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Comparing income and wealth inequality in pre-industrial economies: the case of Castile (Spain) in the eighteenth century

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Most research on inequality in pre-industrial economies has focused on either wealth or income, generating not readily comparable results. In this paper, we use a unique data set of Spain circa 1750 including information on (among other things) wealth and income for the same sample of households. Our findings provide methodological insights showing that a household's position in the income distribution is strongly correlated with its position in the wealth distribution but is also influenced by several other household specific characteristics like human capital of the head of the household and the economic sector of her/his main occupation.

1. Introduction

Our knowledge of the evolution of economic inequality within countries in Modern Europe has expanded considerably in the past years. After the seminal paper by Van Zanden (1995) suggesting that economic growth and urbanization were the main drivers of the increase in inequality in Early Modern Europe, a growing body of more recent evidence for several countries and periods showed that the evolution of economic inequality responded to a more complex pattern. For instance, Alfani (2010, 2015) claims that wealth inequality in northern Italy increased during Early Modern times even though income per capita did not grow and Reis (2017) argues that income inequality decreased in a Portuguese economy that stagnated from 1565 to 1770. There are researches of long-term trends in income inequality for England (Allen, 2019), low countries (Ryckbosch, 2016), Japan (Saito, 2015), Poland (Malinowski and Van Zanden, 2017), Spain (Santiago-Caballero, 2011), and USA (Lindert, 2000; Lindert and Williamson, 2016). Researches focused on wealth inequality is available for Ottoman Empire (Canbakal et al., 2018; Ergene et al., 2013), Spain (García-Montero, 2015), and Sweden (Bengtsson et al., 2017).

The two most important dimensions of economic inequality in these studies are related with income (a flow) and wealth (a set of assets). Although many researchers implicitly assume that these two variables are very good substitutes of each other, there is no available study on the relationship between these two variables for pre-industrial Europe.

In general, incomes are composed by the returns to physical assets (capital or land), financial assets, human capital, and raw labor; on the other hand, for a given person or household, the stream of incomes influence savings that accumulate in future wealth. The

relative importance of the different kinds of assets in total wealth and in the generation of income changed substantially with economic growth. In modern societies, the agricultural sector plays a relatively minor role in aggregate production (Caselli 2004), income inequality is only weakly linked to the distribution of land property, and a large bulk of income inequality is related with labor incomes and retribution to human capital (Shorrocks 1982). However, in traditional pre-industrial economies, most of the population worked in the primary sector; land and labor were the most important productive factors; and land property was a major source of income, power, and status. In these economies, where average human capital was relatively low, most of economic inequality is expected to be explained by land distribution. Even though labor retributions can be an important share of the total value of production, if labor is evenly distributed across individuals, its contribution to total income inequality would be small. So far, many scholars have relied on the methodological assumption that, in pre-industrial economies, inequality of assets like land or real estate could be considered a reasonable proxy of income inequality because the different subsets of wealth would correlate very well with each other and all of them would correlate very well with income (for instance, Alfani 2015; Lindert 1991, 2014; Alfani and Ammannati 2017).

The validity of this assumption, which we will scrutinize in this paper, is not completely beyond dispute. In highly urbanized commercial junctures, trading capital is probably important (Soltow and Van Zanden 1998) and in less economically advanced societies, labor income differences can be important: Nicolini and Ramos-Palencia (2016) have suggested that labor incomes contribute up to 65% of income inequality in urban areas of Old Castile in the eighteenth century, and Álvarez and Ramos-Palencia (2018) have stressed the importance of human capital to explain income inequality in the same region and period.

This paper presents a new data set to analyse economic inequality in Spain based on information, circa 1750, from Palencia, Madrid, Guadalajara, and Granada. This data set has some unique characteristics. First, it combines information from two different sources: probate inventories, which contain detailed descriptions of household wealth; and the Ensenada Cadastre, a mid-century government census that contains information about household income, the contribution of each income source (for instance land or labor) to total income, and other characteristics like household head's occupation and ability to sign. Second, the data set enables us to link the households from the set of inventories with their corresponding records in the Cadastre; this connection makes it possible to analyze the relationship between the *income* of a household when the Cadastre was produced and the *wealth* of that household some years later, when its head passes away. This data set opens the possibility to link the distributions of income and wealth so that we can propose hypotheses to understand their differences and the possible shortcomings of using one as a proxy for the other. An important result is that, even though our information on wealth and income come from completely independent sources, there is a remarkably high association between the two variables that suggests they well capture some meaningful dimension of economic affluence.

However, other household characteristics are also relevant to understand the relationship between income and wealth: the occupation of the head of the household and her/his human capital have a sizable impact on the determination of income for a given level of wealth. Our analysis also confirms that for households whose head is working in the primary sector, wealth is strongly associated to incomes from land but for households from the secondary and tertiary sectors, the distribution of labour incomes and entrepreneurial profits have the most important role on shaping the overall distribution of income. The rest of the paper is organized as follows. In Section 2 we discuss previous estimates of economic inequality from the literature. Section 3 describes the Spanish economy's historical context and presents the

data. Our principal findings are summarized in Section 4, and we offer some conclusions in Section 5.

2. Inequality estimation prior to households' surveys

The three leading approaches used by economic historians to study economic inequality are constructing social tables, mining tax records, and analyzing probate inventories. The *social tables* are based on dividing the population (or subset of income earners) into groups (the usual criterion is occupation or social status) and then assigning an average income to each group. If one assumes that most inequality stems from differences *across* groups rather than *within* a group, then this methodology is similar in spirit to the treatment of modern data sets when populations are divided into (say) quintiles. In modern data sets, households are ordered according to their income and so, by definition, the quintiles (or deciles) are nonoverlapping subgroups. In social tables, however, the richest households of one group can be richer than the poorest households of the next highest group (Modalsli 2015). Once the profile of incomes for a population is constructed in this way, standard measures of inequality can be calculated (Williamson and Lindert 1980; Milanovic et al. 2007; Milanovic et al. 2011). For instance, Milanovic et al. (2007) analyzed groups of households having similar income in Old Castile in 1752 with information from the Ensenada Cadastre (as summarized in Ramos-Palencia 2010).

