DOCUMENTOS DE TRABAJO
ISSN 2174-4912

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Èric Gómez-i-Aznar ∝

DT-AEHE N°1904
www.aehe.net

asociación española de historia económica

January 2019

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CAPITAL HUMANO A COMIENZOS DEL SIGLO XVIII EN CATALUÑA: *AGE-HEAPING* Y CAPACIDAD ARITMÉTICA EN UNA ECONOMÍA EN PROCESO DE CAMBIO

Èric Gómez-i-Aznar[‡]

DT- 1904, January 2019
JEL: I21, J24, N33, O10

RESUMEN

Este artículo examina los niveles de *numeracy* de Cataluña en los primeros años del siglo XVIII. La metodología del *age-heaping* se aplica a una fuente, los registros municipales de habitantes (padrons), con menos sesgos que otras fuentes utilizadas en la literatura. Además, esta fuente permite considerar un gran número de observaciones (sobre 6,700) y ofrece una cobertura geográfica sustancial. El estudio del caso catalán es particularmente atractivo debido a la escasa información disponible para el capital humano en el siglo XVIII, un período crucial en la transición de una sociedad preindustrial a una industrial. Los resultados muestran unos elevados niveles de capacidad aritmética a principios del siglo, principalmente en las zonas urbanas y entre las clases medias, con valores cercanos a los de otras partes de Europa occidental. Además, apuntan a cambios en los grupos ocupacionales como un factor clave potencial en la evolución positiva de esta capacidad, siendo un posible buen indicador del aprendizaje en el lugar de trabajo. Los indicadores parciales de riqueza también parecen vincular los niveles de aritmética con el acceso a la igualdad de oportunidades.

Palabras clave: Capital humano, Aritmética, Crecimiento económico, Desigualdad, Cataluña.

ABSTRACT

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This article examines numeracy levels in Catalonia in the first years of the 18th century. The age-heaping methodology is applied to a source, the municipal registers of inhabitants (padrons), which is less biased than other sources commonly used in the literature. Moreover, this source allows considering a large number of observations (over 6,700) and offers a substantial geographical coverage. The study of the Catalan case is particularly appealing due to the scarce information available for human capital in the 18th-century, a crucial period in the transition from a preindustrial to an industrial society. The results show high levels of arithmetic capacity at the beginning of the century, mainly in urban areas and among the middle classes, with values close to those of other parts of Western Europe. In addition, they point to changes in occupational groups as a potential key factor in the positive evolution of this capacity, possibly making it a good indicator of learning in the workplace. Partial indicators of wealth also appear to link numeracy levels with access to equal opportunities.

Keywords: Human Capital, Numeracy, Economic Growth, Inequality, Catalonia.

[‡] PhD student at the University of Barcelona, Spain. E-mail: ericgomezaznar@gmail.com

HUMAN CAPITAL AT THE BEGINNINGS OF THE 18TH CENTURY CATALONIA: AGE-HEAPING AND NUMERACY IN A CHANGING ECONOMY[1, 2]

1.- Introduction

Human capital is regarded as a relevant factor in modern economic growth theories (Romer 1986, Lucas 1988, Mankiw, Romer and Weil 1992, Jones 1995, Glaeser et al 2004, Galor 2011). In contrast, the contribution of human capital in the initial phases of industrialization, and whether it favored the appearance of industrialization in certain regions before others, is one of the most open debates within economic history. The role played by the accumulation of human capital in the very long run and in pre-industrial societies has opposing versions. On the one hand, those who consider that it was minimal (Mitch 1993; Allen 2003; McCloskey 2010) and, on the other, those who claim it had a significant effect (Galor & Weil 2000; Baten & van Zanden 2008; Mokyr 2009; Becker et al 2011).

In order to be able to evaluate the role of human capital in economic growth, a human capital indicator is necessary. The most frequent indicators used to calculate human capital for contemporary periods are years of schooling (Barro and Lee 1996, 2001 and 2013), spending on education (Saint-Paul and Verdier 1993), productivity rises due to education (Woessmann 2003), schooling rate (Becker and Woessman 2009) or PISA test results (Hanushek and Woessman 2010). These data are nonetheless very difficult to obtain for pre-statistical periods both in Europe and in Spain of the Early Modern Period. One of the most frequent indicators is that of literacy reflected in the censuses. For periods prior to 1800, this indicator is obtained by analyzing signature of documents capacity (notarial registers, wedding registers…).

Another indicator used in the modern period is numeracy, which measures one of the basic capacities for economic development: numerical skills for economic and commercial ends. Numeracy, using age heaping as a proxy through the calculation of Whipple and ABCC indices, is considered a good alternative indicator to literacy for those periods such as the Early Modern

[1] PhD student at the University of Barcelona, Department of Economic History and Institutions, Faculty of Economics and Business, Av Diagonal 690, 08034 Barcelona. Address E-mail: ericgomezaznar@gmail.com

[2] I am grateful to my PhD directors Miquel Gutiérrez-Poch and Julio Martinez-Galarraga for their comments, as well as to Dácil Tania Juif and Sara Torregrosa Hetland. My thanks also go to all the participants in the session on 'Numeracy, Human Capital and its Determinants' at the WEHC in Kyoto, and in the seminars of the Economics Institute of the University of the Republic in Montevideo, the Department of Economic History, Institutions, Policy and World Economy of UB, and the UB group Work, Institutions and Gender of the Department of Contemporary History, Universitat de Barcelona.

Period when these sources are scarce or non-existent (A'Hearn, Baten and Crayen 2009; Crayen and Baten 2010; Hippe 2013). In recent years, different academic articles have been published on the levels of arithmetic capacity in some of the regions under the rule of the Hispanic monarchy during the 18th century: Castilla (Tollnek and Baten 2017; Álvarez and Ramos Palencia 2018) and the region of Rio de la Plata (Vicario 2014); in addition to prior articles on Colombia, Mexico and Peru (Manzel, Baten and Stolz 2012) or even for periods preceding the Conquista (Juif and Baten 2013).

This study obtains results for 18th-century Catalonia, the only region in the Mediterranean that was an early follower of the British Industrial Revolution (Vilar 1974). Outlining the evolution of human capital in this region in the long term, and comparing it with other regions of southern and northern Europe, is important in order to help evaluate its role in economic development. Catalonia joined international commerce during the 17th and 18th centuries with a specialization in sectors such as wine and spirits (Valls 2004); and during this period experienced rapid population growth and an intensification in the agricultural and the proto-industrialization sectors (Torras 1994). The latter provided continuity in the organization of production and in human capital, facilitating the future transition to the factory (Marfany 2010).

In Catalonia throughout the 18th century, a model of trade relations became consolidated, turning Catalonia into an open economy. A key factor in the emergence and consolidation of the first cotton manufacturer was the importation of cotton and linen fabric in exchange for Catalan viticulture production (Sánchez 2012). As early as the 19th century, the industrialization process was characterized by the adoption of a modern manufacturing system in the textile sector (Nadal 1975; Sánchez 2000), complemented by other more traditional pioneer sectors (Nadal and Catalán 1994). Therefore, this industrial growth of the 18th century was based on this double process, which facilitated technological adaptation (Feliu 2012, p.92). It is in this context that Catalonia, considered, at the end of the 18th century, as "little England" and Barcelona as the "Catalan Manchester", would end up becoming the "factory of Spain" in the 19th century" (Martinez-Galarraga and Prat 2016).

The main contribution of this article is the obtaining of levels of arithmetic capacity in 18th-century Catalonia via a new source: local municipal registers (*padrons*). These registers contain information for calculating the age heaping of all the male population (in some cases, the female population as well) of a municipality. In contrast to other sources used for this period, such as military lists, tax information or hospital registers, this source reduces possible biases, since it encompasses all age groups, occupations, and social classes[3]. Furthermore, it registers all of the population (at least male) in a locality, regardless of their social and economic status,

[3] The only exception is the registers that do not include the clergy.

making it possible to solve the problem of under-representation of the lowest classes or tax evasion, which can be found in other sources from the Early Modern Period[4].

The sample used in this article acquires information from thirteen different Catalan municipalities (which cover ten of the twelve administrative divisions of the period) around the 1720s. Although the geographical coverage of the sample is somewhat limited, its importance lies in that it allows us to use information for a period for which we have very few human capital indicators. More importantly, with over 14,000 observations (of which 6,639 are considered to calculate numeracy levels), it is a large data set to compute numeracy levels that additionally provides information per sector of activity, occupation, property and gender. This allows us to obtain a numerical indicator to be able to evaluate its development in the long run, and make the comparison with other European regions.

This article is organized in the following manner: section two deals with an overview of the existing literature. In the third part we explain the methodology used and the means of calculating age heaping. We also describe the source, the content and the means of obtaining the information, and the localities that make up our sample. In section four we present the results obtained and finally, a conclusion sums up the paper.

