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by

BRIAN A'HEARN,

STEFANO CHIANESE

AND GIOVANNI VECCHI

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The Economy in Leonardo da Vinci's Time

Brian A'Hearn
Pembroke College, University of Oxford

Stefano Chianese
University of Rome "Tor Vergata"

Giovanni Vecchi
University of Rome "Tor Vergata"

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Abstract

This paper presents the main economic features, in quantitative terms, of the society in which Leonardo Da Vinci lived from the second half of the 15th century to the early 16th century. Using data from Florence's Land Register of 1427 combined with new data on the household budgets of Leonardo and of his family, the paper proposes two hypotheses. The first regards the importance of the demand for goods linked to art and culture. The city's economic élite managed to appropriate about two thirds of the economy's surplus for itself (i.e. what was left after the population had been guaranteed a minimum level of subsistence) and it showed a growing demand for luxury goods that permitted and incentivized the work of talented individuals of the time. In this context, Leonardo's genius fell on fertile ground. The second hypothesis regards pre-industrial social mobility (upward mobility in particular): Leonardo's household accounts support the theory that the economic fluidity of renaissance Florence may have been considerably greater than the literature on economic history would have us believe.

Keywords: Renaissance; Tuscany; Florence; household budgets; living standards; economic inequality; social mobility.

JEL classification: N01, N33, I30, D63.

1 Introduction

What has economics to say about the Renaissance? One certainly feels an unease about reducing one of western civilisation's great moments to the working of supply and demand; yet there is something in it. The *supply* of artistic and intellectual innovations may have been a cultural phenomenon, following its own internal dynamic. But even here the development of a commercial society, with its requirements for literacy and numeracy, its bustling cities and entrepreneurial spirit, and its links with trading partners throughout the known world, cannot have been without importance. And when it comes to the *demand* for art, architecture, and ideas, it is impossible to ignore the role of wealth, incomes, prices, and the market, properly the realm of economics. Leonardo's Florence, and North-Central Italy more broadly, was an unusual time and place in preindustrial Europe. It offered an unparalleled concentration of wealth, which found its way into status competition, conspicuous consumption, and a market for cultural innovations.

In this paper, inspired by the 500th anniversary of Leonardo's death, we therefore investigate two areas of interest. First, we describe, in quantitative terms, the main characteristics of the economy in Leonardo's day, covering a timespan running from about 1450 to 1520. The methodological approach is mainly quantitative (and 'cliometric'), thanks to the availability of new and fairly abundant micro- and macroeconomic data (Section 2). The second area of study involves estimating Leonardo's standard of living, looking for confirmation in his own household accounts (Section 3). Our interest in Leonardo's family budgets, which is all the more justified by this aspect of his life having been little examined as yet, provides us with the opportunity to look at two questions of wider interest (Section 4). The first is whether Leonardo was able to become one of the greatest geniuses of all time thanks to supply-side factors ('Leonardo as the expression of the extraordinary level of culture reached in Florence in the 15th century') or, on the contrary, thanks to economic factors on the demand side ('Leonardo as a response to the growing demand for luxury and artistic goods by an élite appropriating the surplus of a thriving Florentine economy'). The second question deals with the issue of social mobility: Leonardo's economic life does not, of course, allow us to make any statistical inferences, but it suggests or at least contributes to the hypothesis that, even in pre-industrial societies, merit and talent make

it possible to climb the social and economic ladder more easily than has been suggested by most of the historiography (Barone and Mocetti, 2018).

2 How prosperous was the economy in Leonardo's time?

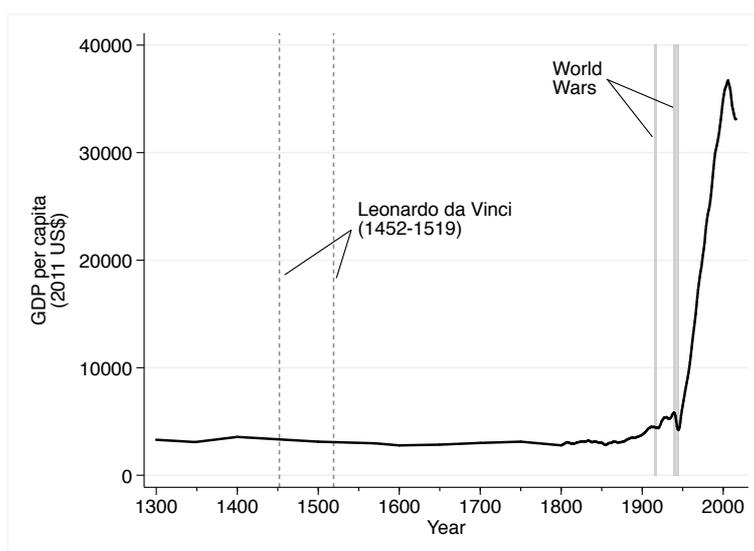
The reconstruction of historical statistics covering several centuries has made much progress over the last few decades. Economic historians have tended to focus on macroeconomic indicators, typically those defined in national accounts systems, and they have given priority to Gross Domestic Product (GDP). This is neither an easy task at the empirical level, nor from the conceptual point of view. As regards the difficulty of finding suitable sources and data, there is not much to add to the problems listed by the pioneers of this discipline – time and technology have simply enabled the production of historical statistical series to accelerate. From the conceptual point of view, even if this not the occasion to go into detail, it is important to remember Fenoaltea's (2018) claim that despite its name, GDP may not be a good measure of a nation's total product, but only of a part, i.e. 'predominantly market-oriented, paid-employment-generating economic activity'. The home production carried out by women, to give just one concrete example, is not included in the calculation of GDP. This is a very significant omission given that this indicator is used to study the distant past, when the economy was predominantly rural and women worked primarily in the home. With these caveats in mind, we shall begin this section by examining the estimates of Italy's GDP over the last seven centuries.

