contribution of this chapter is that existing literature focuses on large firms. Instead, the research study of this chapter focuses on small and medium-sized enterprises (SMEs), that is, firms with less than 250 employees. Using a unique dataset on Spanish SMEs that includes information on the hierarchical level of the person making decisions on a number of firm issues, the results show that the determinants of decentralization in SMEs are not necessarily the same than for larger firms. The delegation of decision rights to basic workers or a team of workers is positively correlated to firm characteristics such as the use of internal networks, the number of workplaces or the firm's export intensity. However, unlike previous studies for larger firms, firm size is found not to matter. The allocation of authority is also related to the composition of the firm's labor force; in particular, to the average education of workers and, importantly, to their distribution as well.[1]

Chapter 2 using a panel of countries covering the period 1970-2004, looks at the contribution of political leaders to enhance citizens education and investigates how the educational attainment of the

[1]This chapter was supervised by Prof. Susana Iranzo.

population is affected while a leader with higher education remains in office. For this purpose, the empirical analysis considers educational transitions of political leaders in office defined as the change in the educational level of political leader from one mandate to other. The research findings show that the educational attainment of population increases when a more educated leader remains in office. Moreover, the educational attainment of the population is negatively impacted when a country transitions from an educated leader to a less educated one. These results are a plausible explanation for the effect of leader's education on economic growth found in the previous literature. Also, the empirical analysis contributes to the literature by providing further evidence in the scant but emerging literature that links leaders' characteristics with countries' performance. Altogether, results suggest that the socio-economic background of political leaders may be informative about the type of policies they can be more sensitive. Therefore, this claims for the convenience of the use of "open lists" in democratic countries, where voters can decide not only about the party in the government but also about the individuals in each list.

Finally, *Chapter 3* analyzes the impact of duration of primary education on school enrollment, graduation and drop-outs rates. The empirical analysis draws upon a panel data for non-OECD countries covering the period 1970-2012. The results show that for children in elementary school one additional grade of primary education have a negative impact on the enrollment rate, while the effect on drop-outs is positive. Analogously, it is obtained that an additional grade in primary education reduces the enrollment rate in secondary education. These results are in line with the fertility model approach, that is, in developing and underdeveloped countries parents do not have incentive to send children to school given the high perceived economic value of children. Thus, an increase in duration of primary education discourages their continuation in the education system. Although previous literature provides evidence that increasing compulsory schooling in developed countries have positive returns in terms of earnings and non-pecuniary outcomes (school externalities), this may not apply for developing and underdeveloped countries where children earnings are one component of the household income and in many cases represent the support of the entire family. Therefore, policies consisting in lasting the duration of primary education, which have been proved to be successful in developed countries, may fail in developing and underdeveloped countries since it might have an undesired impact on children educational outcomes (enrollment, graduation or drop-outs).[2]

[2]Chapters 2 and 3 were supervised by Prof. Luis Díaz-Serrano.

CHAPTER 1

Delegation of Decisions in Small Firms: Some Empirical Evidence from Spanish SMEs.

1.1 Introduction

The decentralization or delegation of decisions within the firm is an important issue because the allocation of decision rights and other organizational aspects of the firm are related to several indicators of firm performance. For instance, Kastl et al. (2013) find a positive relation between delegation and firm R&D activity and Caroli and Van Reenen (2001) obtain a positive effect of organizational changes (including the decentralization of authority) on firm productivity. Similarly, Cooke (1994) and Boning et al. (2007) stress the relationship between the firm's organizational design and productivity, whereas Ichniowski (1990) and Osterman (2006) highlight the relationship with financial results and wages, respectively.

By decentralization of decisions we mean the delegation of decision rights from the owner or manager (the principal, hereafter) to the plant supervisor and/or floor workers (the agent, hereafter) who potentially possess more information about the specific matters of the firm. However, the interests of the principal and the agent might not be aligned, and the agent can use his or her informational advantage to make choices that are not in the best interest of the principal. A large theoretical literature has analyzed this trade-off between the benefits and the costs of decentralization.

In recent years some efforts have also been made to empirically test the theories concerning delegation of authority. For example, using a survey of Italian manufacturing firms, Colombo and Delmastro (2004) investigate the relationship between the allocation of decision-making authority and internal aspects of the firm's organizational structure. Acemoglu et al. (2007) study decentralization on a dataset on British and French firms and emphasize an establishment's distance to the technological frontier, as well as firm age and the heterogeneity in which the firm operates as determinants of decentralization. Bloom et al. (2012) find that product-market competition and trust are associated with decentralization while the religious preferences of a region can be associated with centralization. Similarly, Guadalupe and Wulf (2010) find that product market competition has an effect on the number of layers between division managers and the Chief Executive Officers (CEO). Wait and Meagher (2008) model the allocation of decision making rights between a principal and an agent when there are multiple decisions to be made and empirically find that delegation is more likely the more competitive the product market is and also in the case of exporting firms. All these works focus on large firms though. Instead, in this paper we focus on small and medium-sized enterprises (SMEs), that is, firms with less than 250 employees, which is an important contribution of the paper.

SMEs play a key role in many economies like Spain and other southern European countries. Just to have an idea of their economic importance, as of 2011, 99.88% of Spanish firms were SMEs and they employed about 60% of the total workforce. In the Spanish region we look at in this paper, Catalonia, SMEs represent 99.86% of total businesses and contribute to 51.3% of the region gross value added. SMEs have certain particularities that make them different from larger firms. One such aspect is the ownership structure; many of them are family businesses (that is, the majority of the voting securities are held by a single family) which has clear implications for the hierarchical organization and the allocation of decision rights within the firm. Moreover, given their reduced size they naturally tend to have fewer hierarchical layers and the information from bottom workers (and customers) to supervisors and managers can flow more easily than in larger firms. A priori, all these factors would make us expect higher levels of centralization of decisions among SMEs and thus it is not obvious what factors, if any, would lead to the delegation of decision making in small and medium-sized firms.

We use the existing theoretical predictions and empirical findings concerning the delegation of decision rights within large firms as a guideline to empirically explore the determinants of decentralization in small and medium-sized firms. To that aim, we use a unique database that

provides detailed information on the allocation of a number of decision rights for a sample of over 300 manufacturing SMEs in the Spanish region of Catalonia. As the dataset contains rich information not only on the firms but also on a sample of their workers, in addition to the firm characteristics commonly stressed in the literature, we can consider workers characteristics that previous empirical works did not include. For example, we investigate the role of workers skills and the distribution of workers skills as possible determinants of decentralization within the firm.

The rest of the paper is organized as follows. Section 1.2 presents the empirical and theoretical literature about the determinants of decentralization. Section 1.3 describes the dataset. In Section 1.4 the econometric model is specified and main results are presented. Finally, Section 1.5 concludes.

1.2 Determinants of Decentralization within the Firm: A Literature Review

As said above the principal-agent problem lies at the heart of the decentralization problem and there is a rich stream of theoretical papers analyzing the issue within this framework.[1] For instance, Aghion and Tirole (1997) show that the optimal transfer of decision authority to the agent depends positively on the information advantage he or she enjoys with respect to the principal and the extent of the private benefits he or she can extract from exercising decision-making power. If the agent's private benefits are large, delegation may increase both the agent's initiative to acquire information and his or her participation in the contractual relationship. Similarly, Laffont and Martimort (1998) argue that decentralization emerges whenever limits of communication and collusive behavior among agents are taken into account. That is, the trade-off between the superior knowledge of the agent and the agency costs of managerial delegation determines the optimal degree of decentralization or, in other words, the determinants governing the decision to delegate authority depend on the costs and benefits it implies. Among the *benefits*

[1]There exists another important strand of literature on decentralization that ignores the problem of conflicting objectives between the principal and the agent and, instead, emphasizes the issue of coordination of imperfectly informed actors –see for example, Geanakoplos and Milgrom (1991),Bolton and Dewatripont (1994), Aghion and Tirole (1997), Garicano (2000), Hart and Moore (2005) and Alonso et al. (2008). These papers also highlight the fact that hierarchical organizations that centralize the decision-making tend to have organization failures due to information transmission leaks (Keren and Levhari, 1983, 1989) and delays in transmitting information from the top to the bottom of the hierarchy (Radner, 1993; Van Zandt, 1999).

of decentralization we have the following: *i*) it reduces the costs of information transfer and communication because the information is processed at the level at which it is used (Caroli and Van Reenen, 2001); *ii*) it increases the agent's initiative and participation (Aghion and Tirole, 1997) and so it may increase productivity through increased involvement of lower level staff and higher job satisfaction (Caroli and Van Reenen, 2001); *iii*) it allows full exploitation of agent's competencies as it fosters task specialization (Bolton and Dewatripont, 1994; Geanakoplos and Milgrom, 1991); *iv*) it increases the response of firms to market changes and *v*) it reduces delays because it allows tasks to be performed concurrently.

On the other hand, decentralization entails some *costs*: *i*) as it is natural in a context of asymmetric information, there is a control cost; that is, agents are tempted to hide valuable information in order to achieve their own objectives that generally are not congruent with those of their superior (Aghion and Tirole, 1997; Poitevin, 2000; Wait and Meagher, 2008; Christie et al., 2003); *ii*) there tends to be duplication of information between hierarchical levels (Greenan and Guellec, 1994; Caroli and Van Reenen, 2001); *iii*) it might increase the risk of errors because specialized monitoring disappears and there are less direct controls over the production process; *iv*) it might lead to increased stress of workers due to the greater responsibility they face; *v*) as decentralization leads to skill upgrading, it might also lead to increased wage inequality (Aghion et al., 1999).

Some of the costs and benefits of decentralization are related to internal aspects of the firm (for example, the ease with which information flows between hierarchical levels or the skills of the workforce) while others have to do with external factors (market conditions or uncertain demand). We use the classification between internal and external factors as guidance to our empirical work and try to identify the determinants that affect the delegation of decisions in practice.

1.2.1 Internal Factors

Among the factors intrinsic to the firm that might affect the allocation of decision rights, the theoretical and empirical literatures have emphasized the following: firm size and the firm organizational structure, the use of communication technologies, firm human capital, firm age and the use of pay incentives.

Firm size might difficult the flow of information within the firm and makes local knowledge important (Colombo and Delmastro, 2004). In effect, a larger size might lead to information overload within the firm, which increases the principal's marginal disutility of getting informed and

presses him to delegate decision-making power to the agent who is closer to the firm's operations.

As for the firm organizational structure, the organization in several plants requires greater coordination among them, which encourages the centralization of decision making.[2] However, the physical distance between the agent and the principal is also greater if the plant belongs to a multi-unit firm, and this can have two opposite effects. First, a greater physical distance reinforces the informational advantage on local issues enjoyed by the agent and makes communication with the principal more difficult, which favors decentralization. Second, it becomes harder for the principal to monitor the decisions taken by the agent which, in the absence of effective incentive systems, would lead to greater centralization. Thus, it has an ambiguous effect on decentralization. Likewise, the communication technologies used by the firm might either centralize or decentralize the decision-making process (Garicano and Rossi-Hansberg, 2006). On the one hand, the decentralization disadvantage of losing control is reduced as advanced communication technologies allow the principal to monitor the agent and to be informed. On the other hand, they can also reduce the disadvantages of centralization by speeding up the transmission of information from the top to the bottom of the hierarchy.[3] Therefore, the effect of communication technologies is ambiguous too.

The firm human capital is another important factor because decentralization requires higher levels of human capital of workers in order to deal with increased responsibility and uncertainty. Other arguments supporting this idea are the fact that skilled workers are more autonomous and less likely to make mistakes, they are better at communicating which reduces the risk of duplicating information and they are more able to analyze new pieces of knowledge so that the benefits of local information processing are enhanced (Caroli et al., 2001). We go one step further and consider not only the firm average human capital but also the dispersion of skills among the labor force. In effect, although neglected in the literature on the allocation of decision rights, some studies analyzing firm productivity such as Iranzo et al. (2008); Ilmakunnas and Maliranta (2005); Hellerstein et al. (1999) have looked at the composition of the labor force and found that it does also matter.

Firm age is generally included as a control variable without a clear theoretical prediction. Acemoglu et al. (2007), for instance, find that, on average, younger firms tend to be more decen-

[2]The use of yardstick competition, though, may increase the ability of the company's headquarters to decentralize decision-making (Colombo and Delmastro, 2004).

[3]Keren and Levhari (1979); Keren and Levhari (1983), Radner (1993) and Aghion and Tirole (1997) consider that the use of advanced communication technologies reinforces the trend towards centralization of decision making.

tralized than older firms.[4]

The nature of the decision is also important. Aghion and Tirole (1997) show that the need to delegate authority is higher for decisions that involve large private benefits for the agent while the decisions about projects that involve a large pay-off to the principal tend to be centralized. For instance, decisions such as hiring staff, that affects the agent's power and personal relationships with subordinates, are more likely to be delegated whereas decisions that require greater coordination should be retained with the agent's superior.

Finally, given the principal-agent problem it is necessary to also take into consideration the use of pay incentives. Colombo and Delmastro (2004) argue that the degree of decentralization is influenced by the ability of the principal to design efficient incentive schemes to induce certain behavior of the agent and so the use of individual pay incentives would be associated to higher decentralization.

1.2.2 External Factors

Among the external factors to the firm that affect decentralization we focus on the conditions of the markets in which firms operate; in particular, product market competition and whether or not the firm operates in international markets. Regarding product market competition, Guadalupe and Wulf (2010) argue that competition increases the need for timely decisions that make better use of local knowledge and find that it leads to flatter firms. However, Bloom et al. (2012) present counter-arguments to this notion: very strong competition, i.e., more firms, means more public knowledge so there is less need to delegate to privately knowledgeable managers, and conclude that ultimately the effect of competition on decentralization is an empirical issue. The export status of a firm is also important because an establishment selling in a foreign market will be under higher competitive pressures to adopt the most productive work system and this may lead to more flexible work organizations (Osterman, 1994). Empirically, Marin and Verdier (2003) find that greater international competition leads to the delegation of authority from the CEO to the managers and Wait and Meagher (2008) find that workplaces that export are more likely to decentralize decision-making rights.

[4] According to their data about 45% of the firms under the age of five years are decentralized, compared to 30% for the older firms.

1.3 Data Description

The data comes from a unique survey on small and medium-sized firms,[5] conducted during 2005 and 2006 in the Spanish region of Catalonia.[6] It contains a rich set of questions and information that is not typically available in standard firm-level datasets.[7] All in all, it includes information for a cross-section of about 500 firms covering the main manufacturing and service sectors representative of the Catalan economy. For homogeneity and ease of comparability, in this paper we focus on manufacturing SMEs, that is, 318 firms.[8] Workers from three different hierarchical levels (core employees, supervisors and managers) in each firm were sampled randomly. On average, about half of the workforce in a firm was interviewed and we have information on those workers as well.

Table 1.1 provides descriptive statistics of the firm and worker characteristics of the final sample used in our main regression models.[9] Notice that as these are small and medium-sized enterprises, the average number of employees is rather small, 28 workers. A high percentage of the firms (82%) are family business, on average they have 2 workcenters and the average firm age is 30 years. As for the workers characteristics, most of them are male (78% of the interviewed workers); they have on average 10 years of schooling; basic workers and supervisors have spent on average 9 and 12 years, respectively working in the current firm. Finally, regarding incentive payments, as there are many workers whose salary does not include a variable component, on average, the percentage of the salary that depends on firm performance is rather small, 0.53% and 1% of the wages of basic workers and supervisors, respectively.

[5] That is, firms with less than 250 employees.

[6] The survey is called "*Enquesta Empresarial de Desenvolupament de Producte i Necessitats de Cualificacions Transversals*" and was run by the Catalonian SME association, *Petita i Mitjana Empresa de Catalunya (PIMEC)*.

[7] The survey shares some similarities with the British Workplace Employment Relations Survey (WERS), upon which it was based, containing additional questions not included in the WERS.

[8] They include the following two-digit NACE-code sectors: Food products and beverages (15), Chemicals (24), Rubber and plastic products (25), Fabricated metal products, except machinery and equipment (28), Machinery and mechanical equipment (29), Electrical machinery and instruments (31), Radio, television and communication equipment (32), Medical, precision and optical instruments, watches and clocks (33), Motor vehicles, trailers and semi-trailers (34), Furniture; manufacturing not elsewhere classified (36).

[9] As in Colombo and Delmastro (2004), in our main empirical models we stack the firm-level data according to the eleven firm decisions we have information on, and create a pseudo-panel. As we have 318 firms and eleven decisions for each firm, we have a total of $3,498$ firm-decision pairs. There are fewer observations in the cases of those variables for which the information on some firms is missing.

Table 1.1: Summary Statistics.

	Obs.	No. firms	Mean	Std. Dev.
Firm characteristics				
Firm Size (No. of employees)	2332	212	28.439	28.857
Firm age	3267	297	30.256	23.727
Number of workcenters	3212	292	2.575	6.259
Family firm (dummy var)	3454	314	0.822	0.383
Internal Networks (dummy var)	3025	275	0.669	0.471
Sector:	3498	318		
- Food and beverages (%)			16.04	
- Chemicals (%)			0.31	
- Rubber and plastics (%)			9.75	
- Metal products (%)			30.5	
- Mechanical machinery & equip (%)			20.13	
- Electrical machinery & instruments (%)			10.06	
- Radio, television & communication equip (%)			2.52	
- Furniture (%)			8.18	
- Others (%)			2.51	
Worker characteristics				
Gender (dummy var)	3498	318	0.784	0.251
Foreign (dummy var)	3454	314	0.068	0.185
Years of schooling	3498	318	10.073	2.099
Seniority of Basic workers (years)	3289	299	9.036	5.843
Seniority of Supervisors (years)	2574	234	12.297	8.175
Age of workers	3498	318	38.996	5.572
Incentives[a]:				
- Supervisors	3355	305	0.533	2.203
- Basic workers	2673	243	0.989	3.732
External Factors				
Intensity of competition	3421	311	2.132	0.694
Export intensity	3322	302	0.337	0.778

Note: [a] Percentage of salary depending on firm performance.

1.3.1 Measuring Decentralization

The survey contains questions on who in the firm decides on a number of issues. In particular, the following firm decisions are considered: *i*) daily tasks planning, *ii*) weekly tasks planning, *iii*) follow-up of results, *iv*) customer relations, *v*) quality control, *vi*) supply purchases, *vii*) machinery and equipment maintenance, *viii*) job listing, *ix*) hiring, *x*) production technology choice and *xi*) training. The possible answers to those questions range from 1 to 5, depending on who makes the decision: the firm's owner (value 1), manager (value 2), supervisor (value 3), a group of workers (value 4) or basic workers (value 5). Thus, according to our definition of decentralization a value of 5 corresponds to the greatest degree of delegation or decentralization of decisions and a value of 1 to the greatest degree of centralization, while a value of 3 would constitute partial delegation.

It is worthwhile pointing out that the degree of centralization of decisions for these small and medium-sized firms is quite high. In most firms many of the decisions are taken by the owner or the manager. Only 3.6% and 2.9% of the firm-decisions observations correspond to core/basic employees and to a group of workers, respectively, with partial delegation to the supervisor accounting for 23.2% of the observations. Thus, in order to avoid econometric problems of thin cells for low levels of centralization, we group some of the answers to the decision questions and consider 2 possible models depending on how the dependent variable is defined:

- A model of *Centralization* (if the decision is taken by the firm's owner or manager), *Partial Delegation* (if the decision is made by a supervisor) and *Decentralization* (if the decision is made by either a group of workers or core employees). Figure 1.1 (a) shows the distribution of the allocation of decision rights in this case, with 70.3% of the observations indicating centralization, 23.2% representing partial delegation and 6.5% decentralization.

- A model of just *Centralization* (if the decision is taken by firm's owner or manager) and *Decentralization* (if the decision is made by a supervisor, a group of workers or core employees). As Figure 1.1 (b) shows, 29.7% of the observations correspond to decentralization now.

In the first case we estimate an ordered probit model whereas in the second case we estimate a simple probit model.