2.- Literature Review

2.1.- Human capital in Europe during the Early Modern Period

Evaluating the evolution of human capital in the long run is complicated by the difficulty of finding indicators. The concept of human capital is broad and comprises all of those abilities necessary for carrying out economic activity. The limitation of sources means that partial indicators are commonly used. Furthermore, outside of northern and central Europe it often becomes still more difficult to obtain comparable, homogeneous data such as rates of school registration between 1830 and 1910 (Lindert 2004) or schooling and literacy since 1870 (Crafts 1996).

Literacy can be measured with different techniques, but the most important are the historical censuses that reflect reading and writing ability. In the absence of this information for more remote periods in time, the proportion of people with the capacity to sign notarial documents or marriage registers is used. There are enormous differences among regions in literacy data for fifteen European regions for around 1800 (Reis 2005)[5]. This disparity and the

[4] Vicario (2014) uses a similar source to analyze the characteristics of human capital in the region of Rio de la Plata for the 1744-1858 period. For her study she uses local population censuses.

[5] In the case of rates for men; from 60% in northeastern Europe, to 20% in some parts of Italy and levels below 10% in Eastern Europe.

low levels of some areas lead authors like Robert Allen (2003) to conclude that literacy is not a factor that can explain European economic performance between 1300 and 1800[6].

Other researchers, who use indicators other than literacy rates, in contrast, defend the hypothesis that human capital did indeed play an important role during the Early Modern Period. Apart from numeracy, mentioned above, there are numerous other methods: the number of secondary schools (Boucekkine et al 2007), the production of books (Baten and Van Zanden 2008) or the stock of total years of schooling (de Pleijt 2015). All these studies evaluate the formation of human capital in the very long run and point out that it could have played an important role.

Some academics have hypothesized that the Protestant Reform must have favored the increase of human capital levels (Becker et al 2011), although other authors maintain that Protestantism has no effect when it interacts with other probable determinants of economic development (Cantoni 2015). Although the Protestant Reform could have been a stimulus for the development of education in northern and central Europe, the Catholic Church reacted to it with measures directed at popular education like the creation and boosting of the teaching religious orders: Jesuits, Capuchins, Carmelites, Piarists, etc. (Hebrard 1989). This progress was due to ecclesiastical promotion following the Council of Trent (Vergara 1993) but also due to the interest on the part of local authorities in promoting education (Solà 2011, p.102).

Other academics (de Pleijt and Weisdorf 2017) propose that the Industrial Revolution in England probably saw a process of de-skilling, an effect also observed in the development of the fishing industry in northern Europe (Ojala, Pehkonen and Eloranta 2016). In contrast, in the case of France other authors claim that the industrial revolution brought with it an improvement in human capital (Franck and Galor 2015) but this disappeared from the mid-19th century (Diebolt, Le Chapelain and Menard 2017). Finally, some authors suggest the so-called upper-tail knowledge hypothesis in which a minority but highly qualified group allowed the implementation of new technologies (Mokyr and Voth 2009, Meisensenzahl and Mokyr 2011; Squicciarini and Voigtländer 2015; Zeev, Mokyr, and Van der Beek 2017).

2.2.- Human capital in pre-industrial Spain

Literacy has been the most used indicator of human capital to analyze the Spanish case (Viñao 1990, 1999; Nuñez 1992, 2003, 2005; Sarasua 2002). The construction of indicators for an earlier period than the first statistical data for Spain faces the same difficulties related with scarcity, heterogeneity and lack of precision of sources mentioned above. The first regional estimations of literacy available for Spain date from 1860 (Núñez 1992), and levels of education were low[7]. The

[6] Allen (2003) notes that literacy in 1800 was: England 53%; Holland 68%; Belgium 49%; Germany 35%; France 37%; Austria-Hungary 21%; Poland 21%; Italy 22%; Spain 20%.
[7] In 1860, only 20.1 percent of the population was able to read and write.

lack of homogeneous statistical data prior to 1860 means that we do not know the evolution of human capital levels, and its potential impact on regional economic growth, making for enormous methodological problems in the study of the evolution of the level of knowledge in Early Modern Period Spain. The most used system is the ability to sign documents (Soubeyroux 1985), but the data is fragmentary.

For this reason, some academics have not considered human capital as a pre-requisite for the partial industrialization of Spain, and a wide inspection of schooling and literacy data appears to support this standpoint. The historical framework is the existing paradox in Spain, where the most industrialized areas have relatively low literacy levels (excepting Madrid and the Basque Country), and the more literate areas are less developed (Nadal 1995). Given these low literacy levels, Nadal (1995), using the role of qualified industrial workers and professional training, and Rosés (1998), maintain the idea that Catalan industrialization was possible because the level of human capital present in industry could be enough to adopt and modify new technologies. For Rosés (1998), this is the consequence of the fact that a significant proportion of education was carried out informally in the workplace. This learning by doing did not favor literacy directly, but it did raise the skills level of industrial workers.

This has led to the development of industrial professional training for skilled workers and technicians being considered a possible key factor in the success of industrialization, mainly during the Second Industrial Revolution. Between 1889 and 1935 supply and demand for Spanish professional training grew, due to the role of the public administration and the institutionalization of the education system in the mid-19th century (Lozano López de Medrano 2008a). The two most industrial areas of Spain (Catalonia and the Basque Country) had the highest number of trade schools. Here, there was less State participation in finance, which meant that the development of the network of technical training schools relied on the role of local corporations. This gave them greater flexibility with regards the academic content of official State regulation – which in turn favored greater curricular specialization for the local productive fabric.

Manzel (2009) applies numeracy and uses age heaping methodology to determine the arithmetic levels of the Spanish population between 1830 and 1930. This study, in the same way as the literacy data for 1860, shows that the most economically dynamic regions were not among those that had lower levels of numeracy than other regions. Juif and Baten (2013) also used numeracy for earlier periods to calculate the levels for certain Hispanic localities, obtaining results below those of other European areas.

There are some works which link human capital levels in Spain with inequality. For the 18th century, Álvarez and Ramos Palencia (2018) use the *Catastro de Ensenada* (a registry or census carried out in 1749) to show that in pre-industrial Castilla, human capital (measured in numeracy and literacy) contributed to income inequality. For mid-19th century Spain, Beltrán

Tapia and Martinez-Galarraga (2018) maintain that the degree of inequality of access to land, measured as the proportion of agricultural laborers who were non-owners, over the population working in agriculture, had a negative impact on male literacy rates in preindustrial Spain.

2.3.- Human capital in Catalonia during the Early Modern Period

The Catalan case, as indicated in the previous section, is a clear example of the Spanish paradox, which Nadal (1995) notes regarding the modest development of literacy rates in the most industrialized regions. Núñez (1992) and Manzel (2009) also contribute data which appear to confirm this hypothesis for Catalonia. The scarcity of data mentioned above, also characterized Catalonia, impinging on the ability to evaluate human capital. Literacy levels in modern Catalonia is a subject with few academic antecedents -both in cities and in rural areas. For example, to study Catalan literacy prior to 1860, there is, to the best of our knowledge, only information for the towns of Girona (Antón 1998), Mataró (Ventura 1986) and Terrassa (Fernández Clarés 2007), and frequently information only reflects certain social strata.

In addition, Expósito (2015) shows that Catalonia was much more diverse and literate than traditionally supposed. This is a viewpoint shared by Solà (2011, p.108), since the elementary schools network appears to have strengthened during the 16th and 17th centuries in Catalonia. The municipalities were also concerned about popular education and usually provided a space for a teacher to give classes to children. There were three types of classes: writing, or reading and writing, or reading, writing and counting. The fact that the service was free was a key element for the access of all social classes, the cost of education being covered by local institutions or with Church profits and incomes. The institution that paid for schooling was the one that appointed the teacher (Solà 2011, p.117). Burgos (1994) highlights the extension of the primary school system in the 18th century, and elaborates a detailed list of the Catalan towns that had a school between 1730 and 1800, obtaining elevated numbers[8]. Also, the index of schooling coverage obtained by Lloret (1991), analyzing the data from Zamora's questionnaire, yields ample results.

Evidently, as noted by Expósito (2015), these figures do not indicate literacy levels, but are an important indicator to bear in mind when evaluating the conditions of the spread of education in Catalonia. Hence, we encounter diverse evidence of the extension of education. In the town of Vilafranca del Penedès in the 16th century, there was an elementary school and in the 17th and 18th centuries different religious orders gave free classes (Solà 2011). For the population of Cervera there is a list of teachers who were paid by the municipality between 1338 and 1770 (Duran i Sanpere 1977). In Olot there are records from as early as the 15th century that a teacher

[8] In municipalities of over 1,000 inhabitants (a total of 164), 69% had a school; in cities bigger than 2,000 inhabitants (61), the percentage was 85%. But this was also the case in more than fifty towns of between 500 and 1,000 inhabitants. Hence, "half the population of Catalonia lived in places that had an open school at some point in the 18th century" (Burgos, 1994) (own translation).

authorized by the Church gave classes in a house rented by the Town Council, and that in the 18th century, this council selected and paid fourteen teachers for children's basic education (Expósito 2015).