2.1 Italy

The long-term trend of Italy's per capita GDP (see Figure 1) shows that there was substantial stagnation during the entire pre-unification period. There is a significant difference between the level of per capita GDP prevailing in the pre-industrial economy and the levels observed today – there has been a 13-fold increase, net of inflation.

The scale used in Figure 1 obscures both the frequency and the intensity of annual variations. It should be borne in mind that although the Italian economy was probably ahead of its time, technologically speaking, in the early Middle Ages (Cipolla 1952),

Figure 1 – Italy’s per capita GDP, from 1300 to the present day.

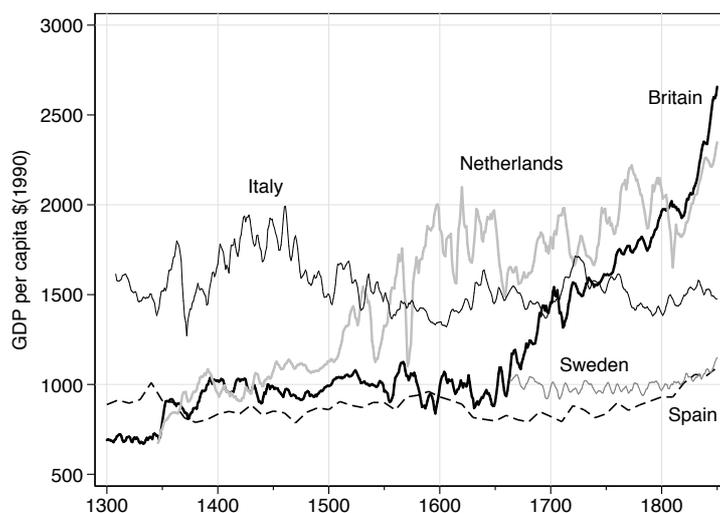


Source: for the years 1300-1860, the Maddison project. From 1861, estimates based on Brunetti et al. (2017).

there were frequent famines, even within the same generation, and the same was true of wars, epidemics and numerous other calamities, the effects of which were clearly significant for the living conditions of the population. Figure 1 traces a long flat line that is a useful stylization to capture the radical change that took place with the advent of “modern economic development”, as described by Kuznets (1966), but it doesn’t do justice to the cyclical movements of the series. These can be seen by isolating the pre-industrial era (Figure 2).

According to Figure 2, in Leonardo’s time, or, more precisely, at the time Leonardo was born, north-central Italy was the richest place in Europe: the place to be. Yet the graph shows a clear downward trend: decade after decade, despite an increase in the total GDP of the Italian economy, we observe a slow but inexorable decline in *per capita* GDP, as the former was accompanied by an even greater increase in the population, (Malanima 2006, 21). Despite this decline, Italy remained one of the most advanced countries until the mid-1700s.

Figure 2 – GDP per capita in selected European economies, 1300–1800.



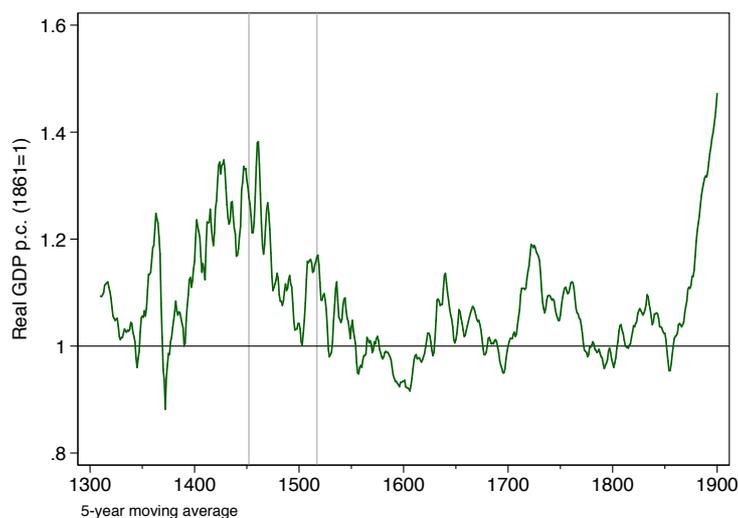
Source: A’Hearn (2014). The graph shows 3-year moving averages.

2.2 Tuscany

To understand the living conditions that prevailed in the Tuscan economy at the time of the renaissance, Figure 3 makes a comparison with the situation four centuries later, immediately after unification in 1861. For this period, we have tolerably accurate estimates of GDP, according to which per capita GDP in the center-north was about €2,246 at 2013 prices (Brunetti et al. 2017). Today, the figure is more than 14 times greater! Other indicators for northern Italy paint a picture of considerable backwardness. Absolute poverty, defined by the standards of the day, stood at roughly 35% of the population, perhaps half of them in *extreme* poverty – unable even to purchase an adequate diet (Amendola et al. 2017). In Figure 3 we compare renaissance living standards against 1861, a well-understood reference point.

