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THE ROLE OF SCHOOL LEADERSHIP ON STUDENT ACHIEVEMENT: EVIDENCE FROM TIMSS2003

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SUMMARY

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INTRODUCTION

Leadership, and especially head-teachers' leadership, has been object of study since the late '60s, but the concept of leadership is neither unanimously defined, nor a consensus has been yet reached on its actual role and actual relevance within the school environment (Fullan, 2001; Sergiovanni, 2001; Harris, 2005). Good leadership can certainly contribute to school improvement by abetting the motivation, participation, and coordination of the teachers; recent studies have widened the range of action of school leadership research to the various organizational levels: school managers, department heads, coordinators, teachers (Goldhaber, 2002; Harris, 2004), and distributed leadership that could yield a higher impact on student achievement than what yet shown (Spillane et al., 2001, 2004). This report takes its moves within the strand of research that identifies a significant role of leadership for student achievement (e.g. Edmonds, 1979; Cheng, 2002; Marzano, 2003) and tries to understand whether there are patterns of behavior of head-teachers that yield better results than others with respect to facilitating the student learning process and whether such patterns are consistent or replicable across countries.

To address this question, the study uses the TIMSS2003 and investigates the relationship between head-teacher time allocation and school characteristics, student background, and student achievement in 18 countries. The model used in the empirical analysis is a three level Multilevel Model with random effects (evaluated using the R-Statistics software) that aims at evaluating the interaction effect between a particular school level variable (the time used by the head-teacher in managerial or leadership activities) and the explanatory variables describing school and student characteristics. What the study shows is that head-teacher specialization (either in management or in leadership) has negligible direct effect on student achievement. Most of all, however, head-teacher specialization is correlated to a lower impact of family SES on student achievement.

Moreover, by investigating the impact of school management and school leadership on student achievement on students with different family background in terms of education, it is apparent that the high concentrations of school leadership are especially valuable for students of lower SES. On the other hand, the high concentrations of school management are most valuable for the students of higher SES. One possible explanation of these effects is that the attentiveness to the leadership process implies a deep involvement of the head-teacher in activities related to the modeling and tailoring of the educational process to the needs of the students. Such process has its highest payoffs on the students who come from disadvantaged situations and need special attentions in order to fully express their potential. On the other hand, the focus on the managerial side aims at rationalizing and making the best use of resources. This approach has high payoffs on students of all extractions, but is specifically relevant for the students of higher SES who are possibly already quite independent and whose performance can improve autonomously by making use of the extra resources that the management can provide.

The analysis replication of the analysis on a country-by-country level confirms the existence of the afore-mentioned effects. More specifically, the results of the analysis suggest that, *in the majority of cases, the head-teacher specialization appears to be correlated to a significant reduction in the dependence of student results from their family socioeconomic status*. The same effect can be identified for both Math and Science in most countries. Nonetheless, the identification of a specialization-effect does not say much about the reasons for its existence. One possible explanation is that *head-teachers are professionals that try to use at its best the opportunities provided by the institutional setup of the school system*. In the more decentralized school systems that leave to the schools responsibilities in terms of monetary sanctions/incentives (hiring and firing, salary upgrades…), the head-teachers would tend to make use of these opportunities and focus most on management activities. Vice versa, in more centralized school systems, which leave to the schools only responsibilities that do not involve a monetary side, the head-

teachers would stress their roles as role-models, educators, and motivators for their staff and collaborators. Hence, the final part of the research investigates whether the effect of the declared head-teacher specialization appears to go *in the same direction* as it could be predicted by looking at the macro-level institutional characteristics of the school system.

These data suggest that school leadership and school management do have an impact on student results. However, the variables that enter in the process of determining the head-teacher time allocation are too many for indicating any specific policy direction based on average country behaviors. Still, the specialization of head-teachers in leadership or management is related to significant turnouts in terms of reduced needs of the students to rely only on the family resources (family SES) for improving their performance. In policy terms, such results suggest the need of allowing for different managerial strategies that could exploit local knowledge leads to foster the system's equity and excellence.

The dissertation is organized in 4 chapter plus 2 appendixes. The first introductory chapter looks at the economic nature of the educational good, the importance of its dissemination, and what are some of the possible interaction schemes among the system actors. The second chapter dives in the concepts of school leadership and management by looking at how it has evolved in the past 40 years. Subsequently, it addresses the limitations of the studies that have tried to establish a link between school leadership and student achievement, suggests how these limits can be overcome by means of a more comprehensive definition of the concept and of more advanced statistical techniques. The third chapter presents the research project on the TIMSS2003 dataset, the operationalization of the variables, the model for the statistical analysis, and the results of the study. The fourth chapter further discusses the results by contextualizing them within the legal and operational frameworks of the analyzed educational systems, and it concludes by addressing the limitation of the study, the indications for further research, and the possible suggestions in terms of policy making. The first appendix presents in

detail the statistics for all the countries under investigation. The second and last appendix shows the detailed results for the analytic models at aggregate level and reports the dispersion of the residuals for each model.

CHAPTER 1

THE ECONOMIC NATURE OF THE EDUCATIONAL GOOD AND MODELS OF INTERACTION BETWEEN SYSTEM AGENTS

1. *The Economic Nature of the Educational good*

The economic success of every individual, and the overall social progress it could bring about, largely depend on the origin of the abilities and knowledge of the individual and the way in which these are acquired. Parents, the influence of peers, individual skills and schooling are just some of the factors contributing to the development of abilities and human capital; however, school is particularly important, as it can be directly affected by public policies, and as such, its role needs to be emphasized.

The recent mid-term review of the Lisbon Strategy confirmed the central role of education, and training in European businesses in bolstering employment and growth. The Communication "Efficiency and Equity in European Education and Training Systems", adopted on the 8 September by the European Commission, acknowledged a series of important principles for the development of education and training. Firstly, the Communication stated that "the combination of local autonomy for institutions and central accountability systems can improve student performance. However, accountability systems should be designed to ensure a full commitment to equity and to avoid the potentially inequitable local consequences of decentralized decisions, e.g. on the definition of school catchments." (2006: 6).[1] Furthermore, the communication underlined that "free access to higher education does not necessarily guarantee equity. To strengthen both efficiency and equity Member States should create appropriate conditions and incentives to generate higher investment from public and private sources, including, where appropriate, through tuition fees combined with accompanying financial measures

[1] The quotation is cited on http://ec.europa.eu/education/policies/2010/doc/comm481_en.pdf.

for the disadvantaged." (2006: 8).[2] Lastly, the Commission called upon Member Sates to develop a "culture of evaluation" to better understand and control the various systems.

Attempts have been made to improve the quality of the systems by creating a sort of market for education that abides by the principle of subsidiarity.[3] The ability to take on this project does, however, depend on the object of the service, i.e. education, and on the structure of the problem, i.e. how to improve the quality of the system so as to improve the quality of student performance.

This chapter sets the stage for the subsequent arguments on the role of school leadership on student achievement. Specifically, it focuses on the economic characteristics of education as a good and, in line with these characteristics, sets forth diverse strategies that can be implemented to manage the service, by combining the autonomy of schools with effective systems of accountability and by favoring the development of public and private partnerships to finance the service, so as to augment the accountability of the stakeholders when it comes to decision-making and taking strategic action.

1.1. Education – a private good

To be defined as "public" [4], goods must have two fundamental characteristics:

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[2] ibid.

[3] The principle of subsidiarity became a part of European law with the signing of the Treaty of Maastricht. According to Article 3(b), "the Community shall take action, in accordance with the principle of subsidiarity, only if and in so far as the objectives of the proposed action cannot be sufficiently achieved by the Member States and can therefore, by reason of the scale or effects of the proposed action, be better achieved by the Community." (http://www.worldwideschool.org/library/books/hst/european/TheTreatyoftheEuropeanUnion---TheMaastrichtTreaty/chap3.html)
In line with the principle of subsidiarity, public roles are to be assigned to those closest to the general population, who understand their needs and are aware of their resources. Only in certain exceptions can they be in the hands of those not in close proximity with the local community. This implies two kinds of subsidiarity: vertical subsidiarity (between public institutions) and horizontal subsidiarity (between public institutions and civil society).

[4] Paul A. Samuelson was the first economist to be associated with the Theory of Public Goods. In his well-known paper of 1954, "The Pure Theory of Public Expenditure", he defined "collective consumption goods" as:
"...[goods] which all enjoy in common in the sense that each individual's consumption of such a good leads to no subtractions from any other individual's consumption of that good...".
The definition used in the paper is used in most reference material and found in almost all manuals on microeconomics, e.g. Hal R. Varian's *Microeconomic Analysis* (1992).

- ✓ *non-rivalry*: the consumption of the good by one individual does not affect the simultaneous consumption of the same good by another individual;
- ✓ *non-excludability*: everyone can benefit from goods, regardless of whether or not they paid for production.

Certain social services, for example the National Defense, are public or collective goods, because all those present on national territory can make use of the good (in this case service) even if they have not contributed financially to the creation of the service. Moreover, access is not limited to only one person.

Education, on the other hand, does not have the same characteristics. Recent technological progress in the telecommunication and IT sectors has done away with the restriction of having teachers and students present in the same room at the same time. Thus, the marginal costs of providing the service – education – have been greatly reduced if not virtually eliminated so that education is no longer affected by the problem of rivalry in consumption.[5] However, if providing others with this service – assuming they have free access to the above-mentioned communication tools – entails little if no cost at all, it means that someone could be excluded from the service, whether the service be provided directly, in paper form or by means of a computer. The possibility of excluding an individual from the benefits of education means that the good can be listed among the private goods.[6]

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[5] Do notice that this argument is only valid in Developed countries. In many instances, the problem still relates to the actual availability of the service and the Goal 2 of the Millennium Development Goals sets forth the clear objective of "ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling" (http://www.un.org/millenniumgoals/pdf/mdg2007.pdf).

[6] This reasoning is based on the ideas put forward by A. Atkinson and J.E. Stiglitz (1980). A substantial literature has further developed this definition and has referred to education as a "nonpure public good". This definition focuses on the fact that, on one side, the provision of the good is – theoretically – not affected by rivalry in consumption and, on the other side, the consumption of the good has positive spillovers. However, education is not a pure public good because individuals can be excluded from having access to the good. Such situation would derive from formal decisions of the decision makers, either at central (policy makers) or local level (individual providers, managers of a specific school). In this latter sense education is very close to the so called "club goods" (Buchanan, 1965). In the text, I have preferred to limit myself to a "more crude" clustering by which I simply enlist education as a private good. The reason for this choice

1.2. Education – a meritorious good

In accordance with international law, education has four key aims:

- ✓ to fully develop the human personality;[7]
- ✓ to strengthen respect for human rights and fundamental freedoms;[8]
- ✓ to recognize every individual as an active member of society,[9]
- ✓ to promote understanding, tolerance and friendship among all nations, racial or religious groups.[10]

These four aims can be broken down further, thereby underlining the significant role of education, in particular, in:

- ✓ the dissemination of information and material of social and cultural benefit;[11]
- ✓ the development of national values;[12]
- ✓ the socio-economic development of the community;[13]
- ✓ the development of a sense of moral and social responsibility;[14]

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lies with the aim of the chapter, which is to give a broad image of the service as an economic good that can be traded and exchanged.

	Excludable	Non-excludable
Rivalrous	**Private goods** food, clothing, toys, furniture, cars	**Common-pool resources** water, fish, hunting game
Non-rivalrous	**Club goods** cable television	**Public goods** national defense, free-to-air television, air

[7] Universal Declaration of Human Rights – Article 26 (2), International Covenant on Economic, Social and Cultural Rights – Article 13, Convention on the Rights of the Child – Article 29, American Convention on Human Rights – Articles 2 (2) and 12 (4).
[8] Declaration by United Nations – Article 55, Universal Declaration of Human Rights – Article 26 (2), International Covenant on Economic, Social and Cultural Rights – Article 13, Convention on the Rights of the Child – Article 29 (b).
[9] International Covenant on Economic, Social and Cultural Rights – Article 13, Declaration of the Rights of the Child - Principle 7, Convention on the Rights of the Child – Article 29 (d), American Declaration of the Rights and Duties of Man – Article XII, American Convention on Human Rights – Article 12 (1).
[10] Universal Declaration of Human Rights – Article 26, International Covenant on Economic, Social and Cultural Rights – Article 13, Declaration of the Rights of the Child – Principle 10, Convention on the Rights of the Child – Article 29 (d).
[11] Declaration of the Rights of the Child – Principle 17, American Convention on Human Rights – Article 12 (7).
[12] Convention on the Rights of the Child – Article 29 (c), American Convention on Human Rights – Article 4.
[13] American Declaration of the Rights and Duties of Man – Article XII, American Convention on Human Rights – Articles 2 and 12.

- ✓ the development of skills and sound judgement;[15]
- ✓ the development of respect for the natural environment.[16]

Although the points made in the previous paragraph highlighted the private nature of the good, these citations of international norms clarify why the spreading of education is just as beneficial to a single person as it is to the entire community. The Public authority is keen to guarantee that all members of the community have full access to the service, because education *produces positive externalities*, or, as stated by Bowen (1977), the advantages of bettering the level of education are not limited to those investing or making use of the service.

Education is, therefore, a good meritorious of the Public interest; thus, the public authority strives to eliminate any obstacles impeding access to it and to ensure that the largest number of people can benefit from it, regardless of the preferences of each individual. In other words, the Public authority interferes with the preferences of consumers, by imposing certain rules that are not necessarily linked to the individual's preferences. Indeed, the aim of public intervention in this case is "to do some good" even if it is not perceived as such (Musgrave and Musgrave, 1982).

The Public authority is called upon to intervene in the supply phase, as (Johnes, 1993):

- ✓ *The capital market is flawed in many* ways. As a result, young students' access is limited when it comes to them investing in their education, because the only guarantor they can offer is their future income.
- ✓ *The risks* involved in education need to be reduced, because students are not always able to use education in their favor – there is a high percentage of school drop-outs – nor are they aware of the market value of "the final product". It is estimated that in the United States the average gross cost of an 18 year-old

[14] Declaration of the Rights of the Child – Principle 7, American Convention on Human Rights – Article 12 (4).
[15] Declaration of the Rights of the Child – Principle 7and 10.
[16] Convention on the Rights of the Child – Article 29 (e).

dropping out of school is $450,000 (€350,000). The sum includes the lowest income tax, the highest health care and social benefits and the highest costs related to criminal acts or delinquency.

- ✓ The Public authority is keen to intervene in favor of a *redistributing objective* that aims to guarantee that worthy students are not excluded from the benefits of the service due to a lack of financial means;
- ✓ The Public authority intervenes to repair any flaws in the market which could result in a *below par investment*.

1.3. Education – a relational good

One of the positive effects of education is the reduction in social costs taken on by the community. These costs are related to teenage pregnancy and delinquency, problems that are inextricably linked to insufficient sex education and the presence of groups of youngsters who feel left out, and choose alternative paths in life.

Equally significant is the fact that the production process of the good or service is linked to an exchange of information between teachers and students. Throughout life, but especially in higher education where knowledge can be converted into a service, the dimension of exchange becomes crucial, as society today is particularly dynamic and knowledge quickly becomes outdated or useless when not shared. Education is useful when a rapport is established between those offering the good and those seeking it out. This dimension of interactivity defines education – the service – as a relational good. What counts is the way in which the service is provided and the way in which it is consumed, and only a continuous exchange of information, based on the principle of reciprocity (Zamagni, Bruni, 2004 and Paletta, 2005) can guarantee the furthering of knowledge.

Europe has adopted this principle and has set, for 2010, an objective to create “the most competitive and dynamic knowledge-based society in the world”. Ján Figel’, European Commissioner responsible for Education, Training, Culture and Youth, recently highlighted

the practical dimension of education and the need to monitor the lifelong development of the service, because “without lifelong learning there will be less and less lifelong earning. So, on one side it is about more options for jobs, about keeping up with the changing times. On the other, it is about the important mental changes we need to build up: that education is an important investment throughout life, not only once, but continually, that it is in the interest of citizens, and societies.” Janez Potočnik, European Commissioner responsible for Science and Research, underlined the communication dimension of education which, alongside research and innovation, is one of the pillars on which tomorrow’s society will be built. “[...] knowledge and innovation have been singled out as one of the three main areas that can bring economic growth and jobs to Europe. They are among the areas that call for immediate action within the renewed Lisbon Strategy. […] we need to create real tangible links between research and innovation so as to enable technology transfer into the industry as well as between research and other economic policies. In fact, we need a new paradigm in which the dimension of knowledge creation and use is an essential dimension of every sound and sustainable economic policy.”

2. *Education as the object of a System of Interaction between Agents*

The theory on human capital places man at the centre of production processes and singles him out as the contributing factor to an increase in personal income and a country’s wealth.[17] Onorato Grassi (2004) defines human capital as “the grouping of every individual’s resources and knowledge, used to design theories, projects, solutions and initiatives within a context of social interaction and within a system of shared relationships.” This definition echoes the description given earlier of education, a good, or rather a private good, which, first and foremost, is useful for the individual, but whose

[17] The development of the theory is owed to the Chicago School of Economics and, in particular, to the work of Jacob Mincer ("Investment in Human Capital and Personal Income Distribution", *The Journal of Political Economy*, 1958) and Gary Becker (*Human Capital*, 1964).

effects on the progress of society as a whole makes it a good meritorious of Public interest. The last part of the definition highlights the fact that the good is produced by a relational process, in which an individual invests to acquire information and thereafter uses that information to produce new knowledge. He then shares this knowledge to bolster the progress of a society he is part of.

This description of individual human capital can be divided into two parts, namely a cognitive and non-cognitive part. The non-material resources developed by individuals to produce new knowledge are grouped under the name Social Capital (SC).

Various experts have endeavored to define – from diverse perspectives – the content of Social Capital. According to Loury (1977) and Bourdieu (1980, 1986), it is the network of personal and social relations of a player (an individual or group) which can be used to fulfill personal aims or climb socially. These resources differ from person to person and can benefit the development of children's and adolescents' human capital.

Coleman and Putnam went a step further when they questioned the forms of social capital. Each expert singled out three forms:

- ✓ obligations and mutual trust, information channels and social norms (Coleman, 1988);
- ✓ trust, norms and moral obligations, social networks of citizens' activities (Putnam, 2000).

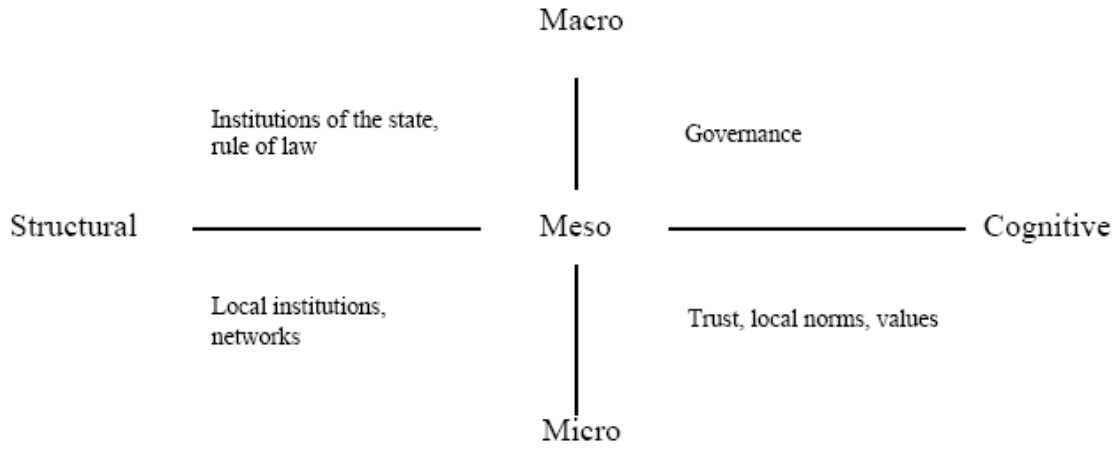
Grootaert and van Bastelaer's studies (2002) grouped the types of knowledge and highlighted a conceptual paradigm to analyze SC, as summarized in Figure 1, based on two indicators: forms (manifestations) and scopes (units of observation).

As for the formal aspect, SC has two dimensions: participatory and subjective. The first includes objective institutions that can be observed from the outside. Members abide by the institutions' rules and values. The second dimension comprises subjective and intangible factors, such as attitudes, behavior norms and mutual trust. These types of Social Capital reinforce each other, although they can also be unrelated.

As for the scopes of Social Capital, there are three action levels:

- ✓ the micro level: family nuclei, networks of families and the norms and values that underpin them;
- ✓ the meso level: horizontal and vertical relations between the groups at micro level and other institutions;
- ✓ the macro level: institutional and political contexts that provide the background for all social and economic activities.

Figure 1: Forms and Scopes of Social Capital (Grootaert & van Bastelaer, 2002: 4)



When re-reading these definitions, it becomes clear that SC includes those social resources that encourage natural cooperation for the common good. Social Capital can, therefore, be considered in two ways.

On the one hand, it is a resource for every individual interacting with fellow individuals and institutions (he therefore develops his very own non-cognitive resources) to deepen his knowledge and better his skills. From a system perspective, such a viewpoint is uninteresting, because of its excessive unevenness and because it depends to a wide extent on the characteristics of each subject.

At aggregate level, however, it is possible to study the structure of SC which the providers of the service (Public authority or market) can build and make available to all. In a

possible system, the problem is now *the evaluation of the suitability of the structures and the abstract ties that can be created by the system and its components to facilitate the development of knowledge and skills.*

Clearly, by posing the problem thus, a precise strategy has been chosen, i.e. to concentrate on the formal education and training systems (schools, technical institutes, territorial authorities, Ministries, institutional bodies) and the relational structures that the agents of the system can set up. An alternative would have been to examine the structure of the social capital of a specific community or ethnic group and attempt to determine if the social capital does in fact improve the know-how and skills of the youth. Many times, informal education is the greatest source of knowledge and skills for the individual; however, when formal education is discarded, the variables being studied noticeably multiply, making any form of generalization extremely vague. In addition, as stated in the introduction, despite school being just one of the factors that contributes to the development of individual abilities and human capital, it is singular, because it can be directly influenced by public policies. That is why so much attention is called to it.

Given that our objective is to understand how the quality of the formal systems of education and training can be improved so as to ultimately bolster the quality of students' results, two problems need to be tackled:

- ✓ the ability to produce sufficient information to monitor students' progress over time;
- ✓ the ability to understand which networks of relations the agents of the system are able to put in place so as to contribute to the development of the human capital of the users.

The paragraphs below briefly look at the economic theories developed to provide answers to these two questions.

1.4. Information and Control

The decision to consider "the progress of students" as information that needs to be collected is a clear-cut one, based on previous considerations. Indeed, the acquisition of basic knowledge is just one of the many aims of education and training systems.[18] At system level, there are, however, at least two reasons why efforts should be concentrated on this specific aspect, i.e. the correlation between knowledge and future earnings and the measurement of knowledge.

Firstly, many parents and policy makers know that knowledge is a crucial part of school performance. The problem is to understand if students' results in standardized tests are linked to individual performance in the workplace and to the growth potential of the economy. Until not so long ago, the scarcity of data meant that it was very difficult to study the relationship between variations in skills and knowledge and economic results. These data are now available in the United States and in other countries and the end results of the studies carried out show that the quality determined by test results is directly related to individual earnings, productivity and economic growth. Many studies – most of them carried out in America – show that better standardized test results are connected to greater monetary advantages (Hanushek, 2002); (Hanushek and Raymond, 2003); (Hanushek and Raymond, 2006).

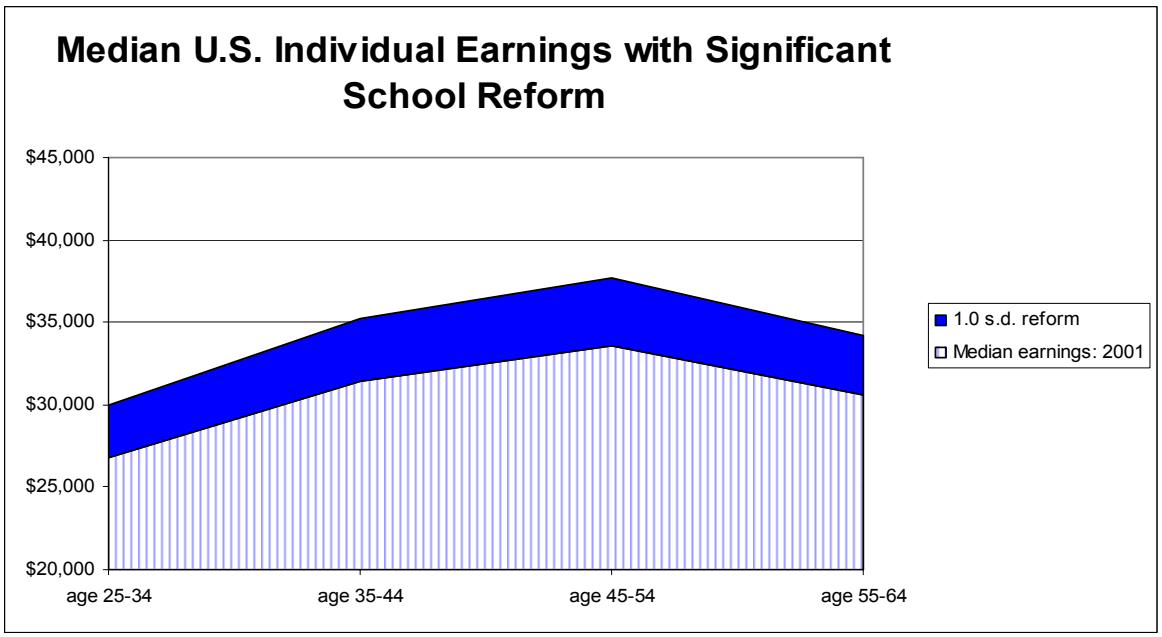
The studies of Murnane et al (2000) and Lazear (2003) – described by Hanushek (2003) – measure the impact of test results on salaries. These studies, carried out using diverse national data sets, and by following students from school to the work-place, show how – once results were standardized – improved performance in mathematics results at the end

[18] More specifically, the Council of Europe has identified numerous objectives for European Education and Training Systems:

- ✓ Reading, Writing and Basic Arithmetic;
- ✓ Mathematics, The Sciences and Technology;
- ✓ Foreign Languages;
- ✓ IT and Applying Technology;
- ✓ Learning to Learn;
- ✓ Social Skills;
- ✓ Entrepreneurship;
- ✓ General Knowledge.

of secondary school was linked to a 12% increase of a basic annual salary. The impact of a standard variation in test results is shown in Figure 2, based on the average salary of American employees in 2001. In brief, average earnings, despite differences owing to age, amounted to approximately $30,000, and an improvement in mathematics results would mean that the average salary would increase by $3,600 for every year that an individual works.

Figure 2: Variations in median U.S individual earnings based on significant school reform (Hanushek, 2003)



Vittadini (2004) provides further evidence in support of the connection between the growth of knowledge and future individual earnings. According to Vittadini, investing in education is a key factor in the growth of a country: if the length of formal education were to be increased by another year, then, in 25 years time, national income would be up by almost 32%.

Clearly, the correlation between knowledge and future income earnings is not yet comprehensive. There may be – and there probably are – a number of other factors related to education that justify a person's life story. Many of these factors are, however, non-cognitive – motivation, perseverance, networking abilities, entrepreneurship – but

given their oblique nature, their development depends on schooling, just as any individual's extra-scholastic experiences. Evaluating non-cognitive factors is an uncertain experiment and depends on the possibility, and ability, to monitor each individual's life. On the one hand, this uncertainty threatens the possibility to make deductions at system level; on the other hand, it raises a number of questions regarding the limits of the Public interference in the monitoring and regulating of society.

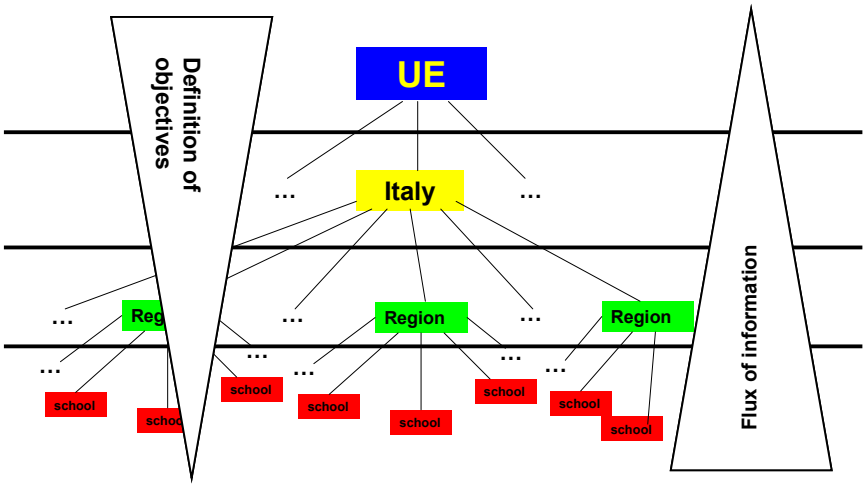
On the basis of such deliberations, it would seem appropriate to focus the tools of service quality control on the factors linked to the production of knowledge. The object being controlled may change – production process or goods produced – or even the level at which controls are carried out, be it central or local. Different factors abide by different legislative structures and needs. Due to length constraints, let us simply focus on the model underlying the systems interested in decentralizing the operational aspects of the system, all the while maintaining control over results. This approach is in line with the European trend discussed in the introduction, which aims to improve the quality of systems, making up a sort of market for education that respects the principle of subsidiarity. In this perspective, the problem for the liberalization of management is ensuring that enough information is being passed from schools to those with the power and responsibility to allocate resources.

The Principal-Agent Theory (Eisenhardt, 1989 and Guston, 1996) is based on the existence of organizations – coined agencies – that bring the good/service to consumers. These agencies are managed at local level, but their final objectives are decided at a higher level. Clearly, each school acts as an agency within the education and training systems. In Italy, for example, according to Article 117 of the Constitution, the institutions in charge of defining the aims of the education sector are of course schools (also the agencies providing the service), regional authorities, the State and lastly, The European Union.

The European Union, in particular, is not directly responsible for the definition of the education and training systems' objectives. By promoting transparent coordination between Member States, the EU highlights the central themes for the youth (participation, information, volunteering and research) and favors greater inclusion of the youth in other policies (education and training, the fight against racism and xenophobia, employment) (EC, 2002). The European Commission monitors the qualitative development of the EU's Education and Training Systems through a system of 29 indicators and 5 benchmarks (EC, 2006).

This brief description reveals the existence of at least four decision-making levels, each with specific abilities and responsibilities. By limiting analysis to (1) the problem of defining the system's aims and (2) the quantity of information available to stakeholders, it becomes clear that these two problems are heading in opposite directions. Number 1 has a top-down approach (the institution at the highest level defines objectives around which the institution at the lowest level can work). Number 2 has a bottom-up approach, i.e. the school at the lowest level has the most information regarding students and the highest levels can only base their decisions on less-detailed information. This analysis is shown in Figure 3.