One factor to bear in mind is that a wide range of schools, whether municipal, parish or private, did not ensure schooling for the entire population of children, due to the fact that the number of children of school-going age far exceeded the places available. Moreover, it merits highlighting that although some of these schools were free, the opportunity costs of most of the population meant that many children helped to maintain their families, instead of going to school. Another factor to bear in mind is that formal schools always focused on a part of the male population, and despite the fact that from the 18th century initiatives emerged to promote popular female education (Solà 2011, p.112), most women did not have access to education. Hence, exceptions aside, only the wealthiest families could afford a private teacher in the home for the education of girls (Puig 2010). Furthermore, in contrast to boys who learned grammar, rhetoric and a trade in the workplace, girls' education offered at schools consisted of a domestic curriculum that focused directly on girls' responsibilities within the home.

However, the low investment in public education and the high opportunity costs for families meant that school could not be the main means of securing education in pre-industrial societies. A key element in the transmission of knowledge in Girona was the apprenticeships of craftspeople and liberal professionals (Antón 1999), or the training offered to young people in workhouses in Barcelona, which gave access to guilds, to domestic service or to the army (Carbonell-Esteller and Marfany 2017). Also, in areas with a predominantly rural economy, the population also needed to access literacy and arithmetic, which stimulated the education process (Expósito 2015). But, this knowledge which was acquired more formally and which was difficult to quantify, throughout the 19th century tended to become uniform and began to be taught in classrooms. However, this does not mean that access to non-formal education did not coexist for a long time and that it did not exist previously.

An element to be highlighted in Catalonia as from the last decades of the eighteenth century, in the formation of human capital levels, is the Barcelona Chamber of Commerce. This institution created a series of schools, which were free, to teach technical and practical knowledge with the aim of improving the skills of the workforce (Monés 1987). The Chamber of Commerce facilitated the transition to an industrial technology (Agustí 1983, p.55) and also contributed to creating favorable conditions for innovation necessary for the introduction of the factory system (Sánchez 2012). The collaboration between scientists and artisans is a key factor in the introduction of the first machines of the initial industrialization of Catalonia (Agustí 1983, p.75). Nevertheless, the main school continued to be the workshop or the home itself, since the learning process was fundamentally practical. Additionally, as mentioned above, many

professional training schools in Catalonia at the end of the 19th century lay outside of official regulation (Lozano López de Medrano 2008b, p.203) [9].

3.- A new source for measuring numeracy: municipal registers of inhabitants (*padrons*)

3.1.- Methodology

Numeracy is the term that refers to people's capacity to calculate. This capacity is the ability to process, understand and transmit mathematical and numerical information. Arithmetic capacity is a good indicator of the informal training available in this period (see Nadal 1995, Roses 1998, Humphries 2003, Wallis 2008, Mokyr 2009, de Pleijt 2015). Knowing how to do basic mathematical operations is a need in a context that was increasingly more monetized and industrious. For this reason, numeracy could also be a good indicator of a market-oriented economy instead of a subsistence economy where monetary transactions are not very frequent.

In order to obtain historical information about numerical skills, we can use the calculation of age heaping (Mokyr 1985; A'Hearn, Baten and Crayen 2009). This refers to the tendency to round off ages into numbers ending with zero or five when a person does not know their exact age. For this reason, age heaping exists in a census (consequently indicating lower numerical skills) when there is a high frequency of observations with numbers ending in zero or five[10]. It is for this reason that age heaping is an indicator of the numeracy of a population and it is considered a good proxy for arithmetic capacity (Blum and Krauss 2017).

Age heaping can be used as an indicator of the numerical skills of a group of individuals but also refers to the conditions and factors of the context where these individuals are. For this reason, in periods when education was generalized, it has a high correlation with literacy (A'Hearn, Baten and Crayen 2009) and with other environmental factors such as height (Baten, Crayen and Voth 2010).

In contrast, other authors question whether age heaping is a good proxy for numeracy (Spenneman 2017), and others point out that more than an indicator of cognitive abilities, what it could indicate is institutional and cultural modernization (A'Hearn, Delfino and Nuvolari 2016). Moreover, the quality of the local censuses, used to calculate numeracy, varies according to the period and the place (Szołtysek, Poniat and Gruber, 2018).

[9] It being managed by religious orders, local corporations, workers' associations, or even the factories themselves, which enabled them to adapt better to local companies' demands,

[10] The reason for using numbers ending in zero and five when someone does not know their own age is biological. In many cultures in the world, people learn to count using their hands and their fingers, since we use our body to communicate with other individuals (Sheets-Johnstone, 2010).

This is calculated using a transformed Whipple Index called ABCC Index. The Whipple Index (WI) shows the number of ages ending in zero or five over the total:

$$WI = \frac{\sum_{i=5}^{14} n_{si}}{\frac{1}{5}\sum_{i=2a}^{62} n_i} \; x\; 100 \qquad (1)$$

where *i* represents age and *n*, the number of observations. The margin of values is between 100 and 500, where the value of 100 means that there is no age heaping and 500 indicates that all observations end with five or zero[11]. A'Hearn, Baten and Crayen (2009) propose a linear transformation of Whipple, the ABCC index[12], expressed as:

$$ABCC = \left(1 - \frac{WI-100}{400}\right) x100 \qquad (2)$$

The ABBC index has the advantage of being more comprehensible than the Whipple, since the values encompassed are from one to a hundred, where a hundred is maximum arithmetic capacity and zero, minimum. In this article we have used the observations of age cohorts of between the ages of 23 and 62[13] for the calculation of the age heaping indicator. In the age cohort of between twenty-three and thirty two years, and due to a possibly greater capacity to remember age, the correction factor proposed by Crayen and Baten (2010) is applied[14].

3.2.- Municipal registers of inhabitants (padrons)

In order to employ the age heaping methodology we need to have individualized ages and not group ages. In the case of the regions that were beneath the rule of the Spanish Empire during the Early Modern Period, the source we use to obtain these ages is the municipal register of inhabitants. The municipal register is a list of citizens living in each locality, where, from the Middle Ages, those who wanted to become full residents, were noted down. As from the 18th century it is possible to find registers with ages and occupations, making a possible to calculate age heaping according to professional category. This is not a fiscal source, although it could be applied for this end, and for this reason there is less bias and concealment than in other sources of the same period.

[11] Values below 100 are possible in samples with a great number of observations.

[12] The abbreviation "ABCC" makes reference to the initials of the authors, plus that of Gregory Clark, who suggested this index.

[13] The youngest people may recall their age with greater exactitude due to external factors where it is required to know it, and for this reason those below the age of 23 are excluded. People over the age of 62 are excluded for two reasons: on the one hand, to avoid an age effect which might upwardly bias the sample (Crayen and Baten 2010) since in the Early Modern Period individuals who reached this age were those who had the best living conditions and lower levels of mortality, and consequently higher literacy rates; and on the other hand because they might be tempted to exaggerate their age to impress their interlocutors or because they do not remember their age (Ewbank 1981; Reis 2008).

[14] To make the adjustment we use the following equation: $ABCC_{23\text{-}32adjust}=((ABCC_{23\text{-}32}-100)*0{,}25)-ABCC_{23\text{-}32.}$

The municipal population registers are divided into two large groups, according to whether they measure the population of residents or inhabitants (García España 1991). These two groups are: the primitive set – from the beginning of the 15th century to the mid-18th century, and the modern set, from the mid-18th century to the present. The primitive censuses are characterized by three fundamental features: the final unit is the resident and not the person, its main goal is not to gain knowledge about the population and its characteristics, but they were almost always carried out for primarily fiscal reasons and only secondarily gave the size of the population measured in residents[15]; and the primary information was provided by the authorities of the towns without the obligation to refer to the element that was the object of study.

In contrast, modern censuses are defined by four factors: the fundamental unit is the person; they try to include all the inhabitants and only design defects can lead to coverage which is not total; their aim is almost exclusively to gain knowledge about the population and its main characteristics to later apply them to the subject that might require this information; and primary information is supplied directly by people, with the authorities going to find the information at the households themselves ("Calle hita" in Old Spanish).

The Bourbon territorial and fiscal organization of Catalonia which emerged from the defeat of the pro-Habsburg forces in the War of the Spanish Succession of 1714, was built on the pre-existing territorial structure of *vegueries* and *sotsvegueries*. There was no rupture of the territorial organization, so as to take advantage of the knowledge and resources of the previous administration, and thus facilitate the imposition of the Nueva Planta decree (1716). Patiño[16], in charge of its implementation, designed the jurisdictions using the sum of the pre-existing *vegueries* (Burgueño and Gras, 2014, p.96). 18th-century Catalonia was divided into twelve jurisdictions[17] (whose location is shown in figure 1), and the sample analyzed has information from municipal registers of ten of them[18]. Few registers from the 18th century have been conserved, due to different conflicts throughout the 19th and 20th centuries, and therefore the registers used are from those localities where we were able to locate this source.