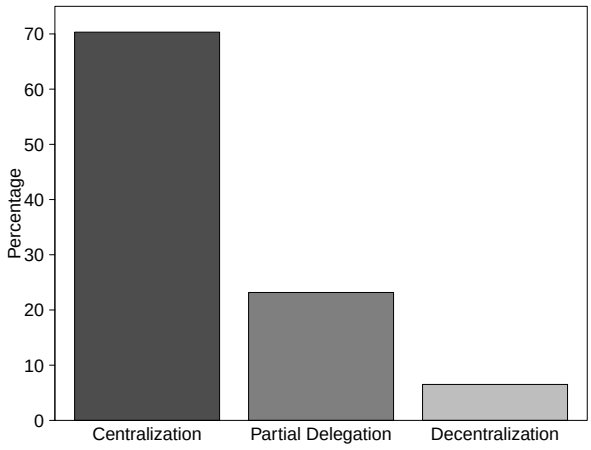
1.3.2 Measuring the Determinants of Decentralization

Based on our discussion on internal and external factors, we briefly discuss the proxies used in our empirical analysis for each of the determinants of decentralization, as well as their expected signs.[10]

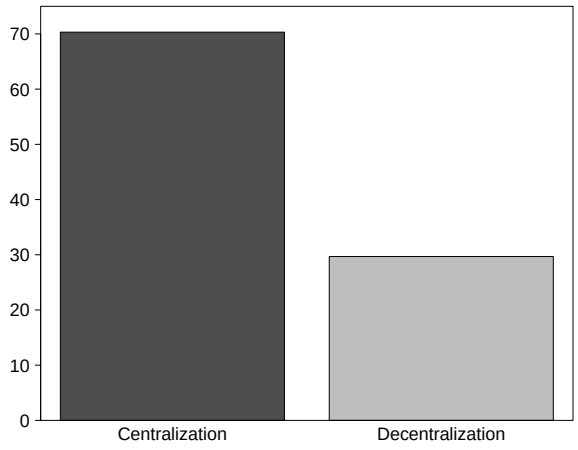
Firm size is measured as the logarithm of the number of employees in the firm and, according to the literature, we would expect it to have a positive impact on decentralization. The organizational structure of the firm is captured by *Workcenters*, the number of workcenters that the firm has and its expected sign is uncertain. As a proxy for information communication technologies we use a dummy variable (*Internal Networks*) that takes value one if the firm has an intranet and zero otherwise. As explained above, its expected sign is ambiguous.

[10]Table 1.5 in Appendix 1 lists all variables with definitions and expected sign.

Figure 1.1: Allocation of Decision Rights within the Firm (based on the question in the survey "Who makes decision...?").



(a) Distribution of the allocation of decision rights (Model 1): Centralization (70.3%), Partial Delegation (23.2%) and Decentralization (6.5%).



(b) Distribution of the allocation of decision rights (Model 2): Centralization (70.3%) and Decentralization (29.7%).

As for the workers variables, human capital is measured as the average *years of schooling* of the workers in the firm and their experience in the firm (*seniority*).[11] We expect these variables to have a positive impact on the delegation of authority. Importantly, we also consider the dispersion of workers skills; in particular, the standard deviation of years of schooling (*years of schooling std dev*) and experience (*seniority std dev*) of workers in the firm. There is no theory on whether a more or less homogeneous labor force facilitates the delegation of authority from top to bottom workers and so a priori there is no expected sign on these variables. The use of incentive schemes to motivate employees is proxied by *Supervisor incentives* and *Basic worker incentives* which are respectively the percentage of their wages that depend on firm performance. Based on the theory, we would expect a positive effect of these variables on decentralization.

We also include a dummy variable for *family firms*. Family firms are different from non-family firms in a number of dimensions. For example, Bassanini et al. (2013) show that family firms tend to have lower compensation packages but also lower job insecurity. It is not unreasonable

[11] Ideally we would like to include the overall work experience of the workers but we only know the number of years they have been working in the current firm. Thus, although imperfect, we use it as a proxy for experience. Another issue with this variable to bear in mind (and that might complicate the interpretation of results) is its high correlation with workers age.

to think then that family firms might have different organizational arrangements in terms of decision-making as well. Although there is no formal prediction on the literature on delegation, Colombo and Delmastro (2004) argue that owner-managers (about 89% of the observations in our sample) may be unwilling to delegate authority due to personal preferences for autocratic decision-making.

Regarding the external factors influencing decentralization we include two proxies for product-market conditions: a variable directly measuring the intensity of competition and the firm's export intensity. The former is based on the subjective answers to the question in the survey "Considering the market in which the company operates (national, international), how many competing firms are there?" Possible answers range from 1 ("few competitors") to 3 ("many competitors"). So, a high value of this variable corresponds to a more competitive environment. The firm's export intensity was constructed from the information on the firms market share in domestic and international markets. In particular, we took the ratio between the share of sales in foreign markets versus the share of sales in the domestic market. Although there is no consensus on the effect of intensity of competition, most previous empirical studies have obtained a positive correlation between export intensity and decentralization.

We complete the list of explanatory variables with some additional controls for the workforce such as the ratio of men to women and the percentage of foreigners in the firm. We also control for the effect of each particular decision by including decision-specific dummies.[12]

1.4 Empirical Model and Results

As explained, we use the answers to the 11 firm decisions contained in the survey as our measure of decentralization or delegation of authority within the firm and estimate two types of models:

1. Discrete choice models (ordered probit and simple probit models) on the stacked data of firm-decision observations and

2. OLS models with a (continuous) decentralization index at the firm-level as dependent variable.

We explain each type of model and present the estimation results next.

[12]We estimated different specifications of the model. The results reported include individual decision dummies but we also estimated other specifications with decision-group dummies instead of individual decision dummies obtaining qualitatively similar results.

1.4.1 Discrete Choice Models

The choice of allocation of authority across hierarchical levels reflects the firm's profit maximization. Let D_{ij}^* denote the "optimal" allocation of authority over decision i for firm j, which is given by:

$$D_{ij}^* = \gamma X_j + v_i + \varepsilon_{ij}, \quad (i = 1, \ldots, 11; j = 1, \ldots, 318) \tag{1.1}$$

where X_j is the vector of firm internal and external factors governing decentralization, as well as other firm and worker controls, v_i is a decision-specific fixed effect and ε_{ij} is a random disturbance term.

We do not observe D_{ij}^* but just a latent variable, D_{ij}, which in the case of the ordered probit model takes values from 1 to 3 and whose relation with the optimal allocation of authority is as follows:

$$\begin{array}{ll} D_{ij} = 1 \ (Centralization) & \text{if } D_{ij}^* \leq \mu_1 \\ D_{ij} = 2 \ (Partial \ Delegation) & \text{if } \mu_1 < D_{ij}^* \leq \mu_2 \\ D_{ij} = 3 \ (Decentralization) & \text{if } D_{ij}^* > \mu_2 \end{array} \tag{1.2}$$

Or in the case of a simple probit model:

$$\begin{array}{ll} D_{ij} = 0 \ (Centralization) & \text{if } D_{ij}^* \leq \mu_0 \\ D_{ij} = 1 \ (Decentralization) & \text{if } D_{ij}^* > \mu_0 \end{array} \tag{1.3}$$

with μ_k being, in either case, the threshold that separates the different discrete categories of delegation of authority.

Table 1.2 reports the marginal effects of the baseline ordered probit estimation. Since we are interested in the decentralization of decision rights, we will focus on the marginal effects of this outcome. Decentralization is negatively and significantly associated to the use of intra-firm communication technologies (*Internal Networks*). In particular, using internal networks decreases the probability to delegate decisions onto basic workers by 3 percentage points and it increases the probability of either the firm's owner or the manager making the decisions by 13 percentage points. This means that the use of an intranet and other communication technologies makes it easier for the owner or the manager to have access to all the relevant information as to make herself the decisions without having to delegate on workers (decentralization) or supervisors (partial delegation).

Firm size does not result significant –and as we will see, it is not significant in any of the other models. This constitutes an important difference with previous empirical studies considering larger firms that generally find quite a robust positive effect of firm size on decentralization. The fact that we do not find it here makes us think that there is a minimum firm size beyond which

the costs of information transfer and communication entailed by centralization are too high so that it becomes optimal for firms to decentralize decisions. Given our dataset of SMEs, firm size might be too "small" as to capture that effect. With reference to the other firm characteristics, firm age has the expected negative sign although it fails to be statistically significant, while the coefficients on the number of workcenters and being a family firm are also insignificant.

With regard to workers characteristics, the average years of schooling is positively and significantly correlated to decentralization. The probability of decentralization increases by 0.3 percentage points (and that of centralization decreases by 1.3 percentage points) with one additional year of average schooling of the firm's labor force. On the other hand, average seniority has a null effect on delegation. The other relevant and statistically significant result is the negative correlation between the dispersion of workers schooling and decentralization. This means that the delegation of decisions from top to bottom workers is more likely the more homogeneous, in terms of skills or education, is the workforce.[13] Delegation also appears to be positively associated to pay incentives to both basic workers and supervisors, although the coefficient is only statistically different from zero in the case of supervisors.[14] Basing part of the supervisors' salaries on firm performance increases the probability of delegation to workers (decentralization) by 0.1 percentage points and that of partial delegation by 0.5 percentage points. As for the additional control on workers characteristics, it is worthwhile to note the negative and significant coefficient on the dummy variable for being a foreigner. That is, firms with a higher percentage of foreign workers tend to decentralize (even partially delegate) less whereas the gender composition does not seem to have any significant impact on delegation.

The external factors considered here have signs that are in line with those obtained in previous empirical studies: the firm export intensity is positively and significantly correlated with decentralization while the effect of the intensity of competition (which is based on the manager's

[13]Decentralization also appears positively correlated to the dispersion of workers seniority. We do not want to stress much this result though, because the first moment (average seniority) is irrelevant (a coefficient of small magnitude and statistically insignificant) and, as pointed out, seniority in the firm is an imperfect measure of human capital. Moreover, as Tables 1.6 through 1.8 show (See Appendix 1), this result is not as robust as the relation between delegation and the dispersion of workers schooling.

[14]Throughout all the specifications, the point estimates on workers pay incentives display large standard errors that prevent the coefficients from being statistically significant. This could respond to an identification problem as few workers in the dataset receive pay incentives and even for those who do receive them the percentage of their wages depending on firm performance is rather small. In other words, there is not much variability in these variables whose values tend to cluster around 0.

Table 1.2: Results of the Baseline Ordered Probit Model: Marginal Effects.

	Centralization	**Partial Deleg.**	**Decentralization**
	$P[Dec = 1]$	$P[Dec = 2]$	$P[Dec = 3]$
Firm Size	0.022	-0.018	-0.004
	(0.022)	(0.018)	(0.004)
Internal Networks	0.134***	-0.104***	-0.030***
	(0.037)	(0.028)	(0.010)
Workcenters	-0.002	0.002	0.000
	(0.002)	(0.001)	(0.000)
Firm age	0.024	-0.020	-0.005
	(0.025)	(0.020)	(0.005)
Years of schooling	-0.013*	0.011*	0.003*
	(0.008)	(0.006)	(0.002)
Years of schooling (Std. dev)	0.069***	-0.056***	-0.013***
	(0.017)	(0.014)	(0.004)
Seniority	-0.000	0.000	0.000
	(0.004)	(0.003)	(0.001)
Seniority (Std. dev)	-0.015***	0.012***	0.003***
	(0.005)	(0.004)	(0.001)
Basic workers incentives	-0.005	0.004	0.001
	(0.008)	(0.007)	(0.002)
Supervisor incentives	-0.006*	0.005*	0.001*
	(0.003)	(0.003)	(0.001)
Intensity of competition	0.029	-0.023	-0.006
	(0.022)	(0.018)	(0.004)
Export intensity	-0.089***	0.072***	0.017***
	(0.017)	(0.014)	(0.004)
Family firm	-0.049	0.040	0.009
	(0.034)	(0.028)	(0.006)
Ratio of men to women	0.007	-0.005	-0.001
	(0.036)	(0.029)	(0.007)
Foreign	0.197***	-0.159***	-0.038***
	(0.071)	(0.057)	(0.015)
PST	-0.141***	0.110***	0.031***
	(0.030)	(0.023)	(0.008)
Provinces dummies	Yes	Yes	Yes
Decision dummies	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes
Sample size	1,297	1,297	1,297
Log Likelihood	-826.36	-826.36	-826.36
Pseudo-R2	0.18	0.18	0.18

Notes: Categorical Dependent Variable: Centralization, Partial Delegation and Decentralization. This table reports the marginal effects for each possible outcome of the dependent variable. *** Significant at 1%, ** Significant at 5%, * Significant at 10%. Robust stand. errors in parentheses.

subjective perception) would be inconclusive as the coefficient fails to be statistically significant.

Finally, as the cross-section nature of the data does not allow us to use firm-fixed effects but only decision-specific fixed effects, it is important to somehow control for some of the remaining unobserved heterogeneity at the firm-level by including variables that might be correlated with the tendency to delegate authority. One type of such variables is the use of certain Human Resource Practices that go hand in hand with the delegation of decisions from top to bottom

Table 1.3: Results of the Baseline Probit Model.

	Marginal Effects	**Std. Error**
Firm Size	-0.032	(0.022)
Internal Networks	-0.104***	(0.040)
Workcenters	0.003*	(0.002)
Firm age	-0.015	(0.027)
Years of schooling	0.012	(0.008)
Years of schooling (Std. dev)	-0.071***	(0.019)
Seniority	-0.001	(0.004)
Seniority (Std. dev)	0.017***	(0.005)
Basic workers incentives	-0.002	(0.009)
Supervisor incentives	0.006	(0.004)
Intensity of competition	-0.038*	(0.022)
Export intensity	0.099***	(0.022)
Family firm	0.038	(0.036)
Ratio of men to women	0.007	(0.039)
Foreign	-0.153*	(0.083)
PST	0.154***	(0.034)
Provinces dummies	Yes	
Decision dummies	Yes	
Sector dummies	Yes	
Sample size	1,297	
Log Likelihood	-619.80	
Pseudo-R2	0.23	

Notes: Dependent Variable: Decentralization. This table reports the marginal effects of the baseline probit model. *** Significant at 1%, ** Significant at 5%, * Significant at 10%. Robust standard errors in parentheses.

workers. Thus, we use a dummy variable for whether the firm uses Problems Solution Teams (PST), one of the human resource management practices for which information is available.[15]

By and large, we obtain the same qualitative results with our baseline probit model where decentralization is defined as the allocation of decision rights to any hierarchical level below the manager. The estimation results are presented in Table 1.3. Clearly, we confirm the negative correlation between decentralization and the use of internal communication technologies and the dispersion of workers education, and the positive correlation between decentralization and export intensity. In this case, we also obtain a positive correlation between delegation and the number of workcenters and a negative and significant (at the 10% significance level) effect of intensity of competition on the probability to decentralize which is not completely incongruent with the previous literature.

As robustness checks, we estimate the models separately for different groups of decisions. Using factor analysis, we identify the decisions that are more related among them and consequently

[15]In all the models, this variable is statistically significant and positively correlated with decentralization.

group the 11 firm decisions into 3 subgroups: *task planning decisions* (daily and weekly tasks planning decisions), *labor decisions* (decisions on job listing, hiring and training) and *production decisions* (that include the decisions on follow-up of results, quality control, supply purchases, machinery and equipment maintenance and production technology choice). Tables 1.6 through 1.9 (see Appendix 1) report the results of the ordered probit estimation and for the simple probit model for each of those sub-groups. Although we lose estimation precision when we split the sample into the 3 decision subgroups and due to the large standard errors some of the variable coefficients are no longer significant, we confirm the most important qualitative results obtained for the pooled firm-decisions data. Decentralization is significant and negatively correlated with the use of internal networks (in the case of production decisions), the heterogeneity of workers educational levels (labor and task planning decisions) and the intensity of competition (task planning decisions), whereas it is positively and significantly correlated with the firm export intensity (production and labor decisions).

1.4.2 OLS Models

Alternatively to the estimation of discrete choice models on the stacked data of firm-decision observations, we construct different continuous indices of decentralization at the firm-level and estimate simple linear OLS models. In particular, we compute an overall index of decentralization based on the 11 decisions and indices for the 3 different subgroups of decisions listed above, that is, for task-planning, labor and production decisions.

Table 1.4 presents the OLS estimation results for those decentralization indices. It is worthwhile noting that as we have now only firm-level observations (instead of the pseudo-panel of firm-decision observations) the sample size is considerably reduced and this results in large standard errors and identification problems in some of the specifications.[16] Yet, we confirm the robustness of most of our previous results. Firms with more homogeneous workforce in terms of education tend to decentralize more –the coefficient on the dispersion of years of schooling is negative throughout all the models and it is also highly significant with the only exception of the group of production decisions. Delegation is also higher when firms use pay incentives for basic workers, although this effect is only statistically significant in the pooled data. The use of internal networks presents, except for task planning decisions, a negative coefficient that is now only significant in the case of labor decisions. Other firm characteristics such as size or being

[16]There is complete information on all the relevant variables for a total of just 119 firms.

Table 1.4: Estimation Results (OLS).

	All decisions	**Only Task planning decisions**	**Only Labor decisions**	**Only Production decisions**
Firm Size	0.040	0.137	0.039	0.024
	(0.076)	(0.107)	(0.097)	(0.076)
Internal Networks	-0.201	0.114	-0.266*	-0.274*
	(0.129)	(0.187)	(0.156)	(0.145)
Workcenters	0.005	0.019*	0.006	-0.002
	(0.006)	(0.011)	(0.008)	(0.005)
Firm age	-0.074	-0.040	-0.087	-0.068
	(0.087)	(0.129)	(0.118)	(0.103)
Yrs. of schooling	0.035	0.075*	0.012	0.024
	(0.028)	(0.039)	(0.036)	(0.032)
Yrs. of schooling (Std. dev)	-0.129**	-0.247**	-0.161*	-0.067
	(0.063)	(0.096)	(0.082)	(0.071)
Seniority	0.004	0.012	0.009	-0.009
	(0.013)	(0.019)	(0.016)	(0.015)
Seniority (Std. dev)	0.023	0.012	0.003	0.050***
	(0.016)	(0.026)	(0.021)	(0.017)
Basic workers incentives	0.036*	0.040	0.042	0.019
	(0.021)	(0.028)	(0.027)	(0.023)
Supervisor incentives	0.002	0.014	-0.013	0.012
	(0.012)	(0.017)	(0.016)	(0.014)
Intensity of competition	-0.077	-0.254**	-0.034	-0.029
	(0.080)	(0.106)	(0.106)	(0.082)
Export intensity	0.204***	0.119	0.295***	0.187**
	(0.057)	(0.073)	(0.069)	(0.073)
Family firm	-0.022	-0.099	-0.065	0.037
	(0.112)	(0.162)	(0.142)	(0.129)
Ratio of men to women	0.002	0.050	0.025	-0.017
	(0.145)	(0.274)	(0.155)	(0.131)
Foreign	-0.317	-0.554	0.114	-0.562*
	(0.271)	(0.447)	(0.306)	(0.297)
PST	0.301***	0.303*	0.374**	0.284**
	(0.113)	(0.160)	(0.145)	(0.122)
Constant	-0.001	-0.254	0.283	-0.112
	(0.522)	(0.690)	(0.669)	(0.562)
Provinces dummies	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes
Sample size	119	119	119	119
R2 Adj.	0.11	0.21	0.06	0.09
F-stat	2.23	3.28	2.20	2.52
Log Likelihood	-72.48	-115.31	-99.43	-83.54

Notes: *** Significant at 1%, ** Significant at 5 %, * Significant at 10 %. Robust standard errors in parentheses.

a family firm continue to have statistically insignificant coefficients. Finally, decentralization is higher (and this effect is generally statistically significant) for all decisions and for all groups of decisions among those firms that export more while firms facing more intense competition tend to centralize decisions more, although this correlation is only significant in the case of task planning decisions.

1.5 Conclusions

Using a unique dataset on SMEs, we empirically investigate the factors affecting decentralization or delegation of authority within the firm in the case of small and medium-sized enterprises. Since most of the studies on decentralization have looked at large companies, this is an important contribution of the paper.