Figure 3: Availability of information and the definition of aims at various levels

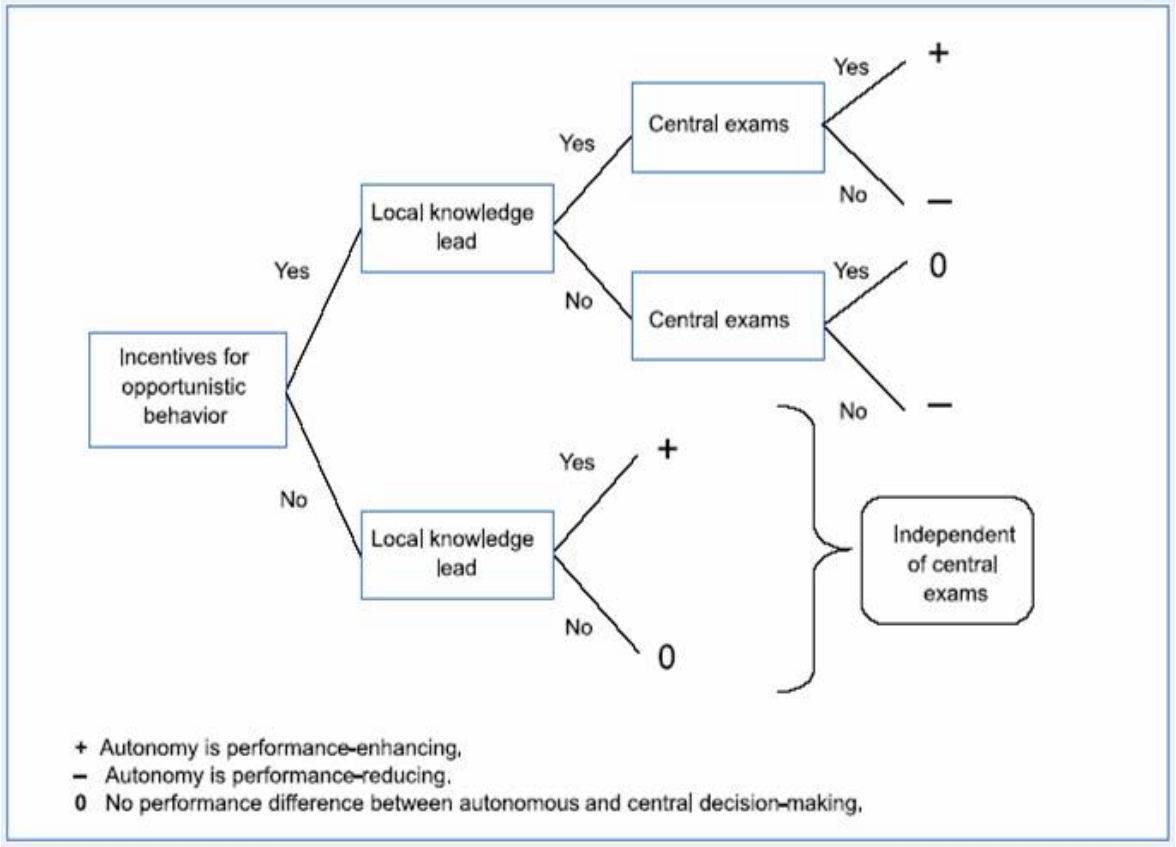


The figure shows an asymmetry in information availability that favors the lower levels. The risks include that the lower levels use the asymmetry in their favor, resulting in opportunistic behavior and personal gain, instead of the fulfillment of aims; for example, the development of students' knowledge and abilities is deemed one of the primary aims of the system. If Italy were to implement a finance model for schools whereby the sum of monetary backing was directly related to the number of school drop-outs (in theory, a low percentage of drop-outs indicates better service quality), schools could limit the number of students failed every year to decrease the number of drop-outs. In this way, schools could boast improved performance, and therefore receive more funding; however, in the medium-long term, such actions would prove harmful to the development of the effectiveness of the system, because even those students not above aboard would be passing the year.

The studies of Bishop and Wößmann (2001), Wößmann (2003), Fuchs and Wößmann (2004) show how such opportunistic behavior can be reduced, by adopting centralized control systems that ensure harmony between behavior and fulfilling the objectives of the system (see Figure 4).

This theory is necessary to understand, in the long-term, how the possibility of enhancing the quality of the education and training systems depends on the ability of the systems to adopt the right tools to gather information on the results of the service. Hence, one of the first policies should focus on the need to invest so as to develop systems suitable for the control of the results produced by the service.

Figure 4: Behavior in a controlled situation (Wößmann, 2003)



Note: "Incentives for opportunistic behavior" and "local knowledge lead" are features of the respective decision-making area which can be organized either autonomously or non-autonomously.

1.5. Models of Interaction between Agents of the System[19]

The existence of mechanisms controlling the results of the service means that the leader is not required to rigidly control the production process of the service, which, as a result, can be adapted by each agent – the schools – to their specific environmental needs. This means that there is an opportunity to create a market for education, where schools have the responsibility of identifying their stakeholders and defining the strategies for interaction with these stakeholders.

The theory on stakeholders was first put forth by Freeman in 1984. According to Freeman, stakeholders are groups whose support ensures the existence of an organization. As for

[19] These are based largely on the ideas expressed in A. Paletta and D. Vidoni (2006).

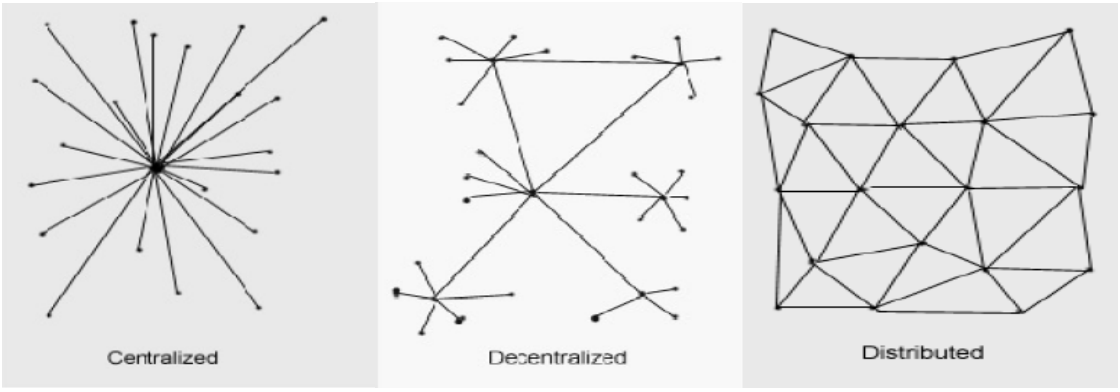
schools, stakeholders comprise families, businesses, the economic and cultural sectors.[20] According to the theory, the values of each group are vital and it is the management's responsibility to decide what type of relationship it wishes to establish with the stakeholders (Freeman, 1984). This approach is based on the belief that economic value is created by the exchange of information between peoples who voluntarily meet and work together to improve their situation. This principle is perfectly aligned with the definition of education as a good to be shared, and because of it, methods of interaction between schools and stakeholders can be focused on.

Networks are structures that show the links created between the various players of the service. School networks can be institutional or informal, created by means of alliances; for example, two or more schools may privately agree on the selection process of students – directing stronger students to pre-selected schools and the weaker ones to others – thereby generating a form of social segregation (Bottani, 2002).

The aims and structure of the networks are different and comprise specific abilities and suitable organization and cooperation mechanisms to hold everything together (see Figure 5).

[20] It must be noted that many of the needs of these stakeholders are not passed on through exchange, but either by general rights (e.g. culture) or by obligatory contributions (e.g. taxes and public spending).

Figure 5: Centralized, Decentralized and Distributed Networks



In a centralized or star-shaped network, there is a hub linking every part of the network. An example could be a network of schools working around a specific project and under a single school that not only manages all resources, but also heads and manages the entire network. There are no direct links between the remaining parts. All parts, excluding the hub, are only connected to one other part. For parts to exchange information, they need to go through the hub.

There is an increased complexity and management problem in a decentralized network, which comprises a number of star sub-networks. The parts of the sub-network are connected to their own hub, and the network is characterized by the presence of more than one hub linked by a bridge. This type of network is exemplified in private schools qualified in the training of staff. There are numerous sub-networks with a strong cultural identity or in close geographical proximity to one another, all of them connected to each other by the “initiator” of the network, a university or research institute, a foundation or private organization. Those networks with local authorities for “initiators”, as exemplified above, are decentralized networks in which local authorities put various tools in place (agreements, pacts) to promote the involvement of local sub-networks.

Lastly, a network may be characterized by the absence of a hub, a central or local control element. Every part of the network is connected to at least another two parts. Any two parts have at least two ways to exchange information. The advantages of a distributed

network are its greater overall flexibility and fortitude. The advantage is that due to the lack of a central authority, the exchange of ideas and sharing of information is informal.

The three structures are of course “ideal” examples and there are most definitely networks with characteristics of all three models. Nevertheless, networks, as models of governance, aim to fulfill integrated objectives by using mainly communication strategies that favor trusting relations and adaptability (Grimaldi, Serpieri, Staibano, 2006). It is not only the structure that is important, but also the quality of the functioning, determined by the quality of communication and the repetition of interaction (Amin, Cohendet, 2004). Indeed, due to the uncertainty and complexity of policies, the planning within a network is based on comparison and persuasion. The planning phase is characterized by process planning rather than the definition of exact objectives. The focus of those involved is conveyed by establishing a mission statement, values and strategies for the future of the system. In other words, it is not only the final aim that is important, but the methods by which that aim is agreed upon.

3. *The Service – Management and Effectiveness*

Within a prospective market, schools are no longer a single entity, but rather a cog in a much more intricate wheel, each component making every effort to fulfill its objectives and mutual collaboration enhancing the performance of all. Within each institution, head-teachers are ultimately responsible for the well-being of the management of relations with other network members. Their work is aimed at improving the effectiveness of schools.

There are two fields of research that have dealt with the problem of defining the term “effectiveness”. The first, School Effectiveness (SE), is characterized by a top-down approach; the second, School Improvement (SI), by a converse bottom-up approach. The two fields have, for a long time, been researched separately and SE has always examined effectiveness in terms of cognitive outcome in primary disciplines, i.e. mathematics,

languages, the sciences, etc. and other indicators – relatively easy to measure[21] - including success at school level and attendance.

Only recently did School Improvement studies begin to consider the performance outcome of students and mostly in studies inspired by an Anglo-Saxon tradition[22], viewed by many as too "quantitative" and not enough attentive to the "qualitative"[23] aspects of the learning process. The main objection is that in a school, students do not only get facts and figures; they also receive an education that should respect and bring forward specific sets of values. This topic is too important and complex – especially with regard to its heavy ideological implications – that it would not be suitable to continue on this matter here. What must be underlined is that the disagreements on "what to measure in education" – other dimensions alternative to accountability in cognitive outcomes – represents one of the chief moments in an ideological clash in society and schools within SE and SI studies. This debate is partly connected to the issues of subsidiarity, autonomy, the decentralization of the education sector and its possible privatization, all of which cannot be considered an alternative to SE and SI studies, which are growing in all education systems, whatever their legal and organizational form.

It is therefore clear that the differences between the two fields of study are significant, but not contradictory. In the last decade or so, it has become clear that the two studies need to be combined. SE and SI are fused in the definition given by Scheerens (2000): the effectiveness of schools "is the degree by which schools reach their primary objectives", even if, in the words of the author, "effectiveness involves a certain amount of complexity, as different primary objectives and mechanisms through which schools influence their

[21] They are easy to measure, despite the fact that much effort is required to set up databases and information systems that gather the data, correctly and systematically.

[22] In other words, in those countries where school leaders were put under external pressure by the introduction of accountability systems based on cognitive outcomes.

[23] Critics do not deem quantitative data measurable. In their opinion, such data can only be evaluated by a system of peer-review.

students can be identified".[24] This definition of effectiveness is a "general" one; it can be used when referring to any objective and is necessary to overcome the self-inference processes that seem to characterize the schooling system today.

4. *The way forward*

These initial notes suggest that education is a *private good* to be used by individuals, but whose positive effects on social progress as a whole make its diffusion meritorious of Public interest. Furthermore, the service is created through a relational process, in which individuals invest to acquire information, which they in turn use to produce more knowledge and which they then pass on to others, thereby favoring social progress.

Underlining the relational dimension of the service leads to an analysis of the structural aspects of schools, not as single institutions, but as an intricate part of a much more complex system which, as shown in the paragraphs dealing with networks, can take on different forms.

The head-teacher then emerges as a leader possibly in charge of internal stability and of relations between single institutions and other members of a network for the continued improvement of the service. The following chapters will investigate more in depth the leadership dimension of the head-teacher and – in line with the outcomes orientation of the latest research in SI and SE – will propose and experimentally test a method for gauging the influence of head-teacher actions on student achievement.

[24] The agreement between the players involved (teachers, students, families, government, etc.) on the objectives is one of the premises for the effectiveness of schools (Scheerens, 2000).

CHAPTER 2

RESEARCH ON SCHOOL LEADERSHIP: FINDINGS, LIMITATIONS, AND DEVELOPMENTS AHEAD

1. *The concept of School Leadership*[25]

Research on school leadership and school management is gaining momentum with the increasing awareness that – within the school environment – the head-teachers are the actors in charge of translating policies into everyday practice. In particular, The Conclusions of the Council on efficiency and equity in education and training (2006/C 298/03) recognize that "the quality of school leadership … [is one of the] key factors in achieving high quality learning outcomes."

The Birmingham City Council Education Service defines the 'core purpose of the head-teacher' as follows:

> To provide professional leadership for a school which secures its success and improvement, ensuring high quality education for all its pupils and improved standards of learning and achievement. The head-teacher provides vision, leadership and direction for the school and ensures that it is managed and organized to meet its aims and targets. (Brighouse, 2000)

Traditional views of leaders – as special people who set the direction, make the key decisions, and energize the troops – are deeply rooted in an individualistic and non-systemic world view (Senge, 1990: 340). So long as such myths prevail, they reinforce a focus on short-term events and charismatic heroes rather than on systemic forces and collective learning.

The contemporary view of effective school leaders has since moved on, and is summed up by Riley and MacBeath:

> 'Effective' school leaders are distinguished by their vision and passion and by their capacity to bring a critical spirit into the complex and demanding job of

[25] This section relies heavily on Bezzina, Vidoni, Paletta (2007)

> headship, whilst at the same time focusing on staff and pupil performance, and on classroom pedagogy. (1998: 151)

Contemporary leadership literature refers to collaborative styles of leadership. Du Quesnay (2003) believes the key to successful school management is to distribute responsibility among staff. She contends:

> It's about building people's confidence and sense of value to the school. When you walk into a school where it happens – and there are too many where it doesn't – you can feel the buzz in the atmosphere. (2003: 11)

One way of adding a sense of value to the school is to nurture a shared vision amongst the school's stakeholders, since this provides the focus and energy for learning. As Senge (1990: 206) states:

> Today, 'vision' is a familiar concept in corporate leadership. But when you look carefully you find that most 'visions' are one person's (or one group's) vision imposed on an organization. Such visions, at best, command compliance – not commitment. A shared vision is a vision that many people are truly committed to, because it reflects their own personal vision.

The past decade has produced some major developments in the re-conceptualization of educational leadership for successful school reform. Leadership is now associated with concepts such as empowerment, transformation, and community. Leadership no longer refers only to titular or officially designated leaders, but can be distributed within the school among members of teaching or support staff. Indeed, Silins & Mulford (2002) indicate that the more distributed the leadership is throughout the school community, in particular to teachers, the better the performance of that school in terms of student outcomes. The ability to lead is dependent on others and the relationships or networks leaders cultivate. Thus, teachers as leaders and teachers as supporters of leaders are beginning to play a central role in determining school reform (Harris and Muijs, 2005).

The concept of teacher leadership is not a new concept in a number of countries, notably the United States, Canada, and Australia, and researchers have documented leadership roles and functions of teachers in processes of successful school reform for some time (Silins *et al.,* 2000). More recently, researchers have begun exploring efforts that involve

teacher leaders at various levels of school improvement in additional countries. Their work examines teacher leadership as it relates to distributed leadership, sustainable leadership, teacher teaming, and collective approaches to school improvement (Hollingsworth, 2004).

An effective school leader, however, must be able to translate this shared vision into day-to-day practice. Caldwell and Spinks argue that "having vision alone is of course, not sufficient... School leaders must gain the commitment of others to that vision, and then ensure that it shapes the policies, plans and day-to-day activities in the school" (1988: 174).

A shared vision translates itself into day-to-day practice through effective strategic planning and operational target setting (Davies and Ellison, 1999). Day, Harris and Hadfield (2001) go further and argue that a school leaders' vision is continually tested by difficult day-to-day decisions:

> Continuing poor teaching by a member of staff, for example, creates a leadership dilemma, cutting across the head-teachers' personal framework of values and beliefs, their ideological and educative commitments to the development of everyone in the school community. Engaging in dismissal procedures touches upon the culture of the school, staff morale, and the nature of the relationship between leader and led. (Day, Harris and Hadfield, 2001: 31)

The authors stress that successful head-teachers do not shrink from taking such 'tough decisions', illustrating the clear if painful boundary that must be drawn at key times between the personal and professional relationships which are at the heart of the educational health of school communities.

2. *School leadership in the literature: a controversial issue*[26]

However convincing and well referenced these evidences could be, such consideration have not always been the case. Indeed, academic research has long debated – and is still debating – about the relative role of school and family characteristics as determinants of student achievement.

[26] This section relies heavily on Bezzina, Vidoni, Paletta (2007).

In the Equality of Educational Opportunity Study, Coleman and his associates (1966) indicate that student performance was explained by such factors as students' family background and the characteristics of other students in the school; differences among schools – on the other hand – bore little relationship with student results. This milestone-study led to a substantial body of literature investigating the role of the family socioeconomic status and other student characteristics in determining student results (Bielby, 1981; Jencks et al., 1979; Reynolds 1992; Reynolds & Creemers, 1990, Sewell & Hauser, 1975; White, 1982). Although the researchers use different definitions of the variable "Socioeconomic Status" (SES) and the operationalization of such definitions affects the strength of the relationship, the positive association between family background and student achievement is generally accepted as a fact (White, 1982).

The underlying conventional wisdom beneath these studies can be summarized in the title of a famous piece by Bernstein (1970), "Education cannot compensate for society". However, if the latter were the case, the school could do very little to "raising and leveling the bar"[27] of knowledge, especially for those individual coming from lower socioeconomic backgrounds. Hence, the school could not be a means for improving social equity, i.e. for granting equality of opportunities to all the individuals, regardless of their social conditions. The awareness of such problem served as stimuli for investigating the causes of such assessments and the possibility of developing strategies for improving such dubious results. This section will first investigate the research – developed mostly in the field of SI – that supports the claim that "leadership matters". Then, it will present some key results attaining to body of literature that that investigates the limits to these studies and a finds negligible role of leadership on student achievement no substantial role of school leadership for influencing student achievement, and it will suggest some research

[27] The expression is taken from J. Douglas Willms, Canadian Research Institute for Social Policy, University of New Brunswick. For further details refer to: Raising and Levelling the Bar: A Collaborative Research Initiative on Children's Learning, Behavioural, and Health Outcomes, http://www.unbcrisp.ca/learningbar/

avenues that could bring results useful for bringing closer the two positions (analyzed in depth in the following section).

2.1. School leadership: pros…

Effective leadership is accepted by many as a central component in implementing and sustaining school improvement. Evidence from school improvement literature, starting with seminal studies in the United States (Brookover *et al.,* 1979; Edmonds, 1982) and the United Kingdom (Mortimore, 2000; Rutter *et al.,* 1979; Southworth, 1995), highlights that effective leaders exercise a direct or indirect but powerful influence on the school's capacity to implement reforms and improve students' levels of achievement. Bolman stresses the fact that participative leadership, mediated through teacher activity, contributed effectively to student outcomes (Bolam et al., 1993). Louis refers to the same participative dimension, and he highlights how leaders of high achieving schools "worked effectively to stimulate professional discussion and to create the networks of conversation that tied faculty together around common issues of instruction and teaching" (Louis et al., 1996: 194). The issue of networking ability is raised by Leitner (1994), who points out that head-teachers in high achieving schools engage more in behavior associated with cultural linkage than head-teachers in other schools. In Leitner's study, student achievement appears to be influenced by environmental and organizational characteristics and SES.

Although it is teacher performance that directly affects student performance, quality of leadership matters in determining the motivation of teachers and the quality of their teaching (Evans, 1999; Sergiovanni, 2001; Cheng, 2002). Indeed, a number of researchers points to the role of "transformational leadership" and to the head-teacher capacity to build a "shared vision". Involving the teachers in a process of "shaping" their schools will cause them to be more motivated and to teach differently; thus, this process will make a difference to the learning and motivation of students (Elmore, Peterson and McCarthey, 1996). Leithwood and Jantzi (1999) suggest that "transformational leadership"

has strong direct effects on school conditions, which in turn have strong direct effects on classroom conditions. Wiley (2001) supports this claim and suggests that transformational leadership is mostly effective within a strong professional community. Moreover, the more distributed the leadership is throughout the school community, in particular to teachers, the better the performance of that school in terms of student outcomes (Silins & Mulford, 2002). The existence of distributed leadership is especially crucial in case of shocks that can leave the school without its leader. To this respect, McMahon indicates that head-teachers' departure could be followed by an unstable period of leadership detrimental to teacher cohesion and student results (McMahon, 2001).

Table 1: Positive effects of School Leadership Research on Student Achievement, sample reference studies of the past 2 decades

Bolam et al. (1993)	Participative leadership, mediated through teacher activity, contributed effectively to student outcomes.
Leitner (1994)	Head-teachers in high achieving schools engage more in behavior associated with cultural linkage than head-teachers in other schools. Student learning appeared to be influenced by environmental and organizational characteristics and SES.
Louis et al. (1996)	One of the few recent quantitative studies, leaders in high achieving schools "worked effectively to stimulate professional discussion and to create the networks of conversation that tied faculty together around common issues of instruction and teaching" (p. 194).
Leithwood & Jantzi (1999)	Transformational leadership has strong direct effects on school conditions, which in turn have strong direct effects on classroom conditions.
McMahon (2001)	The departure of one head-teacher was followed by an unstable period of leadership reflected in a drop in SATs scores, pupil behavior problems, poor staff communication and morale, and an unfavorable inspection report.
Wiley (2001)	Transformational leadership has an effect, especially within a strong professional community.
Cheng (2002)	Head-teachers' leadership has a direct effect on organizational characteristics and teacher performance. It is teacher performance that directly affects student performance.
Silins & Mulford (2002)	The more distributed the leadership is throughout the school community, in particular to teachers, the better the performance of that school in terms of student outcomes.

The aforementioned studies advocate the need of developing shared vision, distributing leadership and building the school culture necessary to current restructuring efforts in schools (Leithwood, Jantzi and Steinbech, 1999), and they are some of the recent result of the research strand that can roughly been identified with the term School Improvement

(SI). The 'first phase' of school improvement started to take shape as a distinct body of approaches in the late 1970's and early 1980's (Potter, Reynolds and Chapman, 2002). This first phase was characterized by the Organization for Economic Cooperation and Development's International School Improvement Project (ISIP) (Hopkins, 1987) but unfortunately many of the initiatives associated with this first phase of school improvement were 'free floating, rather than representing a systematic, programmatic and coherent approach to school change' (Potter, Reynolds and Chapman, 2002: 244). The emphasis was upon organizational change, school self-evaluation and on individual schools and teachers to own the change process. However, there was no significant conceptual or practical connection of these initiatives to student learning outcomes. Furthermore, they were variable and fragmented in conception and application, and consequently in the eyes of most school improvers and practitioners struggled to impact upon classroom practice (Reynolds, 1999). Despite this somewhat negative analysis, Hopkins does acknowledge that many of these studies initiated:

> …widespread research into, and understanding of, the change process and the school as an organisation… The studies highlighted the limitations of externally imposed changes, the importance of focusing on the school as the unit of change, and the need to take the change process seriously… Similarly, the research on schools as organisations, demonstrated the importance of linking curriculum innovation to organisational change. (2001a: 29)

The early 1990's gave rise to the 'second phase' of the development of school improvement. This phase was characterized by the bringing together of the various contributions from both the school improvement and the school effectiveness communities. As already pointed out in the previous chapter, a number of effectiveness and improvement researchers and practitioners had called for a fusion of approaches and insights (Reynolds, Hopkins and Stoll, 1993; Hopkins, Ainscow et al., 1994; Gray et al., 1996) and this led to a merged perspective (Hopkins, Reynolds and Stoll in Gray et al., 1996). The school effectiveness tradition had made significant contributions to this new, merged intellectual enterprise, such as the value-added methodology for judging school

effectiveness and for bringing about a large-scale, proven knowledge base about 'what works' at school level to improve student outcomes (Teddlie and Reynolds, 2000).

The more recent 'third age' of school improvement practice and philosophy, which started during the mid 1990's, attempts to draw the lessons from contemporary improvement programs and reforms. It is apparent in a number of improvement programs in the United Kingdom such as the Improving the Quality of Education for All Project (IQEA) (Hopkins, 2001a), the High Reliability Schools Project (HRS) (Stringfield, 1995) and other projects. In Canada, it has been in evidence in the various phases of work conducted in the Halton Board of Education (Stoll and Fink, 1996). In the Netherlands it is in evidence in the Dutch National School Improvement Project (Hopkins, 2001; Hopkins, Ainscow and West, 1994; Reynolds et al., 1996). In the United States, it is evident in the work carried by the Education Trust in North Carolina (Education Trust, 2005).

Given the fact that there are significant variations amongst these programs, if one were to attempt to draw some conclusions from these examples of third age improvement initiatives, it becomes clear that there has been an enhanced focus upon the importance of pupil outcomes. Instead of the earlier emphasis upon improving processes, the focus is now upon seeing if these improvements are powerful enough to affect pupil outcomes. This is not to say that the importance of the 'process' of improvement has been shelved, but there has been an adoption of a 'mixed' methodological orientation, in which bodies of quantitative 'outcome' data plus qualitative 'process' data are used to measure educational quality, and variation in that quality. This includes an audit of existing classroom and school processes and outcomes, and comparison with desired end states, in particular the educational experiences of different pupil groups (Potter, Reynolds and Chapman, 2002: 245).

There has also been an increasing consciousness of the importance of 'capacity building' through an increased concern to ensure that the improvement programs relate to, and impact upon, practitioners and practices through using increasingly sophisticated training,

coaching and development programs (Harris, 2002). This increasing awareness of capacity building includes not only staff development, but also medium-term strategic planning, change strategies that use 'pressure and support', as well as the intelligent use of external support agencies (Stoll and Fink, 1996). This third wave of school improvement also brings with it an appreciation of the importance of cultural change in order to embed and sustain school improvement. There has been a focus on a careful balance between 'vision building' and the adapting of structures to support those aspirations.

2.2. …and cons…

The advancements presented in the previous paragraphs go in the direction of defining school leadership as a complex phenomenon that influences student learning (mostly) by means of intermediate variables. Such broad conceptualization, however, entails major challenges when trying to draw substantial conclusions on the role of school leadership on student achievement. Indeed, Hallinger & Heck (1996, 1998) point out that the effects of leadership on student achievement are indirect if not difficult to measure because, despite the traditional rhetoric concerning head-teacher effects, the actual results of empirical studies in the U.S. and U.K. are not altogether consistent in size or direction. Hence, "even as a group the studies do not resolve the most important and practical issues entailed in understanding the principal's role in contributing to school effectiveness. These concern the means by which principals achieve an impact on school outcomes as well as the interplay with contextual forces that influence the exercise of school leadership" (Hallinger and Heck, 1998: 186).

Table 2: Negligible or null effects of School Leadership on Student Achievement, sample reference studies of the past 2 decades

Hallinger & Heck, (1996, 1998)	The effects are indirect if not difficult to measure because "despite the traditional rhetoric concerning principal effects, the actual results of empirical studies in the U.S. and U.K. are not altogether consistent in size or direction."
Scheerens & Bosker (1997)	Educational leadership does not have a positive and significant relationship with student achievement
Van de Grift & Houtveen (1999)	Weak correlation between leadership and educational achievement in three subjects (arithmetic, language and information processing). The findings provide evidence that head-teachers do have an effect on their schools
Witziers, B., Bosker R. J. and Krüger M. L. (2003)	The small positive effects found in this meta-analysis confirm earlier research findings on the limitations of the direct effects approach to linking leadership with student achievement.
Miller and Rowan (2006)	The researchers analyze on two Australian databases to estimate a series of three-level growth models of student achievement at the elementary and secondary levels. Their results indicate that organic forms of management are not a particularly powerful determinant of student achievement at either of these levels of schooling.

In general, the critiques to the studies on school leadership effects on student learning relate to two main orders of causes. In *theoretical and conceptual terms*, we are yet far from a unique definition of leadership; which makes the concept difficult to measure. Moreover, the different studies are difficult to compare due to the existing contextual differences and to the lack of a complete understanding of what are the intermediate variables between leadership and student achievement. In *methodological terms*, problems can be identified with respect to the validation of instruments (the questionnaires used, the scarcity of contextual information collected, and the reliability of the student achievement measures). Moreover, many of the studies – especially the earlier ones and those referred to some of the largest datasets – do not make use of the appropriate statistical techniques. Zirkel and Greenwood (1987) list is an absence of "multivariate, longitudinal studies designed to trace causation" (Zirkel and Greenwood, 1987:256), while other studies do not take adequately into account the fact that the data has a hierarchic structure (students are nested in classes that are nested in schools that are nested in

regions that are nested in countries and so on) so that the characteristics of the study-units at each level of reference must be considered separately in the regression.

