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Spatial Sources of Inequalities and Determinants of Redistribution

Roberto Brunetti

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Résumé

Cette thèse contribue au débat académique et public sur les inégalités économiques en étudiant *i) les déterminants spatiaux des inégalités* et *ii) les déterminants de la redistribution*. En ce qui concerne le *i)*, l'accent est mis sur le patrimoine immobilier, qui représente la principale composante du patrimoine total dans plusieurs pays. Comme la valeur de la terre représente une part importante de la valeur des logements, il est nécessaire d'analyser les facteurs qui peuvent influencer la valeur des terrains afin de pleinement comprendre la dynamique de la distribution de la richesse. Cette thèse se concentre sur le rôle des imperfections du marché du crédit et des choix résidentiels des ménages (chapitre 1), ainsi que sur l'importance du cadre institutionnel dans la détermination de l'offre de logements (chapitre 2). En ce qui concerne le *ii)*, l'accent est mis sur la demande et l'offre de politiques de redistribution. Étant donné qu'au cours des dernières années, la redistribution n'a pas augmenté face à l'accroissement des inégalités, une compréhension plus approfondie des raisons pour lesquelles les gens s'abstiennent de soutenir la redistribution est justifiée. Le chapitre 3 étudie l'importance des croyances dans la méritocratie et dans le "trickle-down economics" pour comprendre la position des gens sur la redistribution. En outre, étant donné que les décideurs politiques peuvent toujours s'écarter des préférences des agents, il est nécessaire de s'interroger sur le lien démocratique entre les électeurs et l'élaboration des politiques. Ce champ d'investigation est analysé dans le chapitre 4.

Chapitre 1 : Tri spatial et inégalités persistantes

Dans le chapitre 1, je présente un modèle théorique dont l'objectif est de mettre en lumière l'interconnexion entre les choix résidentiels des ménages, la richesse immobilière et les inégalités à long terme. La valeur des investissements en logement dépend fortement de la localisation, ce qui soulève la question de l'imbrication en-

tre le tri spatial des individus et la distribution de la richesse immobilière. Dans notre modèle, les agents choisissent combien ils consomment et combien ils laissent en héritage à leurs enfants. Les agents décident également où s'installer mais ne peuvent pas payer n'importe quel prix pour acheter une maison, car les marchés du crédit sont imparfaits et une mise de fonds est nécessaire pour obtenir un prêt hypothécaire. Cette exigence implique que la capacité des agents à emprunter dépend de la richesse reçue en héritage de leurs parents. Cette dernière est la seule source d'hétérogénéité entre les agents.

Nous montrons que la contrainte d'emprunt plafonne la capacité de paiement des agents dans les localisations les plus attractives. Cela crée une distorsion dans la formation du prix des maisons et dans le mécanisme de capitalisation standard. Si nous supposons une distribution homogène de la richesse, la contrainte d'emprunt donne lieu au *symmetry-breaking*. En effet, certains agents "chanceux" peuvent vivre dans des endroits attrayants tout en payant un prix qui est plafonné par la limite d'emprunt. Cela crée un écart d'utilité entre ces ménages et le reste de la population. Cet écart d'utilité se traduit également par un héritage plus élevé laissé aux descendants, générant des inégalités lors des périodes suivantes. Les inégalités sont donc endogènes dans notre modèle. Lorsque nous supposons une distribution hétérogène de la richesse, nous montrons que la contrainte d'emprunt entraîne un *trriage spatial de la richesse*, puisque les agents les plus riches sont en mesure de surenchérir sur le reste de la population et de s'installer dans les lieux les plus attrayants. Nous montrons également que la richesse laissée aux enfants dépend de l'emplacement, de sorte que les enfants des agents les plus riches et les mieux situés reçoivent l'héritage le plus élevé peuvent eux-mêmes s'installer dans les zones les plus attrayantes. Par conséquent, tant le tri spatial que les inégalités de richesse se perpétuent dans la trajectoire de transition. Enfin, il existe deux types d'états stationnaires : un état stationnaire dans lequel il n'y a pas d'inégalités de richesse et où tous les agents peuvent emprunter n'importe quelle somme d'argent ; ou un état stationnaire avec des inégalités persistantes et un tri spatial. Ainsi, le tri spatial se traduit par une inégalité persistante. Nous déclinons également un plan d'imposition optimal qui doit combiner une taxe sur les rentes foncières et sur les revenus.

Chapitre 2 : Pouvoir de vote des municipalités et offre de logement. Les résultats de la coopération intercommunale française

Dans le deuxième chapitre, j'étudie un autre déterminant important de la valeur des biens immobiliers, à savoir le processus décisionnel local. Je me concentre sur la France où, ces dernières années, la prise de décision en matière d'urbanisme fait intervenir deux niveaux de collectivités locales : la commune et l'établissement public de coopération intercommunale (ci-après EPCI). Des décisions sur diverses questions sont prises au sein d'un conseil de délégués municipaux qui sont directement élus par les citoyens lors des élections municipales. Cela crée un lien direct entre les préférences des citoyens et les décisions des délégués. Cependant, la représentation de chaque municipalité n'est pas égale, car le nombre de délégués par commune dépend de la part de la population de la commune dans l'EPCI. Dans ce chapitre, j'analyse comment le pouvoir de vote des communes au sein du conseil intercommunal influence le nombre de permis de construire accordés. Je collecte un jeu de données original qui comprend le nombre de délégués par commune dans les EPCI les plus denses. Cela me permet de calculer un indice de pouvoir de vote, l'indice de Banzhaf, qui a été largement utilisé pour étudier la distribution du pouvoir de vote dans les systèmes de type fédéral. En outre, j'utilise une approche à variable instrumentale en tirant parti de deux réformes promues par le gouvernement central qui ont modifié l'attribution des délégués dans de nombreux EPCI.

Je constate que les municipalités ayant un vote plus élevé au sein du pouvoir du conseil intercommunal accordent plus de permis de construire pour les unités de logement unifamiliales et moins de permis de construire pour les unités d'appartement. Cette différence d'effets suggère que le développement à faible densité est perçu plus positivement que le développement à forte densité par la population locale, poussant ainsi les délégués à promouvoir le premier et à limiter le second. Ensuite, j'étudie également comment l'effet du pouvoir de vote varie en fonction de la densité de logement de la municipalité et du taux d'accession à la propriété. Ces variables servent à évaluer la résistance locale aux nouveaux développements. Les municipalités densément construites sont susceptibles de présenter une demande de logements plus élevée, des coûts de congestion plus importants et donc une opposition féroce aux nouvelles constructions (NIMBYism : "Not in My BackYard"). En outre, les propriétaires sont susceptibles de s'opposer aux nouvelles constructions pour protéger la valeur de leur maison. Je trouve que l'effet du pouvoir de vote sur les logements unifamiliaux et multifamiliaux est plus fort dans les municipalités densément construites et les propriétaires, mais l'effet n'est statistiquement significatif que pour les municipalités densément construites.

Chapitre 3 : Croyances dans le Mérite, “Trickle-Down economics” et préférences pour la redistribution : Une expérience avec le top et bottom 20%

Le chapitre 3 porte sur une expérience en ligne menée aux États-Unis afin d'étudier la relation entre les préférences des individus en matière de redistribution et les différents récits sur les mérites et les démérites des riches et des pauvres. L'expérience combine un cadre “spectators-stakeholders” avec une “conjoint table analysis” : un spectateur, choisi parmi les 20% supérieurs et inférieurs de la distribution des revenus aux États-Unis, décide du montant à redistribuer entre un individu dont le revenu annuel est supérieur à \$100 000 et un individu dont le revenu annuel est inférieur à \$10 000. L'individu à revenu élevé reçoit toujours une dotation initiale de \$50 tandis que celui à faible revenu reçoit \$1, de sorte que la distribution de l'argent dans l'expérience rappelle les différences de revenu dans le monde réel. Les individus sont décrits avec différentes caractéristiques qui mettent en évidence les mérites et les démérites des deux parties prenantes. En particulier, nous nous concentrons sur la dimension de l'effort, de sorte que les parties prenantes à faible revenu et à revenu élevé sont décrites comme travaillant plus de 10 heures par jour ou moins de 6 heures par jour. De plus, l'individu riche est décrit soit comme le fondateur, soit comme l'héritier de son entreprise, ce qui souligne son talent et son image de “self-made man/woman”. Enfin, l'entreprise compte soit plus de 1000 employés, soit moins de 5 employés : cet attribut vise à mettre en évidence la capacité de la dimension de “trickle-down economics”.

Nous constatons que l'attribut qui compte le plus dans les choix de redistribution est l'effort des pauvres, les participants redistribuant significativement plus lorsque l'acteur à faible revenu est décrit comme travaillant plus de 10 heures par jour. L'effort des riches n'affecte que les choix des participants à haut revenu, mais toujours dans une moindre mesure que l'effort des pauvres. Deuxièmement, l'effet des différents attributs qui soulignent le mérite des deux parties prenantes est toujours plus fort pour les spectateurs riches. Cela implique que les spectateurs aisés sont plus méritocratiques que les spectateurs à faibles revenus. Troisièmement, nous constatons que les décideurs à faibles revenus redistribuent systématiquement plus que les décideurs à hauts revenus, même lorsque nous contrôlons l'idéologie et les caractéristiques socio-démographiques. Enfin, nous ne trouvons aucune preuve de

l'influence de la composante du "Trickle-down" sur les préférences de redistribution, à la seule exception des riches libéraux et modérés, qui redistribuent moins quand l'entreprise de l'individu à hauts revenus a plus de 5000 employés.

Chapitre 4 : La redistribution est-elle déterminée par les préférences des élus ou des électeurs ? Une expérience avec des élus locaux français

Le dernier chapitre de cette thèse se concentre sur le côté offre de la redistribution. Nous menons une expérience de redistribution en ligne avec 773 politiciens locaux français et 661 non-politiciens français afin d'étudier les déterminants des choix de redistribution. Les participants choisissent un taux d'imposition fixe à appliquer à des groupes de citoyens français. Une partie du produit de l'impôt est perdue, tandis que le reste est redistribué de manière égale au sein du groupe. L'environnement de choix diffère en ce qui concerne le degré d'information sur le taux d'imposition préféré de l'électeur médian et le degré de concurrence politique. Nous sollicitons également les croyances des participants concernant la préférence de l'électeur médian et le choix fiscal du concurrent avec lequel ils sont appariés.

Nous constatons que les préférences des électeurs affectent les choix fiscaux tant lorsque les participants jouent le rôle de dictateurs que lorsqu'ils sont en compétition. Pourtant, même lorsque l'information est donnée, nous observons une déviation entre le taux d'imposition choisi et la préférence de l'électeur médian. Cette déviation est due aux croyances des participants sur ce que l'électeur médian veut et ce que le concurrent choisit, qui ne s'alignent pas toujours sur l'information reçue. En outre, nous constatons que lorsqu'aucune information sur l'électeur médian n'est donnée, les choix des participants sont fortement motivés par l'idéologie. Au contraire, lorsque l'information est fournie, l'idéologie des participants n'a aucun effet. Enfin, la principale différence entre les politiciens et les non-politiciens concerne leurs croyances, les politiciens croyant que les électeurs préfèrent un taux d'imposition plus faible que les non-politiciens. Cela conduit les politiciens à choisir un taux d'imposition plus faible uniquement lorsqu'ils ne reçoivent aucune information.

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General Introduction

As an economist working on economic inequalities, the obvious way to begin my dissertation *in medias res*, in the middle of events, is to present a list of statistics on the rise of inequalities worldwide. However, before doing so, we must ascertain that inequalities *per se* are an issue. For instance, it could be argued that a certain level of inequality benefits our societies, as long as it incentivizes people to work hard (efficiency argument). Additionally, one could focus on the well-being of the least advantaged people instead of income differences (Rawlsian school). Inequalities can even be considered fair when they are seen as the result of differences in individual effort and talent (meritocratic view). Yet, it is becoming clear that inequalities have some destabilizing effects on our societies: Inequalities have been shown to cause political polarization and increasing support for radical parties (Han, 2016, Stewart et al., 2020), a disproportionate influence in politics by economic elites (Gilens and Page, 2014, Bartels, 2016, Cagé, 2020), falling social mobility and socio-economic opportunities (Corak, 2013) and other undesirable outcomes in health, life expectancy and erosion of social cohesion (Wilkinson et al., 2009, Stiglitz, 2012). Therefore, a thorough study of economic inequalities and their determinants appears fundamental to understand and face some of the biggest challenges for our societies.

This dissertation contributes to the academic and public debate on economic inequalities by investigating *i) the spatial drivers of inequalities* and *ii) the determinants of redistribution*. Regarding *i)*, the focus is on housing wealth, which represents the major component of total wealth in several countries. As land accounts for a large share of housing value, it is necessary to analyze the factors that can influence land values to understand of the dynamics of the entire wealth distribution. This thesis will focus on the role of credit market imperfections and households' residential choices (chapter 1) and on the importance of the institutional framework in influencing housing supply (chapter 2). Regarding *ii)*, the focus is redistribution demand and supply. As in the last years redistribution did not increase in

the face of increasing inequalities, a deeper understanding of why people refrain from supporting redistribution is warranted. Chapter 3 studies the importance of the beliefs in meritocracy and in the trickle-down economics to understand people's stance on redistribution. Moreover, given that policymakers could still deviate from people's preferences, it is necessary to question the democratic link between voters and policymaking. This line of inquiry is analyzed in chapter 4.

The following introduction will first present a concise overview of the evolution of income and wealth inequality in the last 50 years by comparing the case of the US and France. These two countries represent, respectively, the most unequal country among developed countries and a country with mild inequalities (Chancel et al., 2021). This comparison is helpful to highlight the importance of housing wealth to explain wealth inequality dynamics in France. Then, I will discuss the weak increase of redistribution and the reasons why redistribution did not increase as much as we might expect, especially in the US. Finally, I will outline the content of each chapter, by reporting the research question, the methodology, and the main results.

The evolution of income and wealth inequalities

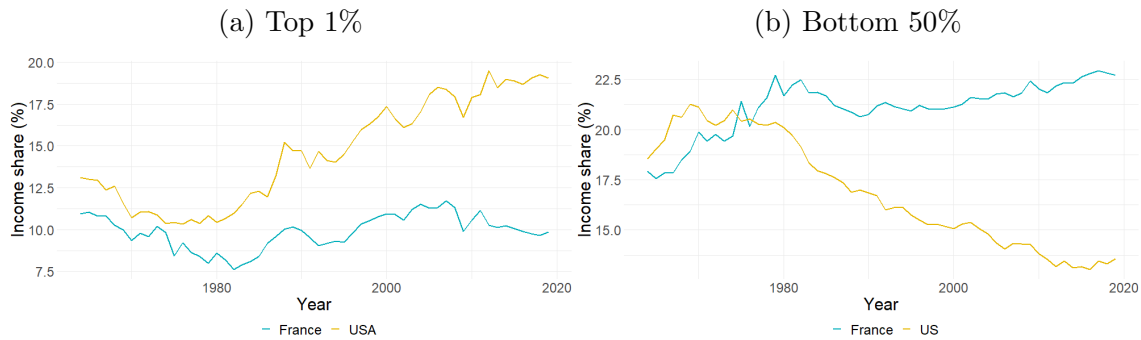
It is now a well-established fact that inequalities have been rising in the last decades (Piketty and Saez, 2014, Chancel et al., 2021). Let us take the case of the US and France. Figure I.1 plots the evolution of the pre-tax income share of the top 1% and bottom 50% of the American and French income distribution.¹ In 2021, the pre-tax national income share of the top 1% was 19% in the US and 9.84% in France. Nowadays, income inequalities are more severe in the US than in France. However, the gap between these two countries has not always been so wide. In 1970, the share of income accruing to the top 1% was 10.69% in the US and 9.34% in France.² The income inequality trend of these two countries is entirely different: Pre-tax income inequalities have been surging in the US while they remained constant in France.

Let us now shift our attention to wealth inequalities. Figure I.2 plots the evolution of the top 1% and the bottom 50% net wealth share in the US and France. The share of total national wealth owned by the top 1% in the US increased from

¹For the sake of brevity, I will focus only on the top 1% in this introduction, but using different inequality measures would not change the broad picture.

²Another widely used index, the top 10/bottom 50 ratio, has increased from 7.94 in 1970 to 16.83 in 2021 in the US, while it decreased from 8.38 in 1970 to 7.09 in 2021 in France.

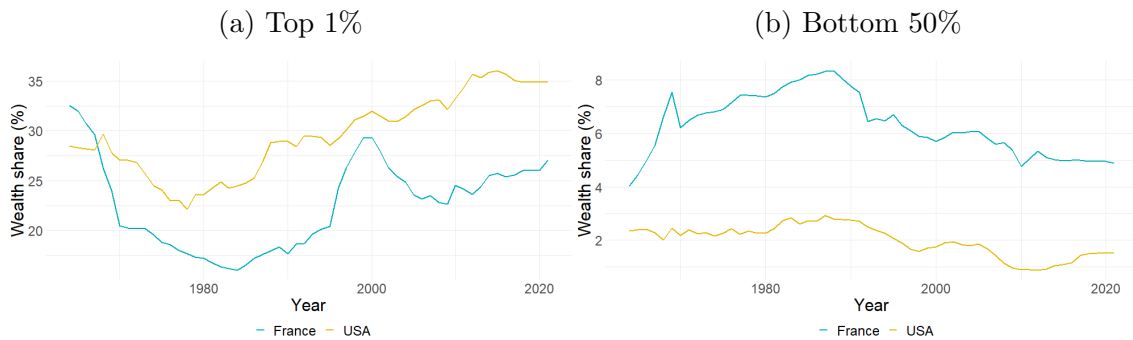
Figure I.1: Evolution of income inequalities in the US and in France



Source: World Inequality Database

27.08% in 1970 to 34.87% in 2021. In France, the same share surged from 17.22% in 1970 to 27.03% in 2021.³ Wealth inequalities have been advancing both in the US *and* in France. Wealth inequalities are still lower in France than in the US and, in both countries, they are still much lower than levels experienced in the Gilded Age.⁴ However, the trend raises some flags and needs careful scrutiny.

Figure I.2: Evolution of wealth inequalities in the US and in France



Source: World Inequality Database

If we distinguish housing wealth from other forms of private wealth, another contrast between the American and the French case arises: In 2011-2012, the share of housing wealth in total households' wealth was 25% in the US, while it was 63% in France (Trannoy et al., 2022). The importance of housing wealth in France also reflects in its aggregate value, which amounts to 7 trillion euros, 6 times French GDP

³Concerning the top 10/bottom 50 ratio, over the 1970-2021 period, it increased from 162 to 235 in the US and from 46.97 to 60.78 in France.

⁴For instance, the top 1% in France owned around 54% of total wealth before the first world war.

(Trannoy et al., 2022). Housing wealth is widespread among the entire population. In France, the homeownership rate is 60%, which is close to the average among OECD countries (Causa et al., 2019).⁵ Housing is the major asset for most families, especially for the middle class, for which the share of housing in total assets is larger than 60% in the majority of OECD countries (Causa et al., 2019). Finally, the predominance of housing wealth in France reflects also in the composition of bequests and donations: 37.7% of inherited wealth and 48.6% of wealth received as a donation is made of real estate (INSEE, 2018).

Let us now consider the distribution of the enormous French housing wealth. A stylized fact is that housing wealth inequalities are more narrow than financial wealth inequalities. Nevertheless, this does not mean that the former need to be underestimated. In France, the top 10% in terms of gross wealth owns 40.4% of the total housing wealth (INSEE, 2021). The average value of all housing units beyond the primary residence in the top decile is 145,197 euros, around 12 times more than in the bottom decile (Bérard and Trannoy, 2019). Given the aggregate value of housing wealth and its unequal distribution among the population, it is evident that studying wealth dynamics goes hand in hand with focusing on housing wealth.

Recent research has highlighted the importance of housing wealth to explain long-run wealth inequalities (Piketty and Zucman, 2014, Kuhn et al., 2020, Bonnet et al., 2021, Knoll et al., 2017). The increasing importance of housing wealth is the primary driver of the rise of the wealth/income ratio in France and other countries such as the UK and Germany (Piketty, 2013, Bonnet et al., 2021). In particular, the rise of real estate values is mainly explained by the value of land and marginally by an increase in construction costs (Knoll et al., 2017). Thus, any factor influencing housing and land values can substantially impact the entire wealth distribution.

What determines the value of housing? For real estate business practitioners, there is no room for doubts: “Location, location, location”. This simple idea is at the heart of the monocentric city model, developed by Alonso (1964), Mills (1967) and Muth (1969). The focus is on people’s location choices in a city characterized by a Central Business District (CBD) where all jobs are available. People face a trade-off between house prices and commuting costs. The further people locate from

⁵Homeownership rates vary from around 80% in the Slovak Republic, Hungary, and Spain to around 40% in Germany, Denmark, and Austria, with an average of 60%.

the CBD, the more they need to pay in commuting costs (direct monetary costs, opportunity cost of time loss), and the less they are willing to pay for land. The equilibrium price is then decreasing with distance from the CBD.⁶

Many papers found a negative land price gradient, supporting one of the main predictions of the monocentric city model (Duranton and Puga, 2015). In the case of France, Combes et al. (2019) find a clear negative relationship between the distance from the city center and land prices. In Greater Paris, the land value in the center (less than 3 km from Notre Dame) is 20 fold land value in the periphery (20 km from the center) (Chapelle et al., 2021). The case of France is interesting because the city center is often characterized by historical amenities, which make the center even more attractive. Prices in city centers are so high that only a tiny fraction of the population can afford to invest in housing, especially given that obtaining a mortgage requires meeting some income and wealth requirements. The two-way connection between individual wealth and location choices can reinforce wealth inequalities, as wealthy individuals can invest in the best-located places, reap the highest housing investment gains and increase their wealth even more. This intuition is at the heart of chapter 1, which presents a theoretical model which investigates the interconnection between credit market imperfections, households' location choices, and the dynamics of the wealth distribution.

When studying house prices, we also need to focus on the elasticity of the housing supply. In particular, land use regulations can limit new buildings and, therefore, decrease the housing supply elasticity (Gyourko and Molloy, 2015). Local governments play an essential role, as the decentralization of the decision-making power over urban development creates a “local trap” (Purcell, 2006), which can lead to a mixture of low housing supply elasticity, high housing costs, and disproportionate capital gains to homeowners. The reason is that different groups of the local population are inclined to vote against new development. The literature mainly focuses on homeowners (Fischel, 2005, Ortalo-Magné and Prat, 2014), as they want to preserve the value of their house, which is, in most cases, their most valuable

⁶The idea that the value of housing and, in particular, of land depends on its location is an ancient one. Ricardo (1817) already claimed that, all else equal, differences in rent of two parcels of land should reflect differences in revenues which are given, for instance, by the quality of the soil. The same concept was developed by Von Thünen (1826), who developed the first ever fully specified formal economic model to explain the distribution of different agricultural activities with respect to the distance from the center.

asset. However, many other local interests can influence local decision-making, like landowners, tenants, real-estate companies (Solé-Ollé and Viladecans-Marsal, 2013, Hilber and Robert-Nicoud, 2013, Schone et al., 2013).⁷ Local politics on land use regulations is the result of a struggle between the groups who favor the preservation of the *status quo* and groups favoring more intense development.

Even in this case, France is of particular interest. A recent study from the OECD found that France is one of the countries with the lowest housing supply elasticity (Cavalleri et al., 2019), despite its low population density and relatively low geographical barriers to new buildings. This hints at the role played by local governments and local regulations to explain this low elasticity, especially given the local opposition that might arise from the high number of homeowners.⁸ The other French peculiarity is that nowadays, decisions on local urban development are taken by municipal delegates who constitute the councils of inter-municipal communities. Inter-municipal communities consist of several municipalities cooperating to provide public goods. Each municipality has a different number of delegates which depends on its population, creating substantial differences in voting power in the decision-making process. Chapter 2 investigates how each municipality's voting power impacts the granting of new building permits.

Redistribution demand and supply

We now delve into the role of redistribution in limiting the rise of inequalities. Given the current level of inequalities, the question posed by Shapiro (2002) remains unanswered: “Why the poor don’t soak the rich?”. This provocative question highlights one of the puzzles of modern politics. Democracy should be a force in favor of inequality reduction. This is why in the nineteenth century, in all countries, the Right opposed universal suffrage while the Left supported it. The idea was that by giving voting rights to the least advantaged people, the latter would have demanded, among other things, more downward redistribution. However, this hypothesis has been refuted as there has been no systematic relationship between democracy and

⁷In the sociology literature, Molotch (1976) coined the expression of the “growth machine” to regroup all those parts which will favor urban and economic development.

⁸Local opposition to urban development has even been initiated in an expression: “Maire bâtisseur, maire battu”, which roughly translates to “Builder mayor, defeated mayor”.

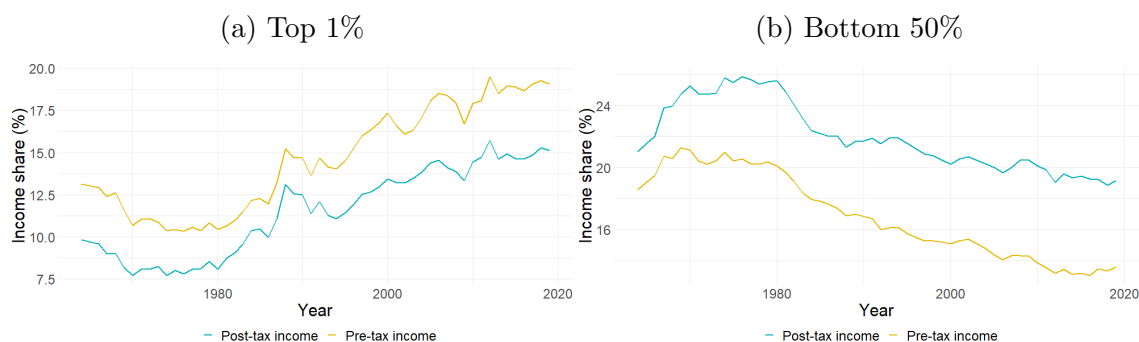
downward redistribution - not even a detectable relationship between the expansions of the franchise and episodes of downward redistribution (Shapiro, 2002).