We consider eleven strategic decisions to a firm's activity and test the predictions of economic theory for a sample of 318 Spanish manufacturing firms. In particular, we estimate discrete choice models on the probability to delegate decisions from the owner or manager to lower hierarchical levels in the firm (basic workers and/or supervisors). Our main empirical results are easily summarized. First, as found in previous studies, internal aspects of the firms such as the use of internal networks or the number of workplaces affect the degree of decentralization of decisions in the firm. External aspects such as product market conditions, proxied by the intensity of competition and the firm's export intensity, are significant determinants of delegation as well.

It is also important to note some of the differences we obtain with respect to the previous empirical works considering larger firms. For instance, while the positive effect of firm size on decentralization tends to be a generally pretty robust result, in our sample of small and medium-sized firms it is never a significant explanatory factor of delegation of decisions. Other aspects such as the use of pay incentives does not seem to matter much either. However, in this case caution is in order as one can not be sure whether pay incentives genuinely do not affect the allocation of decision-making rights in SMEs or whether this is rather an identification problem due to the low use of this type of incentives.

Finally, we show that workers characteristics and the composition of the firm's labor force are also related to the delegation of decisions. In particular, workers with a higher educational level and a more homogeneous labor force in terms of education are associated to higher degrees of delegation in the firm.

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Appendix 1. Tables

Table 1.5: Explanatory Variables and Expected Signs.

Variables	Description	Expected Sign on Decentralization
Firm characteristics		
Firm Size	Logarithm of number of employees in the firm.	+
Internal Networks	Dummy variable that takes value 1 when the firm uses internal networks, 0 otherwise.	?
Workcenters	Number of workcenters of the firm.	?
Firm age	Logarithm of firm age.	−
Family firm	Dummy variable that takes value 1 if it is a family-owned firm, 0 otherwise.	−
Workers' characteristics		
Years of schooling	Mean of years of schooling of workers in the firm.	+
Dispersion of schooling	Standard deviation of years of schooling of workers.	?
Seniority	Mean of seniority of workers (years).	+
Dispersion of seniority	Standard deviation of seniority of workers.	?
Supervisor incentives	Mean of percentage of supervisors' earnings that corresponds to company incentives.	+
Basic workers incentives	Mean of percentage of basic workers earnings that corresponds to company incentives.	+
External Factors		
Intensity of competition	Index that measures the intensity of competition.	?
Export intensity	Ratio of sales in foreign markets/sales in domestic market.	+

Table 1.6: Results of Ordered Probit Model (Marginal Effects): Task Planning Decisions.

	Centralization	**Partial Deleg.**	**Decentralization**
	$P[Dec = 1]$	$P[Dec = 2]$	$P[Dec = 3]$
Firm Size	-0.049	0.046	0.003
	(0.061)	(0.058)	(0.004)
Internal Networks	-0.037	0.035	0.002
	(0.088)	(0.083)	(0.005)
Workcenters	-0.012**	0.011**	0.001
	(0.005)	(0.005)	(0.000)
Firm age	-0.019	0.018	0.001
	(0.067)	(0.064)	(0.004)
Years of schooling	-0.032	0.031	0.002
	(0.021)	(0.020)	(0.001)
Years of schooling (Std. dev)	0.166***	-0.157***	-0.009*
	(0.047)	(0.045)	(0.005)
Seniority	-0.007	0.007	0.000
	(0.009)	(0.009)	(0.000)
Seniority (Std. dev)	-0.007	0.007	0.000
	(0.013)	(0.012)	(0.001)
Basic workers incentives	-0.023	0.022	0.001
	(0.024)	(0.022)	(0.001)
Supervisor incentives	-0.014	0.014	0.001
	(0.009)	(0.008)	(0.001)
Intensity of competition	0.127**	-0.120**	-0.007*
	(0.057)	(0.055)	(0.004)
Export intensity	-0.056	0.053	0.003
	(0.049)	(0.046)	(0.003)
Family firm	0.012	-0.011	-0.001
	(0.089)	(0.084)	(0.005)
Ratio of men to women	-0.092	0.087	0.005
	(0.109)	(0.103)	(0.007)
Foreign	0.243	-0.230	-0.013
	(0.229)	(0.217)	(0.014)
PST	-0.149*	0.139*	0.010
	(0.078)	(0.073)	(0.007)
Provinces dummies	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes
Sample size	236	236	236
Log Likelihood	-157.35	-157.35	-157.35
Pseudo-R^2	0.14	0.14	0.14

Notes: Categorical Dependent Variable: Centralization, Partial Delegation and Decentralization. This table reports the marginal effects for each possible outcome of the dependent variable. *** Significant at 1%, ** Significant at 5%, * Significant at 10%. Robust stand. errors in parentheses.

Table 1.7: Results of Ordered Probit Model (Marginal Effects): Labor Decisions.

	Centralization	**Partial Deleg.**	**Decentralization**
	$P[Dec = 1]$	$P[Dec = 2]$	$P[Dec = 3]$
Firm Size	0.057	-0.043	-0.013
	(0.039)	(0.031)	(0.009)
Internal Networks	0.086	-0.064	-0.022
	(0.062)	(0.044)	(0.019)
Workcenters	-0.003	0.002	0.001
	(0.002)	(0.002)	(0.001)
Firm age	-0.010	0.008	0.002
	(0.037)	(0.028)	(0.009)
Years of schooling	-0.003	0.002	0.001
	(0.011)	(0.009)	(0.003)
Years of schooling (Std. dev)	0.085***	-0.065***	-0.020**
	(0.029)	(0.023)	(0.008)
Seniority	-0.000	0.000	0.000
	(0.006)	(0.005)	(0.002)
Seniority (Std. dev)	-0.003	0.002	0.001
	(0.008)	(0.006)	(0.002)
Basic workers incentives	-0.000	0.000	0.000
	(0.013)	(0.010)	(0.003)
Supervisor incentives	0.004	-0.003	-0.001
	(0.006)	(0.005)	(0.001)
Intensity of competition	0.008	-0.006	-0.002
	(0.036)	(0.028)	(0.009)
Export intensity	-0.106***	0.081***	0.025***
	(0.031)	(0.025)	(0.009)
Family firm	-0.028	0.022	0.007
	(0.058)	(0.045)	(0.013)
Ratio of men to women	-0.019	0.015	0.005
	(0.056)	(0.043)	(0.013)
Foreign	-0.039	0.030	0.009
	(0.095)	(0.073)	(0.022)
PST	-0.093*	0.069*	0.024*
	(0.051)	(0.038)	(0.014)
Provinces dummies	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes
Sample size	350	350	350
Log Likelihood	-195.91	-195.91	-195.91
Pseudo-R^2	0.09	0.09	0.09

Notes: Categorical Dependent Variable: Centralization, Partial Delegation and Decentralization. This table reports the marginal effects for each possible outcome of the dependent variable. *** Significant at 1%, ** Significant at 5%, * Significant at 10%. Robust stand. errors in parentheses.

Table 1.8: Results of Ordered Probit Model (Marginal Effects): Production Decisions.

	Centralization	**Partial Deleg.**	**Decentralization**
	$P[Dec = 1]$	$P[Dec = 2]$	$P[Dec = 3]$
Firm Size	0.004	-0.003	-0.002
	(0.033)	(0.019)	(0.014)
Internal Networks	0.165***	-0.089***	-0.077***
	(0.054)	(0.027)	(0.029)
Workcenters	0.002	-0.001	-0.001
	(0.002)	(0.001)	(0.001)
Firm age	0.043	-0.025	-0.018
	(0.038)	(0.022)	(0.016)
Years of schooling	-0.007	0.004	0.003
	(0.012)	(0.007)	(0.005)
Years of schooling (Std. dev)	0.026	-0.015	-0.011
	(0.025)	(0.015)	(0.011)
Seniority	0.007	-0.004	-0.003
	(0.006)	(0.004)	(0.003)
Seniority (Std. dev)	-0.027***	0.016***	0.011***
	(0.008)	(0.005)	(0.003)
Basic workers incentives	0.007	-0.004	-0.003
	(0.013)	(0.008)	(0.005)
Supervisor incentives	-0.009*	0.006	0.004
	(0.006)	(0.003)	(0.002)
Intensity of competition	-0.001	0.000	0.000
	(0.032)	(0.019)	(0.013)
Export intensity	-0.077***	0.045***	0.032***
	(0.022)	(0.013)	(0.009)
Family firm	-0.077	0.047	0.030
	(0.052)	(0.033)	(0.019)
Ratio of men to women	0.019	-0.011	-0.008
	(0.063)	(0.037)	(0.026)
Foreign	0.330***	-0.194***	-0.136***
	(0.109)	(0.064)	(0.047)
PST	-0.152***	0.084***	0.068***
	(0.044)	(0.024)	(0.022)
Provinces dummies	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes
Sample size	593	593	593
Log Likelihood	-481.21	-481.21	-481.21
Pseudo-R^2	0.06	0.06	0.06

Notes: Categorical Dependent Variable: Centralization, Partial Delegation and Decentralization. This table reports the marginal effects for each possible outcome of the dependent variable. *** Significant at 1%, ** Significant at 5%, * Significant at 10%. Robust stand. errors in parentheses.

Table 1.9: Results of Probit Model for each Group of Decisions: Marginal Effects.

	Only Task planning decisions	**Only Labor decisions**	**Only Production decisions**
Firm Size	0.023	-0.061*	-0.017
	(0.058)	(0.037)	(0.033)
Internal Networks	0.053	-0.056	-0.141**
	(0.091)	(0.063)	(0.057)
Workcenters	0.012*	0.004	-0.002
	(0.007)	(0.003)	(0.003)
Firm age	0.043	0.006	-0.022
	(0.069)	(0.039)	(0.042)
Years of schooling	0.028	0.004	0.002
	(0.021)	(0.012)	(0.013)
Years of schooling (Std. dev)	-0.155***	-0.076**	-0.032
	(0.047)	(0.030)	(0.028)
Seniority	0.012	-0.000	-0.010
	(0.010)	(0.007)	(0.007)
Seniority (St. Dev.)	0.001	0.003	0.030***
	(0.013)	(0.008)	(0.008)
Basic workers incentives	0.006	-0.001	-0.012
	(0.027)	(0.014)	(0.014)
Supervisor incentives	0.020	-0.001	0.010
	(0.013)	(0.007)	(0.007)
Intensity of competition	-0.138**	-0.008	-0.004
	(0.055)	(0.034)	(0.033)
Export intensity	0.054	0.105***	0.105***
	(0.057)	(0.033)	(0.032)
Family firm	-0.040	0.031	0.056
	(0.095)	(0.057)	(0.056)
Ratio of men to women	0.059	0.033	-0.008
	(0.101)	(0.063)	(0.061)
Foreign	-0.186	0.060	-0.265**
	(0.232)	(0.120)	(0.124)
PST	0.180**	0.097*	0.155***
	(0.081)	(0.054)	(0.049)
Provinces dummies	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes
Sample size	236	350	593
Log Likelihood	-139.59	-159.39	-357.73
Pseudo-R^2	0.14	0.11	0.07

Notes: Dependent Variable: Decentralization. This table reports the marginal effects of the probit model for each group of decision. *** Significant at 1%, ** Significant at 5%, * Significant at 10%. Robust standard errors in parentheses.

CHAPTER 2

Do More Educated Leaders Raise Citizens' Education?

2.1 Introduction

Recent literature has been demonstrated that leaders play an important role by affecting policy and economic outcomes (Jones and Olken, 2005; Dreher et al., 2009; Besley et al., 2011) and that citizens (voters) pay more attention to leaders' characteristics rather than political parties (Besley and Coate, 1997; Osborne and Slivinski, 1996). More specifically, literature shows that leaders' quality, measured by their educational level and personal background, matters for economic growth (Dreher et al., 2009; Besley et al., 2011) and reforms (Dreher et al., 2009; Göhlmann and Vaubel, 2007) in a country.

According to Besley et al. (2011), leaders matters for growth since some of them are more competent than others and are more able to make better policy choices which enhance economic performance. They consider that the return to having more educated leaders comes from the assumption that highly educated leaders are also better citizens and are more likely to act in the benefit of public interest.[1]

The main goal of this paper is analyze whether political leaders would matter for policy outcomes and more specifically those regarding the educational achievement of the population. We consider that one of the key means that the leader has an effect on outcomes is his/her

[1] Besley et al. (2011) define a 'highly' educated leader as one who has at least a postgraduate qualification.

educational attainment. So, a possible explanation to the potential effect of leader's education on economic growth could be through enhancing the education of the population. Human capital is an important input into the production function of a country and has been emphasized as a critical determinant of economic progress.

Our paper contributes to the literature on leaders' characteristics and their impact on countries' outcomes. We look at the contribution of a leader to enhance citizens' education. We investigate how the educational attainment of population is affected while a leader with higher education remains in office. For this purpose, we consider educational transitions of the leaders defined as the change in the educational level of political leader from one mandate to other. Using a dataset for the period 1970-2004 and over 140 countries, we show that there is a significant effect of these transitions on our measure of educational attainment of the population.

Given the aim described above, the paper is organized as follows: Section 2.2 begins with an overview of literature that highlights the importance of political leader on different policy outcomes and especially those that emphasize education as a major feature of the leader; Section 2.3 provides the conceptual framework of our hypothesis; Section 2.4 describes the databases and variables used; Section 2.5 describes the econometric model and method of estimation; Section 2.6 presents the results and finally, Section 2.7 concludes.

2.2 Literature Review

Recently, a growing body of literature studies the importance of leader's characteristics in explaining outcomes. From a theoretical point of view, as Besley et al. (2011) note, this can be motivated using the citizen-candidate type approach as presented in Besley and Coate (1997) and Osborne and Slivinski (1996). These authors model political competition as a game between citizens competing to hold public office, where selection based on policy preferences, talent or virtue can affect policy outcomes.

From the empirical side, some studies look at the influence of leaders and their personal characteristics on political and economic outcomes such as economic policy, monetary policy and changes in the form of government. Related to the influence of leaders, i.e. who is the head of government, Jones and Olken (2005) show that the quality of leaders matters for economic growth. They stand the role of national leadership rather than the deterministic country characteristics and relatively persistent policy variables that have been focused in the most econometric work explaining economic growth. This is precisely the conceptual framework we adopt in this

paper. Later, Jones and Olken (2009) investigate the effects of assassinations and assassination attempts against political leaders on the institutional setup within a country between 1875 and 2004. They find that a successful assassination of autocrats will significantly increase the likelihood of a transition to democracy thereafter. A related study by Hayo and Voigt (2011) produce similar results. Hayo and Voigt (2011) find that changes in the constitution can be explained by characteristics of the political system, internal and external political conflicts, and political leaders, whereas economic and socio-demographic variables do not matter. Despite the results of both Jones and Olken (2009) and Hayo and Voigt (2011) demonstrate that the circumstances under which the reign of political leaders is terminated matter for changes in the form of government, their results do not indicate whether individual characteristics of political leaders themselves are relevant for such changes.

Some studies highlight the gender of the leader as a relevant characteristic and investigate the impact of women on economic policy. For instance, Chattopadhyay and Duflo (2004) analyze the influence of women representation in local councils in India on the types of locally provided public goods. They show that council members invest more in infrastructure that is directly related to the needs of their own gender. According to their findings women invest more in infrastructure such as water and roads while men in education.[2] Similarly, Svaleryd (2009) studies whether women's representation in Swedish local councils affects local public expenditure structures and finds a positive relation between the share of women on local councils and the spending on child care and education relative to elderly care. Dollar et al. (2001) study the role of women in government by examining the relationship between female participation in government legislatures and the level of perceived corruption. Their results show that increases in female participation lead to more honest government since countries exhibit lower levels of corruption. Also, Baltrunaite et al. (2012) analyze the effects of gender quotas in politics on the quality of politicians and show that the increase in female representation increases the average education level of elected politicians.

Other relevant characteristics are leaders' educational attainment and professional background. Our study is framed in the literature that stresses the impact of leaders' education on economic outcomes. Göhlmann and Vaubel (2007) find strong evidence that the inflation preferences of members of the central bank council depend on their education and professional experience. According to their findings, more law graduates in the council come along with higher inflation

[2]This paper is framed for studies on the effect of political reservation, i.e. reserving political office for particular groups in the population. Chattopadhyay and Duflo (2004) studied reservations for women and they argue that reservation matters by changing the identities of those elected to office.

rates compared to economists while former members of the central bank staff are accompanied by significantly lower inflation rates than former politicians. Dreher et al. (2009) studied the impact of education and profession on implementation of market-liberalizing reforms and found that entrepreneurs, professional scientists, and trained economists are significantly more reform oriented. For these authors when it comes to designing reform policy, politicians' education and professional experience is likely to be important. Congleton and Zhang (2009) use a similar approach and analyze the influence of U.S. presidents on economic growth. Their results indicate that higher levels of education and specific professional experiences of a president substantially increase economic growth. Constant and Tien (2010) show that foreign education of the leaders matters for Foreign Direct Investments (FDI) inflows in their home countries above and beyond standard determinants of FDI which are also essential for a country's economic growth. Finally, Besley et al. (2011) expand the set of random leadership transitions to show that leaders matter for growth as in the previous work of Jones and Olken (2005) and provide evidence supporting the view that heterogeneity among leaders' educational attainment is important with growth being higher by having leaders who are more highly educated.

2.3 Hypothesis

Our hypothesis is derived from the findings described in the previous section. It has been found that the elected representative (leader), at least to some degree, can pursue his or her own interests (Svaleryd, 2009). For instance, a general finding is that women prefer higher social spending than men (Lott and Kenny, 1999; Abrams and Settle, 1999; Aidt and Dallal, 2008).[3] Also, Hayo and Neumeier (2012) found that governments led by prime ministers from a poor socioeconomic background spend significantly more on social security, education, health, infrastructure, and public safety. Since these results support the idea that leaders spend more in certain areas according to their preferences, we expect that more educated leaders invest more in education issues.

As mentioned before, some authors highlight the impact of the educational level of leaders on economic growth, but they did not give further explanation on the 'why'. We hypothesize that a potential explanation for this link is that more educated leaders will take decisions and promote

[3] Abrams and Settle (1999), Aidt and Dallal (2008) and Lott and Kenny (1999) study the effect of women's suffrage on the growth of welfare state and the scope of government. Their findings show that social spending is systematically higher where women have and use the right to vote.

policies that will increase the human capital of the population. A greater stock of human capital implies a more skilled and productive workforce, which in turn will increase country's output (Barro and Lee, 2001).

Economic theory suggests that human capital is an important determinant of growth, and empirical evidence for a broad group of countries confirms this linkage (Barro, 1991; Benhabib and Spiegel, 1994; Romer, 1986, 1989; Lucas, 1988; Jones and Manuelli, 1990). According to these theories, human capital can boost growth through stimulating technological creation, invention and innovation, as well as facilitating the uptake and imitation of new technologies. Also, countries that start with a higher level of educational attainment in their population grow faster for a given level of initial per capita GDP and for given values of policy-related variables (Barro, 1991).

While there is little doubt of the theoretical importance of human capital for economic growth, and that only by providing more and more education countries can continue to prosper in a globalized economy, there has yet to emerge a consensus among empirical growth researchers on how to measure and model human capital in growth regressions. Some authors consider that education contributes to economic growth and productivity, but beyond a threshold its contribution is small and uncertain. For instance, Wolf (2002) argues that high private returns to education are not matched by high or consistent social returns, and that even if some education has a positive impact cannot be extrapolated endlessly as education expands. Sala-I-Martin et al. (2004) create a list of variables that are robust in explaining long-term economic growth, in this list one of the most important variables is the primary education enrollment rate.

2.4 Dataset and Variables

Our dataset on political leaders contains information for 214 countries over the period 1848-2004. However, for country level educational attainment there is only available data after 1970. Therefore, we restrict our study to the period 1970-2004 and over 140 countries. The database was constructed from different sources as explained below. In order to identify the primary ruler in each country and year we use Archigos data.[4] This database identifies the effective leader of each independent state and year based on the characteristics of the political system in place between 1875 and 2004 for 188 countries where two rules are generally followed: *i*) in Parliamentary regimes, the prime minister is coded as the ruler while in Presidential systems, it is the president; *ii*) in communist states, the Chairman of the Party is coded as the effective ruler.

[4]For more details about this data see Goemans et al. (2009).