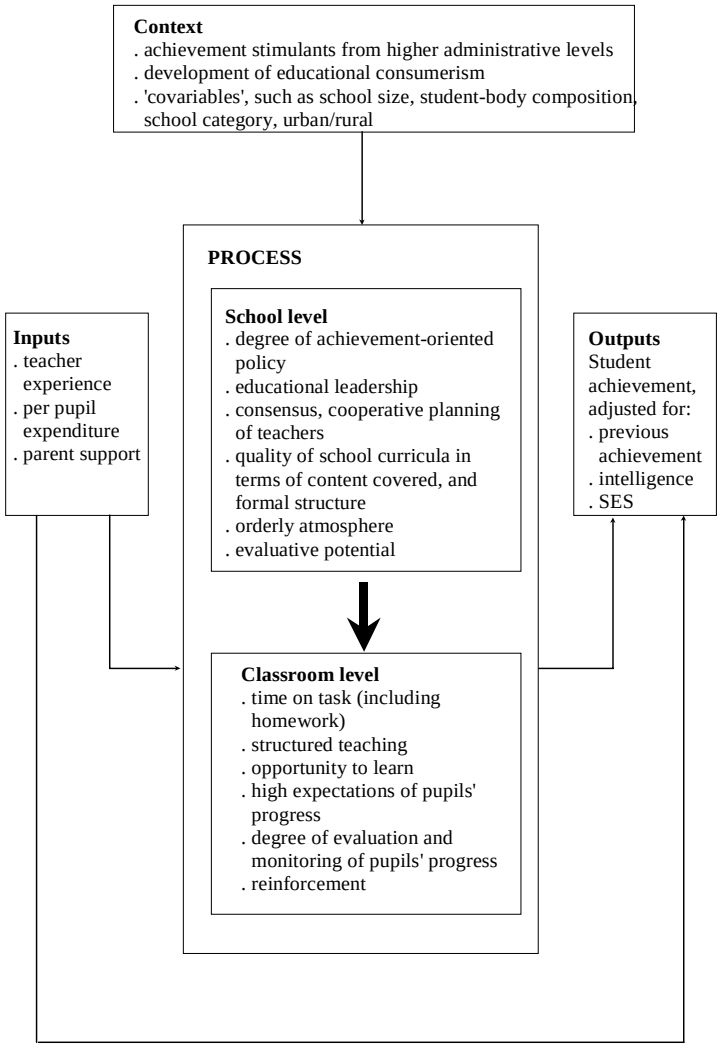
Witziers, Bosker, and Krüger perform a quantitative meta-analysis on 42 studies (37 for direct effect and 5 for indirect effects) examining to what extent head-teachers affect student outcomes. Their research indicates that not more than 1% of the variation in student achievement is associated with differences in educational leadership, and – in general – suggests the existence of heavy limitations to the direct effects approach to linking leadership with student achievement (Witziers, B., Bosker R. J. and Krüger M. L. 2003). In their review of 70 studies, Marzano et al. (2004) show the existence of contradictory evidences ranging from effect size for leadership and achievement as high as .50 (which translates mathematically into a one-standard-deviation difference in results) to studies in which leaders who displayed the very same leadership qualities had only a marginal--or worse, a negative--impact on student achievement (correlations as low as -.02).

Analyses using data from the Third International Mathematics and Science Study (TIMSS) in multilevel regression models suggest that although instructional leaders tailor their behaviors to their schools' environments, variations in behavior are not consistently associated with variation in instructional effectiveness as measured by instructional outcomes such as student achievement (Wiseman, 2001). The recent analysis of Miller and Rowan (2006) on two Australian databases to estimate a series of three-level growth models of student achievement at the elementary and secondary levels indicates that organic forms of management are not a particularly powerful determinant of student achievement at either of these levels of schooling. Moreover, numerous in-depth studies performed in the Netherlands fail to find a significant correlation between leadership and educational achievement (Van de Grift and Houtveen, 1999; Scheerens & Bosker, 1997, Scheerens, 2000). To add one extra little piece to the confusion on head-teacher leadership, recent research – as indicated previously – is also dealing with the issue of

leadership distributed to other individuals within the school context, such as the teachers. The most recent and comprehensive review of the teacher leadership literature (York-Barr & Duke, 2004; see also Murphy, 2005) was able to locate only five empirical studies of teacher leadership effects on pupils and none reported significant positive effects.

For these reasons, recent research has often dwelled more on the role of *intermediate variables* such as school climate (Scheerens, 2000). Indeed, the problem relates to identifying exactly the relationship between the different elements intervening in the determination of student results. Especially within the field of SE, various structures have been proposed for modeling these interactions.

Figure 6: An integrated model of school effectiveness.



Source: Scheerens, 1990

Scheerens' integrated model of school effectiveness – depicted in Figure 6 – highlights the interaction among the various dimensions that ultimately influence outputs, and looks inside the school's "black-box" by identifying a set of crucial variables. Scheerens and Bosker (1997) used this model as the starting point for a re-analysis and meta-analysis of existing studies and datasets. On average, their results indicate that resource-input factors have a negligible effect, school factors have a small effect, and instructional factors have an average to large effect. However, as Scheerens points out, "there is an interesting difference between the relatively small effect size for the school level variables reported in the meta-analysis and the degree of certainty and consensus on the relevance of these factors in the more qualitative research reviews." Table 3 (taken from Scheerens and Bosker, 1997) summarizes their results and highlights the rather small effect of school leadership in the studies under review.

Table 3: Review of the evidence from qualitative reviews, international studies and research syntheses.

	Qualitative reviews	International analyses	Research syntheses
Resource input variables:			
Pupil-teacher ratio		-0.03	0.02
Teacher training		0.00	-0.03
Teacher experience			0.04
Teachers' salaries			-0.07
Expenditure per pupil			0.20
School organizational factors:			
Productive climate culture	+		
Achievement pressure for basic	+	0.02	0.14
subjects	+	0.04	0.05
Educational leadership	+	0.00	0.15
Monitoring/evaluation	+	-0.02	0.03
Cooperation/consensus	+	0.08	0.13
Parental involvement	+		
Staff development	+	0.20	
High expectations	+	0.04	0.11
Orderly climate			
Instructional conditions:	+	0.15	0.09
Opportunity to learn	+	0.00/-0.01 (n.s.)	0.19/0.06
Time on task/homework	+	-0.01 (n.s.)	0.11 (n.s.)
Monitoring at classroom level			
Aspects of structured teaching:			0.27
-cooperative learning			0.48
-feedback			0.58
-reinforcement			0.22
Differentiation/adaptive instruction			

Source: Scheerens and Bosker, 1997

These latter studies debate the strong emphasis on leadership reported in previous section, but they do not dismiss the issue. Indeed, it is very likely that – as previously indicated – the shallowness of results were due to theoretical and conceptual problems existing in the definition of leadership, together with the methodological issues related to the adequate models of analysis and the availability of data. The following two sections will try to make the stage a little clearer by presenting a possible taxonomy of educational management and leadership models, and by presenting the statistical models and techniques that could be best fit for investigating the issue.

3. *Taxonomy of School Management and Leadership Styles*[28]

The models of school management are multiple and often borrow various features from other subjects (Mintzberg, 1983; Drucker, 1986; Senge, 1990; Miolo Vitali, 1993). Such conceptual and methodological plurality may be confusing with regard to the meaning of school management and school leadership, but it is extremely useful to investigate the complex economic and organizational nature of the school (Bush 1995). These models vary depending on the organizational cultures (Cameron and Ettington, 1988; Bergquist, 1992; Handy, 1993). The different models are perspectives, alternative and not necessarily exhaustive ways to describe the schools, like "frames that open windows on the world and filter some things, allowing others to go easily through" (Bolman and Deal, 1991).

The following section describes a possible – although non-exhaustive – topology so school management and leadership models. A synthesis of the used criteria and of the main features associated with these models appears in table 4.

Table 4: Management models and leadership styles.

School management model	Management By Procedures	Collegial Management	Organized Anarchy	Political Management	Management By Objectives
Focus	Task	Team work	Individual freedom	Lobbies	Results
School objectives	Defined outside	Shared	Ambiguous	Compromise	Top down
Prevalent ways of organizational integration	Formal structures; laws and regulations	Task force, interdisciplinary team, traditions, values	Loosely coupled	Representative commissions	Managerial hierarchy
Decision processes	Non discretionary	Democratic participation	Unintentional (Garbage can)	Lobbying	Formalized, Rational
Systems of internal control	Bureaucratic	Informal control by the social group	Self-control	Check Balance	Deviations from budget and objectives
Leadership styles	Inspective	Cultural manager	Leader "shadow"	Mediator	Chief Executive Officer

Source: Paletta A. and Vidoni D. (2006)

[28] This section relies greatly on Paletta, Vidoni (2006) and on Bezzina, Vidoni, Paletta (2007).

3.1. When central bureaucracy chokes leadership

The management by procedures model is specifically relevant for a highly centralized situation where the central power (generally the Ministry) defines at the national level the rules for most of the aspects of school life, such as on recruitment, career, and salary, definition of the school curriculum, school accountability, financial management, internal organization. In such a case, the individual school representatives do not have any real decisional power.

The leadership model is bureaucratic because the role of the head-teacher is to make sure that the school operators apply correctly the laws and the strict administrative procedures.

Management by procedures is focused on tasks, rather than on individuals. The school managers must adhere to the prescriptions specific of the assigned roles, and they must give up any attempt to interpret such roles in an autonomous way (Romano and Serpieri, 2004).

3.2. Collegial management

An alternative approach puts school leadership within a portrait of the school as a professional community or collegiums of teachers and students.

The idea is that hierarchy is not a realistic representation of the interpersonal relationships within a school. The concept of peer community represents better a situation where power is diffused, and consensus among head of institute, teachers, and the other stakeholders is the basis of the coordination within the institution (Campbell and Southworth, 1993).

The leader is a cultural manager, and acts like a mentor, a coach, and a facilitator of the organizational processes. Leaders derive their authority from their professional expertise, not from a hierarchical determination. Hierarchical authority depends on the position occupied in an office; professional authority is the result of the leader's competences and experiences in the pedagogic-didactic field.

The collegial model works best with small numbers, continuous interaction, and some degree of informality. The button rooms are organizational structures (committees, task force, etc.) that guarantee the involvement of the members and sharing of ideas (Harris, 2002). The optimum is a situation where everybody is involved until reaching some form of consensus. The real situation may require some upper boundaries to participation and time devoted. Voting is the method for solving situations where disagreements prevent discussion and reciprocal persuasion to achieve the necessary agreement (Westmeyer, 1990).

Nonetheless, in a collegial culture, voting should be the exception rather than the rule. In fact, as a professional community, the school recalls the Ouchi's "clan form" (1980) where trust among members is the most important mechanism of organizational integration, and it derives from the members deep adherence to the common cultural values expressed in the codes of the teacher profession.

The diffusion and acceptance of cultural values as intellectual integrity, quality of teaching, openness, tolerance, and impartiality creates a common field for discussion and research of consensus about the school objectives. This situation is propaedeutic to the actual implementation of the foresaid values.

On the other hand, if recognizing each other in the same cultural norms is the main coordination mechanism, strict checks on results and behaviors do not need to exist. The teachers' high degree of control on the planning and carrying out of their work should create strong motivations, if such control was not enough, strong mechanisms of social and peer control should realign teachers behaviors to the school mission.

In the collegial models, the leader is a mediator of participative activities, decisions are collegial, and often come out of a long and endeavoring process that should end with a consensus on the basis of all the participants shared values (Bush, 1995). As Wiley (2001) suggest, this model of leadership has an effect, especially within a strong professional community.

However, this model presents two main limits. It appears too normative and idealistic with regard to the school management, and it underestimates the conflicts and the difficulties existing when chasing unanimous agreement. It does not address the responsibility of the head of institute toward the stakeholders because collegiality makes it impossible to identify one single person as the referent of shared management processes.

3.3. The symbolic exercise of leadership in organized anarchy

The apparent inexistence of any integration in the school as anarchy (Cohen, March and Olsen, 1972) is counterpart to the organizational glue of cultural norms that is the paramount characteristic of the collegial form.

In the loosely coupled system (Weick, 1976) what happens in one part does not necessarily affect the other components of the system. For example, the teachers of a subject may do their job in relative isolation without interacting with the teachers of other subjects for design, monitoring, or correcting student performances; although one teacher's ineffectiveness may result in a crisis in a specific area, the lack of connection between the different parts prevents the spreading of the crisis. If teachers promote projects for widening the educational offer, they do so for individual visibility rather than for a real wish to improve the existing situation (Capaldo and Rondanini, 2002). The person responsible for the administrative services gives priority to certain issues rather than others on the basis of personal judgment, instead of following the priorities set out by the headmaster.

The examples show an organizational culture with a strong sense of freedom and of individualism that leads people to disregard the collective nature of the school management processes. The prevailing form of interaction is inactivity, some cases present at most fluid, sporadic, and non systematic participation to the problems of the school management as a whole. In organized anarchy, problem solving strategies are counter-intuitive and the concept of organization requires itself a temporary suspension of

the traditional principles of administrative rationality. Actually, decisions come out of the casual strike of four fluxes weakly connected: problems, solutions to previous problems, participants looking for solutions to problems, opportunities to solve the problems. The situation evolves, but no one controls the process.

Cohen and March (1974) talk of “unobtrusive management” and symbolic leadership: “the presidency is an illusion and that the role is in large measure a symbolic one with only modest influence on campus life”. In fact uncertainty and ambiguity are the roots of this managerial model, and they make the leaders unable to lead the organization towards a rationally defined direction. At most, leaders may implement some strategies to eventually influence the subjects’ decisions, like choosing the place for discussing the open questions, or following in person the selection and the use of staff members.

The organized anarchy model offers interesting hints and enriches the conceptual categories for school management. Organized anarchy is not necessarily negative; it may be in fact a very advantageous solution in highly complex and turbulent situations. An organization that prefers individualism and spontaneity to flexibility may respond better to environmental changes than a culture that favors stability (Birnbaum, 1992). Although in general the role may have little influence, leadership may still be effective if carried out in accordance to the organizational context. Nonetheless, the limit of the model is that it carries the organizational fragmentation to the limit, and it gives the managers no indications on how to manage complexity.

3.4. School as a political arena of conflicting interests

According to Baldridge (1980): “the political model assumes that complex organisations can be studied as miniature political systems, with interest-group dynamics and conflicts similar to those in city, state, and other political situations”.

In an analogy with the collegiate culture, the culture characterizing the political model is internally focused and self-referenced with respect to the educational objectives, yet is

also a culture broken into many disciplinary and professional sub-cultures: teachers/administrative personnel; tenured teachers/non tenured teachers; staff/students; staff/head teacher; school/community. Generic interdependence among the academic units (Thompson, 1967) exist to bring disciplinary sub cultures in mutual contact for resolving problems of dependence on the common resources, but conflict is viewed as a natural phenomenon and power accrues to dominant coalitions rather than being the preserve of formal leaders (Bush, 1995).

From an historical point of view, the features of cultural fragmentation within this organizational culture have been officially recognized between the 1960s-1970s with the first wave of governance reform centered on the principle of “participant democracy” (Neave, 2001).

Central steering boards become a political arena where every professional group puts to use their own resources to gain power and impose their own cultural codes (Bolman and Deal, 1991). Decisions emerge after a complex process of bargaining and negotiation. In potentially conflicting contexts in which none of the professional groups can claim to be dominant, the construction of the consensus and the reaching of a compromise constitute the main decisional and control rules.

In the political model power is diffused and becomes manifest through complex decisional networks organized into committees. The committees have memberships widely representative of group interests, overlapping memberships, and functions of coordination attributed to the teachers. This democratic way of governance is deemed necessary in the reaching of a consensus and in the coordination and effective implementation of the institutional policies. On the other hand, it is destined to generate slow and conservative decisional processes with results that can prove to be more the fruit of compromises rather than the best way to problem solving.

3.5. Management by objectives

The usual way of representing the managerial culture of a firm is its hierarchy, its division in structures and formal processes for taking decisions, communicate, inform and control (Mintzberg, 1983).

Hughes (1985) documents how this approach can be used for schools. The author affirms that schools adhere quite well to Weber's definition of bureaucracy because they present division of labor, hierarchical structures, rules and regulations, impersonal procedures, and technical assumption criteria based on merit.

Another characteristic is the rationality of the decision-making processes that, in terms of managerial instruments, imply an active role of the school manager in setting up systems for strategic planning, human resource management, information system development, and budgetary control of results.

Moreover, the school manager has a large discretionary space over strategies. Such autonomy relies on the belief that leaders with freedom of action may obtain better results than leaders who strictly follow strategies planned at national level (Davies and Ellison, 2003). Freedom of action for obtaining specific results should increase motivation and should start a learning mechanism that – in the long run – favor the best realization of the school's objectives. The school managers increase their professional expertise and become aware of the economic and financial consequences of their didactic and pedagogic choices. Therefore, they can concentrate on strategies, rather than on specific tasks.

Together with broad managerial autonomy, school managers are responsible to the local communities and the territorial authorities for the outcomes of their dependents, and for the activity of the school as a whole. School managers are like executive directors in charge of realizing the objectives defined by the board, to which they respond to the obtained outcomes.

This set-up legitimizes a hierarchical management model where the school manager is responsible for the decisions on the general objectives of the school, internally allocates human and financial resources, manages internal and external fluxes of information, evaluates the progress of teachers, pupils and schools.

3.6. The school: a complex system

These five models are useful simplifications that try to explain how schools work in term of:

- ✓ Sticking to the rules (management by procedures);
- ✓ Participating and sharing common cultural values among the members of the organization (collegial management);
- ✓ Individual freedom and operative flexibility related to mostly self-referenced teachers (organized anarchy);
- ✓ The existence of conflicting interest groups requiring the research of a compromise (political management);
- ✓ The leader exerting the power in an authoritarian way through formal structures and control mechanisms (management by objectives).

The five models are only ideal images whose adherence to actual practices needs to be assessed by taking into account contingent variables like the history and the political development of a specific national system (Dimmock and Walzer, 2002), the structure of the schools (elementary, middle, high), their institutional mission (for example, a lyceum or a vocational education institution), their geographical localization (urban or suburban), the school climate and culture (existence of tensions, relative stability, easiness of the operative environment) (Birnbaum, 1988; Handy, 1993).

4. *Necessary analytic tools for investigating school leadership*

4.1. Models of analysis of school leadership

This taxonomy presents us with a structure of the pathways by which the head-teacher can intervene and influence the development of the school. It is apparent that these pathways are mostly indirect. Indeed, head-teachers put their imprint in contextual and staff elements, and then let the latter intervene directly on the students. Thus, as Hallinger & Heck assert, "Well-designed studies must use theoretical models that allow for the likelihood that the relationship between principal actions and school outcomes is indirect rather than direct" (1996, p. 24). The literature presents a number of theoretical models that have been used to represent the causal chain linking educational leadership to student outcomes. To the point, the most comprehensive scheme is Hallinger and Heck's (1996) adaptation of Pitner's (1988) taxonomy, which they used for classifying 42 non-experimental studies of head-teacher effects that emerged during the period from 1980 to 1995. The conceptual scheme can be summarized as:[29]

1. *Direct effects models without antecedents and intervening variables*. This model poses a direct relationship between leadership and student achievement in the absence of other intermediate features of the school organization;
2. *Direct effects with antecedent variables*. In this model, the leadership variable stands as both an independent and dependent variable. As an independent variable, the head-teacher's behavior directly influences student achievement. As a dependent variable, the head's behavior is subject to the effect of antecedent variables related to the school and its environment;

[29] This summary – used for its concise and pointy presentation – is cited from: Shalabi, F. (2002) Effective Schooling in the West Bank University of Twente Press: Twente http://doc.utwente.nl/36123/

3. *Mediated effects without antecedent variables*. This model assumes that the school leader's actions affect student outcomes indirectly through other variables while standing as an independent variable;
4. *Mediated effects with antecedent variables*. In this model, the leadership variable stands as a dependent variable and influences student outcomes indirectly through other variables standing in a mediated position;
5. *Reciprocal effects model*. This model assumes that the relationship between student learning, the head-teacher and features of the school and its environment is interactive. Each variable affects and depends on another variable.

These models do allow for an adequate conceptualization of the functioning of leadership, but they could not be used without the adequate output data and the adequate statistical techniques for implementing the algorithms.

4.2. The response variable: adequate measures of student achievement

The availability of adequate data is possibly one of the most pressing problems in any modeling endeavor. In a long term process such as education, the main issues on the ground regards possibly the existence of reliable longitudinal data for understanding whether the student has made any progress and what are the determinants of such progress. The issue of longitudinal data entails problems along two strands. The first of them is the "longitudinal" aspect itself because the costs and difficulties related to following individual students through time bring about major problems in terms of the availability of such sort of data, especially at international level. Various hypotheses have been put forward on what to do. Eurostat is supporting a project for the development of a European Student Registry; however, the project is not receiving much support and does not seem to attract the interest of Member States. With respect to international surveys, TIMSS tests every four years students of the 4^{th} and 8^{th} grade, so that it is possible to follow longitudinally at least the cohort, if not the individual student. PISA will start doing something similar starting with the 2009 edition, when optional modules will be available

to countries that want to test students also at age 9. These countries will be able to follow the progress of the cohort after 2 PISA rounds (every 3 years), when individuals of the same cohort will be tested again in the main PISA study done at age 15.

Solving the longitudinal problem, however, is not sufficient because, when trying to compare student results, one of the main problems relates to the creation of comparable units of measure for learning levels of groups of students at different points in time. Although the Classical Test Theory is still broadly used to measure learning, it is not useful in this case because when two different tests are assigned to the same (or different) group of students and their performances are summarized by raw scores (number of correct answers), the ability of students cannot be compared on the basis of the scores obtained in the two tests. The main problem arising is that of a student with scarce abilities obtaining a higher raw score in a relatively simple test than that obtained by a more skilled student in a more difficult test. That is the typical problem arising when the same students are given two tests at different points in time (years): the test of the first year is easier than the following. Item Response Theory (IRT) and Rasch Analysis are the statistical theories that offer the best tools for coping with these issues. All the main international surveys are scaled using IRT and details can be found:

- ✓ PISA: http://www.pisa.oecd.org/document/13/0,3343,en_32252351_32236173_35188685_1_1_1_1,00.html;
- ✓ TIMSS: http://timss.bc.edu/timss2003i/technicalD.html

4.3. A hierarchical model specification

Once we have a model for conceptualizing leadership, and the adequate response data for implementing the analysis, the third issue regards the structure of the dataset and the models that can be used for correctly investigating it. Specifically, hierarchical data are very common in the social and behavioral sciences. This kind of data involves measurement at multiple levels such as individual and groups as, for example, classes

and schools. In general, hierarchical data are obtained by measurement of units grouped at different levels. Groups can be defined as “natural” individuals’ clusters. In particular, hierarchical data can be obtained by multistage sampling. For instance, one might sample schools within school districts, and then sample students within sampled schools. Moreover one can obtain hierarchical data in the experimental contexts when the experimental plan presents a nested treatment structure. In all these cases the individuals present some common characteristics (these can be observed or unobserved).

In the hierarchical data analysis the lower level of observation (commonly the individual level) is called first level and following the hierarchy of data one can define the second, third, etc levels. The variables introduced in a multilevel analysis can be observed at different levels but the dependent variable must be collected at the first level.

In the social research context one generally considers the individuals as interacting with the social context to which they belong. This means that individuals are influenced by the characteristics of the groups and that the observations coming from the same group cannot be considered independent.

The analysis of hierarchical data (involving characteristics measured at different level of aggregation) can be faced by means of aggregation of the disaggregated measures or disaggregation of aggregated ones. Both the solutions present statistical drawbacks. In particular the disaggregation causes spurious statistical significance in regression model estimation without the introduction of information in the model specification, some authors called this practice “the miraculous multiplication of the number of units” (most of times the information used for the disaggregation procedure is connected with one or more individual level variables). On the other side the aggregation causes the loss of statistical “power” (the aggregation lowers the observations number), the well known ecological fallacy (or “Robinson effect”, Robinson, 1950) and the “Simpson’s Paradox” (see Lindley and Novick, 1981).

For these reasons models involving the grouped individuals cannot be specified without considering the dependence structure of the individual observations. Moreover, the multilevel structure of the data involves the possibility to consider variables measured at different levels of the hierarchy. Analysis models that contain this kind of variables are known as multilevel models. The specification of multilevel models consists in the definition of functional forms allowing for group specific coefficients. In order to specify these models one can follow:

- ✓ Fixed effects approach that considers only fixed factors and optional covariates as predictors.
- ✓ or Random effects approach considering one or more random factors and optional covariates as predictors (mixed effects model).

The decision about most favorable approach can be based on theoretical and practical consideration.

In experimental research a factor, defining different treatments, is said to have fixed effect if all possible treatments are considered in the experiment plan. A random effect is attributed to a factor defining treatments that can be considered a sample of all possible treatments. From a statistical point of view a random effect can be attributed to a factor defining large groups' number. In this case the fixed effect approach cannot be considered parsimonious and consequently one can consider the random effects model specification.

Moreover, one can interpret the group specific coefficients as direct effects of the grouping factor. In this case the model specification must include a factor (the grouping variable) in the explicative variables matrix. It is important to note that the inclusion of a factor makes impossible the use of group level variables (these would, in fact, cause perfect collinearity). This model specification implies the estimation of a coefficient for each macro-unit. Otherwise, the group specific effects can be considered as residuals from an average regression function. In this context, the residuals can be assumed as randomly drawn from a population with zero mean and unknown variance. The treatment of the

individual effects under this hypothesis implies the specification of the random coefficients model. The random coefficient model only implies the estimation of the variance of the group effect.

Summarizing, the choice between the two approaches can be influenced by the focus of statistical inference, the nature of the observed set of groups, the magnitude of group sample sizes and the population distributions involved. In particular:

1. if the groups are regarded as a sample form a larger population, the random coefficients model is appropriate;
2. if the researcher wishes to test effects of group-level variables, the random coefficients model should be used;
3. if the average group size is relatively small (some authors suggests a range from 2 to 50 or 100 observations), the random coefficients model has important advantages from an inferential point of view.

Finally, the random coefficient model is mostly used with the additional assumption that the random coefficients are normally distributed. If this assumption is a poor approximation of the real condition, the model results may be unreliable. Other discussions about the choice between fixed and random coefficients can be found in Searle et al. (1992) and in Hsiao (1995). Based on a review of the literature and on simulation studies, Ita G. G. Kreft (1996) concluded, "for researchers specifically interested in variance components, and posterior means, random coefficients modeling provides them with separate estimates for separate contexts, and the iteration procedure improves the estimates of the variance components." Compared with classical regression, multi-level modeling is more helpful in revealing differences in variance among units of analysis in different groups which comprise the levels.

CHAPTER 3

AN ANALYSIS OF THE ROLE OF SCHOOL LEADERSHIP ON STUDENT ACHIEVEMENT USING THE TIMSS2003 DATASET

1. *Background of the CRELL pilot project on "The role of school leadership on student achievement"*

The pilot project on "The role of school leadership on student achievement" was developed within the framework of CRELL, the Centre for Research on Lifelong Learning of the European Commission,[30] which was established following the Council conclusions of 24 May 2005 on new indicators in education and training:

> "the establishment of the 'research unit on lifelong learning' at the Joint Research Centre in Ispra can significantly increase the Commission's research capacity in terms of the development of new indicators".[31]

CRELL has started its operation at the beginning of 2005 in Ispra within the Institute for the Protection and Security of the Citizen (IPSC), Unit of Applied Statistics and Econometrics.[32] Among its activities, the CRELL proposes the development of new indicators that could help evaluating the progress of European member States towards reaching the Lisbon objectives in the field of education and training.[33]

Indeed, the goal of turning the EU into the most competitive and dynamic knowledge-based economy by 2010 relies on the development of education and training systems in a lifelong learning and in a worldwide perspective. Although the development of an indicator on school leadership effectiveness in terms of student achievement is not directly mentioned as an objective, school management is instrumental to many of the key issues identified in the Detailed Work Program on the follow-up of the objectives of Education

[30] http://crell.jrc.ec.europa.eu/
[31] Look at Appendix 2 for further details on the CRELL organization and work-program.
[32] http://webfarm.jrc.cec.eu.int/uasa/
[33]

and Training Systems in Europe.[34] In fact, at the micro level, school managers are responsible for the development and implementation of the managerial and didactic strategies adopted by the individual schools or by networks of institutions.

On the basis of this rationale, the project investigated the possibility of producing new evidence on the existence of a relationship between school leader activities and student achievement. Along with the suggestions of Jaap Scheerens (Scheerens, 2005), the project was initially conceived on three strands of activities:

1. qualitative analysis of school leadership characteristics and implementation in selected target countries,
2. quantitative analysis of existing datasets,
3. field survey for collection of new data on school, teacher, family, and student characteristics, as well as measures of student achievement.

Points 1. and 3. were subsequently marginalized to avoid replication of existing research. In fact, the OECD, the Organization for Economic Cooperation and Development, is also looking closely at the issue of school leadership. With respect to point 1., it has set-up a project on “Improving School Leadership” with the following objectives:

1. to synthesize research and country practices on issues related to improving leadership in schools;
2. to identify innovative and successful policy initiatives and practices;
3. to facilitate exchanges of lessons and policy options among countries; and
4. to identify policy options for governments to consider.

Nineteen countries[35] are pursuing these objectives by means of Individual country background reports on the policies and structures that impact on the role and development of effective school leadership, a series of international workshops and expert

[34] http://europa.eu/scadplus/leg/en/cha/c11086.htm

[35] Specifically, the participating countries are: Australia, Austria, Belgium (Flanders), Chile, Denmark, Finland, France, Hungary, Ireland, Israel, Korea, The Netherlands, New Zealand, Norway, Portugal, Slovenia, Spain, Sweden, UK/Eng, UK/N. Ireland, UK/Scotland

commissioned papers to explore key issues, complementary analysis of other OECD materials, some case studies. The project is at an advanced stage of development and there was no point in replicating it in a smaller scale. Therefore, CRELL has opted for *complementing* the information with a project specifically targeted to the Euro-Mediterranean countries and presently involving Italy, Spain, Turkey, Albania, Israel, Cyprus, Malta, Greece, and Algeria.

With respect to point 3., the European Commission is already cooperating with the OECD for the preparation of the Survey on Teachers, Trainers and Learning (TALIS), which will study of 20 teachers in 200 lower secondary schools in numerous countries (many of which are European). The survey will report in March 2009, (fieldwork in 2008) and should provide data on a number of different issues, among which:

1. The kinds of professional development that teachers want and get,
2. The core practices and beliefs of teachers,
3. Teacher appraisal systems,
4. and, of course, different aspects of school leadership.

One of the most interesting aspects of the study is that countries can opt for interviewing the staff of schools whose students have been included in the PISA survey. The possibility of eventually matching the two datasets[36] would provide the countries with invaluable information on the relationship between staff characteristics and student achievement. Thus, any smaller scale study in the area would not have provided a clear value added to these already existing initiatives and could not be supported in terms of cost effectiveness. For these reasons, the investigation focused on the remaining research strand – quantitative analysis of existing datasets. As commented in the previous chapter, one key issue for investigating school leadership in a comparative perspective regards the need of having *reliable and comparable micro data* in terms of *school, teachers, and individual student characteristics* and in terms of *student knowledge* (possibly proxied by their

[36] Once taking into account the caveats expressed by Scheerens (2005).

scores in standardized tests). Then, a project developed inside CRELL cannot but i*nvestigate the situation in European countries first*, and eventually extend the comparison to a worldwide perspective at a later stage. These requirements limit substantially the range of datasets that could be of use. Moreover, and looking back at the considerations of chapter one, student scores in standardized tests are only a proxy of their knowledge and of their future results. In a lifelong learning perspective, the reason for stressing the need of improving student results is that "learning begets learning" (Heckman, 2000), achievement promotes individual earnings and economic growth (Hanushek, 2003), and productivity directly derives from social abilities and cognitive skills specific to the job and occupation (Bishop, 1997). Therefore, the student scores of interest are those that better proxy future earnings, i.e. Mathematics and Science scores.

