Exploring the relationship between personal income inequality, property values, and property tax revenue over time: A panel data analysis for Spain (2006-2016)

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Abstract

The aim of this paper is to analyze the evolving relationship over time among per- sonal income inequality, property values, and property tax revenue. We specifically ex- amine the case of Spain from 2006 to 2016, a period marked by the tail end of economic expansion, the bursting of a real estate bubble, the repercussions of the 2008 financial crisis, and the subsequent Great Recession, alongside the initial stages of economic re- covery starting from 2015. Spain's notable rate of owner-occupied primary residences (averaging 84% throughout this time frame), along with substantial heterogeneity in both average personal income and its distribution within municipalities, justifies the importance of this research. Given the substantial reliance of municipal finances on property tax, understanding these dynamics is, in our view, paramount. To capture the structural dynamics of this relationship, we employ a panel data analysis covering 1,015 municipalities with more than 6,000 inhabitants over the specified period. The research uncovers prevalent and significant inequality across these municipalities, pri- marily caused by decreased average income per capita, a reduced average-to-median income ratio, and a declining labor force. A negative relationship is also found between personal income inequality within municipalities and local tax revenue.

Keywords: local public finances; Great Recession; property tax; personal income in- equality; residential property values.

JEL Classification: D31, D63, H40, H71, H72

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1. Introduction

Since the 2008 Great Recession, economic inequality has once again become a pivotal topic in both political and academic discussions, captivating public interest (Atkinson, 2015; Mi- lanovich, 2014; Piketty, 2014; Stiglitz, 2012). It is universally recognized that this issue, by affecting a country's economic development and the outcomes of implemented public policies, holds crucial significance for its economic and social appeal. An economy marked by significant inequality is likely to see the adoption of income redistribution measures, which often alter individuals' choices, leading to a decrease in actual growth. Inequality, known for its significant impact on national economic development and policy outcomes, is often met with distributive measures that can sometimes hinder growth. In this vein, the World Economic Forum and the World Bank have identified inequality as a major threat to social stability and an obstacle to eradicating extreme poverty by 2030, despite global commitments to Sustainable Development Goals. This widening gap between the rich and poor is a multifaceted issue affecting standards of living, education, and consumption, with income and wealth as its primary monetary indicators. The lack of awareness around the importance of income and wealth distribution undermines efforts to address economic disparities.

As we have argued, inequality negatively affects the level of well-being that citizens can access. Mitigating these welfare losses is one of the primary functions entrusted to the public sectors by societies with preferences revealing aversion to inequality. To achieve this, governments at all jurisdictional levels have a wide range of public intervention mechanisms available to them. These mechanisms can reduce inequality both in the formation of market income (often referred to as pre-distribution) and in its subsequent distribution, following the operation of public transfer mechanisms, including monetary and in-kind transfers as well as direct and indirect tax payments. When operating together, public spending policies and the taxes that finance them produce net redistributive effects that reduce income inequality (Joumard et al., 2013).

Indeed, in this paper, we focus on one of the most important tax instruments available to local governments to finance their public spending policies, which is closely related to citizens' wealth: the property tax. These taxes levy on the real estate wealth owned by citizens residing in each municipality, typically applying tax rates proportional to the value of the properties. This value is measured based on an administrative estimate known as the cadastral value, which generally tends to be lower than the market price of the property, although these values are often reviewed and/or updated over time.

As a general rule, there is a positive relationship between the average real estate property values of a municipality and the average personal income of its residents. This results in municipalities with higher average personal income receiving higher revenue from the property tax (Awasthi, 2020; Norregaard, 2013; Sepulveda and Martinez-Vazquez, 2012).

Likewise, the literature on local income inequality has frequently found positive relationships between the average personal income of municipalities and the inequality with which this personal income is distributed (Boulant et al., 2016; Kayhan, 2022; Moser and Schnetzer, 2017).

Our research aims to analyze the evolving relationship over time among personal income inequality, property values, and property tax revenue, focusing on the case of Spain, a country with one of the highest rates of owner-occupied primary residences in the European Union. Specifically, the aim of this paper is twofold. First, it seeks to examine the significant impacts that the 2008 economic crisis had on both the broader economy and public finances, particularly at the local level, and how these changes have affected income distribution across different regions. Essentially, the goal is to analyze how the crisis altered the landscape of income inequality within municipalities. Second, recognizing that economic disparities stem not only from income variations but also from differing real estate wealth levels, the paper investigates how shifts in municipal income distribution have subsequently affected the collection of real estate taxes, which are a primary source of local public revenues. In this sense, our research aims to understand the resulting changes in the determination of local tax revenues.