The educational data for the leaders has been collected by Besley and Reynal-Querol.[5] This dataset contains information on leaders' educational attainment for a core sample of 1,672 leaders in 193 countries between 1847 and 2004. The database provides, as a measure of educated leaders, a core variable called *College degree* which is a dummy variable equal to 1 if the leader has college or post-graduate education (i.e. master's degree or PhD).[6] We use *College degree* to construct the educational transitions which are explained in more detail below.

For population's educational attainment at country level, income per capita and other country characteristics we use World Bank data.[7] Following Persson and Tabellini (2009), our measure of democracy is based on the Polity IV data covering all major independent states in the global system over the period 1800-2012. This data provides a measure of democracy (POLITY2) which capture three different dimensions: how competitive and open the recruitment of chief executive is; the extent to which the chief executive is constrained institutionally; and how competitive and regulated political participation is (Besley et al., 2011). Finally, we assemble a new database which contains information on 587 leaders and 165 countries where the primary completion rate was available (2800 obs.).[8]

Table 2.1 contains the description of the outcome variable and the explanatory variables used in this work. Our outcome variable is population's primary education completion rate (hereafter *PCRT*). This variable is constructed as the ratio, expressed in percentage, between the total number of new entrants in the last grade of primary education, regardless of age, and the total population of the theoretical entrance age to the last grade of primary. It is calculated by taking the total number of students in the last grade of primary school, minus the number of repeaters in that grade, divided by the total number of children of official graduation age. The ratio can exceed 100% due to over-aged and under-aged children who enter primary school late/early and/or repeat grades. This variable is the one which is available for a broader sample of countries and years.

In order to assess the impact of changes in the education of political leaders, we create two types of transitions: positive and negative. A *positive transition* is picked-up by a dummy variable that takes the value 1 when a country transitions from a non-educated leader (a leader with no

[5]We thank Besley and Reynal Querol for providing their database.

[6]See Besley and Reynal-Querol (2011) for more details on the construction of this dataset.

[7]Education data comes from wbopendata available in Stata developed by Azevedo (2011).

[8]Our sample selection is driven by data availability. While data on education are available for 214 countries over the period 1848-2004, we lose observations due to missing control variables. The list of leaders considered in our sample are shown in Table 2.4 in Appendix 2.

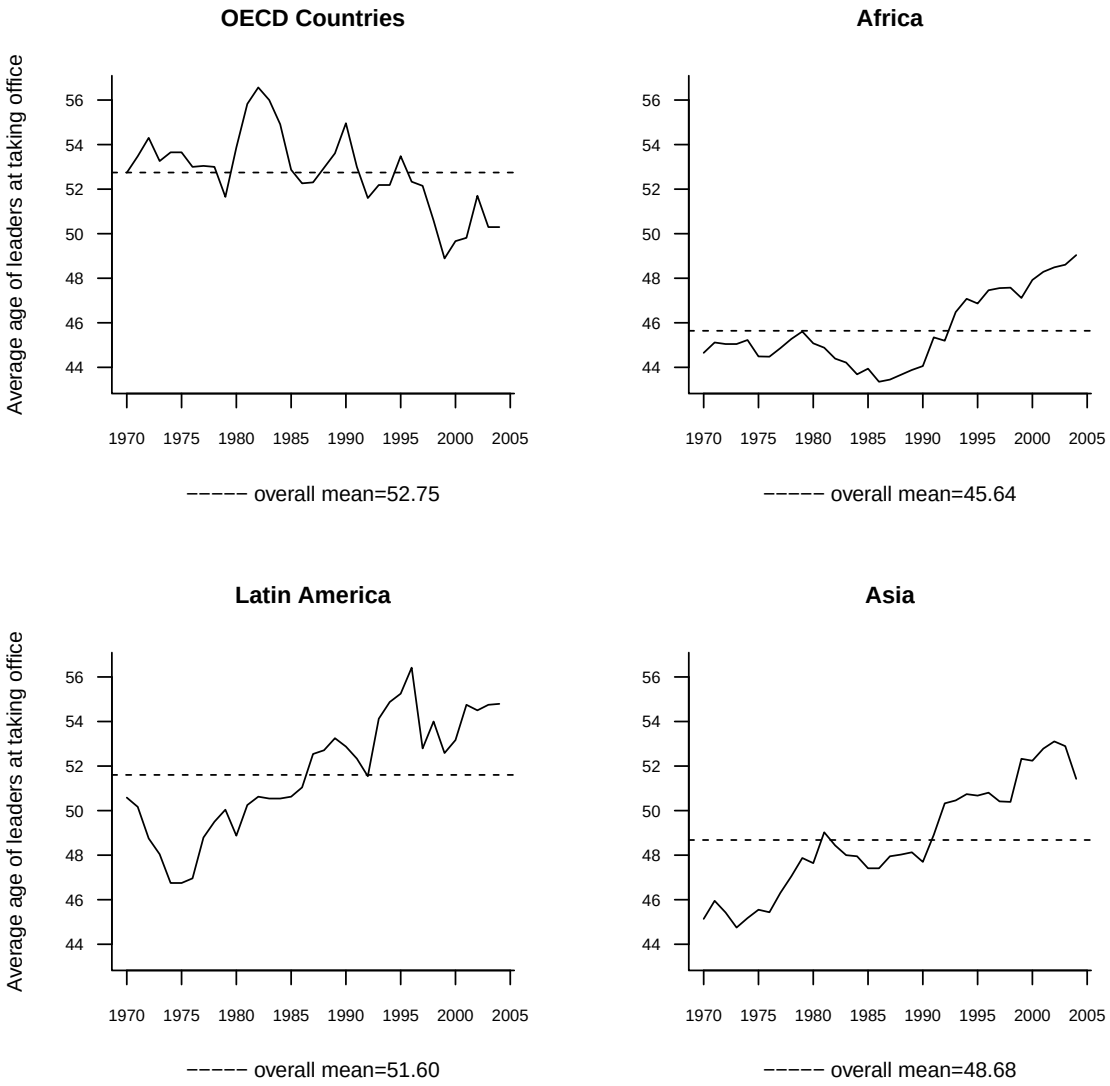
college education) to an educated one (a leader with at least college education) until the end of the period in our sample. Analogously, a *negative transition* is picked-up by a dummy variable that takes the value 1 when a country transitions from an educated leader (a leader with at least college education) to a non-educated one (a leader with no college education) until the end of the period. Countries that experience both types of transitions are excluded from the sample. As we will explain later, countries that do not experience any transition will be used as a control group to assess the impact of leaders educational transitions.

The leader characteristics we control for are education, age and time the leader remains in office (*tenure*). Country controls are GDP per capita, number of grades (years) required to complete primary education (*duration of primary*) and whether country's political regime is a democracy or not. In Table 2.2 we show a summary statistics of our data. In our sample, on average, the primary completion rate is 73.3% and the duration of primary is about 5.75 years. In 52.1% of the years there is a positive transition and in 7.9% of the years there is a negative transition. In 46.1% of the country-year observations the regime is democratic. The average age of a leader is about 56 years and the average number of years in office is about 8.52. We can observe that all of them vary across countries and time.

Table 2.3 details descriptive statistics by group of countries. As can be seen, Latin America and OECD countries do not experienced negative transitions during the period considered in our sample. Concerning positive transitions, Latin America has the highest value with 75.7% of the country-year observations, while the lowest value corresponds to Asia with 45.1%.

Figures 2.1 to 2.3 depict the evolution over time of different leaders' characteristics (age, tenure and education) for Latin America, Asia, Africa and OECD countries. In each graph of these figures a dashed horizontal line indicates the overall mean of the characteristic for all the period (1970-2004). In Figure 2.1, we observe that the average age of African leaders upon entering in office is about 46 years , while in Asia it is about 49 years. Latin American leaders are, on average, 52 years old, almost the same as in OECD countries which it is about 53. In the case of Latin America and Asian countries, it can be seen a growing trend in the age of the leaders at taking office. In this sense, more experienced leaders are being elected to rule as the case of OECD countries who present the oldest leader's age for holding office. In terms of the number of years in office, Figure 2.2 shows that African and Asian leaders spend, on average, more time in office that the heads of government in Latin American and OECD countries. More specifically, on average the term of office for African leaders is 9.79 years, for an Asian leaders

Figure 2.1: Average Age of Leaders at Taking office.

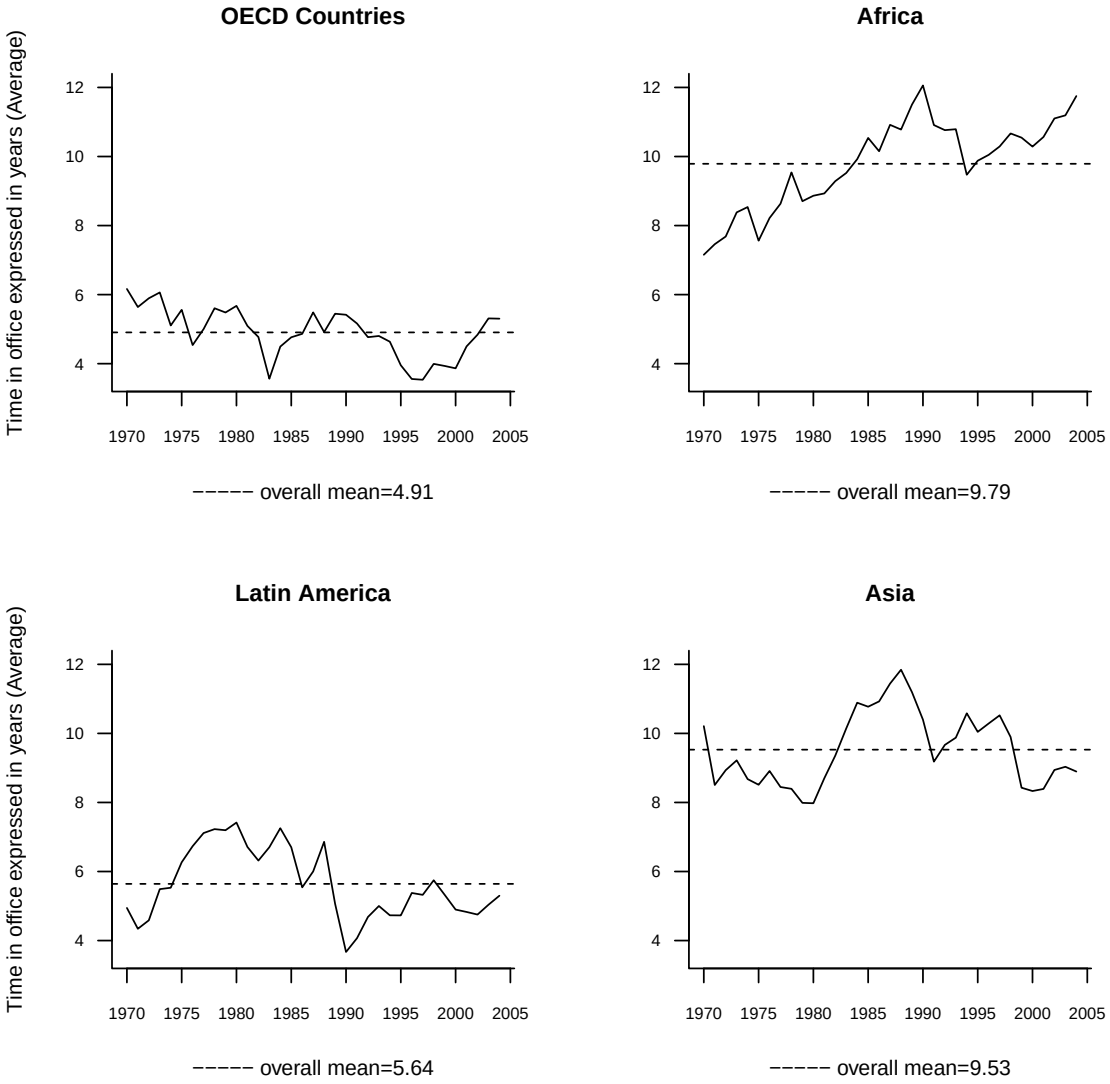


Note: The dashed horizontal line indicates the overall mean of the age of leaders –at taking office– for all the period (1970-2004). Source: own elaboration.

is 9.53 years, while for Latin American and OECD leaders are 5.64 and 4.91 years, respectively. Furthermore, we can observe that African leaders, on average, remain in power much longer than their counterparts.

Figure 2.3 looks at the variation over time in the proportion of leaders who have college degree across countries. We observe a growing tendency in the proportion of educated leaders. In this figure, Asian countries experience the more dramatic increment in the proportion of educated leaders ranging from 46% in 1970 to 80% in 2004. On average, Latin American and OECD countries have higher proportions of educated leaders, 85% and 86%, respectively; while these figures in African and Asian countries are 62% and 66%, respectively. It is worth noting, that

Figure 2.2: Average Tenure of Leaders (expressed in years).

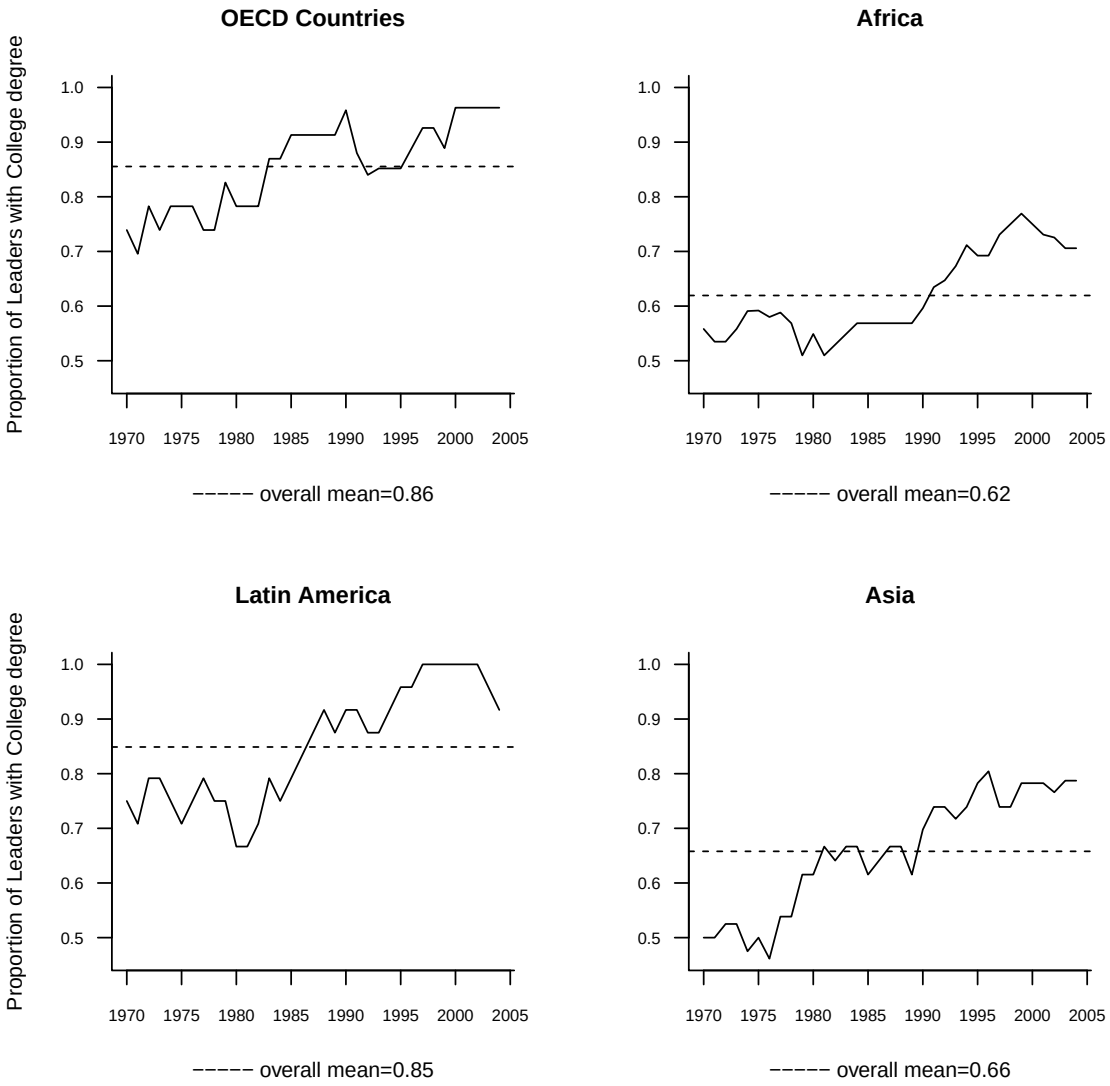


Note: The dashed horizontal line indicates the overall mean of the tenure of leaders for all the period (1970-2004). Source: own elaboration.

Latin American and OECD countries present almost the same evolution in the characteristics of the leaders ruling in these countries during the period of our study. The same applies for Asian and African countries.

Figure 2.4 displays the evolution of primary completion rate ($PCRT$). In this figure, we observe that, on average, OECD countries have the higher level of educational attainment given that about 96.77% of the students in the last grade of primary complete the primary education, while African countries present the lowest rate (48.91%). For Latin American and Asian countries the rate of students completing the last grade of primary are 77.19% and 80.26%, respectively. Comparing Figures 2.3 and 2.4, we observe both an increase in the proportion of educated leaders and an

Figure 2.3: Evolution of Proportion of Leaders with at least College Degree.



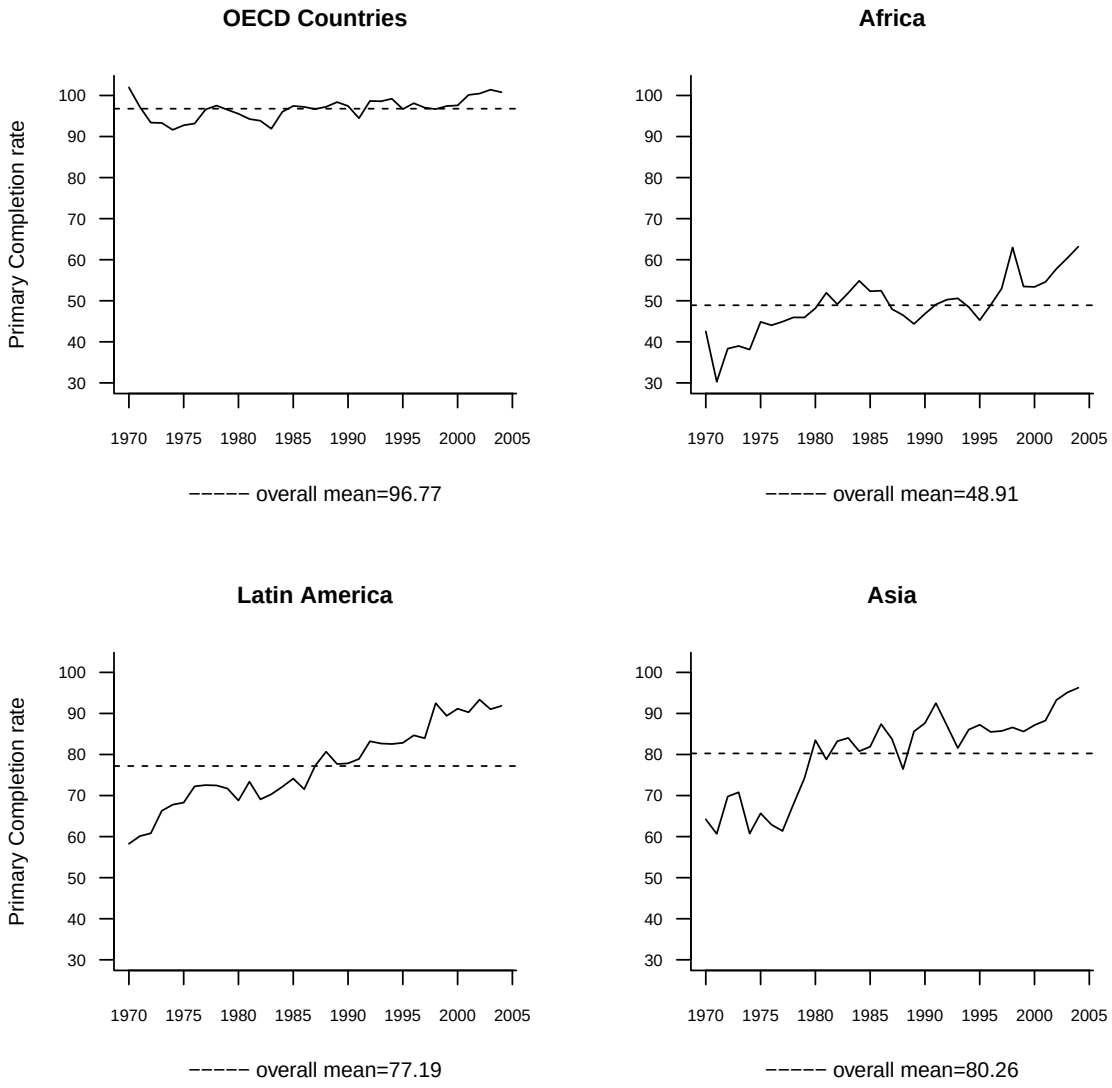
Note: The dashed horizontal line indicates the overall mean of the proportion of leaders with at least college degree for all the period (1970-2004). Source: own elaboration.

increase in the primary completion rate.[9]

In order to illustrate the potential effect of the leaders' educational transitions on the educational attainment of the population, Figure 2.5 shows the evolution of primary completion rate in Italy and indicate when the transitions occurs. In the graph, a solid vertical line indicates the year at which a leader without higher education came to power (negative transition), and a dashed vertical line indicates the year at which a leader with higher education came to power (positive transition). As can be seen in Figure 2.5, Italy experienced growth in the primary completion

[9]Figure 2.6 in Appendix 2 shows the same analysis across countries. In a descriptive way, our data shows that countries with higher proportion of educated leaders have higher completion rates.