Tax records are another important source of information when seeking to estimate inequality, especially when one considers that the variables of wealth and income have emerged naturally as tax bases in many historical contexts. An already classic example of this approach is in studies by Herlihy (1978) and Herlihy and Klapisch-Zuber (1985) of the Florentine Catasto, which registered households' wealth. Other very well-known example is given by Piketty and co-authors' studies of wealth inequality looking at estate tax returns (Piketty et al. 2006, Atkinson et al. 2009). Alfani (2010) explores wealth inequality in 16th- and seventeenth century Ivrea (Italy) based on records of the *estimi*, a tax on the value of real estate owned by households. Other approaches are based on other kinds of fiscal records: Soltow and van Zanden (1998) use the introduction of an income tax in 1749 in the States of Overijssel to analyze inequality in pre-industrial Holland; and Santiago-Caballero (2011) uses the tithe paid by each grain producer as a proxy for income and then deduces from that information the extent of income inequality in eighteenth century Guadalajara, Spain. Of course, information from such sources is likely to be far from perfect; it is common for taxes to be based on only a subset of the household's assets (usually land or real estate) or on a specific activity or type of consumption linked in some way to the household's income (Soltow and Van Zanden 1998: 26).

Other important sources for any analysis of historical economic inequality are the scattered but numerous collections of probate inventories from around the world (Jones 1980, 1982; Lindert 1981; McCants 2006, 2007). Although such inventories provide extremely rich and detailed descriptions of the wealth of many households, they are not a priori suitable for the study of inequality owing to selection biases (Lindert 1981; Jones 1982). Two biases in particular are commonly identified: first, the age distribution of deceased household heads differs from the age distribution of all household heads; second, richer households are naturally over-represented within the survival inventories. When using probate inventories in this paper, we will follow the recommended approach of dealing with selection bias by constructing weights (or multipliers) to correct for the observed bias. As described in Section 4, our weights use income as an attribute linked to wealth.

Finally, there is an alternative -and indirect- approach suggested by Williamson (2002) who argued that changes in the ratio of average land rent to average unskilled wages are a good proxy for changes in economic inequality. Other authors have modified this idea by using per-capita gross domestic product instead of land rents (Dobado González and García-Montero, 2010; Álvarez-Nogal and Prados de la Escosura 2013).

3. Reconstruction of wealth and income in eighteenth century Spain

3.1. Context and sources

Even though the economic evolution of Modern Spain can be described in general terms as a process of relative retardation, the eighteenth century featured positive changes in Spanish demographic growth, moderate economic expansion, administrative (colonial) reform, and geopolitical relevance. From an economic viewpoint, Herr (1989) points out that "one could draw a geographical line that separated the North and East—where industry was thriving and the farmers were well-off—from the Centre and South, where industry was backward and the farmers and day labourers in the countryside were exploited by the rural oligarchy."

For this paper we chose, from north to south, three regions; the first one corresponds to the province of Palencia; the second one, in the Centre of Castile, is comprised by Guadalajara City and some small towns close to Madrid; the third one, in the South, incorporates some in the province of Granada; see figure 1. In the second half of the eighteenth century, the population of the province of Palencia was distributed irregularly; more than two thirds resided in the province's south (Tierra de Campos and El Cerrato Palentino). These areas were characterized by relatively large population centers with significant secondary and tertiary sectors. In the center of Castile, this paper analyzes Las Vegas, which is close to Madrid City; and Guadalajara City. The Las Vegas economy was predominantly agro-pastoral and produced mainly cereals, vegetables, oil, and wine. The city of Guadalajara (5,218 inhabitants) was an important industrial nucleus during the eighteenth century because the Bourbons established the *Real Fábrica de Paños* (the former Royal Cloth Mills) there in 1719. Finally, we studied two areas in Granada: Lecrín Valley in the southwest and Baza in the northeast, both of them mainly agricultural. An expanded version of this characterization can be found in section A of the Appendix.

Characterization of wealth and income distributions of the populations from these three regions was based on two different and connected data sets. The first one includes information contained in 194 probate inventories (PIs); the second one consists of more than 6,000 Ensenada Cadastre records on the characteristics of households from the same areas as the inventories. A *probate inventory* is a comprehensive list of all the goods owned by a deceased individual at the time of death, and it was usually elaborated by a notary or judicial authority within a few days of that time. They are an excellent source to study material wellbeing providing a very detailed list of the assets owned by the household.

The Ensenada Cadastre (EC) is a census that was undertaken in the middle of the eighteenth century with the purpose of improving the Spanish monarchy's fiscal organization recording the annual income from urban and rural properties (houses and buildings), mortgage and/or property interest collectible and payable, heads of livestock and the personal income (daily wages and/or benefits derived from their profession) of the family head. More details on the characteristics of the sources can be found in section B of the Appendix.

Figure 1. Spain, circa 1750 (Palencia, Madrid, Guadalajara, and Granada).

3.2. Assembling the data set

Once all the available probate inventories of a given location were collected, they were linked (using information on name, spouse's name, childrens' names among other pieces of information) with the incomes recorded in the Cadastre. With the exception of Burgos, Galicia, Madrid and Murcia (the only province in which the Cadastre was repeated as it was riddled with inaccuracies), the collection of information for the Cadastre was practically finished by the end of 1754 and all of the towns included in our sample conducted the Cadastre between 1751 and 1753. Taking these dates into account, we opted to search probate inventories from 1753 onwards.

The PIs in our data set are all the available inventories between the years 1753 and 1768 from 11 geographic units (GUs) in three different regions of Castile. There were two motivations for the particular geographic coverage of these data. First, we sought to collect all the available inventories in the province of Palencia for the purpose of analyzing several economic aspects of that province. For this purpose, we registered 116 inventories from 7 of its GUs (Palencia City, Boedo and Ojeda Valleys, Cerrato, Guardo-Cervera, Saldaña-Valdavia, Tierra de Campos, and Aguilar). Second, we wanted to incorporate two additional regions—one in the Centre of Castile (close to the city of Madrid) and another in the south (in the province of Granada)—so that we could expand on the first data set's number of observations and geographical coverage (figure 2). We selected two GUs in each region (Guadalajara City and Las Vegas in the Centre; Baza and Lecrín Valley in Granada) and collected all the available inventories in each of these four geographic units: 49 inventories in the Centre and 29 inventories in Granada. These were combined with our 116 Palentine PIs to create our 194-PI Data Set 1 (DS1).

