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An Historical Analysis of the Expansion Of Compulsory Schooling in Europe After the Second World War

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Abstract

From 1945 to 1975, fifteen Western European countries passed school-leaving age laws that raised the number of years of compulsory schooling for the first time after the Second World War. In order to understand the driving forces behind the increase in compulsory schooling and to explain the timing of this expansion, several areas of research have been reviewed. Economic, political economy and institutional hypotheses have been formulated to explain the passage of the legislation. The results of the estimation of the Cox proportional hazard model are in favour of the modernization theory when the overall period is considered. The 'role of the state' theory performs better until 1970 whereas after the Golden Age, technology and openness appear to be the most important determinants of the expansion of compulsory schooling. Surprisingly, there is no evidence of "contagion effect" in the law's passage.

1. Introduction

This paper explores the causes of the increase in the number of years of compulsory schooling in western Europe after 1945 by testing theories drawn from different literatures.

The expansion of compulsory schooling after the Second World War represented a very important policy change: a reform that can be considered among the first structural adjustments common to the majority

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of European countries. The increase in school-leaving age laid the basis for further educational expansion.

Specifically, over the period 1950-2000, fifteen Western European countries extended the school-leaving age by one year or longer; mainly during the twenty-five years after the war. The change in legislation was undertaken by countries with different traditions and experiences in educational policy such as Nordic, Anglo-Saxon and Continental countries. Indeed, European countries were different and the war had a dissimilar impact on their economies. However, new equilibria at both national and international level led countries to undertake this policy change in education. This can be considered as a structural adjustment to address the needs of the post-war society.

Many theories have been proposed in sociology and political science to explain the expansion of education during this "period of extensive development of the educational and training system".[1] However, these important contributions have not explained the timing of the changes in school-leaving age laws. In the existing literature there are two kinds of analyses related to the expansion of education. On one hand, there are macroeconomic studies,[2] which suffer from the limitation of not considering the role of institutions, thus lacking an historical contextualization of the policy changes. On the other hand, the country-level studies are too specific to allow any inference about how common factors may have influenced the way in which countries have shaped their education policy. Consequently, this topic has not been adequately studied so far.

What is missing in the existing literature is a comparative analysis of the education policies undertaken at European level. Comparative work by Diebolt and Fontevielle (2001) and Ringer (1979) represents a good

[1] Diebolt (1999), p.30.
[2] For instance, Mankiw, Romer and Veil (1992).

start but is not sufficient to understand what factors, beyond the national boundaries, drove the expansion of compulsory schooling.[3]

The question addressed here is how is it possible to explain the timing of the changes in school-leaving age laws that occurred in most European countries after the war? I aim to contribute to the existing literature in two ways. First, I will adopt a comparative approach by undertaking a quantitative analysis using a new dataset constructed for a panel of fifteen European countries over the period 1950-2000. The second intended contribution is methodological: I make use of the technique of duration analysis, recently used in political economy, to study the determinants of specific policy changes.

The paper proceeds as follows. First, I review the origins and the main features of the compulsory schooling laws that characterised the European experience after the war. Then I analyse the main theories that scholars have proposed to explain the expansion of education and I will derive from these the hypotheses that I will test empirically. After that I describe the dataset I have constructed and I will explain the methodology for the quantitative analysis. Finally, I will provide comments on the results of the empirical investigation, a brief discussion and concluding remarks.

2. Historical background

Following the definition provided by the OECD, compulsory schooling is "the span of years during which every normal child must be receiving a formal education".[4] Compulsory schooling was introduced in

[3] The focus of these analyses is limited to a small number of countries: to France and Germany the former and to France, Germany and the United Kingdom the latter.
[4] OECD (1983), p.12

most Western countries[5] between the second half of the nineteenth century and the beginning of the twentieth century.[6]

Economic historians have been interested in the topic of formal education in order to understand how institutions can create the conditions to promote economic development and growth.[7] Landes' (1969) work has shown that cultural, social and educational factors were essential in determining the development of more advanced technologies. Therefore, one may wonder how important was education in the process of industrialization. Interestingly, compulsory schooling was introduced only at a relatively late stage of industrialization whereas basic human capital, measured by literacy rates, was already widespread (Cipolla 1969). In fact, the basic skills of reading, writing and arithmetic were provided by a variety of religious and secular institutions in Western Europe at this time.[8] Some historians have provided evidence in favour of the importance of the spread of basic knowledge for the process of industrialization to start. According to Cipolla (1969), Britain had a large pool of literacy before the Industrial Revolution, whereas Cameron (1985) shows how countries like the Netherlands, Switzerland and the Nordic countries, lacking a large supply of coal, could successfully industrialize as a result of their skilled population that acted as a substitute for natural resources. Conversely, the author explains the late industrialization of Southern European countries as a consequence of the low levels of literacy and the late development of formal education. Why was compulsory schooling not institutionalized before the nineteenth century and only after the beginning of the industrialization process in most European countries?

[5] Maynes (1985), p.25.
[6] The exception is represented by Germany. In Prussia compulsory schooling was introduced in 1763 and extended to the German Empire in 1871.
[7] See for instance Cipolla (1969), Nicholas (1990) as well as Tortella (1990) and Sandberg (1982).
[8] Maynes (1985), p.7.

Mitch (1983) argued in his doctoral dissertation, that an earlier introduction of compulsory schooling would have been socially desirable but not economically necessary as there was a lack of demand for educated workers. In fact, literate workers did not benefit from any wage premium with respect to their illiterate counterparts. In general Mitch (1990) rejects the "indispensability" of formal education by providing historical examples of the successful development of trade and financial activities for which the labour force had acquired on-the-job skills and not formal education. Later, things changed: "indications that the demand for literate workers was shifting to the right are the shift after 1840 of the labour force toward occupations making relatively active use of literacy and evidence indicating increasing use of literacy within given occupations".[9]

The shift in demand was probably generated by the greater complexity of the productive activity and by the need of having a disciplined, responsible and industrious working class as Bordieu and Passeron (1977) have claimed. This would suggest that schooling became compulsory first in more industrialized countries where the demand for education was already high. This is what Landes and Solmon (1972) have argued happened in the United States where the institutionalization of schooling may be seen as the formalization of a social change that was taking place in the American society. Scholars have not yet reached a definitive conclusion for Europe, but enrolments in primary school were already high when compulsion was established.[10] The introduction of compulsory schooling in Europe was a revolutionary policy change. In this regard, the process of nation building is likely to have been another factor that accelerated the need to introduce secular

[9] Mitch (1983), p.287.
[10] Craig (1981), p.184.

education in Western European countries.[11] It is important to acknowledge that the number of years of schooling that was initially made compulsory was very low especially in Southern Europe. In Italy, for instance, the Casati Act of 1859 established two years of compulsory schooling, whereas in Denmark seven years of compulsory education were enacted in 1814 but attendance was only compulsory three days per week.[12] This may also be due to the fact that the higher the level of education the more disconnected it was from the productive activity as "education above the primary level had practically nothing to do with business".[13] Educational programmes with modern subjects became available as an alternative to the classical secondary education only in a later phase of industrialization.[14] Moreover attendance was low, especially in the countryside at harvest time,[15] and the power of the state to enforce compulsion was low due to budget constraints.

After this major economic and social change that created the common impetus for reform in Western Europe, education expanded by following national patterns and there was no other institutional response that was undertaken in the same epoch by various European countries. Moreover, the economic depression that followed the Great War and the slow recovery during the interwar period imposed important constraints on government expenditure for social services such as public education. Although by 1937 public expenditure as a share of GDP was 10 percent above the 1913 level,[16] this was a result of the fall in GDP caused by the

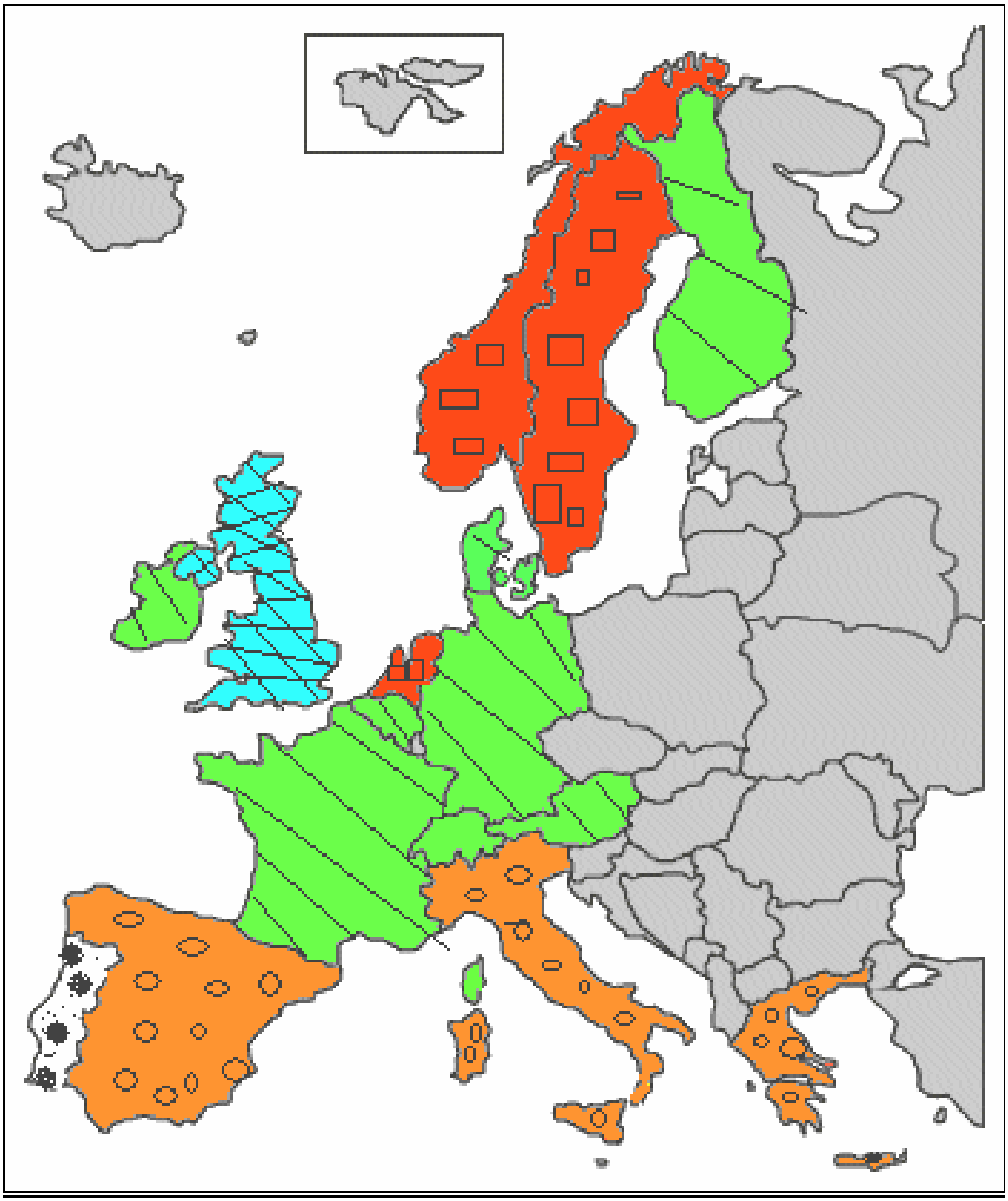
[11] Cipolla (1969), p.70.
[12] Flora et al. (1987).
[13] Ringer (1979), p.2.
[14] Ringer (1979), p.5.
[15] Maynes (1985), chapter 7.
[16] The average value of public expenditure in 1913 was 14.04% of GDP whereas in 1937 was 24.74%. I have calculated these values from the table in Tanzi and Schuknecht (2000), p.6. The sample of countries comprises Austria, France, Germany, Ireland, Italy, Norway, Sweden, Switzerland and the United Kingdom.

depression rather than a real increase in public spending for social services (Tanzi and Schuknecht 2000).