Figure 2.4: Evolution of Primary Completion Rate.



Note: The dashed horizontal line indicates the overall mean of the Primary Completion Rate for all the period (1970-2004). Source: own elaboration.

rate coincident with the positive transitions and experienced growth reversals in the completion rate when a leader without higher education remained in office (negative transition). However, the linkages between these transitions and particular changes in the primary completion rate may be due to specific events occurring during that period. Therefore, in the next section we test our hypothesis of whether more educated leaders matter for improving the educational attainment of population using more rigorous econometric methods.

Figure 2.5: Primary Completion Rate and Educational Transitions: Italy.

Note: The solid vertical line indicates the year at which a leader without higher education came to power (*negative transition*). The dashed line indicates the year at which a leader with higher education came to power (*positive transition*). Source: own elaboration.

2.5 Empirical Strategy

In order to test the hypothesis that leader's education might have an impact on population's educational attainment, we consider the following empirical model:

$$\Delta y_{ilt} = \alpha + y_{il,t-1}\delta + d_{it}\gamma + \mathbf{Z}_{lt}\lambda + \mathbf{X}_{it}\beta + \mu_l + \varepsilon_{ilt} \tag{2.1}$$

where y_{ilt} is the educational attainment of population (Primary Education Completion Rate) in country i at time t while leader l is in office; Δ is the difference operator; d_{it} picks the transition, the change of the educational level of the political leader in country i at time t; Z_{lt} is a matrix containing the leaders characteristics; X_{it} is a matrix containing a set of covariates controlling for country characteristics; μ_l is a leader-specific fixed-effect; ε_{ilt} is a time-varying error term, and $\alpha, \delta, \gamma, \lambda$ and β are a set of parameters to be estimated. Since we are interested in assessing the impact of a characteristic of the political leader (education), the inclusion in Equation 2.1 of leader specific effects is very convenient. On the one hand, we can control for leader's unobserved heterogeneity, which is not controlled for through the leader characteristics included in Z_{lt}. On the other hand, since one leader can be in office only in one country, the leader-specific effect also

absorbs the country-specific effects.

Our main coefficient of interest is γ, which reflects the effect of the educational transition of the leader (positive or negative) on the growth rate of the primary completion rate ($PCRT$). In order to assess the impact of an educational transition of the leader, countries are compared with a control group of countries that not experience any transition. When we analyze the impact of a positive transition (from a leader without to a leader with college education), countries experiencing this type of transition are compared with countries that have non-educated leaders during all period of study. On the contrary, countries experiencing negative transitions (from a leader with to a leader without college education) are compared with countries that have leaders with college education throughout the period of study (see Table 2.5 in Appendix 2).

Our outcome variable (y_{it}) is the Primary Completion Rate ($PCRT$). In order to capture potential state-dependence in our outcome variable (Δy_{it}), that is, changes in the level of education of the population depends on its initial value when a leader takes office, we include our endogenous variable lagged one period ($y_{i,t-1}$). Those countries that have higher primary completion rate will grow at a lower rate than those countries that have lower completion rates in $t-1$.

The characteristics of the leader we consider are age and years in office (*tenure*). Age is considered since this variable can be associated with cognitive abilities which are important for political decision making and accurately expressing one's political preferences or the level of government responsiveness (Lau and Redlawsk, 2008). Tenure is also important, since is a proxy of the leader's experience. In order to control for differences between income levels across countries, we include the GDP per capita lagged one year, and GDP growth. We also control for democracy status, since the effect of the leader is supposed to be stronger in autocratic environments where there are fewer constraints on a leader's power compared to democratic regimes (Jones and Olken, 2005; Barro, 1999). Finally, we control for the duration of the primary which may affect the primary completion rate, since the longer the duration of primary the more likely to dropout (Angrist and Krueger, 1991).

The econometric strategy used to estimate Equation 2.1 consists of differencing the equation in order to remove the leader-specific effect μ_i. However, differencing means that even strictly exogenous variables can become endogenous, in addition to the presence of non-strictly exogenous variables. Therefore, by construction, in Equation 2.1 we have the lagged difference of our endogenous variable and it may be that the difference of other explanatory variables is correlated with the error term, which in turn creates a severe problem of endogeneity. Hence, our core

specification will include not only correlated and heteroskedastic residuals, but also non-strictly exogenous and endogenous variables as covariates. In this context, a fixed-effects model with the Newey–West corrected covariance matrix provides consistent estimates of the standard errors in the presence of serial correlation and heteroskedasticity in the residuals. However, the presence of endogenous covariates creates severe identification problems in the econometric estimation that in turn lead to inconsistent estimate of model.

In order to estimate Equation 2.1, we use a variant of the Arellano and Bond (1991) Generalized Method of Moments (GMM) estimator. Arellano and Bover (1995), Blundell and Bond (1998) and Bond (2002) show that often lags for the levels of these variables are poor instruments, and they suggest suitable conditions for fixing this problem. One alternative is to instrument endogenous and non-strictly exogenous variables with lags of their own first differences, instead of with lags for the variables in levels. The GMM variant of the original Arellano and Bond's estimator used here incorporates these elements. In particular, the method we use here has both one-and two-step versions. We adopt the two-step method as it is the most efficient, though the estimated variances tend to be biased downwards. In order to fix this, we apply the finite-sample correction of the two-step covariance matrix proposed in Windmeijer (2005), without which those standard errors tend to be severely downward biased.[10]

2.6 Empirical Results

Table 2.6 reports the results from the estimation of our core model (Equation 2.1) by the Generalized Method of Moments (GMM) . Model 1 presents the results considering just the educational level of the leader by a dummy variable (college degree or not). Models 2 and 3 show the effects of the positive and negative transitions on the $PCRT$, respectively. As we mention in the previous section, the control group for the *positive transition* are those countries which have non-educated leader all period of study and for *negative transition* are those countries that have leaders with college education throughout the period of study. Hence, the interpretation of all results regarding the impact of the educational transition is relative to these baseline groups. We first comment on the results regarding our control variables, and later we focus on our variables of interest.

Our results indicates that laggard countries in terms of educational achievement tend to experience a greater growth rate of the $PCRT$, since we find a significant and negative effect of the initial value of the primary completion rate ($PCRT_{t-1}$) for all specifications.

[10] See Roodman (2009) for details.

Controlling for leader's characteristics, we find that age and tenure, which are proxies of leader's experience affect positively the educational attainment of the population. This result indicates that the greater the experience of leaders the greater the effect on the educational level of the population, since they are more able to make decisions given his/her previous experience. We consider a squared polynomial on age of the political leader and obtain that the effect of age is inverted U-shaped. This result indicated that the effect is positive but decreasing.

With respect to country variables, we observe that logarithm of GDP per capita lagged one period and the growth rate of the log GDP per capita exert a positive and statistically significant effect on the growth rate of the *PCRT*. On the contrary, the duration of primary education and democracy has a negative effect on the growth rate of *PCRT*. This negative effect of duration of primary indicates that in countries where students have to spend more years in primary education may also experience higher levels of drop-outs. The negative effect obtained for democratic countries can be explained by the fact that high levels of schooling are both a prerequisite for democracy and a major cause of democratization (Lipset, 1959; Barro, 1999; Glaeser et al., 2004).[11] Therefore, democratic countries with higher levels of primary completion rate will have a lower growth rate compared to non-democratic countries where the educational attainment tend to be lower.

Concerning our specific research question our results reveal that leaders' education indeed affects the education level of population. Model 1 shows that in the annual growth rate of the *PCRT* is larger in countries where the leader possesses a college degree. However, this result could be explained by the fact that in countries more prone to have educated leaders, also exhibit a structural propensity to experience a higher growth rate of the *PCRT*. In order to disentangle this, we also include the impact of both transitions.

Ours results shows that when a *positive transition* occurs there is an increase in the level of educational attainment, which means that the performance of leaders ruling with (at least) college degree is better than their counterparts without higher education. This result supports the main hypothesis we propose in this study, since the educational attainment of population increases when the country transitions from a non-educated leader to an educated one compared to those countries with non-educated leaders all the time.

Other result that supports our hypothesis is that unlike positive transition, we find that tran-

[11] According to Acemoglu et al. (2005), education is argued to promote democracy both because it enables a "culture of democracy" to develop and because it leads to greater prosperity, which is also thought to cause political development.

sitioning from an educated leader to a less educated one the educational attainment of population is impacted negatively. We obtain that during the negative transitions, the primary completion rate experiences a growth reversal comparing to those countries which have educated leader all period of study.

The statistical significant effect of our two main explanatory variables measuring educational transitions support the finding with the educational level, showing that more educated leaders lead to more educated citizens.

Finally, we also report the Hansen test of over-identifying restrictions, which is a test of the validity of instrumental variables.[12] The Hansen J statistic replaces the Sargan test used in the original one-step Arellano-Bond estimator, since the Hansen test is robust to heteroskedasticity or autocorrelation.[13] We find that the validity of the instruments is confirmed for all the specifications used, since χ^2 statistic is not significant in any model. Alternatively, we also show the results of the Arellano-Bond test for autocorrelation AR(1) and AR(2).[14] We observe that AR(1) structure cannot be rejected for estimated models 1 and 2, while the AR(2) structure is rejected for all of them. The results of these tests indicate that there is no serial correlation between the first-differenced variables used as instruments and the first differences of the residuals . Therefore, they are good instruments.[15]

2.7 Conclusions

In this paper we estimate the effect of educational transitions on the educational attainment of population during the period 1970-2004. We find that more educated leaders lead to more educated citizens. We find that the educational attainment of population increases when the

[12]Under the null hypothesis the statistic follows a chi-square where the degrees of freedom are determined by the number of instruments used in the estimation.

[13]See Roodman (2009) for details.

[14]The null hypothesis is no autocorrelation and is applied to the differenced residuals. The test for AR (1) process in first differences usually rejects the null hypothesis because $\Delta\varepsilon_{ilt}$ is mathematically related to $\Delta\varepsilon_{il,t-1}$ with which it shares a $\varepsilon_{il,t-1}$ term. So, negative first-order serial correlation is expected in differences and evidence of it is uninformative. The test for AR (2) in first differences is more important, because it will detect autocorrelation in levels between the $\varepsilon_{il,t-1}$ in $\Delta\varepsilon_{ilt}$ and the $\varepsilon_{il,t-2}$ in $\Delta\varepsilon_{il,t-2}$.

[15]An AR(1) structure implies that serial autocorrelation is removed after one difference, whereas a higher order structure AR(s), with s$\geq$2, means that a first difference is not enough to remove autocorrelation. Given that the estimation method used here uses as instruments the first differences, the persistence of this correlation after applying a first difference would imply that they are endogenous, and hence bad instruments.

country transitions from a non-educated leader to an educated leader compared to those countries with non-educated leaders all the time. On the contrary, a negative transition, i.e. from a highly educated leader to a leader with just secondary education, have a negative impact on the educational attainment of the population. These findings support the main hypothesis we propose in this study. We hypothesize that the positive link between the education of the political leader and the education of the population we find here, is as plausible explanation for the effect of leader's education on economic growth found in the previous literature. We contribute to the literature by providing further evidence in the scant but emerging literature that links leaders' characteristics with countries' performance. All this evidence taken together suggests that the socio-economic background of political leaders may be informative about the type of policies they can be more sensitive. Therefore, this claims for the convenience of the use of "open lists" in democratic countries, where voters can decide not only about the party in the government but also about the individuals in each list.

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Appendix 2. Tables and Figures.

Table 2.1: Variables Description and Sources.

Variables	Description	Source	Period Covered
Dependent variable			
Primary completion rate	Percentage of students completing the last year of primary school. The ratio can exceed 100% due to over-aged and under-aged children who enter primary school late/early and/or repeat grades.	United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics.	1970-2050
Explanatory variables			
Positive transition	Dummy variable that takes the value 1 when a country transitions from a non-educated leader to an educated one until the end of the period in our sample.	Own based on Besley and Reynal-Querol data.	1847-2004
Negative transition	Dummy variable that takes value the 1 when a country transitions from an educated leader to a non-educated one until the end of the period.		
Leaders' Characteristics			
College degree	Dummy variable equal to 1 if the leader has college education or post-graduate qualification (i.e. master's degree or PhD)	Besley and Reynal-Querol data	1847-2004
Age	Age of leader	Archigos data	1875-2004
Tenure	Natural log of Time in office	Archigos data	1875-2004
Country Characteristics			
Duration of primary	Number of grades (years) in primary education	UNESCO Institute for Statistics.	1970-2050
Democracy	1 if the POLITY2 variable has a positive value in the year the leader is selected.	Polity IV data	1800-2010
Log (GDP)	Log of per capita income measured in the year when the leader is selected.	World Bank data	1960-2011
Urban population growth	Urban population refers to people living in urban areas as defined by national statistical offices	World Bank Staff estimates based on United Nations, World Urbanization Prospects.	1960-2012

Table 2.2: Summary Statistics (All sample)

	Mean	**Std. Dev.**			**Observations**	
		overall	between	within	N	n
Primary Completion rate						
Levels	73.321	28.871	26.762	11.209	2800	165
Δ	0.868	5.211	2.250	5.046	2293	158
Positive transition	0.521	0.500	0.423	0.309	817	44
Negative transition	0.079	0.269	0.222	0.115	904	59
College degree	0.718	0.450	0.355	0.288	2800	165
Age	56.274	11.530	8.917	8.186	2800	165
Tenure (years)	8.522	8.283	5.323	5.796	2800	165
Democracy	0.461	0.499	0.424	0.290	2590	147
Duration of primary	5.756	0.825	0.935	0.210	2800	165
Log(GDP per cap.)	7.453	1.498	1.521	0.216	2594	161
Urban population growth	3.210	2.547	2.258	1.392	2797	165

Notes: N=Number of observations per Country-years; n=Number of Countries.

Table 2.3: Summary Statistics by Group of Countries

Sample:	**OECD Countries**			**Africa**			**Latin America**			**Asia**		
	Mean	**Std. Dev.**	**N**	**Mean**	**Std. Dev.**	**N**	**Mean**	**Std. Dev.**	**N**	**Mean**	**Std. Dev.**	**N**
Primary Completion rate												
Levels	96.856	7.918	397	49.426	26.521	1008	77.733	19.71	504	82.401	23.171	588
Δ	0.272	3.016	346	1.116	5.605	832	0.911	3.519	404	1.195	5.354	467
Positive transition	0.629	0.485	140	0.544	0.498	663	0.757	0.432	70	0.451	0.498	506
Negative transition	0	0	403	0.16	0.367	444	0	0	210	0.109	0.312	386
College degree	0.859	0.348	858	0.621	0.485	1754	0.849	0.358	840	0.665	0.472	1472
Age	57.076	8.700	858	55.047	11.898	1754	56.713	10.645	840	57.937	12.342	1472
Tenure (years)	4.875	5.122	858	9.84	7.842	1754	5.642	7.193	840	9.52	9.324	1472
Democracy	0.932	0.253	775	0.227	0.419	1697	0.645	0.479	805	0.299	0.458	1368
Duration of primary	5.611	0.817	858	6.045	0.66	1754	5.952	0.537	840	5.313	0.905	1374
Log(GDP per cap.)	9.587	0.574	827	6.186	0.982	1561	7.74	0.667	816	7.398	1.621	1052
Urban population growth	0.859	0.767	858	4.626	2.358	1754	2.713	1.375	840	3.669	3.207	1371

Table 2.4: Political Leaders Included in our Sample

Country	Leader	Deg.	Country	Leader	Deg.
Afghanistan	Burhanuddin Rabbani	1	Brunei Darussalam	Hassanal Bolkiah	1
Afghanistan	Karmal	1	Bulgaria	Berov	1
Afghanistan	Sardar M. Daud Khan	0	Bulgaria	Dimitrov, P.	1
Afghanistan	Taraki	0	Bulgaria	Kostov	1
Albania	Berisha	1	Bulgaria	Mladenov	0
Albania	Fatos Nano	1	Bulgaria	Popov	1
Albania	Meta	1	Bulgaria	Saksgoburggotski	1
Algeria	Benjedid	0	Bulgaria	Videnov	1
Algeria	Boumedienne	1	Bulgaria	Zhivkov	0
Algeria	Bouteflika	0	Burkina Faso	Campaore	1
Algeria	Kafi	0	Burkina Faso	Gerard Kango	0
Algeria	Zeroual	0	Burkina Faso	J. P. Ouedraogo	0
Angola	Dos Santos	1	Burkina Faso	Lamizana	0
Antigua & Barbuda	Bird, Vere Cornwall	0	Burkina Faso	Sankara	0
Argentina	Eduardo Duhalde	1	Burkina Faso	Zerbo	0
Argentina	Lanusse	1	Burundi	Bagaza	1
Argentina	Levingston	1	Burundi	Buyoya	1
Argentina	Menem	1	Burundi	Micombero	1
Argentina	Nestor Kirchner	1	Burundi	Ndayizeye	1
Argentina	Peron, Isabel	0	Cambodia	Hun Sen	0
Argentina	Videla	1	Cambodia	Ranariddh	1
Argentina	de la Rua	1	Cameroon	Ahidjo	0
Armenia	Kocharian	1	Cameroon	Biya	1
Armenia	Ter-Petrosyan	1	Canada	Chretien	1
Austria	Klima	1	Cape Verde	Neves	1
Austria	Kreisky	1	Cape Verde	Pires	0
Austria	Schussel	1	Cape Verde	Veiga	1
Azerbaijan	H. Aliyev	1	Central African Rep.	Bokassa	0
Azerbaijan	Ilhma Aliyev	1	Central African Rep.	Dacko	0
Bahamas	Ingraham	1	Central African Rep.	Francois Bozize	0
Bahrain	Hamad I. Al-Khalifah	1	Central African Rep.	Kolingba	0
Bahrain	Isa Ibn Al-Khalifah	0	Chad	Deby	1
Bangladesh	Ershad	0	Chad	Habre	0
Bangladesh	Sattar	1	Chad	Malloum	1
Bangladesh	Ziaur Rahman	0	Chad	Tombalbaye	0
Barbados	Arthur	1	Chile	Allende	1
Belarus	Hryb	0	Chile	Frei Montalva	1
Belarus	Lukashenko	1	Chile	Frei Ruiz-Tagle	1
Belarus	Shushkevich	1	Chile	Pinochet	1
Belgium	Eyskens, M.	1	Chile	Ricardo Lagos	1
Belgium	Martens	1	China	Deng Xiaoping	1
Belgium	Tindemans	1	China	Jiang Zemin	1
Belize	Esquivel	1	Colombia	Alvaro Uribe Velez	1
Belize	Musa	1	Colombia	Arango	1
Benin	Ahomadegbe	1	Colombia	Barco Vargas, Virgilio	1
Benin	Kerekou	1	Colombia	Betancur	1
Benin	Maga	0	Colombia	Lleras Restropo	1
Benin	Soglo, Nicephore	0	Colombia	Pastrana Borrero	1
Bhutan	Lyonpo Jigme Thinley	1	Colombia	Pizano	1
Bhutan	Lyonpo Sangay Ngedup	1	Colombia	Trujillo	1
Bhutan	Lyonpo Yeshey Zimba	1	Colombia	Turbay	0
Bhutan	Wangchuck, Jigme Singye	1	Comoros	Abdallah	0
Bolivia	Banzer Suarez	1	Comoros	Azali Assoumani	1
Bolivia	Carlos Mesa	1	Comoros	Djohar	1
Bolivia	Gonzalo Sanchez	1	Congo, Dem. Rep.	Joseph Kabila	0
Bolivia	Jorge Quiroga Ramirez	1	Congo, Dem. Rep.	Laurent Kabila	1
Bolivia	Paz Zamora	1	Congo, Dem. Rep.	Mobutu	0
Botswana	Khama	1	Congo, Rep.	Lissouba	1
Botswana	Masire	0	Congo, Rep.	Ngouabi	1
Botswana	Mogae	1	Congo, Rep.	Nguesso	1
Brazil	Cardoso	1	Congo, Rep.	Opango	1
Brazil	Figueiredo	1	Costa Rica	Arias	1
Brazil	Franco, Itamar	1	Costa Rica	Calderon Fournier	1
Brazil	Geisel	1	Costa Rica	Carazo Odio	1
Brazil	Lula da Silva	0	Costa Rica	Figueres Ferrer	0
Brazil	Medici	1	Costa Rica	Figueres Olsen	1
Brazil	Mello	1	Costa Rica	Monge Alverez	0
Brazil	Sarnay	1	Costa Rica	Quiros, Daniel	1
Costa Rica	Rodriguez Echeverria	1	Fiji	Rabuka	1
Costa Rica	de la Espriella	1	Finland	Halonen	1
Cote d'Ivoire	Guei	1	Finland	Koivisto	1
Cote d'Ivoire	Houphouet-Boigny	1	Finland	Marthi Ahtisaari	1

Note: Deg. = 1 if the leader has college education or post-graduate qualification).