The distribution of the information from the municipal registers used is based on the data extracted for all persons per household, street-by-street, noting their main characteristics (age, occupation, kinship). This indicates that those in charge of compiling the register went from home to home, collecting the information and that they wanted to include all the inhabitants (in some cases only males, but all males, whether adults or boys).

To carry out these *padrons*, the compilers did not use the previous information from the Campoflorido census of 1712, nor did they use other registers such as those of the church. The registers were made by the local authorities, with precise and homogeneous instructions, and

[15] In some cases, it may indicate the number of souls, which are persons who lived in the home.
[16] Intendand of Catolonia from 1711 to 1718.
[17] Barcelona, Cervera, Girona, Lleida, Manresa, Mataró, Puigcerdà, Talarn, Tarragona, Tortosa, Vic and Vilafranca del Penedès. The Vall d'Aran was its own entity and not considered a jurisdiction.
[18] There is also a register for one locality in the Vall d'Aran.

under the supervision of Patiño. In some cases, we know the names of those in charge of the compilation of registers and the cost this implied for the municipality[19]. Thus, the registers used to calculate the global evolution of arithmetic capacity, would be considered as modern[20]. In the case of the two localities in the jurisdiction of Mataró (Alella and Caldes de Montbui), we used the list of residents taken from the census[21].

FIGURE 1
Location of municipalities in the sample[22]

The analysis of numeracy can be broken down into sectors of activity, occupation, social groups and gender. The classification in sectors of activity (primary, secondary and tertiary) follows the PST System of the Cambridge group (Wrigley, 2006)[23]; and the preponderance of

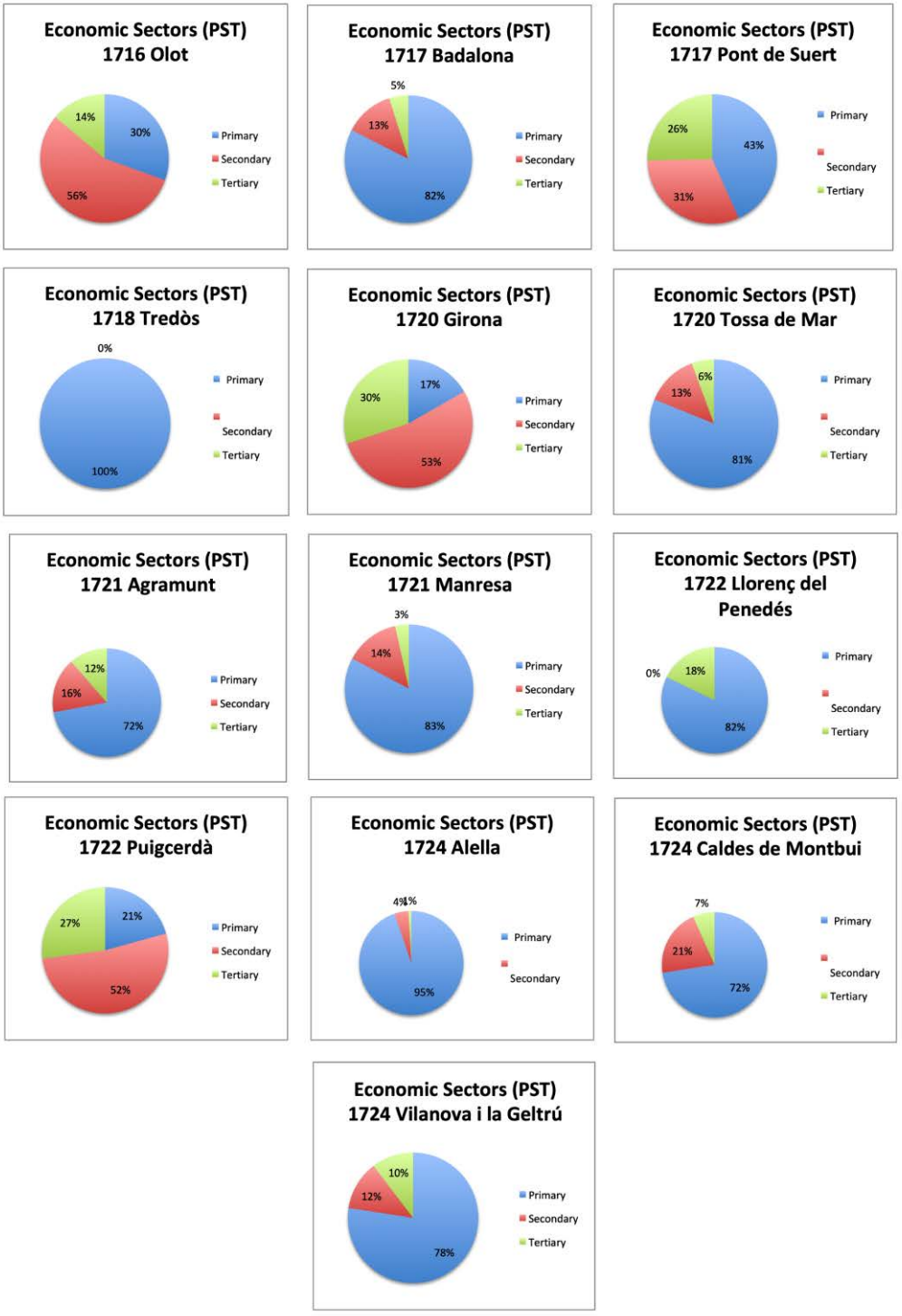
[19] For example, in Olot the municipal register indicates that it was compiled by the notary, Francesc Masbernat, who was also the municipal secretary, assisted by the scribe Pere Pau Vayreda; the cost also appears.
[20] In order to evaluate the quality of the source, we have included the frequency distributions of the final digit for the ages in table A.1 of the appendices.
[21] The list is compiled after the census and the person who compiled it, added one year to all the ages. In this case, we have taken away one year from the sample so as to calculate age heaping.
[22] The different colors correspond to the division into jurisdictions.
[23] The abbreviation "PST" refers to the initials of the primary, secondary and tertiary sectors.

each sector is what allows us to identify a locality as urban or rural. To carry out the categorization of occupations we apply the HISCO methodology, a codification system which permits the construction of quantifiable and comparable models of historic occupation in diverse contexts (van Leeuwen, Maas, and Miles 2002); and in order to determine the level of training linked to these, we use the HISCLASS, a classification system that allows the analysis of social mobility derived from this occupational stratification (van Leeuwen and Maas, 2011).

In the concrete case of Catalonia, we use the solutions adopted previously for the period between the 15th and the 20th century for problems of inspecificity of some occupations and to prevent the loss of the extensive information contained in some municipal registers (Mora, Marín and Villar 2014). In the case of gender, the levels of men and women can be analyzed in those registers that contain this information.

To calculate numeracy levels according to professional category, we analyze the municipal registers which indicate occupations, and we use the head of the family as the unit of study. Also, to indicate global results we use the male head of the family, since it is the indicator that is common in all registers. On analyzing occupations according to the PST system, they are classified as to whether they belong to the primary, secondary or tertiary sectors. The study of the composition of the municipal registers per sector of activity which can be observed in figure 2, shows that some localities at the beginnings of the 18th century already had an extensive manufacturing and service sector and a reduced agricultural sector.

FIGURE 2
Percentages of sector of activity per municipality



Sources: Olot 1716 municipal register ACG; Badalona 1717 municipal register AHMB; Pont de Suert 1717 municipal register AHLL; Tredòs 1717 municipal register 1717; Girona 1720 municipal register AHMG; Tossa de Mar 1720 municipal register AHLL; Agramunt 1721 municipal register AHLL; ACA; Manresa 1721 municipal register AHM; Puigcerdà 1722 municipal register ACC; Llorenç del Penedès 1722 municipal register AHLL; Alella 1724 ACA; Caldes de Motbui 1724; Vilanova i la Geltrú 1724,.

To indicate whether the municipality is urban or rural we use the size of each sector regardless of the number of inhabitants, a criterion also used by other academics for pre-industrial British localities (Glennie and Whyte 2000, p.167-168). Thus, if the weight of primary sector activities is greater, the municipality is regarded as rural. By contrast, if the weight of manufacturing and service activities is greater than rural ones, the municipality is considered urban. Except in the case of Manresa, in the rest of the cases it coincides that rural municipalities are demographically smaller and urban ones have greater number of inhabitants.