The general idea that an enlarged franchise would lead to more redistribution is in line with the classical political economy of government growth, developed by Meltzer and Richard (1981). The Meltzer and Richard model assumes a tax system with a simple inequality-efficiency trade-off. Increasing a lump-sum flat tax rate leads to more redistribution but at the cost of a lower incentive for workers to supply effort and, therefore, a lower sum of money to redistribute. Preferences are single-peaked (everyone has a preferred tax rate) and can be ordered along the income dimension so that low-income individuals favor a higher tax than high-income individuals. The decisive voter is the voter with the median income, called the median voter, as all parties find it strategic to favor these middle-ground positions to obtain the highest number of votes (Downs, 1957). The result of this model is relatively straightforward. When inequalities increase, and so does the distance between the median income and the mean income, the median voter will favor more redistribution, and policymakers will satisfy this request.

Let us discuss the model's predictions in light of some simple data. Figure I.3 shows the evolution of both pre-tax and post-tax income share of the top 1% and bottom 50% of the American income distribution. The gap between the two lines is then a proxy of the amount of redistribution. While inequalities increased substantially, the amount of redistribution did not follow the same trend. If, for instance, we considered the top 1% in 1970, the difference between pre-tax and post-tax income was 3 percentage points, which increased to 3.9 percentage points in 2019. The increase in redistribution is much milder than the increase in inequalities. This is the central puzzle in the political economy of redistribution, which many scholars are still trying to solve (Blanchard and Rodrik, 2021).

As a standard approach in economics, we can focus on the two sides of redistributive policies: demand for and supply of redistribution. Let us start with the former. There is evidence that the evolution of inequalities did not match an increase in demand for redistribution (Kenworthy and McCall, 2008, Kuziemko et al., 2015). For example, Kuziemko et al. (2015) show that there has been no increase in stated support for redistribution in the US since the 1970s. Even people who would benefit from redistribution, like low-income individuals, often refrain from supporting it (Kuziemko et al., 2015, Holland, 2018, Blanchard and Rodrik, 2021, Gethin et al., 2022). Cross-sectional evidence does not support the claims of the

Figure I.3: Pre-tax and post-tax income share in the US



Source: World Inequality Database

Meltzer and Richard model either: More unequal countries (US, UK) are associated with a high inequalities acceptance and lower support for redistribution than more equal societies (France, Italy, Norway) (Grimalda et al., 2018, Almås et al., 2020, Buser et al., 2020).

There are many possible reasons to explain the divergence between theory and evidence on demand for redistribution.⁹ A promising explanation relies on people’s beliefs in meritocracy, that is, the belief that the economic system is fair as it rewards merit (ability + effort) with success (Mijs, 2021). This belief leads people to praise the successes of the rich and blame the poor’s misfortune by lowering their redistributive preferences. The belief in meritocracy strengthens as narratives (in the sense of Shiller (2017)) about the deserving rich and undeserving poor become widespread. In this sense, downward redistribution is not considered desirable as it transfers resources from worthy people to lazy poor. Chapter 3 will leverage survey data from American participants to explore the relative importance of the narratives about the “deserving rich” and “undeserving poor” to explain peoples’ preferences for redistribution.

Another possible explanation for the low redistribution level relies on the representation quality. Indeed, focusing on the supply of redistribution means focusing on the well-functioning of representation in a democracy. If we consider citizens’ preferences for redistribution as given, decision-makers should meet this demand. However, this is hardly the general rule. The assumption of the Meltzer and Richard

⁹For a review of the different determinants of redistribution, see Alesina and Giuliano (2011) and (Mengel and Weidenholzer, 2022).

model that does not hold could be the responsiveness of politicians to an increase in demand for redistribution. Politicians may have many different reasons to deviate from the median voter’s wishes: the influence of lobbies, parties’ priorities, politicians’ *own* preferences, and the lack of perfect knowledge of what voters want, among many others. The question of how citizens’ preferences are represented is still debated, particularly in the case of taxation. Chapter 4 presents an experiment with actual politicians to study how policymakers’ ideology and voters’ preferences influence redistributive choices.

Outline

This dissertation draws from different fields of economics, mainly Urban Economics, Public Economics, and Experimental Economics, and it occasionally borrows from the political science and sociology literature (especially for Chapters 3 and 4). Additionally, I employ different research methods, as this dissertation includes a purely theoretical chapter (Chapter 1), an empirical chapter leveraging observational data (Chapter 2), and two chapters where I run online experiments (Chapter 3 and 4).¹⁰ In the subsequent paragraphs, I will present a summary of each chapter’s content and main results.

Chapter 1 presents a theoretical model whose aim is to shed light on the interconnection between residential choices, housing wealth, and long-run inequalities. As highlighted in this general introduction, the value of housing investments is deeply location-dependent, raising the question of how individuals’ spatial sorting and the housing wealth distribution are intertwined. In our model, agents choose how much to consume and the inheritance to leave to their offspring. Agents also decide where to locate but cannot pay any price to purchase a house because credit markets are imperfect, and a downpayment is required to obtain a mortgage. This down-

¹⁰This dissertation is composed of working papers co-authored by different colleagues: The two working papers corresponding to Chapter 1 are cosigned by Fabien Moizeau (my PhD supervisor) and Carl Gagné (researcher at INRAe, Rennes, and professor in Laval University, Canada). The working paper which constitutes Chapter 2 is single-authored. Chapter 3 is cosigned by Gianluca Grimalda (Kiel Institute for the World Economy, Germany) and Maria Marino (Universitat de Barcelona, Spain) and is part of an on-going project on the role of narratives about the merits and demerits of the poor and the rich in shaping people’s preferences for redistribution. Finally, the working paper which constitutes Chapter 4 is co-authored with Matthieu Pourieux (Ph.D. from the University of Rennes 1).

payment requirement makes agents' ability to borrow depend on the inheritance received from their parents. The latter is the only source of heterogeneity across agents.

We show that borrowing constraints limit agents' ability to pay in the most attractive locations. This distorts the house price formation and the standard capitalization mechanism. If we assume a homogenous wealth distribution, the borrowing constraint gives rise to *symmetry-breaking* (Matsuyama, 2000, 2006). Indeed, some "lucky" agents get to live in attractive locations while paying a price that is capped by the borrowing limit. This creates a utility gap between these "lucky" households and the rest of the population. The utility gap also translates to a higher inheritance left to the descendants so that inequalities will arise in subsequent periods. Inequalities are, therefore, endogenous in our model. When we assume a heterogeneous wealth distribution, we show that the borrowing constraint leads to *spatial wealth sorting* since wealthier agents can outbid the rest of the population and locate in the most attractive locations. We further show that the wealth left to the children is location-dependent so that the children of the wealthiest and best-located agents receive the highest inheritance and can locate themselves in the most attractive areas. Consequently, the spatial sorting and wealth inequalities perpetuate in the transitional path. Finally, there are two types of steady states: a steady state in which there are no wealth inequalities and all agents can borrow any amount of money; or a steady state with persistent inequalities and spatial sorting. Thus, spatial sorting translates into persistent inequality. We also derive an optimal tax schedule that must combine a tax on land rents and an income tax.

The second chapter studies another critical determinant of real-estate values: local decision-making. The focus is on France, where in the last years, the decision-making on urban planning involves two local governments tiers: the municipality and the inter-municipal community (*établissement publique de coopération intercommunale*, hereafter EPCI). Decisions on various issues are taken in a council of municipal delegates whom citizens directly elect in municipal elections. This creates a direct connection between citizens' preferences and delegates' decision-making. However, the representation of each municipality is not equal, as the number of delegates per municipality depends on the municipality's population share in the EPCI. In this chapter, I analyze how municipalities' voting power in the inter-municipal council influences the number of granted building permits. I collect an original dataset that includes the number of delegates per municipality in the densest EPCIs. This allows

me to compute an index of voting power, the Banzhaf index, which has been widely used to study the distribution of voting power in federal-type systems. Further, I use an instrumental variable approach by leveraging two reforms promoted by the central government, which changed the allocation of delegates in many EPCIs.

I find that a higher municipality's voting power leads to fewer building permits granted for multi-family housing units and more permits granted for single-family housing units. This suggests that municipalities can exploit their voting power to limit new high-density housing constructions, which are more likely to be perceived negatively by the local population. On the contrary, given that the local population might perceive single-family units more positively, delegates might try to foster low-density development. Both effects are stronger in more densely built municipalities, which could exhibit a fiercer NIMBYsm (Not In My BackYard) preferences, but results are not conclusive. Moreover, there is no evidence of the effect of the voting power on new buildings to be larger in homeowners municipalities. These suggests that delegates convey their constituency's preferences in the inter-municipal council, as they limit high-density development which is more likely to be seen negatively by the local population.

Chapter 3 involves an online experiment conducted in the US to study the relationship between people's redistributive preferences and the different narratives about the merit and the demerit of rich and poor people. The experiment combines a spectator-stakeholders framework (Almás et al., 2020) with a conjoint table analysis (Bansak et al., 2021): A spectator, who is selected among the top and bottom 20% of the American income distribution, decides how much to redistribute between a stakeholder with a yearly income higher than \$100,000 and a stakeholder with a yearly income lower than \$10,000. The high-income stakeholder always receives an initial endowment of \$50. In contrast, the low-income stakeholder always receives \$1. Therefore, the distribution of money in the experiment is reminiscent of real-world income differences. The stakeholders are described with different characteristics which highlight the merits and demerits of the two stakeholders. In particular, we focus on the effort dimension so that low-income and high-income stakeholders are described as working more than 10 hours a day or less than 6 hours a day. Moreover, the rich stakeholder is described either as the founder or inheritor of his/her firm, highlighting the stakeholder's talent and image of a self-made man/woman. Finally, the firm has more than 1000 or less than 5 employees: This attribute is meant to highlight the capacity of the trickle-down dimension.

We find that the attribute that matters the most in redistribution choices is the effort of the poor, as participants redistribute significantly more when the low-income stakeholder is described as working more than 10 hours per day. The effort of the rich is affecting only high-income participants' choices, but still to a lesser degree than the poor's merit. Second, the effect of the different attributes that highlight the merit of the two stakeholders are always stronger for rich spectators. This implies that the affluent are more meritocratic than low-income spectators. Third, we find that low-income decision-makers redistribute systematically more than high-income decision-makers even when we control for ideology and socio-demographic characteristics. Finally, we do not find evidence of the trickle-down component influencing redistributive preferences, with the only exception of rich liberals and moderates, for whom the effect is significant.

The last chapter of this dissertation focuses on the supply side of redistribution. We conduct an online redistribution experiment with 773 French local politicians and 661 French non-politicians to study the determinants of redistributive choices. Participants choose a flat tax rate to be applied to groups of French citizens. One part of the tax proceeds is lost, while the remainder is equally redistributed among the group. The choice environment differs with respect to the degree of information about the median voter's preferred tax rate and the degree of political competition. We also elicit participants' beliefs about the median voter's preference and the competitor's tax choice.

We find that the attribute that matters the most in redistribution choices is the effort of the poor, as participants redistribute significantly more when the low-income stakeholder is described as working more than 10 hours per day. The effort of the rich affects only high-income participants' choices, but still to a lesser degree than the poor's merit. Second, the effect of the different attributes that highlight the merit of the two stakeholders is always more substantial for wealthy spectators. This suggests that the affluent are more meritocratic than low-income spectators. Third, we find that low-income decision-makers redistribute systematically more than high-income decision-makers, even when we control for ideology and socio-demographic characteristics. Finally, we do not find evidence of the trickle-down component influencing redistributive preferences, except for rich liberals, for whom the effect is significant.

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Chapter 1

Spatial Sorting and Persistent Inequality¹

Contents

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¹The working paper corresponding to this chapter is coauthored with Carl Gagné (researcher at INRAe, Rennes, and professor in Laval University, Canada) and Fabien Moizeau (my PhD supervisor).

1 Introduction

As a locational space, land is a major social and economic factor. Given that it accounts for a large and increasing share of housing value, land is a major asset that represents a fundamental channel of intergenerational wealth transmission and inequality (Piketty and Zucman, 2014; Knoll *et al.*, 2017; Kuhn *et al.*, 2020; Bonnet *et al.*, 2021).² Land/housing also accounts for a large share of households' budget, and its purchase requires access to credit which is often limited by borrowing constraints (Acolin *et al.*, 2016). The ability of households to purchase a home depends on their wealth and the home's location.³ This suggests that households' location choices, private wealth, and inheritance are tightly intertwined. Furthermore, a large capital stock can be attributable to financial assets transferred between generations (Dynan *et al.*, 2002). Hence, high land rents could reduce savings for bequest motives and cause an under-investment in productive capital. Since housing is a durable good, its price impacts the structure of wealth left to children (housing assets vs. financial assets) and, in turn, on capital accumulation. In this paper, we argue that long-run wealth distribution and efficiency depend on the interplay between bidding for locations and the composition of inherited wealth (housing asset and financial asset). As a consequence, land taxation and inheritance taxation are interconnected.

For our purpose, we develop a model of a dynamic economy in which housing wealth reflects residential choices and the access to mortgage credit is imperfect. As purchasing a home in a given location involves large expenditures amounting to many years of income for most households, access to mortgage credit becomes an important determinant of homeownership. However, it can be limited by downpayment requirements that prevent households with little savings from purchasing a home in their desired location (Rosenthal *et al.*, 1991; Stein, 1995; Ortalo-Magné

²The land value represents, on average, half of the aggregate housing value in the U.S. and France. This share is higher in large cities (see Kuhn *et al.*, 2018 and Trannoy and Wasmer, 2022). Housing wealth also amounts to 50% of households' portfolios on average in OECD countries (Causa *et al.*, 2019). In France in 2018, 37.7 % of inherited wealth and 48.6 % of wealth received as a donation is represented by real estate (INSEE, 2018).

³Land rent varies widely across and within urban areas (see Combes *et al.*, 2019; Gaigné *et al.*, 2022). For example, in Greater Paris, the land value in the center (less than 3 km from Notre Dame) is 20-fold land value in the periphery (20 km from the center) (Chapelle *et al.*, 2022).

and Rady, 2006).⁴ We also consider an infinite sequence of non-overlapping generations connected *via* intergenerational transfers. Agents can only be heterogeneous in the inherited wealth composed of a voluntary bequest and the proceeds from the sale of the parents' house. In order to capture the spatial dimension of housing wealth, we consider that one-period lived agents choose their place of residence defined by its attributes that vary spatially (accessibility to jobs, amenities, facilities). The borrowing constraint is endogenous as it is specified on the inherited wealth and the equilibrium house price in each city location.

We first characterize the residential equilibrium that can arise at each date depending on the shape of the wealth distribution. Starting with the case of homogeneous agents, we show that the economy can experience *symmetry-breaking* as in Matsuyama (2000, 2006). This is a consequence of the borrowing constraint, which limits agents' access to credit in expensive attractive locations. The population polarizes into rich agents who obtain a higher utility which is location-dependent and leave a higher inheritance to their offspring, and poor agents, who obtain a lower homogeneous utility and leave a lower inheritance to their descendants. Thus, wealth inequality occurs endogenously.

We then turn to a heterogeneous population and show that the borrowing constraint generates *spatial wealth sorting*: the wealthier the agent, the closer she resides to the most attractive locations. The key mechanism is that wealthier agents are less likely to be constrained and limited to pay to live in a location. The borrowing constraint thus creates heterogeneity in agents' ability to pay. For a given wealth distribution, the city space is partitioned into distinct areas where residents hold the same status: constrained or unconstrained. We also show that there are two types of winners thanks to the borrowing limit: (i) The constrained agents who pay the price capped by the borrowing limit and (ii) the wealthier agents who are not credit-constrained but face less competition to buy land in attractive sites. *This highlights that the housing market generates implicit transfers between the various agent types.* We also show that the rent gradient decreases with distance from attractive sites, but its magnitude depends on whether the area hosts constrained or non-constrained residents.

⁴Frictions such as agency costs prevent agents from pledging the full value of their property for repayment. Borrowing constraints' tightness increased in the aftermath of the financial crisis as credit institutions tightened mortgage credit availability (Acolin *et al.*, 2016).

Further, we study the dynamics of the model. As it turns out that wealthier parents leave a larger inheritance to their offspring, we show that the spatial sorting and the wealth ranking maintain along the transitional path. However, the number and size of ‘constrained’ and ‘unconstrained’ areas can vary along the transitional path depending on the assumptions on credit market imperfections. Two long-run equilibria can arise. Either the long-run wealth distribution is degenerate, and no agent is constrained, or the population is polarized into low-wealth dynasties and dynasties who are wealthier. Spatial sorting translates into persistent inequality when the opportunity cost of land and/or commuting costs are high. Wealthy dynasties maintain a high level of wealth, not only because they can finance their housing investment but also because they have access to more attractive sites. This makes their investment highly profitable and contributes to leaving a high inheritance. Poor dynasties are excluded from living in the most attractive locations and reside in poverty trap areas. Therefore, land use restrictions and poor transport infrastructures magnify long-run wealth inequalities.

Our framework also bears a strong implication on tax design. According to the *Henry George Theorem* (HGT hereafter), a confiscatory tax on land rents is efficient and sufficient to finance urban public expenditures (Arnott and Stiglitz, 1979). In our model, spatial heterogeneity associated with altruistic agents and credit constraints create rents that are transferred between generations. This causes the market price of land to deviate from its shadow price and long-run inequalities. We show that the decentralization of the social optimum can be achieved by using two tax instruments. First, when agents are altruistic and credit markets are perfect, a tax on the land value received by donees is efficient and sufficient to finance public expenditures. Such land taxation yields a better allocation of resources between consumption and wealth left to the next generation, as well as between productive capital and housing capital. Second, when the borrowing constraint is binding, an additional tax depending on donors’ level of disposable income is required because the inter-generational transfers within dynasties are too high. Hence, a tax schedule on both inherited wealth (land/housing asset) and income must be implemented to cover public expenditures and achieve the optimal solution involving no long-run inequality.

The remainder of the paper is organized as follows. Section 2 presents the different strands of literature to which our paper is related, highlighting for each of them our contribution. Section 3 introduces the main model. In Section 4, we study

the urban equilibrium arising at each date. In Section 5, we analyze the possible long-run urban equilibria with the associated wealth distributions. In Section 6, we present different extensions of the model. We introduce, respectively, a borrowing cost, a tenure choice, an endogenous size of housing, and housing bubbles. Concluding remarks follow.

2 Related literature

Our paper is related to different strands of literature. First, we contribute to the macroeconomics literature on the relationship between credit market imperfections and persistent inequalities. This literature shows that when credit markets are imperfect, households with little initial wealth face limited investment opportunities, and their children remain poor (Banerjee and Newman, 1993; Galor and Zeira, 1993; Mookherjee and Ray, 2003; Matsuyama, 2000, 2006). Our model is similar to these occupational choice models as locations are vertically differentiated like occupations, and access to the most attractive locations/high-skilled occupations is prevented by borrowing constraints. We depart from these works as households' wealth reflects residential choices involving a trade-off between commuting costs and house prices. The possibility to borrow in one location depends on private wealth and the equilibrium housing price arising in each period.

Second, our paper is at the crossroads of the literature on land taxation and the literature on inheritance taxation, which have been disconnected (Bonnet *et al.*, 2021, is an exception). Since the return to land can be viewed as an economic rent, it is not surprising that the interest in land taxation has resurged recently among economists to finance public expenditures (Stiglitz, 2015). There is a long history of arguments in favor of land taxation.⁵ In particular, according to the HGT, a confiscatory tax on land rents is the only tax needed to finance urban public expenditures (Arnott and Stiglitz, 1979). In our paper, we find that land rent taxation is not sufficient to reach the first best. The addition of a tax on housing assets transferred

⁵Land derives its value from its location, and the return to land can be viewed as an economic rent. Since the land supply is not responsive to its price, it can be taxed without significantly distorting economic behaviors. In addition, as Henry George mentioned in the 19th century in his famous book *Progress and Poverty*, a tax on land value would capture the benefits accruing to landowners from external developments (e.g. the presence of public infrastructures such that transportation networks, parks, schools, streetscape amenities) and not from their efforts. Because taxing pure economic rents does not create a distortion, land taxation is efficient.

between generations is required. Departing from the famous *zero* tax results provided by Chamley (1986) and Judd (1985), recent inheritance taxation models find that some positive tax or subsidy can be socially optimal (Fahri and Werning, 2010; Piketty and Saez, 2013). Uncertainty (implying accidental bequests) and/or at least two sources of inequality (parents differ by their taste for bequests and their productivity/wage) are prerequisites for deriving a positive optimal inheritance tax rate. In our framework, perfect information prevails, agents share the same preferences, and there is no difference in ability or effort across agents as their labor incomes are identical. In our case, inheritance taxation must be positive as the inherited wealth includes housing/land assets.

Third, our model builds on the standard residential choice model (Fujita, 1989), where agents locate within the city and commute between their residences and the business districts. One prediction of the model, which has been dubbed the Alonso-Muth condition, states that when a city resident decides to move marginally away from the city center, the housing expenditures decrease precisely as much as the increase in commuting costs (Duranton and Puga, 2016). Since in our framework agents value the wealth left to their children, agents' bid-rents depend on the future value of housing. In addition, we introduce credit market imperfections that limit the volume of debt of households and restrict their ability to pay for a place of residence. To the best of our knowledge, there is no residential choice model incorporating both a borrowing constraint and intergenerational transfers.⁶ We show that credit market imperfections impact the rent gradient in the city. When agents are borrowing constrained, the Alonso-Muth condition is not met as the rent function does not capitalize commuting costs. When the borrowing constraint is binding, the rent gradient reflects the shape of the wealth distribution as well as the stringency of the borrowing constraint.

Finally, our paper contributes to the literature that studies the effect of credit market imperfections on the housing market (Stein, 1995; Ortalo-Magné and Rady, 1999, Ortalo-Magné and Rady, 2006). These models include an initial downpayment to obtain a mortgage that constrains low-income households (especially young ones) from becoming homeowners. The housing market then reacts to any change in

⁶Dantan and Picard (2019) introduce a borrowing constraint in a monocentric city model that limits households' tenure and residential choices. However, they do not consider any intergenerational transfer.

the credit market through the change in the home-ownership rate of low-income households. We depart from these models in two ways: First, in our model with a continuous space, the borrowing constraint is *location-dependent*; Second, the wealth distribution results from the residential equilibrium.

3 The model

3.1 Time, space, and preferences

Time is discrete and extends to infinity. Each agent lives one period and has a unique offspring at the end of her life. The size of the population is constant, with a mass L of agents, supplying one unit of labor. Dynasties are formed by each infinite parent-child sequence. At the beginning of each period, any agent receives a bequest $y_t \in [\underline{y}_t, \bar{y}_t]$ from her parent with $0 \leq \underline{y}_t \leq \bar{y}_t < \infty$. We denote by $F_t(y)$ the share of agents with wealth below y_t at the beginning of period t . The initial wealth is the only source of ex-ante heterogeneity across agents. At the beginning of each period, agents choose their residential location and the allocation of their total income in order to maximize their welfare.

We consider a system of cities. The formation of a city requires a certain amount of per period fixed costs G , which include costs of public facilities (e.g. transport infrastructure). Locations within each city are heterogeneous and vertically differentiated, that is, locations are more or less attractive places to live. The heterogeneity dimension stems from the disutility from commuting and/or monetary costs (including opportunity costs of time) associated with distance to jobs or amenities attributes, and service facilities.⁷ For sake of simplicity, we consider a linear and monocentric city defined over the one-dimensional space \mathbb{R}_+ where locations differ with respect to the accessibility to the Central Business District (hereafter CBD), hosting all jobs, located at the origin $x = 0$, and where agents earn the same wage w_t (there is no difference in ability or effort across agents). Commuting costs given by $\kappa(x)$ increase with distance x between her residential location and the CBD. The

⁷Combes *et al.* (2019) find that French households devote 13.5% of their expenditure to transportation. The opportunity cost of the time spent in commuting represents from three to six weeks of work for a typical New Yorker and, on average, four weeks of work for a resident of Greater Paris (Proost and Thisse, 2019). Moreover, commuting is perceived by individuals as one of their most stressful and unpleasant activities (Kahneman and Krueger, 2004). All things being equal, all households prefer residential location implying short trips to long trips.

amount of housing available at each location x is normalized to 1 and the opportunity cost of land is given by the constant $R_A \geq 0$. Agents are assumed to purchase one unit of housing. In Section 5, we relax the assumption of fixed lot size and consider that location affects utility through the consumption of amenities available at the place of residence or commuting costs generating utility loss.⁸ Moreover, our results remain valid if the model is extended to a map formed by streets, roads, highways and railway junctions modeled by means of a topological network, with locations characterized by distance to various job centers, service facilities, and exogenous amenities. In such a case, there must exist a location-quality index which subsumes into a single scalar the different accessibility costs (Gaigné *et al.* 2022).

Agents have an altruistic concern for their children and have the same utility function u , which is increasing in consumption c_t and the inheritance left y_{t+1} . While we analyze the short-run equilibrium, we do not need to specify the utility function. We obtain the same equilibrium characteristics whatever we assume *impure* altruism and *pure* altruism. In the former case, parents derive utility from their bequests $u(c_t, y_{t+1})$, which are motivated by *joy of giving*, commonly referred to 'warm glow preferences', like in Banerjee and Newman (1993), Galor and Zeira (1993), Piketty (1997), Matsuyama (2006) and many others in the literature on dynamic inequalities. In the latter case, parents derive utility from the offspring's utility, like in the growth literature with overlapping generations. For example, preferences are $U_t = u(c_t) + \delta U_{t+1}[c_{t+1}(y_{t+1})]$ where δ is a discount factor between generations.