To do so, we examine the case of Spain from 2006 to 2016, a period marked by the tail end of economic expansion, the bursting of a real estate bubble, the repercussions of the 2008 financial crisis, and the subsequent Great Recession, alongside the initial stages of economic recovery starting in 2015. Spain's notable owner-occupied primary residence rate (averaging 84% throughout this time frame), along with substantial heterogeneity in both average personal income and its distribution within municipalities, underscores the significance of our research. Given the substantial reliance of municipal finances on property tax, understand- ing these dynamics is, in our view, paramount. To capture the structural dynamics of this relationship, we employ an econometric panel data analysis covering 1,015 municipalities with more than 6,000 inhabitants over the specified period.

The rest of the paper is organized as follows. Section 2 briefly discusses the related literature. Section 3 describes the data and variables used, along with the main descriptive statistics and the econometric framework. Section 4 presents and discusses the main findings. Section 5 concludes.

2. Literature Review

The relationship between inequality and local public finances has been extensively studied, with a particular focus on how inequality affects tax revenues and government expenditures. Sanguinetti and Besfamille (2004) explored the impact of inter-governmental transfers on local tax effort, highlighting potential disincentives for regions to maximize their tax revenue. Similarly, Kurachi (2015) examined how intergovernmental fiscal relations in Denmark influenced local government expenditures, illustrating conflicts between local tax authorities and central government controllers.

Expanding on these themes, Xi (2017) proposed a balanced tax distribution system, emphasizing the division of tax power between central and local governments to enhance stability in financial fields. Pokrovskaia and Belov (2020) provided insights from Japan's fiscal reform, which increased municipal financial autonomy and tax receipts, suggesting applicable strategies for developing economies.

Martyniuk and Wo-lowiec (2022) discussed the impact of local tax policies on revenue generation and systemic development within municipalities. Aseinov (2020) highlighted the low financial autonomy of Kyrgyzstan's local governments, underscoring their dependence on central government transfers. Mykhailenko (2017) emphasized the low financial autonomy of Kyrgyzstan's local governments, underscoring their dependence on central government transfers, while Peri´c and Jerkovi´c (2013) focused on practical aspects of tax revenue real- ization and the fulfillment of public needs through local taxation. Meanwhile, Ningrum and Ulandari (2021) underscored the importance of taxpayer understanding and participation in the tax system, which significantly impacts local government expenditures.

More directly related to our study, Immel et al. (2019) explored the effect of income inequality on public spending and tax progressivity, finding that strategic allocation of public funds can mitigate adverse inequality effects. Doumbia and Kinda (2019) showed that reallocating public spending towards social protection and infrastructure, funded by cuts in other areas, can reduce income inequality in multiple countries. Battisti and Zeira (2018) highlighted how public policies, including progressive taxation and social benefits, can reduce economic inequality. Hayes and Medina Vidal (2015) found that fiscal policies, such as corporate and inheritance taxes, influence state-level inequality. However, Pyun and Rhee (2015) noted that countries with high income inequality tend to have a smaller fiscal policy impact on output compared to those with more equal income distribution.

Boustan et al. (2013) investigated the impact of income distribution variations on local tax revenue and spending patterns, while Corcoran and Evans (2010) identified a direct correlation between income inequality and education expenditure in U.S. school districts.

Vollrath (2009) examined the historical impact of land inequality on property tax rates, and Borge and Rattsø (2004) studied the connection between income inequality and tax burden.

Recent studies, such as Glaeser et al. (2009), provide insights into how urban inequality influences economic growth, which is directly relevant to our study's focus on property values and local tax revenue. Additionally, Chetty et al. (2016) highlight the long-term impacts of neighborhood characteristics on economic outcomes, emphasizing the importance of spatial considerations in analyzing inequality.

Mastronardi and Cavallo (2020) analyze income inequality in Italy at the municipal level, particularly focusing on areas defined by the National Strategy for Inner Areas. They conduct an econometric analysis to identify the determining factors of personal income inequality in those municipalities, paying special attention to the influence of spatial dimensions. A limi- tation of Mastronardi and Cavallo's work is their use of cross-sectional data, which prevents adequately analyzing the temporal dynamics of inequality. To overcome these shortcomings, our research employs a panel data analysis focusing on the relationship between personal income inequality, property values, and property tax revenue in Spanish municipalities from 2006 to 2016. This period encompasses significant economic fluctuations, providing a com- prehensive view of how income inequality and property tax revenues interact over time.