After 1945, with the end of the war, things changed dramatically. Countries started experiencing unprecedented growth rates and the recovery was faster than the more optimistic could have expected (Eichengreen 1996). Moreover, the new economic and socio-political conditions created the pressure for governments to modernize the education system. The expansion of compulsory schooling was an institutional reconfiguration of the schooling system undertaken in countries very different from each other, with dissimilar economic conditions and different cultural and educational traditions. In addition to the expansion of education, many countries reshaped their education system.[17] The timing of the passage of the school-leaving age laws of fifteen European countries over the period 1938-2000 is presented in figures 1 and 2.

[17] E.g., the 1970 reform in Spain was the first since the Moyano Act of 1857 to reshape the entire educational system (Eurydice, 2005).

Figure 1 Number of years of compulsory schooling in 16 European countries, 1938



Legend

3 years

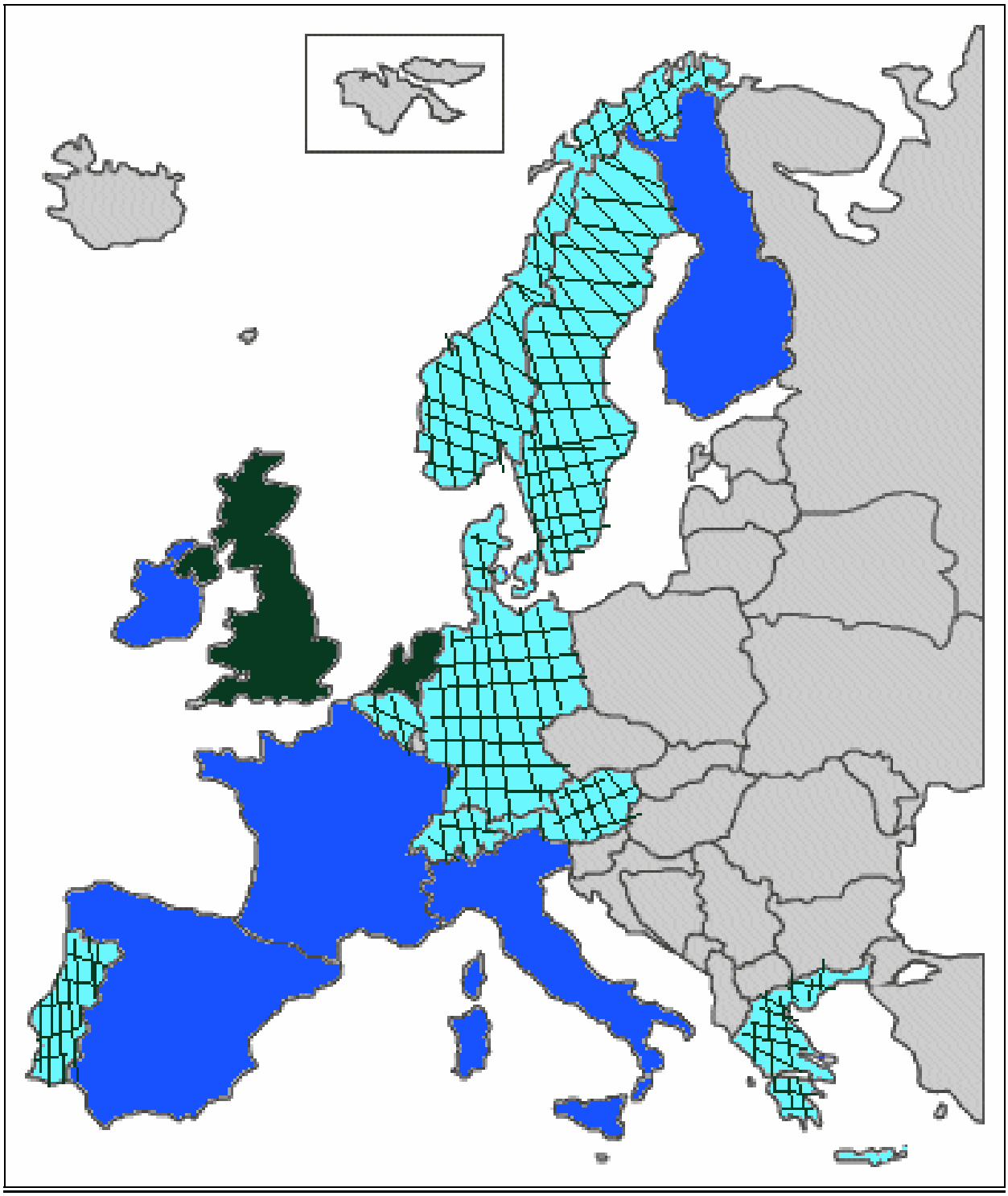
8 years

6 years

9 years

7 years

Figure 2 Number of years of compulsory schooling in 16 European countries, 2000



Legend

9 years

10 years

11 years

Two groups of countries can be identified according to the starting level of compulsory schooling at the end of the Second World War. Austria, Belgium, France, Switzerland, the United Kingdom and the Nordic countries started with high levels of compulsory schooling, varying from 7 to 9 years. On the other hand, Southern European countries had lower initial levels of compulsory schooling, from 3 years for Portugal to 6 for Greece, Italy and Spain. This distinction was reflected in the actual levels of schooling achieved by the population. According to the dataset constructed by Cohen and Soto (2001), that will be used later in this chapter, the rate of educational completion was lower in Southern European countries. However, the Southern European countries overall have increased in the number of years of compulsory schooling more than the other countries since 1945. Italy and Spain increased compulsory schooling twice and the overall change consisted of 4 more years of compulsory schooling. Portugal is the European country that has increased compulsory schooling most since 1945. This was accompanied by a democratisation of access. A Portuguese politician interviewed by Alves and Canário argued that "the fundamental change in the system [has been] expansion".[18]

On the other hand, Nordic countries and the other countries that started with higher levels of compulsory schooling increased the school-leaving age by a year or two. The experience of the United Kingdom is an exception. An education act was already passed by Parliament in 1939 to raise the school-leaving age by one year. However, the law was suspended because of the outbreak of the Second World War.[19] Afterwards, a plan to increase compulsory schooling was included in the 1944 Butler Act but did not become effective until 1947. This was due to the massive destruction caused by the war (Dent 1954).

[18] Alves and Canário (2002), p.658.
[19] Kurian (1988), p.1485.

It is possible to notice that most European countries increased compulsory schooling for the first time in the twenty-five years following the end of the war. In fact, by 1970, 11 countries had passed the school-leaving age laws. After 1990, only Finland, Ireland and Italy increased the school-leaving age by one year and this was the second change for the three countries.

In this context, it would be interesting to understand what were the determinants of this policy change. Namely, what were the new conditions characterising the post-war era that led countries to increase compulsory schooling? These issues have remained largely unexplored in the existing literature and they call for an investigation. This is what I propose to do in the following sections.

3. Theoretical framework

Many theories have been proposed by sociologists and political scientists to explain the development and the expansion of schooling. However, it is important to acknowledge the fact that there are country-specific determinants of the school-leaving age laws that cannot be observed by doing a cross-section analysis over time,[20] and which have played an important role in leading to the passage of the laws. Indeed, cultural factors, legal systems or other institutional settings may have been relevant for the enactment of the compulsory schooling laws. But the question here is what caused the changes in compulsory schooling to be concentrated in the post-war period. Finding an answer depends on finding empirical evidence for the determinants, among those proposed by the theorists of educational expansion.

[20] In order to address this issue, later in the panel regression analysis, fixed effects will be used to take into account country-specific attributes.

In the following paragraphs I will analyse the main theories and formulate the hypotheses to test which theory best accounts for the passage of the school-leaving age laws in Europe after the Second World War.

3.1 Technical-functional theory (modernisation)

According to the “technical-functional theory”, modernization (in the sense of technological advance and greater complexity of the organization of production) creates the demand for a more educated labour force. According to Collins (1971), this happens when the proportion of jobs requiring more educated workers increase and more education is required to perform tasks that previously required less education. As an institutional response to this, states can intervene through education policy. That is, governments can increase the number of years of compulsory schooling in order to endow citizens with the skills necessary to enter into a more complex labour market. This framework differs from human capital theory in that the policy change is not only considered as the private response to monetary incentives (Craig 1981).

How can this theory apply to the European experience in the later twentieth century? Central to the European experience after the war was a technological gap with the United States, low productivity levels and a backlog of unexploited capital. However, the new conditions at both national and international level laid the foundations for a rapid recovery and the adoption of more advanced technologies through import and imitation. In this context, a policy change to increase the amount of time spent in school by the population may have been undertaken by Governments to endow the future generations with the skills that a more complex production system requires. To capture this source of modernization of the countries I will use the variables Gross Domestic Product per capita and technology per capita.

Economic growth can be considered as one of the elements that contribute to organizational and social advance of society. Meyer, Ramirez, Rubinson and Boli-Bennett (1979), by examining the rapid expansion of national educational systems that occurred throughout the world between 1950 and 1970 find a positive impact of the growth of Gross National Product[21] on enrolments growth at every educational level. Also Meyer and Schofer (2005a), find that the growth of Gross Domestic Product had a positive and strong impact on the expansion of tertiary education in the developed countries over the twentieth century.

Meyer and Schofer (2005a) introduce in their model of educational expansion a variable related to technology. They find a coefficient positive but not significant. This is against what the theory would predict. There are two approaches in the literature that should be considered.[22] The first is the neoclassical approach which suggests that what matters is the level of development, that is the level of GDP per capita and technology. To control for this theoretical approach I will use a variable for GDP per capita (GDP_{pc}) and technology per capita ($Technology_{pc}$). I expect to find a negative coefficient for the technology variable as the lower the level of technology the greater would be the incentive for the country to create the conditions that would allow a transfer of technology or stimulate the expansion of education. The coefficient of GDP per capita is expected to be negative as well, but the motivation for this can vary according to the level of development of the countries under study. A negative coefficient for the more backward countries could mean that the lower the level of well-being the greater would be the demand for schooling from the population and the greater the scope for governments to close the gap. On the other hand, a negative coefficient for the more advanced countries

[21] They use Gross National Product because their study includes countries for which early data on Gross Domestic Product were not available.
[22] An exhaustive comparison of these two theoretical approaches has been provided by Aghion and Howitt (2005).

would suggest that at higher levels of GDP countries may want to shift their public spending to higher levels of education in order to increase the complementarities between the labour force and the more innovative technologies. Therefore, at different stages of development the "appropriate institutions"[23] may be different and the aims of the education policy may change.

On the other hand, according to the Schumpeterian approach, what needs to be considered is the relative position of the countries with respect to the leader. In particular, it is the distance from the technological frontier that has an impact on the kind of education policy that governments decide to undertake. Here I will consider two explanatory variables: GDP per capita with respect to the leader ($GDP_{pc}/GDP_{pcleader}$) and technology per capita with respect to the leader ($TECH_{pc}/TECH_{pcleader}$). It could be the case that the further is a country from the technological frontier the greater would be the need to catch-up and therefore the expansion of compulsory schooling could be an appropriate policy to reach this objective. On the other hand, as countries get closer to the technological frontier the less they may need to expand compulsory schooling as they may need to invest more in higher education. This is precisely the argument put forward by Aghion, Meghir and Vandenbussche (2004). In fact, by considering a panel of 19 OECD countries over the period 1960-2000, they show how high levels of education are important for growth when countries get closer to the technological frontier. On the other hand, when countries are relatively far from the technological frontier lower skill-levels are growth enhancing. I expect the coefficient of relative GDP_{pc} and relative $Technology_{pc}$ to be negative.

Another variable that can be used to capture the degree of modernization is the interaction between openness and technology per

[23] Acemoglu, Aghion and Zilibotti (2003), p.2.

capita (Open*Tech). The role of technology has been acknowledged whereas the impact of the greater markets integration can be justified as follows. The phenomenon of globalization[24] can be considered as having a positive impact on the expansion of education

In fact, improvements in communication and transportation and the reduction of cost made easier the interaction between agents of different countries. As a result of this, the expansion of education increases the opportunities for this economic and cultural exchange. Therefore, education becomes an instrument to acquire social and economic well-being and not only "a functionally necessary outcome of the demand created by progress".[25] Fiala and Lanford (1987), by comparing the aims of education in developed and developing countries over the period 1955-1965, find a convergence throughout the world.