The wealth left to the offspring is assumed to be the sum of some parental voluntary bequest b_t and the future housing value net of transaction costs $\theta_{t+1}(x)$ owned and occupied by the parent in the previous period:

$$y_{t+1}(x) = (1 + r)b_t + \theta_{t+1}(x), \quad (1.1)$$

where voluntary bequests are assumed to earn an exogenous rate of return r per generation. Without loss of generality, this interest rate is assumed to be exogenous and determined in world markets. Hence, voluntary bequests can be assimilated to financial assets transmitted to the next generation. Unlike the standard literature on inheritance, we consider the wealth left comprises not only financial assets but

⁸Urban economic theory considers two extreme cases: (i) a fixed housing size and (ii) housing size can adjust freely to new conditions. The latter assumption makes the analysis much more involved without affecting the nature of our results.

also owner-occupied housing. In accordance with empirical evidence, the main form of savings of households is their own home (Causa *et al.*, 2019).⁹ This captures the key feature of our framework in which the amount of inherited wealth depends on the residential choice of parents.

Agents choose c_t and b_t as well as where their location x in order to maximize $u(c_t, y_{t+1})$ considering (1.1) under the following budget constraint:

$$w_t + y_t = c_t + b_t + p_t(x) + \kappa(x) + \tau_t, \quad (1.2)$$

where $p_t(x)$ is the price of housing. Each city levies a (lump-sum) income tax on each inhabitant τ_t to finance public expenditures, which is equal to G/L . We discuss the appropriate design of a tax system in Section 4.

3.2 Housing and credit markets

Agents may need to borrow to purchase the housing unit and they can face a borrowing limit. Following the literature on the housing market and credit rationing (Rosenthal *et al.*, 1991, Stein, 1995, Ortalo-Magné and Rady, 2006, Arce and López-Salido, 2011), agents can borrow up to a certain fraction λ of the house value, $0 \leq \lambda < 1$, meaning that they are able to borrow if

$$\lambda p_t(x) \geq p_t(x) - y_t. \quad (1.3)$$

This downpayment requirement implies that agents must be endowed with at least a level of wealth equal to $(1 - \lambda)p_t$ to be able to purchase the house at x .¹⁰ Hence, if agents' inherited wealth is higher than the house price, $y_t \geq p_t(x)$, then they do not need to borrow. Otherwise, agents can borrow while facing no borrowing constraint when $p_t(x) > y_t \geq (1 - \lambda)p_t(x)$ or they can borrow up to the limit $\lambda p_t(x)$ when $y_t < (1 - \lambda)p_t(x)$. Our key feature is that the borrowing constraint is *location specific* as it depends on the price of housing, which varies with location x . In Section 6, we study the implications of additional costs incurred by lenders to supervise and enforce borrowing contracts to reduce the risk of default. Finally, a more realistic

⁹For example, the main residence of households living in the Eurozone countries accounts for around 50% of their assets.

¹⁰This borrowing constraint can be justified by various stories of agency problems (see Matsuyama, 2006).

modeling of credit rationing on housing demand would require to add a second constraint on an upper limit on the share of current income owner-occupiers can spend on housing (Rosenthal *et al.*, 1991). We put aside this income constraint as we focus on the wealth dynamics and therefore we just need (1.3) for our purpose. Moreover, we assume homogeneous agents' income.

Housing is transmitted among generations using the services of intermediaries, named real estate companies. At each date t , real estate companies buy the housing unit available at location x at price $\theta_t(x) \geq R_A$ from the previous owners living at $t - 1$ and sell it to agents born at t at price $p_t(x)$.¹¹ We initially assume that the housing unit cannot be rented and that all agents purchase the house. We relax this assumption in Section 5. We also assume no depreciation of the housing stock over time. The profit of the intermediary associated with location x is denoted by $\mathbf{v}_t(x)$ and it is expressed as follows

$$\mathbf{v}_t(x) = p_t(x) - \gamma p_t(x) - \theta_t(x)$$

where $\gamma p_t(x)$, with $\gamma \in (0, 1)$, is the cost of adjusting housing services from the last period to the current period. Alternatively, $\gamma p_t(x)$ captures the income accrued to the intermediary. We assume free entry which implies $\mathbf{v}_t(x) = 0$ and, thus, $\theta_t(x) = (1 - \gamma)p_t(x)$.

3.3 Bequest and bid-rent

Maximizing u with respect to c_t and b_t subject to (1.1) and (1.2) yields the following first-order condition¹²

$$u_c(c_t, y_{t+1}) = (1 + r)u_y(c_t, y_{t+1}). \quad (1.4)$$

with $u_c \equiv \partial u / \partial c_t$ and $u_y \equiv \partial u / \partial y_{t+1}$. At the beginning of each period, agents choose where to live to maximize their utility. Since the housing market is competitive, agents bid for available housing units, and real estate companies offer housing units

¹¹At $t = 0$, we could suppose that there are some original agents who are given some property titles and sell their property to the real estate companies.

¹²In order to avoid burdensome expressions, the altruism motive is assumed to be sufficiently strong to have $b_t > 0$ in equilibrium (see Abel, 1987, who characterizes conditions such that bequests are operative). Under pure altruism, $u_y(c_t, y_{t+1}) = \delta u_c[c_{t+1}(y_{t+1})]$.

to the highest bidder. We define the bid-rent as the *maximum* price per unit of housing that an agent endowed with wealth y_t would be willing to pay to live in a location where she enjoys the utility level $u[c_t(x), y_{t+1}(x)]$. The bid-rent depends on the extent of competition from other bidders and imperfections of the credit market.

Let us start with location choices when the borrowing constraint is slack. We denote by Ψ_t the maximum bid-rent that solves the equilibrium condition $u'[c_t(x), y_{t+1}(x)] = 0$ (a prime denotes d/dx) using (1.4) or, equivalently, $c'_t(x)u_c(c_t, y_{t+1}) = y'_{t+1}(x)u_y(c_t, y_{t+1})$. This equation is similar to the 'mobility Euler equation' of Bilal and Rossi-Hansberg (2021). In our case, agents optimize their inheritance by choosing how much to bequeath in financial assets and how much housing wealth to transmit. Using (1.1), (1.2), and (1.4), we obtain that the housing return rate equals the one of the financial asset

$$1 + r = \frac{\theta'_{t+1}(x)}{\Psi'_t(x) + \kappa'(x)}. \quad (1.5)$$

Integrating (1.5), we can express the maximum rent agent y_t can pay for residing at location x without binding the borrowing constraint as follows (see Appendix A for details):

$$\Psi_t(x, K_t) = K_t - \Upsilon_t(x) \quad \text{with} \quad \Upsilon_t(x) \equiv \kappa(x) - \mu p_{t+1}(x), \quad (1.6)$$

where $\mu \equiv (1 - \gamma)/(1 + r) < 1$ and K_t stands for the constant of integration which is independent from x , and will be determined by the pattern of residential choices and borrowing capacities arising at equilibrium. Assuming $p'_{t+1}(x) \leq 0$ (which will be shown later on), it follows that $\Upsilon'_t(x) > 0$ and $\Psi_t(x, K_t)$ is a continuous and decreasing function of x . We obtain the standard trade-off between the price of land and commuting costs: While moving further from the city center, the bid-rent is reduced in order to compensate the agent for higher commuting costs. In our case, there is a second trade-off: by moving away from the CBD, the bid-rent is reduced to compensate the lower value of the housing investment (lower $\theta_{t+1}(x)$).

A key feature of our setup is that the rent endogenously determines whether each agent needs to borrow, possibly facing a borrowing limit. Given that the bid-rent is decreasing with distance, it turns out that a y_t agent is more likely to borrow at more attractive locations where prices are high. We can define for any y_t agent the threshold location $\hat{x}_t(y_t, K_t) \in [0, L]$ such that the borrowing constraint (1.3) is

binding

$$(1 - \lambda)\Psi_t(\hat{x}_t, K_t) = y_t. \quad (1.7)$$

For any location $0 \leq x \leq \hat{x}_t(y_t, K_t)$, the agent endowed with an initial wealth y_t is borrowing constrained. Hence, for any location $0 \leq x \leq \hat{x}_t(y_t, K_t)$, the agent y_t is no more able to make a trade-off between commuting costs and rent as well as to get the same return rate for both the financial and housing assets (Equation (1.5) is no more satisfied). From the implicit function theorem, $d\hat{x}_t/dy_t < 0$ for any given K_t , meaning that the wealthier the agent, the smaller the set of locations where the borrowing constraint binds. Note that the case such that the borrowing constraint is never binding for sufficiently rich households can arise if $(1 - \lambda)\Psi_t(x_t, K_t) < y_t$ for $x \in [0, L]$.

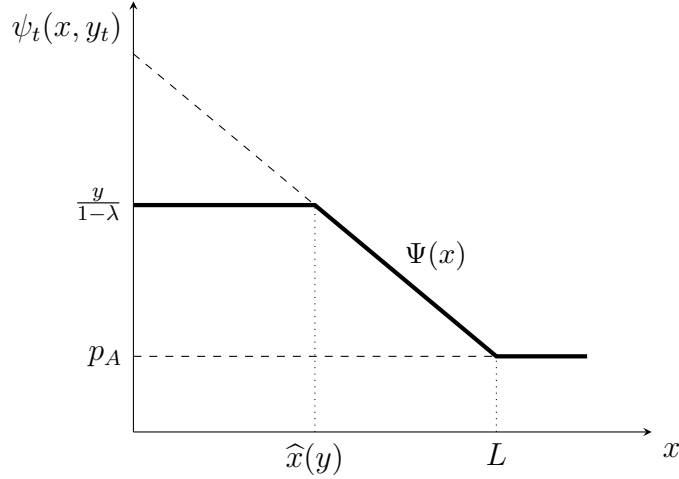
For all locations $x \geq \hat{x}_t(y_t, K_t)$, the y_t agent is not borrowing constrained and her maximum bid-rent is $\Psi_t(x, K_t)$ to reside at x . We thus define the bid-rent function with borrowing constraint denoted by ψ for any agent y_t as follows

$$\psi(x, y_t, K_t) = \begin{cases} \frac{y_t}{1-\lambda}, & \text{for } x \in [0, \hat{x}_t(y_t, K_t)], \\ \Psi_t(x, K_t) = K_t - \Upsilon_t(x), & \text{for } x \in [\hat{x}_t(y_t, K_t), L]. \end{cases} \quad (1.8)$$

Inserting (1.8) and (1.1) in (1.2), we obtain $c_t(x, y_t) + y_{t+1}(x, y_t)/(1+r) = \mathcal{W}_t(x, y_t)$ where $\mathcal{W}_t(x, y_t)$ correspond to the 'lifetime' wealth for agent y_t equal to

$$\mathcal{W}_t(x, y_t) = \begin{cases} w_t + y_t - \Upsilon_t(x) - \frac{y_t}{1-\lambda} - G/L, & \text{for } x \in [0, \hat{x}_t(y_t, K_t)], \\ w_t + y_t - K_t - G/L, & \text{for } x \in [\hat{x}_t(y_t, K_t), L]. \end{cases} \quad (1.9)$$

The bid-rent function (1.8) stresses that the capacity of any agent to pay to reside at location x depends on whether she needs to borrow or not. Credit market imperfections impact the cost of living at any location for all agents. For locations x where the borrowing constraint does not bind, that is $x \geq \max\{0, \hat{x}_t(y_t, K_t)\}$, the agent gets the same lifetime wealth whatever her place of residence and whether she is a borrower or a saver. This is a direct consequence of the bid-rent fully compensating commuting costs and the future sale price. By contrast, for locations where the agent borrows up to the borrowing limit, the rent $y_t/(1 - \lambda)$ does not capitalize commuting costs and future sale price. Hence, the closer she resides in the CBD, the higher her lifetime wealth. *Any agent strictly prefers to live at locations*


 Figure 1.1: Bid-rent for a y_t agent

closer to the CBD where she borrows up to the limit. This relies on the very nature of the borrowing constraint which imposes a cap on the agent's bid-rent.

Land is allocated to the highest bidder, so that the equilibrium price function is given by

$$p_t^*(x) = \max \left\{ \max_{y_t \in [\underline{y}_t, \bar{y}_t]} \psi(x, y_t, K_t), p_A \right\}, \quad (1.10)$$

where $p_t^*(x)$ is a continuous function and $p_A \equiv R_A/(1-\gamma)$. Because $\theta_t(x) \geq R_A$, we must have $p_t^*(x) \geq p_A$ for any $x \in [0, L]$.

By contrast, when there are no credit market imperfections, the bid-rent curve does not depend on individual wealth and the slope of the bid-rent curve does not vary across agents. The housing price at equilibrium is given by $\max\{\Psi_t(x, \mathcal{K}), p_A\}$ with $\Psi_t(x, \mathcal{K}) = \mathcal{K} - \Upsilon_t(x)$ where $\mathcal{K} \equiv (1-\mu)p_A + \kappa(L)$. Indeed, as $\Psi_t(x, \mathcal{K})$ decreases with distance, \mathcal{K} is such that $\Psi_t(L, \mathcal{K}) = p_A$.

4 The urban equilibrium and wealth transfers

In this section, we consider that the distribution of agents across cities is given while their residential location within each city is endogenous. We aim to characterize the urban configuration that arises at any date t given a wealth distribution $F_t(y)$ in any city.

4.1 Spatial sorting, the rent gradient, and the wealth transmission

Borrowing constraints impact agents' ability to borrow and bid for housing. The interaction between credit market imperfections, the wealth distribution, and the house price formation is critical for the emerging residential equilibrium and inter-generational wealth transfers.

Without any borrowing constraint, the maximum bid-rent is identical across individuals. If those living at x_1 pay the price $p_t(x_1) < \Psi_t(x_1, \mathcal{K})$, everyone living at $x \neq x_1$ would try to buy housing at x_1 to be better off. In this case, there would be excess demand for housing at x_1 (and excess supply at $x \neq x_1$), $p_t(x_1)$ would rise ($p_t(x \neq x_1)$ would decrease) until x_1 and $x \neq x_1$ were equally desirable locations, that is, until the highest utility achievable at x_1 is just equal to the highest utility achievable at $x \neq x_1$, regardless of wealth y_t . In equilibrium, $p_t^*(x) = \Psi_t(x, \mathcal{K})$ for all $x \leq L$ and there is no spatial sorting (there exists a continuum of residential equilibria). In the subsequent paragraphs, we show that the nature of competition among agents is different when we introduce borrowing constraints.

Symmetry breaking. Let us first provide the intuitions of the mechanisms at work by considering that at date t all agents own the same wealth y_t^0 . As in Matsuyama (2000, 2006), credit market imperfections can give rise to *symmetry-breaking*, leading the initially homogeneous population to endogenously split into different wealth classes. Our novel feature is that *symmetry-breaking* relies on the interplay between credit market imperfections and agents' location choices. Such a configuration occurs if the wealth level y_t^0 is such that the borrowing constraint binds for an interior location \hat{x}_t^0 , that is $(1 - \lambda) \Psi_t(\hat{x}_t^0) = \hat{y}_t^0$ with $\hat{x}_t^0 \in [0, L]$. Hence, if the city is characterized by a perfectly equal distribution of wealth, then the agents residing at $x \in [0, \hat{x}_t^0]$ obtain the highest utility. Indeed, their lifetime wealth is $\mathcal{W}_t(x) = w_t - \Upsilon_t(x) - \lambda y_t^0 / (1 - \lambda)$ with $\mathcal{W}_t'(x) < 0$ while the rest of the population living at any $x \in [\hat{x}_t^0, L]$ achieve the same level of lifetime wealth, given by $\mathcal{W}_t^0 = w_t + y_t^0 - \mathcal{K} < \mathcal{W}_t(x)$. There is credit rationing as some agents cannot borrow up to their borrowing limit to live close to the center and are relegated to areas where they leave a lower inheritance. Residents in the area $[0, \hat{x}_t^0]$ enjoy a higher lifetime wealth and greater utility because the rent they pay is capped to the level $y_t^0 / (1 - \lambda)$. We disregard the rationing rule that would be implemented to

split identical agents into different categories. In the subsequent period, the society polarizes into rich agents who receive higher wealth from their parents residing in the area $[0, \hat{x}_t^0]$ and poor agents whose parents inhabited area $[\hat{x}_t^0, L]$. Thus, *wealth inequality occurs endogenously*. Without any credit constraint, market equilibrium requires that any agent has the same utility and leaves the same bequest, no matter where she lives. No wealth inequality would arise.

Spatial sorting with heterogeneous agents. Consider now that the initial wealth differs across agents. To grasp the intuition of the heterogeneous case, we consider a wealth distribution with a share s of rich agents endowed with \bar{y}_t , while the rest of the agents $1 - s$ are poor and receive an initial wealth $\underline{y}_t < \bar{y}_t$. Rich agents are not credit-constrained whatever the location x while the borrowing limit is such that $\hat{x}_t \equiv \hat{x}_t(\underline{y}_t) \in (0, L)$. Hence, \bar{y}_t agents can outbid \underline{y}_t agents at $x \in (0, \hat{x}_t)$ to be better off. Hence, the borrowing constraint generates spatial sorting of heterogeneous agents. If $s < \hat{x}_t$, then all the rich agents live in the most attractive sites. However, under this configuration, they do not pay $\Psi_t(x, \mathcal{K})$ as poor agents cannot outbid residents at $x \in [0, s]$ to be better off. The bid-rent of each \bar{y}_t agent is $\Psi_t(x, \bar{K}_t) = \bar{K}_t - \Upsilon_t(x)$, where \bar{K}_t is such that $\bar{K}_t - \Upsilon_t(s) = \underline{y}_t/(1 - \lambda)$ with $\Psi_t(x, \bar{K}_t) < \Psi_t(x, \mathcal{K})$. Hence, the gain captured by a rich agent arising from the borrowing limit increases with a lower level of wealth owned by the poorest agents and with a lower mass of rich agents. A fraction of poor agents can live in $x \in (s, \hat{x}_t)$ and pay a price $\underline{y}_t/(1 - \lambda)$ lower than $\Psi_t(x, \mathcal{K})$. The other poor agents occupy the less attractive sites in (\hat{x}_t, L) and pay $\Psi_t(x, \mathcal{K})$. Therefore, the housing price and agents' lifetime wealth depend on the initial wealth distribution.

The housing market generates implicit transfers between the various types of agents. There are two types of winners thanks to the borrowing limit: (i) the wealthiest agents who are not constrained and pay a housing price that is lower than the price they would pay without borrowing constraint, and (ii) the lucky poor agents who are borrowing-constrained. The resulting lifetime wealth of agents reflects both their ranking in the wealth distribution as well as luck.

More generally,

Proposition 1. *Borrowing constraints lead to spatial wealth sorting. The wealth mapping $y_t^*(x)$ from the location set to the wealth set is such that $1 - F_t(y) = x/L$. Consequently, $y_t^*(x)$ decreases with x as $y_t^{*'}(x) = -1/[Lf_t(y)]$*

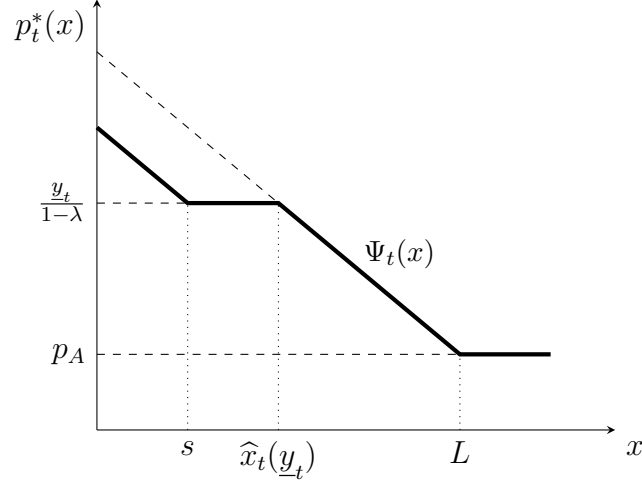


Figure 1.2: Equilibrium with two wealth classes

Proof. From (1.8), we have for any y_t agent that

$$\psi'(x, y_t, K_t) = \begin{cases} 0, & \text{for } x \in [0, \hat{x}_t(y_t, K_t)[, \\ \Psi'_t(x, K_t) < 0, & \text{for } x \in]\hat{x}_t(y_t, K_t), L] \end{cases}$$

considering that ψ is not differentiable at $\hat{x}_t(y_t, K_t)$.

First, suppose that $\hat{x}_t(y_t, K_t) \in [0, L]$ for some y_t . Since $\hat{x}_t(y_t, K_t)$ decreases with y_t , we can define the threshold $\hat{y}_t(K_t) \in [y_t, \bar{y}_t]$ such that, at a given location x , we have $x = \hat{x}(\hat{y}_t, K_t)$. Considering a bid-rent function $\psi(\cdot, y_t, K_t)$, we take a point on that curve $(\hat{x}_t(\hat{y}_t, K_t), \psi(\hat{x}_t(\hat{y}_t, K_t), y_t, K_t))$. By keeping the value of ψ constant, we can then rank the bid-rent slopes according to the wealth level for any $0 \leq x = \hat{x}_t(\hat{y}_t, K_t) \leq L$

$$\psi'(x, y_t, K_t)|_{x=\hat{x}_t(\hat{y}_t, K_t), \psi=\text{const}} = \begin{cases} \Psi'_t(x, K_t), & \text{for any } y_t > \hat{y}_t, \\ 0, & \text{for } y_t < \hat{y}_t. \end{cases}$$

where, from (1.6), $\Psi'_t(x, K_t) = -\Upsilon'_t(x) < 0$. As in Fujita (1989), steeper bid-rents imply locations closer to the CBD as agents with steeper bid-rents bid away the agents with flatter bid-rents. In other words, agents endowed with an initial wealth $y_t > \hat{y}_t$ can outbid agents poorer than \hat{y}_t in more attractive areas, *i.e.* in the area $[0, \hat{x}(\hat{y}_t, K_t)[$.

If $L > \hat{x}(\bar{y}_t, K_t) > 0$, then for any $x \in [0, \hat{x}(\bar{y}_t, K_t)]$ bid-rent slopes are nil for any agent. However, given the bid-rent $y_t/(1-\lambda)$ is strictly increasing with the

agent's wealth and that any constrained borrower strictly prefers to live close to the city center, there is perfect sorting in the area $[0, \hat{x}(\bar{y}_t, K_t)]$.

If $0 < \hat{x}(y_t, K_t) < L$, then for any $x \in [\hat{x}(y_t, K_t), L]$, this implies that there is no $\hat{y}_t \in [y_t, \bar{y}_t]$ such that $x = \hat{x}(\hat{y}_t, K_t)$ for $x \in [\hat{x}(y_t, K_t), L]$. No agent y_t is constrained by the borrowing limit at any $x \in [\hat{x}(y_t, K_t), L]$. There is no sorting in this area as the bid-rent slope is the same whatever the agent y_t for locations $x \in [\hat{x}(y_t, K_t), L]$.

Second, consider that there is no $\hat{x}_t(y_t, K_t) \in [0, L]$ for any y_t . This arises under two cases: (i) the wealth distribution is such that $(1 - \lambda)\Psi_t(x, K_t) > \bar{y}_t$ for any $x \in [0, L]$ meaning that there does not exist $\hat{x}_t(y_t, K_t) \in [0, L]$ for any y_t . This implies that all agents are borrowing constrained (all agents bid $y_t/(1 - \lambda)$ for land and there is perfect sorting in the area $[0, L]$) and (ii) the wealth distribution is such that $(1 - \lambda)\Psi_t(0, K_t) < \underline{y}_t$ meaning that there does not exist $\hat{x}_t(y_t, K_t) \in [0, L]$ for any y_t . This implies that for no agent and no location, the borrowing constraint is binding. One could not rank bid-rent slopes as all agents would be able to pay Ψ_t . \square

Spatial sorting occurs as soon as the wealth distribution and the bid-rent are such that there are borrowing constrained residents in equilibrium, which is guaranteed when the poorest agents are credit constrained at the CBD, that is $(1 - \lambda)\Psi_t(0, \mathcal{K}) > \underline{y}_t$, and not credit constrained at the city fringe, that is $\underline{y}_t > (1 - \lambda)\Psi_t(L, \mathcal{K})$. Otherwise, any agent expends the rent $\Psi_t(x, \mathcal{K})$ and the urban configuration resembles the urban equilibrium of the standard monocentric city model (Fujita, 1989). This proposition stresses the role of the borrowing constraint in generating segregation. Since wealthier agents are less likely to borrow and to confront the obstacle of the borrowing limit, the bid-rent slope is increasing with agents' wealth. It turns out that wealthier households are able to outbid poorer ones. There is *spatial wealth sorting*, that is, the wealthier the residents, the better place to live.¹³

The determination of a residential equilibrium has the nature of a matching problem between real estate companies and consumers in which housing at specific locations x is vertically differentiated, endowed with $\Upsilon(x)$, and consumers differ with respect to their endowed wealth y_t . The ranking of bid-rent slopes implies the

¹³In a different setting of endogenous formation of jurisdictions, Bénabou (1996) also emphasizes that credit market imperfections are sufficient to cause social segregation.

existence of a unique positive assortative matching between locations and wealth levels given by $y_t^*(x)$.¹⁴

Rent gradient and the intergenerational transmission of wealth. We are also able to characterize the rent gradient in the following

Proposition 2. *At any residential equilibrium, the rent function is non-increasing with distance x . Its gradient in a given area depends on whether residents are borrowing-constrained or not.*

The Alonso-Muth condition is satisfied for all locations where agents are not borrowing-constrained as the rent decreases with distance to compensate for higher commuting costs and the lower future sale price. This is not the case for locations where the borrowing constraint binds as the rent gradient is equal to $y_t^{*'}(x) / (1 - \lambda) < 0$. The rent capitalizes neither commuting costs nor the future selling price and its gradient depends solely on the wealth distribution and the intensity of the borrowing constraint λ . The bigger the income gap between two adjacent locations, captured by a steep mapping $y_t^*(x)$, the steeper the rent function. Note that the rent function is flat in locations where agents are constrained and have the same wealth level.