After these considerations, the dataset selection process focused on two possibilities:

- ✓ OECD – PISA 2003 survey,
- ✓ IEA – TIMSS 2003 survey.

Both studies fulfill the requisites. In fact, the surveys involve dozens of countries, many of which are European; the test – both in Mathematics and Science – are IRT based and are both reliable and comparable; substantial background data is collected on individual, teacher, and school characteristics. Neither of the two studies allows for longitudinal tracking of the individual students,[37] but most countries of the European Union are involved in the PISA study, while only 14 do the TIMSS. For these reasons, the analyses specifically referred to Europe generally refer chiefly to the PISA datasets. However, as emerging from Jaap Scheerens' research, the projects that, in the "wake of the main PISA study, have tried to explain these performance differences educational leadership has not received much attention. This is not surprising, because the PISA school questionnaire

[37] The TIMSS tests students of 4th and 8th grade; thus, every 4 years is possible to follow the same cohort of students. From the 2009 edition the PISA study will offer an optional module for testing students at age 15 and at age 9 so that the progress of the same cohort of students could be assessed every 6 years.

does not contain items on leadership" (Scheerens & Witziers, 2005: 12). The TIMSS School Questionnaire, on the other hand, provides some items that are better fit to investigate the issue. Some researchers have already used these variables (i.e. Wiseman, 2001; Suskavcevic and Blake, 2001); nonetheless, some studies – such the one by Suskavcevic and Blake – are limited to the US sample, and all of them limit the investigation to the direct relationship between school leadership and student achievement.

The pilot project take a step forward with respect to the previous studies and attempts to quantify also the indirect impact of school leadership on student achievement.

To address this issue, the analysis requires two basic specifications regarding:

1. What aspect of the head-teacher behavior are we specifically investigating;
2. What is the reference model of interaction between school leadership and student achievement that will be adopted through the analysis.

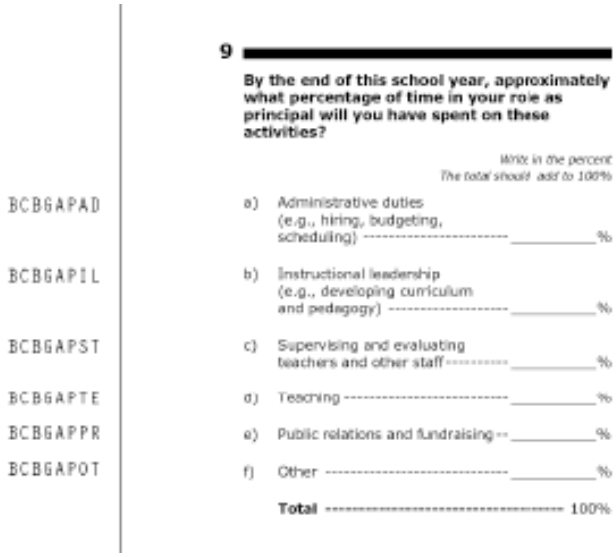
1.1. Management or Leadership?

As detailed in the glossary, the term "leadership" has been used along the text in an omni comprehensive way to refer to all the activities related to "pushing forward" the school in all its dimensions. In this sense, leadership is neither necessarily linked to the sole figure of the head-teacher, nor limited to purely administrative or purely instructional activities. Indeed, the distinction of administrative management from educational leadership has been a source of debate for many years (Krüger, Witziers, Sleegers, & Imants, 1999) and, from time to time, three terms - administration, management and leadership – are still used almost interchangeably. Scholars and researchers continue to debate on the aims and methods of educational leadership and of management (Fidler, 1997), and what leaders should pay attention to. The taxonomy presented in the previous chapter makes the case for considering management the "executive function" of educational leadership, whose primary task is to develop strategies for achieving the school's core targets,

including the desired student results (Card & Krüger, 1998). In this sense, “an educational leader then is someone whose actions (both in relation to administrative and educational tasks) are intentionally geared to influencing the school’s primary processes and, therefore, ultimately students’ achievement levels” (Witziers, Bosker and Krüger, 2003). Their activities are necessarily conditioned by the legal framework in which they operate and by the contextual conditions (student intake, labor market conditions, resources, staff…) of the area where the school is located, but they focus on making the best of the existing situation and consequently favor the student educational development. Accordingly, one possible distinction between leadership and management could be empirical and use the *relative weight of the head-teacher’s administrative and educational tasks* as a means for determining the more-managerial or more-educational leadership style.

Following this approach, the variables of interest in the TIMSS dataset are derived from item 9 and indicate the % of time spent by head-teacher on instructional issues (teaching, supervising teachers, and instructional leadership – i.e. giving demonstration lessons, discussing educational objectives with teachers, initiating curriculum revision and/or planning, training teachers, and providing professional development activities), and the % of time spent on non-instructional issues (internal administrative tasks, representing the school in the community, representing the school in official meetings, talking with parents, counseling and disciplining students, and responding to education officials’ requests).

Figure 7: Item investigating Head-teacher activities.



9

By the end of this school year, approximately what percentage of time in your role as principal will you have spent on these activities?

Write in the percent
The total should add to 100%

BCBGAPAD	a)	Administrative duties (e.g., hiring, budgeting, scheduling) ---------- _____%
BCBGAPIL	b)	Instructional leadership (e.g., developing curriculum and pedagogy) ---------- _____%
BCBGAPST	c)	Supervising and evaluating teachers and other staff ---------- _____%
BCBGAPTE	d)	Teaching ---------- _____%
BCBGAPPR	e)	Public relations and fundraising -- _____%
BCBGAPOT	f)	Other ---------- _____%
		Total ---------- 100%

Excerpt from TIMSS 2003 School Questionnaire

Specifically, in the school questionnaire, head-teachers were requested to allocate their time in six different sectors:

1. Administration – “BCBGAPAD”;
2. Public relations – “BCBGAPPR”;
3. Residual non teaching activities – “BCBGAPOT”;
4. Instructional leadership – “BCBGAPIL”;
5. Supervision of teaching – “BCBGAPST”;
6. Direct teaching – “BCBGAPTE”.

The first three variables indicate the % of time spent by the head-teacher on non-instructional issues, and were aggregated in the variable “Mana” (Management). The values of the last three variables indicate the % of time spent by the head-teacher on instructional issues, and were aggregated in the variable “Lead” (Leadership).

The variables Mana and Lead add to 100% of the head-teacher time and are a crucial component of the analytic model described later in the chapter. In fact, a dichotomous version of the variable Mana is used to identify the cases in which the management

activities are prevalent, and the variables are also to study the model behavior with respect to changes in head-teacher specialization in management or leadership.

Figure 8 shows the average head-teacher time allocation for each of these activities in the countries considered for the study.

Figure 8: Average head-teacher time allocation in reference countries

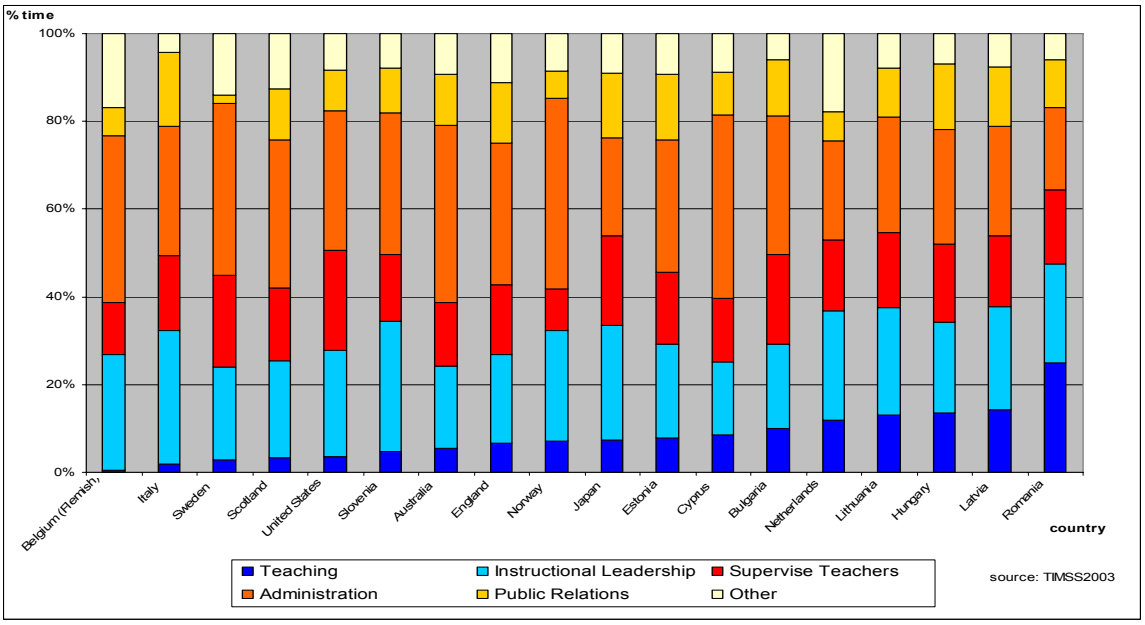


Figure 9 presents the head-teacher time allocation on the basis of the derived variables Management and Leadership. Head-teachers are mostly busy with dealing with the administration (31%) and with instructional leadership (23%); they invest about 16% of their time in supervising the staff and 11% in public relations. On average, only 9% of their time is spent on direct teaching, but such figure is very variable and ranges form the 0.3% of Belgium to the over 25% of Romania. Such variability partially explains the ongoing discussion on whether head-teachers should engage in teaching at all. This debate has strong consequences on the requirements for becoming head-teachers and the professional development programs provided to in-service head-teachers.[38]

[38] To the point, data on headteacher professional development and requirements is scarce. The CRELL Report "Nurturing Learning Communities" (C. Bezzina, D. Vidoni, 2006, LB-NA-22328-EN-C) looks at the characteristics of School Leadership especially in terms of Educational Leadership and propose a set of indicators to measure school leader professional development (Ch. 7).

Still, as it could be expected, no consistent pattern emerges yet among the different average behavior of head-teachers in the different countries. After the considerations of the previous chapters, this result could be expected as the variables that determine head-teachers' time allocation are too many and too different for allowing any macro-level consideration. However, looking more in depth at how the "leadership" and the "management" categories are built, we can see that in all countries individual schools act very differently so that the average levels at country levels end up telling only a very small portion of the story. In most countries, both management and leadership range form 0% to 100% of the head-teacher time with large standard deviations (Table 5).

Figure 9: Average head-teacher time allocation in management and leadership activities

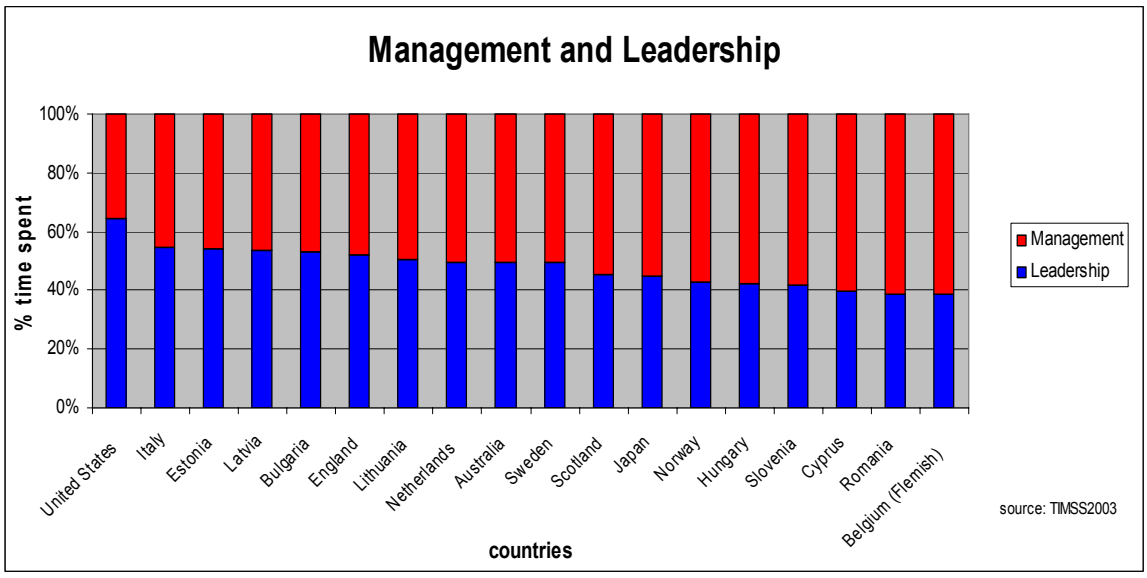


Table 5: leadership and management in the different countries, basic statistics

Leadership	Min	Max	Mean	St. Dev.
Sweden	10.000	95.000	45.000	17.914
USA	5.000	90.000	50.605	16.582
Slovenia	20.000	87.000	49.724	13.559
Scotland	10.000	75.000	41.937	12.123
Romania	25.000	95.000	64.432	13.846
Norway	10.000	80.000	41.722	13.730
Netherlands	10.000	85.000	52.692	17.544
Lithuania	16.000	83.000	54.643	13.133
Latvia	15.000	90.000	54.032	14.569
Japan	20.000	90.000	53.825	13.984
Italy	10.000	80.000	49.393	13.066
Hungary	10.000	80.000	51.925	12.800
Estonia	10.000	85.000	45.621	16.991
England	10.000	85.000	42.824	20.237
Cyprus	15.000	72.000	39.556	12.165
Bulgaria	15.000	80.000	49.500	13.164
Belgium	0.000	90.000	38.725	16.892
Australia	5.000	86.000	38.755	16.501

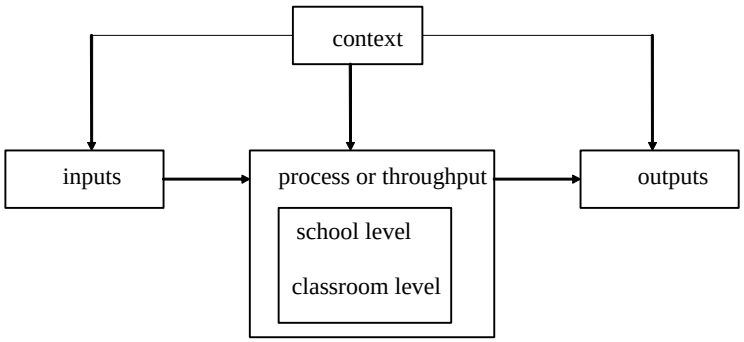
Management	Min	Max	Mean	St. Dev.
Sweden	5.000	90.000	55.000	17.925
USA	10.000	95.000	49.349	16.746
Slovenia	13.000	80.000	50.243	13.423
Scotland	25.000	90.000	57.797	12.149
Romania	5.000	75.000	35.623	13.700
Norway	20.000	90.000	58.030	13.769
Netherlands	15.000	90.000	46.957	17.854
Lithuania	17.000	84.000	45.571	13.077
Latvia	10.000	85.000	46.136	14.524
Japan	10.000	80.000	46.175	13.984
Italy	20.000	90.000	50.607	13.066
Hungary	20.000	90.000	47.973	12.682
Estonia	15.000	90.000	54.436	17.126
England	15.000	90.000	57.392	20.323
Cyprus	30.000	85.000	60.389	12.129
Bulgaria	20.000	85.000	50.449	13.178
Belgium	10.000	100.000	61.282	17.081
Australia	0.000	95.000	60.891	17.020

1.2. Head-teacher – student interaction, the theoretical model of reference

In the afore-presented conception, head-teachers intervene on the “malleable factors” at their reach to make the best of the school environment. To do so, they focus on the administrative (Mana) and/or educational (Lead) tasks depending on their ability and on the existing contextual constraints.

The problem is of course to understand *how and if* the head-teacher actions make a visible difference above and beyond the impact of the contextual conditions. The theoretical model used in this project is based on Scheerens’ model of school effectiveness, already presented in the previous chapter and hereinafter reported in its basic version (Figure 10).

Figure 10: A basic model of school effectiveness



Source: Scheerens, 2000:35

As already discussed, this model of school effectiveness provides a framework for investigating at all the factors and processes that intervene in the formation of the outputs, and school leadership is necessarily only one of the relevant school-level-variables.

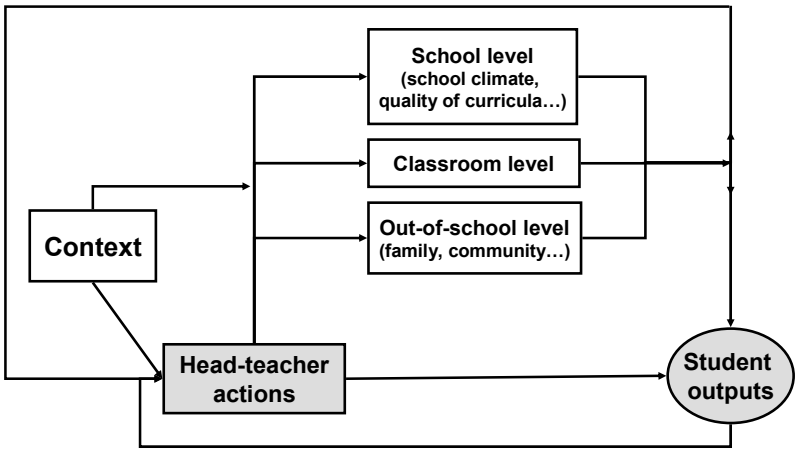
For the aims of the present study, I have modified the base model and considered explicitly the role of the head-teacher (Figure 11). In this representation, head-teachers actions (either Mana or Lead) are influenced by the specific context in which they operate. In turn, their actions can either:

1. Influence students directly (direct teaching, mentoring…),
2. or impact on a range of different policies and situations inside or outside the school (refer to ch.1 for the models of interaction between system agents, and see the previous chapter for a taxonomy of existing models of leadership and management)

In this second case, the head-teacher's impact on student outputs is mediated by other agents and cannot be directly measured. The other agents respond to the head-teacher solicitations and modify their behavior, which affects directly student outputs; the same pattern holds for the head-teacher intervention on resources and background situations.

Head-teachers perceive the results of their interactions with students, system agents, and background conditions and use this feedback to further modify their actions.

Figure 11: Influence of head-teacher actions on student results



On the basis of this approach, the assessment of head-teacher's influence on student outputs depends both on the direct and the indirect effects. Hence, the study will investigate both instances.

In particular, addressing the indirect-effects-issue implies answering the question: "*Do the head-teacher actions make a difference?*" As anticipated, this dimension cannot be measured directly, but we can consider that head-teachers focus on Management or Leadership activities as they consider best for incrementing school quality. Hence, the time they spend on Mana or Lead can be interpreted as a mediating variable between the measured dimensions (context, school, class and individual characteristics) and student results. The differential impact of these characteristics when the head-teacher focuses on Management or Leadership, minus the impact of the head-teacher direct effect, allows us to gauge whether head-teacher actions make a difference at all, whether any of the two strategies (management or leadership) yields more substantial differences, and – eventually – the magnitude of this difference.

2. *The dataset for the analysis*[39]

Although it was not built for this purpose, the TIMMS 2003 project is one of the few databases that can be used to measure school leadership characteristics in terms of

[39] This section makes extensive use of the information available in the TIMSS 2003 User Guide, http://timss.bc.edu/timss2003i/

head-teacher time allocation and the role of school leadership on student achievement. With respect to Europe, the database provides data on 14 countries (Belgium - Flemish Community, Bulgaria, Cyprus, England, Estonia, Hungary, Italy, Latvia, Lithuania, Netherlands, Romania, Scotland, Slovenia, and Sweden). Analyses have been carried out to investigate the models of school leadership in use in these countries and the relationship between school leadership and student achievement. To inscribe the European situation in the world scenario, the same analyses were also performed on Australia, Japan, Norway and the United States of America.

2.1. The TIMSS 2003 Database

The TIMSS 2003 international database contains student achievement data in mathematics and science as well as student, teacher, school, and curricular background data for the 48 countries that participated in TIMSS 2003 at the eighth grade and 26 countries that participated in TIMSS 2003 at the fourth grade. The database includes data from over 360,000 students, about 25,000 teachers, about 12,000 school head-teachers, and the National Research Coordinators of each country.

The TIMSS 2003 data files reflect the result of an extensive series of data management and quality control steps taken to ensure the international comparability, quality, accuracy, and general utility of the database in order to provide a strong foundation for secondary analyses. They contain responses to background questionnaires administered to students, their teachers, and the head-teachers of their schools. As part of the international data files, variables derived for reporting in the international reports are also included. The database also contains student achievement data and scoring reliability data, as well as the responses to national curriculum questionnaires provided by the National Research Coordinators.

In the present study, student, teacher and school background questionnaires were collected linking their information by means of class and school identification codes. The

information about student achievement was then connected to the other information building a full comprehensive archive.

2.2. Scoring reliability

The scoring reliability files for fourth and eighth grades contain data that can be used to investigate the within-country reliability of the TIMSS constructed-response item scoring. The scoring reliability files contain one record for each booklet that was double scored during the scoring reliability exercise of the constructed-response items.

For each constructed-response item in the achievement test, the following three variables are included:

- ✓ Original Score (two-digit score assigned by the first scorer)
- ✓ Second Score (two-digit score assigned by second scorer)
- ✓ Response Score Agreement (degree of agreement between the two scorers)

It should be noted that the Second Score data were used only to evaluate the within-country sampling reliability and were not used in computing the achievement scores reflected in the Student Background files and the international reports.

In addition to the scoring reliability variables, the reliability files also include identification variables to aid in case identification. Some tracking variables are also included that were used in conducting the scoring reliability study within each country.

2.3. Student-teacher linkage

The Student-Teacher Linkage files contain one entry per student-teacher linkage combination in the data. In many cases, students are linked to more than one mathematics and/or science teacher, and in these cases there will be one record for each student-teacher link.

In the present analysis, only the first teacher file was considered for each student. This simplification is connected with the marginal importance of the linkage problem. In fact, the phenomenon of multiple linkages presents a very low frequency. Moreover the teacher

variables, entering the final model specification, have a relatively low effect on the model estimation.

2.4. Data weighting

An important characteristic of the TIMSS studies, and one that has crucial implications for data analysis, is that they use data from carefully-drawn random samples of schools, classes, and students to make inferences about the mathematics and science achievement of the fourth- and eighth-grade student populations in the participating countries (see Foy and Joncas, 2004). For analyses based on these sample data to accurately reflect populations' attributes, it is necessary that they take the design of the sample into account. This is accomplished in part by assigning a sampling weight to each respondent in the sample, and weighting the respondent by its sampling weight in all analyses. The sampling weight properly accounts for the sample design, takes into account any stratification or disproportional sampling of subgroups, and includes adjustments for non-response (see Foy & Joncas, 2004).

The student sampling weight, known as TOTWGT in the international database, must be used whenever student population estimates are required. The use of TOTWGT ensures that the various subgroups that constitute the sample are properly and proportionally represented in the computation of population estimates, and that the sample size will be inflated to approximate the size of the population.

The core of this study relates to the estimation of a multilevel model in which the response variable is collected at the individual (student) level. The weighting variable "TOTWGT" enters the model specification adjusting the variance structure for the real population data structure.

2.5. The jackknife repeated replication technique

The TIMSS 2003 sampling design applied a stratified multistage cluster-sampling technique to the problem of selecting efficient and accurate samples of students while

working with schools and classes. This design capitalized on the structure of the student population (i.e., students grouped in classes within schools) to derive student samples that permitted efficient and economical data collection. Unfortunately, however, such a complex sampling design complicates the task of computing standard errors to quantify sampling variability, as the computational formulas derived from assumptions of simple random sampling generally underestimate the true variability in the data. To avoid this problem, TIMSS uses the jackknife repeated replication technique (JRR) (Wolter, 1985), one of a class of techniques that estimates sampling error through repeated re-sampling of the originally-sampled data. The jackknife was chosen by TIMSS because it is computationally straightforward and provides approximately unbiased estimates of the sampling errors of means, totals, and percentages.

3. *The Model*

3.1. The random intercept model specification

The hierarchical model is a particular type of regression model suitable for multilevel data. Its main characteristic regards the use of variables collected at different level and the consideration of the hierarchical structure in the model specification. In the notation one can commonly distinguish the levels by means of indices like i, j, k, etc. In particular for a two level model we can define:

j as the groups' index (j=1,…,N);

i as the individuals' index (i=1,…,n_i).

Consequently, for individual i in group j, we can define

Y_{ij} as the dependent variable

x_{ij} as the vector of explanatory variables at the individual level

and for group j

z_j as the vector of explanatory variables at the group level.

Without lack of generality, we can define a generic multilevel model (two level model) by

$$y_{ij} = \alpha_j + \beta_j x_{ij} + \varepsilon_{ij}, \quad (1)$$

where x is a single explicative variable observed at the bottom level of the hierarchy, and the random coefficients can be related to a second-level explicative variable z,

$$\alpha_j = \alpha + \gamma_\alpha z_j + \delta_{\alpha j} \quad (2)$$

and

$$\beta_j = \beta + \gamma_\beta z_j + \delta_{\beta j}.$$

Combining these two equations one can obtain a model considering both group specific intercept and slope. Hereinafter we will consider a simplified version of this model allowing for group specific intercept only.

Basing on the considerations collected in the previous section the specification of a random coefficient model in our study seems to be the best choice. First the considered states are only a part of the disposable data and for each state data have been collected on a sample of schools. The hierarchical structure, considered in the present work, is a three level structure having the individuals grouped in the school structures and the schools grouped in the countries. Given that the interest lays mostly the analysis of European states, the third level macro units are a sample of the collected data, which are a sample of the country schools. In other words, we are considering a subset of the available data, which is a sample of the population of schools. Moreover, the number of individuals belonging to the schools varies between 1 and 88 and the average size of the groups is 27.37. Finally, the total number of schools considered in our study is 1901 clustered in 18 countries. The large number of second level groups implies the necessity of parsimonious model specification such as the random coefficients one.

A first step in the hierarchical data random effects analysis is the identification of degree of resemblance between micro-units belonging to the same macro-unit. To this end one can define the “infraclass correlation coefficient”. The definition of this index can be based

on the results of a random effects ANOVA model (or empty model). This model can be written as:

$$y_{ij} = \alpha + \delta_j + \varepsilon_{ij},$$

where α is the population grand mean, δ_j is the specific effect of macro-units and ε_{ij} is the residual effect of the micro-unit i within the macro-unit. Macro-units differ randomly from one another. The group effect δ_j has mean 0 and variance τ^2 (between groups variance) and the residuals have mean 0 and variance σ^2 (within group variance). Commonly the two error components are supposed to be independent; the total variance of y_{ij} is then given by

$$\mathrm{var}\left(y_{ij}\right) = \tau^2 + \sigma^2.$$

This result can be interpreted as a sort of variance decomposition and consequently the infraclass correlation coefficient can be computed as follows:

$$\rho = \frac{\tau^2}{\tau^2 + \sigma^2}.$$

The proportion of variance that is accounted for by the group level is called “correlation coefficient” because it is equal to the correlation between two micro-units belonging to the same macro-unit.

The generic random intercept model (two level model) can be defined combining equation (1) and (2)

$$y_{ij} = \alpha + \gamma z_j + \beta x_{ij} + \varepsilon_{ij} + \delta_j,$$

where the error term is a combination of first and second level terms. This model specification allows the consideration of a covariance structure between the grouped first level observations and from this point of view can be considered a particular case of generalized linear model. As well as in the classical regression models the coefficients of the explanatory variables can be interpreted as the average increase of y due to one unit increase of x (or z).

The model specification can be ideally divided in two segments: the fixed coefficients (or deterministic part of the model) and the random component (or stochastic part of the model). This last term can be defined as depending from the values of one or more explanatory variables in order to consider heteroschedasticity in the model specification. As in the empty model the two residual terms are mutually independent and have zero means. Returning to the deterministic part of the model one can deserve special attention to the variables specification. In particular the distinction between first level, x, and second level variables, z, assumes a relevant role. While the first level variables are directly measured on the individuals, the second level ones can be both directly defined for the macro-units or derived as an aggregation of first level observations.

After the model estimation the group effect can be calculated by a method called empirical Bayes estimation which produces the so-called posterior means. The idea of this method is that the macro-unit effect is “estimated” (or better calculated) by combining two kind of information:

the data from group j,

the model assumption defining the normal distribution of the unobserved group effects.

A “not really solved” issue in the multilevel model specification regards the so called “effects of centering” (Cronbach, 1976). In other words the practice suggests transforming the explanatory variables subtracting the grand mean (arithmetic mean of all observations) and the group means from the original scores. The aim of our work is to specify a model allowing for different variance level depending from the hierarchical structure of the dataset; thus, we consider a random intercept model whose estimated coefficients are not affected by the centering operation for the reason just described.

Further details about the macro-unit effects of computation can be found, for example, in Efron and Morris (1975) and Longford (1993).

3.2. The group size

In most research, the group sizes ni are variable between groups. This characteristic does not constitute a problem. The hierarchical linear models can be applied both to constant (or quasi constant) and variable group sizes. The group sizes have a direct effect on the computation of the posterior means' confidence intervals. Sometimes the group sizes are connected with a data collection problem (as for example the problem of systematic missing data) or the group sizes affect the dependent variable values. In these cases the "group size" must be considered as an explicative variable in order to take into account of its effect on the interest phenomenon. In our research the group sizes cannot be considered as affecting the learning process as reported in Snijders and Bosker (1999). In fact, pupils are grouped by schools and not by classes; consequently we cannot consider the group sizes as affecting the teaching potential.

3.3. The estimation procedure

The estimation of the random intercept model can be easily faced in a likelihood framework. All the likelihood based procedures produce standard errors for most of the estimates and the classical inferential results can be considered in the multilevel model specification. Depending on the statistical software in use, different varieties of ML can be adopted. The two main approaches are the full maximum likelihood and the restricted maximum likelihood (both the procedures requires iterative procedures).

REML estimation has better bias characteristics (Diggle, 1988), handles high correlations more effectively, and is less sensitive to outliers than ML, but cannot be used for model comparison of fixed effects, as noted below in the section on likelihood ratio tests. ML estimations ignore the degrees of freedom used up by fixed effects in mixed models, leading to underestimation of variance components. However, ML may nonetheless be preferred when comparing two models with different parameterizations of the same effect.

When the number of groups is large (an empirical rule suggests that large is here higher than 30) the difference between the two methods is negligible.

Various algorithms are available to determine the multilevel models estimates. All of them are iterative procedures and this means that the researcher must pay attention to the convergence status of the algorithm. The most relevant are:

- ✓ EM (expectation maximization);
- ✓ Fisher scoring;
- ✓ IGLS (Iterative Generalized Least Squares);
- ✓ and RIGLS (Residual or Restricted IGLS).