The interaction between openness and technology per capita is likely to be driven by the positive effect of openness. Therefore, a positive coefficient for the Open*Tech variable would support the modernization theory. On the other hand, a negative coefficient could be found by considering only advanced countries or the post-Golden Age period. This is because what is distinctive of more advanced countries and the late period is the shift from "imitation" based technology to a more innovative approach.[26] In this context countries could change education policy accordingly as governments can decide to invest more in higher education rather than in basic compulsory education in order to train a portion of the labour force for the high-tech sector.

Another factor that can influence the increase in school-leaving age is the starting point (CompSchool50). It is reasonable to assume that it will

[24] There is no unique definition of the word "globalization". Therborn (2000) defines globalization as follows: "tendencies to a world-wide reach, impact, or connectedness of social phenomena or to a world-encompassing awareness among social actors", (p.154).
[25] Meyer and Schofer (2005a), p.13.
[26] Aghion and Howitt (2005), p.2.

be more difficult to enact the law in countries that in 1950 already had a high number of years of compulsory schooling. This is because an additional year of school at higher levels of education would be more expensive than the same increase at lower levels.[27] For teachers need to be better trained but also the opportunity cost of keeping students an additional year in school would be higher. On the other hand, we can expect countries with low starting levels of compulsory schooling to be more likely to pass the law. Therefore in support of the modernization theory I expect to find a negative coefficient for the variable CompSchool50.

A negative coefficient for illiteracy (Illiteracy) would suggest that modern countries want to upgrade the skills of the population by focusing first on the basic level of schooling that would endow the population with the basic skills of literacy and numeracy. Therefore, the expansion of compulsory education could be postponed until illiteracy has been eradicated.

The impact of the proportion of the population aged 0-14 (pop014) on the passage of the law deserves discussion. We can imagine that an increase in the share of the young population would impose pressure on the state budget and therefore should hinder the rise in compulsory schooling. On the other hand, less developed countries with a low starting level of compulsory schooling may want to increase compulsory schooling as a result of demographic expansion. Otherwise they would become less and less competitive over time. Following the theory, I expect this

[27] This can be observed by comparing teachers' wages according to different levels of education. These information can be collected from the publication of the Department for Education and Skills "Statistics Education: Teachers in England" for the United Kingdom. Similar publications are available for other European countries. What can be noticed is that teachers at higher levels of education earn higher salaries. As teachers represent the main "input" in schooling, it follows that an increase of compulsory schooling at higher levels would be more costly.

coefficient to be negative, though an exception could be allowed if only less developed countries in the sample are considered.

3.2 Neo-institutionalism (political economy factors)

This theory has been developed to address the unanswered questions left by the technical-functional theory. In particular, what has been observed is that the expansion of education at all levels is something that goes beyond the experience of rich and developed countries. To understand the driving forces behind this world-wide educational experience, sociologists have analysed global phenomena that may have affected the development of similar institutions across different countries. This is the reason why Meyer and Schofer (2005b) have focused on "how much the institutions of modernity (as opposed to the actual income and resource levels nominally associated with these modern institutions) diffuse around the world independent of socioeconomic developments".[28] In the context of the European expansion of compulsory schooling it is possible to notice that countries at different stages of development, with dissimilar levels of GDP per capita and technology, have enacted the school-leaving age laws to increase compulsory education. Therefore, it seems necessary to investigate whether political economy factors may provide a good explanation to understand this change in education policy.

The common history of European countries is characterized by important socio-political factors that may have been influential for the expansion of compulsory schooling after the 1950s. First, the expanding ideology developed since the aftermath of the Second World War according to which education is essential for progress.[29] This new way of

[28] Meyer and Schofer (2005b), p.5.
[29] The right to receive formal education was introduced in many European post-war constitutions.

thinking marked a radical change from the pre-war period when it was believed necessary to limit the spread of education in order not to have a supply of educated workers that would have been greater than the economy could absorb.[30]

This change was caused by many factors. At international level, the competition among countries, in particular with the Soviet bloc since the mid-1950s, intensified the responsiveness of Western European countries in terms of increasing the education level of the labour force in order to be more competitive in technology and innovation. In fact, the international tension that originated in the aftermath of the war with the Space Race played an important role in amplifying the cultural and technological competition between the Soviet Union and Western countries during the Cold War (Mitchell 2004).

In addition, the process of European integration may have played a role in leading countries to adopt similar changes in education policy. In this regard, it is important to notice that there was a consistent lag between the year of application and when new members joined the European Union. Ireland, for instance, applied in 1961 and joined the European Union in 1986 whereas Portugal and Spain were admitted in 1986 after applying in 1977. In Greece, the application was submitted when the democratic regime was restored in 1975. Many educational reforms that had been invalidated during the regime were re-established[31] and the country could become member of the European Union in 1981.

The influence of European policy on the expansion of education may also have been indirect. In fact, since the creation of the European Coal and Steel Community (ECSC) in 1951, the progressive development of a common market may have influenced the education and training

[30] Abramovitz and David (1973), p.435. They argue that the technological development made a skilled labour force necessary and dismissed the belief that an expansion of education would have caused skilled workers' wages to decrease.
[31] Kurian (1988), p.517.

policy of the participating countries.[32] On the other hand, the development of human capital theory led to the increased awareness of the benefits that education can create in terms of increasing workers' productivity and finally in promoting sustained growth. The writing of Schultz (1961), Becker (1964; 1993) and Mincer (1974) became very influential among policy makers at this time. Another factor that may have affected the expansion of compulsory schooling is the development of institutions favourable to the expansion of education, this is democracy. In this institutional setting the needs of the individual become central to society and the right of the individual to acquire the knowledge and the skills to fully develop his personality is recognized in the constitutions of democratic countries.

The majority of European countries already had democratic institutions at the beginning of the study period, 1950. However, the Western European countries that experienced the greatest expansion of compulsory schooling did not have a democratic regime before. This is the case of Italy, Greece, Spain and Portugal. In Italy for instance, radical school reforms were undertaken as a result of the fall of fascism and in Greece as well, when the military dictatorship ended, many schooling policy changes were undertaken.

Lindert (2004) has shown how the spread of democracy increased enrolments at primary and secondary level more than this increased schooling participation could have caused democracy (this is the reverse causality assumption). I expect to find a positive effect of democracy (Democracy) on the enactment of the school-leaving age law, especially for the more backward countries I have in the sample.

Another factor that can be considered among the political economy determinants of the schooling expansion is the share of the labour force in

[32] This externality can be considered as the "contagion effect" and will be discussed in greater detail later.

the sectors of the economy. According to the median voter theory first introduced by Black (1948) and subsequently developed by Downs (1957), policy makers would choose their electoral programme in order to respond to the needs of the largest share of voters. It arises from this that the repartition of the population according to the different sectors of the economy may have an influence on the expansion of compulsory schooling.

A positive coefficient for the labour force in the service sector (LfServices) would suggest that a more educated labour force is more willing to agree that the government should spend public funding to expand compulsory schooling. This is because education can be considered as a “merit good” and people who have benefited from it may be willing that the future generations could benefit from it too.

On the other hand, a negative value for the coefficient of the labour force in agriculture (LfAgriculture) would confirm the belief that a greater share of unskilled workers in the labour force would act as a brake for a further expansion of education. This is because the population working in agriculture would be less willing to devote public expenditure for a service from which they would not take advantage.

Another political variable worth analyzing is the Gini coefficient, a measure commonly used to measure wealth inequality. Its main advantage is that it can be used to make comparisons across population and countries (Atkinson and Brandolini 2003). According to Hicks (1999), the success of redistribution policies carried out by European countries depended on how power was organized among political institutions. That is, welfare redistribution through education depended on the structure of taxation and public spending (Bradley 2003). Therefore, it may be reasonable to expect a negative sign for the Gini coefficient (GINI). In fact, we can assume that in countries characterized by high levels of income inequality there will be stronger resistance to increasing expenditure on a

social service that is likely to reduce the long-term income inequality. This is the evidence provided by De Gregorio and Lee (1999) who examine a large set of countries over 1960-1990 and show that a higher educational attainment makes the income distribution less unequal.

Another variable used in political economy studies is ethnic fractionalization (Ethnic). This is because, as Weber suggested, [33] there is a plurality of groups that shape educational policy and they can be different according to the context. That is, "the nature of the conflict in each historical period is qualitatively different because the structure of production, schools and other institutions keeps changing".[34] It is not possible to measure the power and the role that different pressure groups have played in determining the expansion of education after the Second World War in different countries. However, it is possible to test the impact of the heterogeneity of the population on the expansion of compulsory schooling. According to Meyer et al. (1979), greater ethnic fractionalization may have been beneficial for the expansion of compulsory schooling because in the European countries it was considered by governments as a driving force toward integration. In the countries I examine there was no clash between ethnic groups. Belgium and Switzerland were multiethnic countries where different national, cultural and linguistic groups lived in the same territory in peace. This would be an extension of the political integration hypothesis described by Craig and Spear (1978). However, it is difficult to draw definitive conclusions on the sign that should be expected for this variable. Therefore the hypothesis for this variable will be two-tailed.

[33] Weber (1962), p.17.
[34] Carnoy and Levin (1985), p.47.

3.3 Role of the State

This theory differs from those previously introduced in that it provides a supply-side explanation. In this framework the timing of the enactment of the school-leaving age laws is considered not to be a result of post-war economic and socio-political conditions, but rather a function of the state's capability to support the expansion of education. Consequently, strong states that emerged at the end of the Second World War had the possibility of devoting resources to education, and specifically to expanding the level of compulsory schooling in the belief that "sustained economic growth needed an (sic) increasingly skilled manpower".[35] This framework also contrasts with the class-conflict theories as it recognizes that as the state becomes more complex and structurally organized, then the possibility for class-conflict is greatly reduced[36] and the "scope for negotiation increases enormously"[37] as Archer (1979) suggests. Within this general framework a stream of the literature has focused on the strength of the state in promoting change in the educational system.[38]

In a very insightful study, Hage and Garnier (1992) have contrasted the strength of the French state and the weakness of the Italian state in promoting the expansion of education at primary and secondary level over 1881-1975. Their definition of strength is based on many indicators such as "the relative power and legitimacy of state bureaucrats, the creation of a highly differentiated educational system, the closing of access to some parts of the educational (*sic*) system, the emphasis on the quality of

[35] Demeulemeester and Diebolt (2005), p.3.
[36] That is to say that the class-conflict model can provide a convincing explanation for the introduction of compulsory schooling that occurred in most European countries towards the end of the nineteenth century when many countries were still experiencing nation-building. On the other hand, after the Second World War this was no longer the case, as Western European countries were unitary states with a single system of law and government. Therefore the power of the state to induce educational change becomes more important as the state becomes the main actor.
[37] Archer (1979), p.237.
[38] Archer (1979), Hage and Garnier (1992) and Thelen (2004) for vocational training.

education, the enforcement of attendance laws and the state's ability to handle educational crises".[39] These variables seem to be important but are difficult to compare across fifteen European countries. Therefore, the empirical analysis will be restricted to some of the variables for which the data is available and comparable across countries.

To control for the role of the state I will introduce GDP per capita growth ($l(GDP_{pc}/GDP_{pc(-1)})$ as an explanatory variable. This is motivated by the fact that the expansion of education will impose a high cost on the government budget. This is the direct cost of keeping students longer in school and the indirect expenditure that is represented by the opportunity cost of the foregone societal earnings. Following this reasoning it seems plausible to assume that greater growth in the previous period will have a positive impact on the increase of school-leaving age as governments would be more willing to increase education spending. Consequently, I expect this coefficient to be positive (by using the log-specification the coefficient should be negative). In fact, most European governments after the Second World War "channelled funds to every corner of national life [and] education was a prime beneficiary"[40] (Marlow-Ferguson 2002). The reason for not having chosen a variable more strictly related to education, such as expenditure on education as a percentage of Gross Domestic Product ,is the this variable raises endogeneity problems. Moreover, from the aftermath of the Second World War until the end of the Golden Age there was a positive correlation between GDP growth and expenditure on education (Tanzi and Schuknecht 2000).