Given (1.9), we have for any $y_t^*(x)$ agent

$$\mathcal{W}'_t(x, y_t^*(x)) = \begin{cases} -\Upsilon'_t(x) + (y_t^{*'}(x) - \psi_y(x, y_t^*))y_t^{*'}(x), & \text{if borrowing-constrained,} \\ y_t^{*'}(x), & \text{otherwise.} \end{cases}$$

From Proposition 1, we know that $y_t^{*'}(x) < 0$. Moreover, $\psi_y(x_t, y_t^*) = 0$ at the urban equilibrium. Hence, for both constrained and non-constrained residents, we deduce that $\mathcal{W}'_t(x, y_t^*(x)) < 0$. Since y_{t+1} is an increasing function, this allows us to offer the following

Proposition 3. *At any residential equilibrium, the inheritance y_{t+1} is continuous and decreasing with distance at any location $x \in [0, L]$.*

Propositions 1 and 3 together imply that spatial sorting and the wealth ranking maintain along the transitional path. The further the parents live from the CBD, the less their offspring inherits. The place where an agent lives thus translates into

¹⁴Applying the bid-rent approach á la Fujita allows to show that the bid-rent function is the Pareto frontier between agents and real estate companies which cross-derivative is crucial to determine the mapping in a TU matching game (Gaigné *et al.*, 2022).

the position of her offspring's in the wealth distribution. As a consequence, the lower the inherited wealth, the further away the offspring will reside. It turns out that dynasties do not change their residential location at any date t . Of course, this relies on our assumption that there is no idiosyncratic shock on wealth, preventing any dynasty from experimenting social mobility as well as any change of its place of residence.

4.2 The social structure of cities

The Propositions 1, 2, and 3 hold regardless of the location of constrained agents. In this subsection, we characterize the residential equilibrium as a set of areas which are subsets of space which host agents who have the same status, constrained or not. The size, number and location of the areas depend on the initial wealth distribution.

In this subsection, we illustrate the model by developing an example while the proof of the general cases is reported in Appendix B. Assume that Ψ_t is linear and decreasing with distance and y_t is Pareto distributed, truncated to the support $[\underline{y}_t, \bar{y}_t]$ with shape parameters $\omega > 0$: $F_t(y) = [1 - (y/\underline{y}_t)^{-\omega}]/\phi_t$ with $\phi_t \equiv 1 - (\bar{y}_t/\underline{y}_t)^{-\omega} \in (0, 1]$. A low value of ω means that the wealth distribution is close to uniform among agents, whereas that distribution gets more and more skewed towards low-wealth agents for larger values of ω . In addition, ϕ_t increases with $\bar{y}_t/\underline{y}_t$.¹⁵ In addition, when perfect sorting occurs, we can deduce that $y_t^*(x)$ is decreasing and *convex* (the cumulative distribution function of a Pareto variable is an increasing and concave function). From Proposition 1, assortative matching requires that the $x\%$ of the wealthiest agents be matched with the $x\%$ of the least distant locations. Formally, the matching function $y_t(x)$ can be retrieved from the following condition:

$$\int_{y_t}^{\bar{y}_t} f_t(y)dy = \frac{1}{L} \int_0^x dx$$

The proportion of the population with wealth greater than or equal to y_t being $1 - F_t(y_t)$, a simple calculation then shows that the equilibrium assignment rule is such that

$$y_t^*(x) = \underline{y}_t \left[\frac{1}{1 - \phi_t + (\phi_t/L)x} \right]^{1/\omega}. \quad (1.11)$$

¹⁵The Pareto distribution is frequently used in the literature on wealth inequality (see, for example, Benhabib and Bisin, 2018, and Saez and Zucman, 2020).

Consider the case where the city structure is characterized by three areas, each one hosting agents with a particular status, constrained or not constrained. The poorest individuals who are assumed to not face any borrowing constraint live at the least attractive places, *i.e.* the city fringe $[\hat{x}_t^0, L]$ and pay $\Psi_t(x, \mathcal{K})$ where the threshold location \hat{x}_t^0 is such that $y_t^*(\hat{x}_t^0) = (1 - \lambda)\Psi_t(\hat{x}_t^0, \mathcal{K})$. The richest agents can afford to live in the most attractive locations $[0, \hat{x}_t^1]$ without being borrowing limited while the intermediate-wealth agents, the only agents who are borrowing-constrained, reside in the area $[\hat{x}_t^1, \hat{x}_t^0]$ and pay $y_t^*(x)/(1 - \lambda)$. The housing price paid by the wealthiest agents is given by the bid-rent $\Psi_t^1(x, K_t^1) = K_t^1 - \Upsilon_t(x)$ where K_t^1 is obtained from $K_t^1 - \Upsilon_t(\hat{x}_t^1) = y_t^*(\hat{x}_t^1)/(1 - \lambda)$ and the location cutoff \hat{x}_t^1 is such that the marginal agent endowed with wealth $\hat{y}_t^1 \equiv y_t^*(\hat{x}_t^1)$ cannot outbid credit-constrained agents, *i.e.*

$$V[\Psi_t^1(x, K_t^1), \hat{y}_t^1] \geq V[y_t^*(x)/(1 - \lambda), \hat{y}_t^1]$$

for any $x \in [\hat{x}_t^1, \hat{x}_t^0]$ where $V(\cdot)$ is the indirect utility. This condition holds if $y_t^*(x) = -(1 - \lambda)\Upsilon_t'(x)$ evaluated at \hat{x}_t^1 and $y_t^*(x)$ is strictly convex. Stated differently, *the gain in housing expenditures by changing her residential location and paying a lower rent $y_t^*(x)/(1 - \lambda)$ must be lower than additional costs associated with distance in equilibrium.* Given Pareto wealth distribution, $y_t^*(x) = -(1 - \lambda)\Upsilon_t'(x)$ becomes

$$\frac{\phi_t(\hat{y}_t^1)^{1+\omega}}{\omega L \underline{y}_t^\omega} = (1 - \lambda)\Upsilon_t'(\hat{x}_t^1).$$

Since $\Upsilon(x)$ increases linearly with distance while $y_t^*(x)$ is decreasing and convex, there is a single solution (see Figure 3).¹⁶ As a consequence, $\Psi_t^1(x, K_t^1)$ is equivalent to the tangent to the curve $y_t^*(x)/(1 - \lambda)$ at \hat{x}_t^1 . Moreover, it is below the curve $y_t^*(x)/(1 - \lambda)$ and parallel to $\Psi_t(x, \mathcal{K})$ (see Figure 1.3). Using the equilibrium condition for which the utility level of the individual living in \hat{x}_t^1 is such that $V(\Psi_t^1, \hat{y}_t^1) = V(\hat{y}_t^1/(1 - \lambda), \hat{y}_t^1)$, we have $\Psi_t^1(\hat{x}_t^1, K_t^1) = \hat{y}_t^1/(1 - \lambda)$ and $\Psi_t^1(x, K_t^1) < \Psi_t(x, \mathcal{K})$ so that $K_t^1 < \mathcal{K}$. (see Figure 1.3). Further, for any $x \in [0, \hat{x}_t^1]$, we have $p_t^*(x) = \Psi_t^1(x, K_t^1) < y_t/(1 - \lambda)$ for all y_t agents with $y_t \in [0, \hat{y}_t^1]$, implying that they are not borrowing-constrained. *Even though the wealthiest agents are not*

¹⁶This property holds if $\kappa(x)$ is linear and the rent is stationary (as shown in Appendix B). Moreover, the linearity property is not necessary for our results and is made for expositional purpose.

credit-constrained, they gain from credit market imperfections as their housing expenditures is reduced by the amount $\mathcal{K} - K_t^1$. Note that if \hat{x}_t^1 does not exist, the city structure would be characterized by two areas: the wealthiest agents with $y_t \geq \hat{y}_t^0$ reside at $x \in [0, \hat{x}_t^0]$ and are borrowing-constrained and the poorest agents live in $x \in [\hat{x}_t^0, L]$ and are not constrained.

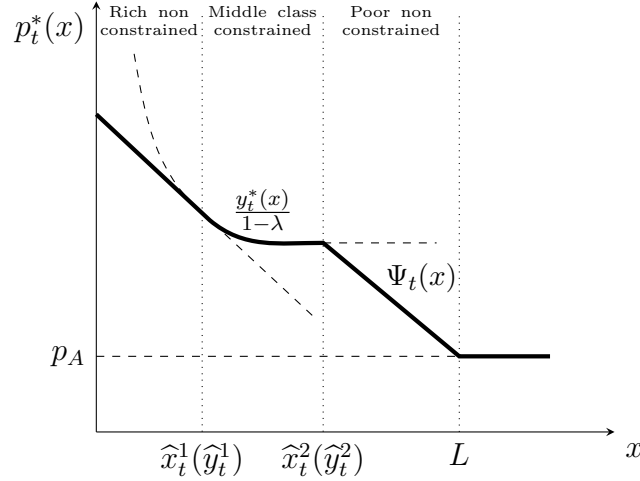


Figure 1.3: Equilibrium with Pareto distribution

We can characterize of the spatial pattern of ‘constrained’ and ‘non-constrained’ areas for any inherited wealth distribution (see Appendix B for details). In accordance with Proposition 1, it turns out that there is no wealth overlapping across areas, that is, the poorest agent living in the area of the city close to the city center is wealthier than the richest agent residing in an area farther away from the city center. It is also worth stressing that there are at most three distinct areas (formally, two *cutoff locations*) as long as the shape of the cumulative distribution function (CDF hereafter) is concave as the generalized Pareto distributions. By contrast, for a wealth distribution where the CDF is increasing and convex (i.e. $y_t^*(x)$ is decreasing and concave), there is at most one cutoff location (the credit-constrained agents would be the wealthiest agents who live in the more attractive places). More generally, when the CDF of wealth distribution is characterized by domains being a convex set while the other domains being a concave set (e.g. log-normal distribution), several cutoff locations can arise. *When there is at least one ‘constrained’ area, inhabitants in areas closer to the city center pay lower house prices wherever they are constrained or not.* Hence, lifetime wealth differentials in this model arise

from inherited wealth differentials, magnified by the assignment of agents across locations.

The social structure of each city is identical when agents are free to move across cities. As the formation of a city requires a certain amount of fixed costs G , the per inhabitant fixed costs G/L decrease as the city size rises. As a result, the existence of fixed costs provides an incentive for city formation. However, a rise in city population implies higher housing prices due to land competition. A spatial equilibrium arises when no agent has an incentive to migrate in an other city. The agents endowed with the same initial wealth must achieve the same level of utility across cities in each period $V_t^*(y_t)$. When borrowing limit applies, it is straightforward to check that there is spatial splitting of identical agents in equilibrium. Agents who have the same initial wealth are split across cities and live at locations implying the same commuting cost so that they reach the same level of utility. The rich agents are attracted by cities hosting agents endowed with a lower initial wealth and who are credit constrained. They have also an incentive to disperse across cities to avoid fierce land competition. The share of agents endowed with y_t living in a city is $1/N$ where N is the number of cities. The social composition of each city is therefore identical. The city size L is such that the poorest agents reach the same utility level across cities, i.e. $w_t + \underline{y}_t - \mathcal{K} - G/L$ does not vary across cities.

5 Wealth distribution in the long run

We now analyze the joint dynamics of the urban equilibrium and the wealth distribution. We first consider long-run wealth distribution under *laissez-faire*. We then determine whether market mechanisms lead to efficient outcomes and whether tax policy can achieve a better allocation of resources. Last, we consider bequests finance the stock of capital which is also used to produce the consumption good. This extension closes the model by providing a link between bequests and wages and allows us to discuss the impact of the housing price on productive investments.

5.1 Long run wealth distribution under *laissez-faire*

In order to get sharper predictions on the long run equilibrium, we assume Cobb-Douglas preferences $u(c_t, y_{t+1}) = c_t^{1-\alpha} y_{t+1}^\alpha$ and that consumption good is produced under constant returns and perfect competition, using labor only. As a result,

agents' bequest and consumption are constant fractions of their lifetime wealth and $w_t = \varphi$ where φ measures the individual productivity, which does not vary across agents. Homotheticity is not essential. We could use preferences so that the rich agents leave a larger fraction of their wealth than the poorer agents. Note that we consider in this Section that no uncertainty occurs and agents have perfect foresight of future housing prices.

The wealth dynamics differs between constrained agents and non-constrained agents and is given by

$$y_{t+1} = \beta \begin{cases} w + y_t - \kappa[x^*(y_t)] - \frac{y_t}{1-\lambda} + \mu p_{t+1}[x^*(y_t)] & \text{if borrowing-constrained,} \\ w + y_t - K_t & \text{otherwise.} \end{cases} \quad (1.12)$$

where $x^*(y_t)$ is the inverse of the wealth mapping, $\beta \equiv \alpha(1+r)$, and $w = \varphi - G/L$ is the wage net of lump-sum tax.

The steady state is associated with the limit distribution of wealth $F_\infty(y)$ and the limit housing price $p_\infty(x)$. Note that, given (1.6), the rent dynamics is forward-looking and can have many solutions. As a first step, we abstract from any dynamics with housing bubbles, allowing us to obtain a tractable solution of the bid-rent Ψ_t . We discuss the consequences of housing bubbles in Section 5.

Full convergence. We first discuss the case where individual wealth converges to the same steady state. This case arises only when *all* agents are not credit-constrained. If no agent is credit-constrained, then $K_t = \mathcal{K}$ with $\mathcal{K} = (1-\mu)p_A + \kappa(L)$ and the agent living at locations x pay the rent given by $\Psi_t(x, \mathcal{K}) = \mathcal{K} - \kappa(x) + \mu\Psi_{t+1}(x, \mathcal{K})$. In Appendix C, we show that $\Psi_\infty(x, \mathcal{K}) = [\mathcal{K} - \kappa(x)]/(1-\mu)$. Given (1.12), the household's steady state wealth is given by the fixed point of $y_{t+1} = \beta(w + y_t - \mathcal{K})$, *i.e.*

$$y_\infty = \frac{\beta(w - \mathcal{K})}{1 - \beta} \equiv y_\infty^e. \quad (1.13)$$

The sufficient and necessary conditions for the existence of a steady state in which there is no wealth inequality are $\beta < 1$ and $y_\infty^e \geq (1-\lambda) \max_{x \in [0, L]} \Psi(x, \mathcal{K})$. Using (1.13) and $\max_{x \in [0, L]} \Psi(x, \mathcal{K}) = \Psi(0, \mathcal{K}) = \mathcal{K}/(1-\mu)$, the latter inequality is equivalent to

$$R_A \leq \underline{R}_A(\lambda) \equiv \frac{1-\gamma}{1-\mu} \left[\frac{w}{1+\rho(\lambda)} - \kappa(L) \right] \quad \text{with} \quad \rho(\lambda) \equiv \frac{(1-\beta)(1-\lambda)}{\beta(1-\mu)}. \quad (1.14)$$

As long as the inequality in (1.14) is satisfied, a steady state exists in which all agents maintain the same level of wealth even though they do not pay the same rent. Land abundance (low R_A) and low commuting costs make the borrowing constraint less stringent. The concavity of utility function and the absence of heterogeneity in productivity imply that wealth inequality declines over time and that each dynasty will own the same steady-state wealth.

Permanent wealth inequality. We now consider steady states with an unequal distribution of wealth, *i.e.* some dynasties are credit-constrained. The existence of persistent inequality requires $\min_{x \in [0, L]} \Psi(x, \mathcal{K}) = (K - \kappa(L))/(1 - \mu) \leq y_\infty^e < (1 - \lambda)\Psi_\infty(0, \mathcal{K})$ or, equivalently, $\underline{R}_A(\lambda) < R_A < \bar{R}_A(\lambda)$ with

$$\bar{R}_A \equiv \frac{1 - \gamma}{1 - \mu} \left[\frac{w - \kappa(L)}{1 + \rho(\lambda)} \right]. \quad (1.15)$$

In such a steady state, the borrowing limit implies a permanent spatial sorting. The poorest dynasties live at the city fringe, $x \in [\hat{x}_\infty^*, L]$ and are non-constrained so that their wealth must converge to y_∞^e with \hat{x}_∞^* such that $y_\infty^e = (1 - \lambda)\Psi(\hat{x}_\infty^*, \mathcal{K})$ or, equivalently,

$$\kappa(\hat{x}_\infty^*) = \mathcal{K} + (1 - \mu)y_\infty^e/(1 - \lambda).$$

The credit-constrained agents are sorted by increasing wealth as the distance to the CBD decreases from $x = \hat{x}_\infty^*$. Wealth dynamics converge to the following steady state

$$y_\infty(x) = \frac{\beta[w - \kappa(x)]}{(1 - \beta)[1 + 1/\rho(\lambda)]} \equiv y_\infty^c(x) \quad (1.16)$$

with $y_\infty^c(\hat{x}_\infty^*) = y_\infty^e$ and $y_\infty^c(x) > y_\infty^e$ when $x \in [0, \hat{x}_\infty^*]$. We show in Appendix C that the wealth of credit-constrained dynasties living at x converges to y_∞^c provided the following convergence condition

$$\lambda < \frac{1 - \beta\mu}{1 + \beta} \equiv \bar{\lambda} \quad (1.17)$$

Hence, the constrained agents pay $y_\infty(x)/(1 - \lambda)$ to reside in x and have steeper bid-rents than constrained agent. Indeed, it is straightforward to check that $|d\Psi(x, \mathcal{K})/dx| > |dy_\infty(x)/dx|/(1 - \lambda)$ regardless of $\kappa(x)$, μ , $\lambda < 1$, and $\beta < 1$.

Note that, given our assumptions, a class of rich unconstrained agents living in the most attractive places cannot emerge in the long run (see Appendix C). The

emergence of rich agents who are not credit-constrained is a transitory configuration. In the long run, their wealth converges to the wealth of the richest constrained agents. We show in section 5 that the introduction of additional costs of borrowing will lead at the steady state to have both unconstrained rich agents and middle wealth constrained agents.

We thus summarize these results in the following Proposition and in Figure 1.4 which depicts the ranges of parameter values in the plane (λ, R_A) associated to a given long run wealth distribution:

Proposition 5. *If and only if $\beta < 1$ and (1.17) hold, the long run city is characterized by one of the following steady-state distributions:*

(i) *Full convergence: agent's wealth converges to the same following steady state y_∞^e . Full convergence arises if and only if $R_A \leq \underline{R}_A$.*

(ii) *Persistent inequality: if $\underline{R}_A \leq R_A < \bar{R}_A$, a fraction $L\hat{x}_\infty^*$ of agents ends up with the long-run wealth y_∞ given by (1.13) while a fraction \hat{x}_∞^* of constrained agents gets a long-run wealth which is location dependent, $y_\infty^c(x)$, and \hat{x}_∞^* is the unique interior solution of $\Psi_\infty(\hat{x}_\infty^*, \mathcal{K})(1 - \lambda) = y_\infty(\hat{x}_\infty^*) = y_\infty^e$.*

Proposition 5 highlights the role played by credit market imperfections and the place of residence on persistent wealth inequality. Item (i) states that when all agents are rich enough, then they can afford to locate anywhere without binding the borrowing constraint. As the rent exactly offsets commuting costs and the future house sale price, wealth dynamics is not location dependent. Even if poor dynasties start with lower amounts of wealth, their wealth converges to the same steady state. Therefore, the long-run wealth distribution is degenerate. Item (ii) provides a characterization of the long run equilibrium with persistent inequality under the condition analogous to the one of Proposition 1, that is, the poorest agents are unconstrained at the city limit and constrained at the CBD ($\underline{R}_A < R_A < \bar{R}_A$). It turns out that richer agents are borrowing-constrained. They live at locations close to the center and differ with respect to their long run wealth. This is due to the location-dependency of the borrowing constraint. *Persistent inequality thus reflects heterogeneity across locations.* The advantage of the credit market imperfections taken by rich borrowing-constrained agents persist as they get a higher long run utility than the one enjoyed in the absence of a borrowing limit.

From Proposition 1, the long run wealth distribution must be such that $1 - F_\infty[y_\infty(\hat{x}_\infty^*)] = \hat{x}_\infty^*/L$. The borrowing constraint is not binding for residents living

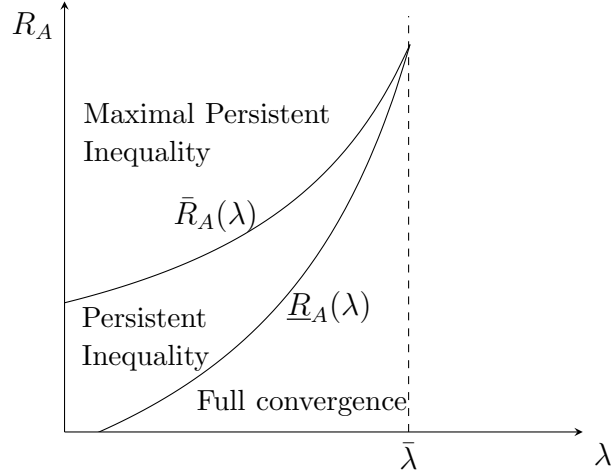


Figure 1.4: Parameter configurations

further away from \hat{x}_∞^* and they converge to $y_\infty^e \leq y_\infty^e(x)$. Notice that if the condition $R_A < \bar{R}_A$ did not hold, all agents would be limited in their capacity to borrow and pay the rent $y_t / (1 - \lambda)$. There would be perfect sorting along $[0, L]$. This case leads to the most unequal wealth distribution with $y_\infty(x)$ given by (1.16) for all $x \in [0, L]$. Notice also that, even though the initial urban configuration may be characterized by several threshold locations \hat{x}_0^* , at most one threshold location \hat{x}_∞^* arises in the long run. Wealth convergence conditions prevent from getting multiple threshold locations in the long run. Indeed, if there were two thresholds $\hat{x}_\infty^{1*} < \hat{x}_\infty^{2*}$ we would have $\Psi_\infty(\hat{x}_\infty^{1*})(1 - \lambda) = y_\infty(\hat{x}_\infty^{1*}) = y_\infty$ and $\Psi_\infty(\hat{x}_\infty^{2*})(1 - \lambda) = y_\infty(\hat{x}_\infty^{2*}) = y_\infty$ which is impossible given the rent is strictly decreasing.

Further, Proposition 5 states that steady states are not path dependent. This property is reminiscent to endogenous inequality models (Matsuyama, 2000) and stems on the endogeneity of the borrowing constraint. Many studies on the role of imperfect capital markets have stressed that initial conditions matter to predict the long run equilibrium because individuals have to be richer than an exogenous wealth level in order to have access to credit (Banerjee and Newman, 1993, Galor and Zeira, 1993). In our model, the agent's position in the wealth distribution determines the capacity to borrow.

As depicted in Figure 1.4, for high level of credit market imperfections (low λ) or when land is scarce (high R_A), persistent inequality can arise because the borrowing constraint becomes tighter. By contrast, low size of urban population allows agents to purchase a house without being constrained. Convergence ensues. Regarding the

effect of the downpayment requirement, we have that $dy_\infty^c/d\lambda < 0$. A tighter downpayment requirement (lower λ) leads to an increase of the constrained agents' wealth. If the downpayment increases, constrained agents' bid-rent $y_t/(1-\lambda)$ lowers. Expenditures for housing decrease and constrained agents end-up richer allowing for higher bequests. Hence, *in the long run, a tighter borrowing constraint increases the long run wealth of richest agents.*

5.2 Achieving a better allocation of resources with land taxation

Efficient allocation of resources. Consider an economy-wide *policy maker* whose objective is to maximize the discounted sum of per capita utilities. The policy maker acquires the land needed for each city from landowners (the agents) at the amount $\mathcal{R} \geq R_A$ and has to choose the population size L per city and the taxation scheme in each city as well as the agents' location, the consumption of the composite good c_t and the bequest b_t . There is a debate of whether or not the social objective should take into account the altruism component of individuals' preferences (see Hammond, 1988, and Harsanyi, 1995 on this debate)¹⁷. We adopt the approach in which the policy maker considers bequest received by the next generation and wage be determined by competitive markets so that $b_{t+1} = (1+r)b_t$ and $w_t = \varphi$. This allows for a more transparent comparison between our decentralized economy and a centralized economy. In addition, to focus on the own effects of credit and land markets, we consider that households are homogeneous (even though households differ in their initial wealth, they would be homogeneous at the steady state as there is no credit market imperfections) and there is no distortion arising from real estate markets ($\gamma = 0$).¹⁸

As all cities are identical, it is sufficient to focus on the representative city. The per-capita resource constraint of the economy yields:

$$c_t = \varphi + y_t - b_t - \Omega \quad \text{with} \quad \Omega \equiv G/L + \mathcal{T}(L)/L + \mathcal{R} \quad (1.18)$$

where $\mathcal{T}(L) = \int_0^L \kappa(x)dx$ is the total transport cost and $y_{t+1} = (1+r)b_t + \mathcal{R}$, where

¹⁷Bernheim (1989) explores the welfare properties of dynastic equilibria. In particular, he shows that intergenerational altruism renders the social objective to be time-inconsistent.

¹⁸When $\gamma > 0$, then the price of housing is not equal to the marginal cost of housing production.

\mathcal{R} is the value of the land property right. Children receive capitalized bequests and a property right to land. The value of land is endogenously determined by the planner. Maximizing the discounted sum of the utilities of current and future generations, given by $\max_{b_t, L, \mathcal{R}} \sum_{t=0}^{\infty} \delta^t u(c_t, y_{t+1})$ with the social discount factor $\delta \leq 1$ and using (1.18) imply that the maximum is achieved when $\mathcal{R} = R_A$, $\partial\Omega/\partial L = 0$ and $\partial \sum_{t=0}^{\infty} \delta^t u[c_t(b_t), y_{t+1}(b_t)]/\partial b_t = 0$.¹⁹ A rise of the population size has two effects: the per capita cost of the public good G/L decreases (economies of scale) while the per capita commuting cost $\mathcal{T}(L)/L$ increases since $\mathcal{T}(L)$ is strictly increasing and convex in L (diseconomies of scale).²⁰ If the population size is chosen in order to maximize the utility level of the city's residents, then $G = (d\mathcal{T}/dL)L - \mathcal{T}(L)$ with $d\mathcal{T}/dL = \kappa(L)$. Hence, regardless of the functional form of the utility function, the utility is maximized when $L = L^o$ where L^o is implicitly given by

$$G = \kappa(L^o)L^o - \mathcal{T}(L^o). \quad (1.19)$$

It can be checked that the population size increases with the fixed requirement in public expenditures and decreases the distance elasticity of commuting cost.²¹

Note that the shadow rent $s(x)$ on land at a distance x from the CBD is the resource saving from having an extra unit of land there. Moving an individual from the city limit to the extra unit of land at x would result in the discounted sum of resource saving $\kappa(L) - \kappa(x)$. The shadow rent on land at the city limit equals the shadow rent on land in non-residential use, which equals R_A . Hence, $s_t(x) = R_A + \sum_{\varsigma=t}^{\infty} \delta^{\varsigma-t} [\kappa(L) - \kappa(x)]$. As a result, the present value of aggregate differential (shadow) land rents is

$$\text{ASLR}_t = \sum_{\varsigma=t}^{\infty} \delta^{\varsigma-t} \int_0^L \kappa(L) - \kappa(x) dx = [\kappa(L)L - \mathcal{T}(L)] \sum_{\varsigma=t}^{\infty} \delta^{\varsigma-t} = \frac{G}{1 - \delta}.$$

When $\delta = 0$, we fall back to the HGT in a static environment, so that, at the optimal population, public expenditures equal the *instantaneous* value of aggregate

¹⁹Note that $\partial \sum_{t=0}^{\infty} \delta^t u[c_t(b_t), y_{t+1}(b_t)]/\partial \mathcal{R} = -u_c(c_t, y_{t+1}) + u_y(c_t, y_{t+1}) < 0$ as $u_c(c_t, y_{t+1}) = (1+r)u_y(c_t, y_{t+1})$ so that \mathcal{R} is equal to the opportunity cost of land R_A .