Continued on next page

Table 2.4 – continued from previous page

Country	Leader	Deg.	Country	Leader	Deg.
Cote d'Ivoire	Konan Bedie	1	France	Chirac	1
Cote d'Ivoire	Laurent Gbagbo	1	France	Giscard D'Estaing	1
Croatia	Mesic	1	France	Mitterand	1
Croatia	Tudjman	1	France	Pompidou	1
Cuba	Fidel Castro	1	Gabon	Bongo	1
Cyprus	Clerides	1	Gambia	Jammeh	0
Cyprus	Kyprianou	1	Gambia	Jawara	1
Cyprus	Makarios	1	Georgia	Saakashvili	1
Cyprus	Tassos N. Papadopoulos	1	Georgia	Shevardnadze	1
Cyprus	Vassiliou	1	Germany	Kohl	1
Czech Rep.	Spidla	1	Germany	Schroder	1
Czech Rep.	V. Klaus	1	Ghana	Acheampong	0
Czech Rep.	Zeman	1	Ghana	Akuffo	1
Denmark	Baunsgaard	0	Ghana	Busia	1
Denmark	Fogh Rasmussen	1	Ghana	John Agyekum Kufuor	1
Denmark	Hartling	1	Ghana	Limann	1
Denmark	Jorgensen	0	Ghana	Rawlings	1
Denmark	Krag	1	Greece	A. Papandreou	1
Denmark	Nyrup Rasmussen	1	Greece	Ionannides	1
Denmark	Schluter	1	Greece	Karamanlis	1
Djibouti	Gouled Aptidon	0	Greece	Konstantinos Karamanlis	1
Djibouti	Guelleh	0	Greece	Mitsotakis	1
Dominica	Charles, Eugenia	1	Greece	Papadopoulos	1
Dominica	Charles, Pierre	1	Greece	Rallis	1
Dominica	Douglas, Roosevelt	1	Grenada	Bishop, Maurice	1
Dominica	James, Edison	1	Grenada	Blaize, Herbert	0
Dominican Rep.	Balaguer	1	Grenada	Brathwaite, Nicholas	1
Dominican Rep.	Fernandez Reyna	1	Grenada	Gairy, Eric	0
Dominican Rep.	Guzman Fernandez	0	Grenada	Mitchell, Keith	1
Dominican Rep.	Hipolito Mejia	1	Guatemala	Alfonso Portillo	1
Ecuador	Alarcon Fabian	1	Guatemala	Arana Osorio	1
Ecuador	Duran Ballen	1	Guatemala	Arzu Yrigoyen	1
Ecuador	Febres Cordaro	1	Guatemala	Berger Perdomo	1
Ecuador	Gustavo Noboa	1	Guatemala	Cerezo	1
Ecuador	Hurtado Larrea	1	Guatemala	Laugerud Garcia	1
Ecuador	Lucio Gutierrez	1	Guatemala	Lucas Garcia	1
Ecuador	Mahuad	1	Guatemala	Mejia Victores	1
Ecuador	Poveda Burbano	1	Guatemala	Rios Montt	1
Ecuador	Rodriguez Lara	1	Guinea	Conte	1
Ecuador	Roldos Aquilers	1	Guinea	Toure	0
Ecuador	Velasco Ibarra	1	Guinea-Bissau	Cabral	0
Egypt, Arab Rep.	Mubarak	1	Guinea-Bissau	Kumba Iala	1
Egypt, Arab Rep.	Sadat	0	Guinea-Bissau	Sanha	1
El Salvador	Calderon Sol	1	Guinea-Bissau	Vieira	0
El Salvador	Cristiani	1	Guyana	Bharrat Jagdeo	1
El Salvador	Duarte	1	Guyana	Burnham	1
El Salvador	Flores, Francisco	1	Guyana	Hoyte	1
El Salvador	Magana Borjo	1	Guyana	Jagan Cheddi	1
El Salvador	Molina	1	Guyana	Janet Jagan	1
El Salvador	Romero Mena	1	Guyana	Samuel Hinds	1
El Salvador	Saca González	0	Haiti	Duvalier, Jean-	0
El Salvador	Sanchez Hernandez	0	Haiti	Namphy	0
Equatorial Guinea	Nguema Mbasogo	1	Haiti	Preval	1
Eritrea	Afeworki	0	Honduras	Callejas	1
Estonia	Kallas	1	Honduras	Paz Garcia	0
Estonia	Laar	1	Honduras	Reina	1
Estonia	Parts	1	Honduras	Suazo Cordova	1
Estonia	Siimann	1	Hungary	Antall	1
Estonia	Vahi	1	Hungary	Grosz	0
Ethiopia	Meles Zenawi	0	Hungary	Horn	1
Ethiopia	Mengistu Marriam	1	Hungary	Kadar	0
Fiji	Chaudhry	0	Hungary	Orban	1
Fiji	Laisenia Qarase	1	Hungary	Peter Medgyessy	1
Fiji	Mara	1	Iceland	Oddsson	1
India	Gandhi, I.	1	Lao PDR	Phomivan	1
India	Gandhi, R.	1	Lao PDR	Phounsavanh	1
India	Manmohan Singh	1	Lao PDR	Siphandon	0
India	Rao	1	Latvia	Berzins	1
India	Vajpayee	1	Latvia	Gailis	1
Indonesia	Megawati Sukarnoputri	0	Latvia	Indulis Emsis	1
Indonesia	Suharto	0	Latvia	Kristopans	1
Indonesia	Wahid	1	Latvia	Repse	1
Iran, Islamic Rep.	Ayatollah Khomeini	0	Latvia	Skele	1

Note: Deg. = 1 if the leader has college education or post-graduate qualification).

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Table 2.4 – continued from previous page

Country	Leader	Deg.	Country	Leader	Deg.
Iran, Islamic Rep.	Khatami	1	Lebanon	Elias Hrawi	1
Iran, Islamic Rep.	Mohammad Reza	0	Lebanon	Emile Lahoud	1
Iran, Islamic Rep.	Rafsanjani	1	Lesotho	Jonathan	0
Iraq	Hassan Al-Bakr	0	Lesotho	Lekhanya	0
Iraq	Iyad Allawi	1	Lesotho	Mokhehle	1
Iraq	Saddam Hussein	1	Lesotho	Mosisili	1
Ireland	Ahern	1	Lesotho	Ramaema	0
Ireland	Bruton	1	Liberia	Tolbert	1
Ireland	Reynolds	1	Libya	Qaddafi	1
Israel	Ariel Sharon	0	Lithuania	Adamkus	1
Italy	Amato	1	Lithuania	Brazauskas	1
Italy	Andreotti	1	Lithuania	Paksas	1
Italy	Berlusconi	1	Luxembourg	Thorn G.	1
Italy	Colombo	1	Luxembourg	Werner	1
Italy	Cossiga	1	Macedonia, FYR	Crvenkovski	1
Italy	Craxi	1	Macedonia, FYR	Georgievski	1
Italy	D'Alema	0	Macedonia, FYR	Hari Kostov	1
Italy	Dini	1	Madagascar	Marc Ravalomanana	0
Italy	Fanfani	1	Madagascar	Ramanantsoa	1
Italy	Goria	1	Madagascar	Ratsiraka	1
Italy	Mita	1	Madagascar	Tsiranana	0
Italy	Moro	1	Madagascar	Zafy	1
Italy	Prodi	1	Malawi	Banda	1
Italy	Rumor	1	Malawi	Bingu wa Mutharika	1
Italy	Spadolini	1	Malawi	Muluzi	1
Jamaica	Manley	1	Malaysia	Ahmad Badawi	1
Jamaica	Patterson	1	Malaysia	Hussein Bin Onn	1
Jamaica	Seaga	1	Malaysia	Mahatir B. Mohammad	1
Japan	Fukuda	1	Malaysia	Razak	1
Japan	Hashimoto	1	Mali	Amadou Toure	1
Japan	Kaifu	1	Mali	Konare	1
Japan	Miki	1	Mali	Traore	0
Japan	Miyazawa	1	Malta	Adami	1
Japan	Murayama	1	Malta	Bonnici	1
Japan	Nakasone	1	Malta	Mintoff	1
Japan	Ohira	1	Malta	Sant	1
Japan	Sato	1	Marshall Islands	Kabua, Imata	1
Japan	Suzuki	0	Marshall Islands	Note, Kessai	1
Japan	Takeshita	1	Mauritania	Ould Ahmed Louly	0
Japan	Tanaka	0	Mauritania	Ould Daddah	1
Jordan	Abdullah I. H.	1	Mauritania	Ould Haidalla	0
Jordan	Hussein I. T.	0	Mauritania	Sidi Ahmed Taya	0
Kazakhstan	Nazarbaev	0	Mauritius	Anerood Jugnauth	1
Kenya	Kenyatta	1	Mauritius	Ramgoolam N.	1
Kenya	Moi	0	Mexico	Echeverria Alvarez	1
Kenya	Mwai Kibaki	1	Mexico	Lopez Portillo	1
Kiribati	Tabai, Ieremia	1	Mexico	Salinas	1
Kiribati	Teannaki, Teatao	1	Mexico	Vicente Fox	1
Kiribati	Tito, Teburoro	1	Mexico	Zedillo	1
Korea, Rep.	Choi Kuy Hay	1	Mexico	de La Madrid	1
Korea, Rep.	Chun Doo Hwan	1	Moldova	Lucinschi	1
Korea, Rep.	Hee Park	1	Moldova	Snegur	1
Korea, Rep.	Kim Dae Jung	0	Moldova	Tarlev	1
Korea, Rep.	Kim Young Sam	1	Mongolia	Bagabandi	1
Korea, Rep.	Roh Moo Hyun	1	Mongolia	Ochirbat	1
Korea, Rep.	Roh Tae Woo	1	Mongolia	Tsedenbal	1
Kuwait	Jabir As-Sabah	0	Morocco	Hassan II	1
Kuwait	Sabah As-Sabah	0	Morocco	Muhammad VI	1
Kyrgyz Rep.	Akayev	1	Mozambique	Chissano	0
Mozambique	Machel	0	Portugal	Caetano	1
Myanmar	Ne Win	0	Portugal	Costa Gomes	1
Myanmar	Than Shwe	0	Portugal	Spinola	1
Namibia	Nujoma	0	Qatar	Ahmed Ath-Thani	1
Nepal	Birendra	1	Qatar	Amad Al Thani	1
Nepal	Gyanendra B. B.	1	Qatar	Khalifah Ath-Thani	1
Netherlands	Biesheuvel	1	Romania	A. Nastase	1
Netherlands	Kok	1	Romania	Ciorbea	1
Netherlands	Lubbers	1	Romania	Isarescu	1
Netherlands	den Uyl	1	Romania	Roman	1
Netherlands	van Agt	1	Romania	Vacariou	1
New Zealand	Holyoake	0	Romania	Vasile	1
New Zealand	Kirk	0	Russian Federation	Putin	1
New Zealand	Marshall	1	Russian Federation	Yeltsin	1

Note: Deg. = 1 if the leader has college education or post-graduate qualification). Continued on next page

Table 2.4 – continued from previous page

Country	Leader	Deg.	Country	Leader	Deg.
New Zealand	Muldoon	0	Rwanda	Habyarimana	1
New Zealand	Rowling	1	Rwanda	Kayibanda	0
Nicaragua	Aleman	1	Rwanda	Paul Kagame	1
Nicaragua	Anastasio Somoza D.	1	Sao Tome & Principe	Manuel Pinto	0
Nicaragua	Daniel Ortega	0	Sao Tome & Principe	Miguel Trovoada	1
Nicaragua	Enrique Bolanos	1	Saudi Arabia	Khalid	0
Nicaragua	Violeta Chamorro	0	Senegal	Abdoulaye Wade	1
Niger	Diori	0	Senegal	Diouf	1
Niger	Kountche	1	Senegal	Senghor	1
Niger	Mainassara	0	Seychelles	James R. Mancham	1
Niger	Mamadou	0	Seychelles	France Albert Rene	1
Niger	Ousmane	1	Sierra Leone	Stevens	1
Niger	Seibou	0	Slovak Rep.	Dzurinda	1
Niger	Wanke	1	Slovak Rep.	Meciar	1
Nigeria	Obasanjo	0	Slovak Rep.	Moravcik	1
Norway	Bondevik	1	Slovenia	Anton Rop	1
Norway	Bratteli	0	Slovenia	Bajuk	1
Norway	Brundtland	1	Slovenia	Drnovsek	1
Norway	Korvald	1	South Africa	Mandela	1
Norway	Nordli	1	South Africa	Mbeki	1
Norway	Stoltenberg	1	South Africa	deKlerk	1
Norway	Syse	1	Spain	Calvo-Sotelo	1
Norway	Willoch	1	Spain	Gonzalez Marquez	1
Oman	Qabus Bin Said	1	Spain	Rodriguez Zapatero	1
Panama	Balladares	1	Sri Lanka	Bandaranaike, S	0
Panama	Dario Paredes	1	Sri Lanka	Jayewardene	1
Panama	Mireya Moscoso	1	Sri Lanka	Kumaratunga	1
Panama	Noriega	0	Sri Lanka	Premadasa	0
Panama	Torrijos Herrera	0	St. Kitts & Nevis	Douglas, Denzil	1
Papua New Guinea	Chan	1	St. Kitts & Nevis	Simmonds, Kennedy A.	1
Papua New Guinea	Morauta	1	St. Lucia	Anthony, Kenny	1
Papua New Guinea	Namaliu	1	St. Lucia	Compton, John G. M.	1
Papua New Guinea	Skate	1	Sudan	Al-Bashir	1
Papua New Guinea	Wingti	1	Sudan	Nimeiri	1
Paraguay	Gonzalez Macchi	1	Swaziland	Dzeliwe Shongwe	0
Paraguay	Nicanor Duarte Frutos	1	Swaziland	Mswati	0
Paraguay	Rodriguez Pedotti	1	Swaziland	Ntombe Thwala	0
Paraguay	Stroessner	1	Swaziland	Subhuza II	0
Paraguay	Wasmosy Monti	1	Sweden	Bildt, C.	1
Peru	Alejandro Toledo	1	Sweden	Carlsson	1
Peru	Belaunde	1	Sweden	Falldin	0
Peru	Fujimori	1	Sweden	Palme	1
Peru	Morales Bermudez	1	Sweden	Persson	0
Peru	Valentin Paniagua	1	Sweden	Ullsten	1
Peru	Velasco Alvarado	1	Syrian Arab Rep.	Al-Assad H.	1
Philippines	Aquino	1	Syrian Arab Rep.	Bashar al-Assad	1
Philippines	Estrada	0	Tajikistan	Rakhmonov	1
Philippines	Gloria Macapagal-Arroyo	1	Tanzania	Mkapa	1
Philippines	Marcos	1	Tanzania	Mwinyi	1
Poland	Gierek	0	Tanzania	Nyerere	1
Poland	Jaruzelski	0	Thailand	Kriangsak	1
Poland	Kania	0	Thailand	Kukrot Pramoj	1
Poland	Kwasniewski	1	Thailand	Leekpai	1
Poland	Walesa	0	Thailand	Prem	1
Thailand	Seni Pramoj	1	United States	Clinton	1
Thailand	Thanin Kraivichien	1	United States	G.W. Bush	1
Togo	Eyadema	0	Uruguay	Bordaberry	0
Tonga	Taufaáhau Tupou IV	1	Uruguay	Jorge Batlle	1
Trinidad & Tobago	Chambers	0	Uruguay	Lacalle de Herrera	1
Trinidad & Tobago	Manning	1	Uruguay	Mendez Manfredini	1
Trinidad & Tobago	Panday	1	Uruguay	Pacheco Areco	0
Trinidad & Tobago	Robinson	1	Uruguay	Sanguinetti	1
Tunisia	Ben Ali Bourguiba	1	Uzbekistan	Karimov	1
Tunisia	Zine Al-Abidine Ben Ali	1	Venezuela	Andres Perez	0
Turkey	Akbulut	1	Venezuela	Caldera Rodriguez	1
Turkey	Ciller	1	Venezuela	Campins	1
Turkey	Demirel	1	Venezuela	Hugo Chavez	1
Turkey	Erdogan	1	Venezuela	Lusinchi	1
Turkey	Ozal	1	Vietnam	Le Duan	0
Uganda	Amin, Idi	0	Vietnam	Nong Duc Manh	1
Uganda	Banaisa	1	Vietnam	Phieu	1
Uganda	Museveni	1	Zambia	Chiluba	1
Uganda	Obote	0	Zambia	Kaunda	0

Note: Deg. = 1 if the leader has college education or post-graduate qualification).