Malanima’s widely-cited estimates of per capita GDP indicate that in Leonardo’s lifetime it was 16-26% *higher* than in the 1860s (Malanima 2003, 2010). That would provide a fair bit of room for better standards of living and lower poverty rates. Malanima offers a poverty line estimate for 1460-70 at 26.3 current Florentine lire; his GDP p.c. estimate for that decade (64.8 lire) is 2.44 times the poverty line. In 1860-70 his calculations put that ratio at only 1.56. Renaissance living standards were (almost) twice as high as those prevailing in Italy in the aftermath of Unification.

Figure 3 – Real GDP per capita, 1300-1900 (1861 = 1).



Source: Malanima and our calculations.

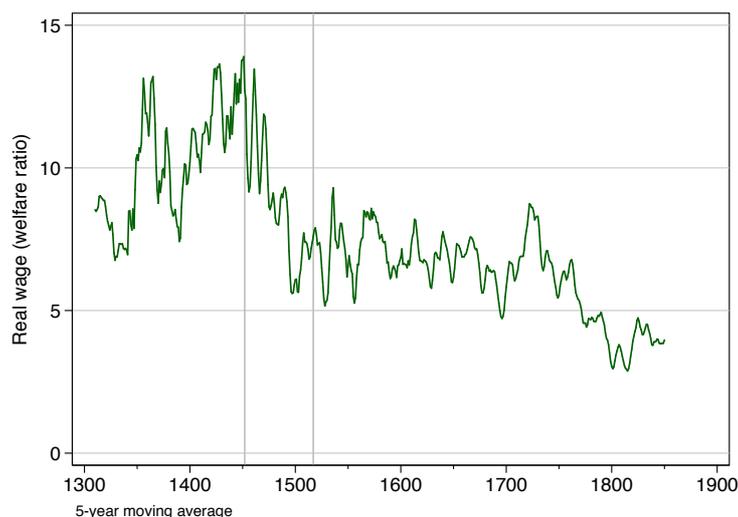
The GDP estimates cannot be taken at face value, in isolation. They are indirect estimates based on prices, wages, and urbanisation rates, assuming relationships calibrated from 19th and 20th century data. And the wage and price data are from Florence alone in our period (later spliced to Milan).¹ In Figure 4 we consider real wages. Here the decline from Leonardo's day to the moment of Italian Unification is even steeper. The real wages of a renaissance stonemason were more than ten times the value of a daily consumption basket for an individual. In 1850 this *welfare ratio* was only 4.2, meaning with a day's work he could support himself and three dependents for a day; supporting a family of four throughout a year would thus require working every one of its 365 days (Malanima 2013). A more recent estimate, for the slightly later period 1862-78, puts the ratio at only 3.0 (Daniele and Malanima 2017).

For unskilled labourers, the long-run trend is very similar to that just described. The same holds for rural workers. Agricultural wages were closely linked to urban unskilled wages: levels were not meaningfully different in Leonardo's time. In this period, however, landowning peasants and sharecroppers fared somewhat better. From some point in the 1500s, their incomes began to be pushed down towards those of wage-earning labourers (Malanima 2002). Urban and rural workers earned much less than

¹ Van Zanden and Felice (2017) question both the level (relative to other countries) and the time trends over various periods (relative to what else is known about Italian history) of this series.

skilled stonemasons. In 1850 a labourer's daily wage bought only 2 daily consumption baskets. The level seems potentially too low, but we can perhaps accept the trend. GDP falling less than wages is the result, according to Malanima, of an increased number of days of work per year.

Figure 4 – Real wages of skilled urban workers.



Source: Malanima (2007).

What is the upshot of all this? Things really were better for the average worker, urban or rural, in Leonardo's time than four centuries later. It is not clear *how much* better they were, however, since we don't know much about the distribution of GDP during the Renaissance, nor about the annual days of employment for the workers (and their family members) whose wages we observe. We can take a step forward in the next section, thanks to an extraordinarily valuable source.

2.3 Florence

The starting point to understand the economy and society in which Leonardo moved is, of course, the city of Florence. Together with Venice, this Tuscan city was the nerve centre of the Italian and European Renaissance. We have much evidence of the dynamism of the Florentine Republic's economy in those years (Goldthwaite, 2009;

Malanima, 2002), but if we want to know about the real living conditions of its population, we need much more detailed data about the individuals and households at that time. The scarcity of this specific type of evidence would normally constitute an unsurpassable barrier to measuring the economic wellbeing of such far distant times. Italy's Middle Ages offer some important exceptions in this regard.

One of these is the Florentine *catasto* (tax register) of 1427. "In 1427 the City of Florence undertook a detailed census of the entire population under its direct authority, together with an exhaustive description of all properties. This documentation, the Land Register, is kept in the archives of Florence and of Pisa, where it has been preserved virtually intact until the present day." These are the opening words of Herlihy and Klapisch-Zuber (1988), who produced a monumental work on the 1427 Florentine *catasto*.² This work led to the creation of a website that gathers and gives access to the data for each of more than 60,000 households surveyed for the tax register. For the analysis carried out in the rest of this section, we have used a version of the database generously offered to us by Peter Lindert – the methodological aspects are described in Lindert (2008).³

The *catasto* was more than a register of real property. What the Republic implemented under its Law of 24 May 1427 was a collection of data on all forms of wealth of individuals living in the city and surrounding area. Households were divided into six categories of which the two most important were the *cittadini*, i.e. those who benefitted from Florentine citizenship, and the *contadini*, inhabitants of the surrounding countryside, who did not. Besides these two macro categories, there were the *religiosi* who were subject to taxation but under different systems, either as individuals or as ecclesiastical institutions; the *distrettuali*, inhabitants of other cities in the Republic and their respective countrymen and women; the *forestieri* (foreigners); and the *arti*, i.e. all the arts and crafts corporations (guilds) of the city.