3.3.- The localities

The thirteen localities analyzed are grouped around 1720. These thirteen registers are distributed in three urban municipalities: Olot (1716), Girona (1720) and Puigcerdà (1721)[24]; and ten rural ones: Badalona (1717), Pont de Suert (1717), Tredòs (1718), Tossa de Mar (1720), Agramunt (1721), Manresa (1721)[25], Llorenç del Penedès (1722), Alella (1724), Caldes de Montbui (1724) and Vilanova i la Geltrú (1724).

The localities from around 1720 were municipalities emerging from the Spanish War of Succession, setting out on the path of economic and demographic recovery. During the 18th century, they went on to trade in agricultural surpluses, triggering economic effervescence which set off the process of industrialization. Some municipalities which were also characterized by demographic growth tied to commercial expansion both in coastal areas - Alella (Ferrer i Alòs 2013), Badalona (García Carreras 1993), Tossa de Mar (Zuchitello p.167) and Vilanova i la Geltrú (Martínez Rodríguez 1987) - or pre-coastal -Caldes de Montbui (Ferrer i Alòs 2013) and Llorenç del Penedès (Claverías 2004) - as well as interior - Agramunt (Tello 1990), or mountain localities: Pont de Suert or Tredòs (Sanllehy 1996). But if something characterizes Catalan localities in the 18th century, it is the consolidation of the first textile manufacturers in the transition from pre-industrial to industrial, such as in Girona (Boadas 1986), Manresa (Ferrer i Alòs 1983, 2013) Puigcerdà (Forga 2012) or Olot (Puig i Reixach 1988; Lluch 1981).

The registers used are shown in figure 3, and are classified in chronological order according to year of compilation. Below, we describe the characteristics and the information they provide[26]. All together, we have obtained over 14,000 observations, of which 6,639[27] are considered to calculate numeracy levels[28]. In some registers there is also information about wealth levels of households (home ownership, having domestic service, or having draft or pack

[24] Puigcerdà in 1722 was the border capital of a *veguería* of small, rural localities; however, it concentrated the secondary and tertiary occupations of the surrounding area (Forga 2012).
[25] Manresa in 1721 was a highly populated locality but with an elevated percentage of primary occupations. This was to change through the 18th century with the growth of the textile sector (Ferrer i Alòs 2013).
[26] Information on number of inhabitants is similar to that supplied by Iglésies (1974), and in some cases like Olot, the registers used have a greater number of observations.
[27] These are the observations for between 23 and 62 years of age.
[28] The number of observations analyzed varies according to whether data for only men or both sexes were used.

animals in the case of agricultural laborers). These are not homogenous indicators for all of the municipalities, but they do allow us to obtain results to be able to evaluate trends in this matter.

In three municipalities (Olot, Badalona, Girona) it is possible to show differentiated results in levels of arithmetic capacity between men and women, not only in the case where a widow is the head of the family, but for all of the female population[29]. Although the professional category is absent for women, except for that of servants, it is possible to make a guess based on the professional activity of the husband or father, accepting that this will contribute a certain skewing of information since it is a masculine classification.

The results of female age heaping have to be used with caution, as shown by Blum, Colvin, McAtackney and McLaughlin (2017) for rural 19th-century Ireland. The main uncertainty with regards the levels of female ABCC lies in the origin of the information contained in the registers. The debate in the pre-industrial periods is about who provided the age. According to Földvári, van Leeuwen and van Leeuwen-li (2012), it was the men who provided the age of the women in the household[30]. By contrast, other authors claim that it was women who provided their own age[31] (de Moor and Zuijderduijn 2011; Baten and Szoltysek 2012). In the case of the registers of Early Modern Period Catalonia, the results show both tendencies, with the exception of the gender gap section, it is not a determinant question since estimations of numeracy are made by the male heads of households and do not alter the results.

[29] Pont de Suert and Tredòs do not have a high enough number of observations ($n \geq 30$) about women to evaluate their arithmetic capacity.
[30] Since comparing the levels of married women and unmarried women, there are great differences.
[31] In some cases women had higher levels of arithmetic capacity than men.

FIGURE 3
List of municipal registers of the sample and their characteristics

City or Village (Corregiment)	Year	N	N(23-62)	Gender	Persons included	Specifications	Type
Olot (Vic)	1716	4125	1687	Both	All	Occupations, Servants, Estructure of household (marrital Status, nº childrens, age of first children), land rights	Urban
Badalona (Barcelona)	1717	657	365	Both	All	Occupations, Servants, Estructure of household (marrital Status, nº childrens, age of first children), land rights	Rural
Pont de Suert (Talarn)	1717	74	37	Both	All	Occupations, Estructure of household (marrital Status, nº childrens, age of first children), land rights	Rural
Tredòs (Vall d'Aran)	1718	116	55	Both	All	Occupations, Servants, Estructure of household (marrital Status, nº childrens, age of first children), land rights	Rural
Girona (Girona)	1720	4696	2264	Both	All	Occupations, Servants, Estructure of household (marrital Status, nº childrens, age of first children), land rights	Urban
Tossa de Mar (Girona)	1720	256	112	Men	Heads of family+boys	Occupations, land rights	Rural
Agramunt (Cervera)	1721	254	126	Men	Heads of family+boys	Occupations, land rights	Rural
Manresa (Manresa)	1721	1612	882	Men	Heads of family+boys	Occupations, land rights	Rural
Puigcerdà (Puigcerdà)	1722	488	252	Men	Heads of family+boys	Occupations, land rights	Urban
Llorenç del Penedès (Vilafranca del Penedès)	1722	40	24	Men	Heads of family+boys	Occupations, land rights	Rural
Alella (Mataró)	1724	121	65	Men	Heads of family+boys	Occupations, land rights	Rural
Caldes de Montui (Mataró)	1724	707	338	Men	Heads of family+boys	Occupations, land rights	Rural
Vilanova i la Geltrú (Tarragona)	1724	807	432	Men	Heads of family+boys	Occupations, land rights, some wages "mossos"	Rural
		13953	**6639**				

Sources: Olot 1716 municipal register ACG; Badalona 1717 municipal register AHMB; Pont de Suert 1717 municipal register AHLL; Tredòs 1717 municipal register 1717; Girona 1720 municipal register AHMG; Tossa de Mar 1720 municipal register AHLL; Agramunt 1721 municipal register AHLL; Manresa 1721 municipal register AHM; Puigcerdà 1722 municipal register ACC; Llorenç del Penedès 1722 municipal register AHLL; Alella 1724 ACA; Caldes de Motbui 1724; Vilanova i la Geltrú 1724, ACG.

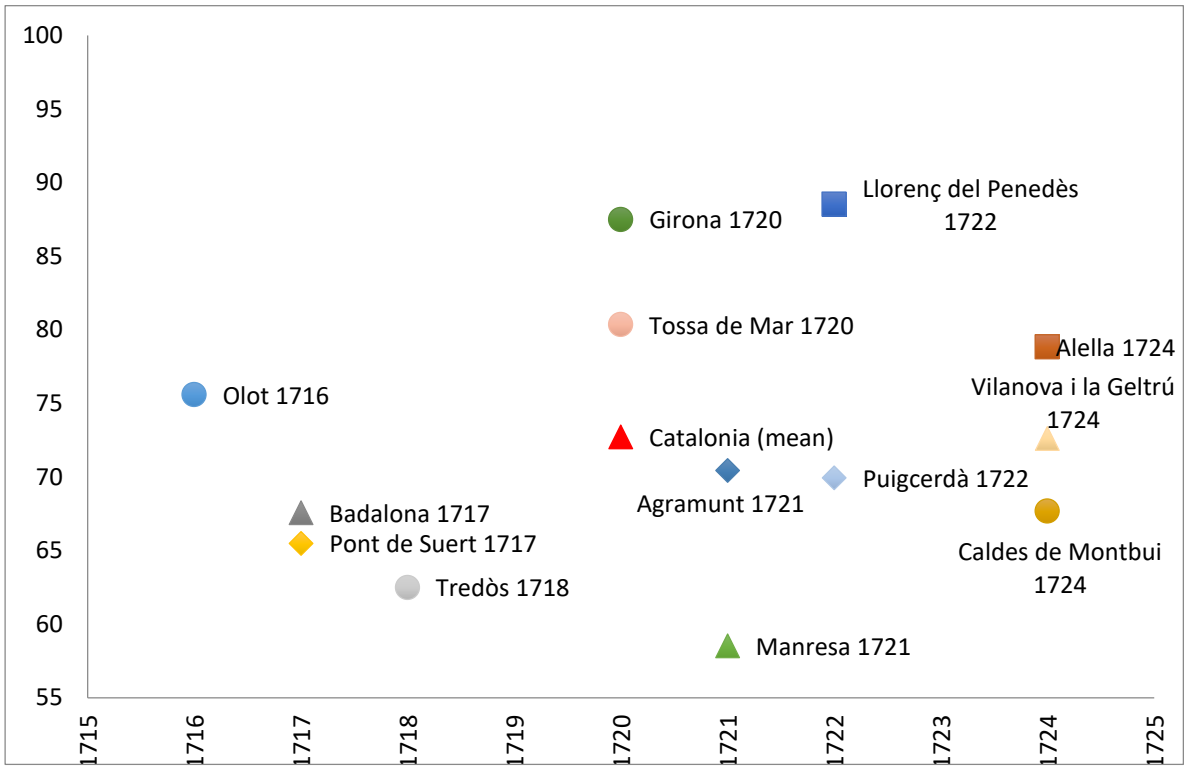
4.- Results

4.1.- Global results

The general results of the arithmetic trend that shows the ABCC index in Catalonia in the early 18th century can be seen in figure 4. Grouped around 1720 there are thirteen registers. With all of these we obtain the mean for the beginning of the 18th century. Figure 4 shows, at the beginning of the 18th century, levels of arithmetic capacity close to seventy percent, although there is a large

variation across the different municipalities[32]. This appears to indicate that, irrespective of the occupational group, households began to prioritize learning a minimal arithmetic capacity.