3. Data and Methodology

The Fedea's 'Local Personal Income and its distribution in Spain' database comprises Span- ish municipalities with a population of more than 5,000 inhabitants that belong to the Au- tonomous Communities and Cities of 'Common Tax Regime' (excluding the Basque Country and Navarre, both with their own tax regimes, so-called 'foral regime'). At the time of con- ducting the research, the database included the years between 2004 and 2016, with some gaps. Currently, it covers the entire period from 2004 to 2018. This database is freely disseminated online by FEDEA (https://www.fedea.net/renta/).[1]

The Fedea database is designed to include municipalities with a population of 5,000 or more. Naturally, there are municipalities that, over the years, experience variations in the number of registered inhabitants, placing them below this threshold (or, conversely, those that were not included in previous years due to not reaching 5,000 inhabitants but are incorporated into the statistic in a given year when they reach that limit). To have a balanced panel for the chosen years, we opted to include in our panel dataset only municipalities that had 6,000

1. See Hortas-Rico et al. (2014) for more details.

inhabitants in 2016, the final year of our analysis, even if they had between 5,000 and 6,000 inhabitants in previous years (2006, 2007, 2011, 2014, and 2015). Therefore, the dataset used in our analysis consists of 6,090 observations (1,015 municipalities in each of the six years).

In selecting the years included in the study, we considered both the years available in the Fedea database at the time of conducting the research and the relevant years during the Great Recession (2011 and 2014), from the end of the previous economic expansion (2006 and 2007) to the beginning of the economic recovery (2015).

For every year and municipality, the data utilized includes personal income inequality metrics, developed by Hortas-Rico et al. (2014), Hortas-Rico and Onrubia (2015), Hortas-Rico and Onrubia (2016), and Hortas-Rico and Onrubia (2022). These metrics cover the resident population at the beginning of each year, the number of personal income tax (IRPF) filers, average per capita personal income (calculated from total personal income divided by population), average income per taxpayer (total personal income divided by the number of IRPF filers), median taxpayer income, key income inequality indicators (Gini and Atkinson 0.5), and income concentration indexes for the top earners (specifically the top 1%, 0.5%, and 0.1%), as well as the distributive structure by quintiles. See Table A1.[2]

These data originate from the microdata of the annual personal income tax filer samples available through the State Tax Administration Agency (Agencia Estatal de Administracion Tributaria, AEAT) and disseminated by the Spanish Institute of Fiscal Studies (Instituto de Estudios Fiscales, IEF), corresponding to the tax years considered.[3]

Additionally, our panel dataset incorporated key factors influencing the size of municipal areas, specifically: population density (a measure of the number of people living in a given area, calculated as the ratio of the municipality's population to its land area, expressed in km2), distance, both as crow flies and in kilometers, from the municipalities to the provincial capital.[4]

While refining the model, three new variables were incorporated into the regression analysis to deepen the investigation:

<u>Population Ageing Rate:</u> this variable is calculated as the ratio of the total active population aged 15 to 64 to the overall population. It was developed to assess the impact of thepopulation's age structure on income inequalities.

2. For details, see Hortas-Rico and Onrubia (2015) at https://www.fedea.net/renta/renta.html.

3. https://ssweb.seap.minhap.es/REL/frontend/inicio/municipios/all/all.

4. Both are available, respectively, on: https://es.distance.to/Pueblo) and road travel time (data available at: https://www.distanciasentreciudades.com).

Number Urban Property: defined as the ratio of the net amount of IBI tax (after deduct- ing mandatory and optional bonuses) to the number of urban properties in each municipality. This measure aims to gauge the tax's impact relative to the available properties.

Average Personal Income/Median Personal Income: the ratio of median to average in- come per taxpayer of the Personal Income Tax for each year and municipality. Incorpo- rating this variable into the econometric model's specifications was motivated by the need to capture, through a single indicator, the distribution pattern of personal income and its effects on income inequality as measured by the Gini index. Despite being based on two cen- tral tendency measures (mean and median), this ratio effectively encapsulates the income distribution's asymmetry, thereby characterizing its inequality.