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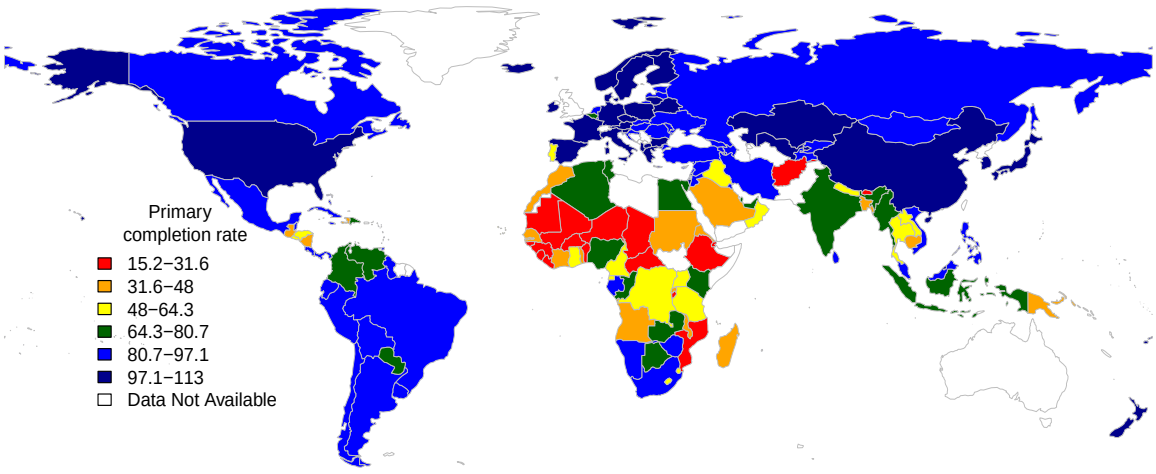
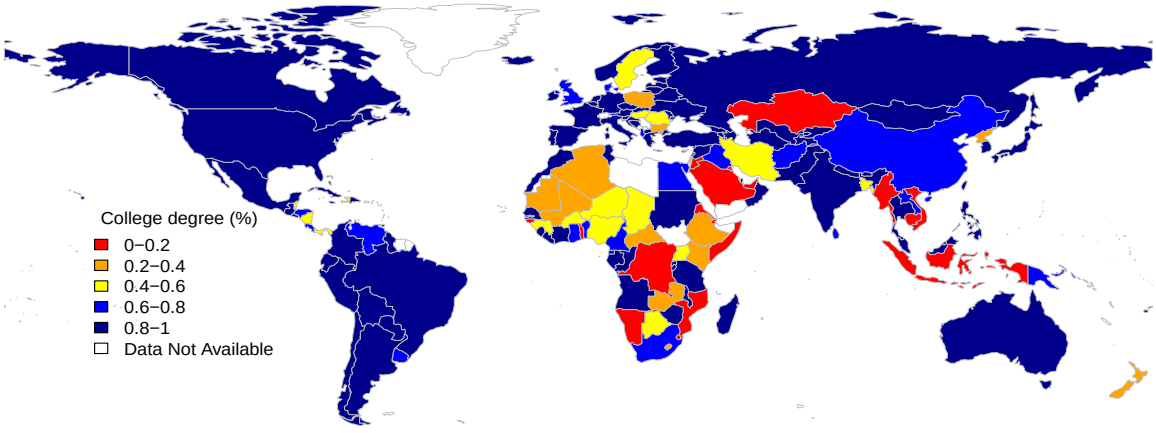
Table 2.4 – continued from previous page

Country	Leader	Deg.	Country	Leader	Deg.
Ukraine	Kravchuk	1	Zambia	Levy Mwanawasa	1
Ukraine	Kuchma	1	Zimbabwe	Mugabe	1
United Arab Emirates	An-Nahayan	0			

Figure 2.6: Distribution of (a) Educational Attainment of Population and (b) Educated Leaders across Countries.



(a)



(b)

Note: Figure (a) shows the Primary Completion Rate across countries (1970-2004). Figure (b) displays the proportion of leaders with at least college degree across countries (1970-2004). Comparing (a) and (b), we observe that those countries with higher proportion of educated leaders have higher completion rates. Source: own elaboration.

Table 2.5: Positive Transitions and Negative Transitions by Country.

Positive Transition				Negative Transition			
Transition No College → College	Obs.	No Transition (Control group) No College degree (All period)	Obs.	Transition College → No College	Obs.	No Transition (Control group) College degree (All period)	Obs.
Bahrain	6	Djibouti	17	Gambia	8	Angola	3
Belize	7	Eritrea	10	Lao PDR	7	Armenia	5
Bhutan	11	Kazakhstan	8	Mauritania	20	Austria	8
Bulgaria	14	Kuwait	28	Myanmar	10	Azerbaijan	11
Burkina Faso	15	Mozambique	19	Togo	26	Bahamas	4
Burundi	28	Namibia	11			Barbados	6
Cameroon	13	Saudi Arabia	1			Brunei Darussalam	27
Cape Verde	8	Swaziland	35			Canada	3
China	9	United Arab Emirates	31			Chile	15
Congo, Rep.	29					Cote d'Ivoire	27
Dominica	6					Croatia	10
Equatorial Guinea	5					Cuba	31
Gabon	22					Cyprus	33
Guinea	20					Czech Republic	10
Guinea-Bissau	2					Estonia	8
Hungary	12					Finland	18
Iran, Islamic Rep.	12					France	17
Ireland	11					Georgia	9
Jamaica	18					Greece	21
Jordan	5					Guyana	24
Lesotho	10					Iceland	7
Libya	12					Kiribati	7
Maldives	2					Kyrgyz Republic	8
Mali	5					Latvia	9
Morocco	34					Lithuania	9
Nepal	7					Luxembourg	11
Oman	25					Macedonia, FYR	12
Poland	8					Malawi	28
Romania	11					Malaysia	18
Rwanda	23					Malta	34
Sao Tome & Principe	1					Marshall Islands	3
Spain	13					Mauritius	22
Turkey	13					Mexico	29
Vietnam	5					Moldova	7
Zambia	5					Netherlands	19
						Paraguay	33
						Peru	19
						Portugal	6
						Qatar	28
						Senegal	26
						Seychelles	7
						Slovak Republic	12
						Slovenia	12
						St. Kitts & Nevis	6
						St. Lucia	11
						St. Vincent & Grenadines	1
						Sudan	7
						Tajikistan	8
						Tanzania	23
						Tonga	15
						Tunisia	33
						Ukraine	10
						United States	7
						Uzbekistan	8
						Zimbabwe	13

Table 2.6: GMM Estimation Results: Primary Completion Rate.

	Model 1		Model 2		Model 3	
Constant	-26.249***	(0.354)	-15.550***	(0.715)	1.248	(4.308)
$PCRT_{t-1}$	-0.493***	(0.001)	-0.104***	(0.002)	-0.175***	(0.008)
College degree	0.751***	(0.271)				
Positive transition			2.302***	(0.127)		
Negative transition					-2.260***	(0.742)
Leaders' characteristics						
Age	1.387***	(0.009)	0.796***	(0.029)	0.702***	(0.116)
Age (squared)	-0.013***	(0.000)	-0.006***	(0.000)	-0.005***	(0.001)
Tenure	1.921***	(0.025)	-0.679***	(0.059)	-0.847***	(0.160)
Country characteristics						
Democracy	-1.504***	(0.040)	-2.629***	(0.143)	-0.748	(0.526)
Duration of primary	-6.480***	(0.024)	-1.039***	(0.051)	-2.523***	(0.247)
Δ Log(GDP per cap.)$_t$	17.716***	(0.062)	14.249***	(0.372)	8.717***	(0.612)
Log(GDP per cap.)$_{t-1}$	6.508***	(0.057)	1.434***	(0.022)	1.565***	(0.177)
Hansen Test (stat.)	268.06		73.19		85.02	
Test AR(1) (z-stat.)	-2.54		-3.72		-1.53	
Test AR(2) (z-stat.)	1.01		0.33		0.96	
Sample size	1692		534		491	
Number of Leaders	370		88		103	
Baseline group			Non-Educated Leaders (AP)		Educated Leaders (AP)	

Notes: AP: All Period. Dependent Variable: Δ Primary Completion Rate. Model 1 presents the results only considering just the educational level of the leader (college degree or not). Models 2 and 3 show the effects of the positive and negative transitions, respectively. All specifications include Leader-fixed effect. Standard errors in parentheses. *** Significant at 1%, ** Significant at 5%, * Significant at 10%

CHAPTER 3

Impact of Duration of Primary Education on School Enrollment, Graduation and Drop-outs: A Cross-Country Analysis

3.1 Introduction

The acquisition of education is a significant and indivisible investment, where individuals incur in costs at the present time in return for rewards in the future. Consequently, individual schooling attainment is largely constrained by family resources and influenced by factors affecting the costs and benefits to households of sending children to school. For developing and underdeveloped countries, parental preferences play a crucial role in these schooling decisions, since families have to choose between sending children to work or keeping them in the school (Bursztyn and Coffman, 2012). Hence, costs to the family include not only the direct costs of school attendance but also the opportunity cost, namely, foregone earnings of time spent in school instead of in alternative productive activities.

Since the relative costs incurred by families can constitute an impediment to acquiring education because of the presence of borrowing constraints, mainly in developing countries, empirical evidence suggests a direct link between schooling costs and school attendance. For example, some of them report dramatic increases in school enrollment with initiatives to eliminate school fees (Kremer, 2003) and to reduce costs associated with accessing schooling (Kremer et al., 1997; Duflo, 2001). However, to the best of our knowledge, previous studies do not pay attention to the

implications of the opportunity cost which is an important factor influencing the decision to send children to school, specially in developing countries.[1] One reason why families might choose not to send children to school is low perceived returns of attending school (Edmonds and Pavcnik, 2005).

In this context, an increase in the duration of primary education makes enrollment decision more difficult for parents and foregone earnings to have a greater say in the decision. Educational reforms that a government can carry out in order to delay leaving school can be translated into both, an increase in direct expenditures on tuition, books or transportation and in the opportunity cost by staying an extra year in primary school, especially affecting students from a certain age that may have the option to work. Thus, a reform in the number of years an individual must spend in the school system could imply an increase in the drop-out rate (or decrease in school enrollment in the following educational level, i.e., secondary), since an additional year not only involves a greater allocation of resources to education by government but also by families. On one hand, schools are required to deal with a significantly enlarged student body and this can create logistical problems with staff and classroom numbers. On the other hand, families "loose" another economically active member for one more year. The latter is especially problematic if family income is near to a subsistence level.

Considering that from a empirical point of view little is known on the extent to which a reform of the number of years (grades) of schooling could have an impact in terms of attendance for primary and secondary education, the aim of this paper is to evaluate the impact of duration of primary education, which is compulsory in most of the countries, on school enrollment, graduation and drop-out rates. We use enrollment rates given that student attendance in school is a key indicator of whether countries or regions are improving educational systems and also, are good proxies for measuring school quality.

In our study we exclude developed countries since they use other mechanism in order to avoid drop-outs and parent's decision of sending children to school is based on different criteria to that of developing and underdeveloped countries, where child labor is more common. We focus on developing and underdeveloped countries where the context is different and the opportunity cost for families can be substantial because most of working children are employed by their

[1]The literature analyzing the impact of the opportunity cost is mainly focused on high school graduates who face the decision to enroll in college or get a job (Hansen, 1963; Catsiapis, 1987; Cameron and Taber, 2004). Therefore, students are who plan their investment in education, contrary to what is considered in this paper where parents are the decision makers.

parents (especially in rural areas) rather than in manufacturing establishments or other forms of wage employment (Edmonds and Pavcnik, 2005). Furthermore, empirical evidence supports the importance of borrowing constraints for developing countries affecting children's progression through the primary school system and cause them to withdraw from school earlier (Jacoby, 1994). Although education is compulsory and free for almost all children, the law in these countries is loosely enforced.[2]

Using cross-country panel data covering the period 1970-2012, we find that for children in elementary school one additional grade of primary education have a negative impact on the enrollment rate, while the effect on drop-outs is positive. We also observe that an additional year (grade) in primary education reduces the enrollment rate in secondary education. These results are in line with fertility models and indicate that families in developing and underdeveloped countries do not have incentive to educate their children, because they need them for providing resources to the household. Therefore, to the extent that children represent a high economic value and families face the decision to invest in their education or send them to work and gain from their earnings in a setting of borrowing constraints, policies increasing the duration of primary education may not have the desired effect as in developed countries. Although previous literature provides evidence that increasing compulsory schooling in developed countries have positive returns in terms of earnings and non-pecuniary outcomes (school externalities), this may not apply for developing and underdeveloped countries where children earnings are one component of the household income and in many cases represent the support of the entire family.

The rest of the paper is structured as follows. The next section provides the conceptual framework of our study. Section 3.3 presents an overview of related literature. Section 3.4 describes the econometric strategy and data. Section 3.5 presents the empirical results. Finally in Section 3.6, we discuss our main findings.

3.2 Conceptual Framework

Schooling decisions occur largely while the person is still a child and living with her parents. From the theoretical point of view, the standard approaches for schooling decisions consider either a

[2]For instance, in Brazil "...Although working is only legal at the age of 16, over 15 percent of 15-year-old children from the bottom quartile households in the income distribution were not enrolled in school in 2006, and over 22 percent reported having a job during the week they were interviewed for the 2006 PNAD..." (Bursztyn and Coffman, 2012, p. 365)

single decision-maker, parents making the decision for their children or dynasties with unified utility functions. Ota and Moffatt (2007) identifies three broad approaches to the modeling of the determinants of children's schooling: *human capital investment model*, *demographic models* and *fertility decision models*.

The first approach is the *human capital investment model*, parents are assumed to make the decision by maximizing their lifetime utility which depends on consumption in two periods, subject to an inter-temporal budget constraint.[3] This model is often used to explain the lower school enrollment for girls than for boys (see Psacharopoulos and Woodhall, 1985; Haddad et al., 1997). Since the choice between schooling and work is assumed to be made by an individual agent, the effect of the household situation, particularly those of an individual child's position within the household, are not fully taken into account.

The second approach is that of *demographic models*. These establish link between the demographic characteristics of a child (e.g. number of siblings, birth order) and their educational attainment (as measured by test scores, completed years of schooling or earnings). In these models, two theories are tested. The first is the "resource dilution effect" which predicts that the more children there are in the household, the lower the educational quality, since the resources of the household, in terms of both material resources and parents' attention, are diluted. The second theory, the "teaching effect", predicts that the presence of siblings has a positive influence on educational achievement through the benefit of either teaching younger siblings or being taught by older siblings. Empirical studies which include the number of children in the household as an explanatory factor tend to support the resource dilution effect, which is also suggested by the fertility decision model. However, when birth order is included as a variable, the results are mixed for both resource dilution and teaching effects (see Kessler, 1991; Travis and Kohli, 1995). Using data from Peru, Patrinos and Psacharopoulos (1997) find that having a greater number of younger siblings implies less schooling, more age-grade distortion in the classroom and more child labor. Related studies are Knodel et al. (1990) and Knodel and Wongsith (1991).[4]

The third approach, *fertility decision model*, is precisely the conceptual framework we adopt in this paper. This model is based on household production models and assumes that high fertility in developing countries results from the high perceived economic value of children and investigates

[3] In the first period, they either invest in children's education or send them to work and gain from their earnings. In the second period, parents become economically inactive and rely on the economic support of their children, whose incomes depend on educational level.

[4] These literature is framed into the demographic approach.

what drives a transition in parents' preference of children. Following from this theoretical contribution some empirical work has been undertaken. These studies typically examine a household's joint decision on how many children to have; how children's time is allocated between schooling, wage work and family work; and how resources are distributed among household members (see e.g. De Tray, 1980; Mueller, 1984). This approach can be used to identify which types of household are more likely to choose to educate their children, particularly to the case of the schooling choice in rural areas. Our paper can be framed in this third approach.

3.3 Literature Review

A large literature investigates the causal effect of years of compulsory schooling (either primary or secondary) on pecuniary and non-pecuniary outcomes. Using compulsory laws as an instrument to analyze this effect, several papers have consistently documented gains to adult outcomes from an additional year of schooling in developed countries. In terms of earnings, Angrist and Krueger (1991) and Acemoglu and Angrist (2001) using data from United States (U.S.), estimate that annual adult earnings are about 10 percent higher for students compelled to stay a year longer in compulsory education. Harmon and Walker (1995) and Oreopoulos (2006) find about 14 percent higher earnings from school compulsion in the United Kingdom. Regarding non-pecuniary outcomes (schooling externalities), Lochner and Moretti (2004) estimate that compulsory schooling in U.S. lowers the likelihood of committing crime or ending up in jail. Black et al. (2004) find that compulsory schooling reduces the chances of teen pregnancy in the U.S. and Norway. Meanwhile, Lleras-Muney (2005) estimates an additional year of compulsory schooling substantially lowers the probability of dying among elderly people in the United States.

Despite of the fact that there is an extensive literature that addresses the issue of the impact of an additional year of schooling on future outcomes in the long-run (earnings or lifetime wealth), previous papers have not yet considered which is the effect in the short-run in terms of school attendance and drop-outs. As far as we are aware, this paper is the first analyzing the potential effect of the changes in the duration of primary education on school enrollment, graduation and drop-out rates.[5]

[5]Most related to our work, Krashinsky (2006) studies the effect of elimination of the fifth year of high school in Ontario, Canada on academic performance in first-year university courses. He finds that cohorts with four years of high school had substantially lower grade point averages in college than those who attended high school for five years.

Since education involves an investment decision, an additional year of schooling implies some cost for both, families and government. Empirical research in this field links schooling decisions with both direct or indirect costs of sending children to school. As pointed out earlier, the direct costs of schooling include school fees, books, uniforms and commuting costs. Some studies have found a direct link between these directs schooling costs and school attendance. Kremer et al. (1997) evaluate a randomized intervention providing uniforms to students who would otherwise need to pay for uniforms in Kenya. After five years, students with the free uniforms had completed 15 percent more schooling. Also, the drop-out rate was 6.8 percent at program schools, and 16.5 percent in comparison schools. The analysis suggests that reducing school fees would reduce drop-out rates. In a related study, Deininger (2003) evaluates the impact of "Universal Primary Education" program in Uganda which dispensed with fees for primary enrollment. He finds that a dramatic increase in primary school attendance and a substantial reduction in inequalities in attendance related to gender, income, and region were associated with the program.

The indirect schooling costs, such as the costs associated with accessing schooling, may also be important. Duflo (2001) finds a large increase in schooling attainment accompanying a school construction program in Indonesia that would have lowered the commuting costs of schooling dramatically. For Mexico, Schultz (2004) examine the impact on school enrollment of a school subsidy program in poor rural communities in Mexico called *Progresa*. He finds an average increase in enrollment of 3.4 percent for all students in grades 1 through 8; the increase was largest among girls who had completed grade 6, at 14.8 percent.[6] Another relevant indirect cost of schooling is foregone income of the child while going to school. Households may also be forced to keep children away from school because their income is close to the subsistence level. In Becker's (1965) model of household production and consumption, the opportunity cost of an individual's time is the marginal value of her or his output in alternative valued activities at home or family business, such as farming. Thus, for these families if the net return to human capital investment is too low compared to investment in other assets, children may be sent to work instead of attending school. Jacoby (1994) investigates the effect of borrowing constraints by looking at how quickly children, with different family backgrounds, progress through the primary school system in Peru. In the Model, children from very high income households or with very low (initial) opportunity costs attend school full-time for essentially their entire educational careers. But, children with a high opportunity cost relative to household income may start school with only part-time attendance.

[6]See Kremer, 2003 for a summarize of evaluations of educational programs in developing countries.

He empirically finds that children start withdrawing from school earlier in households with lower income and durable good holdings and when children are more closely spaced.

3.4 Empirical Strategy and Data

3.4.1 Empirical Model

To evaluate and test the link between the duration of primary education and various educational outcomes such as school enrollment and drop-outs rate, we use a panel data of non OECD countries covering the period 1970-2012 and estimate the following linear model:

$$y_{it} = \alpha + DURPRIM_{it}\gamma + \mathbf{X}_{it}\beta + \mu_i + \varepsilon_{it}; \tag{3.1}$$

where y_{it} is the educational outcome in country i at time t; X_{it} is a matrix containing a set of covariates; μ_i is a country fixed-effect that allows us to control for country's unobserved heterogeneity (such as history and culture that might affect global macro-trends such as rising levels of educational attainment); ε_{it} is a time-varying error term, and α, γ and β are a set of parameters to be estimated. $DURPRIM_{it}$ refers to the duration of primary education in country i at time t. In these equation, our main coefficient of interest is γ, which picks-up the effect of the duration of primary education on the level of enrollment and drop-outs. Equation 3.1 is estimated using a linear fixed-effect panel data model.

Since we are mainly interested in analyzing the impact of policies changing the duration of primary education, we also consider changes in the level of these outcomes and inputs. Equation 3.2 explains the impact of reforms aimed at changing the duration of primary education on educational outcomes of the population:

$$\Delta y_{it} = \alpha + y_{it-1}\delta + \Delta DURPRIM_{it}\gamma + \Delta\mathbf{X}_{it}\beta + \mu_i + \varepsilon_{it}; \tag{3.2}$$

In both equations, our outcome variables (y_{it}) are the school enrollment rate in primary and secondary education, and the completion rate and drop-outs rate in primary education. In Equation 3.2, we include the endogenous variable lagged one period ($y_{i,t-1}$) since the speed of growth in the explained variable depends on the level of this variable the previous year, i.e, those countries that have higher enrollment rates at $t-1$ will grow at a lower rate from $t-1$ to t.