FIGURE 4
Levels of ABCC per municipalities around 1720



Sources: Olot 1716 municipal register ACG; Badalona 1717 municipal register AHMB; Pont de Suert 1717 municipal register AHLL; Tredòs 1717 municipal register 1717; Girona 1720 municipal register AHMG; Tossa de Mar 1720 municipal register AHLL; Agramunt 1721 municipal register AHLL; ACA; Manresa 1721 municipal register AHM; Puigcerdà 1722 municipal register ACC; Llorenç del Penedès 1722 municipal register AHLL; Alella 1724 ACA; Caldes de Motbui 1724; Vilanova i la Geltrú 1724, ACG.

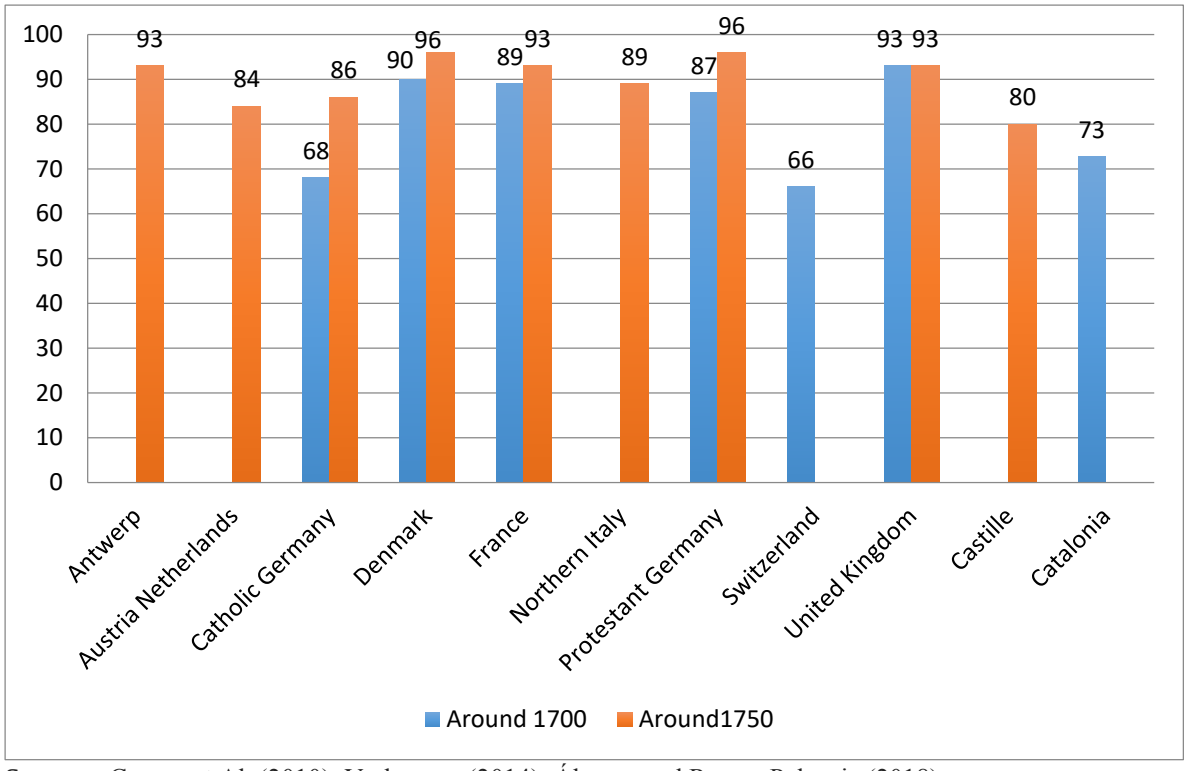
It would appear that education to a minimum numerical capacity was important in the early decades of the 18th century. Despite that fact that these were societies in which formal education was very scarce (compulsory primary education came much later), it could be pointed out that in order to attain a better position in society (and presumably in the job market) in an economy that was increasingly more open and commercial, people needed to attain a certain basic numerical education level.

To complement these initial results Figure 5 shows the levels of arithmetic capacity in different European regions around 1700 and 1750, and compares these with data for Catalonia from figure 4. There was a gradual increase in numeracy in all European regions. Nonetheless,

[32] The values of the ABCC index range from around 60 in Manresa to close to 90 in Girona and Llorenç del Penedès.

the levels of ABCC for Catalonia in the early 1700s are below the northern European regions, although slightly higher than Catholic Germany and Switzerland[33]. Figure 5 also allows a comparison with other areas of Spain. The level in Catalonia at the start of the century was below that of Castilla in the 1750s (Álvarez and Ramos Palencia 2018). In this case, Castilla is proxied with information referred to the provinces of Palencia, Madrid and Guadalajara, which traditionally enjoyed high levels of human capital. The rising trend observed in Europe thus suggests the possibility that in the middle of the century they could have had similar values in the 18th century and this would place Catalonia in a relatively good position within the context of Spain. In what follows the numeracy indicators for Catalonia are examined in more detail by looking at different economic and social divisions.

FIGURE 5
Levels of ABCC in different European regions between 1700 and 1750



Sources: Crayen et Al. (2010); Verhoeven (2014); Álvarez and Ramos Palencia (2018).

4.2.- Results per sector of activity and occupational groups

In table 1, occupational groups are classified according to the sector of activity as per PST (primary, secondary and tertiary). The results are presented separately for urban and rural towns. In rural localities, although primary activities dominate (farmers, fishers, shepherds,…), there are

[33] In Catholic Germany, and particularly in Switzerland, the starting level was lower but the process of improvement in arithmetic capacity was fast.

also manufacturing professions and artisans (carpenters, blacksmiths, shoemakers,…), as well as tertiary activities (doctors, pharmacists, vendors,…). Within the secondary sector, there is a sub-classification of those occupations linked to the textile industry (knitters, tailors, peelers[34],…) due to their importance within the manufacturing process, in both urban and rural settlements.

Table 1 also shows numeracy values according to occupational groups using the HISCO methodology around 1720[35]. Four occupational groups are used and are based on a skills-level, whether formal or obtained through the hands-on learning of a profession, which is obtained through converting the HISCO codes to HISCLASS: unskilled (occupations that require fewer than 30 days of training), low-skilled (require from one month to one year of training), medium-skilled (one to ten years of training) and high-skilled (more than ten years of training)[36]. The HISCO system excludes from professional coding some descriptions which are found on municipal registers, such as nobles, widows, students and particularly the indigent[37].

Table 1 shows the results obtained at around 1720. First, the results show that the arithmetic capacity in Catalan urban areas, with an ABCC index of 82.2, had already reached levels close to the average of the Western European countries. Second, in that year, there was a substantial urban-rural gap, given that rural areas reached an ABCC index of 72.7, that is, ten points below that of the urban areas. In rural municipalities, except for the tertiary sector, workers from primary and secondary sectors showed lower numeracy levels than those in urban localities. This differs from the data for Castilla of 1757, where there are no differences between urban and rural contexts (Álvarez and Ramos Palencia 2018). However, the data also reveal that this difference would be smaller in occupations linked to the textile industry, since rural workers in this sub-sector would have higher levels of arithmetic capacity than other artisans from the secondary sector.

34 The original Catalan term, *paraire* is not translated into other languages in the HISCO, where it is listed as code 75540. It refers to a "peeler" of animal skins, an occupation in the textile industry, but with a level of managerial responsibility.

35 It was compiled using the rural localities of Badalona in 1717, Pont de Suert in 1717, Tredòs in 1718, Tossa de Mar in 1720, Agramunt 1721, Manresa in 1721, Llorenç del Penedès in 1722, Alella 1724, Caldes de Montbui 1724 and Vilafranca del Penedès in 1724; and the urban localities of Olot 1716, Girona 1720 and Puigcerdà 1722.