All heads of household were obliged to declare the number of persons in the household, the age and employment of each, and the real property and movable assets owned within and outside the city of Florence. It was also necessary to declare all debts owned,

² There are many studies that have used this source to study various aspects of the economy, demography and society of renaissance Florence. See, among others, Herlihy and Klapisch-Zuber (1988), van Zanden and Felice (2017), Alfani and Ammannati, (2017), A'Hearn et al., (2016), and Milanovic, Lindert and Williamson (2011).

³ A version of the dataset used is available on the Historical Household Budget (HHB) Project's website: <http://www.hhbproject.com>.

credits to be collected, inventories of merchandise, slaves, cattle, horses and smaller animals. The *catasto* officials had to calculate the earnings derivable from this wealth and note them beneath each entry. In total, data were collected from about 60,000 households, just under 10,000 in the city Florence (Herlihy and Klapisch-Zuber, 1988). In light of the careful analysis of historians and economists, we can confirm that “the first citizens’ Land Register offers, overall, a reliable source of material for quantitative research purposes,” (Conti, 1966).⁴

One of the first findings of our examination of the land register data is the enormous difference between living conditions in the city and those in the countryside. Van Zanden and Felice (2017) estimate that average household wealth was 1,026 florins in the city and barely 68 florins in the county; per capita income in the city was 38 florins against 7 florins in the county. The availability of individual records allows us to go beyond average data to look at income distribution by observing the budgets of individual households. The first exercise of this kind was carried out by A’Hearn et al. (2016). They document a dramatic retrogression between 1427 and 1861; in technical terms, the income distribution in 1427 Florence first-order stochastically dominates (FOD) the income distribution for Italy in 1861. In simple terms, the FOD condition means that any poverty line adopted will yield a smaller incidence of poverty in 1427 Florence than in 1861 Italy. Therefore, the evidence based on historical household budgets confirms the historiography of Italian economic decline, and is consistent with what we know about real wages, urbanization, and nutrition.⁵

What about inequality? Our estimates suggest that in contrast to our observations regarding the incidence of absolute poverty (higher in 1861 than in 1427), income inequality was higher in 1427 Florence (56.8% as measured by the Gini index) than in 1861 Italy (50.4%). That a large city is more unequal than an entire nation is perfectly possible – large cities attract a disproportionate fraction of households at the bottom and at the top of the income distribution, and tend to disproportionately reward the most talented people (e.g., Glaeser et al., 2009). Overall, this finding fits in well with the estimates reported in the preceding sections: Florence was certainly an island of

⁴ The law required the *catasto* to be updated every three years. In fact, before 1431 and then in 1433 two new surveys were carried out with the same rules as the preceding one. But the two new Registers were less effective, especially in terms of revenue. “The bold reform of 1427, which involved a three-yearly census of the economic conditions of all citizens could already be considered a failure by 1433.” (Conti, 1966 p. 64).

⁵ The contrast is certainly exaggerated, for we are comparing the richest city of Renaissance Italy’s richest region with all of Italy in 1861 including the poorest agricultural laborers of its poorest villages.

extraordinary prosperity, but it was also a place that was characterized by extremely wide economic differences.

3 Leonardo's economy

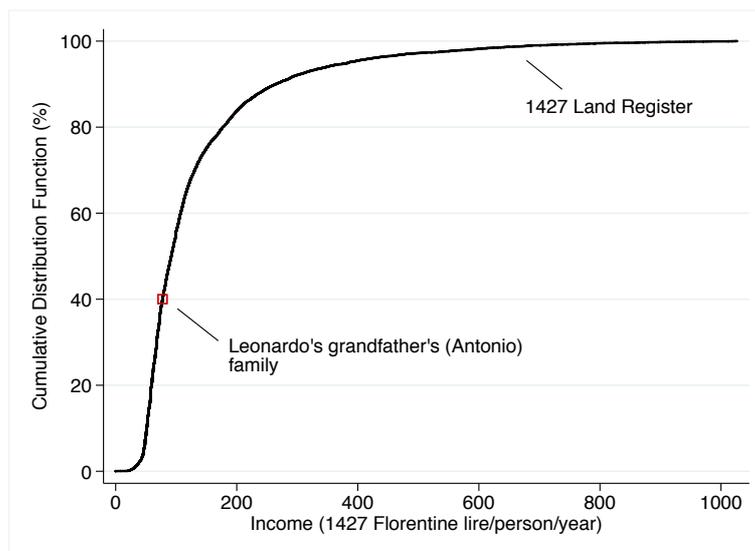
Florence's *catasto* for 1427 is the source we use in this section as a starting point for reconstructing the economic history of Leonardo's family of origin. As is well-known, Leonardo was born out of wedlock in Anchiano, outside Vinci, on 15 April 1452, to Caterina, a peasant woman, and the notary Piero da Vinci; this great genius was an illegitimate child. Despite this, Leonardo was supported by his natural father and lived in Piero's house until he decided to leave Florence.