Technical details can be found, e.g., in Bryk and Raudenbush (1992), Goldstein (1995) or Longford (1993, 1995). In favorable conditions all the algorithms yield the same estimates for a given estimation method ML or REML. The other way round the iterative algorithms can, in non-optimal conditions, yield to different results and also within the same algorithm one can obtain different results considering different starting values. From this point of view the convergence of the estimation algorithm assumes an important role in the results interpretation process.

3.4. The three-level random intercept models

This application considers the individual observations as grouped within schools and the schools grouped within countries. This hierarchical structure correspond to a nested multilevel with three levels. The dependent variable y can be indexed as y_{ijk} where i correspond to the pupil level, j to the school and k to the country. The model can be formulated as follows:

$$y_{ijk} = \alpha + \beta x_{ijk} + \gamma z_{jk} + \eta z_k + \theta_k + \delta_{jk} + \varepsilon_{ijk},$$

where the stochastic part of the model considers three residuals. Their variances can be denoted by:

$$\mathrm{var}(\varepsilon_{ijk}) = \sigma^2,\ \mathrm{var}(\delta_{jk}) = \tau^2 \text{ and } \mathrm{var}(\theta_k) = \varphi^2.$$

As in the two-level model, explicative variables at any of the three levels can be added. All the features discussed for the two level model can be generalized to the three level model.

The model used in the empirical analysis presents a peculiar formulation which aim is to evaluate the interaction effect between a particular school level variable (the prevalence of management in head-teacher activities) and the student level variable summarizing the schooling level of the family members. The management prevalence dummy variable (defined as $I_{(Mana>60\%)}$) produce a classification of the observed values. The model specification reflects this classification. In fact, the fixed component of the model is defined by separated equations for the two data clusters:

$$SCORE_{ijk} = \begin{cases} \alpha_0 + \beta_0 x_{ijk} + \gamma_0 z_{jk} + \theta_k + \delta_{jk} + \varepsilon_{ijk} \text{ for } Mana > 60\% \\ \alpha_1 + \beta_1 x_{ijk} + \gamma_1 z_{jk} + \theta_k + \delta_{jk} + \varepsilon_{ijk} \text{ otherwise} \end{cases} \quad (3)$$

The stochastic part of the model is otherwise invariant to the classification. The three error components are considered independently distributed with zero mean. The estimation process requires an ulterior assumption: the normality. Under this assumption the estimation can be based the maximization of the likelihood (or log-likelihood) function. The ML approach supplies the researcher with estimates of the coefficient of the deterministic part of the model ($\{\alpha_0, \beta_0, \gamma_0, \alpha_1, \beta_1, \gamma_1\}$) and of the error components variances ($\{\sigma^2, \tau^2, \varphi^2\}$).

The model specification is than completed considering a particular variance structure, which is supposed to depend on the “TOTWGT” covariate. The software used for the model estimation is R-Statistics and in particular the Linear Mixed Model estimation library

"nlme". The adopted computational methods are described in Bates, D.M. and Pinheiro (1998) and follow on the general framework of Lindstrom, M.J. and Bates, D.M. (1988).[40]

3.5. The variables of interest

The analyses reported in this work make use of a sub-sample of 21 variables, for 52.036 students observed in 1901 schools clustered in 18 different states. This sample is taken from the 8th grade TIMMS dataset and is used to study the effect of a set of control variables on the student achievement in mathematics and science. The reasons for concentrating on the 8th grade data are both practical and theoretical. On the practical level, only a smaller set of European countries were available in the 4th grade database, and this limitation would have limited the scope of a project that is referred to the whole European Union. Second, in the case of the indirect effects, the ratio is that the head-teacher can create conditions that the students can ultimately profit more for their

[40] Several software packages for multi-level modeling have emerged in the last decade. Some of these are:
R-Statistics, a language and environment for statistical computing and graphics. R is similar to the award-winning S system but it is an open-source-software. It provides a wide variety of statistical and graphical techniques (linear and nonlinear modelling, statistical tests, time series analysis, classification, clustering ...). The environment is organized in specific libraries and the multilevel model estimation can be handled using some of these libraries (e.g. nlme or lme4).
SPSS's "Linear Mixed Models" module, part of its SPSS Advanced Models extension, handles hierarchical linear models (HLM) as well as related models for random or mixed ANOVA and ANCOVA, repeated measures ANOVA and MANOVA, and variance component estimation (VARCOMP).
AMOS and LISREL. It is possible to implement multi-level models in structural equation modeling programs like AMOS and LISREL. LISREL's MLM module is called MULTILEV.
SAS's PROC MIXED procedure can implement several models: simple random-effect only, simple mixed with a single fixed and random effect, split-plot, multilocation, repeated measures, analysis of covariance, random coefficients, and spatial correlation See Littell et al. (1999).
HLM authored Steve Raudenbush and Tony Bryk. Raudenbush heads the longitudinal and *multi-level methods project* at Michigan State University. HLM can read data from a variety of statistical packages, including SPSS, SAS, SYSTAT, and STATA, and it covers nonlinear as well as linear models. This was perhaps the leading package during the development of multi-level modeling in the 1990s. HLM does not have a built-in data editor: data preparation must be done in SPSS (which HLM imports) or another program. HLM does not read ordinal variables, which must be converted to a series of dummy variables in the data preparation stage. Cross-level interaction terms are created automatically by HLM, and there is an option for automatic centering of variables (group mean centered or grand mean centered).
MLWin, a Windows program produced by the UK/Canada Multilevel Models Project, for models with any number of levels. It is the Windows version of the earlier MLn multi-level modeling software package.
Stata, a statistical environment that can implement several multilevel linear and generalized both in the random and fixed effects approach.
MPlus supports multi-level modeling with latent variables.

learning. This conception implies – at least partially – an active role of the student that is aware of the background conditions and is responsive to an entire set of solicitations coming from different sources. Such awareness could be more easily expected from student of about 13 years of age than from their much younger peer of about 9 years old.

Apart of the response variables "Math" and "Science" scores, the analysis involved a set of explanatory variables, 7 of these are student-level characteristics and 14 are school specific characteristics. The analysis did not consider any country specific variable, and the variable selection process adopted in the model specification is based on a backward search.[41]

The individual level dependent variables (referred to as Y_{ij}) are:

1. Average score in Mathematics – "BSMM". It is the arithmetic mean of the five plausible values generated for the Math test;

[41] Some variables were excluded a priori from the selection procedure because not/only partially collected.
Specifically, among the original variables, the exclusion process regarded:
BSBGPS04, Do you have a study desk/table for your use in your home?, (excluded because it was not present in the US questionnaire)
BCBGSBED, Approximately what percentage of students in your school come from economically disadvantaged homes?, (excluded because it was not present in the Norwegian questionnaire)
BCBGSBEA, Approximately what percentage of students in your school come from economically affluent homes?, (excluded because it was not present in the Norwegian questionnaire)
BCBGEPRF, Does your school expect parents to raise funds for the school?, (excluded because it was not present in the English questionnaire)
BCBGEPSE, Does your school expect parents to attend special events (e.g., science fair, concert, sporting events)?, (excluded because it was not present in the English questionnaire)
BCBGEPVO, Does your school expect parents to volunteer for school projects, programs, and trips?, (excluded because it was not present in the English questionnaire)
BCBGEPCH, Does your school expect parents to ensure that their child completes his/her homework?, (excluded because it was not present in the English questionnaire)
BCBGEPSC, Does your school expect parents to serve on school committees (e.g., select school personnel, review school finances)?, (excluded because it was not present in the English questionnaire)
Among the derived variables, the exclusion process regarded:
BSDGASP, Students' Educational Aspirations Relative to Parents' Educational Level, (excluded because it was not consistent with the indications for the available values of the variable)
BSDGCAVL, Use of Computer, (excluded because it was not consistent with the indications for the available values of the variable)
BSDMHW, Index of Time Students Spend Doing Mathematics Homework (TMH) in a Normal School Week, (excluded because it was not consistent with the indications for the available values of the variable)
BSDSHW, Index of Time Students Spend Doing Science Homework (TSH) in a Normal School Week, (excluded because it was not consistent with the indications for the available values of the variable)

2. Average score in Science – “BSMS”. It is the arithmetic mean of the five plausible values generated for the science test;

Even though the TIMSS database offers five math and science achievement plausible values, with no particular preference toward the use of any of these values, numerous analyses have been conducted using only the first plausible value. This approach can be justified when considering that “the imputation error can be ignored” (Gonzales and Smith, 1997: ch.6, p. 3). Gonzales and Smith reach this conclusion upon conducting inter-correlations among the five plausible scores. Although any of the five plausible values would represent equally well student scores in mathematics and science, the project used the mean of the five plausible scores in mathematics and the mean of the five plausible scores in science, as measures of student achievement in these areas.

The individual level independent variables (referred to as X_{ij}) are:

1. Students’ age - “BSDAGE” (expressed in years);
2. Students’ sex dummy variable – “BSBGSEX”;
3. Dummy variable identifying the possess of a calculator – “BSBGPS01”;
4. Dummy variable identifying the possess of a computer – “BSBGPS02”;
5. Ordinal variable the number of possessed books – “BSBGBOOK”;
6. Ordinal variable identifying the highest level of parental education – “BSDGEDUP”
7. Dummy variable identifying the condition in which students speak the test language at home – “BSBGOLAN”.

The school-level variables are (Z_j in the followings):

1. Age of Math teachers (expressed in years) – “MaBTBGAGE”;
2. Experience of the Math teachers (expressed in years) – “MaBTBGTAUT”;
3. Age of science teachers (expressed in years) – “ScBTBGAGE”;
4. Science teachers’ sex dummy variable – “ScBTBGSEX”;
5. Dichotomization of ordinal variable identifying the level of teacher understanding of school goals – “TeachUnd”;

6. Ordinal variable indicating the evaluation of school climate – “climaM” (this variable identifies a joint evaluation of head-teacher and Math teachers and is derived from variables BCDGCH and BTDMCH);
7. Ordinal variable indicating the evaluation of school climate – “climaS” (this variable identifies a joint evaluation of head-teacher and science teachers and is derived from variables BCDGCH +BTDSCH);
8. Permanence of head-teacher in the school (expressed in years) – “BCBGYEPS”;
9. Ordinal variable indicating the highest grade level in school – “BCBGHIGG”;
10. Ordinal variable indicating the level of parental collaboration to school activities – “ParenCol”. It is a combination of parental study support and parental involvement in school activities indicators;
11. Ordinal categorization of the absenteeism rate – “BCBGASTD”;
12. Ordinal categorization of the community dimension – “BCBGCOMU”;
13. Ordinal variable summarizing the evaluation of Science courses in the school – “ValInsS”;
14. Percentage of time dedicated by the head-teacher to management activities – “Mana”, described in the previous section.

The table below shows the descriptive statistics for each of the variables. The frequency tables and the descriptive statistics for each variable in each country are reported in Appendix 1.

Table 6: Variables used in the final model – descriptive statistics

	BCBGASTD	BCBGASTD	BCBGCOMU	BCBGHIGG	BCBGYEPS
Min.	1	1	1	8	1
1st Qu.	1	1	2	9	2
Median	1	1	4	10	5
Mean	1.338	1.338	3.521	10.97	6.813
3rd Qu.	2	2	5	13	10
Max.	4	4	6	14	35
NA's	6802	6802	6819	10769	7640

	BSBGOLAN	BSBGPS01	BSBGPS02	BSDAGE	BSDGEDUP
Min.	1	1	1	10.33	1
1st Qu.	1	1	1	13.83	4
Median	1	1	1	14.33	5
Mean	1.217	1.046	1.203	14.35	4.672
3rd Qu.	1	1	1	14.83	5
Max.	4	2	2	18.42	7
NA's	1652	1934	2280	906	4

	climaM	climaS	BTBGSEX	MaBTBGAGE	MaBTBGTAUT
Min.	2	2	1	1	1
1st Qu.	4	4	1	3	9
Median	4	4	1	4	19
Mean	4.081	4.111	1.496	3.92	18.58
3rd Qu.	5	5	2	5	27
Max.	6	6	2	6	50
NA's	10318	14566	424	4371	5912

	Mana	ParenCol	ScBTBGAGE	ScBTBGSEX	TeachUnd	VallnsS
Min.	5	0	1	1	0	0
1st Qu.	40	0	3	1	1	1
Median	50	1	4	1	1	1
Mean	51.89	0.7085	3.816	1.378	0.7937	1.531
3rd Qu.	62	1	5	2	1	2
Max.	100	1	6	2	1	4
NA's	12186	7168	8348	8345	6940	7469

As apparent from Table 7, many entries are missing from the TIMSS 2003 dataset and some of these missing relate to the explanatory variables used in the model. The observations that carried a flag “NA” (Non Available) for the explanatory variables of the model were eliminated from the analysis. This procedure ends up reducing the sample-sizes for the analysis, and the final number of observations used in the models is summarized in the following table.

Table 7: Sample sizes (raw and after cleaning for missing observations)

	Data	dMat	dSci
Australia	4791	3274	3044
Belgium (Flemish)	4970	3385	3243
Bulgaria	4117	3162	2354
Cyprus	4002	1980	1991
England	2830	853	565
Estonia	4040	3188	3195
Hungary	3302	2584	2511
Italy	4278	3504	3603
Japan	4856	4256	4208
Latria	3630	2607	2472
Lithuania	4964	3481	3277
Netherlands	3065	2389	2021
Norway	4133	3124	2972
Romania	4104	2106	2152
Scotland	3516	1334	1043
Slovenia	3578	2845	2766
Sweden	4256	2414	2215
United States	8912	5550	5243

4. *The results*

4.1. Aggregate results

The model was estimated separately for Math and Science scores; moreover, it was first run on the subgroup of European Union member countries (Belgium - Flemish Community, Bulgaria, Cyprus, England, Estonia, Hungary, Italy, Latvia, Lithuania, Netherlands, Romania, Scotland, Slovenia, Sweden), then on the group of non-EU countries considered (Australia, Japan, Norway and the United States of America), and then on the entire dataset of the 18 countries.

The models for Math and science are partially different. The variables used in each model are reported in the table below.

Table 8: variables entering each of the models.

Model for Math	Model for Science
Size of the community	Sex of the Student
Age of the teacher	Head-teacher time in management>60%
Years of Experience of the teacher	Size of the community
Head-teacher time in management>60%	How often the student speaks at home the language of the test
Sex of Student	Teacher age
Number of Years Principal of the School	Evaluation of science teacher
Highest grade in the school	Sex of teacher
Level of parental collaboration	Number of Years Principal of the School
Teacher Understanding of school goals	Level of parental collaboration
Student absenteeism	Highest grade in the school
School Climate	Teacher Understanding of school goals
Presence of calculator at home	Student absenteeism
Age of student	School Climate
Presence of computer at home	Presence of calculator at home
Number of books at home	Age of student
Maximum level of parental education	Presence of computer at home
	Number of books at home
	Maximum level of parental education

Although the mix of significant variables would likely be different in each country, the same set was also used when replicating the analysis on a country by country basis; the decision was taken to allow for a direct comparison of the results.

Statistical significance for all statistical analyses was set at .05. The three level random effect model used for the analysis does not provide us with any R-Squared measure for gauging the amount of variance explained. However, as indicated by Snijders, we can approximate this figure by looking at the total variance of the basic linear model (Var_0) and the total variance for the multilevel model (Var_x). With these values, the percentage of variance explained by the model can be calculated as follows: (Var_0 - Var_x)/(Var_0).

Table 9: Total, Residual, and Explained variance for Math and Science

Math	Var_0	Var_x	% Explained Var
EU27	2343.845	878.910	62.51%
Non-EU	2822.555	1390.971	50.71%
All	2416.078	1070.966	55.67%
Science	**Var_0**	**Var_x**	**% Explained Var**
EU27	2461.218	815.499	66.87%
Non-EU	2673.160	1327.103	50.35%
All	2451.612	947.995	61.33%

The models appear to be extremely convincing, as they generally explain more than 50% of the variance for both subjects. The tables below show specifically the significant variables in the 6 models side-by-side.

Table 10: Significant variables, Math.

Math	EU			Non EU			Tot		
	Value	Std.Er	p	Value	Std.Er	P	Value	Std.Er	P
(Intercept)	523.743	18.70564	0	386.3136	44.9587	0	511.1803	16.66953	0
I(Mana>60)FALSE: factor(BSDGEDUP)7	300.413	11.63786	0	175.9543	29.5504	0	296.0834	9.933589	0
I(Mana>60)TRUE: factor(BSDGEDUP)7	251.995	17.71836	0	211.5556	30.4972	0	251.3913	14.84026	0
I(Mana>60)FALSE: factor(BSDGEDUP)6	246.927	9.879046	0	148.4426	27.7451	0	244.7764	8.493333	0
I(Mana>60)TRUE: factor(BSDGEDUP)6	215.446	15.61305	0	164.6597	28.2514	0	213.0897	13.14763	0
I(Mana>60)FALSE: factor(BSDGEDUP)5	202.16	9.828009	0	103.4589	27.6942	2E-04	200.0919	8.451963	0
I(Mana>60)TRUE: factor(BSDGEDUP)5	179.959	15.51887	0	116.5495	28.1532	0	175.9441	13.07275	0
I(Mana>60)FALSE: factor(BSDGEDUP)4	155.796	9.813013	0	64.2942	27.6842	0.02	154.5883	8.440147	0
I(Mana>60)TRUE: factor(BSDGEDUP)4	134.286	15.50414	0	77.4626	28.1402	0.006	131.2686	13.06162	0
I(Mana>60)FALSE: factor(BSDGEDUP)3	109.257	9.827514	0				108.3889	8.452209	0
I(Mana>60)TRUE: factor(BSDGEDUP)3	94.3956	15.5563	0				91.4718	13.10307	0
I(Mana>60)FALSE: factor(BSDGEDUP)2	72.0168	10.19432	0				70.247	8.764599	0
I(Mana>60)TRUE: factor(BSDGEDUP)2	48.4223	16.0542	0.003				44.747	13.52551	0.0009
I(Mana>60)FALSE: BSBGBOOK	6.9633	0.311368	0	7.7852	0.47034	0	6.9473	0.258937	0
I(Mana>60)TRUE: BSBGBOOK	6.937	0.486227	0	7.9214	0.60883	0	6.9966	0.395482	0
I(Mana>60)TRUE: BCBGHIGG	3.8747	0.852965	0	5.5483	1.90999	0.004	3.9824	0.783394	0
I(Mana>60)FALSE: ParenCol	3.7729	1.889017	0.046	9.7734	4.34668	0.025	4.8699	1.734616	0.005
I(Mana>60)FALSE: BCBGHIGG	2.9318	0.576141	0				2.8218	0.54048	0
I(Mana>60)TRUE: BCBGYEPS	0.4738	0.228278	0.038				0.3851	0.188283	0.041
I(Mana>60)FALSE: BCBGCOMU	-1.8573	0.518635	4E-04	-2.5966	0.94539	0.006	-1.8596	0.464269	0.0001
I(Mana>60)FALSE: factor(BTBGSEX)2	-2.2899	0.666587	6E-04	2.9229	1.06497	0.006	-1.8079	0.556555	0.0012
I(Mana>60)TRUE: factor(BTBGSEX)2	-2.7444	1.078986	0.011	4.0197	1.33768	0.003			
I(Mana>60)FALSE: BCBGASTD	-3.5672	1.71664	0.038	-7.6282	2.73684	0.006	-4.3471	1.491222	0.0036
I(Mana>60)FALSE: climaM	-5.1141	1.231455	0	-4.8993	1.82668	0.008	-5.3635	1.053157	0
I(Mana>60)FALSE: TeachUnd	-5.5718	2.114633	0.009				-4.7972	1.902201	0.0118
I(Mana>60)TRUE: BCBGASTD	-7.2604	3.039646	0.017				-6.6471	2.368062	0.0051
I(Mana>60)TRUE: BSDAGE	-10.9891	1.119829	0				-9.7171	0.937424	0
I(Mana>60)TRUE:BSBGPS02	-11.5418	1.469228	0	-16.2274	3.47857	0	-11.7266	1.256451	0
I(Mana>60)FALSE:BSBGPS02	-11.7483	0.844352	0	-9.4098	2.47662	1E-04	-11.6537	0.72779	0
I(Mana>60)FALSE: BSDAGE	-12.6182	0.746987	0				-11.7179	0.633483	0
I(Mana>60)TRUE:climaM	-13.5417	2.022903	0	-9.7764	2.49128	1E-04	-11.9923	1.653523	0
I(Mana>60)TRUE: BSBGPS01	-20.1899	3.478476	0	-11.7444	4.85245	0.016	-19.636	2.865011	0
I(Mana>60)FALSE: BSBGPS01	-23.0025	2.296922	0	-13.657	3.9669	6E-04	-22.4036	1.932125	0

Table 11: Significant variables, Science.

Science	EU			Non EU			Tot		
	Value	Std.Er	p	Value	Std.Er	p	Value	Std.Er	P
(Intercept)	492.9978	19.64894	0	358.7928	46.9748	0	481.5546	17.39352	0
I(Mana>60)FALSE: factor(BSDGEDUP)7	287.0253	12.64999	0	173.0762	30.80637	0	281.6765	10.74193	0
I(Mana>60)FALSE: factor(BSDGEDUP)6	236.6974	10.8323	0	148.9026	28.89113	0	233.6108	9.255289	0
I(Mana>60)TRUE: factor(BSDGEDUP)7	230.0337	18.98096	0	222.6183	31.92045	0	230.4865	15.83328	0
I(Mana>60)FALSE: factor(BSDGEDUP)5	189.8138	10.77524	0	106.836	28.8357	0.0002	187.3181	9.209491	0
I(Mana>60)TRUE: factor(BSDGEDUP)6	179.5178	16.80529	0	181.7114	29.50095	0	180.777	14.0766	0
I(Mana>60)TRUE: factor(BSDGEDUP)5	142.9035	16.70055	0	133.6051	29.39821	0	142.5815	13.99391	0
I(Mana>60)FALSE: factor(BSDGEDUP)4	140.6331	10.7583	0	65.0324	28.81895	0.024	139.0299	9.196136	0
I(Mana>60)TRUE: factor(BSDGEDUP)4	94.7718	16.67912	0	94.9303	29.37771	0.0012	95.9893	13.97759	0
I(Mana>60)FALSE: factor(BSDGEDUP)3	92.4788	10.77436	0				91.6702	9.209402	0
I(Mana>60)TRUE	79.7149	33.29411	0.0168						
I(Mana>60)TRUE: factor(BSDGEDUP)3	49.4515	16.73504	0.0031				51.227	14.01971	0.0003
I(Mana>60)FALSE: factor(BSDGEDUP)2	49.2893	11.17935	0				48.3397	9.552406	0
I(Mana>60)TRUE: BSBGBOOK	7.7754	0.52858	0	8.182	0.63729	0	7.6949	0.427609	0
I(Mana>60)FALSE: BSBGBOOK	7.0455	0.33875	0	7.8833	0.50778	0	7.0516	0.280933	0
I(Mana>60)TRUE: BCBGHIGG	3.2646	0.84139	0.0001	7.9966	2.073	0.0001	3.2871	0.784576	0
I(Mana>60)FALSE: BCBGHIGG	1.8651	0.57672	0.0013	3.6443	1.6937	0.0319	1.8666	0.548905	0.0007
I(Mana>60)TRUE: BCBGYEPS	0.5363	0.22521	0.0174				0.4351	0.19037	0.0224
I(Mana>60)FALSE: BCBGYEPS	0.2503	0.12569	0.0466						
I(Mana>60)FALSE: BCBGCOMU	-1.814	0.52631	0.0006				-1.6618	0.478004	0.0005
I(Mana>60)TRUE: factor(BTBGSEX)2	-2.4764	1.1778	0.0355	6.2321	1.39876	0			
I(Mana>60)TRUE: ScBTBGAGE	-2.5232	1.24533	0.043	5.9833	1.86908	0.0015			
I(Mana>60)TRUE: BSBGOLAN	-2.7988	0.9129	0.0022	3.1972	1.45897	0.0284	-2.2538	0.76022	0.003
I(Mana>60)FALSE:climaS	-4.1108	1.23543	0.0009	-5.2967	1.91774	0.006	-4.4833	1.075152	0
I(Mana>60)FALSE: BCBGASTD	-4.238	1.74641	0.0154				-4.7197	1.540279	0.0022
I(Mana>60)FALSE: TeachUnd	-5.2484	2.05473	0.0108				-4.0928	1.884965	0.03
I(Mana>60)TRUE:climaS	-7.9614	2.06737	0.0001	-12.0944	2.66455	0	-7.9207	1.685901	0
I(Mana>60)TRUE: BCBGASTD	-8.5664	3.1109	0.006				-7.7917	2.416265	0.0013
I(Mana>60)FALSE: BSDAGE	-10.0078	0.81088	0				-9.258	0.687229	0
I(Mana>60)TRUE:BSDAGE	-10.4163	1.20746	0	4.5527	2.1191	0.0317	-8.895	1.012857	0
I(Mana>60)FALSE:BSBGPS02	-12.7464	0.9178	0	-10.3354	2.63911	0.0001	-12.6688	0.787663	0
I(Mana>60)TRUE:BSBGPS02	-15.138	1.62772	0	-21.1894	3.69066	0	-15.4372	1.385326	0
I(Mana>60)TRUE:BSBGPS01	-16.0681	3.79484	0	-21.7732	5.21025	0	-17.1707	3.114456	0
I(Mana>60)FALSE:BSBGPS01	-17.3917	2.4886	0	-12.4353	4.20407	0.0031	-17.2266	2.084686	0
I(Mana>60)FALSE: factor(BTBGSEX)2				6.4719	1.14025	0			
I(Mana>60)FALSE: ParenCol							3.9095	1.762043	0.0266

The first point to highlight regards the extremely high impact of student SES and family characteristics in all the models. Indeed, this effect is consistent with the literature (Coleman, 1966; Voelkl, 1995; Crane, 1991; Ensminger & Slusarcick, 1992; Rumberger, 1995; Janosz et al., 1997; Raudenbush & Kasim, 1998; Johnson, Crosnoe, & Elder, 2001), and in all the models the highest level of parental education appears to be the most influential factor; the main difference between EU and non-EU countries is the existence of a threshold at ISCED3 for the non-EU countries. In fact, in Europe any level of parent attainment above primary school is related to better student outcomes,[42] while in the non-EU countries under analysis the differences become relevant only if parents have attained at least middle school. The possessions in the house – a proxy for the family SES – are relevant, and not having a calculator or a computer accounts for a lower performance of at least 10 points in all the models. Similarly, the possession of a larger amount of books is associated with better results, with effects ranging between 7 and 9 points. In EU countries, children older than their peers perform worse; while this is not the case in the other countries under exam (age is irrelevant in Math and slightly inversely correlated in science). The reason of this effect could be linked to the fact that TIMSS is a grade-based examination, and the school cycles in Europe are more fixed than those of the other countries under analysis, so that older children are likely to be students who have not achieved passing marks during the previous year. Girls perform slightly better than boys in Europe, while the opposite is true for the non-European countries. European students in comprehensive schools perform slightly better than their peers both in Math and Science; for non-EU countries the difference is non relevant in Math, but is a little higher in Science (around 7 points). The size of the community has only little impact; the students in cities of 500.000 or more perform 1-2 points better than their peers both in Math and Science in Europe and in Math in non-EU countries. Student absenteeism has a negative effect on

[42] The same effect is visible in the comprehensive models as the EU countries outnumber the non-EU countries.

student results; while more parental support to the study and the parental involvement in school activities lead to better results both in Math and Science. The language spoken at home is relevant only with respect to Science, and students who always speak the local language at home perform slightly better in EU countries (2 points), while the opposite happens outside the EU (3 points difference).

With respect to the school level and consistently with the literature (e.g. Scheerens, 2000, 2005), a positive school climate appears to be the most influential variable on student achievement. The teacher understanding of school goals and the years of presence of the head-teacher in the school have a positive effect in Europe, but no effect in the other countries. The head-teacher focus on management activities (60% time or more) is significant only in the model for Science in EU countries, where it accounts for roughly 80 points with a standard deviation of 33.29411. This effect is rather peculiar because the other variables in this model behave more or less similarly to the corresponding variables in the other models. Thus, further research appears necessary for understanding whether the effect is somehow related to a specific approach to the dealing with science in Europe. With respect to the other models, the negligible impact of the head-teacher actions on student achievement is consistent with and further confirms the large body of literature presented through the text (e.g. Scheerens and Bosker, 1997; Hallinger and Heck, 1998).

Regardless of these negligible direct effects, the Leadership and Management variables appear to have *strong and significant indirect effects*. Indeed, recalling equation (3), the model used in the empirical analysis presents a peculiar formulation whose aim is to evaluate the interaction effect between the prevalence of management in head-teacher activities and the other explanatory variables, and it has the following specification:

$$SCORE_{ijk} = \begin{cases} \alpha_0 + \beta_0 x_{ijk} + \gamma_0 z_{jk} + \theta_k + \delta_{jk} + \varepsilon_{ijk} \text{ for } Mana > 60\% \\ \alpha_1 + \beta_1 x_{ijk} + \gamma_1 z_{jk} + \theta_k + \delta_{jk} + \varepsilon_{ijk} \text{ otherwise} \end{cases}$$

The subsequent analytic step investigated whether the explanatory variables behaved any differently in the two parts of the model, and whether these differences were significant. Of

course, 60% time in Management activities is only one very specific strategy; hence, the model was replicated to test the differences for a wider range of strategies (20 to 80%). Accordingly to how the variables have been constructed, the sum of management and leadership activities covers the entire span of the head-teacher available time; i.e. saying: "At least 50% time on Management activities" is equivalent to saying: "No more than 50% time in Leadership activities" and so forth.

The results suggest the existence of two main types of results. Results of "type-1" indicate that the head-teacher actions have generally a small impact on the role of the variable. This result regards the majority of individual and school variables, and the figures below exemplify this behavior by showing the results for the models estimated for both Math and Science for all the countries in the sample.

Figure 12: Differential impact of individual and school variables on student outcomes in Math for the different head-teacher behaviors, EU and non-EU countries.