36 There is also Armstrong's methodology (1972) for classifying training levels in occupations, although in this study we have opted for HISCLASS to be able also to evaluate social prestige and the weight of textile occupations in the secondary sector. Table A.2 of the appendices provides the results using Armstrong so as to facilitate comparisons with studies that use this methodology.

37 These are encompassed in the code -1 and are excluded from the analysis. The detail of each group can be obtained at https://hicodigos.wordpress.com/clasificacion-por-sector-y-subsector-de-los-codigos-hisco-3/

TABLE 1
Levels of ABCC per sector of activity in 1720

		Basic skills		Occupational skills			
Activity sector	(%)	ABCC 1720		Unskilled (%)	Low skilled (%)	Medium skilled (%)	High skilled (%)	N
Rural								
Primary	70,3	72,2		58,0	12,3	29,7	0,0	1429
Secondary	21,3	70,4		0,2	54,0	44,8	0,9	433
Textile	20,6	*78,7*		0,0	67,4	32,6	0,0	89
Tertiary	8,4	81,6		9,4	25,9	21,8	42,9	170
All rural workers	100	72,7		41,6	22,3	32,1	4,8	2032
			ABCC	67,8	75,2	75,7	82,8	
Urban								
Primary	24,8	74,0		73,2	0,4	26,4	0,0	488
Secondary	54,1	85,4		0,1	48,8	50,9	0,2	1064
Textile	28	*86,4*		0,0	65,1	34,9	0,0	298
Tertiary	21,1	86,8		8,4	19,0	37,5	35,1	416
All urban workers	100	82,2		19,9	30,5	42,0	7,5	1968
			ABCC	70,2	85,2	86,5	87,0	

Sources: Olot 1716 municipal register ACG; Badalona 1717 municipal register AHMB; Pont de Suert 1717 municipal register AHLL; Tredòs 1717 municipal register 1717; Girona 1720 municipal register AHMG; Tossa de Mar 1720 municipal register AHLL; Agramunt 1721 municipal register AHLL; ACA; Manresa 1721 municipal register AHM; Puigcerdà 1722 municipal register ACC; Llorenç del Penedès 1722 municipal register AHLL; Alella 1724 ACA; Caldes de Motbui 1724 Vilanova i la Geltrú 1724, ACG.

Table 1 also indicates that ABCC levels per skill-level correlate. The higher the level of skills training, the greater the level of arithmetic capacity. As expected, the tertiary sector has the highest concentration of highly-trained workers, both in urban and rural areas, with higher numeracy levels in the urban areas. For medium and low-skilled the urban-rural gap is also large, of around ten points. It can be argued that in these urban areas, where subsistence economy was less frequent, and trade relations were more habitual, attaining arithmetic capacity was more necessary, except for the unskilled workers.

Although the results must be taken with some caution, they suggest that the knowledge of numerical skills was a priority for many citizens in Catalonia. Throughout the century Catalonia became a more open economy, there was a substitution of subsistence agriculture for market agriculture, and an intensification of manufacturing production, especially in the textile industry. In a context in which the provision of formal education was rather limited it might be argued that

informal education, that is, learning in the work-place, may have been an important element in the acquisition of this knowledge.

4.3.- Inequality and social prestige

The conversion of the HISCO codes to HISCLASS[38] also allows for the classification of social prestige linked to profession. Although social prestige does not indicate income level, it does make it possible to reflect the numeracy levels of the different social groups. Five groups are used: elites with professions of high social prestige (lawyers, doctors,…); middle classes linked to commercial and administrative professions (vendors, booksellers,…); workers with medium or low-skills linked to their occupational training as artisans or guild workers (tailors, glove-makers,…); farmers or fishers; and unskilled workers such as laborers. The results of the ABCC levels by social prestige for around 1720 can be seen in table 2.

The data from table 2 shows similar levels of ABCC in the distribution by social groups for 1720. The elites, but above all the middle classes linked to mercantile professions and more urban contexts had the highest arithmetic capacity. They were already at the same levels as Europe at the beginning of the century (A'Hearn et al 2009). The workers from the social class linked with medium and low-skilled occupations, are those that register the greatest growth for both dates. It is the middle classes which most increase their levels of numeracy, reaching levels close to those of the elite by the end of the century. The 18th century in Catalonia was a moment of transition between the Ancien Regime and the contemporary period, where there are signs of the decline of the system of traditional guilds and the emergence of an industry which developed throughout the 19th century (Torras 1974). The data on social prestige linked to profession are a demonstration of the social dynamic that surely made numeracy a necessary, though not sufficient, condition for economic and social upward mobility.

The results of table 2 also show that medium and low-skilled workers had similar, quite high levels at the beginning of the 18th century. These results are very similar to those of Tollnek and Baten (2017) for all of Europe, which indicate that farmers had ABCC levels equivalent to skilled urban workers. These high levels showed by farmers as early as the beginning of the 18th century in all of Europe could have provided the workforce with good arithmetic capacity in the rapid occupational changes accompanying the industrial transformation in some European regions. The high numeracy levels of maritime professionals also coincide with the levels of Hispanic sailors studied by van Lottum and Poulsen (2011).

[38] The HISCLASS codes are in list 1 of the appendices.

TABLE 2
ABCC levels by social prestige around 1720

HISCLASS	ABCC 1720	(%)	N
Elite (higher managers and higher professionals)	85,4	5,6	218
Lower middle class (lower managers, professionals, clerical and sales personnel and foremen)	92,5	6,8	250
Skilled workers (medium skilled and lower skilled)	76,7	45,1	1688
Self-employed farmers and fishermen	81,1	13,1	558
Unskilled workers and farm workers	69,1	29,3	1282
ABCC HISCLASS	76,3		

Sources: Olot 1716 municipal register ACG; Badalona 1717 municipal register AHMB; Pont de Suert 1717 municipal register AHLL; Tredòs 1717 municipal register 1717; Girona 1720 municipal register AHMG; Tossa de Mar 1720 municipal register AHLL; Agramunt 1721 municipal register AHLL; ACA; Manresa 1721 municipal register AHM; Puigcerdà 1722 municipal register ACC; Llorenç del Penedès 1722 municipal register AHLL; Alella 1724 ACA; Caldes de Motbui 1724 Vilanova i la Geltrú 1724, ACG.

TABLE 3
ABCC levels according to landownership around 1720

Rights of land	ABCC 1720	(%)	N
Farmers and sharecroppers	81,8	29,4	492
Labourers	67,7	70,6	1180

Sources: Olot 1716 municipal register ACG; Badalona 1717 municipal register AHMB; Pont de Suert 1717 municipal register AHLL; Tredòs 1717 municipal register 1717; Girona 1720 municipal register AHMG; Tossa de Mar 1720 municipal register AHLL; Agramunt 1721 municipal register AHLL; ACA; Manresa 1721 municipal register AHM; Puigcerdà 1722 municipal register ACC; Llorenç del Penedès 1722 municipal register AHLL; Alella 1724 ACA; Caldes de Motbui 1724 Vilanova i la Geltrú 1724, ACG.

An indicator of inequality in the primary sector is that of land ownership. Table 3 shows the ABCC levels of agricultural workers according to their land rights (peasant farmers, market gardeners and sharecroppers), or those without land rights (laborers or farm workers) from the municipal registers containing this information from 1720 The results indicate that ABCC levels in primary occupations could have a strong connection with land-ownership rights (main factor

of production in an organic economy), since this group already cultivated less for the subsistence economy and more for commercial exchange. The index shows great differences between the two groups, close to fourteen points.

In a context with very low provision of public education, access to education could be influenced by income level of the households. Given the lack of direct indicators of income levels, there are other elements to be found in the municipal registers that serve to be able to differentiate wealth levels of the households, such as servants. Table 4 indicates the ABCC levels of households with and without servants in the six registers that contain this information. There are four for 1720 (Olot, Tredòs, Girona and Badalona). Having domestic service in the home was a clear indicator of the wealth level of the household. Table 4 shows that households which had servants had higher levels around 1720 (close to eight points).

TABLE 4
ABCC levels per household according to whether they had servants or not, around 1720

Padrons with servants	ABCC 1720	(%)	N
With servants	86,69	24,3	509
Without servants	78,85	75,7	1609

Sources: Olot 1716 municipal register ACG; Badalona 1717 municipal register AHMB; Tredòs 1717 municipal register AHLL; Girona 1720, municipal register AHMG.

Taken together, the results of tables 2, 3, and 4, albeit partially capturing the numeracy levels for different social groups according to their social prestige, and for different levels of wealth, seem to indicate that in pre-industrial Catalonia, access to numeracy training occurred particularly in the middles classes, mainly among medium and low-skilled workers.

4.4.- Was there a gender gap?