Our story begins with Leonardo's grandfather, Antonio, who was one of the many Florentine citizens who diligently presented their tax returns to the *catasto* officials, listing all their income and properties. The digitization and reprocessing of the *catasto* has made it possible to identify the entry for Antonio di Piero da Vinci del Gonfalone del Drago.⁶ Leonardo's grandfather's family does not seem to have been particularly well-off. Figure 5 shows that, in relation to Florentine society at that time, Antonio was in the fourth income decile: out of 100 Florentine households, only 40 were less well-off than Antonio's family. This is consistent with what Gustavo Uzielli⁷ wrote in 1872, "Antonio had a house with a kitchen garden in the hamlet of Vinci, which at that time belonged to the Hospital of S. Maria Nuova (...) his fortune was extremely modest and it seems he led a very simple life. The Vincis owned nothing in Anchiano at that time." (p. 56). Thus Leonardo's story begins with a family whose standard of living was "below average".

⁶ We have identified the tax data for Leonardo's grandfather by cross-referencing four pieces of information: i) the name (Antonio), ii) the patronymic (Piero), iii) belonging to the subdistrict of Florence *Gonfalone del Drago*, and iv) the size of the household (in 1427 the household comprised three people, as Leonardo's father Piero had been born three months previously). There is only one record that contains all four pieces of information, thereby making it possible to identify the land registry data for Antonio, Leonardo's grandfather.

⁷ Gustavo Uzielli was born in Livorno on 29 May 1839 into a rich Jewish family. After studying for several years in France, he graduated in Pisa with a degree in 'Mathematical and Physical Sciences'. He began teaching mineralogy and geology in 1877, first at the Università di Modena and then at the Royal Turin Polytechnic. Uzielli wrote several papers on Leonardo da Vinci, both as a scientist and as a man of letters and an artist, and also contributed to the founding of the Museo Vinciano (Vinci Museum). He died in Impruneta, near Florence on 7 May 1911.

Figure 5 – The family of Leonardo’s grandfather, 1427.



Source: Based on data from the 1427 *catasto*.

The fact that the tax registers for the years following 1427 have not been digitized makes it very difficult to find tax data for Ser Piero, Leonardo’s father. Piero was a notary from 1448 to 1504 and appears to have been very successful. Uzielli (1872) tells us that Piero “had very many clients, he was the notary for the *Convento della SS. Annunziata*, and for many other religious organizations, and he was continually improving his status with new purchases in Vinci” (p. 64). Piero would eventually become “very rich, and a notary for the leading Florentine families, including the Medici” (p. 72). It seems that Piero exploited the boom in Florence’s economy extremely well, becoming a point of reference for the leading families as well as for lay and religious bodies. We know that on his death he left around 3,500 gold florins to his 12 children (worth approximately €100,000 in today’s money). Leonardo, being illegitimate, had no claim to any share of this legacy.

Piero’s professional success was clearly also a driving force behind the rise of Leonardo, who was able to acquire a good education and above all to gain entry to one of the most important art workshops in Florence, that of Verrocchio. Leonardo’s genius, like that of many other Renaissance artists, writers and humanists, emerged in part thanks to a thriving society and an economy in continuous growth, a dynamism which nurtured social fluidity.

As far as Leonardo's personal accounts are concerned, there is abundant, albeit fragmentary and even, on occasion, confused evidence. Leonardo stayed with his natural father's family at least until 1469 when he was listed among the dependents in the extract from the *catasto*. The family moved permanently to Florence that same year and Leonardo joined Verrocchio's workshop as an apprentice. We know very little about his financial situation during those years, but we do know that he began to work as a painter and was commissioned by the *Signoria* (the government of "Renaissance" Florence) to make an altarpiece for the Chapel of San Bernardo in the Palazzo Vecchio. We have a little more information about his time in Milan. In 1482, Leonardo approached the court of Ludovico Sforza ("il Moro"), later Duke of Milan, sending a now famous letter in which he listed his various talents –a kind of curriculum vitae. Nine of the ten points in this letter illustrate his skills as an engineer, especially in the building of war machines. Leonardo's great versatility made him essential to Ludovico, who paid him handsomely for his work. The sources regarding Leonardo's remuneration at Ludovico's court are highly contradictory. In his *Historia Universale* of 1571, Gaspare Bugato wrote that, "Lodovico il Moro gave Leonardo 500 scudi a year",⁸ but Bishop Matteo Bandello tells us in his novellas that, on being questioned by Cardinal Gurcense the Elder⁹ about the salary he received from Ludovico, "he (the Cardinal) was answered by Lionardo that his ordinary pension was of 2,000 ducats, not including the gifts and presents that the Duke generously gave him every day".¹⁰ The amounts given by the two sources are very different. Most Leonardo scholars seem to give little credence to the sum reported by Bandello, believing that Leonardo's answer was a provocation, a kind of boast that could hardly have been true. (Lopez, 1982: p. 153, Uzielli, 1872: p. 68).

After the fall from power of the Sforza in 1499, Leonardo began a peripatetic career, spending time in almost all the most important Italian cities of the day. In 1500 he was

⁸ The little information that is available about Gaspare Bugato can be found in the *Archivio Biografico Italiano* which in turn takes its information from a compendium by Gianmaria Mazzucchelli called *Gli scrittori d'Italia* (Italian writers), published in 1763. It says that Bugato was, "Milanese, of the Order of Preachers, and flourished after the middle of the 16th century. He was extremely well-versed in theology, in Canon Law, and in history, and he also delighted in poetry written in the vernacular."