Another factor that seems important is the demographic composition of the labour force. This is central to the "population ecology hypothesis".[41] In this context we can define a variable, "State Capacity",[42]

[39] Hage and Garnier (1992), p.157.
[40] Marlow-Ferguson (2002), p.11.
[41] Craig (1981), p.152.

representing the country's ability to support the expansion of education when the share of the active labour force grows faster than the school-age population. A positive coefficient would suggest that this would increase the state's capacity to expand education further. On the other hand, a negative coefficient would imply that it was the demographic expansion that led states to increase the school-leaving age in order to endow the growing future generations with more skills.

Another variable used in the literature to capture the strength of the state in increasing compulsory schooling is the average number of years of schooling.[43] The justification for the choice of this variable is twofold. First, it would be easier for governments merely to formalize a social change than to pay for it. According to Landes and Solmon (1972), the introduction of compulsory schooling in the United States was merely a formalisation of a social change as the enrolments were already very high when the law was enacted. No similar analysis has been carried out of whether this also occurred in Europe after 1945. A positive coefficient for this variable would support the hypothesis that the passage of the law can be considered as the formalization of a social change that was taking place in Europe, whereas a negative coefficient, together with a negative coefficient for CompSchool50, would indicate that countries with lower levels of average years of school needed to modernize and therefore increased compulsory schooling.

I should acknowledge the existence of another aspect of this topic that I was unable to investigate further and that appears to be a promising area for future research. This is the "contagion effect". Spatial dependence as an area of research is still evolving and Smythe (2005) recently found that contagion was among the most important factors in

[42] This is the ratio of the active population (aged 15-64) with respect to the young population (aged 0-14).
[43] For instance by Landes and Solmon (1972).

determining the passage of the Uniform Sales Act in 34 American states between 1906 and 1947. However, in the existing literature, it is possible to observe that many other attempts to model this effect have been less successful.[44]

In the context of my research, the potential importance of the effect that an increase in school-leaving age in a country may have had on the expansion of compulsory schooling in other countries has been acknowledged. In fact, factors such as geographical proximity, similar characteristics of neighbour countries as well as European integration may have led countries to become more responsive to policies adopted in other European countries. I have tried to model this variable in three ways. First, this was done by considering for each country the ratio of the countries that passed the law with respect to its neighbours. Then, I tried to model the contagion effect by controlling for participation in European integration[45] and by normalizing it by the total number of countries that passed the law in a given year. The last experiment relied on the specification of neighbours according to the industrial structure, *viz.* countries with a similar industrial structure were considered as neighbours. However, none of these variables was significant once I introduced them separately in the regressions.

This is an important issue that deserves additional study possibly with specific reference to the contagion theory. This theoretical framework is used in economics to explain a variety of phenomena such as the spread of a financial crisis and the positive peer effect on students' performance. In this context, it may be that countries that increased the number of years students should spend in compulsory schooling led other countries to enact similar legislation. This issue needs further investigation.

[44] See for instance Carruthers et al. (2005).
[45] Done by taking into account whether a country had joined the European Union.

4 Data and methodology

4.1 Data

Sources

The paper employs a novel dataset that has been constructed by drawing from a variety of national and international sources. It covers the period 1950-2000 and it consists of annual data. The dataset includes the following fifteen European countries: Austria, Belgium, Denmark, Finland, France, Greece, Ireland, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom. The detailed information related to the source for each variable that has been used in the analysis is provided in the Appendix.

Dependent variable

The school-leaving age law (SLALAW) is a dummy variable that can take the following values: "0" when the law to increase the number of years of compulsory schooling has not been passed in the country under study, "1" when the country has enacted the law the first time, "2" for the second passage and "3" for the third passage.

This variable has been constructed by examining the fundamental principles and basic legislation of the European education systems described in the Eurydice Database (2005), the historical survey in Flora et al. (1987) and the World Education Encyclopaedias (1988; 2002). These reports are available for every country included in the study except Switzerland. For Switzerland I have used national sources kindly provided by the Federal Schooling Body.[46] The changes in school-leaving age laws since 1938 have been presented in figure 1 and 2. However, there is a limitation in the use of this variable. Considering only the increase in compulsory schooling overlooks the starting point of each country. It seems reasonable to assume that a country that starts with a very low

[46] Arnet (2000), "Das Schulkonkordat vom 29 Oktober 1970".

number of years of compulsory schooling will have more scope for increasing the school-leaving age. This is precisely what happened in the case of Portugal compared to France, Norway and Sweden. In order to solve for this shortcoming I will use the number of years of compulsory schooling for each country at the beginning of the period as an explanatory variable. This is a way of considering the impact of the initial conditions on the subsequent rise in school-leaving age. Moreover, what has been considered in the analysis is the expansion of formal schooling. I could collect accurate information on school attendance and state enforcement capability for certain countries but not others. I acknowledge that it is not possible to have a precise measure of the different rates of enforcement for the fifteen European countries in the sample.

Independent variables

A complete list of the variables used in the empirical analysis, with their definitions, is in Appendix A. Here, the discussion is limited to those variables that necessitate special consideration.

Technology per capita: has been constructed as the number of patents granted to residents and non-residents at a given year. The choice of this variable to measure technology is motivated by the state-of-the-art literature. In fact, many scholars such as Griliches (1984, 1990), Evenson (1984) and Eaton and Kortum (1996; 1998) have shown both advantages and disadvantages in the use of this indicator as a proxy for technology. These authors have also shown that other measures such as the level of scientific publication, expenditure on research and development and performance in the high-technology industrial sector do not seem to work better. Patents remain, as Stern et al. (1990) say, “the most concrete and comparable measure [of overall technological

performance] across countries and time".[47] The choice of patents granted to both residents and non-residents is motivated by data availability. Data for residents only are not available for the whole period 1950-2000. To take into account a possible bias that could arise by considering patents granted to non-residents and therefore introducing a correlation between this variable and openness I have run the regression with the number of patents granted to residents only for 1970-2000. There is virtually no difference in running the regression with the two measures of technology. This may be motivated by the fact that the fifteen European countries under study do not have a very high share of patents granted to foreigners. Therefore, it seems reasonable to extend the use of this measure to the entire period.

Technology per capita with respect to the leader: I have constructed an indicator of technology that gives the position of the country relative to the technological frontier. That is to say, in each period I have measured the position of each country relative to the country that had the greatest number of patents per capita in the period. I have followed the same procedure in order to determine the position of each country with respect to the leader in terms of GDP per capita.

Democracy: This index measures the level of democracy by considering characteristics such as the existence of competitive and open elections, human rights protection, limitations on power holders. It has been taken from Marshall and Jaggers (2000) and Meyer and Schofer (2005a) from whom I have received these data. It can take a value from -10 ("strongly autocratic regime") to +10 ("strongly democratic regime"). It seems to be a better indicator than the dummy variable that is commonly used in the literature and that takes the value of "1" if there is a democratic regime and "0" otherwise. For it allows the analysis of the more subtle differences that characterize different democratic regimes.

[47] Stern et al. (2000), p.18.

Ethnic: measures the ethnic fractionalization of a given country. It is an index that provides a measure of the fractionalization in terms of national, linguistic, religious and cultural characteristics of a population. It does provide a good measure of the complexity of a given society and it has been created and extensively used in the literature to measure the degree of competition of different ethnic groups in a given population. It seems to be the best available indicator. The index I will use has been derived from Taylor and Hudson (1973). It distinguishesfractionalization from diversity. In the existing literature[48] it has been used as an indicator of the competition between ethnic groups even though there are cases where a great ethnic heterogeneity does not necessarily coincide with a greater level of competition between ethnic groups.[49]

4.2 Descriptive statistics

I start by looking at some statistics and how they have changed over the period 1950-2000 in the fifteen European countries under study. The evolution of average years of school, GDP per capita and technology per capita over the period 1950-2000 can be observed in table 2.

[48] See for example Olzak and Tsutsui (1998) and Rosh (1987).
[49] There are many examples in support of this claim such as the multi-ethnic Swiss society as well as the United Kingdom after the waves of immigration from India and Pakistan during the 1950s and 1960s.

Table 2. Evolution of Average years of school, GDP per capita and Technology per capita, 1950-2000, (1950=100)

	Avg Years School*				**Real GDP per capita**				**Technology per capita****			
Country	level 1950	1970	1990	2000	level 1950	1970	1990	2000	level 1950	1970	1990	2000
Austria	6.54	127	155	167	4213.72	265	470	562	0.339	346	480	409
Belgium	5.84	128	160	173	6099.82	199	326	390	0.838	212	158	141
Denmark	7.25	125	150	162	8423.95	190	259	316	0.356	192	130	446
Finland	5.23	141	194	210	5026.91	227	403	473	0.180	166	275	274
France	5.14	136	181	190	5428.66	227	369	412	0.412	120	145	145
Greece	4.29	139	184	208	2792.56	302	429	523	0.060	548	324	957
Ireland	5.99	123	149	160	4265.51	170	332	618	0.160	167	152	979
Italy	3.91	150	204	235	4042.98	272	470	531	0.147	372	213	293
Netherlands	6.89	124	150	160	6948.53	192	280	350	0.212	91	530	504
Norway	7.28	126	156	164	6632.66	169	309	409	0.499	127	126	108
Portugal	1.62	200	314	387	2216.42	284	555	718	0.088	266	65	726
Spain	4.28	136	175	197	2829.70	320	512	638	0.150	145	130	264
Sweden	7.14	125	154	157	7624.51	194	273	310	0.501	339	371	310
Switzerland	9.88	113	126	129	10451.40	197	250	253	1.435	195	168	119
UK	6.73	134	167	188	7524.62	157	240	290	0.268	277	210	212
US	8.93	117	137	140	10702.59	153	247	311	0.283	113	128	197
Mean EU[50]	*5.87*				*5634.80*				*0.376*			
Standard Deviation EU	*1.86*				*2126.63*				*0.344*			
Coefficient of Variation EU	*0.32*				*0.38*				*0.915*			

Source: Cohen and Soto (2001), Penn World Tables (2002) and WIPO (2005).
Note: * Years of schooling of the population aged 25 and over who is studying or not.
** Number of patents for inventions granted each year to residents and non-residents per capita

[50] The mean and the other descriptive statistics have been calculated for the 15 European countries presented in the table.

The table shows how average years of school, GDP per capita and technology per capita have changed since 1950. I examine a stock variable related to human capital such as the average years of school in order to avoid problems of comparability that can arise by using the flow variables. With such flow variables as enrolment rates, differences in national classifications could produce a misleading comparison. International agencies such as the UNESCO divide the number of students enrolled at a certain schooling level by the cohort of the same age group across countries without taking into account the differences that may arise in different schooling systems. By using this approach, rates greater than 100[51] can be found. This type of data are an important but not accurate source of information. This is why I prefer using stock variables such as average years of schooling here and completed primary, secondary and higher education later. The shortcomings that may arise by using flow variables to measure education have been explained in detail in the previous chapter. Average years of schooling have been measured by Cohen and Soto (2001) as the years of schooling of the population aged 25 and over, whether studying or not. In 1950, the United States had higher average years of schooling, 8.93, than the average for the 15 European countries, 5.87. Switzerland was an exception among European countries as the average years of schooling were 9.88 in 1950. According to Marlow-Ferguson (2002), the United States "emerged from the Second World War as the unchallenged leader of educational initiative".[52]

This indicator of human capital has increased over the period 1950-2000 in every country. The increase has been more important in the "olive belt" countries, like Portugal, Italy, Spain and Greece. These are also the countries that had the lowest average years of schooling in 1950: 2.21 in Portugal, 4.86 in Italy, 4.72 in Spain and 4.82 in Greece.