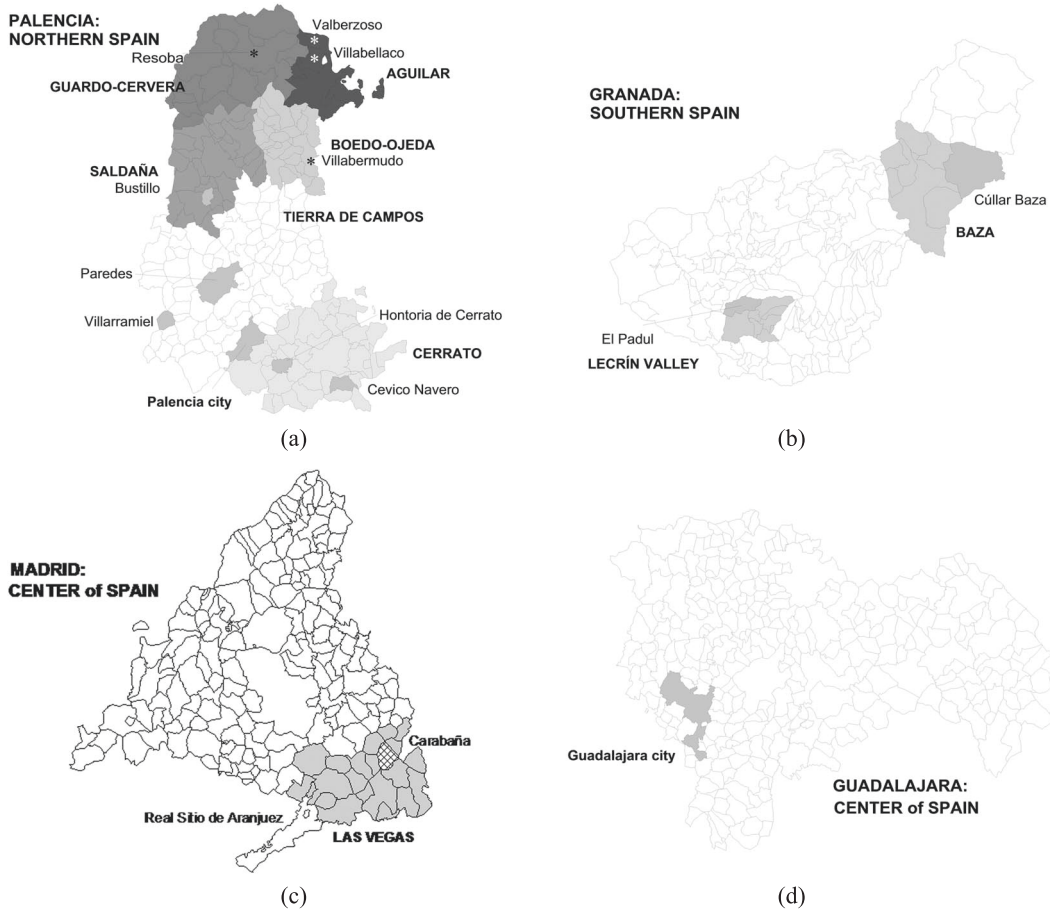

Figure 2. Palencia, Granada, Madrid, and Guadalajara (1753–1768).

An important difference between the 116 inventories in Palencia and the 78 inventories in the Centre and Granada is that, in the former, we have full coverage of the available inventories and they include PIs from all seven GUs. Although we collected all available PIs from two GUs each in the Centre and Granada, those areas are likely not representative of the entire province (see the maps in figure 1).

We complete DS1 by linking the deceased person named in each PI to the corresponding record in the EC. So for each household we assemble economic information that includes total wealth (from the PI) at the time of the household head's death as well as total household income as recorded (by the EC) several years before.

The number of observations in DS1 is 194, and the geographic distribution of these observations is described in column [7] of table 1. The two main variables in our DS1 that are based on the PIs are as follows:

- Wealth: the sum of real estate assets (total of urban and rural properties), financial assets (cash, credits, debts, land rents, advance payments for the funeral service and of estate shares to prospective inheritors), capital assets (farming **implements** and

tools, winemaking and measuring equipment, implements for livestock and for textile production, raw textiles, and livestock) and durable or semi-durable consumption goods (all types of clothes, bed linen, table linen, personal items, etc.). More details on the composition of wealth are given in Nicolini and Ramos-Palencia (2010).

- Year of death: from 1753 to 1768.

The households described by surviving PIs can hardly be other than a biased selection of all households in the population; that is, households with high income and/or wealth are over-represented in the sample of probate inventories. In order to approximate the whole distribution of households in each of the 11 geographical units, we selected one (or two) towns in each GU and recorded all relevant information provided by the EC for every household in those towns; this information is systematized in our Data Set 2 (DS2), which comprises 6,214 households. These data enabled us to approximate the income distribution for each GU. Table 1 reports the information required for this reconstruction process. In the first three columns we present (respectively) the 11 GUs included in our data sets, the provinces in which each is located, and that province's population. Columns [4]–[6] show, for each GU, the number of towns in each province, the average number of households in each town, and total number of households. Column [7] gives the number of PIs in each locality, while columns [8] and [9] list (respectively) the towns included in our DS2 and each town's number of sampled households.

All information in our DS2 (with a total of 6214 observations) comes from the EC, and it yields the following main variables used in the paper.

- Income: this variable is measured in *reales*. One exceptional characteristic of the EC is that it states not only overall household income but also different income sources for each household. In particular the EC distinguishes income derived from (1) land, (2) livestock, (3) buildings and non-land real estate (like mills or barns), (4) ifees, credits and/or debts, and (5) personal earnings. The last item, personal earnings, is the sum of five components as follows: (5-i) labour income of the main activity of the household head; earnings of workers are included here but also incomes of merchants form their commercial activity. (5-ii) additional income obtained from trade associated with the main activity of some workers—for example, profits derived by weavers from selling textiles they produced; (5-iii) labour income from a second occupation (for instance, a shoemaker might generate some additional income by playing the organ in the local church); (5-iv) additional income from trade associated with activity other than the head of household's main activity, as when a shoemaker is also in charge of the distribution of brandy; and (5-v) income derived from agro-pastoral activities on land that is rented from others; this last figure is the net income (that is, after paying the land rents). Components (5-i) and (5-iii) incorporates both labour incomes (with some component of human capital) and profits from activities in commerce and manufacturing; components (5-ii) and (5-iv) are exclusively profits in commerce and manufacturing. So, the sum of components (5-i) to (5-iv) is identified as "Labour and Trade". Component 5-v is called "Land income (tenant)" and it is separated from component (1) because it is not associated to land property but to net land exploitation. It is important to highlight that component 1 can be used as a proxy of land distribution given that income is imputed by taking into account land extension and quality. There are some households for which the occupation is clearly stated but zero total income is recorded. In most of them the heads of the household were women who were supposed to be exempted of taxes. In these cases (productive occupation clearly

Table 1. *Geographic distribution of population and weights in the source data set*