²⁰The aggregate commuting cost is convex regardless of the structure of commuting cost as long as the commuting cost incurred by an agent increases with the distance to jobs. For example, if $\kappa(x) = \kappa x^\epsilon$ with $\kappa > 0$ and $\epsilon > 0$, then $\mathcal{T}(L) = \kappa L^{1+\epsilon}/(1+\epsilon)$ so that $\mathcal{T}(L)$ is convex with city size.

²¹For example, if $\kappa(x) = \kappa x^\epsilon$, then the optimal size of cities is $L^o = [(1+1/\epsilon)G/\kappa]^{1/(1+\epsilon)}$.

differential (shadow) land rents ($G = \text{ASLR}$). Our dynamic framework implies a variant of the HGT. The present value of aggregate differential (shadow) land values equals the present value of public expenditures (given by $\sum_{s=t}^{\infty} \delta^{s-t} G = G/(1 - \delta)$).

The optimality condition associated with bequest, $\partial u[c_t(b_t), y_{t+1}(b_t)]/\partial b_t = 0$, implies:²²

$$u_c(c_t, y_{t+1}) = (1 + r)u_y(c_t, y_{t+1}) + \delta(1 + r)u_c(c_{t+1}, y_{t+2}). \quad (1.20)$$

A higher voluntary bequest reduces the consumption of donors generating a utility loss, but raises not only the current welfare of donors (joy-of-giving effect) but also the welfare of the next generation as the consumption of donees increase. Using (1.20), we have $u_c(c_{\infty}^o, y_{\infty}^o) = (1 + r)u_y(c_{\infty}^o, y_{\infty}^o)/[1 - \delta(1 + r)]$ at the steady state. Therefore, given a Cobb-Douglas utility function, $c_{\infty}^o = (1 - \alpha)[1 - \delta(1 + r)]y_{\infty}^o/\beta$ and the dynamics of optimal transfers within dynasties converges to the following steady state

$$y_{\infty}^o = \frac{\beta}{(1 - \beta)(1 - \tilde{\delta})} \left[\varphi - \kappa(L^0) - \frac{r}{1 + r} R_A \right] \quad \text{with} \quad \tilde{\delta} \equiv \frac{\delta(1 + r)(1 - \alpha)}{1 - \beta} < 1. \quad (1.21)$$

where we have inserted (1.19) in (1.18).

The debate on which tax base to target to raise revenues to finance public expenditure has resurged recently among economists (Schwerho et al., 2019). Land taxation has received much attention because the return to land can be viewed as an economic rent. Indeed, urban land value captures mainly benefits which do not come from the efforts of landowners (presence of public facilities, accessibility to jobs and amenities, ...). In addition, the price elasticity of land supply is very low in the short run and land cannot be moved. Land thus represents a tax base on which a tax can be levied to finance public expenditures without significantly distorting economic behaviors. The idea of land taxation is at the heart of the "single tax movement" and has been formalized in the Henry George Theorem (HGT hereafter) (Arnott and Stiglitz, 1979). The HGT posits that, in a city of optimal population size, differential land rents (i.e. the aggregate over the city of urban land rent less the opportunity cost of land in nonurban use) equal public expenditure, so that taxing differential land rents is sufficient and optimal. We show in what

²²The transversality condition is $\lim_{t \rightarrow \infty} \delta^t u_c(c_t, y_{t+1}) y_{t+1} = 0$.

follows that altruism and credit constraint imply a distortion in the land price formation and preclude the decentralization of Pareto optimal allocations. The HGT needs to be adjusted in our distorted economy. Note that the return of land located at x in our framework is equivalent to the difference between the residential land value at equilibrium and its value non-residential use, given by $\theta_\infty(x) - R_A$ where $\theta_\infty(x) = (1 - \gamma)p_\infty(x)$.

Taxation We are now equipped to determine whether the steady-state equilibrium of the decentralized economy coincides with the planner's optimal solution and to discuss tax instruments that allow for the decentralization of the social optimum. Remember that the HGT posits that, in a city of optimal population size, differential land rents (i.e., the aggregate over the city of urban land rent less the opportunity cost of land in non-urban use) equal public expenditure so that taxing differential land rents is sufficient and optimal. In what follows, we show that altruism and credit constraint imply a distortion in the land price formation and preclude the decentralization of Pareto optimal allocations. The HGT needs to be adjusted in our distorted economy. Note that the return of land located at x in our framework is equivalent to the difference between the residential land value at equilibrium and its value non-residential use, given by $\theta_\infty(x) - R_A$ where $\theta_\infty(x) = (1 - \gamma)p_\infty(x)$.

We assume that the population size of the decentralized city is L^o . Given the specification of our utility function (impure altruism), the decentralized city implies that the ratio y_∞/c_∞ is lower than that of the planner when the credit constraint is not binding. Indeed, agents do not take fully into account the infinite stream of their descendants' utilities. To attain an efficient allocation of resources between consumption and inter-generational transfer, the city government has to implement either a standard Pigouvian tax on consumption equal to $\tau^c = \delta(1+r)/[1+\delta(1+r)]$ where tax revenue is recycled in a lump-sum transfer scheme or Pigouvian subsidy on voluntary bequest equal to $\tau^b = 1 - \delta(1+r)$ financed by a lump-sum tax. This is a well-known feature of this type of model with impure altruism. On the contrary, in the presence of pure altruism (parents derive utility from the offspring's utility), the ratio of inherited wealth to consumption at the *laissez-faire* equilibrium is efficient.

Further, cities must satisfy their budget constraint that requires the present value of public expenditures, $G/(1 - \delta)$, to be equal to the present value of tax revenue levied by the city government. Under pure or impure altruism, the present value of the steady-state differential land price when the credit constraint is not

binding is $\sum_{s=t}^{\infty} \delta^{s-t} [\theta_t(x) - R_A] = [\kappa(L) - \kappa(x)] / [(1 - \mu)(1 - \delta)]$, which is higher than the present value of differential shadow price $s_t(x) - R_A$ because of altruistic preferences (captured through parameter μ in (1.6)). Without credit constraint and without intergenerational altruism, a single 100 % differential land rent tax would be sufficient to finance public expenditures. The presence of altruistic agents makes the differential land rent higher to finance public expenditures. When parents have an altruistic concern for their children, the social optimum decentralization is possible with a tax on *inherited land assets* so that $y_{t+1} = (1 + r)b_t + R_A$ instead of $y_{t+1} = (1 + r)b_t + \theta_{t+1}(x)$. Under this tax regime, equilibrium bid rents at period t equal to $\theta_t^d(x) = R_A + \kappa(L) - \kappa(x)$ which corresponds now to the instantaneous value of shadow land price. Such a result emerges because bid-rents no longer depend on μ as the wealth left to offsprings does not vary with the future value of land ($\partial y_{t+1} / \partial x = 0$ when $y_{t+1} = (1 + r)b_t + R_A$). Hence, public expenditures can be financed by a confiscatory tax on land assets (up to its opportunity cost) received by the descendants given by $\tau_t^\ell(x) = \theta_t^d(x) - R_A$. In this case, $y_\infty^e(\tau_t^\ell(x), \theta_t(x)^d, \tau^c)$ coincides with y_∞^o . Therefore, the motive for intergenerational transfers is crucial in analyzing optimal taxation. Optimal land taxation cannot be disconnected from inheritance taxation.

Proposition 6. *In a city of optimal population size, a single 100 % tax on differential land rents received by donees is efficient and sufficient to finance public expenditures when credit market is perfect.*

When the government taxes land assets left to offspring so that $y_{t+1} = (1 + r)b_t + R_A$ and the credit market is imperfect, credit constraints cause the market price of land at the most attractive locations is lower than the shadow prices of land $s_t(x)$ (or, equivalently, $\theta_t^d(x)$). Under these circumstances, the present value of aggregate land rents ALR_∞^d is expressed as $ALR_\infty^d = [G - \Theta(\hat{x}_\infty^*)] / (1 - \delta)$ (see Appendix C) with

$$\Theta(\hat{x}_\infty^*) \equiv \int_0^{\hat{x}_\infty^*} \tau_\infty^c(x) dx \quad \text{where} \quad \tau_\infty^c(x) \equiv \left[\Psi_\infty^d(x) - \frac{y_\infty^c(x)}{1 - \lambda} \right] \quad (1.22)$$

so that $G / (1 - \delta) = ALR_\infty^d + \Theta(\hat{x}_\infty^*) / (1 - \delta)$. As a result, a single 100 % land rent tax is not sufficient to finance public expenditures when credit constraint is binding as the richest agents capture a fraction of aggregate shadow land rents ($\Theta(\hat{x}_\infty^*)$), which are allocated to consumption c_t and the inheritance left y_{t+1} . Because $\partial y_\infty^0 < \partial R_A < 0$

while y_∞^c is independent from R_A and increases with lower λ , $y_\infty^0 < y_\infty^c$ when R_A is high enough and λ is low enough. In words, *land scarcity and stricter credit constraint make the intergenerational transfers within dynasties too high*. Hence, the tax on inherited land assets is no more the “single” tax necessary to finance public expenditures. A tax schedule on both land rents and income must be designed to finance public expenditures. Thus, when the city size is optimal, the present value of public expenditures equal the aggregate differential land rent plus the present value of additional tax on income $\tau_\infty^c(x)$ which varies with the wealth of agents residing in the more attractive sites. To summarize,

Proposition 7. *The presence of credit constraints implies that a single 100 % land rent tax is not sufficient to finance public expenditures. An additional tax on income, given by $\tau_t^c(x)$, is needed to achieve the optimal solution.*

Finally, if pursuing equality of opportunity is an important goal for policy, our model provides an argument for taxing transfers of wealth between generations to reduce the advantage that some agents get from being born into a highly wealthy family.²³ Borrowing constraints imply inequality in initial wealth resulting from differences in opportunity. According to most theories of justice, it is unfair that two agents with the same behavior and characteristics (w in our case) enjoy unequal welfare levels because one individual received a large inheritance while the other did not (see Fleurbaey, 2008).

5.3 Productive capital vs housing capital

Until now, we have assumed that production occurs according to a linear technology and that there is no capital. In this subsection, we discuss whether our results remain valid when the price of labor is endogenous and the production of the consumption good also depends on the capital stock. The capital stock adjusts to the total savings in the economy at each period, which corresponds in our case to the bequests of all parents, given is $L \int_{\underline{y}_t}^{\bar{y}_t} b_t(y) f(y_t) dy_t$ (see also chapter 9 in Acemoglu, 2009).

In each period, a representative firm located in each city produces the consumption good and uses two inputs, capital and labor. We assume a standard neoclassical production function, given by $g(k_t)$, where $g(\cdot)$ is the per-capita production, and k_t

²³It is the amount of money received by an agent y_t which matters, and not the amount given by the donor (b_t and θ_{t+1}).

the per capita-capital stock. As usual, the wage rate is $w_t = g(k_t) - \tilde{r}k_t \equiv w(k_t)$ where \tilde{r} is the gross rate of return on capital ($\tilde{r} \equiv 1 + r$). The interest rate is exogenous and determined in world markets. As the marginal productivity of capital equals its price in equilibrium, we have $\tilde{r} = \partial g(\cdot)/\partial k_t \equiv g_k(k_t)$. The per-capita total capital stock at time $t + 1$ is given by $k_{t+1} = i_t$ where i_t is the per-capita investment at period t and capital is assumed to fully depreciate after use. As in Acemoglu (2009, chapter 9), the total investment is equal to the sum of individual savings at period t , so that $i_t = \int_{\underline{y}_t}^{\bar{y}_t} b_t(y)f(y_t)dy_t$.

The budget constraint becomes $c_t = w(k_t) - G/L + y_t - b_t - \kappa(x) - p_t(x)$, while the wealth left to offspring remains $y_{t+1} = (1+r)b_t + \theta_{t+1}$. Agents lend their savings b_t as capital to consumption good producers at period t and their children receive the return at time $t + 1$. Assuming that credit market is perfect, the bid-rent is still $\theta_t(x) = \mathcal{K} - \kappa(x) + \theta_{t+1}/(1+r)$. Bequests and consumption depend on the sequence of all current and future prices of labor and land $\{w_\varsigma, \theta_{\varsigma+1}\}_{\varsigma=t}^{\varsigma}$. Utility-maximizing bequest is such that $u_c = (1+r)u_y$ yielding

$$b_t(x) = \alpha [w(k_t) + y_t - G/L - \mathcal{K}_t] - \theta_{t+1}(x)/(1+r) \quad (1.23)$$

As $y_t = (1+r)b_{t-1} + \theta_t$, $\int_0^L b_{t-1}(x)dx = k_t L$, and $g(k_t) = w(k_t) + \tilde{r}k_t$, the dynamics of capital when population size of cities is optimal expresses as

$$\begin{aligned} k_{t+1} &= \frac{1}{L} \int_0^{L^o} b_t(x)dx \\ &= \alpha \left[g(k_t) - \frac{G}{L^o} - \mathcal{K} + \frac{1}{L} \int_0^{L^o} \theta_t(x) - \frac{\theta_{t+1}(x)}{\alpha(1+r)} dx \right] \\ &= \alpha \left[g(k_t) - \kappa(L^o) - \frac{1-\alpha}{\alpha} \frac{R_A}{1+r} - \frac{1}{L} \frac{1-\alpha}{\alpha} \int_0^{L^o} \frac{\theta_{t+1}(x) - R_A}{1+r} dx \right] \end{aligned}$$

as $G/L^o = \kappa(L^o) - \mathcal{T}(L^o)/L^o$. The equilibrium dynamics are similar to those of the basic Solow model and converges to an unique steady-state capital-labor ratio.

It is easy to show that Proposition 6 holds when productive capital is introduced in the model (when prices of labor of capital are still determined by markets) because land prices are still higher than their shadow price. The dynamics of capital with an efficient tax on the differential land rent ($\theta_{t+1}(x) - R_A$) is

$$k_{t+1}^o = \alpha \left[g(k_t) - \kappa(L^o) - \frac{1-\alpha}{\alpha} \frac{R_A}{1+r} \right]. \quad (1.24)$$

Clearly, $k_{t+1}^o > k_{t+1}$. Hence, the presence of land assets in the inherited wealth yielding a transfer of rents $(\theta_{t+1}(x) - R_A)$ between generations implies an under-accumulation of productive capital. Because capital stock is the outcome of decisions taken by previous generations, we also face a potential pecuniary externality as the actions of agents living at period t affect the welfare of the next generation through the price of labor w_{t+1} which depend on k_{t+1} and, in turn, b_t . The impact of bequest b_t on wage $w(k_{t+1})$ of the next generation is $[g_k(k_{t+1}) - \tilde{r}] \partial k_{t+1} / \partial b_t$. Because $g_k(k_{t+1}) = \tilde{r}$ in equilibrium, changes in bequests have no effect on wages of the next generation. A planner allocates resources of a given individual in the same way the individual himself would. In a small open economy where the price of capital is taken as an exogenous parameter, the dynamic inefficiency arises only from the extra land rent, which is transferred between generations.

Proposition 8. *A single 100 % tax on differential land rent received by donees allow a better allocation of resources between housing and productive investment.*

If a fraction of the population becomes credit-constrained, then the voluntary bequests left by credit-constrained parents increase. Hence, credit constraint causes upward pressure on the accumulation of capital. The positive effect of credit constraint offsets or may reverse the negative effects of land rents on the accumulation of productive capital. The role of credit limits has been extensively discussed in the literature on macroeconomic fluctuations since the publication of the Kiyotaki and Moore (1997) article. Empirical evidence shows a positive causal relationship between housing prices and corporate investment through the collateral value (e.g., Chaney et al., 2012). As real estate assets constitute a significant share of the pledgeable assets owned by firms, higher real estate prices are expected to relax the borrowing constraint of firms and, in turn, increase their productive investments (collateral channel). We identify a new channel. By making land competition across households less fierce, credit constraint favors lower house prices and, in turn, yields more savings and investment opportunities (cost channel).

6 Extensions

Our urban model predicts that, without borrowing limit, the housing market mechanism intrinsically promotes the convergence of wealth of different agents. Credit market imperfections modify the distribution of surplus across agents. The bor-

rowing limit can cap the housing price paid by wealthy or lucky agents. The fact that agents with little inherited wealth face limited residential location opportunities explains why wealth inequalities can persist in the long run. We explore four extensions to check the robustness of our results. First, we introduce extra borrowing costs and examine their impact on the long-run wealth distribution. Second, we allow real estate companies to rent and examine how the borrowing constraint impacts tenure choice. Third, the agents are assumed free to choose the size of housing units they want to consume. Finally, we study how housing bubbles impact the borrowing constraint and the urban equilibrium.

6.1 Borrowing costs

We present a generalized model that allows for both a borrowing constraint and some additional borrowing costs. There are many different microfoundations of credit market imperfections, based, for example, on moral hazard and adverse selection. Asymmetric information between borrowers and lenders implies a maximum amount of credit that an agent can borrow (as in Matsuyama, 2006) or/and the interest rate for borrowers is higher than for lenders (as in Galor and Zeira, 1993). We consider that, if agents' inherited wealth is lower than the house price, $y_t < p_t(x)$, then they face some additional borrowing costs. The borrowing cost is assumed to be equal to $\zeta(p_t - y_t) + \phi$ where ζ is the interest rate paid by the borrower and ϕ is the fixed fee that the agent must pay to receive the loan. The interest rate ζ reflects an exogenous default premium with $\zeta > r$. The borrowing fixed cost ϕ refers to overhead costs incurred by lenders, the costs of obtaining the necessary information for each deal, and the costs when issuing a loan (Arellano *et al.*, 2012). We could also assume that ϕ represents psychic costs due to debt aversion and time and hassle costs of incurring debt, which are independent of the amount borrowed (Marx and Turner, 2018).

Under this configuration, the lifetime wealth of borrowers is expressed as follows

$$\mathcal{W}_t^b = w + y_t - \Upsilon_t(x) - p_t(x) - [\zeta(p_t(x) - y_t) + \phi]$$

Let us denote by $\Psi_t^b(x, K_t^b)$ the bid-rent of borrowers that solves the equilibrium

condition $dV [\mathcal{W}_t^b(x, y_t)] / dx = 0$ so that

$$\Psi_t^b(x, K_t^b) = \frac{1}{1 + \zeta} [K_t^b - \Upsilon_t(x)], \quad (1.25)$$

where $\Psi_t^b(x, K_t^b)$ is flatter than $\Psi_t(x, K_t)$ because of the borrowing cost ζ ($|\partial \Psi_t^b(x, K_t^b) / \partial x| < |\partial \Psi_t(x, K_t) / \partial x|$) and the expression of K_t^b depends on the residential location of borrowers. For example, if the borrowers live at the city fringe, then $K_t^b = \mathcal{K}$.

The rent formation endogenously determines whether an agent needs to borrow, possibly facing a borrowing limit. For any agent endowed with y_t the bid-rent function can be written as follows

$$\psi(x, y_t, K_t) = \begin{cases} \frac{y_t}{1-\lambda} & \text{if } y_t < (1-\lambda)\Psi_t^b(x, K_t^b), \\ \Psi_t^b(x, K_t^b) & \text{if } (1-\lambda)\Psi_t^b(x, K_t^b) < y_t < \Psi_t^b(x, K_t^b), \\ \Psi_t^s(x, K_t^s) & \text{if } \Psi_t^s(x, K_t^s) < y_t, \end{cases} \quad (1.26)$$

where superscript s denote savers' bid-rent and constant.

The bid-rent function stresses that the capacity of any agent to pay to reside at location x depends on whether she needs to borrow or not and she is constrained or not. The wealthier the agent, the smaller the set of locations where she needs to borrow. Of course, if the agent is credit-constrained, then she must borrow (as $y_t < (1-\lambda)\Psi_t^b(x, K_t^b) < \Psi_t^b(x, K_t^b)$). If the agents are rich enough, they never need to borrow to live in the city and their bid-rent is $\Psi_t^s(x, K_t^s)$. Without loss of generality, we assume that $p_A > \underline{y}_t > (1-\lambda)p_A$. In words, the poorest agent is not credit-constrained when she lives in the least attractive site (the city limit) as in Sections 3 and 4 while she must borrow regardless of her residential location.

We can rank the bid-rent slopes according to the wealth level for a given ψ . Agents endowed with a wealth y_t outbid the agents with a lower wealth in an attractive area. As in Section 3, housing market forces partition agents across and within areas in the city. Each area is endogenously determined according to the distribution of wealth y_t and hosts the agents having the same status: borrower or not and constrained or not. The agents living in an area close to the city center are wealthier than agents residing in an area further away from the city center. There is perfect sorting.

In equilibrium, the urban configuration is as follows. The richest agents who

do not borrow live in the more attractive locations, *i.e.* in the area $[0, \hat{x}_t^r]$ and pay $\Psi_t^s(x, K_t^s) = K_t^s - \Upsilon_t^s(x)$ while the middle-class agents, who are not credit-constrained, have to borrow and live in the area $[\hat{x}_t^r, \hat{x}_t^c]$ where $\Psi_t(\hat{x}_t^r, K_t^s) = \Psi_t^b(\hat{x}_t^r, K_t^b)$ and $\Psi_t^b(\hat{x}_t^c, K_t^b) = y_t^*(\hat{x}_t^c)/(1 - \lambda)$. The credit-constrained middle-class agents live in the area $[\hat{x}_t^c, \hat{x}_t^p]$ while the poorest agents reside in the area $[\hat{x}_t^p, L]$ where $y_t^*(\hat{x}_t^p)/(1 - \lambda) = \Psi_t^b(\hat{x}_t^p, \mathcal{K})$ with $\Psi_t^b(\hat{x}_t^p, \mathcal{K}) = [\mathcal{K} - \kappa(\hat{x}_t^p) + \mu p_{t+1}(\hat{x}_t^p)]/(1 + \zeta)$. The corresponding lifetime wealth for a y_t -wealth agent is

$$\mathcal{W}_t(x, y_t) = \begin{cases} w + (1 + \zeta)y_t - \mathcal{K} - \phi & \text{if } y_t < \hat{y}_t^p, \\ w + (y_t - y_t/(1 - \lambda))(1 + \zeta) - \Upsilon_t(x) - \phi & \text{if } y_t \in (\hat{y}_t^p, \hat{y}_t^c), \\ w + (1 + \zeta)y_t - K_t^b - \phi & \text{if } y_t \in (\hat{y}_t^c, \hat{y}_t^r), \\ w + y_t - K_t^s & \text{if } y_t > \hat{y}_t^r \end{cases} \quad (1.27)$$

with $\hat{y}_t^p \equiv y_t^*(\hat{x}_t^p)$, $\hat{y}_t^c \equiv y_t^*(\hat{x}_t^c)$, and $\hat{y}_t^r \equiv y_t^*(\hat{x}_t^r)$. In Appendix D, we show that, in the long run, a class of rich unconstrained agents, who do not need to borrow, pulls away from the rest of the population as long as the fee ϕ is large enough. In this case, the emergence of rich agents who are not credit-constrained is not a transitory configuration and their wealth converges to $\beta(w - K_\infty^s)/(1 - \beta) \equiv y_\infty^r$. However, the wealth of unconstrained middle-class agents who are borrowers converges to the wealth of the unconstrained middle-class agents. Again, even if agents start with the same amount of wealth, due to credit market imperfections, the city will be polarized into different classes living in different places in steady state. The system (1.27) makes clear the difference between extra borrowing costs and the borrowing constraint. Unlike the borrowing constraint, extra costs of borrowing are capitalized by the bid rent and the populations who are not credit constrained enjoy a utility independent from the location x .

We thus provide a characterization of the long run wealth distribution:

Proposition 9. *Persistent inequality occurs with three classes of agents: (i) the poorest agents end up with the long-run wealth y_∞^p and live in the less attractive sites; (ii) middle-wealth agents are credit-constrained and get a long-run wealth which is location dependent $y_\infty^m(\hat{x}_\infty^p) = y_\infty^p$; and (iii) the richest agents end up with the long-run wealth $y_\infty^r > y_\infty^m(\hat{x}_\infty^m)$ and live in the more attractive sites.*

Proposition 7 highlights that if the extra costs of borrowing were the only way to capture credit frictions, then, as shown in Galor and Zeira (1993), a degenerate wealth distribution would arise: initially rich agents are savers and converge to a

high wealth level while the initially poor agents are borrowers and get trapped in a low wealth level. The borrowing constraint instead creates symmetry breaking and makes the long-run wealth distribution reflect the spatial sorting.

6.2 Tenure choice

If the price paid by richer or lucky agents to reside in better places is lower than their bid-rents because of borrowing limits, the real estate companies could decide to rent the house instead of selling it to increase their profits. In this case, richer agents could bid to rent units of housing located in more attractive locations. Tenants do not leave any housing wealth to their offspring. Hence, the effect of rental housing market on wealth inequality is unclear. In what follows, we extend our framework considering the endogenous supply of both houses for renting and houses available for sale.