[51] Rates greater than 100 are also found because the number of students who repeat a year of schooling are not separated from those who are enrolled for the first time.
[52] Marlow-Ferguson (2002), p.11.

On the other hand, the lowest growth in terms of average years of schooling was in Switzerland, which, as already indicated, had been a "pioneer in popular education"[53] as Tortella (1994) notes. In other countries such as Austria, Denmark, Ireland, Sweden, where the average years were already quite high (with the exception of Ireland), growth has been below 50 percent with respect to 1950.

GDP per capita has grown very fast. The increase of GDP per capita again has been faster in countries that started at very low levels such as Portugal, Spain, Italy and Greece but also in countries like Austria and Finland. The lowest growth rates were over the period in the United Kingdom, Switzerland and Denmark. In 1950 the per capita GDP of the United States, at $10702.59, was higher not only than the European average of $5634.80 but also than that of any individual European country.[54]

The evolution of technology, measured by using the number of patents per capita granted every year to the residents and non-residents of the country, is not uniform. Belgium, Denmark, Greece, Italy, Portugal, Spain, Switzerland and the United Kingdom experienced an increase in the number of patents per capita granted over 1950-70 and a subsequent decrease over 1970-2000. In the remaining countries the number of patents granted has increased over time. The greatest increase has been in Austria, Netherlands and Sweden. In Europe, France and the United Kingdom had the greatest number of patents granted per capita in 1950 and again in 2000. On the other hand, the United States did not have the most patents per capita in 1950 but they had the greatest absolute number of patents granted during the entire half century.

It is clear from the account above that there are two groups of countries that have followed a different pattern of development: the

[53] Tortella (1994), p.10.
[54] International dollars in 1996 constant prices.

northern and southern. This is not a new classification but has been introduced by economic historians like Sandberg (1982) and Tortella (1994). The latter author identifies a “Latin pattern of modernization”[55] characterized by economic backwardness in the nineteenth century and a rapid catch-up since the 1950s. Following this argument and Abramovitz (1986)’ s analysis, one could argue that many factors contributed to the rapid recovery and extraordinary development of these economies over the second half of the twentieth century. Among these were removal of institutional barriers, the end of authoritarian regimes, greater openness to foreign trade and in general the creation of the appropriate institutional and economic conditions for creating modern states. These factors and many others allowed the less developed Western European countries to reach a “virtuous cycle” characterized by an expansion of education, the adoption of more advanced technologies and sustained economic growth.

[55] Tortella (1994), p.4.

Table 3. Share of the population according to the highest level of completed education,[56] 1960-2000

	Completed Primary			**Completed Secondary**			**Completed Higher**		
Country	1960	1980	2000	1960	1980	2000	1960	1980	2000
Austria	0.40	0.19	0.04	0.24	0.42	0.51	0.04	0.06	0.09
Belgium	0.62	0.45	0.30	0.09	0.16	0.27	0.04	0.11	0.21
Denmark	0.56	0.23	0.04	0.14	0.28	0.45	0.04	0.13	0.21
Finland	0.85	0.52	0.26	0.01	0.26	0.33	0.04	0.12	0.25
France	0.84	0.53	0.32	0.08	0.21	0.33	0.03	0.09	0.17
Greece	0.65	0.66	0.50	0.07	0.12	0.22	0.02	0.06	0.13
Ireland	0.76	0.56	0.37	0.08	0.15	0.27	0.04	0.10	0.18
Italy	0.77	0.62	0.37	0.03	0.11	0.24	0.02	0.04	0.07
Netherlands	0.69	0.39	0.19	0.13	0.26	0.37	0.05	0.14	0.21
Norway	0.59	0.27	0.06	0.19	0.37	0.50	0.05	0.15	0.22
Portugal	0.22	0.41	0.44	0.01	0.04	0.08	0.01	0.03	0.08
Spain	0.74	0.75	0.50	0.02	0.05	0.11	0.03	0.06	0.16
Sweden	0.63	0.30	0.20	0.11	0.26	0.45	0.06	0.16	0.11
Switzerland	0.30	0.12	0.03	0.40	0.51	0.55	0.07	0.15	0.20
United Kingdom	0.64	0.29	0.05	0.13	0.30	0.53	0.05	0.11	0.21
United States	0.41	0.19	0.07	0.31	0.41	0.51	0.15	0.28	0.32
Mean EU[57]	*0.62*	*0.42*	*0.24*	*0.12*	*0.23*	*0.35*	*0.04*	*0.10*	*0.17*
Standard Deviation EU	*0.03*	*0.18*	*0.03*	*0.10*	*0.13*	*0.02*	*0.02*	*0.04*	*0.06*
Coefficient of Variation EU	*0.05*	*0.43*	*0.13*	*0.83*	*0.57*	*0.06*	*0.50*	*0.40*	*0.35*

Source: Cohen and Soto Database (2001)

As a general trend it can be observed from table 3 that the United States clearly had a greater stock of human capital over 1960-2000 than the European average. The only exception was Switzerland, where the share of the population completing secondary education was higher than in the United States throughout the period. Yet, the Swiss completion rate of higher education remained much lower than in the United States.

[56] The three indicators are calculated as the percentage of population aged 25 or over who completed primary, secondary and higher education respectively.
[57] The mean and the other descriptive statistics have been calculated for the 15 European countries presented in the table.

European countries had relatively low rates of completion of secondary and higher education in 1960. However, it can be observed that the European population has become progressively more educated over the period examined. Thus, the share of the population who only completed primary education has decreased, except in Portugal where the achievement of primary education has increased over time. This is probably because Portugal had the greatest share of population with no schooling at the beginning of the period. This was 58 percent in 1960 and it declined to 18 percent in 2000.[58] On the other hand, the share of the population that completed secondary and higher education has increased. The growth of attainment at secondary level has been more notable than the increase in higher education. It is the expansion of secondary education that really characterizes the European experience of the last 55 years. The Nordic countries, Belgium, the Netherlands, Switzerland and the United Kingdom are the countries where at least 20 percent of the population had completed higher education in 2000. Italy and Portugal started with a very small share of the population that had completed higher education and the completion rate remained below 10 percent in 2000.

Again from this table it is possible to recognize a distinctive pattern of schooling expansion in southern Europe. In 1960, these were the countries with the highest share of the population with no schooling experience[59] and the lowest share of the population that has completed secondary and higher education. This is not surprising if one observes the evolution of the spread of literacy across European countries over the nineteenth century.[60] Many factors, cultural, religious and economic have been considered as part of the explanation for this retardation.

[58] The data related to the share of the population with “no schooling” is presented in Cohen and Soto (2001).
[59] Data related to the share of the population with “no schooling” experience that are not presented here are extracted from Cohen and Soto (2001).
[60] Data related to literacy are available in Cipolla (1969), Maynes (1985) and Tortella (1994).

However, equally striking is the catch-up that has occurred in the forty years considered. These countries have got closer to the levels of schooling of the more advanced countries in the sample and the catch-up in schooling participation has been particularly important for Italy.

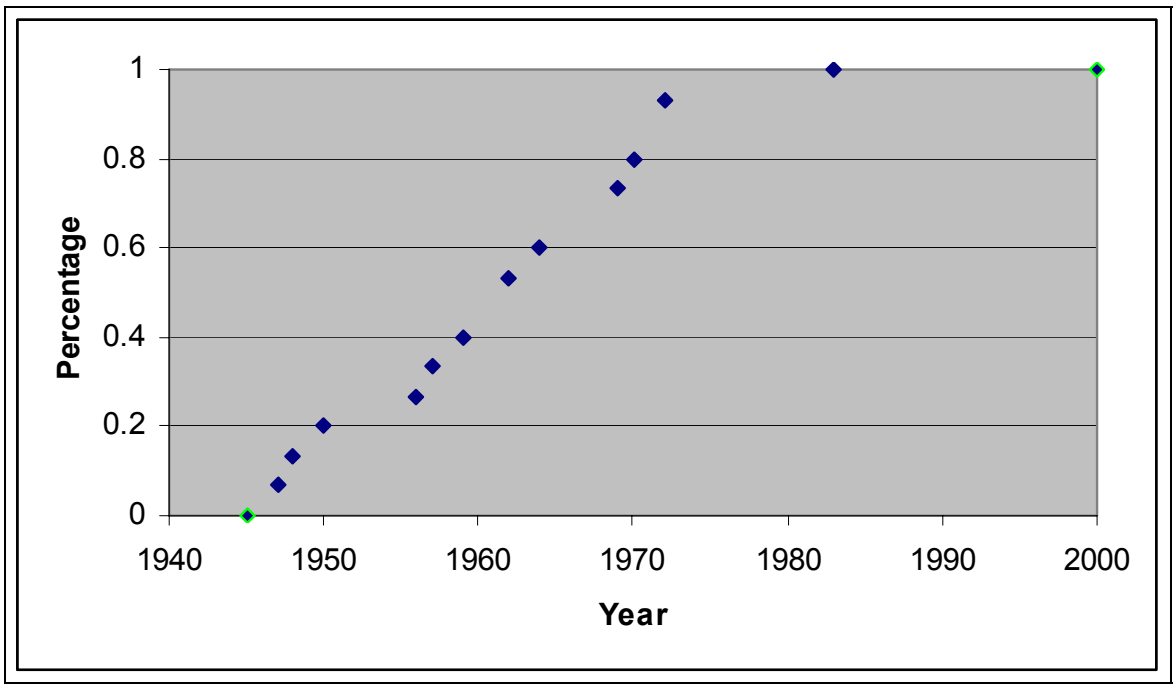
Having examined the characteristics of the individual countries, I divide the period into three sub-periods. The focus will be on the first passage of the compulsory schooling law. The interest of this is whether countries that have passed the law for the first time in different periods also have dissimilar characteristics. The three periods considered are 1950-57, 1958-69 and 1970-2000.[61] This division has been adopted in order to have a balanced number of countries in each sub-group.[62] I will call the countries that raised compulsory schooling laws for the first time during the first period "leaders", those countries that increased the school-leaving age in the second period "followers". In the last period I have the remaining countries that passed the law. These are defined as "late" countries. The distribution of the first passage of the school-leaving age law is the following:[63] over 1950-57 five countries expanded compulsory schooling, in 1958-69 six countries, whereas over 1970-2000, four countries increased the number of years of compulsory education. The first change of the school-leaving age of the European countries I examine was mainly concentrated in the 25 years following the end of the war. This can be seen from the cumulative density function below.

[61] To avoid any bias in the choice of the sub-groups, the same analysis has been carried out by choosing different samples. For instance, by dividing the overall period in three sub-periods of equal length and in another attempt by taking the median as cut-off point for the first sub-period. The analysis has been undertaken without obtaining significantly different results.

[62] It has not been possible to include exactly 5 countries in each sub-group. This is because in 1969 both the Netherlands and Norway increased the school-leaving age. Therefore, in the first sub-period there are 5 countries, 6 in the second and the remaining 4 are included in the last sub-period.

[63] The United Kingdom and Italy have been included in the first group as the first change in compulsory schooling law occurred in 1947 and 1948 respectively.

Figure 3 The cumulative density function of the first SLALAW, 1945-2000



The division into three sub-periods is motivated by the need for a counterfactual. To analyze whether countries that have passed the law in a given period have different features from those that have not passed the law in the same period I need to compare the summary statistics of the two groups of countries. By dividing the overall period in three according to the first passage of the law, in the two sub-periods 1950-1957 and 1958-1969 I will have both countries that passed the law and others that did not. Having created these samples I now carry out the following analysis: I examine the first two sub-periods and consider the two groups of countries: those that passed the law and those that did not. In the second period I remove from the sample the countries that passed the law before 1958. For some of the variables that will be considered later in the regression analysis, I examine whether there is a significant difference between the countries that did and did not pass the law in the first and second period respectively. To do this I examine whether the mean of the two samples is significantly different. This

analysis gives the possibility of having a first perception of what variables may explain the policy change. Moreover, it would be possible to see whether some variables could have an impact on the enactment of the law in the first period and not in the second and vice versa. The results of the computation are shown in table 4.