3.1. Econometric Model

To understand the impact of the economic crisis on income inequality and how this affects IBI tax collection efficiency, we employ the following panel data model:

$$Y_{ct} = \alpha + \beta X_{ct} + u_{ct}, \quad c = 1, \ldots N; \quad t = 1, \ldots, T \tag{1}$$

Here c denotes the number of municipalities studied (N=1,015), and t represents the time series within the panel (covering the years 2006, 2007, 2011, 2014, 2015, and 2016). In our model, Yct represents the value of the dependent variable, which captures either the income inequality, as measured by the Gini coefficient, or, alternatively, the net share of the IBI, across different municipalities and over time, α denotes a constant, while Xct stands for a vector of explanatory variables. These variables include factors such as population, average income per capita, average income of taxpayers, population density, and others, offering insights for each municipality annually.

The error term is depicted in a one-way model as:

$$u_{ct} = \mu_c + \delta_t + \nu_{ct} \tag{2}$$

Within this framework, μc is identified as the time-invariant, unobservable error that is distinct to each municipality, δt represents the error that varies over time but cannot be quantified, and νct denotes the strictly random error inherent in the estimation process.

Given the unique characteristics of each municipality, the model was estimated with fixed effects incorporated into the regression, following a comparison of fixed and random effects via the Hausman test. The revised equation is:

$$Y_{ct} = \alpha + \beta X_{ct} + \mu_c + \delta_t + \nu_{ct}, \quad c = 1, \ldots, 1,015; \quad t = 1, \ldots, T \tag{3}$$

This setup posits that the non-observable effects differ across municipalities (c), but remain constant over time (t). Consequently, the time-averaged equation is:

$$\bar{Y}_i = \alpha + \beta \bar{X}_c + \mu_c + \bar{\nu}_c \quad (4)$$

This approach allows for the integration of unobserved heterogeneity into the estimated constant α, ensuring that each municipality's error term and the constant capturing its unique characteristics are completely independent.

3.2. Descriptive statistics and model selection

The alternative identified outcomes, Gini Index and Net IBI Share, are analyzed in the Table 1. Descriptive statistics, highlight significant income inequality across municipalities, with the Gini index averaging at 46.094 percentage points, peaking at 91.439 in some cases, indicating near-extreme inequality in certain areas. While the average value of the net IBI share stands at approximately 8.764 euros per capita, in some municipalities it reaches a maximum of 12.542 euros. The unemployment rate averages 57.84% of the population. For some municipalities, the population density is high, equal to 21.192.72. The number of properties peaks at 1.458.847, and the impact of the population on income inequality averages 68.11

In the process of determining the most effective specification, various models are explored to achieve the best balance between predictive power and applicability. We start with the Gini Index as the first outcome and then repeat the same procedure using the Net IBI Share as the outcome. For simplicity of exposition, we only present the model with the Gini Index outcome, as it yields the same results, as detailed in Table 2. Model 1, chosen for its generalizability, incorporates variables such as resident population, per capita average income, median income per taxpayer, labor force, population density, cadastral value per property, and income concentration among the wealthiest taxpayers. The income concentration vari- able is initially (a) tested against the top 0.1% and then the top 1% of earners (b). Model 2, while similar in the variables selection to Model 1, replaces the labor force with either the unemployment rate (a) or the population ageing rate (b). Finally, the third model attempts to account for the spatial dimension by including variables such as distance (a) and travel time to major urban centers (b). These variables are tested to analyze economic inequal- ity considering geographical and social characteristics. However, despite their recognized importance, these spatial factors do not demonstrate statistical significance.

Our preferred model is (1), which is further refined by introducing the ratio of average to median income per taxpayer, which replaces the median income variable. This final model configuration shows a comprehensive approach to understanding and estimating income inequality and its determinants in Spanish municipalities.

The model selection (Table 3) and determination of the optimal functional form proceed as follows: first, we estimate the regression for both fixed effects, column (b) of Table 3, and random effects, column (B). Next, the Hausman test (column b-B) is employed to validate the selection of either effect type for inclusion in the model. The Hausman test is crucial in distinguishing between the two effects in panel data analysis, allowing us to choose the most appropriate effect based on efficiency and consistency with the hypothesized model.[5] We notice that the Hausman test statistic is significant, suggesting a preference for the fixed effects model.