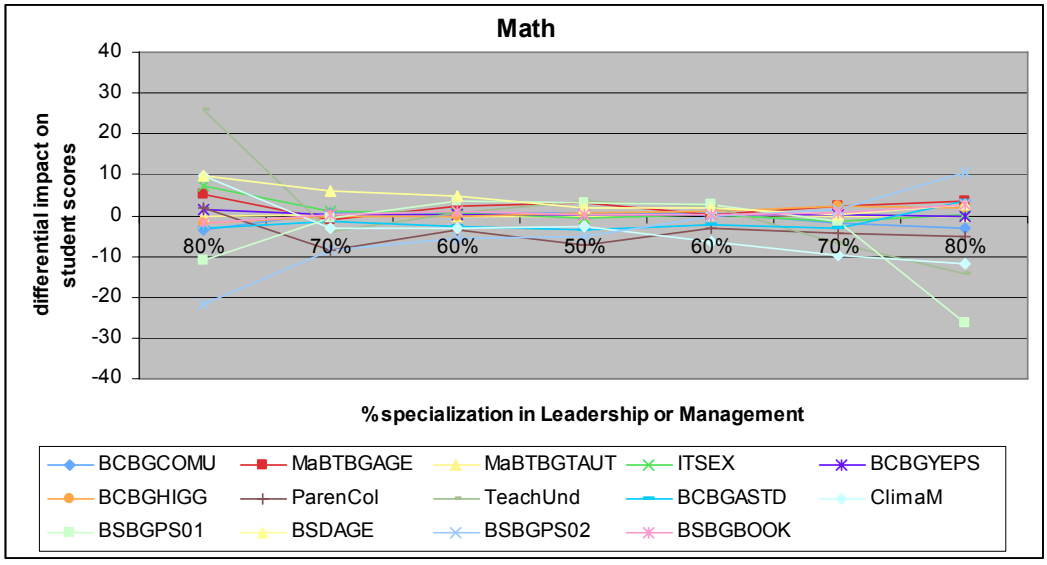
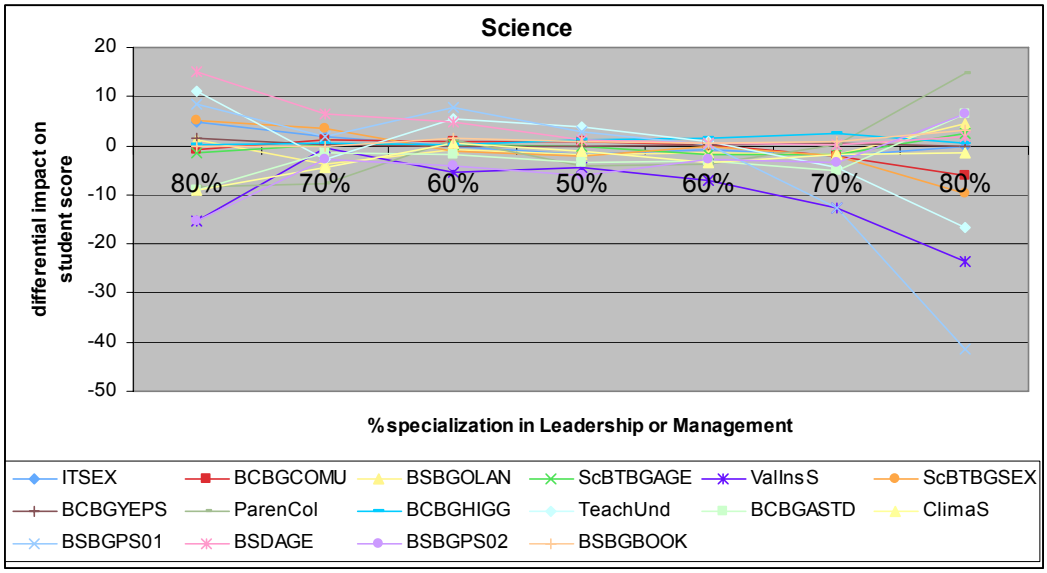


Figure 13: Differential impact of individual and school variables on student outcomes in Science for the different head-teacher behaviors, EU and non-EU countries.



The graphs show that head-teacher actions influence the behavior of some variables only and mostly at very high levels of specialization in Leadership or Management. If we consider only the variables that experience a change by 10 or more points, a heavy specialization in Leadership is related to a greater impact on student results of teacher understanding of school goals (both models), student age (both models), and school climate (only for Math, the impact of climate is instead lower for science). On the other hand, some variables become less important – the evaluation of science courses the ownership of a computer or the ownership of a calculator (only Math). A focus on management is related to greater impact of the ownership of computer (Math) and of parental collaboration (Science). On the other hand, the school climate, the teacher understanding of school goals and the ownership of calculator become less important in Math, while the sex of the teacher, the teacher understanding of school goals, the evaluation of science course, and ownership of calculator become less important in Science. These indications suggest that, in general, the focus on leadership is related to a larger effect of the school organizational variables and lower effect of SES proxies (such as ownership of calculator). The focus on management reduces in general the importance of school organizational variables, while it has mixed effect on the individual SES

variables. The mixed effect could possibly depend on the fact that “focus on Management” means that head-teachers devote their time to administrative activities that are likely to enhance the resources available to the students and the organizational processes by which the students can access these resources. Thus, the ownership of basic tools such as a calculator would become less important because it would be substituted by school resources. On the other hand, these more rationalized structures allow for a better profit of the students who have the availability of more advanced tools (such as a computer) or have the support of their families for studying.

The perception of an interaction effect between head-teacher actions and family SES brings us to the “type-2” effects. These results indicate that the head-teacher actions have an extremely high impact on the role of “highest level of parental education” on student outcomes.

Figure 14: Differential impact of highest level of parental education on student outcomes in Math for the different head-teacher behaviors, EU countries.

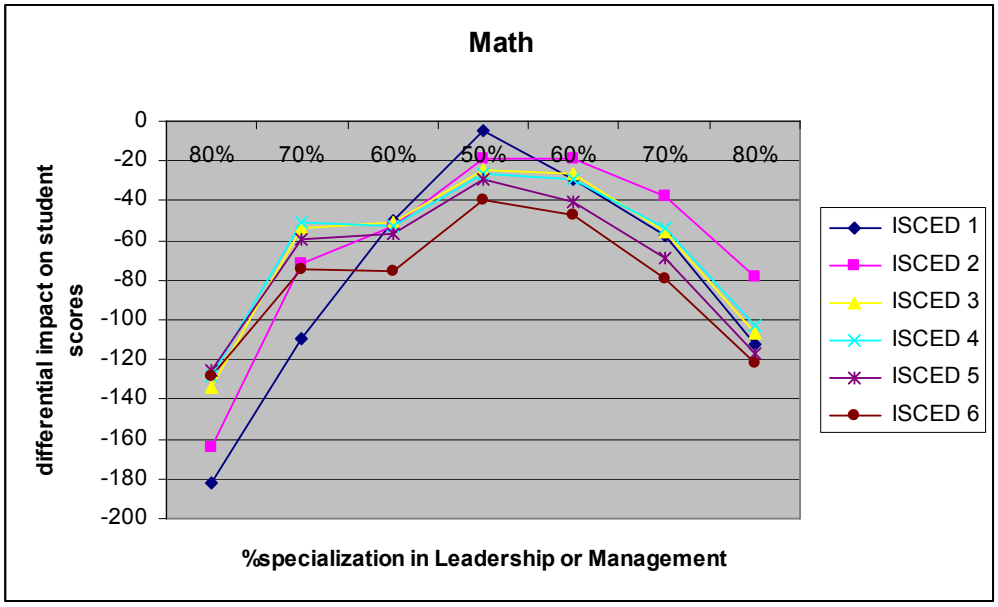


Figure 15: Differential impact of highest level of parental education on student outcomes in Science for the different head-teacher behaviors, EU countries.

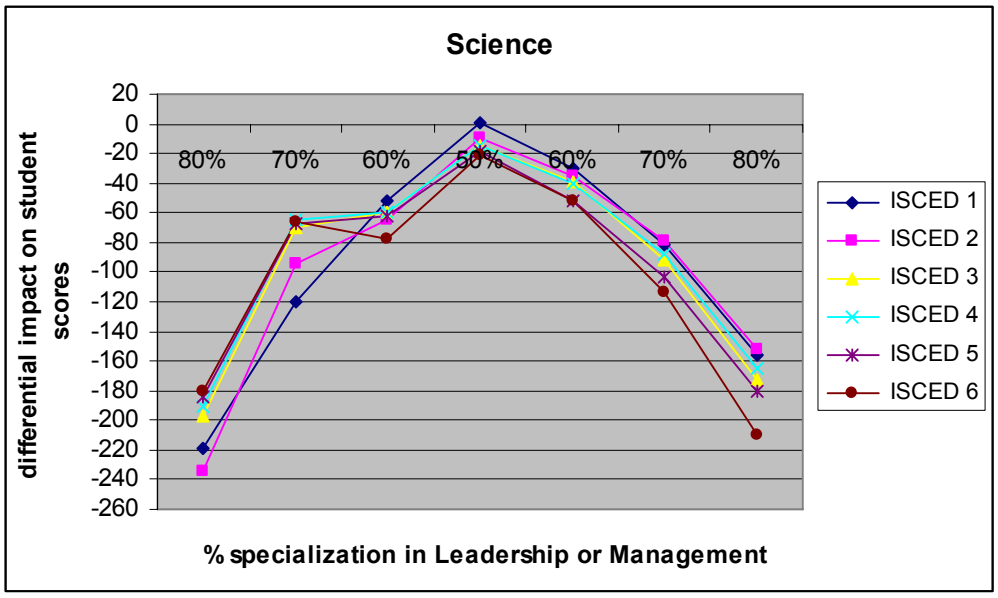


Figure 14 and 15 show the results for the European countries. What is striking in this case is that *head-teacher specialization in either management or leadership reduces substantially the impact of parental education on student outcomes*. As shown earlier, the highest level of parental education – a very strong proxy of the family SES – is the most influential factor for the determination of student results, and this result is true in for all the combinations of Management and Leadership. The literature discussed through the text confirms this result (Bielby, 1981; Jencks et al., 1979; Reynolds et al. 1992; Sewell & Hauser, 1975; White, 1982; Heckman 2000); in fact, the family SES summarizes a vast range of characteristics ranging from availability of material and intellectual resources, to choice of school and area of dwelling. Still, the magnitude by which its importance is reduced tells us that, by specializing in the activities that are most appropriate to the specific situation, the head-teacher can modify the existing situation and create conditions that support the students in their learning process. The specific elements vary greatly (school climate and teacher understanding of school goals are the most relevant throughout), but altogether the school is responsive to the different managerial strategies

so that – in the end - it does make a difference. In sum “education *can* compensate for society”.

Moreover, if we split the impact of the head-teacher activities by level of student’s highest level of parental education, we can see how 70% time spent on leadership activities is especially beneficial to students of lower level of parental education (thus, likely, lower SES), 70% time spent on management is especially beneficial to students of higher level of parental education (Figure 16-17). The effect is consistent also for the other levels of specialization, although the differences are a little less accentuated. This effect suggests that head-teachers highly concerned with educational issues obtain relevant results in terms of *equity* and create environments with characteristics supportive for the low achievers. On the other hand, head-teachers with a strong managerial focus create resource-rich environments that are best profited by the students of higher SES. In this sense, the focus on management could be related to *excellence*.

Figure 16: impact of leadership at 70% on students from different SES.

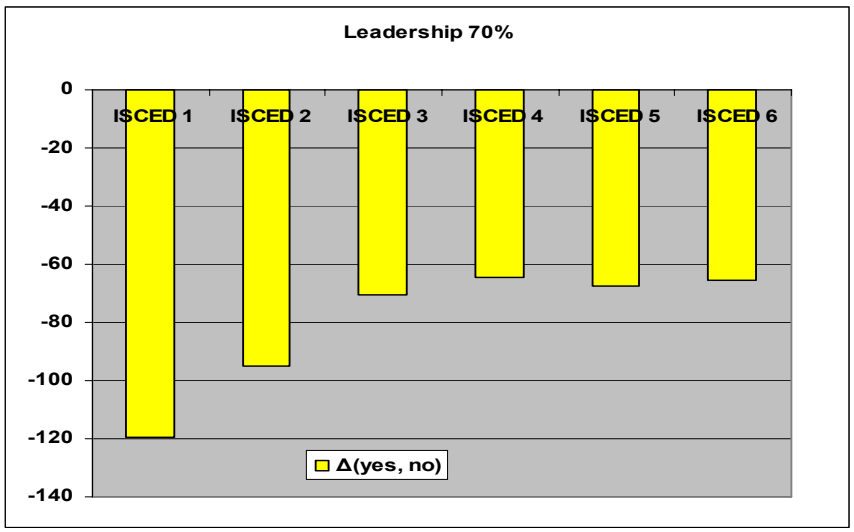
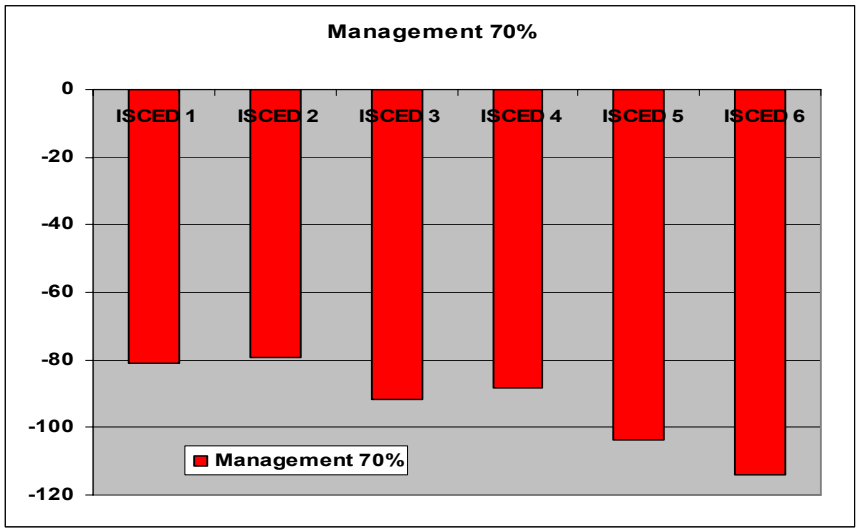


Figure 17: impact of management at 70% on students from different SES.



Although the mayor impact of head-teacher strategies is confirmed, in the analysis of non-EU countries the picture comes out somewhat different (figure 18-19). In this case, in fact, the positive results in reducing the impact of family SES are only associated to a specialization in management. A specialization in Leadership, on the other hand, enhances the relevance of family SES for the determination of student results. Further research is required to understand whether this phenomenon is more general, but a first possible consideration regards the structure of the educational systems under investigation. The educational systems investigated in Europe (ranging from the very centralized cases of Italy and Cyprus to the extremely decentralized case of the Netherlands and Belgium) obey to different logics. In some cases, the head-teachers have a variety of responsibilities also in relation to hiring/firing staff, acquiring resources, chasing funding. In other cases their actions can only regard the educational sphere. Thus, head-teachers must be malleable and play the system with the tools that they have in hands – whether they are administrative or educational. Once we include in the analysis the non-EU countries, on the other hand, there is a prevalence of Anglo-Saxon and decentralized systems where the head-teacher is often the real manager of the institution. In this case a too-heavy-involvement of the head-teachers in educational activities could

be considered as a form of “micro-management” that goes to detriment of their ability to govern the school effectively.

Figure 18: Differential impact of highest level of parental education on student outcomes in Math for the different head-teacher behaviors, EU and non-EU countries.

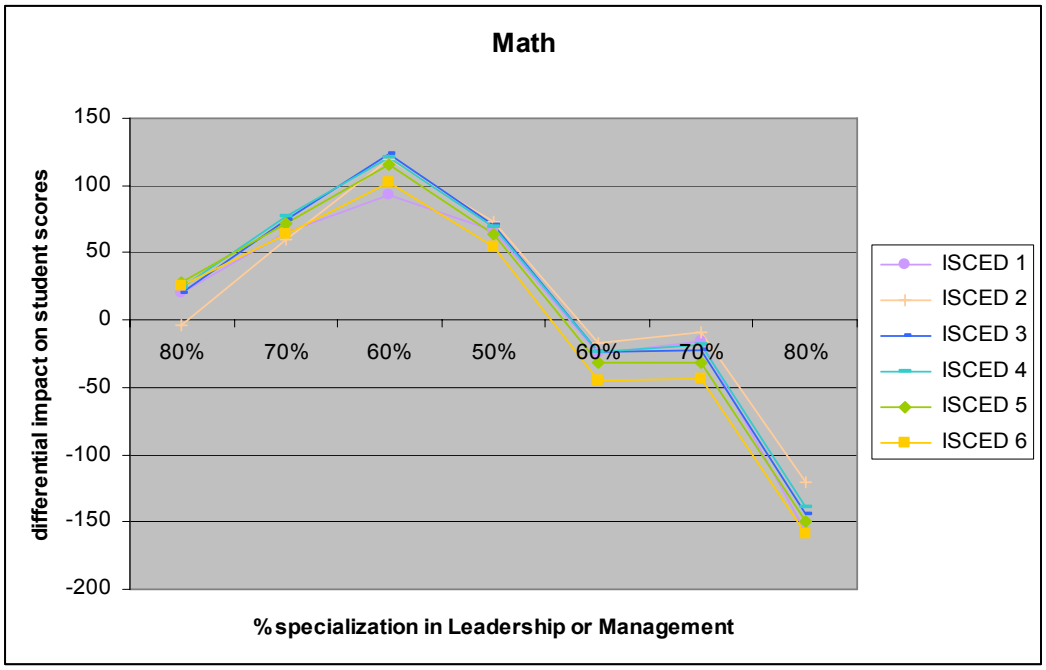
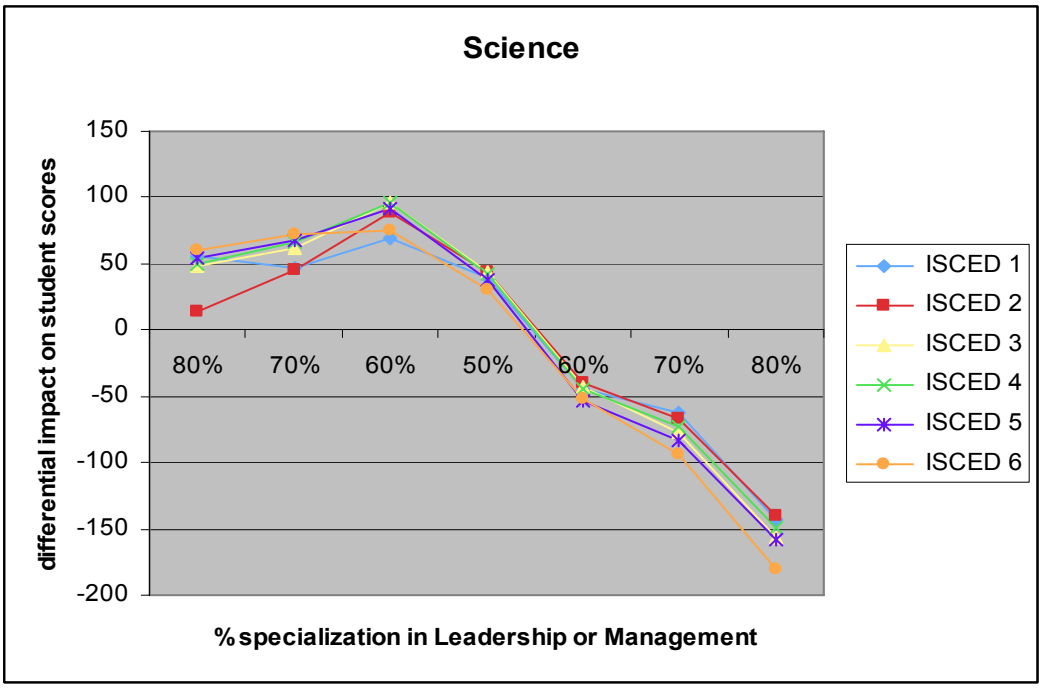


Figure 19: Differential impact of highest level of parental education on student outcomes in Science for the different head-teacher behaviors, EU and non-EU countries.



4.2. Results by country

The analysis was then replicated on a country-by-country basis to investigate whether the aforementioned effects could still be identified in the individual countries.

More specifically, the aim of this part of the research was to understand for the individual country:

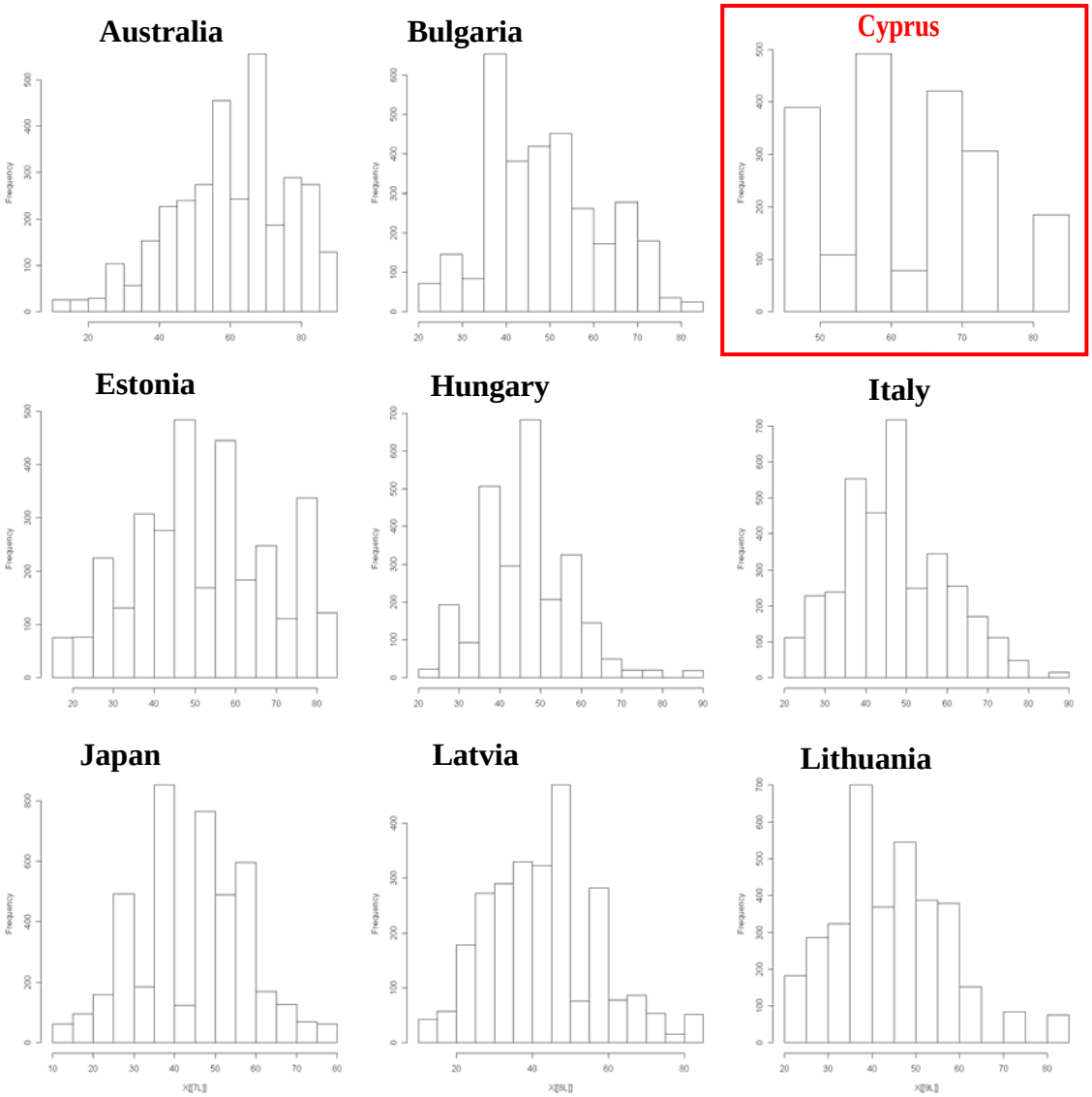
1. With respect to a situation of non-specialization (50% time in management and 50% time in leadership), which kind of head-teacher specialization would appear to be most correlated with a reduction of the relevance of the family socioeconomic status on student results;
2. Whether the effect of the declared head-teacher specialization appears to go *in the same direction* as it could be predicted by looking at the macro-level institutional characteristics of the school system. I.e. whether the specialization in leadership appeared to be most effective in countries with centralized school systems and vice versa the specialization in management appeared to be most effective in the countries with more decentralized systems.

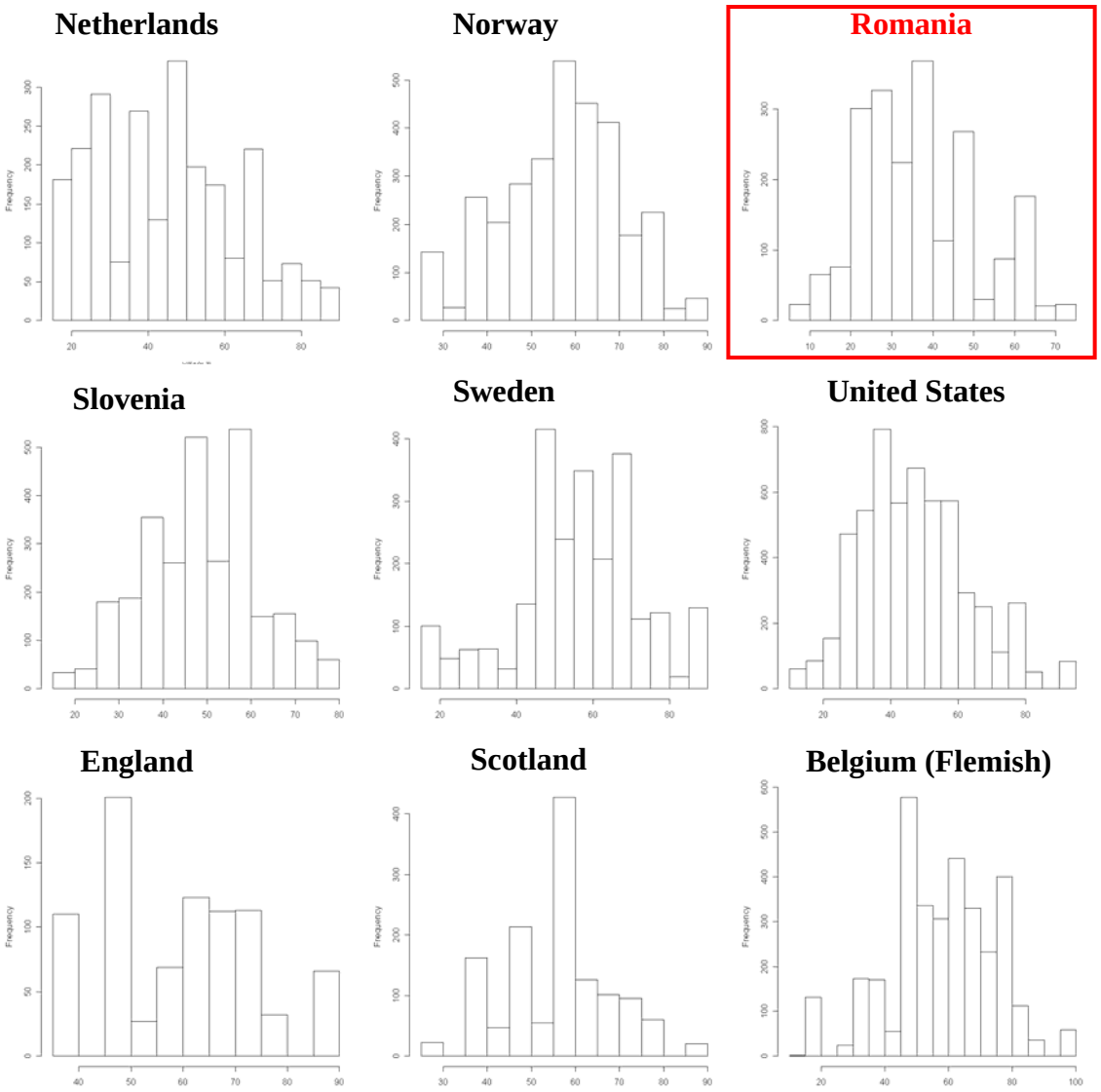
The first step for the analysis involved the definition of the analytic models for the individual countries. This task presented some unexpected difficulties due to the low (or null) number of observations for some variables. The result is the impossibility of using for the individual countries the same analytic model used at aggregate level. Hence, the analysis was carried out making the following modifications to the initial model:

1. the analysis was carried out only looking at the variable management for the values of 40, 50, 60, and 70%;
2. some of the explanatory variables were eliminated because of the limited number of available observations for some specific countries. This limited number of observations caused perfect collinearity among the variables considered in the model;

3. Cyprus and Romania (country code: 196 and 642) were excluded from the analysis because their inclusion would result in an excessive limitation of the explanatory variables for the model;
4. in the variable EDUP (maximum level of parental education), only categories 3, 4, 5, and 6 were considered (ISCED level 2 to 5).

Figure 20: Graphical analysis of the levels of management for the individual countries





The histograms highlight the problem of the reduced number of observation for some levels of the variable management. Specifically, the two countries eliminated from the separate country by country analysis correspond to the graphs circled in red. The linear model estimation is impossible for the extreme categories of management because this model evaluates the interaction between the variable indicating the level of management and all the other variables, and in some cases these interactions are perfectly collinear. In other words, two variables that – in general – would provide different information end up giving the exact same information for the subgroups of observations related to some

specific levels of management; thus, the variables become not distinguishable. This problem is most evident for the variable defining the level of management. In many cases, for the limit levels of 20, 30, 80, or 90%, the observed values of the variable management do not allow for a dichotomist classification. For example, in England, the level of management is never below 30%. In Cyprus, the problem is even greater because all the schools have a management level of 40% or above. Moreover, the variable Math BTBGTAUT (number of years of experience of the Math teacher) is constant if considered in the subgroup related to a level of management equal to 50%; thus, its effect cannot be evaluated.

By redoing the selection of the data considering exclusively the variables included in the final model, some extra observations were recovered for variable EDUP (maximum level of parental education), which is the main objective of the analysis. The final number of cases for the variable for each country is shown in Figure 21 and in Table 12. Still, the number of cases is still so limited that only categories 3, 4, 5, and 6 could be considered (ISCED level 2 to 5).