By construction, $y_{i,t-1}$ is correlated with the error term, which generates a severe problem of endogeneity. In addition, the estimation of Equation 3.2 may present other econometric problems

such as the country-specific effect and the presence of non-strictly exogenous variables. In order to overcome these problems, the strategy used to estimate this equation is the following. First, by differencing the equation the country-specific effect μ_i is removed. However, differencing means that even strictly exogenous variables can become endogenous, in addition to the presence of non-strictly exogenous variables. Therefore, our core specifications will include not only correlated and heteroskedastic residuals, but also non-strictly exogenous and endogenous variables as covariates. In this context, a fixed-effects model with the Newey–West corrected covariance matrix provides consistent estimates of the standard errors in the presence of serial correlation and heteroskedasticity in the residuals. However, the presence of endogenous covariates creates severe identification problems in the econometric estimation that in turn lead to inconsistent estimate of the model. To deal with this problem, we use a variant of the Arellano and Bond (1991) GMM estimator. More specifically, we compute a two-step GMM estimator which provides consistent and robust parameters to heteroskedasticity and serial correlation.[7] However, the two-step estimator computes standard errors that are downward bias. In order to fix this, we apply the finite-sample correction of the two-step covariance matrix proposed in Windmeijer (2005).

The consistency of the GMM estimator depends on whether the lagged values of the explanatory variables are valid instruments in the regression and the error term is not serially correlated. The validity of these assumptions is addressed by using different specification tests. For the validity of the instruments, we use the Hansen test of over-identifying restrictions where the null hypothesis is the joint validity of the instruments.[8] The Hansen J statistic replaces the Sargan test used in the original one-step Arellano-Bond estimator, since the Hansen test is robust to heteroskedasticity or autocorrelation.[9] In order to test the hypothesis of the absence of first and second-order serial correlation in the first differenced residuals, we use the Arellano-Bond test for autocorrelation.

3.4.2 Data

The empirical analysis draws on a variety of datasets. We assemble a database that contains information on population's educational attainment at country level, income per capita and other country characteristics. We use World Bank data which provides various measures on educational

[7] See Roodman (2009) for details.

[8] Under the null hypothesis the statistic follows a chi-square where the degrees of freedom are determined by the number of instruments used in the estimation.

[9] See Roodman (2009) for details.

outcomes (completion rates, drop-outs and enrollment rates) at country level, per capita income and composition of the population.[10] Polity IV data provides a measure of democracy.

Our outcome variables are completion, drop-out and enrollment rates which are useful for comparative research. *Primary Completion Rate* ($PCRT$) is the total number of new entrants in the last grade of primary education, regardless of age, expressed as percentage of the total population of the theoretical entrance age to the last grade of primary.[11] *Drop-out rate* in primary school are the students or pupils who leave school definitively in a given school year, as a percentage of all students enrolled in primary school.

Gross enrollment ratios are defined as the total number of children enrolled in a level (primary or secondary education), regardless of age, divided by the population of the age group that officially corresponds to the same level. Gross enrollment ratios can exceed one-hundred percent due to the inclusion of over-aged and under-aged students because of early or late school entrance and grade repetition. *Net enrollment ratios* are calculated as the ratio of children of the official school age who are enrolled in a particular educational level (primary or secondary education) to the total population of the same age group.

The covariates we consider are the following. *Duration of primary* is the number of grades (years) required to complete primary education. This is our variable of interest. As controls for country characteristics we include the level of the *GDP per capita* lagged one period, and its annual growth. These two variables allows to control for differences in income across countries. Following previous authors, we also include a measure of *Democracy*, which is a dummy variable (Persson and Tabellini, 2009; Besley et al., 2011). Finally, as a control for urban bias of access to education, we include the percentage of urban population. We include this control since children living in rural areas are less likely to be enrolled in school (Deininger, 2003).

Table 3.2 shows summary statistics of these variables. In our sample of non-OECD countries, on average, the primary completion rate is 73.22% and the drop-out rate is about 34 %. Net and gross enrollment rate in primary education are 94.74% and 79.62%, respectively. For secondary education data, on average, the net enrollment rate is 53.19% and the gross enrollment is 51.97%. The duration of primary education is about 6 years. In about 41% of the country-year observations the regime is democratic. On average, the percentage of urban population is about 46%.

[10] Education data comes from wbopendata available in Stata developed by Azevedo (2011).

[11] The ratio can exceed one-hundred percent due to over-aged and under-aged children who enter primary school late/early and/or repeat grades.

3.5 Results

Table 3.3 reports the results of the estimation of our core model in levels (Equation 3.1) for all our educational outcomes. This model is estimated using a linear panel fixed-effect model. We start by discussing the results of our variable of interest, that is, duration of primary education. We observe that the parameter associated to this variable turns out to be statistically significant and negative for primary the completion rate, but positive for the primary drop-out rate. This result indicates that for countries where duration of primary education is longer, the completion rate in primary education is lower, while the drop-out rate is higher. Regarding secondary education, we obtain that the link between duration of primary education and enrollment rate is statistically significant and negative, which means that those countries where duration of primary is longer, the enrollment rate in secondary education (gross and net) is lower. As we will explain later in more detail, these findings are in line with the fertility model approach mentioned in Section 3.2.

With respect to the remaining covariates, they behave as expected. Those factors that have a positive link with enrollment and graduation rates, exhibit a negative link with dropouts. We observe that those countries where the GDP per capita is higher, the completion rate in primary education and the enrollment rate in secondary education is also higher; but the drop-out rate is lower. One common hypothesis is that credit constraints limit the investment of the poor in their children's education (Schultz, 2004). Children from very low income households or with a high opportunity cost relative to household income may have lower attendance rate (Jacoby, 1994). Thus, countries with higher income levels will have higher levels of educational attainment and lower levels of drop-outs.

Similarly, we find that countries with a higher percentage of people living in urban areas have higher levels of completion rates in primary education, as well as higher levels of enrollment in primary and secondary education. This is explained by the fact that people living in rural areas, which may imply higher commuting costs, have limited access to resources and a lower concentration of schools compared to those people in urban areas, where the infrastructure tends to be concentrated. For that reason, a higher percentage of people living in urban areas also implies lower levels of drop-outs in primary education, which is consistent with previous findings on the literature analyzing borrowing constraints and access to school in rural areas where children are employed by their parents to work on the family farm (Schultz, 2004). For countries where the political regimen is democratic, we also observe that completion rates in primary education and

enrollment rates are higher, while the drop-out rate is lower. A common view, is that democratic countries have higher levels of educational attainment compared to non-democratic countries where the educational levels tend to be lower (Lipset, 1959; Barro, 1999; Glaeser et al., 2004)

In Table 3.4 we report the results of our model in differences (Equation 3.2). In this table we focus on the impact of reforms on primary educational outcomes. We estimate the model using a linear panel fixed-effects model and the Generalized Method of Moments (GMM). We begin by discussing the results of our variable of interest, i.e, the changes in the duration of primary education. Our results indicates that changes in the duration of primary education exert a statistically significant and negative impact on the annual growth in the completion and enrollment rates in primary education. Analogously, we also observe that the annual growth rate of drop-out significantly increases if the duration of primary education is lasted. These results are in line with fertility models and remain robust to different specifications and estimation methods. In a setting such as developing and underdeveloped countries where the children are perceived as a high economic value, the cost of schooling is predominantly the opportunity cost of the time a student withdraws from other activities (working) to attend school.

The remaining of the covariates also behave according to expectations. An increase in the percentage of urban population, increases the completion rate in primary education and reduces drop-outs. The growth rate of the logarithm of GDP per capita turns out to be statistically significant and positive for the growth in the completion and enrollment rates in primary education; while its impact on the drop-outs growth rate turns out to be negative. These results indicate that countries increasing their income level experience an increase in completion and enrollment rates in primary education, and a decrease in drop-outs. This means that improving the country's economic situation will turn in a decrease in children's contribution to family income because most working children live in low-income countries.

Our results indicates that laggard countries in terms of educational achievement tend to experience a greater growth rate, since we find a significant and negative effect of the initial value of our outcomes variables for all specifications. This means that those countries that have higher levels of primary enrollment rates will grow at a lower rate than those countries that have lower levels of primary enrollment rates in $t-1$, and so on. This result is consistent in all the alternative models, fixed-effects and GMM.

In models using the GMM estimator, we report the results of the Hansen test of over-identifying restrictions on the validity of the instruments, and the Arellano-Bond test of first

and second order autocorrelation.[12] While autocorrelation of first order prevails by definition, the null hypothesis of second-order autocorrelation must be rejected in order to get consistent estimators. In all models in Table 3, we find that the validity of the instruments is confirmed in all the specifications, since χ^2 statistic is not statistically significant in any model. For the autocorrelation test, we observe that AR(1) structure cannot be rejected in any of the estimated models, while the AR(2) structure is rejected in all of them. The results of both tests indicate that there is no serial correlation between the first-differenced variables used as instruments and the first differences of the residuals ε_{it}. Therefore, they are good instruments.

Table 3.5 presents the results of the estimation of our model in differences (Equation 1) for secondary education. This model explains the impact of changes in the duration of primary education on the enrollment rate of secondary education (gross and net). As in Table 3.4, we estimate this model using the linear panel fixed-effect model and the Generalized Method of Moments (GMM). Results regarding secondary education are in line with those obtained for primary education, that is, increasing the duration of primary education reduces the gross and net enrollment rates in secondary education. It applies the same reasoning as in the case of primary education. However, we consider that for secondary education the effect is easier to interpret because children are closer to the legal age to work, so their economic value is even higher than when they are in the age of attending primary education. As in Table 3.4, the remaining of the covariates provide the same quantitative and qualitative results.

In Table 3.5 we also find that the validity of the instruments is confirmed in all the specifications. Regarding the autocorrelation tests, we observe that AR(1) structure cannot be rejected in any of the estimated models, while the AR(2) structure is rejected in all of them. The results of both tests confirms the consistency of the GMM estimation.

3.6 Conclusions

Using a panel data for non-OECD countries covering the period 1970-2012, we analyze the impact of the duration of primary education on school enrollment, drop-out and completion rates. Our results show that for children in elementary school, one additional grade of primary education have a negative impact on the enrollment rate, while the effect on drop-outs is positive. Analogously, we obtain that an additional grade in primary education also reduces the enrollment rate in secondary education. Results stemming from this paper are in line with the fertility model approach, that

[12] The null hypothesis is no autocorrelation and is applied to the differenced residuals.

is, in developing and underdeveloped countries parents do not have incentive to send children to school given the high perceived economic value of children. Thus, an increase in duration of primary education discourages their continuation in the education system. Our results indicate that this reasoning applies to both primary and secondary education.

Although previous literature provides evidence that increasing compulsory schooling in developed countries have positive returns in terms of earnings and non-pecuniary outcomes (school externalities), this will not apply for developing and underdeveloped countries where children earnings are an important component of the household income and in many cases represent the support of the entire family. Therefore, policies consisting in lasting the duration of primary education, which have been proved to be successful in developed countries, may fail in developing and underdeveloped countries since it might have an undesired impact on children educational outcomes (enrollment, graduation or drop-outs).

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Appendix 3. Tables

Table 3.1: Variables Description and Sources

Variables	Description	Source	Period Covered
Dependent Variables			
Primary Completion Rate	Percentage of students completing the last year of primary school. The ratio can exceed 100% due to over-aged and under-aged children who enter primary school late/early and/or repeat grades.	United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics.	1970-2050
Primary Drop-out rate	Drop-outs in primary school are the students or pupils who leave school definitively in a given school year, as a percentage of all students enrolled in primary school.	UNESCO Institute for Statistics.	1970-2011
Gross Enrollment Rate Primary	Total enrollment in primary education, regardless of age, expressed as a percentage of the population of official primary education age.	UNESCO Institute for Statistics	1970-2050
Net Enrollment Rate Primary	Ratio of children of the official primary school age who are enrolled in primary school to the total population of the official primary school age.	UNESCO Institute for Statistics	1970-2050
Gross Enrollment Rate Secondary	Total enrollment in secondary education, regardless of age, expressed as a percentage of the population of official secondary education age.	UNESCO Institute for Statistics	1970-2050
Net Enrollment Rate Secondary	Ratio of children of the official secondary school age who are enrolled in secondary school to the population of the official secondary school age.	UNESCO Institute for Statistics	1970-2050
Independent Variables			
Duration of Primary	Number of grades (years) required to complete Primary education.	UNESCO Institute for Statistics	1970-2050
Democracy	Dummy that takes value 1 if the country is democratic.	Polity IV data	1800-2010
Log (GDP)	Log of per capita income.	World Bank data	1960-2011
Urban population(%)	Urban population refers to people living in urban areas as defined by national statistical offices.	United Nations, World Urbanization Prospects	1960-2012

Table 3.2: Summary Statistics

	Mean	Std. Dev.			Obs.
		overall	between	within	
Primary Completion Rate					
Levels	73.218	28.387	24.779	13.523	3173
Δ	0.983	5.550	2.410	5.381	2593
Primary Drop-out Rate					
Levels	34.407	23.193	20.299	12.592	2302
Δ	-0.599	5.476	2.772	5.284	1724
Enrollment Rare Primary					
Levels (Gross)	94.742	27.174	22.645	15.309	4941
Δ (Gross)	0.700	4.652	1.319	4.526	4449
Levels (Net)	79.619	19.785	17.966	9.494	2554
Δ (Net)	0.656	2.651	1.600	2.454	2014
Enrollment Rare Secondary					
Levels (Gross)	51.938	31.583	29.577	14.874	4180
Δ (Gross)	1.109	2.990	1.366	2.840	3587
Levels (Net)	53.194	27.473	26.394	11.153	1382
Δ (Net)	0.944	2.844	1.861	2.597	1005
Duration of Primary					
Levels	5.643	0.981	0.931	0.319	7052
Δ	0.002	0.152	0.016	0.152	6888
Democracy	0.407	0.491	0.383	0.327	4492
Log (GDP. Per cap)	7.253	1.450	1.411	0.300	5501
Urban Population (%)	45.727	24.264	23.450	6.378	6868

Table 3.3: Estimation Results for Primary and Secondary Education: Linear Fixed-Effect Model.

	Primary Education				Secondary Education	
	Completion Rate	Drop-out Rate	Gross Enrollment	Net Enrollment	Gross Enrollment	Net Enrollment
Duration of Primary	-4.868***	4.842***	-1.111	2.061	-4.107***	-6.136***
	(1.399)	(1.204)	(2.103)	(1.803)	(1.502)	(1.560)
$Log(GDP)_t$	12.474***	-8.034***	0.998	2.027	10.514***	11.946***
	(3.590)	(2.757)	(3.770)	(2.865)	(3.374)	(4.075)
Democracy	6.310***	-5.729***	5.661**	2.578	3.002*	3.250
	(2.180)	(1.895)	(2.787)	(2.217)	(1.523)	(2.719)
Urban population (%)	1.040***	-1.205***	0.968***	0.883***	1.355***	1.004***
	(0.190)	(0.150)	(0.203)	(0.156)	(0.130)	(0.261)
Constant	-38.579*	118.642***	48.696**	10.548	-61.015***	-50.971**
	(20.237)	(18.251)	(24.089)	(19.382)	((20.669)	(21.765)
Sample size	2397	1938	3407	1914	2919	942
No. Countries	121	121	123	122	122	101
R2 Adj.	0.484	0.512	0.239	0.367	0.628	0.664
F-stat	35.21	51.47	13.77	15.45	59.96	31.47

Notes: The outcome variables are in levels. All specifications include country-fixed effect. Standard errors in parentheses. *** Significant at 1%, ** Significant at 5%, * Significant at 10%.

Table 3.4: Estimation Results for Primary Education: Effect of Changes in Duration of Primary Education.

	Completion Rate		Drop-out Rate		Gross Enrollment		Net Enrollment	
	Linear FE	GMM	Linear FE	GMM	Linear FE	GMM	Linear FE	GMM
$y_{t-1}\delta$	-0.078***	-0.062***	-0.118***	-0.100***	-0.024**	-0.121***	-0.029**	-0.086***
	(0.015)	(0.003)	(0.019)	(0.002)	(0.011)	(0.010)	(0.011)	(0.004)
Δ Duration of Primary	-0.838	-0.923***	2.710***	3.603***	-3.429**	-6.812***	-0.457	-1.028***
	(1.129)	(0.111)	(0.868)	(0.191)	(1.382)	(0.185)	(0.652)	(0.099)
$\Delta Log(GDP)_t$	3.159*	10.136***	-4.562	-7.050***	6.744***	15.972***	1.249	-0.419*
	(1.664)	(0.263)	(3.857)	(0.237)	(1.292)	(0.986)	(1.510)	(0.231)
Δ Democracy	0.360	0.619***	-3.121**	-5.101***	0.487	2.149***	0.070	-0.063
	(0.749)	(0.208)	(1.457)	(0.051)	(0.323)	(0.220)	(0.510)	(0.235)
Δ Urban population (%)	-0.271	1.824***	0.620	-0.198***	-0.145	4.100***	-0.430	-0.975***
	(0.422)	(0.224)	(0.528)	(0.061)	(0.337)	(0.316)	(0.263)	(0.095)
Constant	6.570***	4.362***	3.356***	3.136***	3.011***	9.916***	3.226***	7.979***
	(1.074)	(0.173)	(0.663)	(0.043)	(1.091)	(0.996)	(0.918)	(0.312)
Sample size	1965	1965.00	1474	1474.00	3085	3085.00	1522	1522.00
No. Countries	119	119.00	114	114.00	123	123.00	116	116.00
R2 Adj.	0.0414		0.0782		0.0313		0.0121	
F-stat	6.823		10.16		8.919		2.142	
Hansen Test (stat.)		114.11		109.69		109.15		113.64
Test AR(1) (z-stat.)		-3.68		-5.07		-5.11		-4.38
Test AR(2) (z-stat.)		1.11		0.72		-0.25		1.24

Notes: The outcome variables are in first differences. This Table reports the results using linear panel fixed-effect model and the GMM estimation method. All specifications include country-fixed effect. Standard errors in parentheses. *** Significant at 1%, ** Significant at 5%, * Significant at 10%.

Table 3.5: Estimation Results for Secondary Education: Effect of Changes in Duration of Primary Education.

	Enrollment Rate Secondary (Gross)		Enrollment Rate Secondary (Net)	
	Linear FE	GMM	Linear FE	GMM
$y_{t-1}\delta$	-0.016**	-0.009***	-0.040*	-0.015***
	(0.007)	(0.002)	(0.020)	(0.001)
Δ Duration of Primary	-1.716**	-3.440***	-3.487**	-4.449***
	(0.763)	(0.044)	(1.621)	(0.042)
$\Delta Log(GDP)_t$	4.670***	10.413***	1.862	2.657***
	(1.244)	(0.100)	(1.821)	(0.013)
Δ Democracy	-0.071	0.095	-3.708	-5.064***
	(0.226)	(0.074)	(3.608)	(0.074)
Δ Urban population (%)	0.199	5.694***	0.074	0.535***
	(0.247)	(0.178)	(0.410)	(0.048)
Constant	1.657***	-1.193***	2.900**	1.417***
	(0.338)	(0.082)	(1.132)	(0.058)
Sample size	2517	2517.00	685	685.00
Number of Countries	122	122.00	92	92.00
R2 Adj.	0.0322		0.0830	
F-stat	5.049		3.581	
Hansen Test (stat.)		117.71		85.41
Test AR(1) (z-stat.)		-5.25		-1.69
Test AR(2) (z-stat.)		-0.17		-1.38

Notes: The outcomes variables are in first differences. This table reports the results using linear panel fixed-effect and the GMM. All specifications include country-fixed effect. Standard errors in parentheses. *** Significant at 1%, ** Significant at 5%, * Significant at 10%.