Table 4. Summary statistics of the two sub-periods: 1950-1957 and 1958-1969

	Period 1950-1957						**Period 1958-1969**					
Variables	**Slalaw = 0**			**Slalaw ≥ 1**			**Slalaw = 0**			**Slalaw ≥ 1**		
	Mean	StdDev		Mean	StdDev	t-test	Mean	StdDev		Mean	StdDev	t-test
GDP_{pc}/GDP_{pcUS}[64]	51.79	17.44		81.83	33.70	2.77	62.95	18.19		66.25	14.84	-1.03
$Technology_{pc}$	0.41	0.29		1.14	0.71	3.22	0.55	0.47		0.78	0.33	3.04
LfIndustry	33.66	7.65		42.23	9.60	2.72	36.34	6.90		37.67	6.51	1.00
State Capacity	2.18	0.37		2.30	0.25	1.35	2.39	0.34		2.67	0.29	4.56
GINI	35.89	9.39		33.54	7.37	0.92	34.87	5.39		36.63	8.52	1.13
Illiteracy	7.66	11.60		9.11	16.33	0.27	4.41	5.82		4.00	5.34	-0.34
AvgYearsSchool	6.08	1.51		8.14	3.34	1.93	7.22	1.14		7.26	1.10	-0.18
CompSchool50	6.91	1.30		7.00	2.11	0.13	7.00	0.83		7.34	0.80	2.09
Observations	93			11			85			35		

[64] It is calculated as the GDP per capita relative to the United States, where the value for the United States is converted to 100.

I proceed by examining GDP per capita with respect to the United States (GDP_{pc}/GDP_{pcUS}). This is because it seems interesting to examine the relative position of the European countries with respect to the Western country that was the richest at the end of the Second World War and that has also remained the technological leader. It is possible to observe that in the first period the mean of this variable is significantly different between the group of countries that passed the law and those that did not (at 5 percent level). This shows that countries that passed the law in the first period were closer to the United States in terms of GDP per capita than those that did not. This would support the interpretation that wealthy states tended to pass the first school-leaving age law earlier because they could face the economic and social cost related to the schooling expansion. In the second period the difference is no longer significant. In order to draw this conclusion, an independent group t-test has been performed to determine if the difference of the mean of the two samples is significant. I have also controlled for the possibility that a single country was driving the results I have found. I follow the same procedure for the other variables.

By examining technology per capita ($Technology_{pc}$), it is possible to notice that this variable is significantly different between countries that increased compulsory schooling and those that did not. In both periods countries that augmented the school-leaving age for the first time had a higher level of technology per capita with respect to those that did not.

On the other hand, the share of the labour force in the industrial sector (LfIndustry) is only significant in the first period. Countries that passed the law between 1950 and 1957 had a greater share of the labour force working in industry than those that did not. This could be because countries with a greater share of the labour force moving toward the more advanced sectors of the economy were also those that needed to upgrade the skills of the population.

State capacity is only significant in the second period. This indicates that the countries that enacted the schooling legislation during 1958-1969 were those with a greater ratio of economically active population to school-age population. The Gini coefficient (GINI), illiteracy (Illiteracy) and average years of schooling (AverageYearsSchool) are never statistically different between the countries that passed the law and those that did not.

On the other hand, the variable number of years of compulsory schooling in 1950 (CompSchool50) is statistically different between the two groups of countries in the second period. Countries that passed the law in the second period had a greater number of years of compulsory schooling in 1950 than those that did not.

These are only statistical results that provide an initial thought on the possible determinants of the passage of the school-leaving age laws in the European countries. A more accurate analysis, to try to establish causality, will be carried out in the next section, in which the different theories previously described will be tested against each other through regression analysis.

4.3 Regression analysis

The model

The analysis will be carried out by using the panel data technique and a duration model. Duration analysis has recently become a key tool in economic investigation. This is because many events of interest for economists are related to the length of time before an event occurs.[65] Before being introduced in the economic field, these analytical techniques were mainly used in industrial engineering and biomedical sciences.[66] They were used in medicine to test the rate of survival of

[65] Wooldridge (2002), p.685. The author argues that "some response variable in economics come in the form of a duration, which is the time elapsed until a certain event occurs".
[66] Kiefer (1988), p.647.

patients after a transplant by examining a set of variables, both constant and time varying, that might have affected the rate of survival of patients. This justifies the original name “survival analysis”.

Survival analysis asks: “what is the fraction of the population which will survive past a certain time? Of those that survive, at what rate will they die or fail? ... How do particular circumstances or characteristics increase or decrease the odds of survival?”[67] These are precisely the questions I am concerned with in the context of school-leaving age laws. Moreover, the interest of the analysis relies on trying to understand why some countries increased compulsory schooling before others. Therefore, what really matters in this kind of investigation are the conditions existing before the passage of the law. To understand this, it is necessary to examine the impact of the covariates[68] on the likelihood of the passage of the law and this is precisely what the duration models measure. The duration model I will use belongs to a set of techniques that are now extensively used in this kind of policy studies. For instance, Fishback and Kantor (1998, 2000) used these methodologies in order to study the passage of the Workers’ Compensation Laws in the United States. Also, Chen (2001) has used a discrete-time logit model in order to study the determinants of the passage of the State Fair Employment Legislation in the American states over the period 1945-1964 whereas Box-Steffensmeier and Zorn (1998) used the Cox parametric approach in order to study the pattern of retirement among the justices of the U.S. Supreme Court over the period 1789-1993.

The reason why these models have become widely used in applied research is because they solve many of the shortcomings of the traditional models.[69]

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[67] Elandt-Johnson and Johnson (1980; 1999), definition of survival analysis.
[68] “Covariates” are the independent variables in duration analysis.
[69] Jenkins (2005), provides an exhaustive analysis of the limitations of the traditional models which has inspired my discussion.

What is necessary to take into account for the empirical analysis is the specific nature of the dependent variable, the possibility of countries enacting the law more than once and the time varying covariates. These are some features of the duration models that make them the best candidate to explain the educational policy change that occurred in Europe after the war. As Jenkins (2005) suggests, what is needed is to measure the "chances of making a transition out of the current state at each time period conditional on survival up to that point".[70] This is done by using a function that measures the probability that a country will pass the law given the fact that it has not done so in the previous period. This is known as the "hazard rate".

If we define T,[71] the duration variable, as the random variable that characterizes the time of the passage of the law, and t as the time variable, we can also define the cumulative probability of T as:

$$F(t) = Pr(T \leq t), \quad t \geq 0$$

Therefore F(t) measures the probability that a country passes the law before or at time t. The survival function, that is the complement of the cumulative distribution function, measures the probability that the law has been passed after t. It is derived as follows:

$$S(t) = P(T>t) = 1 - P(T \leq t) = 1 - F(t) = Pr(T>t)$$

where:

$$0 \leq S(t) \leq 1$$

$$S(0) = 1 \text{ and } S(\infty) = 0$$

[70] Jenkins (2005), p.10.
[71] This notation is commonly used in the existing literature for instance by Heckman and Singer (1985) and Wooldridge (2002).

The quantitative analysis of the survival data implies the use of the hazard rate function. This is estimated as the probability of failure conditional on surviving up until that point.

The conditional failure rate will be:

$$h(t) = f(t) / (1 - F(t))$$
$$= f(t)/S(t)$$

where:

$$f(t) = (dF/dt)\,(t)$$

Having defined the main concepts of Survival analysis I will describe the model I will use for the estimation. The choice of the model depends on the nature of the data and the underlying distribution of the hazard rate. Models can be continuous or discrete and parametric, semi-parametric or non-parametric respectively. As Lancaster (1992) comments, "there exists a whole family of parametric distributions".[72]

However, given the nature of my data and the fact that I do not know the exact distribution of the hazard rate, I will use a semi-parametric model, the Cox proportional hazard. This model was introduced by Cox (1972) and has been widely used in the literature to examine the impact of different variables on the time taken for a particular event to occur. The model is semi-parametric, because it does not impose any parameter on the functional form of the hazard rate. It is only assumed that the effect of the different variables on the passage of the law is constant over time and additive. This implies that the model assumes a parametric form on the effect of the variables on the hazard but it does not impose any structure on the hazard rate. The other assumption of the model is the exogeneity of the time fixed and time-varying covariates over time. This implies that the future values of time-varying and time-fixed covariates are independent of the current values

[72] Lancaster (1992), p.34.

of the dependent variable. This implies that the following propositions have to hold true:

$$\forall s \geq t, \quad E(Z_{i,s} \mid h_{i,t}) = 0$$
$$\forall s \geq t, \quad E(X_{i,s} \mid h_{i,t}) = 0$$

The model also requires data to be continuous. A partial estimation with discrete data can be carried out by re-arranging the original dataset. However, as Heckman and Singer (1985) argue, it is better to use continuous data as the discrete Cox model would be implemented by using a logit model. In order to use this model for the estimation I have checked that the initial assumptions hold. I have continuous data, annual data from 1950 until 2000 and it is correct to consider the hazard as proportional.

This is the specification of the hazard function of the Cox proportional hazard model:

$$h_{i,t} = h_{0,t}\, e^{[X_i \alpha + Z_{i,t} \beta]}$$

where:

$h_{i,t}$ is the duration variable

$h_{0,t}$ is the baseline hazard function that is left unspecified

X_i is the vector of the time fixed covariates

$Z_{i,t}$ is the vector of the time-varying covariates

α, β are the coefficients to be estimated

The exponential distribution of the survival times derives from the assumption of constant hazard. By taking the log transformation and by expanding the model, the previous equation becomes:

$$\log h_{i,t} = \log h_{0,t} + \alpha_1 x_{i1} + \alpha_2 x_{i2} + \ldots + \alpha_k x_{ik} + \beta_1 z_{i1,t} + \beta_2 z_{i2,t} + \ldots + \beta_k z_{ik,t}$$

The dependent variable is the duration variable that reflects the timing of the passage of the law. Among the covariates there are constant variables and time-varying variables. To facilitate the understanding of the results I have transformed the hazard ratios in traditional regression coefficients so that it is possible to read the coefficients as in standard regressions. However, the interpretation of the coefficients is slightly different from other regressions and requires a clarification. If a coefficient is significant and positive it means that the covariate considered made the change in schooling legislation more likely to happen. On the other hand, a negative coefficient means that the covariate had a negative impact on the passage of the law, reducing the likelihood of a rise in compulsory schooling. Therefore, what these coefficients measure is the impact of the covariate on the likelihood of the passage of the law. In the estimation I have considered the multiple passages of the school-leaving age laws as well as the possibility of ties by adopting the Breslow specification. In addition, in order to take into account country-specific features that may be relevant for the outcome variable under study, fixed effects will be included in the panel regression. This helps in this kind of cross-country studies (Wei and Wu 2002).

Empirical Results

I have used the model described above to test the theories presented in section 3 in order to establish which one provides the best explanation for the rise of compulsory schooling that has characterized the European experience in education policy in the post-war period. I have run the regressions by using a number of specifications: starting with the fifteen countries over 1950-2000. After, I have divided the time

period in two according to the median of the total number of passages of the school-leaving age law, that is 1970. Consequently, I run a regression that covers 1950-1970 and another from 1971 until 2000. Finally, I have divided the sample of countries in two according to the level of backwardness with respect to human capital. That is to say, I have divided the countries in two groups according to the initial level of average years of schooling, rate of completion of different levels of education and the number of years of compulsory schooling in 1950. The descriptive statistics in an earlier section have also discussed the pattern of development of human capital that has characterized the experience of Southern European countries since 1945. This is the reason why the first group comprises the less developed countries: Greece, Ireland, Italy, Portugal and Spain. The second group comprises the more advanced countries: Austria, Belgium, Denmark, Finland, France, Netherlands, Norway, Sweden, Switzerland and the United Kingdom. Italy is not usually included in the group of backward countries. However, at the end of the Second World War Italy had a very low level of human capital stock characterized by a high rate of illiteracy. In 1951 the rate of illiteracy was 12.9 percent but it fell to 4.5 percent in 1976.[73] This is why I decided to include Italy among the less advanced countries. A further aim behind this organization of the empirical analysis is that it is important to identify the overall trend. Also, it is important to test whether some theories can provide a satisfactory explanation for one historical period but maybe not for the next.