Figure 21: Graphical analysis of the maximum levels of parental education for the individual country samples

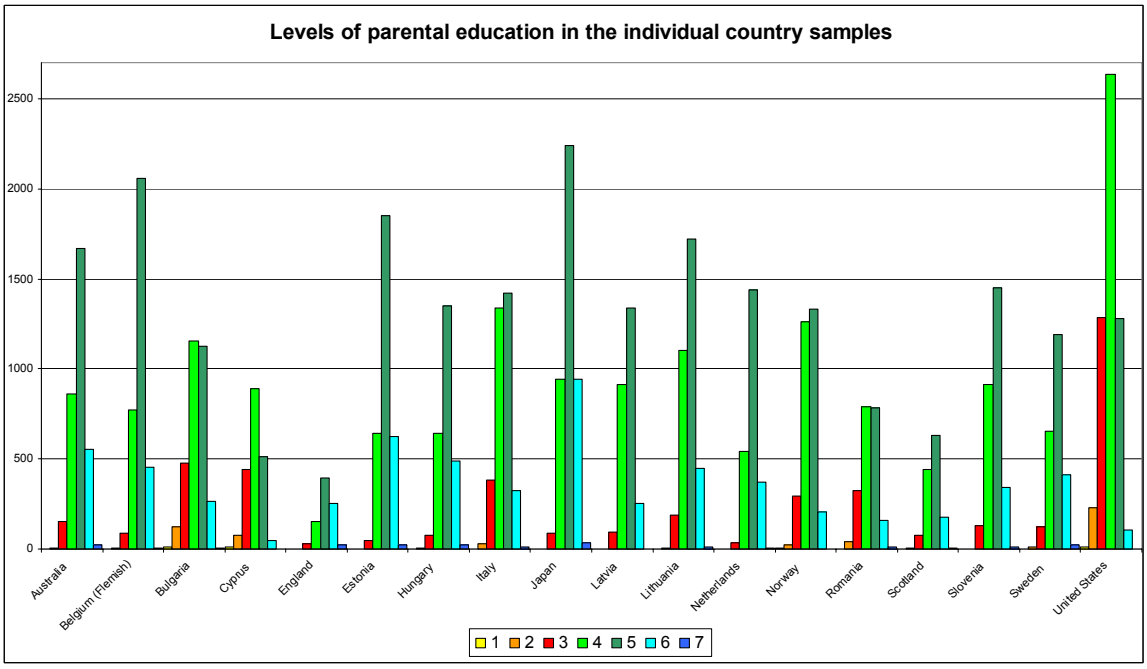


Table 12: Maximum level of parental education for individual student per country

Maximum level of parental education:	1	2	3	4	5	6	7
Australia	-	8	152	863	1670	557	24
Belgium (Flemish)	-	7	87	774	2056	455	6
Bulgaria	13	121	478	1153	1126	263	8
Cyprus*	9	79	445	891	510	46	-
England	-	2	29	154	393	254	21
Estonia	-	-	49	642	1852	624	21
Hungary	-	4	78	641	1350	490	21
Italy	-	30	382	1337	1420	323	12
Japan	-	2	90	945	2240	946	33
Latvia	-	1	96	914	1338	256	2
Lithuania	-	5	189	1104	1724	446	13
Netherlands	-	-	34	544	1438	370	3
Norway	3	26	293	1262	1333	205	2
Romania*	2	39	322	791	784	159	9
Scotland	-	7	76	442	628	175	6
Slovenia	-	1	128	911	1449	344	12
Sweden	-	12	125	654	1190	411	22
United States	13	228	1284	2635	1282	108	-

* the results for Cyprus and Romania are reported for completeness, but the countries have been excluded from the analyses because of the insufficient number of cases for the various categories of the variable Management.

The graphs showing in each country the differential impact of highest level of parental education on student outcomes in Math and Science for the different head-teacher

behaviors have been produced by considering the difference between the coefficients of Mana<=k with k={40, 50, 60 , 70} (TRUE) and Mana<=k (FALSE).

With respect to the original multilevel model, the model for the country-by-country analysis considers a smaller set of variables. This decision results from the application of a criterion aiming at maximizing the statistical comparability between countries and models (Math and Science).

The final model includes the following variables and is the same in all the countries for both Science and Math:

- ✓ % time spent in Management <=k, with k={40, 50, 60 , 70};
- ✓ Size of the community where the school is located;
- ✓ Sex of the student;
- ✓ Possession of a calculator;
- ✓ Maximum level of parental education;
- ✓ Students' age;
- ✓ Number of possessed books.

Regardless of the reduced number of explanatory variables, the model still explains over 80% of the variability among student results.

As discussed earlier, the variable identifying the highest level of parental education is an ordinal variable organized in 7 categories; the analysis was run considering only categories 3-6 (ISCED level 2-5) because the number of cases in the other categories was insufficient for estimating the model. For the same reason, the levels of management (Mana) considered are those between 40 and 70%.

The variables that were eliminated presented problems for the identification of the coefficients at levels of management between 40 and 70%. These problems are related to the low or null variability of the available observation in the relevant subgroups. For example, the variable "parent cooperation" cannot be estimated in:

- ✓ Hungary, Japan, Lithuania, and Romania for “Mana<=70”;
- ✓ Scotland for “Mana<=40”;
- ✓ And is completely non usable for the data of England and Cyprus.

As apparent, the limits to the availability of data reduce to a large extent the range of analyses that could be performed on a country-by-country basis. Still, the individual-country model results can be used for answering the questions sketched at the beginning of the paragraph.

The first step would be to investigate which kind of head-teacher specialization would appear to be most correlated with a reduction of the relevance of the family socioeconomic status on student results. For the reasons afore expressed, not all levels of parental education could be considered; moreover, the main problem at stake relates to detecting the possible existence of a differential effect between the effects of head-teacher specialization and non-specialization on the role of family SES on student results. Thus, the attention has been devoted to the *average* differences among the impact of family SES at the various levels of management and leadership on family SES. Looking at the mean of the differences among the coefficients is justifiable because the variable maximum level of parental education (BSDGEDUP) has a quasi-linear effect so that the mean of the differences at is equivalent to the difference among the means of the coefficients.

Graphically speaking, 4 effects were detectable:

1. **Leadership effect**, the head-teacher specialization in leadership activities reduces significantly more the dependence of student results from family SES than no specialization or than a specialization in management activities;

2. **Management effect**, the head-teacher specialization in management activities reduces significantly more the dependence of student results from family SES than no specialization or than a specialization in leadership activities;
3. **Bidirectional Specialization Effect**, the head-teacher specialization in either leadership or management activities reduces significantly more the dependence of student results from family SES than no specialization;
4. **Null or Unclear Specialization Effect**, the head-teacher specialization in either leadership or management activities did not bring about any significant difference in the dependence of student results from family SES than no specialization.

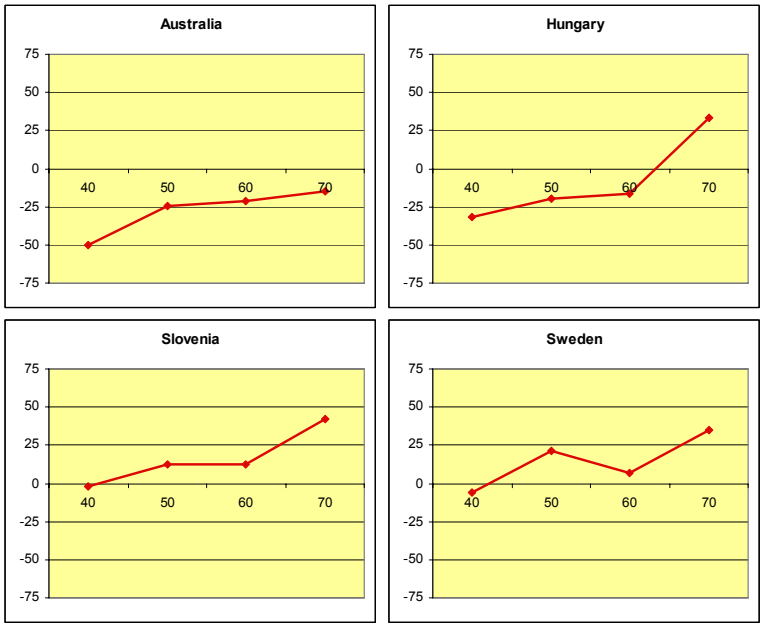
The graphs below show the results for the various countries analyzed.

With respect to student results in Math, Australia, Hungary, Slovenia, and Sweden show a prevalence of the Leadership effect; while England, Norway, Estonia, Latvia, and Scotland show a prevalence of the Management effect. In Bulgaria, Netherlands and in the United States, either specialization appears to be fruitful while not much can be said for Belgium (Flemish community), Italy, Japan and Lithuania.

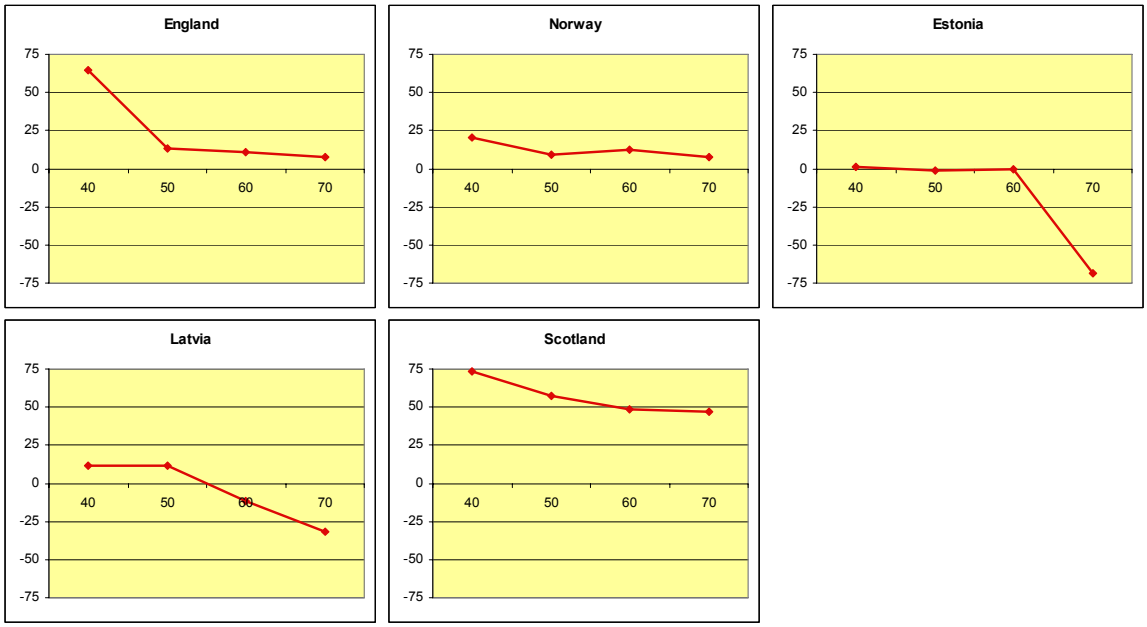
The situation is similar Science, although some differences can be appreciated. In this case, the Leadership specialization effect is visible in Australia, Japan, Netherlands, Slovenia, and Sweden. The Management specialization effect appears in Latvia, Estonia, Norway, and Scotland; the Bi-directional specialization effect seems to be present in Bulgaria and in the United States. While the null or unclear specialization effect regards Belgium (Flemish community), Hungary, Italy, England, and Lithuania.

Figure 22: Differential impact of highest level of parental education on student outcomes in Math for the different head-teacher behaviors, Country-by-country analysis.

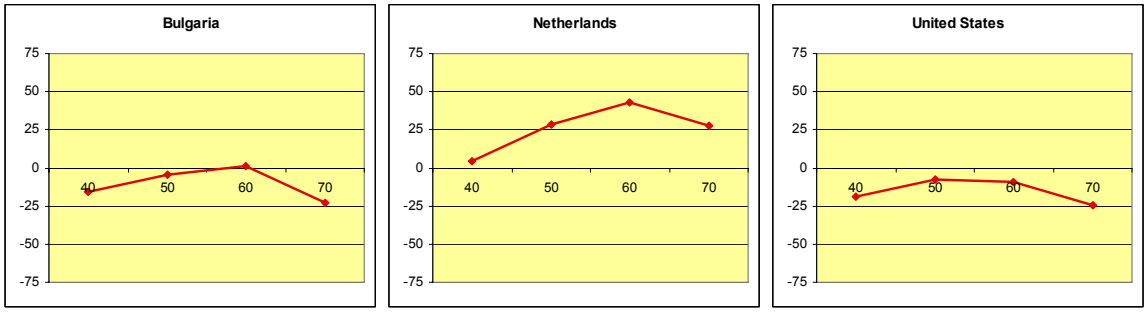
a. Leadership Specialization Effect:



b. Management Specialization Effect:



c. Bidirectional Specialization Effect:



d. Null or Unclear Specialization Effect:

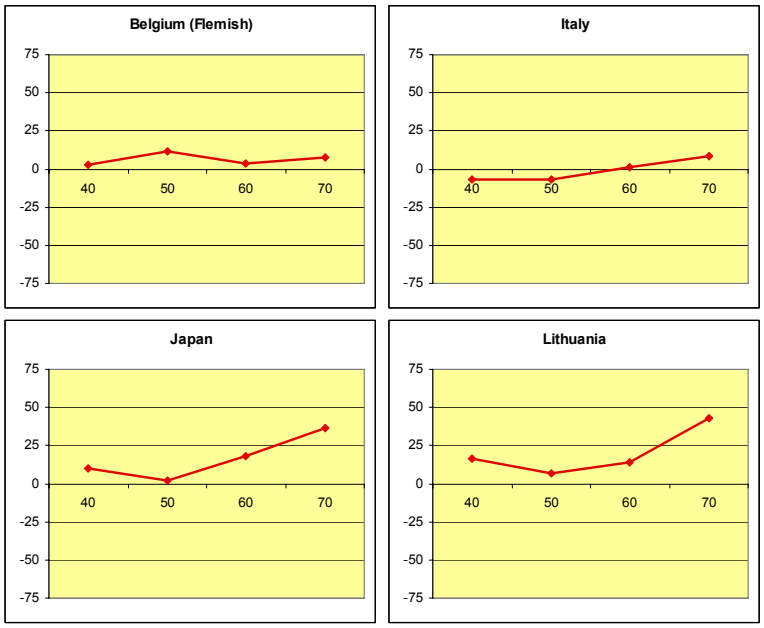
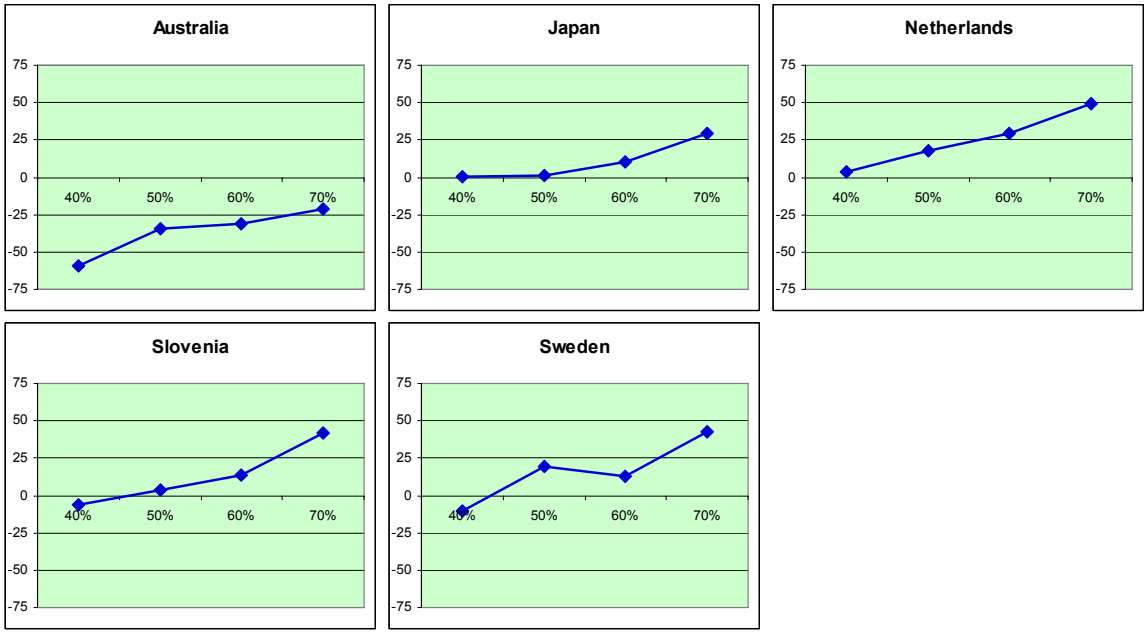
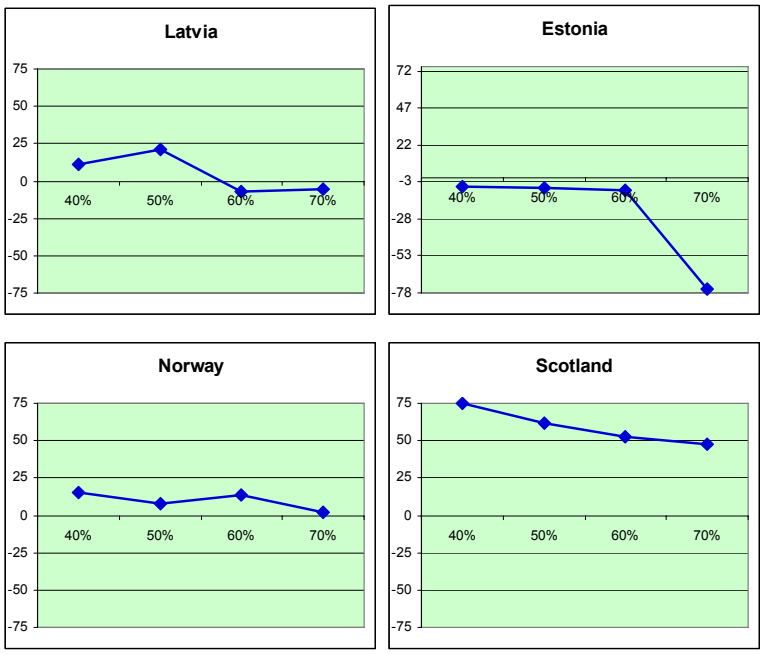


Figure 23: Differential impact of highest level of parental education on student outcomes in Science for the different head-teacher behaviors, Country-by-country analysis.

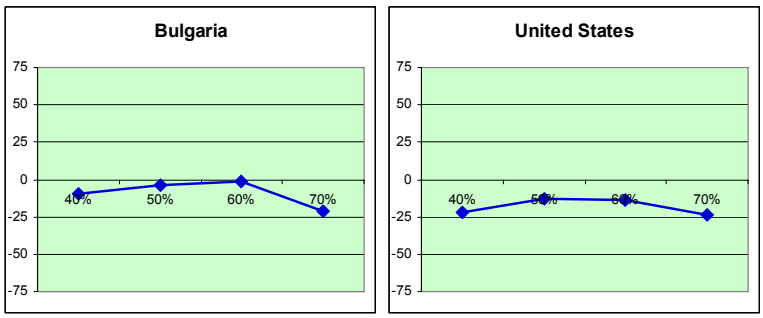
a. Leadership Specialization Effect:



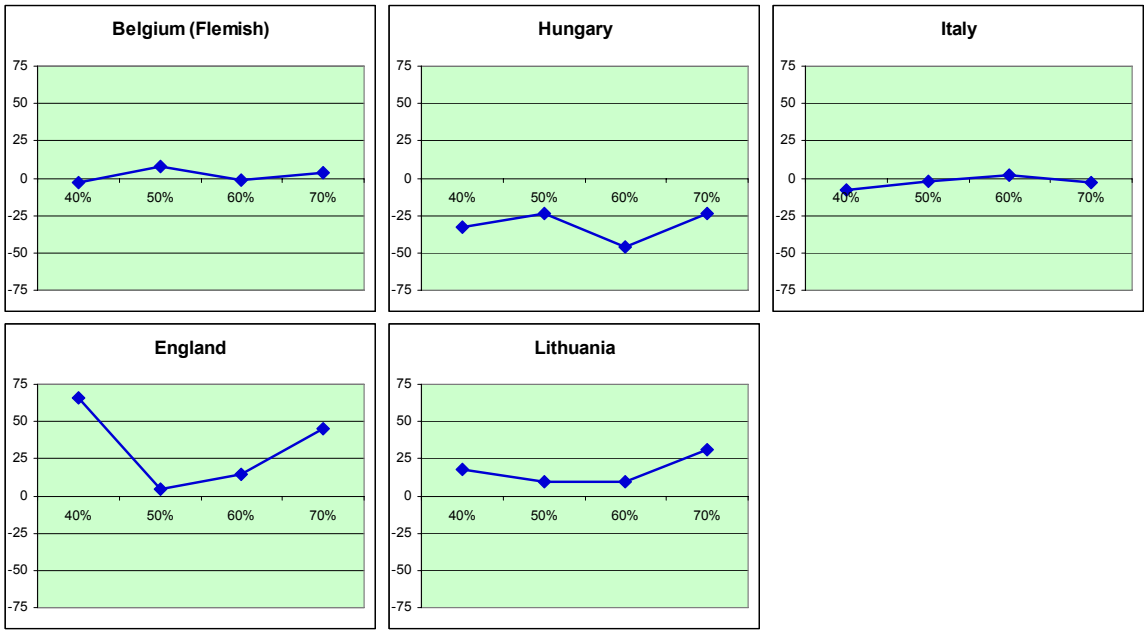
b. Management Specialization Effect:



c. Bidirectional Specialization Effect:



d. Null or Unclear Specialization Effect:



These first results suggest that, in the majority of cases, the head-teacher specialization appears to be correlated with positive results in terms of reduced dependence of student results from their family socioeconomic status. The same effect can be identified for both Math and Science in most countries: in Australia, Slovenia, and Sweden, the Leadership specialization effect is prevalent; in Norway, Scotland, Latvia, and Estonia, the Management specialization effect prevails; in the United States and Bulgaria both specializations appear to bring about the same positive results; while in Belgium (Flemish community), Italy, and Lithuania no relevant difference exists between the results in the cases of specialization or non-specialization. A leadership specialization effect is identifiable in Hungary for Math (but not for Science) and in Japan for Science (but not for

Math). In the Netherlands both specializations appear to bring about positive results for Math, but only the leadership effect can be perceived for Science. In England a management specialization effect can be seen in Math, but neither management nor leadership appear to make the difference for Science.

Still, the identification of a specialization-effect does not say much in terms of the reasons for its existence. The hypothesis would be that the head-teachers are professionals that try to use at its best the opportunities provided by the institutional setup of the school system. In the more decentralized school systems that leave to the schools responsibilities in terms of monetary sanctions/incentives (hiring and firing, salary upgrades…), the head-teachers would tend to make use of these opportunities and focus most on management activities. Vice versa, in more centralized school systems, which leave to the schools only responsibilities that do not involve a monetary side, the head-teachers would stress their roles as role-models, educators, and motivators for their staff and collaborators. Hence, the issue would be to understand whether the effect of the declared head-teacher specialization appears to go *in the same direction* as it could be predicted by looking at the macro-level institutional characteristics of the school system.

To address these issues, a two-steps procedure was adopted. First, the earlier specified grouping of countries in terms of prevalent specialization effect was further specified by adding trend-lines to the country level results. A positive gradient implies that the more time the head-teacher spends in leadership, the lower is the weight of family SES on student results. Vice versa, a negative gradient suggests that the focus on management is the strategy that reduces the most the weight of family SES on student results. Gradients between -1 and 1 indicate a substantially invariant effect of head-teacher specialization on student results. The calculated trends are linear, so that we lose the convexity effect that can be perceived in some countries, but using the gradients allows us to group the

countries on the basis of the overall prevalent effect. The results of these calculations are reported in table 13.

Table 13: Gradient of head-teacher specialization effect per country per subject.

Math		Science	
Country	**Gradient**	**Country**	**Gradient**
Estonia	-21.03	**Estonia**	-20.47
Latvia	-15.33	**Latvia**	-6.1452
England	-12.30	**Scotland**	-6.0536
Scotland	-8.86	**England**	-4.6512
Bulgaria	-2.93	**Bulgaria**	-3.2942
Norway	-2.52	**Norway**	0.1006
United States	-1.79	**Belgium (Flemish)**	0.603
Belgium (Flemish)	0.46	**Hungary**	0.6222
Italy	4.55	**United States**	0.7903
Lithuania	8.65	**Italy**	2.907
Japan	9.50	**Lithuania**	5.4896
Sweden	10.92	**Japan**	10.276
Australia	11.08	**Australia**	10.939
Slovenia	13.26	**Sweden**	13.153
Netherlands	13.53	**Netherlands**	14.85
Hungary	19.81	**Slovenia**	15.317

The following step regarded the clustering of the educational systems on the basis of their institutional characteristics. The educational systems investigated in Europe (ranging from the very centralized cases of Italy and Cyprus to the extremely decentralized case of the Netherlands and Belgium) obey to different logics. In some cases, the head-teachers have a variety of responsibilities also in relation to hiring/firing staff, acquiring resources, chasing funding. In other cases their actions can only regard the educational sphere. Thus, head-teachers must be malleable and play the system with the tools that they have in hands – whether they are administrative or educational. In the non-EU countries under analysis, on the other hand, there is a prevalence of Anglo-Saxon and decentralized systems where the head-teacher is often the real manager of the institution. In this case a too-heavy-involvement of the head-teachers in educational activities could be considered as a form of “micro-management” that goes to detriment of their ability to govern the school effectively.

Table 14 provides a framework for the levels of governance of the systems in the analyzed countries.

Table 14: Overview of educational systems organization

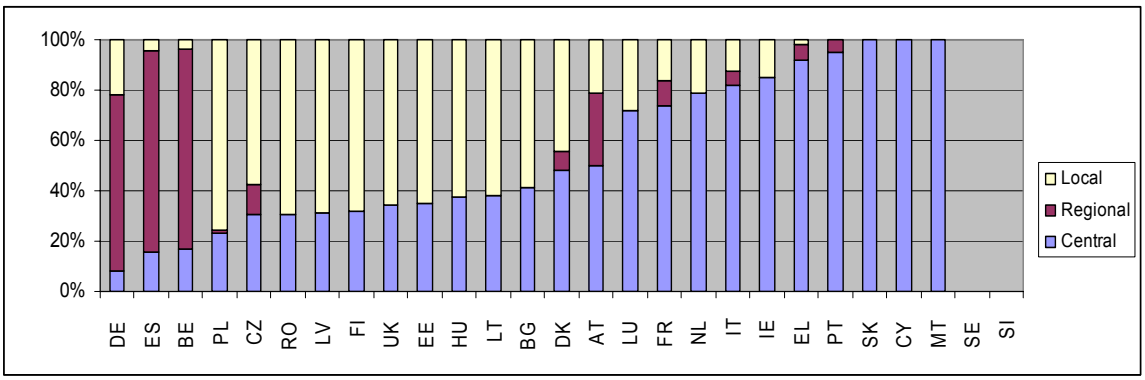
	National level	Second level	Third level	Institutional level	Notes
Australia	National (common wealth) governme nt	6 states and 2 territories	Districts	School councils	Responsibility for education rests with the States and Territories. The Commonwealth (federal) Government promotes national consistency and coherence.
Belgium Flemish	Ministry	school groups and Council of the Community Education		head-teacher (directeur) and the school council (schoolraad)	Devolved responsibility to schools/school governing bodies. Educational policy mainly results from interaction between the governing body at the national level, the intermediate level and the local level
Bulgaria	Ministry	Regional Education Inspectorates		Head-teacher	Policy determined at national level; organizational decisions at local and school level.
Cyprus	Ministry	6 districts		School governing bodies	Centralized management and policy making.
England	Ministry	c.150 local authorities (LAs)		School governing bodies	Devolved responsibility to schools/school governing bodies. Recent legislation allows for the creation of integrated children services departments, at local level, responsible for education, children and young people's health and social services.
	National level	**Second level**	**Third level**	**Institutional level**	**Notes**
Estonia	Riigikogu (Parliame nt) and Ministry	county governor	Local authority	state school councils and school head-teachers	Centralized management and policy making.
Hungary	Ministry	3000+ municipalities or counties (local authorities)		Schools	Policy determined at national level; organizational decisions at local and school level.
Italy	Ministry	20 regions	Provinces and comuni	School councils	Centralized policy making. Increasing delegation of administrative powers from central government via regions, provinces and communes to schools.
Japan	Ministry	47 prefectures	3400+ municipal/ local boards of educ.	Head-teacher	Ministry oversees; prefectures operationally responsible for upper secondary, municipalities for compulsory education.
Latvia	Ministry	Regional Gov.ts	Local authorities	Head-teacher	Devolved responsibility to schools for hiring the teaching and non-teaching staff, managing the financial resources, ensuring the implementation of the regulatory enactments concerning education.

Netherlands	Ministry	Provinces	Municipalities (local authorities)	c. 6300 competent authorities	The school head may hire deputy directors, who ensure qualitative organization of educating process. Devolution of financial and management responsibility to the competent authorities.
Norway	Ministry	County (upper secondary ed.)	Municipalities (primary and lower secondary ed.)	Head-teacher	Policy determined at county and municipal level, decisions enforced by head-teachers
Romania	Ministry	County School Inspectorates	Local Councils	Head-teacher	Policy determined at national level, decisions enforced by head-teachers
Scotland	Ministry	32 local authorities		School boards	Devolved responsibility to local authorities/schools.
Slovenia	Ministry	Municipalities (primary and lower secondary ed.)		Head-teacher	Centralized management and policy making.
Sweden	Ministry	2 national agencies, plus county administrations	289 municipalities	Head-teacher	Municipalities decide how schools are run, following national Ministry guidelines.
USA	Federal government	50 states	Local district school boards	School	Individual states provide policy guidelines; local districts operate schools within these guidelines. Some national (federal) initiatives influence state policy guidelines.

The different strategies adopted in the various systems entail indeed an extreme variability of the action tools available to head-teachers. Going a little more in depth, we can investigate whether this variability is reflected in the access to and control of resources and whether there is any significant trend and in what direction. The literature on New Public Management has identified the strands of activities that facilitate and characterize system decentralization (Hood, 1991; Barzelay, 2001; OECD, 1995, Paletta & Vidoni, 2006). Such reforms do not follow a unique pattern. For example, in the Netherlands the movement towards the decentralization of education started at the higher education level (university and higher VET), then reached lower secondary education, and is now moving towards primary education. Moreover, the intensity of the process varies greatly between countries, and is more visible in some Scandinavian and Central Europe countries than in many Southern European countries. Still, all these reforms insist on three core areas (Kickert, 1997):

- ✓ The introduction of institutionalized market or quasi-market structures;
- ✓ The development of networks, techniques, and managerial instruments derived from the business sector;
- ✓ The transformation of citizens into clients and clients into public service producers.

Figure 24: Sources of public funding of education by administrative level (ISCED 1-6), 2001



With respect to the European situation, there are three basic strategies that identify the administrative levels at which public funds are allocated.

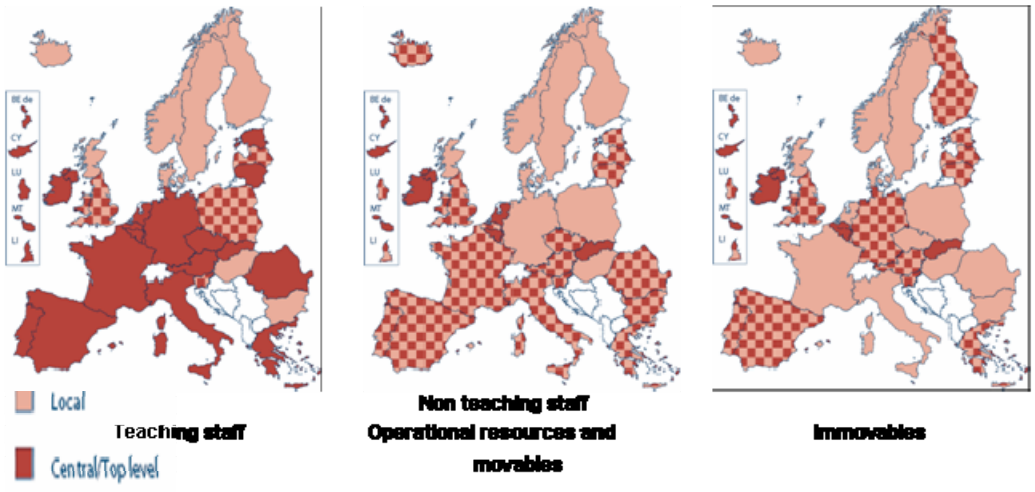
As shown in figure 25, the federative nature of the German, Belgian, and Spanish school systems is apparent also in terms of sources of funding. The rest of the picture is quite mixed, but strongly characterized by centralized funding in Southern Europe and local funding in Central and Northern Europe.