Even though it is not possible to assert with certainty that women were reporting their own age in the municipal registers, this section shows the results of the ABCC levels of men and women separately to be able to take this data into the debate about the gender gap in Europe during the Early Modern Period. The heads of households in the registers are the men, since they had the social prestige and the legal capacity in a society run by men. But in marital unions, especially in the affluent classes, in those with a certain social prestige or in a context of upward social mobility, women played an important role since the social and economic level of the family of the candidate was valued, as well as the economic resources of the dowry that she might bring. In Catalonia, the figure of the *pubilla* existed from the Middle Ages, in order to avoid the division

of family patrimony and to maintain the family economy. It was an institution which bestowed the family assets on the eldest daughter, whenever the family had no son.

Table 5 shows levels of arithmetic capacity for men and women around 1720 for the registers where it is possible to carry out this comparison with the sufficient number of observations[39]. Around 1720 there is data for two urban municipalities: Olot 1716 and Girona 1720; and for one rural locality: Badalona 1717. There are differences in the levels of women and men, but far from the enormous disparities found in the literacy data available for 18th century Catalonia (Antón 1998, Ventura 1986). In two localities (Olot, Badalona) women even have higher levels than those reported by men, as occurs in other areas in Europe (de Moor & Zuijderduijn 2011; Baten & Szoltysek 2012). The differences between male and female ABCC indices might be indicating that women reported their own age. But if we calculate only the information on widows, numeracy levels drop drastically, which could be due to the fact that the male heads of household report their age as proposed by Földvári, van Leeuwen & van Leeuwen-li (2012).

In the case of widows, it must be kept in mind that they usually were more vulnerable in terms of social protection and had less access to equal opportunities. As shown in the results of tables 2, 3, and 4, these factors could also influence the female ABCC results. The only rural municipality with data available, shows that in the rural context women's training could have been high. In the urban case of Girona lower levels are observed for women, but with much more reduced differences than in the case of literacy, and thus the gender issue remains as an open debate.

Since the origin for the information on the municipal registers cannot be clearly confirmed, we cannot make any definitive conclusions. However, these high levels of arithmetic capacity in women would not be so strange in a context where women played an important role in the household, and with Catalan civil law which afforded certain economic rights and permitted a certain protection of their assets, separated from those of the husband (Pérez i Molina 1998). The possible no-existence of the gender gap in numeracy points to a relevant role of women in the formation of human capital.

TABLE 5
ABCC levels by gender around 1720

Padrons with women	ABCC Men	N	ABCC Women	N
Around 1720				
Olot 1716	74,94	795	78,81	1426
Badalona 1717	67,57	185	70,14	340
Girona 1720	87,14	1083	82,77	1625

Sources: Olot 1716 municipal register ACG; Badalona 1717 municipal register AHMB;

[39] The sufficient number of observations considered is from 30 upwards.

5.- Conclusion

This paper examines numeracy skills at the beginnings of eighteenth century Catalonia, using a source that is particularly suitable for measuring age-heaping: the municipal registers of population (*padrons*). The information is obtained for thirteen municipalities which include towns from each one of the 10 administrative divisions (*corregiments*) that existed in Catalonia at that time. Although these towns contain over 14,000 inhabitants, the sample studied (people aged 23-62 years) comprises around 6,700 observations. The diversity of local situations encourages prudence in the construction of a global image, but results obtained appear to indicate that the level of numerical skills in Catalonia was relatively high before the Industrial Revolution. In urban areas, levels were close to those of other European cities as early as the beginning of the century. This coincided with the period in which the Catalan economy was increasingly focused on market-oriented production and when a model of trade relations had become consolidated.

In pre-industrial Catalonia, with a rapid process of intensification of the agricultural sector and protoindustrialization, it appears that the incentives for the acquisition of numerical abilities could have increased in the 18th century. Furthermore, in a context where there was low investment in public education, training in the workplace and in the home could have been the structures that facilitated entrance to a certain level of training and knowledge; and access opportunities to this could be related with inequality. Moreover, despite all the prudence with regards the results for the female population, the fact that they are similar to those obtained for other European regions, shows that women could have been accessing numerical training outside of schools, particularly in the rural domain.

This has implications for future research about this issue, and this study contributes to the debate about whether pre-existing human capital contributed to driving industrialization. In the Catalan case, the numeracy level was relatively high at the beginning of the 18th century. In contrast, the level of human capital in Catalonia in 1860, reflected by literacy indicators, was not particularly high, although arithmetic capacity could be a better indicator of learning in the workplace. These data do not allow us to evaluate whether the level of human capital of the basic indicators of the population was important for the subsequent growth and development of Catalonia. However, they do indicate that the numerical capacity was already high, comparable with other areas in Europe, and that certainly, there must have been training outside of the institutionalized school system. In an economy in transformation, greater human capital was probably required. And Catalan society advanced remarkably in this sense.

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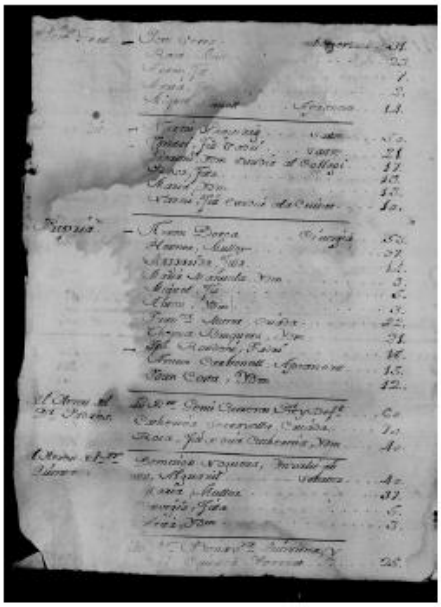
Appendices

Figure A.1
Examples of municipal registers of inhabitants (*padrons*)

Source: Page of the Municipal Register of Badalona, 1717



Source: Page from the Municipal Register of Girona, 1718

TABLE A.1
Distribution of frequencies of terminal digit in ages on municipal registers

Terminal Digit	Olot 1716	Badalona 1717	Pont de Suert 1717	Tredòs 1718	Girona 1720	Tossa de Mar 1720	Agramunt 1721	Manresa 1721	Llorenç del Penedès 1722	Puigcerdà 1722	Alella 1724	Caldes de Montbui 1724	Vilanova i la Geltrú 1724
0	23,7	24,9	33,3	34,6	12,9	17,0	16,7	17,3	4,2	34,9	20,0	33,4	27,5
1	6,3	3,2	0,0	0,0	7,8	17,9	3,2	9,9	4,2	2,4	13,9	1,5	10,0
2	6,0	15,1	9,5	11,5	8,9	5,4	7,1	2,4	4,2	8,7	16,9	7,1	8,3
3	5,2	2,2	4,8	3,8	11,2	1,8	6,3	8,4	8,3	6,7	3,1	6,2	5,8
4	9,5	8,6	9,5	0,0	9,2	6,3	11,1	2,8	8,3	11,9	3,1	9,8	7,2
5	15,8	21,1	14,3	15,4	17,1	18,8	27,0	35,8	25,0	9,1	16,9	12,4	14,4
6	11,0	7,6	4,8	11,5	10,6	18,8	5,6	2,4	4,2	13,1	6,2	8,9	12,3
7	6,2	2,7	4,8	3,8	5,8	5,4	4,8	7,9	12,5	0,8	9,2	4,4	2,5
8	11,9	9,2	4,8	7,7	8,9	2,7	4,8	5,6	4,2	9,9	6,2	10,9	9,0
9	4,4	5,4	14,3	11,5	7,7	6,3	13,5	7,5	25,0	2,4	4,6	5,3	3,0

TABLE A.2
ABCC levels per skills with Armstrong classification in 1720

Armstrong 1720	ABCC	N	%
UNSKILLED	66,8	1138	29,8
SEMI-SKILLED	79,4	589	15,4
SKILLED	81,2	1608	42,1
NON-MANUAL	84,7	242	6,3
PROFESSIONAL	91,9	238	6,2

TABLE A.3
HISCLASS codes and conversion to HISCLASS 5

HISCLASS Code

1	Higher managers
2	Higher professionals
3	Lower managers
4	Lower professionals, [higher and middle] clerical and sales personnel
5	Lower clerical and sales personnel
6	Foremen
7	Medium skilled workers
8	Farmers and fishermen
9	Lower skilled workers
10	Lower skilled farm workers
11	Unskilled workers
12	Unskilled farm workers
13	Unskilled workers not specified
-1	No HISCLASS code

HISCLASS 5

1	1 and 2	Elite (higher managers and higher professionals)
2	3, 4, 5 and 6	Lower middle class (lower managers, professionals, clerical and sales personnel and foremen)
3	8	Self-employed farmers and fishermen
4	7 and 9	Skilled workers (medium skilled and lower skilled)
5	10, 11, 12 and 13	Unskilled workers and farm workers
-1	-1	No code in HISCLASS