The real estate industry. Real estate companies play now a crucial role on the pattern of residential choices emerging at equilibrium. At the beginning of each period, a real estate company owning the house located at x has two options: it can sell the house at price $p_t^h(x)$ and the value of the firm is denoted by $\mathbf{v}^h(x)$ and expressed as follows

$$\mathbf{v}_t^h(x) = p_t^h(x) - \gamma p_t^h(x) - \theta_t(x), \quad (1.28)$$

where $p_t^h(x) \geq p_A$; or it can rent the house out and sell it to the next generation of real estate companies at the end of the period. In this case, the associated value of the firm is

$$\mathbf{v}_t^\tau(x) = p_t^\tau(x) - \Gamma p_t^\tau(x) - \theta_t(x) + \mu p_{t+1}(x), \quad (1.29)$$

where $p_t^\tau(x) \geq rR_A/(1+r)(1-\Gamma)$ and Γ is the cost of adjusting housing services in the case of renting. We assume $\Gamma > \gamma$ as tenants' behavior generates additional maintenance costs (Henderson and Ioannides, 1983). Each firm chooses now the best option so that its profit is given by $\mathbf{v}(x) = \max\{\mathbf{v}^h(x), \mathbf{v}^\tau(x)\}$.

Agents. Agents decide whether to rent or to purchase the house they occupy. We make two simplifying assumptions which are not restrictive. First, there is free access to the rental housing market amounting to say that there is no borrowing requirement for tenants. Second, all agents have the same initial wealth y_t^0 . Consid-

ering a wealth distribution would not change the main results at a price of a more cumbersome presentation of the urban equilibrium.

We can thus write the budget constraint

$$c_t^z + \frac{y_{t+1}(x)}{1+r} = \mathcal{W}_t^z(x) \equiv w - \kappa(x) + y_t^0 - p_t^z(x) + \mathbf{1}_z \mu p_{t+1}(x) \quad (1.30)$$

where $z = h$ if the agent is a homeowner, with $\mathbf{1}_h = 1$, and $z = \tau$ if the agent is a tenant, with $\mathbf{1}_\tau = 0$. Unlike homeowners, tenants do not leave any housing wealth to their offspring.

By maximizing the utility function with respect to c_t and y_{t+1} under (1.30), we obtain $y_{t+1} = y_{t+1}[\mathcal{W}_t^z(x)]$ and $V[\mathcal{W}_t^z(x)]$. Then, for any agent $z = \tau, h$, the bid-rent $\Psi_t^z(x, K_t^z)$ is derived from the equilibrium condition, $dV[\mathcal{W}_t^z(x)]/dx = 0$. Hence,

$$\Psi_t^z(x, K_t^z) = K_t^z - \kappa(x) + \mathbf{1}_z \mu p_{t+1}(x), \text{ for } z = \tau, h, \quad (1.31)$$

where the constants K_t^h and K_t^τ are obtained from the urban configuration arising at equilibrium. Note that only homeowners' bid-rent capitalizes the future house sale price.

Tenants are never constrained by assumption, so that they can pay $\Psi_t^\tau(x, K_t^\tau)$ at any location x . Homeowners can only pay up to $y_t^0/(1-\lambda)$ when the borrowing constraint is binding. The bid-rent function for homeowners is then

$$\psi^h(x, y_t^0, K_t) = \begin{cases} \frac{y_t^0}{1-\lambda}, & \text{when } x \in [0, \hat{x}_t^0] \\ \Psi_t^h(x, K_t^h), & \text{when } x \in [\hat{x}_t^0, L] \end{cases} \quad (1.32)$$

where \hat{x}_t^0 is such that $y_t^0 = \Psi_t^h(\hat{x}_t^0, K_t^h)(1-\lambda)$. Given that agents own the same wealth y_t^0 , non-constrained agents and tenants must experiment the same utility level at the equilibrium. Otherwise, some agents would find profitable to change their location and tenure status by outbidding some already settled residents. Hence, in equilibrium, we have $\mathcal{W}_t^h = \mathcal{W}_t^\tau$ where $\mathcal{W}_t^h = w + y_t^0 - K_t^h$ and $\mathcal{W}_t^\tau = w + y_t^0 - K_t^\tau$ for any $x \geq \hat{x}_t^0$, yielding $K_t^h = K_t^\tau = K_t$ or, equivalently,

$$\Psi_t^\tau(x, K_t) = \Psi_t^h(x, K_t) - \mu p_{t+1}(x) \leq \Psi_t^h(x, K_t).$$

The urban equilibrium. We build an equilibrium with the additional requirement that firms choose their best option between renting and selling given the

agents best location choice. A real estate company sells the house if and only if $\Delta(x) \equiv \mathbf{v}_t^h [\psi^h(x, y_t^0)] - \mathbf{v}_t^\tau [\Psi_t^\tau(x, K_t)] > 0$ with

$$\Delta(x) = (1 - \gamma)\psi^h(x, y_t^0) - (1 - \Gamma)\Psi_t^\tau(x, K_t) - \mu p_{t+1}(x) \quad (1.33)$$

where we have plugged (1.31) and (1.32) into (1.28) and (1.29). Three comments are in order. First, given the bid rents and the borrowing limit, real estate companies are more likely to rent the house located in the most attractive places, *i.e.* where the borrowing limit is binding and imposes a limit on the rent ($x \in [0, \hat{x}_t^0]$). Second, as lifetime wealth of homeowners and tenants is identical when $x \in [\hat{x}_t^0, L]$, with $\mathcal{W}_t^\tau(x) = \mathcal{W}_t^h(x) = \mathcal{W}_t^\tau$, there is no wealth inequality across agents living in the less attractive places, whatever the status of agents (homeowner or tenant). However, the equilibrium spatial structure of city has an impact on the *level* of wealth. Indeed, $K_t = \mathcal{K}$ if the agents living at the city fringe are homeowners or $K_t = \kappa(L) + rR_A/[(1+r)(1-\Gamma)] > \mathcal{K}$ if the agents living at the city fringe are tenants. Since wealth inequalities across agents living in the less attractive locations ($x \in [\hat{x}_t^0, L]$) do not emerge, we do not need to analyze the conditions under which real estate companies prefer either to sell or to rent for locations $x \in [\hat{x}_t^0, L]$. Third, regardless of the status of agents in the less attractive sites ($x \in [\hat{x}_t^0, L]$), the size of the area in which agents are credit-constrained decreases when credit frictions get less severe ($\partial \hat{x}_t^0 / \partial \lambda < 0$). Indeed, $y_t^0 = \Psi_t^h(\hat{x}_t^0, \mathcal{K})(1 - \lambda)$ implies $\mathcal{K} - y_t^0 / (1 - \lambda) = \kappa(\hat{x}_t^0) - \mu p_{t+1}(\hat{x}_t^0)$.

When $0 < \hat{x}_t^0 < L$, wealth inequality can emerge. Indeed, we have $\psi^h = y_t^0 / (1 - \lambda)$ and $\Delta'(x) = (1 - \Gamma)\kappa'(x) - \mu p'_{t+1}(x) > 0$ when $x \in [0, \hat{x}_t^0]$. If $\Delta(0) > 0$ (which is alike when the borrowing limit is not much severe, *i.e.* λ is high), we fall back into our framework developed in Section 3. There is no area hosting tenants and the lifetime wealth of homeowners located in the most attractive sites is higher than the wealth of agents residing in the rest of the city. If $\Delta(0) < 0$ (the borrowing limit is more stringent, λ becomes low), there exists a unique $\bar{x}_t \in [0, \hat{x}_t^0]$ such that the firm located at \bar{x}_t is indifferent between selling or renting, that is $\Delta(\bar{x}_t) = (\Gamma - \gamma)\Psi_t^\tau(\bar{x}_t, K_t^\tau) - \gamma\mu p_{t+1}(\bar{x}_t) > 0$. Under this configuration, real estate companies at any location $x \leq \bar{x}_t$ rent their properties out while those at any location $x > \bar{x}_t$ sell houses at $\psi^h = y_t^0 / (1 - \lambda)$. With respect to the preceding case without any rental market, the number of constrained homeowners is reduced. Real estate companies renting their property in $[0, \bar{x}_t]$ extract more revenues from the tenants. In the area

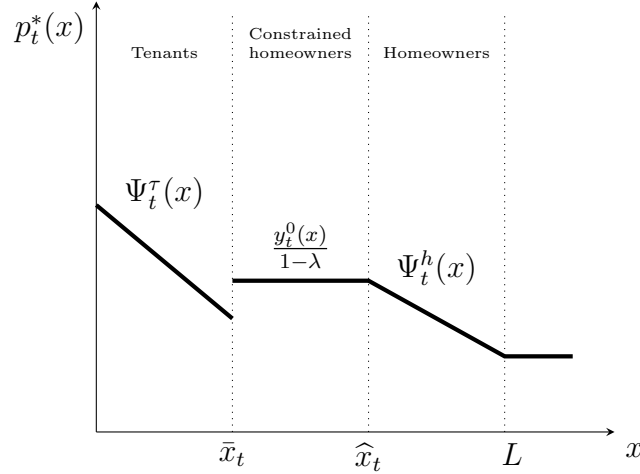


Figure 1.5: Urban equilibrium with tenure choice

$[\bar{x}_t, \hat{x}_t^0]$, there are constrained homeowners who pay the rent $y_t^0/(1-\lambda)$. Because $\Delta(\bar{x}_t) = 0$, we have $\partial\bar{x}_t/\partial\lambda < 0$. A tighter borrowing constraint (lower λ) favors the emergence of an area hosting tenants in the best places (\bar{x}_t increases). As long as $\hat{x}_t^0 > \bar{x}_t$, there is still *symmetry breaking* as constrained homeowners leave a higher bequest than tenants and non-constrained homeowners. However, the lucky homeowners reside no more in the most attractive locations but are settled at \bar{x}_t . Hence, the rental market reduces overall inequality since it decreases the number of constrained homeowners and it shrinks the utility gap between constrained and non-constrained agents. Using $\mathcal{W}_t^\tau = \mathcal{W}_t^h(\hat{x}_t^0)$, the lifetime wealth wedge between the richest agent and the non-constrained agent is given by

$$\begin{aligned}
 \mathcal{W}_t^h(\bar{x}_t) - \mathcal{W}_t^\tau &= -\frac{y_t^0}{1-\lambda} - \kappa(\bar{x}_t) + \mu p_{t+1}(\bar{x}_t) + \mathcal{K} = \\
 &= \kappa(\hat{x}_t^0) - \kappa(\bar{x}_t) + \mu [p_{t+1}(\bar{x}_t) - p_{t+1}(\hat{x}_t^0)].
 \end{aligned}$$

The introduction of borrowing constraints makes a fraction of agents wealthier. However, a stricter borrowing constraint imply that real estate companies may prefer to rent the houses located in better places as agents are ready to become tenants and pay a higher rent to live in this better sites. Note also that a housing policy that would cap the rent of tenants would shrink the area where it is profitable for real estates to supply houses for renting (formally it could reduce Δ).

6.3 Housing demand and locational attributes

We add two ingredients. First, agents can choose the mass of housing units they want to consume. Second, we consider that utility depends on a locational attributes $a(x)$ which captures either commuting time generating a utility loss ($a'(x) < 0$) or the level of (exogenous) amenities available at x ($a'(x)$ can be either positive or negative, like in Brueckner *et al.*, 1999). The utility function is now given by $u(c_t, h_t, a(x), y_{t+1})$ which is increasing with the level of locational attributes a and housing size h_t while the bequest becomes $y_{t+1} = (1 + r)b_t + \theta_{t+1}h_t$ and agents face the budget constraint $c_t + b_t + p_t h_t = \mathcal{I}_t(x, y_t)$ with $\mathcal{I}_t(x, y_t) \equiv w - \kappa(x) + y_t$ the wealth and income resources net of commuting costs. We assume that the composite good, the wealth left to offsprings, and housing are normal goods.

Let us first put aside the borrowing constraint. The maximum bid-rent per unit of housing $\Psi_t(x, y_t)$ is such that the indirect utility level $u[c_t(x, y_t), h(x, y_t), a(x), = y_{t+1}(x, y_t)]u^*(y_t)$ achieves the same level regardless of the residential location (for a given wealth y_t). The bid-rent is the solution to the following differential equation (see Appendix A for details)

$$\Psi_t'(x) = \frac{-\kappa'(x) + u_a a'(x)/u_c}{h_t(x, y_t)} + \mu p_{t+1}'(x). \quad (1.34)$$

Contrary to the case with exogenous lot size, the slope of the bid-rent depends on housing size. This is a modified version of the Alonso-Muth condition. Agents living far from the business districts and/or amenities are compensated for their long and costly commutes by enjoying lower price per units of housing and, in turn, larger housing. The standard urban models ignore the future value of housing. To simplify the discussion, it is assumed that $-\kappa'(x) + u_a a'(x)/u_c < 0$, making the slope of bid-rents negative at all locations regardless of the pattern of amenities in the city. In Appendix A, we show that two spatial patterns can emerge at equilibrium. If commuting generates high loss of utility or the city center amenity advantage over the city fringe is strong, so that $\partial^2 \Psi_t / \partial x \partial y_t < 0$, then the wealthiest agents live toward the city center. This corresponds to the European residential pattern. Otherwise, if $\partial^2 \Psi_t / \partial x \partial y_t > 0$, spatial sorting is reversed so that the wealthiest agents reside in the sites farther away from the CBD, like in US cities.

Let us now consider the impact of a borrowing constraint. We now determine whether the wealthiest agents gain from borrowing requirements under variable

housing consumption. The borrowing constraint is now given by $\lambda e_t(x) \geq e_t(x) - y_t$ where $e_t(x, y_t) \equiv p_t(x) h_t(x, y_t)$ represents housing expenditures so that agents can borrow if and only if

$$e_t(x, y_t) \leq \frac{y_t}{1 - \lambda}. \quad (1.35)$$

We can define $\tilde{\Psi}_t(x, y_t)$ the bid-rent and $\tilde{h}_t(x, y_t)$ the housing demand when the borrowing constraint binds, that is $\tilde{h}_t(x, y_t) \tilde{\Psi}_t(x, y_t) = y_t / (1 - \lambda)$. As a consequence, the bid-rent is no more flat when the borrowing limit is binding as the agent can adjust her housing demand. The bid-rent is now chosen so that the agent enjoys the same utility level regardless of both the residential location and the status (constrained or unconstrained), so that $u(\tilde{c}_t, \tilde{y}_{t+1}, \tilde{h}_t) = u(c_t, y_{t+1}, h_t) = u^*(y_t)$. This is in contrast with the fixed lot size case. However, in Appendix A, we show that $\tilde{\Psi}(x, y_t) < \Psi(x, y_t)$ and $\tilde{h}(x, y_t) < h(x, y_t)$. As in the previous sections, credit constraint implies lower bid-rent.

When $\partial^2 \Psi_t / \partial x \partial y_t < 0$, the presence of a borrowing constraint does not modify the European spatial sorting. As in the case with fixed lot size, rich unconstrained agents benefit from a softer competition for land because constrained poor residents pay a lower bid-rent, that is $\tilde{\Psi}(x, y_t) < \Psi(x, y_t)$. By contrast, when $\partial^2 \Psi_t / \partial x \partial y_t > 0$, it is likely that the American spatial pattern can be modified by the presence of a borrowing constraint. Because $\tilde{\Psi}(x, y_t) < \Psi(x, y_t)$ for credit-constrained agents, they can be outbid by wealthier agents within the area in which the borrowing constraint of these poor agents is binding. The spatial wealth ranking is twisted so that agents with the same wealth can be split across locations. The wealthiest agents reside in locations close to the CBD and to the city limit. As some agents are credit-constrained, the size of their housing and housing prices that they pay are lower than under the configuration with no borrowing limit. Therefore, the wealthiest agents still benefit from the existence of credit constraints because they can enjoy lower housing unit prices, and the distance traveled declines.

Endogenous housing demand makes the wealth dynamics be location-dependent an increasing function of $\mathcal{I}_t(x, y_t)$ with $\mathcal{I}'_t(x, y_t^*(x)) = dy_t^*/dx - \kappa'(x)$. When the European spatial sorting arises or when, in the case of the American city $dy_t^*/dx > \kappa'(x)$ then we get that $\mathcal{I}'_t(x, y_t^*(x)) > 0$, then we get that the wealth sorting persist along the transitional path. By contrast, in the extreme case where $0 < dy_t^*/dx < \kappa'(x)$ then $\mathcal{I}'_t(x, y_t^*(x)) < 0$ the wealth ordering may be reshuffled in the next generation: offsprings of current rich generations get the lowest wealth level. This surprising

result is due to the indivisibility arising from the fact that an agent is assigned to a single location.

6.4 Bubbly dynamics

So far, we have studied the rent dynamics by assuming away housing bubbles. If we do no more impose the transversality condition, a wider class of solutions may exist. We now explore rent dynamics with bubbles where house prices are now expressed as $\tilde{p}_t(x) = p_t(x) + a_t$ with $p_t(x)$ the fundamental solution of equation (C.2) and a_t a bubble. Under this configuration, we have

$$p_t(x) + a_t = \mu [p_{t+1}(x) + \mathbb{E}_t(a_{t+1})] + \mathcal{K} - \kappa(x). \quad (1.36)$$

where \mathbb{E}_t stands for the expectation operator. Any a_t such that $a_t = \mu \mathbb{E}_t(a_{t+1})$ is a solution of equation (C.1). As $\mu < 1$, a_t explodes in expected value. All agents expect the sale price to increase in the future. The bubble a_t does not modify the wealth dynamics of non-constrained agents as the rent does internalize the future sale price and thus the bubble. However, the bubble has some key consequences on the borrowing constraint. As it is recognized that rapidly rising house prices increases pressure to relax borrowing constraints (Acolin *et al.*, 2016), we integrate into the downpayment requirement the expectation of the future rise of house prices as follows $\tilde{p}_t(x) - y_t < \lambda \tilde{p}_{t+1}(x)$ which is equivalent to

$$p_t(x) - \lambda p_{t+1}(x) - (\lambda/\mu - 1)a_t < y_t$$

with p_t given by (C.4) and where we have used (1.36) and $a_t = \mu \mathbb{E}_t(a_{t+1})$. The dynamics of \hat{x}_t^* does depend on the trend followed by the bubble a_t . The bubble generates two opposite effects on the borrowing constraint. On the one hand, expectations on an increase of the pledgeable sale price make less stringent the borrowing constraint. On the other hand, rising sale prices will increase the need to borrow and render tighter the borrowing constraint. The overall effect depends on the credit market imperfections and on the type of bubble.

Assume that the bubble follows a deterministic increasing trend, given by $a_t = \mu^{-t} a_0$ with a_0 an arbitrary initial condition. In this case, if credit market frictions are weak (resp., strong), *i.e.* $\lambda/\mu > 1$ (resp., $<$) the borrowing constraint becomes

less tight (resp., tighter). In the long run, the whole population ends up satisfying the borrowing constraint (resp., being borrowing-constrained).

Consider now that the bubble follows a stochastic dynamics given by

$$a_{t+1} = \begin{cases} \frac{1}{\mu\pi}a_t + \zeta_{t+1} & \text{with probability } \pi, \\ \zeta_{t+1} & \text{with probability } 1 - \pi. \end{cases}$$

with $\mathbb{E}_t[\zeta_{t+1}] = 0$. It amounts to consider that the bubble bursts with some probability $1 - \pi$ or keeps on soaring with probability π the dynamics of the city would change. Take $\lambda/\mu > 1$, as in the deterministic case as long as the bubble inflates the borrowing constraint would become less stringent and credit would be easier. After a bursting of the bubble, the borrowing constraint can suddenly be binding for a part of the population.

7 Concluding remarks

This paper presents a residential choice model with two key features, a borrowing constraint and intergenerational transfers. The borrowing constraint ties agents' bid-rent function to their wealth. Therefore, wealthier agents can outbid the rest of the population in the most attractive locations leading to *spatial wealth sorting*. We characterize the residential equilibrium for any given wealth distribution. We show that the borrowing constraint strongly impacts the pattern of the price formation. In areas where agents are constrained, the Alonso-Muth conditions are not met, and the price does not capitalize higher commuting costs. This benefits constrained residents who are closer to the city center. We show that the borrowing constraint also lowers the price paid by unconstrained rich agents living close to the center. Moreover, when the population is homogeneous with respect to wealth, the borrowing constraint can generate *symmetry-breaking* and benefit constrained residents closer to the city.

We also show that in any equilibrium bequests are location-dependent: agents living closer to attractive locations leave a higher bequest. The ranking of any dynasty in the wealth distribution maintains along the transitional path. Finally, depending on the parameter values, the steady state can be characterized by either wealth equality or persistent inequality. In the latter case, spatial sorting translates into persistent inequality. Our model also provides an argument for an optimal tax

schedule that combines both taxation on rents and on inheritance. When there are frictions in the credit market, the Henry George Theorem does not hold, and a confiscatory tax on land is no more optimal for financing public goods.

We have finally explored four extensions of the model. First, we consider an additional credit market imperfection, a borrowing cost made of both a higher interest rate and a fixed cost for borrowers to get access to loans. This addition allows us to highlight that the borrowing constraint is the only type of friction that generates symmetry-breaking and endogenous inequality. Second, we introduce a rental market. Residents can thus avoid the hurdle of the borrowing constraint by renting a house, and real estate companies can find it profitable to rent housing units instead of selling to constrained agents. This new market equilibrium effect reduces the opportunities for rich agents to reap the advantages of the borrowing constraint, as tenants and owners-occupiers compete for the most attractive sites resulting in higher land rents. However, spatial sorting and symmetry breaking can occur in the areas where real estate companies still find it profitable to sell to constrained agents. Third, we introduce an endogenous housing demand and heterogeneity in local amenities. Even though spatial sorting may be different under these circumstances, our main results remain valid. Credit constraint makes land competition less fierce and generates wealth inequalities. Finally, we introduce housing bubbles in the house price dynamics. The bubble has two effects on the borrowing constraint: It makes housing more expensive, increasing the necessity to borrow. However, it also relaxes the constraints as the pledgeable value of the investment increases. We show that the spatial sorting result and its long-run effect on wealth inequality hold.

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Appendix A

Spatial Sorting and Persistent Inequality

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A.1 Bid-rents

A.1 Fixed housing size. The rent function is derived from the following condition

$$\frac{dV(\mathcal{W}_t(x, y_t))}{dx} = 0$$

which is equivalent to

$$-\kappa'(x) - \Psi'_t(x, K_t) + \frac{\theta'_{t+1}(x)}{1+r} = 0 \quad (\text{A.1})$$

and by rearranging terms

$$\Psi'_t(x, K_t) = -\kappa'(x) + \frac{\theta'_{t+1}(x)}{1+r}. \quad (\text{A.2})$$

Integrating with respect to x yields

$$\Psi_t(x, K_t) = K_t - \Upsilon_t(x) \text{ with } \Upsilon_t(x) \equiv \kappa(x) - \frac{\theta_{t+1}(x)}{1+r} \quad (\text{A.3})$$

where K_t is the constant of integration.

A.2 Endogenous housing size with no borrowing limit. The utility function is given by $u(c_t, h_t, x, y_{t+1})$ which is increasing with housing size h_t . The dependence of the utility on x could be decreasing or increasing. Under this configuration, the bequest is $y_{t+1} = (1+r)b_t + \theta_{t+1}h_t$ and agents face the following budget constraint $c_t + b_t + p_t h_t = \mathcal{I}_t(x, y_t)$ with $\mathcal{I}_t(x, y_t) \equiv w - \kappa(x) + y_t$. Hence, the budget constraint is now

$$\mathcal{I}_t(x, y_t) = c_t + \frac{y_{t+1}}{1+r} + \left[p_t(x) - \frac{\theta_{t+1}(x)}{1+r} \right] h_t(x), \quad (\text{A.4})$$

where p_t is the price paid for one unit of housing. The first order conditions are

$$u_h/u_y = (1+r)[p_t - \theta_{t+1}/(1+r)] \text{ and } u_h/u_c = p_t - \theta_{t+1}/(1+r) \quad (\text{A.5})$$

which implicitly gives the housing demand $h_t^*(x, y_t)$. It is decreasing with the unit price net of the discounted future price and increasing with y_t . The indirect utility is

$$u \left(\mathcal{I}_t - \frac{y_{t+1}}{1+r} - [p_t(x) - \mu p_{t+1}(x)] h_t^*, h_t^*, x, y_{t+1} \right) \equiv V_t(x, y_t).$$

Using (A.5), the bid-rent is the solution of $V'_t(x, y_t) = 0$ or, equivalently, the following differential equation

$$\frac{\partial \Psi_t}{\partial x} = \frac{-\kappa'(x) + u_x/u_c}{h_t^*(x, y_t)} + \mu p'_{t+1}(x). \quad (\text{A.6})$$

The cross-derivative then writes

$$\frac{\partial^2 \Psi_t}{\partial x \partial y_t} = \frac{\partial h}{\partial y_t} \frac{\kappa'(x) - u_x/u_c}{[h^*]^2} + \frac{\partial \left[\frac{u_x}{u_c} \right] / \partial y_t}{h^*}.$$

Let us consider the first component. Since housing is a normal good ($\partial h_t / \partial y_t > 0$), a high-wealth agent consumes more housing units at each location than an agent endowed with a lower wealth. As both commuting costs and location attributes are such that $\kappa'(x) - u_a a'(x) / u_c > 0$, the first component is positive implying that the bid-rent slope in absolute terms decreases with wealth. With variable housing consumption, spatial sorting occurs even if there is no borrowing limit. Real estate companies allocate housing to the highest bidders so that agents with steeper bid-rents bid away their counterparts with flatter bid-rents. This first component makes agents to be sorted by increasing wealth order as the distance to the CBD rises. As is well-known, variable land consumption and income independent commuting costs imply a positive correlation between distance and income (see, Fujita, 1989, chapter 2). The second component captures how the marginal rate of substitution between private good and locational attributes varies with income. If it increases with income, then the second component plays in the opposite direction and makes the richer residents more willing to live at the CBD. Such a configuration arises when $a'(x) < 0$ for any x (e.g. utility loss because of commuting time or the city center is endowed with more or better amenities as in European cities) and u_a / u_c increases with y_t (this is consistent with CES preferences under a particular parameter restriction). The total effect is a priori ambiguous. If commuting generates high loss of utility or the city center amenity advantage over the city fringe is strong, so that $\partial^2 \Psi_t / \partial x \partial y_t < 0$, then the wealthiest agents live toward the CBD. This corresponds to the European residential pattern. Otherwise, if $\partial^2 \Psi_t / \partial x \partial y_t > 0$, spatial sorting is reversed so that the wealthiest agents reside in the sites farther away from the CBD, like in US cities.