Rather than the sources of funding, however, the key characteristic of decentralization pertains to the financial independence of the schools and freedom for using the allocated budgets.[43] In terms of school management, financial independence influences the possibility that head-teachers have of choosing staff who shares their view of the school mission and of defining the objectives of the school. The maps reported below – which indicate the level of the decision making authority in a number of core areas – confirm the

[43] For an exhaustive description of the models currently adopted in Europe please refer to: ATKINSON, M., LAMONT, E., GULLIVER, C., WHITE, R. and KINDER, K. (2005). School Funding: a Review of Existing Models in European and OECD Countries (LGA Research Report 3/05). Slough: NFER.

initial indication of a mixed picture where Scandinavian countries tend to allow for more autonomy at the local level, while Southern Europe is still highly centralized, especially with respect to the selection and payment of the Teaching staff.

Figure 25: Location of decision-making authority to determine the overall amount of public expenditure earmarked for schools providing compulsory education, public sector or equivalent, 2002/03



On the basis of this information, the school systems of Australia, England, Latvia, the Netherlands, Norway, and Scotland could be considered as the most decentralized. In Belgium, Hungary, Italy, Sweden, and the United States, the school system is either organized around a system of local control or is in a transition period from a centralized situation. Estonia, Japan, Slovenia, and Lithuania are the school systems were the centralization is still strong.

The table below presents the school systems of the various countries investigated and clustered in terms of *levels of school autonomy*. The last 2 columns recall the gradients for head-teacher effectiveness in Math and Science.

Table 15: School systems by level of school autonomy and gradient in Math and Science.

Country	Notes	Type*	Math	Science
Australia	Responsibility for education rests with the States and Territories. The Commonwealth (federal) Government promotes national consistency and coherence.	a	11.08	10.94
England	Devolved responsibility to schools/school governing bodies. Recent legislation allows for the creation of integrated children services departments, at local level, responsible for education, children and young people's health and social services.	a	-12.30	-4.65
Latvia	Devolved responsibility to schools for hiring the teaching and non-teaching staff, managing the financial resources, ensuring the implementation of the regulatory enactments concerning education. The school head may hire deputy directors, who ensure qualitative organization of educating process.	a	-15.33	-6.15
Netherlands	Devolution of financial and management responsibility to the competent authorities.	a	13.53	14.85
Norway	Policy determined at county and municipal level, decisions enforced by head-teachers	a	-2.52	0.10
Scotland	Devolved responsibility to local authorities/schools.	a	-8.86	-6.05
Belgium Flemish	Devolved responsibility to schools/school governing bodies. Educational policy mainly results from interaction between the governing body at the national level, the intermediate level and the local level	b	0.46	0.60
Bulgaria	Policy determined at national level; organizational decisions at local and school level.	b	-2.93	-3.29
Italy	Centralized policy making. Increasing delegation of administrative powers from central government via regions, provinces and municipalities to schools.	b	4.55	2.91
Sweden	Municipalities decide how schools are run, following national Ministry guidelines.	b	10.92	13.15
USA	Individual states provide policy guidelines; local districts operate schools within these guidelines. Some national (federal) initiatives influence state policy guidelines.	b	-1.79	0.79
Estonia	Centralized management and policy making.	c	-21.03	-20.47
Hungary	Policy determined at national level; practical organization decisions taken at local and school level.	c	19.81	0.62
Japan	Ministry oversees; prefectures operationally responsible for upper secondary, municipalities for compulsory education.	c	9.50	10.28
Slovenia	Centralized management and policy making.	c	13.26	15.32
Lithuania	historically centralized management and policy making, in transition towards a more decentralized management	c	8.65	5.49

* Type a: decentralized school systems characterized by school autonomy; Type b: school systems characterized by the control of local authorities or in transition from a centralized situation; Type c: more centralized school systems.

In general, in the more decentralized school systems, the managerial focus of the head-teacher seems to be the winning strategy in terms of correlation with a reduced dependence of student results from their family SES; while the leadership specialization appears to be the best option in the more centralized systems. The school systems characterized by local control or in transition are a mixed picture. In fact, this cluster

groups the schools where no clear specialization effect can be detected, but it also includes some systems such as Sweden or Hungary typified by the leadership-specialization effect and the USA where the management-specialization effect appears to be stronger. A possible reason for such variety is that the definition of “control of local authorities or in transition from a centralized situation” is sufficiently general to allow for many different institutional setups to co-exist. Examples of these different situations are certainly Italy and the United States. For a long time Italy has been a highly centralized system that left little or no space of maneuvering to the individual schools. After the Constitutional reform of 2001, the Legislator has intended to create a more decentralized system built on autonomous schools; many progresses have been made in this direction, but much is left to do. In fact, the Italian school system has not yet completed its transition-phase towards decentralization, and presently the head-teachers have some authority with respect to budget allocation, non-permanent staff selection, and calendar organization, but they cannot take any substantial decision in terms of monetary incentives and sanctions so that they must rely on non-monetary incentives to motivate their staff. Moreover, school headship is not yet a career per se so much as it is the last step of the teaching career; thus, the new head-teachers do not necessarily have the professional training to attend to the most managerial parts of the job. Training courses and activities are now being organized, but the path towards a clear shaping of the head-teacher profession is still long (Paletta Vidoni, 2006). This sketch depicts a situation in which the head-teacher could slowly specialize more and more in management, but the leadership-specialization would presently be the most probable choice. In the United States, the fact that education is a responsibility of each of the 50 federal States implies that each State is autonomous with respect to the organization of the school system. In practical terms, most of the times the responsibility for the practical arrangements and management falls on the Local School Boards, which are more than 15.000. On one side, this situation explains why the U.S. is often referred to as a “laboratory”: so many different

micro-cosmos can experiment an enormous variety of solutions in school organization and practices. On the other side, having the *de facto* responsible authority (Local School Board) so close-by means that the head-teachers must dedicate a large share of their efforts to respond positively to the requests of the Board. Moreover, school headship in the U.S. is per se a profession with specific training and formation requirements different from the requisites for a teacher and aiming more at developing the managerial know-how of the perspective principals. These facts would therefore point towards the existence of a management-specialization effect.

Three systems behave differently than expected; while being some of the most decentralized systems, in Australia and in the Netherlands there is a strong leadership-specialization effect. Vice versa, Estonia is a centralized school system where the head-teacher specialization effect tends towards management. The reasons for these discrepancies should be investigated more in depth as they are likely to be indicators of more complex dynamics. For example, In the Netherlands both public and private schools are fully-funded by the Government, which – in turn – lays down a complex set of statutes and regulations that the schools must comply with. By giving the schools organizational autonomy and freeing them from the need of seeking many resources, the Dutch government implicitly frees the head-teachers from the need of investing too much time on administrative issues such as fund raising or public relations and allows them to invest their efforts "to develop distinctive approaches to meeting … [the school] goals. The sponsor has the responsibility of defining its distinctive character and government must take care not to interfere with this legally-protected distinctiveness, which extends to the worldview reflected in instruction and school life, and also to many of the details of management" (Glenn, 2005: 20).

As often pointed out throughout the text, the variables and the data available for this analysis are limited; given these limitations, no causal link should be searched between the results and the underlying socio-economic processes. Still, the existence of a

parallelism between the institutional characteristics of school systems and the prevalent head-teacher specialization effect suggests that head-teachers are professional that do their best to favor the good functioning of their schools *by using the tools that the existing regulations give them*.

CHAPTER 4

DISCUSSION AND CONCLUSIONS

"*Do head-teachers make a difference?*" This study tried to shed some further light on this long-debated question by looking at subset of 18 countries in the TIMSS 2003 8th grade dataset and investigating whether the head-teacher's specialization in administrative or educational tasks (management or leadership) has an influence on student outputs, both in terms of direct and indirect effects.

The key-variables of interest considered in the analysis indicate the % of time spent by head-teachers on instructional issues (teaching, supervising teachers, and instructional leadership – i.e. giving demonstration lessons, discussing educational objectives with teachers, initiating curriculum revision and/or planning, training teachers, and providing professional development activities), and the % of time spent on non-instructional issues (internal administrative tasks, representing the school in the community, representing the school in official meetings, talking with parents, counseling and disciplining students, and responding to education officials' requests). For the purposes of the research, these variables were aggregated in the two derived variables Management and Leadership that indicate the total amount of time spent by the head-teacher in non-instructional (Mana) and instructional (Lead) activities.

These notes on the construction of the variables also indicate the first limitation of the study; in fact, a self reported measure of the % time used in a range of activities does not give any indication on the *outputs* of those tasks. It is impossible to discern whether larger amounts of time spent in one activity instead of another were the result of specific choice or simply of the individual head-teacher's inability to carry out the task effectively.

Maybe due to this limitation, the head-teacher's focus on Management activities (60% time or more) does not have a statistically significant impact on student achievement. This

result is consistent with the large body of literature presented through the text (e.g. Scheerens and Bosker, 1997; Hallinger and Heck, 1998) and could be partly due to the definition of the variable, but – most likely – it depends on the fact that:

1. the head-teacher effects on student outputs are mostly indirect;
2. the range of actions that head-teachers can implement is necessarily limited by the institutional set-up of the system (macro level) and by the environmental conditions of the school (micro level).

In terms of point 1., the subsequent step of the investigation built a three-level multilevel model for evaluating *whether the focus of head-teacher's actions makes a significant difference in the behavior of the other variables*. If so, what are the variables that are mostly affected, and what is the magnitude of this difference.

The model is stable and explains above 90% of the variance among student results. However, this result must be considered only an indicative figure, obtained by considering the estimated variance as the difference between the total variance and the variance of the residuals. This naïve procedure been used because the model does not provide any R-squared measure.

The model shows a *strong link between the head-teacher's actions and how much student achievement depends from the maximum level of parental education*.

Moreover, in the case of EU27 countries, the model indicate that a strong focus on leadership activities is especially beneficial to students of lower level of parental education (thus, likely, lower SES), while the head-teacher specialization on management is especially beneficial to students of higher level of parental education. One possible explanation of these effects is that the attentiveness to the leadership process implies a deep involvement of the head-teacher in activities related to the modeling and tailoring of the educational process to the needs of the students. Such process has its highest payoffs on the students who come from disadvantaged situations and need special attentions in order to fully express their potential and favor *equity*. On the other hand, the

focus on the managerial side aims at rationalizing and making the best use of resources. This approach has high payoffs on students of all extractions, but is specifically relevant for the students of higher SES who are possibly already quite independent and whose performance can improve autonomously by making use of the extra resources that the management can provide. In this sense, the focus on management can be seen as a tool for favoring *excellence*.

The analysis for Non-EU countries partly confirms the result. Indeed, in this specific case, the positive results in reducing the impact of family SES are only associated to a specialization in management. A specialization in Leadership, on the other hand, enhances the relevance of family SES for the determination of student results. Further research is required to understand whether this phenomenon is more general, but a first possible consideration regards the structure of the educational systems under investigation. The educational systems investigated in Europe (ranging from the very centralized cases of Italy and Cyprus to the extremely decentralized case of the Netherlands and Belgium) obey to different logics. In some cases, the head-teachers have a variety of responsibilities also in relation to hiring/firing staff, acquiring resources, chasing funding. In other cases their actions can only regard the educational sphere. Thus, head-teachers must be malleable and play the system with the tools that they have in hands – whether they are administrative or educational. In the non-EU countries under analysis, on the other hand, there is a prevalence of Anglo-Saxon and decentralized systems where the head-teacher is often the real manager of the institution. In this case a too-heavy-involvement of the head-teachers in educational activities could be considered as a form of “micro-management” that goes to detriment of their ability to govern the school effectively.

The analysis was then replicated on a country-by-country level to investigate whether the effects afore hypothesized could be confirmed. More specifically, the country-by-country analysis looked at the following issues:

1. With respect to a situation of non-specialization (50% time in management and 50% time in leadership), which kind of head-teacher specialization would appear to be most correlated with a reduction of the relevance of the family socioeconomic status on student results;
2. Whether the effect of the declared head-teacher specialization appears to go *in the same direction* as it could be predicted by looking at the macro-level institutional characteristics of the school system. I.e. whether the specialization in leadership appeared to be most effective in countries with centralized school systems and vice versa the specialization in management appeared to be most effective in the countries with more decentralized systems.

With respect to the first question, the results of the analysis suggest that, *in the majority of cases, the head-teacher specialization appears to be correlated with positive results in terms of reduced dependence of student results from their family socioeconomic status*. The same effect can be identified for both Math and Science in most countries: in Australia, Slovenia, and Sweden, the Leadership specialization effect is prevalent; in Norway, Scotland, Latvia, and Estonia, the Management specialization effect prevails; in the United States and Bulgaria both specializations appear to bring about the same positive results; while in Belgium (Flemish community), Italy, and Lithuania no relevant difference exists between the results in the cases of specialization or non-specialization. A leadership specialization effect is identifiable in Hungary for Math (but not for Science) and in Japan for Science (but not for Math). In the Netherlands both specializations appear to bring about positive results for Math, but only the leadership effect can be perceived for Science. In England a management specialization effect can be seen in Math, but neither management nor leadership appear to make the difference for Science.

Still, the identification of a specialization-effect does not say much about the reasons for its existence. One possible explanation is that *head-teachers are professionals that try to use at its best the opportunities provided by the institutional setup of the school system*. In

the more decentralized school systems that leave to the schools responsibilities in terms of monetary sanctions/incentives (hiring and firing, salary upgrades…), the head-teachers would tend to make use of these opportunities and focus most on management activities. Vice versa, in more centralized school systems, which leave to the schools only responsibilities that do not involve a monetary side, the head-teachers would stress their roles as role-models, educators, and motivators for their staff and collaborators. Hence, the issue was to understand whether the effect of the declared head-teacher specialization appears to go *in the same direction* as it could be predicted by looking at the macro-level institutional characteristics of the school system.

In general, this hypothesis was confirmed. In the more decentralized school systems, the managerial focus of the head-teacher seems to be the winning strategy for reducing the dependence of student results from their family SES; while the leadership specialization appears to be the best option in the more centralized systems. The school systems characterized by local control or in transition are a mixed picture. In fact, this cluster groups the schools where no clear specialization effect can be detected, but it also includes some systems such as Sweden or Hungary typified by the leadership-specialization effect and the USA where the management-specialization effect appears to be stronger. A possible reason for such variety is that the definition of “control of local authorities or in transition from a centralized situation” is sufficiently general to allow for many different institutional setups to co-exist.

Three systems behave differently than expected; while being some of the most decentralized systems, in Australia and in the Netherlands there is a strong leadership-specialization effect. Vice versa, Estonia is a centralized school system where the head-teacher specialization effect tends towards management. The reasons for these discrepancies should be investigated more in depth as they are likely to be indicators of more complex dynamics.

Suggestion for Researchers

Of course, further research would be needed to adequately contextualize the results within the different educational systems. Indeed, the first suggestion for further research strongly points to the need of blending quantitative and qualitative research methods so to provide a more comprehensive and in-depth picture.

The second suggestion, instead, regards an issue of variables. By making explicit the indirect role of the head-teacher in the manner previously described, the role of other school organizational variables (teacher collaboration, evaluation of courses, distributed leadership…) was strongly reduced. It is very likely that the problem is linked to the definition of the variables, but the existence of evidence suggesting their relatively lower importance would need further research to identify what are the areas that – in a situation of scarce resources – would need to be prioritized in terms of investments.

One school variable that proved again to be extremely relevant is school climate. However, this subject could also be further analyzed. In fact, the direction of the causal chain is unclear and the issue could be flawed by problems of endogenity – i.e. is "climate" a cause of better result, an effect, or a concurrent factor?

The last – but not least – point regards the intimate structure of the research project, which was conceived and implemented on a "one shot" database. Although "forced" to use the TIMSS 2003 database for the limitedness of alternative internationally comparable data sources, doubts still remain on the real possibility of gauging a long-term process such as school leadership on a picture taken at one very specific instant in time. Teaching and learning are activities that require years to produce results, even more so an indirect activity such as school leadership, which would mostly produce influences on teaching and learning opportunities. The results of the students tested in the TIMSS, therefore, are very likely to be dependent from the *past history* of the student rather than on the specific

activity of the current head-teacher. For this reason, the availability of longitudinal, reliable, and comparable data is perceived as the only possible way out.

1. *Suggestions for policy makers*

Nonetheless, these analyses have produced results. Of course, these evidences must be further contextualized in the legal framework and practices of each country, and the considerations carried out along these pages show that the variables that enter in the process of determining the head-teacher time allocation are too many for suggesting any specific policy direction based on average country behaviors.

Still, the existence of a parallelism between the institutional characteristics of school systems and the prevalent head-teacher specialization effect suggests some new insights on the role of school management and school leadership for fostering the quality of education in general and, especially, for creating environments that are conducive to learning. Although not directly related to the data, the inference that could be drawn from these analyses is that head-teachers are professional who do their best to favor the good functioning of their schools *by using the tools that the existing regulations give them*. If this were the case, I would consider necessary to give some further thought to two main areas:

- ✓ *The individual dimension of the head-teachers*, including their formation and professional development,
- ✓ *The institutional dimension of the head-teachers and their responsibilities*, with the aim of finding the best balance between school autonomy and State responsibility.

The first issue is a problem of *knowledge of the available space of action and availability of the adequate tools, know-how, and incentives*. As often reiterated through the text, the analyses presented are necessarily limited in scope because of the limits of the available data. Among others, one issue that could not be investigated relates to the specific roles

and responsibilities of the head-teachers in the various countries. Even in situations non-dissimilar in terms of the practical space of action of the school head, the actual conditions may vary greatly. For example, head-teachers in Italy and in the United States have about the same level of individual freedom of action; still, the Italian head-teachers are theoretically responsible for a variety of tasks ranging from the school administration, to the management of staff and staff relations, and of the student matters. Their U.S. counterparts do certainly cover the administrative and managerial areas, but they are also assisted by other institutional figures, such as the assistant-principal in charge of student matters. This difference can partly explain the relatively higher specialization in management of U.S. head-teachers, and should therefore be taken as an extra caution to the interpretation of the data. In this case, however, I am mostly concerned with the prescriptive side of the issue. In fact, in many cases, the definition of the specific tasks and duties of the head-teachers is just as foggy as in Italy. Such confusion poses an unnecessary extra-burden to an already demanding profession, and it complicates the definition of effective training and formation programs.

Indeed, however limited in their actions and responsibilities, head-teachers need to acquire some specific knowledge and skills distinct from the knowledge and skills of teachers, at least because they are applied to different age-groups (adults instead of youngsters) and to different objects (the school as an institution instead of specific subjects). Although some people may be born leaders, this natural inclination is not the rule, but many more could became competent leaders with adequate coaching.

In many countries training is not a requirement for appointment as a head-teacher so that many find themselves in leadership positions, without being adequately trained, prepared or exposed beforehand. Some teaching experience would certainly be a requirement, as it would provide the necessary knowledge of the specific institutional characteristics of the school world, but headship also requires some specific know-how and – especially – a practical component that current leadership training and development programs often tend

to neglect. The University must and will keep playing a central role in the development of head-teacher training, but synergies with other actors and cross-fertilization projects should be favored for they would give to the perspective head-teacher useful background experiences of the logics and rules that shape institutions and organizations other that the schools. In this sense, experiences and programs such as those promoted in the UK by the National College for School Leadership (http://www.ncsl.org.uk/programmes/npqh/) appear to be very promising.

Of course, creating the conditions for a true professionalization of head-teachers must necessarily be accompanied by the provisions necessary to make school-headship an attractive career choice. Indeed, apart from being expensive to provide, the training just suggested (theoretical study of specific areas ranging from management, to coaching, from economics, to sociology; practical experience in teaching; experience in environments other than the school) implies a substantial investment by the individual. Thus, if they are to select a career in school headship rather than in another profession, individuals must be able to foresee returns to their investments. Moreover, if being a head-teacher is also related to bearing a specific load of responsibilities above and beyond those of the fellow teachers and staff members, the pay-offs for the head-teacher career should also be sufficiently different from those of the teaching career so to create the conditions for convincing current teachers to undertake the extra-efforts and investments necessary to “cross the border”.

To the point, at least 2 projects are studying these problems and could provide some useful insights:

- ✓ the OECD Activity on Improving School Leadership (http://www.oecd.org/edu/schoolleadership), dealing with continental Europe, and non-European OECD countries;
- ✓ the CRELL – Euromed project (http://crell.jrc.ec.europa.eu), dealing with the problem of educational leadership in the Euro-Mediterranean region.

The second issue relates to the need of *finding the right balance between school autonomy and central control*. Indeed, this issue is both a prerequisite and a logic result of the just-presented-considerations. Professional head-teachers, professionals in general, are useful *if and only if* they have some decision-making power and are responsible for the results of their decisions. Thus, for head-teachers to exist the schools must have some autonomy, the question is *how much*.

As suggested earlier, education is a *private good* to be used by individuals, but whose positive effects on social progress as a whole make its diffusion meritorious of Public interest. Furthermore, the provision of education as a service is created through a relational process, in which individuals invest to acquire information, which they in turn use to produce more knowledge and which they then pass on to others, thereby favoring social progress. In a context of school autonomy, Governments would provide the necessary funding for the system functioning, while head-teachers would catalyze the expectations for education in their community of action and mold schools that can provide a service that is demand-driven and respectful of the needs of the community and of society at large. However, such design would impose a dramatic burden on the individual head-teacher and managerial team in terms of responsibility and would imply enormous problems for the public authority for contrasting the risks of service fragmentation and free-riding. Indeed, research shows that autonomous schools are not more efficient and more effective than schools governed by a central administration unless the school management team is able to use profitably the benefits of autonomy to manage the increasing complexity of the school environment.

Still, completely centralized school system is not a less risky option. Historically, many countries have gone in such direction, and Italy is a typical example of the problems related to such choice. For the longest time, the Italian school system was a branch of the Italian administrative system; if this characteristic meant that the Ministry decided over disciplinary contents and teaching method, it also safeguarded the system from becoming

self-referenced. Such strong central control had the advantages of relieving the teachers from the need of defining the values at the basis of the didactics, and it was a warranty for the student. In fact, if the State is the keeper of the "common good", the fact that the sole coordinator of the entire system promotes such good as the system's main objective implies that all the people may – at least theoretically – learn the same contents. Still, this design was conceived and conceivable in an age – the late 1850s – when the main problem for the newly-created Italy was to give to all its inhabitants basic alphabetization and a sense of citizenship. The needs of the present global society have deeply modified the structure of the Italian school system, and many of the postulates it relied upon are now uncertain. In terms of contents, if creating a sentiment of citizenship can be seen as a priority under certain historical conditions, the success of a trans- and supra- national experiment as the European Union suggests the need of going beyond such frameworks. Looking at the U.S. experience, Glenn points out that "Government oversteps its appropriate limits when it seeks to use schooling to shape the character of its citizens. The Founders considered but did not adopt proposals for a national system of education for that very purpose ..." (Glenn, 1995, p. 112); such references should be carefully considered also because are aligned with the international *acquis* of educational law. As affirmed in international treaties and covenants, education is an individual right and it is a right of the family to decide the kind of education for their children. Thus, educational systems should be designed so to recover and guarantee the centrality of the individual freedom of choice, and such architectures require that stakeholders other than the State play a major role in the provision of the system. In organizational terms, at present, the schooling experience tends to be "total": for everybody, until adulthood (at least until the age of 18), for as long as it is necessary for the society's productive needs, and it must be extremely differentiated so to adapt to multiple and emerging needs. In a centralized school system the Government funds, evaluates, organizes, manages, and provides the service; these tasks could be adequately designed and carried out around a relatively

narrow object – such as alphabetization – for a relatively small number of people. Many doubts remain on the possibility of continuing to do so in the present society *without the support of other social actors and without the delegation of some of the aforementioned tasks to the individual schools*. Indeed, the constitutional reform of 2001 goes in this direction, and it introduces the idea of "school autonomy"[44] and takes an important step in the creation of "quasi-markets" in education, where a plurality of providers manage schools while the state (which may be one of the providers) finances the provision of services and controls for quality. In Europe, the already recalled Communication "Efficiency and Equity in European Education and Training Systems" states that "the combination of local autonomy for institutions and central accountability systems can improve student performance. However, accountability systems should be designed to ensure a full commitment to equity and to avoid the potentially inequitable local consequences of decentralized decisions, e.g. on the definition of school catchments."

The use of "school autonomy" not as a mere tool, but as a new organizational principle to clarify how responsibilities are distributed and shared can open the way to finding the right balance between central demands and local and individual needs. The *Charter school* movement in the U.S. is a good example of this tension; Charter schools depend on the initiative of private stake-holders (a group of teachers, of parents, a confessional or pedagogic community) but are classified as public schools, fully-funded by the State, and allowed to be distinctive so long as they meet various State standards. In such environments, the professional dimension of the school management team is magnified: the general performance objectives to be reached are clearly set out by the public authority. The community of stake-holders that the school serves identifies the specific mission and vision of the institution, and the management team has the freedom of implying a variety of tools (budget allocation, employment of staff, specific curriculum, extra curricular activities, calendar organization) to achieve the required goals en-light of

[44] Constitution of the Republic of Italy, Article 117.m

the existing mission and vision. The movement is still young and further research needs to be done to gauge its effectiveness, but the charter schools and similar experiences are important pieces in putting together the puzzle of “what schools for tomorrow”, which will need to mediate between central, local, and individual interests and will need professionals able to implement different managerial strategies that could exploit local knowledge leads to foster the system’s equity and excellence.

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Abstract

Leadership, and especially head-teachers' leadership, has been object of study since the late '60s, but the concept of leadership is neither unanimously defined, nor a consensus has been yet reached on its actual role and actual relevance within the school environment (Fullan, 2001; Sergiovanni, 2001; Harris, 2005). Good leadership can certainly contribute to school improvement by abetting the motivation, participation, and coordination of the teachers; recent studies have widened the range of action of school leadership research to the various organizational levels: school managers, department heads, coordinators, teachers (Goldhaber, 2002; Harris, 2004), and distributed leadership that could yield a higher impact on student achievement than what yet shown (Spillane et al., 2001, 2004). This dissertation takes its moves within the strand of research that identifies a significant role of leadership for student achievement (e.g. Edmonds, 1979; Cheng, 2002; Marzano, 2003) and tries to understand whether there are patterns of behavior of head-teachers that yield better results than others with respect to facilitating the student learning process and whether such patterns are consistent or replicable across countries.

To address this question, the study uses the TIMSS2003 and investigates the relationship between head-teacher time allocation and school characteristics, student background, and student achievement in 18 countries. The model used in the empirical analysis is a three level Multilevel Model with random effects (evaluated using the R-Statistics software) that aims at evaluating the interaction effect between a particular school level variable (the time used by the head-teacher in managerial or leadership activities) and the explanatory variables describing school and student characteristics. What the study shows is that head-teacher specialization (either in management or in leadership) has negligible direct effect on student achievement. Most of all, however, head-teacher specialization is correlated to a lower impact of family SES on student achievement. Moreover, by investigating the impact of school management and school leadership on student achievement on students with different family background in terms of education, it is apparent that the high concentrations of school leadership are especially valuable for students of lower SES. On the other hand, the high concentrations of school management are most valuable for the students of higher SES. One possible explanation of these effects is that the attentiveness to the leadership process implies a deep involvement of the head-teacher in activities related to the modeling and tailoring of the educational process to the needs of the students. Such process has its highest payoffs on the students who come from disadvantaged situations and need special attentions in order to fully express their potential. On the other hand, the focus on the managerial side aims at rationalizing and making the best use of resources. This approach has high payoffs on students of all extractions, but is specifically relevant for the students of higher SES who are possibly already quite independent and whose performance can improve autonomously by making use of the extra resources that the management can provide.

The analysis replication of the analysis on a country-by-country level confirms the existence of the afore-mentioned effects. More specifically, the results of the analysis suggest that, in the majority of cases, the head-teacher specialization appears to be correlated to a significant reduction in the dependence of student results from their family socioeconomic status. The same effect can be identified for both Math and Science in most countries. Nonetheless, the identification of a specialization-effect does not say much about the reasons for its existence. One possible explanation is that head-teachers are professionals that try to use at its best the opportunities provided by the institutional setup of the school system. In the more decentralized school systems that leave to the schools responsibilities in terms of monetary sanctions/incentives (hiring and firing, salary upgrades…), the head-teachers would tend to make use of these opportunities and focus most on management activities. Vice versa, in more centralized school systems, which leave to the schools only responsibilities that do not involve a monetary side, the head-teachers would stress their roles as role-models, educators, and motivators for their staff and collaborators. Hence, the final part of the research investigates whether the effect of the declared head-teacher specialization appears to go in the same direction as it could be predicted by looking at the macro-level institutional characteristics of the school system.

These data suggest that school leadership and school management do have an impact on student results. However, the variables that enter in the process of determining the head-teacher time allocation are too many for indicating any specific policy direction based on average country behaviors. Still, the specialization of head-teachers in leadership or management is related to significant turnouts in terms of reduced needs of the students to rely only on the family resources (family SES) for improving their performance. In policy terms, such results suggest the need of allowing for different managerial strategies that could exploit local knowledge leads to foster the system's equity and excellence.

The report is organized in 4 chapter plus 2 appendixes. The first introductory chapter looks at the economic nature of the educational good, the importance of its dissemination, and what are some of the possible interaction schemes among the system actors. The second chapter dives in the concepts of school leadership and management by looking at how it has evolved in the past 40 years. Subsequently, it addresses the limitations of the studies that have tried to establish a link between school leadership and student achievement, suggests how these limits can be overcome by means of a more comprehensive definition of the concept and of more advanced statistical techniques. The third chapter presents the research project on the TIMSS2003 dataset, the operationalization of the variables, the model for the statistical analysis, and the results of the study. The fourth chapter further discusses the results by contextualizing them within the legal and operational frameworks of the analyzed educational systems, and it concludes by addressing the limitation of the study, the indications for further research, and the possible suggestions in terms of policy making. The first appendix presents in detail the statistics for all the countries under investigation. The second and last appendix shows the detailed results for the analytic models at aggregate level and reports the dispersion of the residuals for each model.

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