⁹ Cardinal Gurcense can be identified as Raymond Perault, who was born in 1435 in France and died in Viterbo in 1505 after a long career as a bishop and then a cardinal. At the time he was mentioned by Bandello, he was Bishop of Gurk (Gurgense) in Austria.

¹⁰ Matteo Bandello (Castelnuovo Scrivia, 1485 – Bazens, 1561) was a bishop and a writer who lived from the end of the 15th to the middle of the 16th century. His most important literary work was undoubtedly his collection of Novellas which, among other things, were a source of inspiration for William Shakespeare in his comedies such as *Much Ado About Nothing* and *Twelfth Night*.

in Venice, where he was put in charge of surveying the course of the river Isonzo for strategic and military purposes, in 1502 he worked for Cesare Borgia in Romagna as an architect and military engineer. The following year he returned to Florence where he was responsible for operations in the siege of Pisa and later did a wall painting of the Battle of Anghiari for the great Council Hall in the Palazzo Vecchio. In 1508 he was back in Milan, where he finished a second version of the Virgin of the Rocks, staying there until 1513 as «*peintre et ingénieur ordinaire*» for the King of France. There are some records of Leonardo's earnings during his second stay in Milan too. Jean D'Auton (1466-1528), official historian at the court of King Louis XII of France provided some important information in his *Chroniques de Louis XII*, republished in 1891 by Maulde La Clavière.¹¹ In a long list of people who received a salary from the King, we find mention of Leonardo for the years 1510 and 1511, when he earned the considerable sum of 400 livres a year.

In 1513 Leonardo was in the Papal States to design a new harbor in Civitavecchia. In 1517 he moved to France to be at the court of Francis I for which there are various sources of information on his earnings. The aforementioned Gaspare Uzielli (1872) reported that, “it seems that from that time Leonardo was employed by the court with an allowance of 700 scudi a year.”¹²

In Figure 6 we compare Leonardo's income at various points in time, as derived from the sources described previously, with his income in Florence for 1427. This is intended to make it easier for us to understand not only Leonardo's standard of living, but also his position in relation to his contemporaries. In the absence of data from subsequent tax registers (the last one is for 1495), we have used the data from the 1427 *catasto*, suitably adjusted for purchasing power, taking it as an approximation of the income distribution for the (later) years when Leonardo lived and worked.¹³ At the age of 30,

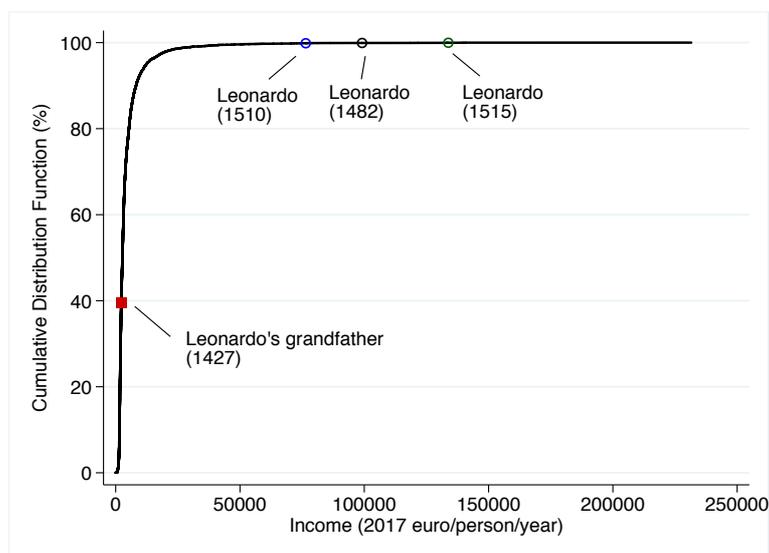
¹¹ Maulde La Clavière (1848-1902), was a French historian educated at the École des Chartes, who was the founder of the Société internationale d'histoire diplomatique in September 1898. The citation of Leonardo's earnings is reported in an appendix of the second volume of the work on page 379.

¹² According to Versiero (2008), however, “he lived in a manor house near the royal residence of Amboise, with a pension of 1,000 scudi for himself and one of 300 scudi for Melzi, the only one of his students to follow him there.” In this case too, it is difficult to determine which is the most realistic figure. Our choice is the one most referred to, which seems to be that reported by Gaspare Uzielli, and also reported by Henry Roujon in an article published in 1913 in *Le Temps*.

¹³ It is not trivial to convert incomes originally expressed in Milanese scudi or French livres into a common currency and then into today's euro values – at a methodological level the calculations are subject to non-negligible margins of error. Some authors multiply the gold content of the currency (e.g. one Milanese scudo contained 3.25-3.5 grams of gold) by the current price of gold, while others use a consumer price index. We use the second method in this paper, based on the series in Malanima (2010).

Leonardo had a disposable income which nowadays would be worth roughly €100,000, which put him among the ten richest men in Florence in 1427, though a long way from the top of the list (the Borromei and the Strozzi had incomes that were several orders of magnitude greater than Leonardo's). He was nevertheless in a position almost inconceivable for someone with his family background. By the age of 65 Leonardo had further improved his financial position. His income had risen to the equivalent of €140,000, moving him up five places in the list of incomes for Florence in 1427.

Figure 6 – Leonardo da Vinci's incomes in the context of Florence of 1427.