Geographic unit [1]	Province [2]	Population [3]	Towns, villages, and *lugares* [4]	Average number of households [5]	Total number of households [6]	Probate inventories [7]	Towns surveyed [8]	Households sampled [9]	Average size of cities & towns in sample [10]	*Freq* [11]
Aguilar	Palencia	7,168	68	26	1,795	17	Valberzoso, Villabellaco	62	31	29
Baza	Granada	20,918	8	648	5,366	16	Cúllar Baza	678	678	8
Boedo and Ojeda Valleys	Palencia	9,484	45	53	2,385	10	Villabermudo	77	77	31
Cerrato	Palencia	19,372	41	105	4,313	12	Cevico Navero, Hontoria	201	101	21
Guadalajara City	Guadalajara	5,238	1	1,333	1,333	12	Guadalajara City	1,301	1,301	1
Guardo-Cervera	Palencia	11,000	49	48	2,372	21	Resoba	63	63	38
Las Vegas (excl. Aranjuez)	Madrid	23,904	22	284	6,401	37	Carabaña	182	182	35
Lecrín Valley	Granada	9,484	17	139	2,398	13	El Padul	258	258	9
Palencia City	Palencia	9,639	1	2,374	2,374	24	Palencia City	2,259	2,259	1
Saldaña-Valdavia	Palencia	3,652	29	36	1,044	0	Bustillo de la Vega	34	34	31
Tierra de Campos (excl. Palencia City)	Palencia	45,869	75	150	11,220	32	Paredes, Villarramiel	1,099	550	10
Data Set Total		165,728	356	5,196	41,001	194		6,214		
Castile Total		6,570,499			1,685,832					

Notes: In column [3], values reported for the province of Palencia are from Marcos Martín (1985, pp. 21–29) and those for the other provinces are from author calculations based on the EC; data for "Castile Total" (inhabitants c. 1752) are from GRUPO 75 (1977, p. 64). The census from Ensenada Cadastre reports the population in neighbors, not inhabitants. Spanish historiography for that period generally uses the following equivalence: 1 neighbor $\approx$ 4 inhabitants. The size of a listed town may differ from its size in our data set because the number of household heads included in the *Libros de Cabeza de Familia* need not coincide with the quantity of households included in *Libros de Hacienda*, which is our source for information on individual households. The reason is because the *Libros de Hacienda* includes any household member—and not just the household head—who derived income from any kind of property and/or employment. More details in section B of the Appendix.

stated but total income equal to zero) we have imputed an income using information of incomes in the same occupation from the EC. This generates another source of income called "imputed". The impact of this imputation on the estimation of inequality is negligible. More details about the imputing mechanism in Nicolini and Ramos-Palencia (2016: 756).

- Economic sector: the sector in which the household head's main income-generating activity is performed as referred by Books of the Head of Household. We classified household heads as being workers in the primary, secondary, or tertiary sectors in accordance with their reported main jobs and with reference to the Cambridge group's PST system (Wrigley, 2005) and the HISCO/HISCLASS classification scheme documented by van Leeuwen et al. (2002) and van Leeuwen and Maas (2011). When the occupation recorded in the EC was not indicative of an economic sector, we assumed that the focal household head worked in the primary (resp. tertiary) sector if more than half of that head's total income derives from rural (resp. urban) properties. After this procedure, there remained observations for which an economic sector could not be reliably assigned; these instances usually involve the poor, the disabled, and women. For more details on how households are assigned to an economic sector, see Nicolini and Ramos-Palencia (2010).
- Following Álvarez and Ramos-Palencia (2018: 112), we have considered two dimensions of human capital: basic skills, as measured using indicators of literacy, and the working skills required by the household head's main occupation. These variables are
  - Signature: a dichotomic variable that proxies literacy by the ability to sign the statement of the Private Answers of the EC. Only 141 households have information on signature because signatures were recorded in the book *Memorials* which are not available for all the localities.
  - Skill: a dichotomic variable that takes the value 1 if the occupation of the head of the household requires high or medium skill levels or 0 if it requires no or low levels of skills. Occupational skills are assigned according to the HISCO/HISCLASS classification scheme mentioned before. For more details on the relationship between occupation and skills in eighteenth century Spain see Alvarez and Ramos-Palencia (2018).
- Population: data on population of the city-town-village of residence are based on a census of people and buildings undertaken in 1756 followed by a population census (the Vecindario General) in 1759 (see Camarero and Campos, 1991; and, INE 1996).

The DS1, with the 194 observations from PIs, incorporates all the variables from the EC and also the variable wealth from the PIs.

4. Estimation and results

An unusual characteristic of our data sets is the coexistence of a *complete* set of a given area's available inventories and a *representative* set of household incomes in that area. For the 116 observations from Palencia, we can compare the distribution of inventories (recall that our PI data is complete for that region) with the income distribution among the related population. This latter distribution is approximated by first compiling a complete list of the households of one town in each GU and then using population-based weights (in column [11] of table 1) to compensate for the quantity of households in the towns of each locality *not* being proportional

to that GU's total population. Two kinds of weightings are applied in this paper. The first one is based on population and is devised for the purpose of constructing, for each region, a corrected income distribution from the data in the EC. The bias that we seek to minimize here is that the sample size of each GU in each region is not proportional to that region's population. In Palencia, for example, Guardo-Cervera has 63 of the observations in DS2 (1.5% of the province's total) but comprises 9.3% of the households in Palencia. In this case we weight each observation in DS2 by the ratio of relative population to relative sample size. The second weighting strategy is income based and is intended to construct a corrected wealth distribution using each GU's income distribution (obtained via the first strategy). The problem to be solved here is that wealthier households are over-represented in the surviving probate inventories; we would therefore like to give more weight (in the wealth distribution) to PIs coming from relatively poorer households. Section 4 explains this weighting strategy in more detail (when we present the econometric estimations).

In the province of Palencia, only 2.6% of the inventories come from households in the first (lowest) income quintile and another 7.8% come from the second quintile; thus, the 40% of households in the distribution's bottom part account for only 10.4% of all inventories, which means that the size of the selection bias is considerable. Despite this evident strong selection bias of PIs, our matched data reveal that households whose income is below the median are not completely absent from the records of wealth. In particular: the weighted median income in Palencia in DS2 is 698 *reales*, and in DS1 altogether 23 (19.8%) of Palentine households have income below that level; the implication is that nearly a fifth of the PIs are from households whose income is below the median.

In the combined sample of the three localities, weighted average income is 1,972.0 *reales* while weighted average wealth is 24,492.6 *reales*. The distributions of the levels of the two variables are positively skewed (the median is smaller than the mean because there are few observations with very large values) and the logarithmic transformation of the two variables is much more symmetric. In fact, standard tests do not reject normality in the log transformation or neither wealth nor income. As expected, the (weighted) Gini index is larger for the wealth distribution (57.36) than for income distribution (50.99).