4. Empirical results

In Table 4 we report all our results when considering the Gini index as the dependent variable to be explained. In column (1) we show the pooled OLS, in column (2) our preferred FE model and in column (3) and (4) we re-estimate the FE model on restricted samples of mu- nicipalities. When examining the impact of population dynamics, it's crucial to understand that, broadly speaking and holding other factors constant, significant demographic growth generally acts to level the socioeconomic playing field. This leveling effect is attributed to the diminishing influence of wealth inherited from previous generations: in essence, each new generation faces the challenge of establishing its own economic footing, for better or worse. In contrast, when population growth stagnates or declines, the significance of pre- viously accumulated wealth becomes more pronounced, leading to increased socioeconomic inequality, with all the consequences for the well-being that arise from it.[6] Nevertheless, in the framework of this analysis, which incorporates a diverse array of explanatory vari- ables and acknowledges the significant heterogeneity across Spanish municipalities, changes in population size increase the Gini index, whereas density contribute only marginally to the increase in inequality (see col. 1 and col.2).

The study also reveals that higher average income per capita, the gap between average and median income per taxpayer, and a larger labor force negatively affect the Gini index, suggesting a decrease in inequality. However, an increase in inequality is observed with a rise in the earnings of the top 1,000 earners and with higher property values. This detailed examination suggests a complex interplay of factors: while certain elements work to narrow the gap between the rich and the poor, others, especially those related to high-income earners and real estate values, tend to exacerbate it.

5. As it is well known, if there is a correlation between individual effects and the explanatory variables, the fixed effects model is considered consistent, while the random effects model is considered inconsistent. Con- versely, if individual effects are uncorrelated with the model's regressors, both models are deemed consistent, but the random effects model is preferred for its efficiency. See Cameron and Trivedi (2005).
6. See Atkinson (2015) or Piketty (2016), among others.

After comparing the outcomes from both the pooled panel regression and the FE regression models for the inequality index, as outlined in Table 4 (col.1 and 2), it became clear that the fixed effects model offered more definitive and reliable insights. In Table 4 (col. 2), unlike the results obtained with the pooled OLS, those achieved with the fixed effects are indeed all highly statistically significant. This prompted a further examination of how vari- ous explanatory variables influence the Gini index. Indeed, we first focus on municipalities with populations exceeding 50,000 inhabitants, see (col. 3), and then on those with more than 100,000 inhabitants, reported in column (4).

In municipalities with a population greater than 50,000 (138 in total), the analysis revealed that all coefficients are statistically significant, indicating that the impact of all variables on inequality mirrored the behaviour observed in the model estimated in the full sample (col. 1). In contrast, for the municipalities with populations above 100,000 (58 in total), some variables, (namely the ratio of average to median income per taxpayer, population density, and the highest income bracket - top 1.000), demonstrated diminished statistical significance.

Finally, in Table 5, we report the estimation of the models with Net IBI Share as outcome. In column (1) we show the pooled OLS, in column (2) our preferred FE model and in column (3) we re-estimate the FE model on municipalities with populations exceeding 100,000 inhabitants.

The findings also highlight a correlation between shifts in inequality's structure, indicated by an uptick in the Gini index, and a reduced capacity for municipalities to augment revenues from local property taxes (IBI). Essentially, a rise in economic inequality is linked to a decrease in the collectable share of IBI revenue. Moreover, an increase in population, which slightly raises inequality as previously noted, further reduces the tax obligation. On the other hand, revenues collected from IBI are positively affected by increases in the average income per capita, the number of urban properties, and their assessed cadastral value. All estimated coefficients in the model are highly statistically significant, with a margin of error set at 1%, as detailed in Table 5 (col. 1). This layered analysis sheds light on the intricate dynamics between demographic trends, economic factors, and the financial mechanisms of local governments.

When the analysis was extended to include the 58 municipalities with populations exceeding 100,000 inhabitants, referenced in Table 5 (col.3), all the explanatory variables demonstrated a high statistical significance, with the only exception of the cadastral value. This suggests that, particularly in larger urban areas, the impact of cadastral value does not align with the trends observed across the wider dataset.

5. Concluding remarks

The results of this study show that, from 2006 to 2016, there was a high degree of income inequality among Spanish municipalities with populations equal to or greater than 6,000 inhabitants, corresponding to Autonomous Communities with a common fiscal regime. The Gini index has an average value of 46.094 percentage points. For some municipalities, the index reaches the maximum value of 91.439 percentage points, indicating highly significant inequality. Although it identifies different levels of economic inequality for each municipality, the Gini coefficient does not provide any information on the specific causes of income distribution inequality and, therefore, does not allow for a timely and critical contribution to improving or solving the problem.