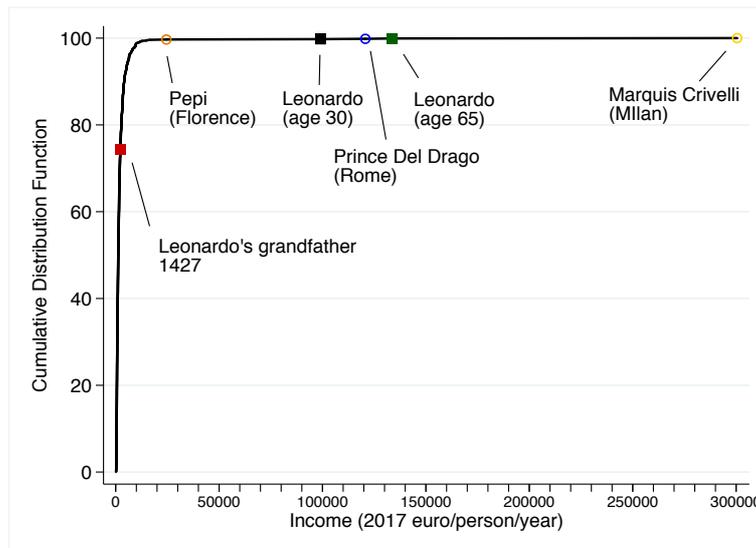


Source: Our estimates.

A final experiment, shown in Figure 7, places Leonardo's incomes in the income distribution for Italian subjects in the Kingdom of Italy following Unification. The income distribution curve for 1861, expressed in 2017 euros, is taken from Amendola and Vecchi (2017). Leonardo's incomes are placed on this curve and indicated with small squares. To make interpretation easier, we have added some additional data on aristocratic households collected as part of an ongoing research project involving historical family archives, both the easily accessible ones in Italy's state archives and those kept in the homes of the descendants of the families in question.¹⁴

¹⁴ This project was launched in cooperation with the Pepi family in Florence and is part of a broader international project called the Historical Household Budget (HHB) Project, available for consultation at: <http://www.hhbproject.com>. See A'Hearn, Chianese and Vecchi (2019) on this subject. The authors would like to thank Marcella Lorenzini for sharing the (preliminary) estimates for the Crivelli family shown in Figure 7.

Figure 7 – Leonardo in terms of the Italian aristocracy in 1861.



Source: Our estimates and A’Hearn et al. (2019).

The journey through time shown in Figure 7 is purely for evocative purposes as it helps us to understand how to measure the gap between Leonardo’s standard of living (used here as a benchmark of the highest standards of living in Renaissance Florence) with Italy’s population in 1861. The graph shows how Leonardo would have had very few rivals in the new Kingdom of Italy in terms of financial resources – he would have been part of a very restricted economic élite, comprising the great noble families that had survived four centuries of economic decline.

Leonardo died on 2 May, 1519, at the age of 67. Despite earning huge sums of money throughout his life, his will appears to indicate that he had not accumulated a great fortune. At the end of his life, this great artist was left with the vineyard outside Milan given to him by Ludovico Sforza, a farm near Fiesole, 400 scudi left to his half-brothers and sisters in Florence, some clothes and a fine collection of books.

4 Conclusions

Renaissance Italy was a prosperous corner of Europe. This much emerges from comparisons of GDP per capita, urbanisation, or the purchasing power of wages. The same favourable assessment can be made relative to north-central Italy’s own future,

with the ratio of GDP per person to the poverty line falling from about 2.5 in the 1460s to only 1.5 in the 1860s.

But we are not concerned here with the broad market for mass-produced consumption goods that features in many accounts of industrialization. What mattered for the market for artistic, architectural, and intellectual innovations was the concentration of the region's wealth in its cities. In the case of Florence, this resulted from heavy taxation and restrictions on economic activity in the countryside and the lesser cities of the Republic (Epstein 1991). Mean household wealth in the city of Florence in 1427 (779 florins) was nearly *ten times* what it was in the rest of the Florentine state (84 florins).¹⁵

Within the city, too, wealth was concentrated. A third of the city's families declared zero taxable wealth. Another third could not have afforded Leonardo's *Adoration of the Magi* (for which he was offered 300 florins, early in his career), even if they had liquidated all their wealth (Etro 2018: 526).¹⁶ Yet in the upper tail of the wealth distribution, there were 524 households with taxable wealth of at least 3,000 florins (or 10 *Adorations of the Magi*), and 16 with fortunes in excess of 30,000 florins. Milanovic et al. (2011) introduced the *inequality extraction ratio*, a measure of the capacity of the economic élite to appropriate a surplus from the total income generated by society, i.e. the amount left after the population had been guaranteed a minimum level of subsistence. Looking at Florence in Leonardo's day, about two thirds of the maximum possible inequality was reached, a high value by modern standards, though not among the highest values for pre-industrial societies for which data are available (three quarters, on average). This extraction ratio was a necessary condition, albeit not sufficient, to fuel the demand for the goods that artists and writers could supply.

There was a degree of social mobility in this wealthy city, Leonardo's own family being one example (Padgett 2010). Goldthwaite (2009: 547) underlines the importance of Florentine society being open to the '*gente nuova*' ("new people"), and of their economic and political role, documenting a relatively high level of upward mobility. The story of another great artist of that time, Botticelli (1445-1510), seems similar to

¹⁵ Median wealth was 130 and 25 florins respectively for the city and the remainder of the Republic, respectively. These figures refer to *taxable* wealth, a net measure excluding debts and the value of the family dwelling. Households were also allowed to deduct 200 florins per dependent ("*bocca*"); this amount has *not* been deducted from the family wealth figures just reported. The clergy and military personnel living in Florence were not enumerated in the *catasto*.