Regarding the relative importance of the different sources of income across the income distribution, one could posit that labor income (or, more generally, our category "Labor and Trade" income) is relatively larger in the bottom part of the distribution resulting in a less-than-proportional increase in income (vis-à-vis wealth). Table 2 confirms that this seems to be the case; the table shows different percentiles with their average total income, average income from different sources (as explained in section 3.B), number of inventories in each group and average wealth according the PIs. With the exception of the first income group, the share of labor income in total income (Column 8) decreases as long as we move upwards within the income distribution while the opposite happens with the shares of land income and livestock income in total income (Columns 4 and 5 respectively); the peculiarity of the first income group is probably related with the fact that in the very bottom of the distribution there are some households with extremely low or zero labour income whose head's occupation are characterized as "widow" or "pauper". The information in table 2 also confirms that there is a positive association between average total income (Column 3) and average wealth (Column 11) of each group.

If we move upwards within the income distribution, economic specialization and occupational structure change. The shares of household's heads working in the primary and secondary sector decrease while the household whose head works in the tertiary sector are relatively more frequent in the top of the distribution: only 3.2% of the head of households

Table 2. *Sources of income across the income distribution in the Ensenada Cadastre data set*

	Ensenada Cadastre (EC)								Probate inventories	
		Average income in *reales*								
Income intervals in *reales** [1]	Households sampled* [2]	Total income [3]	Land properties [4]	Livestock [5]	Buildings and non-land real estate [6]	Financial assets (census) [7]	Labour and trade [8]	Land income (tenant) [9]	Inventories [10]	Average wealth in *reales* [11]
<=360	1,836 [29%]	161.9	16.2	3.4	19.9	−3.6	125.7	0.3	7	4,336.6
>360 and < =540	1,484 [24%]	460.1	25.3	10.7	15.1	−3.6	411.4	1.2	14	6,229.0
>540 and < =986	1,345 [22%]	735.5	91.0	25.2	37.7	−8.8	583.0	7.5	44	8,023.5
>986 and < =3,284	1,239 [20%]	1,614.7	343.2	116.2	79.1	−34.2	1,047.1	63.4	102	20,534.8
Richest 5% > 3,284	310 [05%]	6,988.8	1,975.5	756.9	302.8	−104.7	3,650.7	407.5	27	80,978.4
Average	6,214 [100%]	987.5	197.5	70.0	48.5	−15.9	652.5	35.0		

Source: Author calculations.

Note (*): Income intervals in *reales* are calculated from the dataset in Ensenada Cadastre; the Household Income Percentiles used are the 29% (360 reales), 53% (540 reales), 75% (986 reales), and 95% (3,284 reales), respectively. The groups are not equally sized because many households have exactly the same income of 360 *reales* and 540 *reales* which are the values of the 25^{th} and 50^{th} percentile. Hence, for instance, in the first income bracket (<=360) all the households with income of 360 *reales* are included.

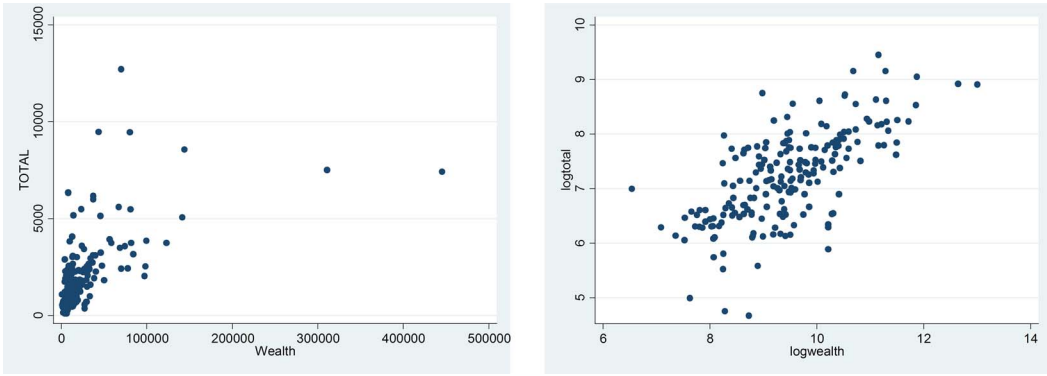

Figure 3. Wealth and total income in the 194 inventories. Graph 1 Variables in levels. Graph 2 Variables in logarithms. Source: Author calculations.

in the bottom 29% of the income distribution work in the tertiary sector but 27% of them do so in the top 5% of the distribution. The most usual occupations in the first income bracket of table 2 are "*Jornalero*", a daily laborer (without specifying economic sector), and "Worker of Gremio de la Puebla", an artisan in the traditional textile sector. In the second income bracket, "*Mancebo del Campo*" (a daily laborer in agricultural activities) and "*Jornalero*" are the first and the second more frequent and the category of farmers ("*Labrador*") appears third in the list. In the third income group, "Labrador" is the most frequent followed by "*Jornalero*" and "*Mancebo del Campo*". In the quintile between 75% and 95% of the income distribution, the most frequent occupation is by far "*Labrador*" (much more frequent than the second in the list "Gremio de la Puebla"). Finally, in the top 5% of the income distribution the two most frequent categories are "*Labrador*" and Merchant ("*Mercader*"). Of course, the occupation of the head of the households is directly related to the relative importance of the different sources of income: within the group of merchants in the top ventile, 95% of total income is from Labor and Trade while, 80% of total income comes from land or livestock within the group of *Labradores*.

Probably the most important advantage of our data set is the possibility to establish a precise relationship between income (when the Cadastre was produced) and wealth (when the household head died) for each household in DS1. In figure 3, Graphs 1 and 2 plot this relationship when using variables given in (respectively) levels and logs. The association revealed in each graph—and especially the second—is remarkable.

It is difficult here to infer a causal relationship between income and wealth because, on the one hand, wealth can be viewed as the accumulation of past income streams and, on the other hand, income is determined in part by the returns on wealth. In the case of societies such as the Ancien Régime, the tendency is to suppose that, because wealth does not change significantly within a generation, wealth drives income more so than income drives wealth (Alfani 2010, p. 514). In any event, our econometric approach is more in the line of a descriptive aid to understanding the association between variables—and possibly to inferring how one variable's distribution is affected by that of some other variable. That is, we do not attempt to explain one variable's behavior by identifying exogenous variation in the other variable.

For the purpose of devising a simple theoretical framework in which to discuss the relationship between these two variables, we assume that the deceased household head's wealth equals that of an individual still thriving and that income is a function of wealth. We then hypothesize that

$$X_i = Y_i + r\,\mathrm{PW}_i \tag{1}$$

$$\mathrm{TW}_i = \mathrm{NPW}_i + \mathrm{PW}_i \tag{2}$$

In these equations, X_i is the income of household i, Y_i is the wage, TW_i is total wealth (as recorded in inventories), PW_i is productive wealth or wealth that produces a flow of economic returns (as with land, for instance), NPW_i is nonproductive wealth (e.g., durable consumption goods), and r is the average rate of return on productive wealth.