The housing market clearing condition holds if the mapping $y_t^*(x)$ satisfies the

following condition:

$$f_t(y_t)h_t^*(x, y_t)dy_t = dx. \quad (\text{A.7})$$

This condition states that the amount of land available between any x and $x+dx > x$ and the subspace occupied by the agents whose wealth varies from y_t to $y_t + dy_t$ are the same. The city-size is such that the available land in the city equals land demand expressed by city residents

$$\int_0^{\bar{x}_t} f_t(y_t^*(x))h_t^*(x, y_t^*(x))dx = \int_0^{\bar{x}_t} dx.$$

Using (A.4) and (A.5) yields $dV_t(x, y_t^*(x))/dx = u_c(dy_t^*/dx) > 0$ in equilibrium and $y_{t+1} = (1+r)g[\mathcal{I}_t(x, y_t)]$ where g denotes an increasing function of lifetime wealth $\mathcal{I}_t(x, y_t)$ with

$$\frac{d\mathcal{I}_t(x, y_t^*(x))}{dx} = \frac{dy_t^*}{dx} - \kappa'(x).$$

Given the wealth mapping could be such that $dy_t^*/dx > 0$ or < 0 , the sign of $d\mathcal{I}_t(x, y_t^*(x))/dx$ is ambiguous. In addition

$$\frac{de_t(x, y_t)}{dy_t} = \frac{e_t}{\mathcal{I}_t(x, y_t)} \left[\frac{dp_t(x, y_t)}{d\mathcal{I}_t} \frac{\mathcal{I}_t(x, y_t)}{p_t(x, y_t)} + \frac{\mathcal{I}_t(x, y_t)}{h_t(x, y_t)} \frac{dh_t^*(x, y_t)}{d\mathcal{I}_t} \right].$$

A.3 Endogenous housing size under Cobb-Douglas utility with no borrowing limit. Assuming a Cobb-Douglas utility function $u(c_t, h_t, x, y_{t+1}) = [a(x)]^{\alpha_a} c_t^{\alpha_c} h_t^{\alpha_h} y_{t+1}^{\alpha_y}$ with a a function of x and $\alpha_c + \alpha_h + \alpha_y = 1$, the demand for housing is such that

$$h^*(x, y_t) = \frac{\alpha_h \mathcal{I}_t(x, y_t)}{p_t(x) - \frac{\theta_{t+1}(x)}{1+r}}. \quad (\text{A.8})$$

From (A.8), one can express the housing expenditures $e(x, y_t)$ as follows

$$e_t(x, y_t) = \alpha_h \mathcal{I}_t(x, y_t) + \frac{\theta_{t+1}(x)}{1+r} h_t^*(x, y_t) = \alpha_h \mathcal{I}_t(x, y_t) \frac{p_t(x)}{p_t(x) - \frac{\theta_{t+1}(x)}{1+r}}.$$

We must have $e_t(x, y_t) < \mathcal{I}_t(x, y_t)$ or, equivalently,

$$p_t(x) > \frac{1}{1 - \alpha_h} \frac{\theta_{t+1}(x)}{1+r}.$$

We also have $\partial e_t(x, y_t)/\partial y_t = e_t(x, y_t)/\mathcal{I}_t(x, y_t) \in (0, 1)$.

Then, the indirect utility is given by

$$V(x, y_t) = k [a(x)]^{\alpha_a} \left(p_t(x) - \frac{\theta_{t+1}(x)}{1+r} \right)^{-\alpha_h} \mathcal{I}_t(x, y_t)$$

where $k \equiv (1+r)^{\alpha_y} \alpha_c^{\alpha_c} \alpha_h^{\alpha_h} \alpha_y^{\alpha_y}$. The bid-rent of a y_t agent located at x must solve $\partial V(x, y_t)/\partial x = 0$ or, equivalently,

$$-\alpha_h \frac{\partial \ln \left[\Psi(x, y_t) - \frac{\theta_{t+1}(x)}{1+r} \right]}{\partial x} + \frac{\partial \ln \mathcal{I}_t(x, y_t)}{\partial x} + \alpha_a \frac{\partial \ln a(x)}{\partial x} = 0$$

Integrating the above equation leads to

$$\Psi_t(x, y_t) = \frac{\theta_{t+1}(x)}{1+r} + [a(x)]^{\frac{\alpha_a}{\alpha_h}} [\mathcal{I}_t(x, y_t)]^{\frac{1}{\alpha_h}} K_t(y_t). \quad (\text{A.9})$$

where $K_t(y_t)$ is the constant of integration which is independent of x so that

$$V(x, y_t) = k [K_t(y_t)]^{-\alpha_h}. \quad (\text{A.10})$$

A.4 Endogenous housing size under Cobb-Douglas utility with borrowing limit. We denote by $\tilde{\Psi}_t(x, y_t)$ the bid-rent and $\tilde{h}_t(x, y_t)$ the housing demand when the borrowing constraint binds, with

$$\tilde{h}_t(x, y_t) = \frac{y_t}{1-\lambda} \frac{1}{\tilde{\Psi}_t(x, y_t)}. \quad (\text{A.11})$$

Under Cobb-Douglas function and credit constraint, the indirect utility with

$$\tilde{V}(x, y_t) = \tilde{k} [a(x)]^{\alpha_a} \left[\mathcal{I}_t(x, y_t) - \tilde{\mathcal{H}}_t(x, y_t) \right]^{1-\alpha_h} \left(\frac{y_t}{1-\lambda} \right)^{\alpha_h} \left[\tilde{\Psi}_t(x, y_t) \right]^{-\alpha_h}$$

where $\tilde{k} \equiv (1+r)^{\alpha_y} \alpha_c^{\alpha_c} \alpha_y^{\alpha_y} / (1-\alpha_h)^{1-\alpha_h}$ and $\tilde{\mathcal{H}}_t(x, y_t) \equiv \frac{y_t}{1-\lambda} - \frac{\theta_{t+1}(x)}{1+r} \tilde{h}_t(x, y_t)$.

It turns out that now the bid-rent $\tilde{\Psi}_t(x)$ solves $\partial \tilde{V}(x, y_t)/\partial x = 0$. The bid-rent of a y_t agent must satisfy

$$(1-\alpha_h) \frac{\partial \ln \left[\mathcal{I}_t(x, y_t) - \left(\tilde{\Psi}_t - \frac{\theta_{t+1}}{1+r} \right) \frac{y_t}{1-\lambda} \frac{1}{p_t(x)} \right]}{\partial x} - \alpha_h \frac{\partial \ln \tilde{\Psi}_t(x, y_t)}{\partial x} + \alpha_a \frac{\partial \ln a(x)}{\partial x} = 0.$$

Integrating the above equation leads to the maximum bid-rent of a y_t agent residing

at x , namely $\tilde{\Psi}_t(x, y_t)$, implicitly given by

$$\tilde{\Psi}_t(x, y_t) - \left[\mathcal{I}_t(x, y_t) - \left(1 - \frac{\theta_{t+1}}{1+r} \frac{1}{\tilde{\Psi}_t(x, y_t)} \right) \frac{y_t}{1-\lambda} \right]^{\frac{1-\alpha_h}{\alpha_h}} [a(x)]^{\frac{\alpha_a}{\alpha_h}} \tilde{K}_t(y_t) = 0. \quad (\text{A.12})$$

where $\tilde{K}_t(y_t)$ is the constant of integration. Using the implicit function theorem, it is straightforward to check that $\partial \tilde{\Psi}_t(x, y_t) / \partial x < 0$ and

$$\tilde{V}(x, y_t) = \tilde{k} \left(\frac{y_t}{1-\lambda} \right)^{\alpha_h} [\tilde{K}_t(y_t)]^{-\alpha_h}.$$

Indirect utilities can be reexpressed as follows

$$\tilde{V}(x, y_t) = \tilde{k} [a(x)]^{\alpha_a} \left[\mathcal{I}_t(x, y_t) - \left[\tilde{\Psi}_t(x, y_t) - \frac{\theta_{t+1}(x)}{1+r} \right] \tilde{h}_t(x, y_t) \right]^{1-\alpha_h} [\tilde{h}_t(x, y_t)]^{\alpha_h} \quad (\text{A.13})$$

and

$$V(x, y_t) = \tilde{k} [a(x)]^{\alpha_a} \left[\mathcal{I}_t(x, y_t) - \left[\Psi_t(x, y_t) - \frac{\theta_{t+1}(x)}{1+r} \right] h_t(x, y_t) \right]^{1-\alpha_h} [h_t(x, y_t)]^{\alpha_h} \quad (\text{A.14})$$

Remind that

$$h_t^*(x, y_t) = \arg \max_h \left[\mathcal{I}_t(x, y_t) - \left[\Psi_t(x, y_t) - \frac{\theta_{t+1}(x)}{1+r} \right] h \right]^{1-\alpha_h} h^{\alpha_h} \quad (\text{A.15})$$

If there exists a location \hat{x}_t such that

$$\Psi(\hat{x}_t, y_t) h(\hat{x}_t, y_t) = \frac{y_t}{1-\lambda} \quad (\text{A.16})$$

it turns out that $\Psi(\hat{x}_t, y_t) = \tilde{\Psi}_t(x, y_t)$, $h^*(\hat{x}_t, y_t) = \tilde{h}(\hat{x}_t, y_t)$ and $\tilde{V}(\hat{x}_t, y_t) = V(\hat{x}_t, y_t)$. As bid-rents are such that $\partial \tilde{V}(x, y_t) / \partial x = 0$ and $\partial V(x, y_t) / \partial x = 0$, we deduce that $\tilde{V}(x, y_t) = V(x, y_t) = u^*(y_t)$.

We then show $\tilde{\Psi}_t(x, y_t) < \Psi_t(x, y_t)$ and $\tilde{h}_t(x, y_t) < h_t(x, y_t)$ for any x such that $\Psi_t(x, y_t) h_t(x, y_t) > y_t / (1-\lambda)$.

Indeed if $\tilde{\Psi}_t(x, y_t) \geq \Psi_t(x, y_t)$, it turns out that

$$h^{\alpha_h} \left[\mathcal{I}_t(x, y_t) - \left[\Psi_t(x, y_t) - \frac{\theta_{t+1}(x)}{1+r} \right] h \right]^{1-\alpha_h} \geq h^{\alpha_h} \left[\mathcal{I}_t(x, y_t) - \left[\tilde{\Psi}_t(x, y_t) - \frac{\theta_{t+1}(x)}{1+r} \right] h \right]^{1-\alpha_h}$$

and given (A.15) and (A.11), it is impossible to get $\tilde{V}(x, y_t) = V(x, y_t) = u^*(y_t)$.

When we have $\tilde{\Psi}_t(x, y_t) < \Psi_t(x, y_t)$, then

$$\begin{aligned} & \left[\mathcal{I}_t(x, y_t) - \left[\Psi_t(x, y_t) - \frac{\theta_{t+1}(x)}{1+r} \right] h \right]^{1-\alpha_h} h^{\alpha_h} < \\ & \left[\mathcal{I}_t(x, y_t) - \left[\tilde{\Psi}_t(x, y_t) - \frac{\theta_{t+1}(x)}{1+r} \right] h \right]^{1-\alpha_h} h^{\alpha_h} \end{aligned}$$

and it turns out that \tilde{h} is on the upper leg of $\left[\mathcal{I}_t(x, y_t) - \left[\tilde{\Psi}_t(x, y_t) - \frac{\theta_{t+1}(x)}{1+r} \right] h \right]^{1-\alpha_h} h^{\alpha_h}$ and is such that $\tilde{V}(x, y_t) = V(x, y_t) = u^*(y_t)$. We thus get $\tilde{h}_t(x, y_t) < h_t(x, y_t)$.

We have that \hat{x}_t is implicitly defined by

$$e_t(\hat{x}_t, y_t) = \frac{y_t}{1-\lambda}. \quad (\text{A.17})$$

Applying the implicit function theorem, we have

$$\frac{d\hat{x}}{dy} = \frac{(1/1-\lambda) - \partial e_t(\hat{x}_t, y_t)/\partial y_t}{\partial e_t(\hat{x}_t, y_t)/\partial x_t}.$$

Since $\partial e_t(x, y_t)/\partial y_t \in (0, 1)$, we have $d\hat{x}/dy \geq 0$ if and only if $\partial e_t(\hat{x}_t, y_t)/\partial x_t = \Psi_x(\hat{x}_t, y_t)h + h_x\Psi(\hat{x}_t, y_t) \geq 0$ meaning that housing expenditures increase with x .

A.5 Studying the spatial sorting of agents with endogenous housing size.

Two cases must be considered in order to characterize the spatial sorting.

Case 1. $\partial^2\Psi(x, y_t)/\partial x\partial y_t < 0$, **for any** x . Case 1 assumes that the bid-rent is still steeper for the richer agents despite endogenous housing, that is, for any given \hat{y}_t ,

$$\frac{\partial\Psi(x, y_t)}{\partial x_t} \Big|_{y_t > \hat{y}_t} < \frac{\partial\Psi(x, y_t)}{\partial x_t} \Big|_{y_t = \hat{y}_t}. \quad (\text{A.18})$$

(i) If $d\hat{x}/dy < 0$ the bid-rent can be written as follows

$$\psi(x, y_t, K_t) = \begin{cases} \tilde{\Psi}_t(x, y_t) & \text{for } x \in [0, \hat{x}_t(y_t, K_t)[, \\ \Psi_t(x, K_t) & \text{for } x \in]\hat{x}_t(y_t, K_t), L]. \end{cases}$$

Defining $\hat{x}(\hat{y}_t, K_t)$ such that $e_t(\hat{x}_t, \hat{y}_t) = \hat{y}_t(1-\lambda)$, we take a point on that curve

$(\hat{x}_t(\hat{y}_t, K_t), \psi(\hat{x}_t(\hat{y}_t, K_t), y_t, K_t))$. By keeping the value of ψ constant, we can then rank the bid-rent slopes according to the wealth level for any $0 \leq x = \hat{x}_t(\hat{y}_t, K_t) \leq L$

$$\psi'(x, y_t, K_t)|_{x=\hat{x}_t(\hat{y}_t, K_t), \psi=\text{const}} = \begin{cases} \partial\Psi(x, y_t)/\partial x_t, & \text{for any } y_t > \hat{y}_t, \\ \tilde{\Psi}'_t(x, K_t), & \text{for } y_t < \hat{y}_t. \end{cases}$$

Moreover, we have shown that $\Psi_t(\hat{x}_t, y_t) = \tilde{\Psi}_t(\hat{x}_t, y_t)$ and $\tilde{\Psi}_t(x, y_t) < \Psi_t(x, y_t)$ for any x such that $\Psi_t(x, y_t)h_t(x, y_t) > y_t/(1 - \lambda)$. This also implies that

$$\frac{\partial\Psi}{\partial x}\Big|_{x \rightarrow \hat{x}(y_t)} < \frac{\partial\tilde{\Psi}}{\partial x}\Big|_{x \rightarrow \hat{x}(y_t)}. \quad (\text{A.19})$$

Given (A.18) and (A.19), we get

$$\frac{\partial\tilde{\Psi}(x, y_t)}{\partial x}\Big|_{x \rightarrow \hat{x}^-(\hat{y}_t), y_t = \bar{y}, \bar{y} < \hat{y}_t} > \frac{\partial\Psi(x, y_t)}{\partial x}\Big|_{x \rightarrow \hat{x}^-(\hat{y}_t), y_t = \bar{y}, \bar{y} < \hat{y}_t} > \frac{\partial\Psi(x, y_t)}{\partial x}\Big|_{x \rightarrow \hat{x}^-(\hat{y}_t), y_t > \hat{y}_t}.$$

We deduce that agents endowed with a wealth $y_t > \hat{y}_t$ can outbid agents poorer than \hat{y}_t in more attractive areas, *i.e.* in the area $[0, \hat{x}(\hat{y}_t, K_t)[$.

Further, if there exists a location \hat{x} such that

$$\left[\frac{\theta_{t+1}(\hat{x})}{1+r} + [a(\hat{x})]^{\frac{\alpha a}{\alpha h}} [\mathcal{I}_t(\hat{x}, y_t^*(\hat{x}))]^{\frac{1}{\alpha h}} K_t(y_t^*(\hat{x})) \right] h(\hat{x}, K_t) = \frac{y_t^*(\hat{x})}{1-\lambda}$$

then there are constrained agents at the residential equilibrium. We thus deduce from Proof of Proposition 4, that richer residents living closer to the CBD pay a lower land rent than in a case without any borrowing constraint.

(ii) If $d\hat{x}/dy > 0$ we have

$$\psi(x, y_t, K_t) = \begin{cases} \Psi_t(x, K_t) & \text{for } x \in [0, \hat{x}_t(y_t, K_t)[, \\ \tilde{\Psi}_t(x, y_t) & \text{for } x \in]\hat{x}_t(y_t, K_t), L]. \end{cases}$$

Then at $\hat{x}(\hat{y}_t, K_t)$ such that $e_t(\hat{x}_t, \hat{y}_t) = \hat{y}_t/(1 - \lambda)$, we have

$$\frac{\partial\Psi}{\partial x}\Big|_{x \rightarrow \hat{x}^-(\hat{y}_t), y_t < \hat{y}_t} > \frac{\partial\Psi}{\partial x}\Big|_{x \rightarrow \hat{x}^-(\hat{y}_t), y_t > \hat{y}_t}.$$

We thus deduce that agents endowed with a wealth $y_t > \hat{y}_t$ can outbid agents

poorer than \hat{y}_t in more attractive areas, *i.e.* in the area $[0, \hat{x}(\hat{y}_t, K_t)]$. Still, richer individuals will take advantage of the presence of poorer constrained agents at equilibrium.

Case 2. $\partial^2\Psi(x, y_t)/\partial x\partial y_t > 0$, **for any** x . If we assume by contrast that the bid-rent is steeper for the poorer agents, it turns out that

$$\left. \frac{\partial\Psi}{\partial x} \right|_{x \rightarrow \hat{x}(\hat{y}_t), y_t < \hat{y}_t} < \left. \frac{\partial\Psi}{\partial x} \right|_{x \rightarrow \hat{x}(\hat{y}_t), y_t > \hat{y}_t}$$

leading the ranking of the bid-rent slopes to be ambiguous.

A.2 The social structure of cities

We show that *if there exists a cutoff location* $\hat{x}_t^0 \in [0, L]$ *such that* $y_t^*(\hat{x}_t^0)/(1 - \lambda) = \Psi_t(\hat{x}_t^0, \mathcal{K})$, *amounting to have*

$$(1 - \lambda)\Psi_t(0, \mathcal{K}) > \underline{y}_t > (1 - \lambda)\Psi_t(L, \mathcal{K}), \quad (\text{B.1})$$

then the city is partitioned into distinct areas defined by cutoff locations \hat{x}_t^j , $j = 1, \dots, J$ *with* $0 < \hat{x}_t^J < \dots < \hat{x}_t^1 < \dots < \hat{x}_t^0 < L$ *such that*

(i) *Residents living in the area* $[\hat{x}_t^0, L]$ *are not borrowing constrained and pay the rent* $\Psi_t(x, \mathcal{K})$.

(ii) *If there exists* $\hat{x}_t^1 \in [0, \hat{x}_t^0]$ *such that*

$$-y_t^{*\prime}(\hat{x}_t^1) = (1 - \lambda)\Upsilon'(\hat{x}_t^1) \quad \text{and} \quad y_t^*(x) \text{ is convex at } \hat{x}_t^1, \quad (\text{B.2})$$

then residents in area $x \in [\hat{x}_t^1, \hat{x}_t^0]$ *are borrowing constrained and pay the rent* $y_t^*(x)/(1 - \lambda)$. *Otherwise, all residents are borrowing constrained in the area* $x \in [0, \hat{x}_t^0]$.

(iii) *Provided that (B.2) holds. If there exists* $\hat{x}_t^2 > 0$ *such that*

$$\frac{y_t^*(\hat{x}_t^2)}{1 - \lambda} = \Psi_t(\hat{x}_t^2, K_t^1) \quad \text{with} \quad K_t^1 = \Upsilon_t(\hat{x}_t^1) + \frac{y_t^*(\hat{x}_t^1)}{1 - \lambda} \quad (\text{B.3})$$

then residents in the area $[\hat{x}_t^2, \hat{x}_t^1]$ *are not borrowing constrained and pay the rent*

$\Psi_t(x, K_t^1) = K_t^1 - \Upsilon_t(x)$. Otherwise, residents living in the area $[0, \hat{x}_t^1]$ are not borrowing constrained.

(iv) Provided cutoff locations with counting number $z = 0, \dots, j$ exist, if \hat{x}_t^j is given by (B.2), respectively (B.3), then the area $[\hat{x}_t^j, \hat{x}_t^{j+1}]$ hosts borrowing constrained, respectively unconstrained residents.

The city hosts at most two types of agents in equilibrium, those who are credit-constrained and those who are not, under condition (B.1). The linearity of Ψ_t is obtained if $\kappa(x)$ is linear and the rent is stationary (as shown later in the Appendix). This is not necessary for our results and this is made for expositional purpose. Condition (B.1) is easily satisfied as one can always find an agricultural rent so that the housing price at the city fringe is very low and even the poorest resident is not borrowing constrained. By contrast, it is relevant to consider that the willingness to pay at the CBD is high enough so that it prevents some poor agents from borrowing without facing any limit.

Let us now consider particular wealth distributions.

Case 1. Concave wealth distributions. Let us consider that y_t is distributed according to truncated Pareto distributed, on the support $[\underline{y}_t, \bar{y}_t]$ with shape parameters $\omega > 0$: $F_t(y) = [1 - (y/\underline{y}_t)^{-\omega}]/\phi_t$ with $\phi_t \equiv 1 - (\bar{y}_t/\underline{y}_t)^{-\omega} \in (0, 1]$. The mapping $y_t^*(x) = F_t^{-1}(1 - \frac{x}{L})$ is expressed as follows:

$$y_t^*(x) = \underline{y}_t \left[\frac{1}{1 - \phi_t + (\phi_t/L)x} \right]^{1/\omega}. \quad (\text{B.4})$$

If the distribution is such that

$$-\left. \frac{dy_t^*(x)}{dx} \right|_{x=L} = -\frac{1}{\omega} \frac{\phi_t}{L} \underline{y}_t < \Upsilon'(L) \quad (\text{B.5})$$

and that condition (B.1) is satisfied then the urban equilibrium is characterized as follows:

(i) Agents with wealth $\underline{y}_t \leq y_t(x) \leq \hat{y}_t^2$ reside in the area $[\hat{x}_t^2(\hat{y}_t^2), L]$ and are not borrowing-constrained.

(ii) Agents with wealth $\hat{y}_t^2 \leq y_t(x) \leq \hat{y}_t^1$ reside in the area $[\hat{x}_t^1(\hat{y}_t^1), \hat{x}_t^2(\hat{y}_t^2)]$ and borrow up to their borrowing limit.

(iii) Agents with wealth $\widehat{y}_t^1 \leq y_t(x) \leq \bar{y}_t$ reside in the area $[0, \widehat{x}_t^1(\widehat{y}_t^1)]$ and are not borrowing-constrained.

(iv) The equilibrium rent is such that

$$p_t^*(x) = \begin{cases} \Psi_t(x, K_t) = K_t^1 - \Upsilon_t(x), & \text{for } x \in [0, \widehat{x}_t^1(\widehat{y}_t^1)] \\ \frac{y_t^*(x)}{1-\lambda}, & \text{for } x \in [\widehat{x}_t^1(\widehat{y}_t^1), \widehat{x}_t^2(\widehat{y}_t^2, \mathcal{K})] \\ \Psi_t(x, \mathcal{K}) = \mathcal{K} - \Upsilon_t(x), & \text{for } x \in [\widehat{x}_t^2(\widehat{y}_t^2, \mathcal{K}), L]. \end{cases}$$

with $\widehat{x}_t^1(\widehat{y}_t^1)$ such that

$$\left. \frac{dy_t^*(x)}{dx} \right|_{x=\widehat{x}_t^1} = (1-\lambda)\Upsilon'(\widehat{x}_t^1),$$

K_t^1 such that

$$K_t^1 - \Upsilon_t(\widehat{x}_t^1) = \widehat{y}_t^1(\widehat{x}_t^1)/(1-\lambda),$$

and $\widehat{x}_t^2(\widehat{y}_t^2, \mathcal{K})$ such that

$$\mathcal{K} - \Upsilon_t(\widehat{x}_t^2) = \widehat{y}_t^2(\widehat{x}_t^2)/(1-\lambda).$$

Let us characterize the threshold distances and the rent function.

First, assuming (B.1) holds implies that the poorest agent does not need to borrow at the city fringe. The bid-rent at L is equal to $\Psi_t(L, \mathcal{K}) = p_A = \theta_{t+1}(L)/(1-\gamma) = R_A/(1-\gamma)$. Using (A.3), we get

$$\mathcal{K} - \Upsilon(L) = \frac{R_A}{1-\gamma}$$

leading to

$$\mathcal{K} = \kappa(L) + R_A \left(\frac{1}{1-\gamma} - \frac{1}{1+r} \right). \quad (\text{B.6})$$

Hence, the rent function for non-constrained agents living at $[\widehat{x}_t^2(\widehat{y}_t^2, \mathcal{K}), L]$ is

$$\Psi_t(x, \mathcal{K}) = \mathcal{K} - \Upsilon_t(x).$$

Since the mapping $y_t^*(x)$ given by (B.4) is decreasing and convex, and that $\Psi_t(x, \mathcal{K})$ is a decreasing function, we consider that the wealth distribution is such

that there exists \widehat{x}_t^2 satisfying

$$\Psi_t(\widehat{x}_t^2, \mathcal{K}) = \frac{\widehat{y}_t^2}{1-\lambda} \text{ and } \widehat{y}_t^2 = F_t^{-1}\left(1 - \frac{\widehat{x}_t^2}{L}\right),$$

and given (B.1), we have

$$\frac{y_t^*(x)}{1-\lambda} \geq \Psi_t(x, \mathcal{K}), \text{ for any } x \in [\widehat{x}_t^2, L],$$

implying that the agents are not borrowing-constrained.