¹⁶ Etro estimates that the mean value of a painting commissioned in the 15th century was 126 florins. A mature Leonardo would be offered 3,000 florins for the *Battle of Anghiari*.

that of Leonardo, being a tale of formidable economic success, achieved despite the modest origins of his father, Mariano di Vanni Filipepi, one of three brothers who had a simple tanner's shop.

One aspect of status competition was conspicuous consumption. Indeed, this was the distinguishing feature of the Renaissance economy, according to Goldthwaite (2009): "If any distinctive economic activity marks the period, it is conspicuous consumption. The increased production of art, and of luxury goods in general, is one of the most characteristic features of the Renaissance; and indeed it is at this time that art created consciously as such, emerges as a distinct category of goods." It is no accident that the moment that gave us Brunelleschi's dome and Michelangelo's David also produced Savonarola and the bonfire of the vanities.

References

- A'Hearn B., S. Chianese and G. Vecchi (2019), "Aristocracy and Inequality in Italy, 1861-1931", HHB Working Paper Series, No. 18, forthcoming.
- A'Hearn B., N. Amendola, and G. Vecchi (2016), "On Historical Household Budgets", *Rivista di Storia Economica*, a. XXXII, n. 2.
- Barone G. and Mocetti S.,(2018), Intergenerational mobility in the very long run: Florence 1427-2011, Bank of Italy Working Paper Series, No. 1060, April 2018.
- Breschi M. and Malanima P. (2002), *Prezzi, redditi, popolazioni in Italia: 600 anni (dal secolo XIV al secolo XX)*, Udine, SIDES.
- Daniele V. and Malanima P. (2017), "Regional wages and the north-south disparity in Italy after the Unification," *Rivista di storia economica*, vol. 33 no. 2 (August 2017), pp. 117-58.
- Epstein S.R. (1991), "Cities, Regions, and the Late Medieval Crisis: Sicily and Tuscany Compared," *Past and Present*, no. 130 (Feb. 1991), pp. 3-50.
- Etro F. (2018), "The Economics of Renaissance Art", *Journal of Economic History*, vol. 78 no. 2.
- Fenoaltea S. (2018). Spleen: the failures of the cliometric school, HHB Working Paper Series, No. 14, December 2018.
- Fouquet R. and Broadberry S. (2015), Seven Centuries of European Economic Growth and Decline, Centre for Climate Change Economics and Policy Working Paper No. 232.
- Goldthwaite R.A. (1987), "The Economy of Renaissance Italy: The Preconditions for Luxury Consumption," *I Tatti Studies in the Italian Renaissance*, vol. 2, pp. 15-39.
- Goldthwaite R.A. (2009), *The Economy of Renaissance Italy: The Preconditions for Luxury Consumption*, Baltimore, The John Hopkins University Press.
- Hatfield R. (2002), *The Wealth of Michelangelo*. Rome: Edizioni di Storia e letteratura.
- Herlihy D. and Klapisch-Zuber Ch. (1988), *I toscani e le loro famiglie. Uno studio sul catasto fiorentino del 1427*. Bologna: Il Mulino.
- La Claviere M.(1889), *Chroniques de Louis XII par Jean d'Auton*. Paris: Renouard.
- Lindert, P. (2008), "Tuscany 1427", mimeo.
- Lopez G. (1982), *Leonardo e Ludovico il Moro*. Milan: Mursia.
- Malanima P. (2002), *L'economia italiana. Dalla crescita medievale alla crescita contemporanea*. Bologna: Il Mulino.
- Malanima P. (2003), "Measuring the Italian Economy, 1300-1861," *Rivista di storia economica*, vol. 19 no.3 (December 2003), pp. 265-95.

- Malanima P. (2003), "Measuring the Italian Economy. 1300-1861," *Rivista di Storia Economica* a. XIX, n. 3, dicembre 2003.
- Malanima P. (2010), "The long decline of a leading economy: GDP in central and northern Italy, 1300–1913," *European Review of Economic History*, 15, 169-219.
- Malanima P. (2013), When did England overtake Italy? Medieval and early modern divergence in prices and wages, *European Review of Economic History*, 17, 45–70.
- Padgett J. (2010), "Open Elite? Social Mobility, Marriage, and Family in Florence, 1282-1494," *Renaissance Quarterly*, vol. 63 no. 2 (Summer 2010), pp. 357-411.
- Uzielli G. (1872), *Ricerche intorno a Leonardo Da Vinci*, Florence, Stabilimento G. Pellas.
- van Zanden J. L. and Felice E. (2017), "Benchmarking the Middle Ages. XV century Tuscany in European Perspective," *Centre for Global Economic History Working Paper Series*, no. 81 (October 2017).
- Vecchi G. (2011). *In ricchezza e in povertà. Il benessere degli italiani dall'Unità a oggi*. Bologna: Il Mulino.
- Vecchi G. (2017). *Measuring Wellbeing: A History of Italian Living Standards*. New York: Oxford University Press.
- Versiero M. and Postigliola A. (2008). *Il dono della libertà e l'ambizione dei tiranni: la scienza del potere di Leonardo da Vinci, tra arte e filosofia : tesi di dottorato*. Naples, Università degli Studi L'Orientale.