In the simplest case, where the rate of return on productive assets is the same for every household and where both wages and non-productive wealth are zero, income will be a constant proportion of total wealth and so inequality of income or wealth (as measured by standard indices, such as the Gini index), will be equal. A possible explanation for the empirical evidence that wealth inequality always exceeds income inequality is that wages are nonzero and also larger (as a share of total income) in the lower part of the distribution but Nicolini and Ramos-Palencia (2016) have shown that, for a sample of households in Palencia (circa 1750) labor incomes have a positive contribution to total income inequality and therefore they are positively correlated with total income.

After characterizing both income and wealth in terms of levels, one can estimate.

$$X_i = \alpha + \beta\,\mathrm{TW}_i + \gamma Zi + e_i \tag{3}$$

As before, X_i and TW_i denote household i's income and total wealth (respectively); here Z_i is a set of control variables linked to the focal household's observable economic characteristics (e.g., economic sector, place of residence, skill of the head of the household, etc.). The estimated α would be the income level when wealth and all the control variables are equal to zero), and the estimate β would be the rate of return on wealth. Because inventories incorporate total wealth, β is a downward-biased estimate of the rate of return on productive wealth.

We mentioned previously that the PIs available in archives (which are the base for our DS1) are not a random sample of the households in their geographic area because the more affluent households are over-represented. In order to correct for this selection bias, we first constructed a distribution of household income for the 11 GUs in our DS2. Because the number of observations in each GU is not proportional to its population, we weight each observation in DS2 so as to make the relative size of each GU proportional to its relative population. Then, given that distribution, we calculated the percentage of households in our DS1 that belong to the corresponding income group in DS2; see table 3. Suppose we consider the 194 observations of the three regions together; then there are only 4 households (out of those 194 with PIs) in the first quintile, which implies that the poorest 20% of households accounted for only 2.1% of the inventories. At the other extreme, the richest 10% of households accounted for 39.7% of the inventories; this means that households in the highest *decile* are 37.8 times more likely to be included in the collection of probate inventories than are households in the lowest *quintile*. Our econometric model addresses this problem by weighting each observation in DS1 with the ratio between the percentage of household

Table 3. *Weights and income ranges in probate inventories, c. 1750–1770*

Weights	Inventories	% Inventories	% Population	Income ranges From	To
9.70	4	2.1	20	0.0	264.0
6.47	6	3.1	20	264.5	450.0
1.49	26	13.4	20	451.5	662.5
0.78	25	12.9	10	663.0	897.5
1.29	15	7.7	10	898.0	1,122.5
0.47	41	21.1	10	1,123.0	1,808.0
0.25	77	39.7	10	1,810.0	61,350.0
	194	100.0			

Source: Author calculations.

Table 4. *Linear relationship between income, wealth, and household characteristc (levels), OLS*

	Dependent variable: *Income*		
	(A)	(B)	(C)
Wealth	0.030*** (0.003)	0.029*** (0.003)	0.020*** (0.002)
Secondary		412.198** (204.750)	−80.399 (146.965)
Tertiary		506.792* (281.447)	−64.710 (238.454)
Population		−0.024 (0.0269)	
Skill			884.845*** (167.200)
Literacy			355.170*** (119.884)
Constant	557.80*** (71.255)	537.617*** (93.285)	394.101*** (70.048)
R-squared	0.395	0.4145	0.6382
Adj R-squared	0.392	0.4021	0.6248
F-statistic	125.32	33.45	47.62
N	194	194	141

Source: Author calculations. *Note:* Standard errors are reported in parentheses. Significant at *10%, **5%, ***1%.

in its quintile and the percentage of inventories in that quintile in DS2. This is the strategy suggested by Lindert (1981) and applied by previous researchers using the information from PIs to calculate average wealth or wealth inequality (Jones 1982; Lindert 1986; Roine and Waldenström 2015).

The results from our weighted regression of equation (3) are presented in table 4. The first specification in column A shows that wealth is highly significant predictor of income and it explains almost 40% of the variance of this variable (adjusted R^2 of 0.39). The value of the constant is 557 *reales*; this can be interpreted as the annual wage that those with hardly any wealth would earn and it is not very far from what many *jornaleros* (day laborers) did actually earn. The β-value of 0.030, which is equivalent to r in equation (1), means that an increase in wealth of 100 monetary units is associated with an increase in income of 3 monetary units. If one assumes that wealth is exogenous and that causality runs from wealth to income, then we can use this information to conclude (howsoever provisionally) that the average rate of return would be 3%. In Castile during this period, the rates of return on financial investments range from 3 to 10% (Yun-Casalilla 1987: 357; Álvarez-Nogal 2009: 129–30).

The second specification in column B includes, together with wealth, three other variables: the two dummy variables that identify the economic sector of the head of the household, and the population size of the town or city where the household is located. The dummy *Secondary* is statistically significant and its value of 412 indicates that on average, a head of the household working in the secondary sector would earn 412 *reales* more than a person with the same wealth in the primary (omitted) sector. The effect of working in the tertiary sector seems to be slightly larger than working in the secondary sector, but we can reject the hypothesis of this parameter being equal to zero only at 90% of confidence. Conditional on the other variables, population size does not seem to influence income. The addition of these variables does not produce a sizeable impact on the R^2.

Lastly, Specification 3 in column C omits the variable *Population* and incorporates our two dichotomous variables representing levels of human capital: *Literacy* and *Skill*. The parameters of both these variables are highly significant showing that human capital is an important element influencing the relationship between income and wealth. Additionally, the parameter associated to wealth is smaller than in Specification 1 suggesting that there is some positive correlation between wealth and our measures of human capital. The parameters of the two variables of economic sectors lose statistical significance, suggesting a positive correlation between them and our human capital variables. The percentage of explained variance increases substantially (adjusted $R^2 = 0.62$). We will discuss some implications of these results in the next section.

Although analysis in terms of a linear relationship is extremely useful, figure 3's Graph 1 and the pattern of residuals both suggest that a linear specification is likely suboptimal in light of the data's concavity. If the aim is to model nonlinear relationship between the variables, a log-in-log specification is theoretically appealing on two counts: (i) it uses the log of income, which is consistent with empirical observations documenting that the income distribution is well approximated by a log-normal distribution (Modalsli 2015); and (ii) it presumes (implicitly) that the wealth elasticity of income is constant, which allows for straightforward comparisons of this variable across different estimations. Furthermore, if we assume that wages are well described by a log-normal distribution, then we can use the approach advocated by Davidson and McKinnon (1981) to assess the relative merits of a semi-log approximation (with wages in logs and wealth in levels) and a log–log approximation (with both variables in logs). That test clearly rejects the semi-log in favour of the log–log approximation. We therefore estimated the following alternative specification, in which the two main variables are logs:

$$x_i = \alpha' + \beta' \, \mathrm{tw}_i + \gamma' \mathrm{Z}_i + e'_i \tag{4}$$

Here, x_i is the log of household i 's income, tw_i is the log of that household's total wealth, and Z_i is a set of other household characteristics.