To assess the goodness of fit of the model it has not been possible to use the traditional regression diagnostics. This is because the Cox model fits the maximum likelihood hazard on survival time data. To avoid problems that may have arisen as a result of the fact that failure times are rather broadly grouped because yearly observations have been used, the robust variance estimator has been used following

[73] Kurian (1988), p.650.

the method developed by Lin and Wei (1989). Consequently all the standard errors in the regressions have been expressed by means of "robust standard errors". This methodology provides more consistent estimations of the standard errors than the conventional variance-covariance matrix (Guo and Lin 1994).[74] I have estimated these "robust standard errors" for every regression.

What can be done to examine the suitability of the model is to analyse the residuals. Thus I have computed the Cox-Snell residuals. To do this Martingale residuals were calculated as a prerequisite of calculating the Cox-Snell residuals. These residuals were plotted against a reference 45° line. In each of the regressions that will be presented the pattern of the residuals follows quite closely the reference line. This is why these results are shown and can be considered as satisfactory for the regression diagnostics. Also, the pseudo-likelihood is an indicator that can only be used to make comparisons between different estimations of the model but the absolute value does not have any meaning.

I proceed now by estimating the following Cox proportional hazard model:

$$\log h_{i,t} = \log h_{0,t} + \alpha_1 YearsComp50 + \beta_1 GDP_{pc} + \beta_2 Technology_{pc} + \beta_3 Open*Tech + \beta_4\, pop014 + \beta_5 Illiteracy + \beta_6 Democracy + \beta_7 GINI + \beta_8 Ethnic + \beta_9 LfAgriculture + \beta_{10} LfServices + \beta_{11} StateCapacity + \beta_{12} AvgYearsSchool + \beta_{13}(l(GDP_{pc}/GDP_{pc(-1)}))$$

This specification of the model allows testing the three theories against each other. The first regression covers 1950-2000 whereas the other two cover period 1950-1970 and 1971-2000 respectively. This division of the sample in two sub-periods is motivated by the following reasoning. The year 1970 coincides with the median of the number of passages of the school-leaving age laws for the fifteen European

[74] Guo and Lin (1994), p.632.

countries studied over 1950-2000. It is also an important date in economic history because it is close to the end of the Golden Age, a period during which most European countries grew at an extraordinary pace. In this context, it would be interesting to examine whether a theory that provides a good explanation for the changes in compulsory schooling laws over 1950-1970 is also the theory that has the greatest explanatory power in the subsequent period. Table 5 presented in the next page shows the results of the estimation.

Table 5. Estimation results 15 European countries, 1950-2000

Theories[75]	(1-2-3)	(1-2-3)	(1-2-3)
Time period	1950-2000	1950-1970	1971-2000
Dependent variable	_t	_t	_t
GDP_{pc}	0.118	-6.271	0.980
	(1.29)	(7.07)	(3.76)
$Technology_{pc}$	-3.280**	7.860	-3.565**
	(1.43)	(9.81)	(1.60)
Open*Tech	0.0215**	-0.307	0.0206**
	(0.0096)	(0.31)	(0.0087)
pop014	0.0572	0.492	0.284
	(0.23)	(1.34)	(0.50)
Illiteracy	0.0557	0.00512	0.225
	(0.085)	(0.25)	(0.25)
YearsComp50	-0.103	-1.173	0.107
	(0.14)	(0.83)	(0.20)
Democracy	0.0608	0.214	2.014
	(0.073)	(0.15)	(1.39)
GINI	-0.0302	0.00109	-0.0462
	(0.039)	(0.090)	(0.046)
Ethnic	0.000463	0.0106	-0.00120
	(0.0091)	(0.066)	(0.022)
LfAgriculture	-0.0361	-0.116	-0.104
	(0.048)	(0.23)	(0.13)
LlfServices	-0.0745**	-0.0606**	-0.107**
	(0.091)	(0.24)	(0.11)
StateCapacity	1.046	6.209	1.676
	(1.67)	(11.1)	(2.55)
AvgYearsSchool	0.223	0.729	0.238
	(0.38)	(2.00)	(0.49)
$l(GDP/GDP_{(-1)})$	-11.04	22.31**	-3.992
	(7.46)	(8.72)	(22.7)
Observations	749	300	449
Pseudo log-likelihood	-50.62	-20.17	-23.82

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

[75]Note: Theory 1:modernization theory
Theory 2: political-economy theory
Theory 3: role of the state theory
This notation is used for the next estimations

The results of the continuous time, Cox proportional hazard model estimation show that when the whole period is considered, the theory of modernization seems to provide the better explanation. The coefficient of technology per capita is significant at 5 percent level and with the negative sign as suggested by the theory. It indicates that the greater is the level of technology of a country the lower is the probability that the country will raise compulsory schooling. This implies that one feature common to the European countries that passed the law was the low level of technology. This is consistent with the modernization theory that states that as countries modernize and the production becomes more complex, then countries need to endow the labour force with a greater level of skills. Therefore, these results may be an indicator that governments perceived the technological gap and increased the number of years of compulsory schooling in order to endow the future labour force with the skills necessary for the adoption of more advanced technologies. This may have been the case for many countries included in the sample. Countries like Denmark, Ireland, Italy, Portugal and Spain were agricultural societies until the end of the Second World War. Since then a rapid process of economic development has taken place and the expansion of compulsory schooling may be regarded as a specific consequence of the process of modernization. Moreover, the level of technology per capita has grown at a very high rate over the period 1950-2000 for those countries that started with low levels such as Greece, Ireland and Portugal. Nevertheless, also in countries like Austria, Denmark and the Netherlands the level of technology per capita was in 2000 more than four times greater than the value of 1950, as shown in table 2.

The variable that captures the interaction between openness and technology exhibits a coefficient (0.0215) that is significant at 5 percent level. This shows one of the characteristics of the countries that passed the law. That is to say, the greater openness to foreign trade and the

expectation of adopting more advanced technologies in the future may have induced governments to increase compulsory schooling. This may have been particularly important for some countries. In Ireland, for example, as a result of the greater openness and the perceived role of education as an aid to economic and technological advance, schooling "was to undergo rapid and broadly based change from the mid-1960s onwards".[76] The remaining variables in the regression that are related to the political-economy and role of the State theories are not significant.

In the second estimation, that covers 1950-1970, the only significant variable is GDP per capita growth. We find that the stronger the growth rate in the previous period, the greater has been the impact on the passage of the law. This result is robust when the role of the state theory is tested alone.[77] In this case, also the coefficient of average years of schooling becomes significant and negative. This implies that the lower the schooling level of the population the more likely was the passage of the law. Therefore, over 1950-1970 the role of the state theory provides the best explanation of the passage of the school-leaving age laws. This is consistent with what happened during the Golden Age, as it was a period of fast growth, and with what scholars like Meyer et al. (1979) and Lindert (2004) have argued. However, as explained above, I have tried to model the "contagion effect" in many ways without obtaining significant results.

The third regression concerns the period after the Golden Age, 1971-2000. It can be noticed that the wealth effect disappears and this coincides with the end of the economic boom. In fact, the role of the state theory is no longer the better theory to understand the policy change. According to Marlow-Ferguson (2002), after 1970 Governments disposed of limited resources and there was great competition for the allocation of these resources across the different sectors of the Welfare

[76] Marlow-Ferguson (2002), p.623.
[77] The results of these regressions are shown in the Appendix B.

State.[78] In this case the modernization theory again provides the better explanation. Both coefficients of technology per capita and the interaction between technology and openness are highly significant. Technology is negative, which would suggest that countries with lower levels of technology augmented the school-leaving age because they needed to increase the technological endowment and this required a more educated labour force. This can be understood by the complementarity between compulsory education and the available technologies. Also, the greater openness of this countries and the interaction with technology seem to be an important part of the explanation as it has been found by considering the whole period. On the other hand, the political-economy theory is inconsistent with the empirical evidence.

The last regressions consider the differences between the two groups of countries, the more backward and the more developed. The choice for the division in the two groups has been explained before and it mainly relies on the initial conditions with respect to the human capital stock. This analysis is carried out to understand whether factors that differ across groups of countries have characterized the expansion of school-leaving age. The first estimation is related to Greece, Ireland, Italy, Portugal and Spain whereas in the second regression the remaining countries are included. The results are presented in the following table.

[78] Marlow-Ferguson (2002), p.11.

Table 6. Estimation results 2 groups of European countries, 1950-2000

Theory	(2-3)	(1-2-3)
Group	1	2
Dependent variable	_t	_t
GDP_{pc}		-9.230**
		(4.01)
$Technology_{pc}$		-1.096
		(2.41)
Open*Tech		0.101***
		(0.034)
pop014		1.214
		(1.44)
Illiteracy		7.604
		(5.51)
YearsComp50		2.654***
		(0.92)
Democracy	0.0600	-0.721
	(0.15)	(0.78)
GINI	0.177***	-0.222
	(0.059)	(0.14)
Ethnic	-0.0384	0.162***
	(0.030)	(0.048)
LfAgriculture	-0.0394	0.610**
	(0.030)	(0.28)
LlfServices	0.354***	0.589**
	(0.036)	(0.26)
StateCapacity	-1.835*	20.84
	(1.01)	(16.0)
AvgYearsSchool	0.265	2.950
	(0.44)	(1.83)
$l(GDP_{pc}/GDP_{pc(-1)})$	-20.59*	-58.74*
	(11.4)	(31.0)
Observations	250	499
Pseudo log-likelihooc	-10.60	-14.46

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

For the estimation of the first group of countries, the modernization theory has been excluded as it did not find any empirical support. This is because none of the variables was significant. Between the other two theories, the role of the state theory performs better. In

fact, State Capacity and GDP growth are significant at 1 percent level. The results show that the greater the level of State Capacity, the less likely were these countries to increase compulsory schooling. This is to say that the demographic expansion had a positive impact on the increase of compulsory schooling. According to Baines (1998), the demographic expansion was due to a decline of mortality and a rise in fertility that occurred in all Western countries after the war. However, the high fertility rates did not last long. Whereas in 1950 the fertility rate was above the replacement level, in the 1970s it remained at this level only in Ireland, Spain and Portugal. In the 1990s it became less than two for all the European countries (Baines 1998). This demographic expansion had a major impact on social change and induced Governments to undertake democratic reforms such as the expansion of compulsory schooling.

Moreover, according to the results, the greater the GDP growth in the previous period, the stronger was its impact on the change in legislation. These results seem to suggest that demographic pressure had a positive impact on leading governments to increase compulsory schooling. This may be because governments felt the need to increase the number of years of compulsory schooling in order to shape the level of skills of the future labour force. This was made possible by the high growth rates that allowed countries to bear the cost arising from the schooling expansion. In fact, the substantial increase in compulsory schooling experienced by these countries was concentrated between the end of the Second World War and the end of the Golden Age.

The results of the political-economy theory are worth discussion. Both the Gini coefficient and the share of the labour force in the service sector are significant at 1 percent level. According to these results, income inequality had a negative impact on the passage of the schooling-age laws. The coefficient of the labour force in the service sector is negative and unexpected. According to the political-economy

theory, the share of the labour force in the service sector should have had a positive impact on the passage of the law. This is because higher levels of human capital are necessary in societies that have a more sophisticated system of production and that have a greater proportion of the labour force working in sectors where the nature of the employment is more complex. However, this might be justified by the fact that the nature of services varies according to the level of development of a country. That is to say, in the less developed countries services may have lower human capital intensity than in more advanced countries. Therefore, for these countries a better explanatory variable could be the share of the labour force working in industry. Surprisingly, the variable Democracy does not achieve statistical significance. This runs against the conclusions of qualitative studies showing the importance of democratic institutions for the expansion of schooling.