The analysis focuses on several key variables that are essential for determining the economic development potential of different municipalities. The model demonstrates that certain aspects of development potential, such as the active population aged between 15 and 64 years, the ratio of average to median income per taxpayer, average income per inhabitant, the number of taxpayers in the top 1,000 of the income distribution, and the cadastral value of properties, have an inversely proportional effect on economic inequality: as the values of these variables increase, inequality decreases. In other words, improvements in these areas contribute to reducing inequality within municipalities.

Conversely, when the values of these key variables decrease, their impact on inequality is negative, causing inequality to rise. Similarly, moderate increases in the number of inhabitants and population density lead to slight but noticeable increases in income inequality. Addressing our main objective, we found that negative changes in economic inequality reduce a municipality's ability to generate revenue through property taxes, which are crucial for local finances. Specifically, increases in economic inequality result in lower net IBI (property tax) shares and subsequently reduce municipal tax revenue.

From our research findings, several policy implications emerge. Given the significant disparities, local institutions must urgently undertake reforms to reduce inequalities. These reforms should focus on developing municipal models that ensure equitable wage policies, increase resources for the most vulnerable populations, and create comprehensive strategies for active inclusion. This includes generating decent, well-paid jobs for those excluded from the labor market.

While these reforms are complex and challenge long-established realities, they can be achieved through direct policies. For instance, establishing a unified municipal fund to support poorer municipalities could be a practical approach. The wealth and well-being of each municipality rely on the local administration's ability to provide growth and development opportunities for all residents. This can be done through investments in education, training, and employment that enhance capacity and competitiveness.

Identifying economic inequalities among different municipalities means finding solutions that promote socio-economic development and proper redistributive policies. This requires conscious, synergistic, and planned actions to balance resources between wealthier areas and those at a significant disadvantage.

Undoubtedly, many important issues raised in this study require further attention. Due to space constraints and the specific focus of our analysis, we have left some questions unresolved. In future research, we plan to incorporate the spatial characteristics of municipalities, which could significantly enhance our analysis. By including factors such as territorial development, the availability of urban green spaces, modes of urban transportation distribution, and local usage patterns of water and energy, we could gain invaluable insights.

This comprehensive analysis would enable local governments to craft tailored action plans that promote equitable and sustainable development across different regions. By considering both geographical and social dimensions, researchers can develop strategies aimed at building resilient communities and reducing disparities that limit the growth prospects of economically disadvantaged municipalities.

Furthermore, extending the time period of our research to include more recent years, utilizing newly available data from Fedea, could offer a deeper and more nuanced understanding of our analysis. This expanded temporal frame would allow us to capture more current trends and shifts, providing a richer context for policy development and implementation, from a dynamic approach.

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Appendix

Table 1. Descriptive statistics of variables used in the regression model

Variable	N	Average	Dev. Std.	Min	Max
Gini	6,090	46.094	6.914	12.918	91.439
Net IBI Share	6,090	8.764	3.895	12.821	12.542
Pop	6,090	36,228	125,869	5.09	3,265,038
Average income pc	6,090	8,016	3,196	2,225	40,412
Med income pc	6,090	14,147	4,435	2,883	49,829
N. Urban Property	6,090	17,514	56,326	10,089	1,458,847
Cadastral Value	6,090	55,848	34,346	9,043	597,101
Labor force	6,090	24,742	84,618	2,637	2,202,953
Unemployment	6,090	11.749	5.233	0.030	57.843
Population Aging rate	6,090	68.116	4.225	7.406	235.832
Pop Density	6,090	865.450	1,894,456	5.2637	21,192.72
Top 100	6,090	760.714	545.593	0.3670	8,722,827
Top 1000	6,090	209.388	274.438	0.0324	5,757,352
Km	6,090	49.439	41.842	0	291.96
Road Travel	6,090	0.686	0.714	0	6.933
Average Income/Median Income	6,090	77.393	12.675	9.612	165.870

Note: Variables are described by their observation count, mean, variability around the mean (standard deviation), and distribution's minimum and maximum values. Population Aging Rate measures the impact of population structure on income inequalities by calculating the ratio of the total active population aged between 15 and 64 years to the total population. Top 100 represents the wealthiest 1% of the population, and Top 1000 signifies the wealthier 0.1% of the population. Distance in km and travel time refer to the kilometers and road travel time from municipalities to the province's center. Average Income/Median Income serves as an indicator of income distribution asymmetry.

Source: Own elaboration.