In this case, the parameter β' can be interpreted as the percentage change in income associated with each percentage-point increase in wealth. Results of the regression with variables in logs are reported in table 5.

Specification 1 in column A shows the simplest case with only wealth as a regressor. Here the elasticity of 0.626 suggests that an increase of 1 percentage point in wealth is associated with an increase of slightly more than half a percentage point in income. Specification 2 in column B includes the two dummies for economic sectors and the log of population. Coefficients for the dummies indicating secondary and tertiary sectors are positive and very similar to each other (0.715 and 0.741 respectively); this result suggests that, for a given level

Table 5. *Linear relationship between income, wealth and household characteristic (logarithms), OLS*

	Dependent variable: logarithm of *Income*		
	(A)	(B)	(C)
Log of wealth	0.626*** (0.058)	0.573*** (0.056)	0.397*** (0.057)
Secondary		0.715*** (0.146)	0.444*** (0.137)
Tertiary		0.741*** (0.218)	0.282 (0.210)
Log of popul.		−0.084** (0.039)	−0.152*** (0.034)
Literacy (sign.)			0.067 (0.117)
Skill (occup.)			0.737*** (0.150)
Constant	0.086* (0.511)	1.763*** (0.593)	3.724*** (0.560)
R-squared	0.376	0.465	0.611
Adj R-squared	0.372	0.454	0.594
F-statistic	115.53	41.08	35.10
N	194	194	141

Source: Author calculations. *Note:* Standard errors are reported in parentheses. Significant at *10%, **5%, ***1%.

of wealth, income is around 100% higher for households whose head is working in those sectors (vis-à-vis the omitted primary sector). Additionally, the parameter associated with population is negative and statistically significant suggesting that income would be smaller in larger towns, once you control for wealth and economic sector.

The inclusion of the two variables of human capital in Specification 3 (column C) reduces wealth elasticity compared with the two previous specifications; this suggests, like in the case of the estimation in levels, that human capital is correlated with wealth and that some of the influence of wealth on income (found in the simpler specification) goes through the correlation between wealth and human capital. In this specification, the estimated parameter related to Literacy is not significant but the one of Skills (proxied by occupation) is statistically significant and economically relevant. An estimated parameter of 0.737 implies that the change from a low-skilled occupation to a high-skilled occupation would increase household income by more than 100%. As expected, the two variables capturing human capital are correlated with each other: the parameter associated to *Literacy* becomes significant if *Skill* and *Population* are excluded from the regression. The parameter associated to tertiary sector is not statistically significant in Specification 3 suggesting that, after controlling for human capital, working in the tertiary sectors does not add income for a given level of wealth. Although smaller than in Specification 2, the parameter of the variable Secondary is still statistically significant: working in the secondary sector would imply a 55% larger household's income than working in agriculture, ceteris paribus.

Given that the EC provides a description of the occupation of the head of the household we can check if the association between wealth and income is similar across economic sectors (primary, secondary and tertiary). Figure 4 shows the associations between the log of wealth and the log of total income for the 194 observations in DS1. In the upper left block, the graph includes the households for which the economic sector is not specified in the data set. The other three blocks show that the positive association between the two variables is noticeable in the three sectors. Table 6 reports the results of simple OLS regression between overall income and wealth for each of the three economic sectors confirming, despite of the very small sample size, that wealth is a good predictor for household income in the three sectors.

Figure 4. The association between income and wealth across the three economic sectors. *Source:* Author calculations.

Table 6. *Relationship between total income and wealth across sectors (in logarithms), OLS*

	Dependent variable: *Log INCOME*		
	Primary sector	Secondary sector	Tertiary sector
Log wealth	0.642*** (0.054)	0 .315** (0 .065)	0.396*** (0.09)
Constant	1.112** (0.515)	4.432*** (0.625)	3.726*** (0.84)
R-squared	0.537	0.352	0.529
Adj R-squared	0.533	0.337	0.504
F-statistic	139.52	22.88	21.34
N	122	44	21

Source: Author calculations. *Note:* Standard errors are reported in parentheses. Significant at *10%, **5%, ***1%. Total observations across the three regressions are less than the original 194 because there are seven households whose occupation description does not allow to assign an economic sector.

From a methodological point of view, this finding reinforces the idea that wealth and income can be reasonable substitutes when analysing economic inequality.

In order to explore the role of each income source in this association between wealth and income, we take advantage that the EC provides specific information on the different sources of income for each household in our two data sets. Incomes from land, other real estate assets and livestock are clearly stated for each household in the EC. Labour incomes and entrepreneurial profits in the secondary and tertiary sector are summarized in the category "Labour and Trade" (components 5-i to 5-iv mentioned and described in the previous section) which proxies reasonably well incomes related to labour, human capital and entrepreneurial profits. With this information we generated figure 5 showing the association between the log of wealth and the log of income derived exclusively from land (component 1

Figure 5. The association between income from land and wealth across the three economic sectors. *Source:* Author calculations.

in previous section): the two variables are clearly and positively associated in the subsample with households related to primary sector (upper right block of figure 5) but the association is clearly weaker in the other two sectors.

The opposite seems to be true when we look at the association between the log of total wealth and the log of "Labour and Trade" component. Figure 6 suggest that for these variables the association is stronger in the secondary and tertiary sectors (the two blocks at the bottom of the graph) than in the primary sector (upper right block). Confirming this hypothesis would entail to uncover two different underlying mechanisms driving the association between wealth and income: in agrarian sectors wealth distribution is mainly associated to incomes from land while in the more modern sectors mostly linked to urban networks, wealth is associated to labour incomes and profits from trade and manufacturing.

In order to get a more formal quantitative support to this hypothesis we have run simple OLS regressions between the variables and across sectors. The first block of table 7 shows the results of the regression of the logs of land income on the log of total wealth, and the second block of the table shows the result of the regression of logs of income from "Labour and trade" on the log of total wealth. The results confirm that wealth is associated to land income in the primary sector and this association disappears in the other two sectors; on the other hand, wealth is associated to "Labour and trade" income in the secondary and tertiary sectors and this association is not observable in the primary sector. Of course, the sample is very small and even smaller when it is restricted to some economic sectors (only 13 observations in the tertiary sector in the first regression), but the statistically significant parameters in four of the six regressions tend to reinforce the hypothesis of different patterns of inequality suggested by figures 5 and 6.