The last estimation includes the following countries: Austria, Belgium, Denmark, Finland, France, the Netherlands, Norway, Sweden, Switzerland and the United Kingdom. In this context the theory that seems to better explain the rise in school-leaving age is the modernization theory. However, it is not possible to draw a definitive conclusion as also some variables of the other theories are significant and with the expected sign.

Among the variables of the technical-functional theory, the higher the number of years of compulsory schooling at the beginning of the period, the lower was the increase in number of years of compulsory schooling among the countries in the sample. This is consistent with the evidence as countries that had higher levels of compulsory schooling at the end of the Second World War also had less scope for expanding compulsory schooling as it has been shown in figures 1 and 2. GDP per capita has a strong impact on the passage of the school-leaving age laws. It exhibits a negative coefficient (-9.230) and is significant at 5 percent level. This can be explained by the fact that advanced Western

European countries being more likely to invest in higher education as their GDP level increases and less in compulsory education. Because they already had widespread secondary education, instead of using public spending to increase the attendance at secondary school they preferred to invest in higher education in order to create a greater complementarity between the skills of the labour force and high-level technologies.

The findings also indicate the importance of technology per capita once its interaction with openness has been taken into account. The coefficient of openness and technology is negative and highly significant. It may be that the intensified process of globalization and technological innovation have created the need for a different kind of human capital. Instead of additional expansion of compulsory education, that is basic secondary education, in these countries there has been the need for a greater share of highly educated workers in order to implement and develop new technologies. This would support the idea that education policies may be adequate until a certain stage of development is reached but may become inappropriate at a later stage. What is important is that countries like France, the United Kingdom and the Nordic countries have experienced an unprecedented expansion of higher education since 1970 (Gellert 1993).

Concerning the other theories, the coefficient of ethnic fractionalization is significant at 5 percent level and positive. This may be because a positive coefficient reflects greater openness of societies in a more integrated world and this has a positive impact on the expansion of institutions such as compulsory schooling. Or it may be that governments try to ensure that different ethnic groups reach similar levels of compulsory schooling.

The coefficient of services is significant and positive as explained by the theory whereas the coefficient of agriculture is positive, which is unexpected. It is not clear why this coefficient exhibits a positive sign

against what the political-economy theory would predict. With respect to the role of the state theory, the growth rate is significant and it had a positive impact on the passage of the law.

5 Robustness analysis: endogeneity

One could argue that there exists a reverse causality between schooling and technology. That is to say that higher levels of wealth and more advanced technologies create the need for a more educated labour force and this leads to an institutional response in terms of increasing the school-leaving age. On the other hand, higher levels of schooling could create a more prosperous society and lead to the creation of advanced technologies as a result of the greater pool of skilled workers.[79]

I argue that the correlation between technology and the expansion of compulsory schooling reflects only the impact of the former on the latter and not the reverse. To test this I cannot use the tools that are commonly used in the literature to tackle the endogeneity problem such as lagged variables and instrumental variables. This is because the former methodology by using a lagging of explanatory variables relies on temporal requirements of causality. In this case it would not be effective as the passage of the school-leaving age law strongly relies on the fact that compulsory schooling has not been increased before.

The instrumental variable approach does not seem viable in this case as it is very difficult to think of variables correlated with technology but not with the error term. Natural experiments such as the one used by Acemoglu et al. (2005) to show how institutions have an impact on long-run growth by illustrating the outcome of the introduction of very different

[79] In what follows I provide a proof for technology as the problem of reverse causality for GDP and schooling has been extensively studied by scholars (i.e., Barro (1991), Bils and Klenow (2000), etc.). Most results show that faster growth can induce more schooling but a definitive answer has not been reached.

types of institutions in North and South Korea cannot be found in this case. Therefore, the Hausman specification test cannot be used here to test for endogeneity. Thus, it does not seem possible to deal with the problem of endogeneity by using the traditional techniques.

To address the issue I show[80] that only higher education matters for technology and that school-leaving age laws only concern primary and secondary levels of schooling. I do this by demonstrating that the assumption $E(Z_{i,s} \mid h_{i,t}) = 0$ is true. I proceed as follows. First, I regress the level of technology on three schooling variables: completed primary, secondary school and completed higher education. In this case the linear functional form has been assumed. In addition, different functional forms have been tested and lead to the same results.

If I find that only higher education has an impact on technology this would support the hypothesis of absence of endogeneity. This is because the rise in compulsory schooling has occurred at primary and secondary level and if these variables do not have an impact on technology this would falsify the possibility of reverse causality. Moreover, it seems a reasonable assumption as it is the share of workers with higher education that is more likely to work in the research and development sector and to contribute to the advance of technology. The results of the cross-sectional time series with fixed effects are presented in the table below.

[80] This methodology has been suggested by Dr Murtin and Dr Petrongolo, LSE Department of Economics.

Table 7. Results of the cross-sectional time series regression

ti	
constant	-1.783 (0.502)
comprim	0.209 (0.626)
comsec	0.971 (1.077)
comhigh	1.096* (0.645)
Observations	150
Groups	15
R-squared	0.374

Note: ti=ln(technologypc)-T; T=mean(technologypc)
comprim=share of the population that has completed primary school
comsec=share of the population that has completed secondary school
comhigh=share of the population that has completed higher education

From the above results it is possible to observe that only higher education has a positive and significant impact on technology. Therefore, it is possible to reject the hypothesis of endogeneity. This does not mean that primary and secondary school are independent from the technological capacity of a country. As suggested by Aghion et al. (2004), primary and secondary schooling can foster growth when a country is far from the technological frontier, that is to say when a country makes use of “imitative technology”. On the other hand, when a country is closer to the technological frontier, higher education becomes important for growth because it allows the country to develop “innovative technology”. Thus, the expansion of higher education is important for the development of the more advanced technologies and not for the importation of basic technologies from other countries. This is coherent with the explanation provided here as the technological variable used in this study, patents, represents innovative technology only and the empirical results show that it is independent from primary and secondary schooling.

6 Concluding remarks

This paper has addressed the research question: “what have been the determinants of the increase in the number of years of compulsory schooling that has characterized the experience of many European countries since the end of the Second World War?”

I have adopted a new method to deal with this historical issue. I have used a comparative approach by looking at the experience of fifteen European countries over the period 1950-2000, whereas previous analyses have mainly focused on single country experience. Also, I have undertaken an analytical analysis against the descriptive approach of the majority of the existing studies.

To examine the factors that led to the expansion of compulsory schooling, the explanatory power of three theories from the sociology and political science literature has been tested. Empirically, a dataset has been assembled by using a variety of national and international sources. In using it, I have introduced to economic history the technique of survival analysis that is commonly used in medical studies and has been recently used for political economy investigations.

The empirical evidence I have found is in support of the theory of modernization when the overall period is considered. However, during the Golden Age, the unprecedented growth experienced by most European countries had a strong impact on the passage of the school-leaving age laws. The technical-functional theory performs better again after 1970. This is when the technological gap was perceived by European governments as particularly important and the globalization process greatly enhanced the need to modernize the educational system. On the other hand, the more advanced of the fifteen European countries considered soon shifted the focus of their policies to higher education. This is because they already had reached high participation rates in secondary education and the progressive “scientization” of technology required a more educated labour force by creating greater

complementarities between highly educated workers and the new equipment.

The importance of national factors, of “contagion” as well as of the process of European integration in determining the expansion of formal education is acknowledged and it appears to be a promising area for future research.

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Appendix

A) Independent variables

This is the list of the explanatory variables used in the analysis:

Real GDP per capita (GDP_{pc}). Measured in international $ in 1996 constant prices.

Real GDP per capita growth ($l(GDP/GDP_{(-1)})$). Log of the ratio of the current level of GDP to the level of the previous year.

GDP per capita with respect to the United States (GDP_{pc}/GDP_{pcUS}). (US = 100 in each year)

GDP with respect to the leader ($GDP_{pc}/GDP_{pcleader}$). Ratio of the value of GDP per capita for a country to the GDP per capita of the country with the highest level of this at a given year.

Technology per capita ($Technology_{pc}$). Number of patents granted every year to residents and non-residents divided by the population.

Technology with respect to the leader ($TECH_{pc}/TECH_{pcleader}$). Technology per capita divided by the number of patents granted to the country that has the greatest level of technology per capita at a given year.

Openness (OPENNESS). Exports plus imports divided by Gross Domestic Product.

Indicator of openness and technology (Open*Tech). Product: Openness * $Technology_{pc.}$

Population (POP). Population in '000s.

Population according to the age group (pop014; pop1564; pop65above). Share of the population divided according to the age groups: 0-14, 15-64 and 65 and above.

Partial dependency (State Capacity). Ratio of the pop1564 with respect to pop014.

Share of the labour force working in the three sectors of the economy (LFAgriculture; LFIndustry; LFServices). Number of people working in the agricultural, industrial and service sector divided by the total labour force.

Illiteracy (Illiteracy). Share of the population who lacks the basic skills of literacy and numeracy.

Average years of school (AvgYearsSchool). Average number of years of schooling of the population.

Years of compulsory school in 1950 (CompSchool50). Number of years of compulsory schooling in each country at the beginning of the period, 1950.

Share of the population according to the highest level of education completed (Completed Primary, Completed Secondary, Completed Higher). Share of the population according to the highest level of completed education: primary, secondary or higher education.

Democracy (Democracy). Index that can take a value from -10 (when a country is “strongly autocratic”) to +10 (when a country is “strongly democratic”). It is based on features such as: competitive and open elections, absence of autocratic characteristics such as unlimited executive authority.

Ethnic: (Ethnic). The index measures the ethnic composition existing in a country in a given year.

Gini coefficient (GINI). Concentration of the distribution of wealth among the population.

B) Regression results

These are the complete results of which a part is presented in table 3.6, p.154. Regression results, Cox proportional hazard model, 15 countries, 1950-1970 (Austria, Belgium, Denmark, Finland, France, Greece, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom)

Theories Dependent variable	(1-2-3) _t	(1) _t	(2) _t	(3) _t	(1-2) _t	(2-3) _t	(1-3) _t
GDP_{pc}	-6.27	-2.41			-5.78		-1.93
	(7.07)	(2.39)			(4.01)		(2.04)
$Technology_{pc}$	7.86	1.03			2.82		2.58
	(9.81)	(3.13)			(4.20)		(2.96)
Open*Tech	-0.31	-0.08			-0.15		-0.13**
	(0.31)	(0.05)			(0.10)		(0.05)
pop014	0.49	-0.24*			-0.31		-0.0009
	(1.34)	(0.14)			(0.23)		(0.79)
Illiteracy	-0.01	-0.14			-0.09		-0.08
	(0.25)	(0.13)			(0.12)		(0.15)
YearsComp50	-1.17	-0.92*			-1.43**		-0.84
	(0.83)	(0.52)			(0.59)		(0.53)
Democracy	0.21		-0.05*		0.24**	-0.06	
	(0.15)		(0.03)		(0.12)	(0.05)	
GINI	0.001		0.003		0.01	0.008	
	(0.09)		(0.04)		(0.05)	(0.05)	
Ethnic	0.01		-0.02		0.05*	-0.01	
	(0.07)		(0.01)		(0.03)	(0.01)	
LfAgriculture	-0.12		0.01		-0.09	0.04	
	(0.23)		(0.05)		(0.06)	(0.05)	
LlfServices	-0.06		-0.003		-0.05	0.06	
	(0.24)		(0.10)		(0.12)	(0.12)	
StateCapacity	6.21			0.79		1.43	1.98
	(11.1)			(0.96)		(0.96)	(6.27)
AvgYearsSchool	0.73			-0.35**		-0.11	0.36
	(2.00)			(0.15)		(0.32)	(0.57)
$l(GDP_{pc}/GDP_{pc(-1)})$	-22.31**			-18.87**		-19.94**	-22.18***
	(8.72)			(9.32)		(8.28)	(7.08)
Observations	300	300	300	300	300	300	300
Pseudo log-likelihood	-20.17	-22.94	-25.49	-24.78	-21.93	-24.07	-21.25

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
Note: Theory 1: modernization theory; Theory 2: political-economy theory; Theory 3: role of the state theory

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