Table 2. Construction of the Regression Model with panel data - Gini Index

Y_{it}= Gini Index	Model 1		Model 2		Model 3	
	a)	b)	a)	b)	a)	b)
Pop	0.151***	0.131***	0.0055	0.0500*	0.151***	0.151***
	(0.0347)	(0.0341)	(0.0263)	(0.0276)	(0.0347)	(0.0347)
Average income pc	0.349***	0.358***	1.191***	0.399***	0.349***	0.349***
	(0.0721)	(0.0692)	(0.0763)	(0.0723)	(0.0721)	(0.0721)
Med income pc	-1.621***	-1.564***	-1.538***	-1.619***	-1.621***	-1.621***
	(0.0243)	(0.0241)	(0.0232)	(0.0242)	(0.0243)	(0.0243)
Labor force	-0.153***	-0.138***			-0.153***	-0.153***
	(0.0330)	(0.0324)			(0.0330)	(0.0330)
Unemployment			0.428***			
			(0.0172)			
Population Aging rate				-0.143***		
				(0.0188)		
Pop Density	0.0041***	0.0034***	0.0023**	0.0036***	0.0041***	0.0041***
	(0.0010)	(0.0010)	(0.0010)	(0.0010)	(0.0010)	(0.0010)
Cadastral Value	0.0323***	0.0271***	0.0138***	0.0318***	0.0323***	0.0323***
	(0.0034)	(0.0034)	(0.0033)	(0.0034)	(0.0034)	(0.0034)
Top 100		0.0031***				
		(0.00012)				
Top 1000	0.0054***		0.0035***	0.0052***	0.0054***	0.0054***
	(0.0002)		(0.0002)	(0.0002)	(0.0002)	(0.0002)
Km					0.0241	
					(0.0568)	
Road Travel						2.219
						(5.236)
Constant	58.10***	57.26***	49.61***	67.72***	56.91***	56.58***
	(1.313)	(1.273)	(1.284)	(1.841)	(3.101)	(3.825)
FE (Municipalities)	✓	✓	✓	✓	✓	✓
N. Observ.	6,090	6,090	6,090	6,090	6,090	6,090
N. Municipalities	1,015	1,015	1,015	1,015	1,015	1,015
Rho	0.871	0.827	0.654	0.863	0.869	0.870
R-squared	0.539	0.556	0.588	0.542	0.539	0.539

Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Population Aging Rate measures the impact of population structure on income inequalities by calculating the ratio of the total active population aged between 15 and 64 years to the total population. Top 100 represents the wealthiest 1% of the population, and Top 1000 signifies the wealthier 0.1% of the population. Distance in km and travel time refer to the kilometers and road travel time from municipalities to the province's center. Average Income/Median Income serves as an indicator of income distribution asymmetry. Source: Own elaboration.

Table 3. Hausman Specification Test - Gini Index, Net IBI Share

	Y_{ct}= Gini Index			Y_{ct}= Net IBI Share		
Variables	**(b) FE**	**(B) RE**	**(b - B)**	**(b) FE**	**(B) RE**	**(b - B)**
Gini				-108.0***	-20.71	-87.298**
				(18.85)	(21.39)	(7.391)
Pop	0.231***	0.167***	0.064*	-247.2***	-262.1***	-14.964***
	(0.0365)	(0.0180)	(0.0332)	(51.81)	(15.41)	(60.257)
Average income pc	1.179***	-0.390***	-0.789***	828.4***	-59.80	888.169***
	(0.0739)	(0.0223)	(0.0732)	(122.8)	(74.18)	(127.448)
Average Income/Median Income	0.344***	-0.355***	0.0105**			
	(0.0058)	(0.0049)	(0.0034)			
Pop Density	0.00488***	-0.00005*	0.00493***			
	(0.00108)	(0.00003)	(0.00112)			
N. Urban Property				3.019***	1.249***	1.771***
				(0.0463)	(0.0343)	(0.0437)
Cadastral Value	0.0496***	0.0330***	0.0166***	30.61***	68.15***	-37.54***
	(0.00359)	(0.00200)	(0.00314)	(6.532)	(5.831)	(5.243)
Top 1000	0.00476***	0.00464***	0.00012**			
	(0.00026)	(0.00023)	(0.00015)			
Labor force	-0.221***	-0.246***	0.0257**			
	(0.0347)	(0.0268)	(0.0239)			
N. Observ.	6,090	6,090	6,090	6,090	6,090	6,090
N. Municipalities	1,015	1,015	1,015	1,015	1,015	1,015

b = consistent for H_0 and H_a; obtained from regression
B = inconsistent for H_a; efficient for H_0; obtained from regression
Test: H_0: differences in the coefficients are not systematic
Chi² Test: ¡ 0.05 (All model coefficients are ≠ from zero)
Chi² (7) = (b-B)' $[(V_b - V_B)^(-1)](b-B)$ = 606.55
Prob ¿ Chi² = 0.0000
Chi² (5) = (b-B)' $[(V_b - V_B)^(-1)](b-B) = 1865.89 Prob > Chi^2 = 0.0000$

Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Average Income/Median Income: indicator of asymmetry of income distribution; Top 1000: 0.1% richer than the population. Source: Own elaboration.

Table 4. Models Gini index

Y_{ct}= Gini Index	Pooled OLS (1)	FE (2)	Pop > 50,000 (3)	Pop >100,000 (4)
Pop	0.167***	0.231***		
	(0.0267)	(0.0365)		
Average income pc	-0.390***	-1.179***	-1.562***	-1.904***
	(0.0315)	(0.0739)	(0.214)	(0.320)
Average Income/Median Income	-0.355***	-0.344***	-0.161***	-0.0363
	(0.0066)	(0.0058)	(0.0227)	(0.0431)
Pop Density	-0.00005	0.00488***	0.00313***	-0.0002
	(0.00003)	(0.00108)	(0.00117)	(0.0020)
Cadastral Value	0.0330***	0.0496***	0.0228***	0.0259***
	(0.0029)	(0.00359)	(0.00683)	(0.0098)
Top 1000	0.0046***	0.00476***	0.00399***	-0.00009
	(0.0003)	(0.00026)	(0.000538)	(0.0010)
Labor force	-0.247***	-0.221***	-0.0878***	-0.0878***
	(0.0393)	(0.0347)	(0.0214)	(0.0214)
Constant	73.94***	71.28***	73.27***	84.24***
	(0.549)	(1.436)	(4.825)	(9.443)
N. Observ.	6,090	6,090	807	339
FE (Municipalities)		✓	✓	✓
N. Municipalities	1,015	1,015	138	58
R-squared	0.547	0.491	0.230	0.269

Note: Standard robust errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Average Income/Median Income: indicator of asymmetry of income distribution; Top 1000: 0.1% richer than the population. Source: Own elaboration.

Table 5. Models Net IBI Share

Y_{ct}= Net IBI Share	Pooled OLS	FE	Pop >100,000
	(1)	(2)	(3)
Gini Index	44.14*	-108.0***	-1.734***
	(22.93)	(18.85)	(512.8)
Pop	57.31	-247.2***	
	(68.49)	(51.81)	
Average income pc	-182.0**	828.4***	16.638***
	(72.61)	(122.8)	(2.674)
N. Urban Property	0.529***	3.019***	4.943***
	(0.151)	(0.0463)	(0.176)
Cadastral Value	67.96***	30.61***	204.9**
	(7.744)	(6.532)	(82.09)
Constant	-6.957***	-38.538***	-701.456***
	(887.7)	(2.292)	(47.135)
N. Observ.	6,090	6,090	339
FE (Municipalities)		✓	✓
N. Municipalities	1,015	1,015	58
R-squared	0.907	0.501	0.771

Note: Standard robust errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Source: Own elaboration.

Table A.1. Variables used in the regression model and their information

Indicator	Description and Unit of Measurement
Gini	Gini Index (Basis points)
Net IBI Share	Liquid Quota of IBI (Euro)
Pop	Population (Inhabitants)
Average income pc	Average per-capita income (Euro)
Med income pc	Median income per taxpayer (Euro)
N. Urban Property	Number of urban property (Number of Urban
Cadastral value	Cadastral value (Euro for Urban Property)
Labor force	Total active population (Total Labor force on first of January each year, people aged 15-64 y
Unemployment	Unemployment rate (Unemployed/Total Labo
Population Aging rate	Aging rate of the population (Total Active Population aged 15-64 years/Po
Pop Density	Population density (Number of inhabitants of the municipality per Km^2 of territory)
Top 100	Top 100 (Share of income corresponding to the wealthiest 1% of the population)
Top 1000	Top 1000 (Share of income corresponding to the wealthiest 0.1% of the population)
Km	Distance from municipalities to the provincial (The most populated center of the province)
Road Travel	Road travel time (Decimals)
Average Income/Median Income	Average and Median Income (Average Income/Median Income)