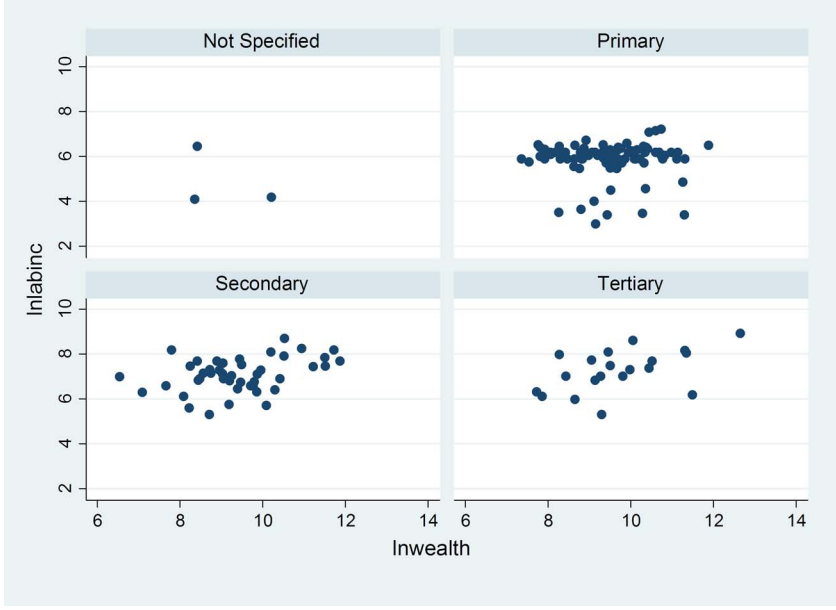

Figure 6. The association between personal income and wealth across the three economic sectors. *Source:* Author calculations.

Table 7. *Relationship between land income, labour and trade income, and wealth across sectors (in logarithms), OLS*

	Dependent variable: *Log LANDINCOME*			Dependent variable: *Log LABINCOME*		
	Primary sector	Secondary sector	Tertiary sector	Primary sector	Secondary sector	Tertiary sector
Log wealth	0.917***	0.267	0.087	−0.004	0.233**	0.372**
	(0.104)	(0.279)	(0.334)	(0.080)	(0.090)	(0.148)
Constant	−2.467**	3.144	4.780	5.924***	4.884***	3.642**
	(0.992)	(2.701)	(3.320)	(0.760)	(0.857)	(1.452)
R-squared	0.417	0.042	0.006	0.000	0.137	0.259
Adj R-squared	0.412	−0.004	−0.084	−0.010	0.116	0.218
F-statistic	77.96	0.91	0.07	0.00	6.64	6.30
N	111	23	13	101	44	20

Source: Author calculations. *Note:* Standard errors are reported in parentheses. Significant at *10%, **5%, ***1%. Total observations across the three regressions are less than the original 194 because there are seven households whose occupation description does not allow to assign an economic sector and some households have zero labour income.

5. Conclusions

We find that the income assigned by the EC and the wealth registered in the PIs are closely associated suggesting that both variables capture very well a unique dimension of economic inequality in pre-industrial economies and that a given household's location in one

distribution depends strongly on its location in the other. Given that many times, data scarcity forces researchers to use the distribution of wealth, real estate or other assets to approximate the distribution of income (Alfani and Ammannati 2017, Lindert 2014), the confirmation that household's wealth can be a very good predictor of income is extremely valuable from a methodological point of view.

Using an econometric specification in which both income and wealth are stated in terms of their logarithms the elasticity of income with respect to wealth varies between 0.4 and 0.6 (depending on the specification). These values imply that a 10% increase in the wealth of a household is associated with its income being from 4% to 6% higher. Elasticity that is less than 1 is consistent with general observations –confirmed with our data- that wealth inequality is greater than income inequality.

The parameters associated with our *Secondary* and *Tertiary* dummy variables are positive and the former is statistically significant in all the specifications. This result suggests that, for a given level of wealth, households with a head who works in one of those sectors, particularly in the secondary sector, tend to have more income than households with a head who works in the primary sector. Variables proxying human capital also have a sizable impact on the income distribution: for a given level of wealth those heads of households with skills (mainly captured by the kind of occupation but also by the ability to sign) have significantly larger incomes than those without skills highlighting the importance of the human capital in the determination of labor incomes (Alvarez and Ramos-Palencia 2018).

For instance, using the parameters obtained in the regression in levels (specification C in table 4), we can compare the income predicted by our equation for a head of a household without any wealth or human capital and working in the agricultural sector (394 *reales*) with the income predicted for a similar household but with some human capital; if we add literacy to this head of the household, income would increase 90% (up to 749 *reales*) and if we predict the income with a high-skill occupation income would increase 224% (up to 1278 *reales*). A similar exercise can be done with the regression using variables in logs (specification C in table 5); in this case a household working in the secondary sector would have an income 55% larger than a household with the same wealth and whose head has the same level of human capital but works in the primary sector; a household with a skilled head working in the secondary sector will have an income 220% higher than the baseline case (i.e. agricultural non-skilled) with the same level of wealth.

These examples show that the way in which the wealth and income distributions are related is more complex than the one suggested by a pure traditional and agricultural society in which land and real estate are the only productive assets generating social differentiation. Rather, our results suggest the relationship between income and wealth can be affected in some non -trivial ways if the whole society or some households experience shocks like mortality picks or migration (voluntary or forced) that change the nature and strength of that correlation; in particular, they coincide with other approaches emphasizing the role of human capital and labor incomes in shaping the income distribution (Nicolini and Ramos-Palencia 2016) and the possible effect of changes in the relative supply and demand of skills in the long run evolution of inequality (Van Zanden 1995).

The positive association between income and wealth is observable in the three sectors (Agriculture, Manufacturing and Services) but while in the primary sector income from land is the one that correlates with total household's wealth, this variable is more closely associated to labor incomes in the secondary and tertiary sectors. These systematic differences in the relationship between income sources and wealth across economic sectors confirm that there is not a unique pattern of inequality in the different parts of the society. There is a kind of a

"traditional" inequality with a close relationship between real estate wealth and income in the agrarian sector but, in the more dynamic sectors associated with manufactures, services and urban networks, inequality is different and more related to labor incomes, entrepreneurial activity and, human capital.

This multidimensional nature of the income inequality is not necessarily surprising, and the roles of different kinds of assets and human capital in the income distribution have been already emphasized for urban sophisticated economies in the seventeenth and eighteenth centuries (Soltow and Van Zanden 1998). However, the confirmation of this pattern in a relatively backward and traditional economy (Álvarez-Nogal and Prados de la Escosura 2013) would suggest that in Modern Europe, structural change, urbanization and sophistication of labor markets would generate complex changes in the income distribution and in the relationship between overall income, income sources and wealth that can be overlooked if we focus only on one dimension of economic inequality.

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