Second, let us consider the area $[\widehat{x}_t^1(\widehat{y}_t^1), \widehat{x}_t^2(\widehat{y}_t^2, \mathcal{K})]$. We define $\widehat{x}_t^1(\widehat{y}_t^1)$ such that it satisfies

$$\frac{dy_t^*(\widehat{x}_t^1)}{dx} = (1-\lambda)\Upsilon'(\widehat{x}_t^1).$$

It is unique given $y_t^*(x)$ is decreasing and convex and that $(1-\lambda)\Upsilon'$ is assumed to be constant ($\Psi_t(x, \mathcal{K})$ is assumed to be linear and decreasing). Hence, for any $x \in [\widehat{x}_t^1(\widehat{y}_t^1), \widehat{x}_t^2(\widehat{y}_t^2, \mathcal{K})]$

$$\frac{y_t^*(x)}{1-\lambda} \leq \Psi_t(x, \mathcal{K}),$$

and given (B.5), we have for $x \in [\widehat{x}_t^1(\widehat{y}_t^1), \widehat{x}_t^2(\widehat{y}_t^2, \mathcal{K})]$

$$-\frac{dy_t^*(x)/(1-\lambda)}{dx} \leq -\frac{d\Psi_t(x, \mathcal{K})}{dx} = \frac{d\Upsilon(x)}{dx}.$$

It turns out that all residents are borrowing-constrained and they are sorted across space. At \widehat{x}_t^1 , the agent $\widehat{y}_t^1 = y_t^*(\widehat{x}_t^1)$ has no interest to deviate to another location $x \in [\widehat{x}_t^1(\widehat{y}_t^1), \widehat{x}_t^2(\widehat{y}_t^2, \mathcal{K})]$ paying $y_t^*(x)/(1-\lambda)$, that is

$$V[\mathcal{W}_t(\Psi(\widehat{x}_t^1, K_t^1), \widehat{y}_t^1)] \geq V[\mathcal{W}_t(y_t^*(x)/(1-\lambda), \widehat{y}_t^1)],$$

since

$$-\frac{dy_t^*(x)/(1-\lambda)}{dx} \leq \frac{d\Upsilon(x)}{dx}$$

any deviation leads to a decrease of \mathcal{W}_t .

The bid-rent $\Psi(x, K_t^1)$ at \widehat{x}_t^1 is such that the borrowing constraint is binding. This allows us to get K_t^1

$$K_t^1 - \Upsilon_t(\widehat{x}_t^1) = \widehat{y}_t^1(\widehat{x}_t^1)/(1-\lambda).$$

Note that as $y_t^*(x)/(1-\lambda) \leq \Psi_t(x, \mathcal{K})$ for any $x \in [\hat{x}_t^1(\hat{y}_t^1), \hat{x}_t^2(\hat{y}_t^2, \mathcal{K})]$, we deduce that

$$K_t^1 < \mathcal{K}.$$

Third, residents in $x \in [0, \hat{x}_t^1(\hat{y}_t^1)]$ are sorted according to wealth along space. The rent is $\Psi(x, K_t^1) = K_t^1 - \Upsilon_t(x)$. As $y_t^*(x)$ is convex and Ψ linear we deduce that $y_t^*(x)/(1-\lambda) > \Psi(x, K_t^1)$ implying that inhabitants are not borrowing-constrained.

Remark that the Pareto distribution could be such that there does not exist any \hat{x}_t^1 . If this was the case then the urban configuration would be characterized by two types of urban areas:

(i) Agents with wealth $\underline{y}_t \leq y_t(x) \leq \hat{y}_t^2$ reside in the area $[\hat{x}_t^2(\hat{y}_t^2), L]$ and are not borrowing-constrained.

(ii) Agents with wealth $\hat{y}_t^2 \leq y_t(x) \leq \bar{y}_t$ reside in the area $[0, \hat{x}_t^2(\hat{y}_t^2)]$ and borrow up to their borrowing limit.

This proof could be extended to any other concave c.d.f. leading to a decreasing and convex mapping $y_t^*(x)$.

Case 2. Convex wealth distributions. Let us consider that y_t is distributed according to a convex c.d.f. F_t on the support $[\underline{y}_t, \bar{y}_t]$ leading to a concave mapping $y_t^*(x)$. If condition (B.1), then the urban equilibrium is characterized as follows

(i) Agents with wealth $\underline{y}_t \leq y_t(x) \leq y_t^*(\hat{x})$ reside in the area $[\hat{x}_t, L]$ and are not borrowing-constrained.

(ii) Agents with wealth $y_t^*(\hat{x}) \leq y_t(x) \leq \bar{y}_t$ reside in the area $[0, \hat{x}_t]$ and are borrowing-constrained.

(iv) The equilibrium rent is such that

$$p_t^*(x) = \begin{cases} \frac{y_t^*(x)}{1-\lambda}, & \text{for } x \in [0, \hat{x}_t] \\ \Psi_t(x, \mathcal{K}) = \mathcal{K} - \Upsilon_t(x), & \text{for } x \in [\hat{x}_t, L]. \end{cases}$$

with

$$y_t^*(x) = F_t^{-1}(1 - x/L)$$

\hat{x}_t such that

$$y_t^*(\hat{x}) = F_t^{-1}(1 - \hat{x}/L) = \Psi_t(\hat{x}, \mathcal{K}).$$

A convex c.d.f. F_t leads to a concave wealth mapping $y_t^*(x) = F_t^{-1}(1 - x/L)$.

Given (B.1), there exists \widehat{x}_t such that

$$\begin{aligned} y_t^*(\widehat{x}_t) &= F_t^{-1}(1 - \widehat{x}_t/L) = \Psi_t(\widehat{x}_t, \mathcal{K}), \\ y_t^*(x) &\leq \Psi_t(x, \mathcal{K}) \text{ for any } x \in [0, \widehat{x}_t], \\ \text{and } y_t^*(x) &\geq \Psi_t(x, \mathcal{K}) \text{ for any } x \in [\widehat{x}_t, L]. \end{aligned}$$

We thus deduce that for all agents with wealth $y_t \leq y_t^*(x) \leq y_t^*(\widehat{x}_t)$ residing in the area $[\widehat{x}_t, L]$ they are not borrowing-constrained. By definition of $\Psi_t(x, \mathcal{K})$, no agent in this area has an interest to move to another location in $[\widehat{x}_t, L]$. In addition, no one living in $[\widehat{x}_t, L]$ would be able to outbid residents of $x \in [0, \widehat{x}_t]$ who have wealth $y_t^*(\widehat{x}_t) \leq y_t^*(x) \leq \bar{y}_t$ and are borrowing-constrained. Take an agent $y = y_t^*(x)$ residing at $x \in [0, \widehat{x}_t]$. First, given that she is borrowing-constrained, she is not able to outbid richer agents at any location $x' < x$. Second, she has no interest to deviate to another location $x' > x, x' \in [0, \widehat{x}_t]$ paying a lower bid-rent $y_t(x')/(1 - \lambda)$, that is

$$V[\mathcal{W}_t(y/(1 - \lambda), y)] \geq V[\mathcal{W}_t(y_t^*(x')/(1 - \lambda), y)],$$

because since the mapping $y_t^*(x)$ is concave we have

$$-\frac{dy_t^*(x)/(1 - \lambda)}{dx} - \Upsilon'(x) < 0$$

implying that the benefit of paying a lower rent $y_t^*(x')/(1 - \lambda)$ is outweighed by the extra transportation cost. Third, since any borrowing-constrained agent enjoys greater utility rather than paying $\Psi_t(x, \mathcal{K})$, the agent y has no interest to live at a location $x' \in [\widehat{x}_t, L]$.

Remark that if (B.1) does not hold, it turns out that there does not exist any \widehat{x} . The urban equilibrium is such that no resident is borrowing-constrained and the rent is $p_t^*(x) = \Psi_t(x, \mathcal{K})$ for any $x \in [0, L]$.

Case 3. Distributions with concave and convex portions. A log-normal distribution or a Frechet distribution fall into this case. We still assume condition (B.1) holds. We adapt the above proofs of cases 1 and 2. We focus on areas where the mapping is such that $y_t^*(x)/(1 - \lambda) \leq \Psi_t(x, \mathcal{K})$.

First, assume that the mapping is such that there exists a unique tangency point

\tilde{x} such that

$$-\frac{dy_t^*(\tilde{x})/(1-\lambda)}{dx} = \Upsilon'(\tilde{x}) \text{ and } y_t^*(x)/(1-\lambda) \text{ is convex at } x = \tilde{x}. \quad (\text{B.7})$$

The proof is similar to case 1 and leads to the following urban configuration:

(i) Agents with wealth $\underline{y}_t \leq y_t(x) \leq \hat{y}_t$ reside in the area $[\hat{x}_t(\hat{y}_t), L]$ and are not borrowing-constrained.

(ii) Agents with wealth $\hat{y}_t \leq y_t(x) \leq y_t^*(\tilde{x}_t)$ reside in the area $[\tilde{x}_t, \hat{x}_t(\hat{y}_t)]$ and borrow up to their borrowing limit.

(iii) Agents with wealth $y_t^*(\tilde{x}_t) \leq y_t(x) \leq \bar{y}_t$ reside in the area $[0, \tilde{x}_t]$ and are not borrowing-constrained.

(iv) The equilibrium rent is such that

$$p_t^*(x) = \begin{cases} \Psi_t(x, K_t) = K_t^1 - \Upsilon_t(x), & \text{for } x \in [0, \tilde{x}_t] \\ \frac{y_t^*(x)}{1-\lambda}, & \text{for } x \in [\tilde{x}_t, \hat{x}_t(\hat{y}_t, \mathcal{K})] \\ \Psi_t(x, \mathcal{K}) = \mathcal{K} - \Upsilon_t(x), & \text{for } x \in [\hat{x}_t(\hat{y}_t, \mathcal{K}), L]. \end{cases}$$

with \tilde{x}_t satisfying (B.7) and K_t^1 such that

$$K_t^1 - \Upsilon_t(\tilde{x}_t) = y_t^*(\tilde{x}_t)/(1-\lambda),$$

and $\hat{x}_t(\hat{y}_t, \mathcal{K})$ such that

$$\mathcal{K} - \Upsilon_t(\hat{x}_t) = \hat{y}_t(\hat{x}_t)/(1-\lambda)$$

with \mathcal{K} given by (B.6).

Second, assume w.l.o.g. that the mapping is such that there are two points \tilde{x} and \tilde{x}' , $\tilde{x} < \tilde{x}'$, such that

$$-\frac{dy_t^*(z)/(1-\lambda)}{dx} = \Upsilon'(z) \text{ and } y_t^*(z)/(1-\lambda) \text{ convex, for } z = \tilde{x}, \tilde{x}'. \quad (\text{B.8})$$

We define the constant $\tilde{K}_t' - \Upsilon_t(\tilde{x}') = y_t^*(\tilde{x}')/(1-\lambda)$. Two cases must be considered.

If $y_t^*(x)/(1-\lambda) > \Psi(x, \tilde{K}_t') = \tilde{K}_t' - \Upsilon_t(x)$ for any $x \in [0, \tilde{x}']$ than all agents with wealth $y_t \geq y_t^*(\tilde{x}')$ are not borrowing-constrained when paying the rent $\Psi(x, \tilde{K}_t')$.

Following the same reasoning as in proof of case 1, we have the same type of urban configuration as in case 1:

(i) Agents with wealth $\underline{y}_t \leq y_t(x) \leq \hat{y}_t$ reside in the area $[\hat{x}_t(\hat{y}_t), L]$ and are not borrowing-constrained. The location \hat{x}_t is such that $\Psi(\hat{x}_t, \mathcal{K}) = y_t^*(\hat{x}_t)/(1 - \lambda)$.

(ii) Agents with wealth $\hat{y}_t \leq y_t(x) \leq y_t^*(\tilde{x}'_t)$ reside in the area $[\tilde{x}'_t, \hat{x}_t(\hat{y}_t)]$ and borrow up to their borrowing limit.

(iii) Agents with wealth $y_t^*(\tilde{x}'_t) \leq y_t(x) \leq \bar{y}_t$ reside in the area $[0, \tilde{x}'_t]$, are not borrowing-constrained and pay the rent $\Psi(x, \tilde{K}'_t)$.

If there exist locations $x \neq \tilde{x}'$ such that $y_t^*(x)/(1 - \lambda) = \Psi(x, \tilde{K}'_t)$, take the highest solution \bar{x} . We know that $\Psi(x, \tilde{K}'_t)$ intersects from above $y_t^*(x)/(1 - \lambda)$ at \bar{x} and that individuals with wealth $y_t^*(x) \in [y_t^*(\bar{x}), y_t^*(\tilde{x}'_t)]$ are not borrowing-constrained, that is $y_t^*(x)/(1 - \lambda) > \Psi(x, \tilde{K}'_t)$. At \tilde{x}' , we can then apply the same reasoning as in case 1 and deduce that all residents in area $[0, \tilde{x}'_t]$ pay the rent $\Psi(x, \tilde{K}'_t)$ with \tilde{K}'_t such that $\tilde{K}'_t - \Upsilon_t(\tilde{x}') = y_t^*(\tilde{x}')/(1 - \lambda)$.

The reasoning remains valid with several points satisfying (B.8).

A.3 Proposition 5

C.1 Rent dynamics and long-run wealth for non-constrained dynasties.

We define a non-constrained dynasty a sequence of generations living at the city fringe such that the active agent and all her descendants are never constrained. Consider that these agents live at locations x where the rent is $\Psi_t(x, \mathcal{K})$. Let us consider the dynamics of the rent $p_t^*(x) = \Psi_t(x, \mathcal{K})$ expressed as follows

$$\Psi_t(x, \mathcal{K}) = \mu\Psi_{t+1}(x, \mathcal{K}) + \mathcal{K} - \kappa(x) \quad (\text{C.1})$$

where we have replaced $\theta_{t+1}(x)/(1 + r)$ by $\mu\Psi_{t+1}(x, \mathcal{K})$ and where $\mathcal{K} \equiv \kappa(L) + rp_A/(1 + r)$. We consider that there are some locations x such that these dynamics hold at any date t . In particular, if at some date t , $\underline{y}_t > p_A(1 - \lambda)$, and if the sequence $\left\{ \underline{y}_z \right\}_{z=t}^{\infty}$ is monotonously increasing, then these rent dynamics prevail at the city fringe. In this case, the rent can thus be solved by iterating forward the system. Hence,

$$\Psi_t(x, \mathcal{K}) = \lim_{\varsigma \rightarrow \infty} \mu^{\varsigma+1} \Psi_{t+1+\varsigma}(x, \mathcal{K}) + \lim_{\varsigma \rightarrow \infty} \sum_{j=0}^{\varsigma} \mu^j [\mathcal{K} - \kappa(x)]. \quad (\text{C.2})$$

In order to find a solution, we abstract from the presence of any housing bubble and we impose a transversality condition, that is,

$$\lim_{t \rightarrow \infty} \Psi_t(x, \mathcal{K}) < \infty. \quad (\text{C.3})$$

As $\mu < 1$, we obtain

$$\Psi_t(x, \mathcal{K}) = \Psi(x, \mathcal{K}) = \frac{1}{1 - \mu} [\mathcal{K} - \kappa(x)]. \quad (\text{C.4})$$

This rent is constant over time.

Given (1.12), if $\beta < 1$, then the wealth of non-constrained dynasties living at the city fringe converges to

$$y_\infty = \frac{\beta}{1 - \beta} (w - \mathcal{K}). \quad (\text{C.5})$$

At the steady state, these dynasties reside at $x \in [\hat{x}_\infty, L]$, where \hat{x}_∞ is given by

$$(1 - \lambda) \Psi_\infty(\hat{x}_\infty, \mathcal{K}) = y_\infty.$$

Note that if \hat{x}_∞ exists, it is necessarily unique. By rearranging terms, we finally obtain

$$\kappa(\hat{x}_\infty) = \mathcal{K} \left[1 + \frac{\beta(1 - \mu)}{(1 - \beta)(1 - \lambda)} \right] - \frac{w\beta(1 - \mu)}{(1 - \beta)(1 - \lambda)}. \quad (\text{C.6})$$

C.2 Long run wealth and rent of constrained dynasties. Consider now constrained dynasties residing at locations $x \in [0, \hat{x}_t^*]$. They pay the rent $p_t^*(x) = y_t^*(x)/(1 - \lambda)$ at each t . Thus, the dynamics of the equilibrium rent $p_t^*(x)$ follows the dynamics of $y_t^*(x)$. From (1.12), agents living at $x \in [0, \hat{x}_t^*]$ follow the following dynamics:

$$y_{t+1}(x) = \beta \left\{ w - \kappa(x) + \left(y_t^*(x) - \frac{y_t^*(x)}{1 - \lambda} \right) + \mu \frac{y_{t+1}^*(x)}{1 - \lambda} \right\}.$$

As we assume that bequest is positive it amounts to have $w - \kappa(x) + y_t^*(x) - \frac{y_t^*(x)}{1 - \lambda} > 0$. Hence, in order for the above equation to hold for $y_{t+1} > 0$ a necessary condition is that

$$1 - \frac{\beta\mu}{1 - \lambda} > 0 \Leftrightarrow 1 - \lambda > \alpha(1 - \gamma). \quad (\text{C.7})$$

Rearranging terms leads to

$$y_{t+1}(x) = \frac{\beta(1-\lambda)}{1-\lambda-\beta\mu} \left[w - \kappa(x) - \frac{\lambda y_t(x)}{1-\lambda} \right].$$

If

$$1 > \frac{\beta\lambda}{1-\lambda-\beta\mu} \Leftrightarrow \lambda < \frac{1-\beta\mu}{1+\beta} \quad (\text{C.8})$$

then the wealth converges to

$$y_{\infty}^*(x) = \frac{\beta(1-\lambda)}{1-\lambda-\beta\mu+\beta\lambda} [w - \kappa(x)] > 0. \quad (\text{C.9})$$

These households live in the area $[0, \hat{x}_{\infty}]$, with \hat{x}_{∞} defined by

$$y_{\infty}(\hat{x}_{\infty}) = (1-\lambda)\Psi_{\infty}(\hat{x}_{\infty})$$

and it can be checked that it leads to (C.6).

C.3 Long-run urban configurations. Claim *In the long run, (i) non-constrained agents always live further away than constrained agents and (ii) there can be at most one threshold location \hat{x}_{∞} .*

(i) By contradiction, assume a long run urban equilibrium with non-constrained agents living in $[0, \hat{x}_{\infty}]$ and constrained-agents living in $[\hat{x}_{\infty}, L]$. The non-constrained agents would pay the rent $\Psi_{\infty}(x, \hat{K}_{\infty})$ with \hat{K}_{∞} such that $y_{\infty}(\hat{x}_{\infty}) = \Psi_{\infty}(\hat{x}_{\infty}, \hat{K}_{\infty})(1-\lambda)$ and, given the dynamics (1.12), they would all end up with the same long-run wealth level $y_{\infty}^1 = y_{\infty}(\hat{x}_{\infty}) = \Psi_{\infty}(\hat{x}_{\infty}^2, \hat{K}_{\infty})(1-\lambda)$. By assumption, for any $x \in [0, \hat{x}_{\infty}[$, $y_{\infty}^1 > \Psi_{\infty}(x, \hat{K}_{\infty})(1-\lambda)$ which is a contradiction as Ψ_{∞} is strictly decreasing with x . (ii) By contradiction, assume, w.l.o.g., a long run urban equilibrium with 3 threshold-locations denoted by $\hat{x}_{\infty}^1, \hat{x}_{\infty}^2, \hat{x}_{\infty}^3$ such that there are constrained residents in $[0, \hat{x}_{\infty}^1]$ and $[\hat{x}_{\infty}^2, \hat{x}_{\infty}^3]$. and non-constrained agents in between. Applying the same logic as in item (i) there cannot be constrained agents further away from the CBD than non-constrained agents. According to this claim, the long run spatial sorting is that constrained agents live close to the CBD and non-constrained further away.

A.4 Long-run effects of borrowing cost

In the long run, there are three types of agents: Rich agents who do not need to borrow and live close to the city center, the middle class which is borrowing-constrained and poor agents who borrow and live at the periphery. The poorest agents live close to the city fringe and pay

$$\Psi_{\infty}^p(x) = \frac{\mathcal{K} - \kappa(x)}{1 + \zeta - \mu}$$

and their wealth converges to

$$y_{\infty}^p = \frac{\beta}{1 - \beta(1 + \zeta)} [w - \phi - \mathcal{K}].$$

Next, a group of constrained agents lives closer has a long-run wealth equal to

$$y_{\infty}^m(x) = \frac{\beta(1 - \lambda)}{\beta - \beta\mu - \lambda[1 - \beta(1 + \zeta)]} [w - \kappa(x) - \phi].$$

and they pay $y_{\infty}^m(x)/(1 - \lambda)$. The threshold location \hat{x}_{∞}^p separating these first two groups is such that $\Psi_{\infty}^p(\hat{x}_{\infty}^p) = y_{\infty}^m(\hat{x}_{\infty}^p)/(1 - \lambda)$. It follows that

$$\kappa(\hat{x}_{\infty}^p) = \mathcal{K} - \frac{1 + \zeta - \mu}{1 - \lambda} y_{\infty}^c(\hat{x}_{\infty}^p)$$

leading to $y_{\infty}^m(\hat{x}_{\infty}^p) = y_{\infty}^p$.

Finally, the richest agents live in the city center and they do not need to borrow, so that they pay

$$\Psi_{\infty}^s(x) = \frac{K_{\infty}^s - \kappa(x)}{1 - \mu}$$

and their wealth converges to

$$y_{\infty}^r = \frac{\beta}{1 - \beta} [w - K_{\infty}^s].$$

As $y_{\infty}^m(\hat{x}_{\infty}^m)/(1 - \lambda) = \Psi_{\infty}^s(\hat{x}_{\infty}^m)$, we have

$$\frac{\beta}{\beta - \beta\mu - \lambda[1 - \beta(1 + \zeta)]} [w - \kappa(\hat{x}_{\infty}^m) - \phi] = \frac{K_{\infty}^s - \kappa(\hat{x}_{\infty}^m)}{1 - \mu}$$

so that we can find the constant

$$K_\infty^s = \frac{\beta(1-\mu)}{\beta - \beta\mu - \lambda[1 - \beta(1 + \zeta)]} [w - \kappa(\hat{x}_\infty^m) - \phi] + \kappa(\hat{x}_\infty^m).$$

The threshold location \hat{x}_∞^m is defined by the number of rich agents who diverge in the transitional path, n_r , once the rich savers pull away from the rest of the population. This equilibrium configuration is possible only if $y_\infty^r > y_\infty^m(\hat{x}_\infty^m)$, leading to

$$\frac{\beta}{1-\beta} [w - K_\infty^s] > \frac{\beta(1-\lambda)}{\beta - \beta\mu - \lambda[1 - \beta(1 + \zeta)]} [w - \kappa(\hat{x}_\infty^m) - \phi].$$

Plugging K_∞^s leads to,

$$\phi > [w - \kappa(\hat{x}_t^m)] \left[\frac{1 - \beta(1 + \zeta)}{(1 - \lambda)(1 - \beta) + \beta(1 - \mu)} \right].$$

In other words, wealthy agents diverge only if the borrowing cost is high enough.

Chapter 2

Municipalities' Voting Power and Housing Supply: Evidence from French Inter-municipal Cooperation¹

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¹The draft corresponding to this chapter is single-authored.

1 Introduction

High housing costs are a common feature of urban areas (Glaeser et al., 2005, Gyourko et al., 2013, Glaeser and Gyourko, 2018, Combes et al., 2019), which can give rise to social consequences such as the crowding out of low-income households and disproportionate high capital gains to real estate owners. There is a consensus among urban economists on the importance of housing supply inelasticity to explain such a phenomenon (Gyourko et al., 2013). The source of this inelasticity can be traced back to geographical constraints (Saiz, 2010) but also local decision-making (Gyourko and Molloy, 2015). Indeed, local governments mainly manage urban development by setting land use regulations and granting building permits. As resistance to new development grows, local policymakers can limit their city's urban development to gain political support.

One way to overcome local resistance to new housing construction is to transfer the decision-making power over urban planning to higher tier local governments (Glaeser and Gyourko, 2018) such as inter-municipal communities. Inter-municipal communities consist of several municipalities cooperating to exploit economies of scale, provide public goods and internalize externalities (Bel and Warner, 2015, Ferraresi et al., 2018). Further, inter-municipal communities often set general land-use regulation and actively plan future urban development (Luca and Modrego, 2021) so that municipalities might partially lose autonomy in managing urban development.

France represents an interesting case study for the consequences of inter-municipal cooperation on urban development for at least three reasons: First, since 2014, all municipalities have been forced to be part of an inter-municipal community (*Établissement Public de Coopération Intercommunale*, hereafter EPCI),² leading to a high number of inter-municipal communities covering the entire French territory. Second, decisions on urban planning are taken by inter-municipal councils of municipal delegates who are directly elected in municipal elections. This creates an electoral constraint that reinforces the connection between delegates' positions on urban planning and their local constituency. Finally, given that the number of delegates of a municipality depends on its population share in the EPCI, municipalities do not have equal representation within the council, leading to power imbalances.

²Other countries have similar types of inter-municipal communities. For example, they are named *Unioni di comuni* in Italy, *Mancomunidades* in Spain, and *Zweckverbände* in Germany.

This paper investigates how municipalities' voting power within inter-municipal communities' councils influences new housing supply. With this aim, I collected an original dataset including the number of delegates per municipality in the densest EPCIs between 2014 and 2019. This dataset is used to compute the Banzhaf index (Banzhaf III, 1964) for each municipality, providing a measure of voting power within the EPCI's council. I use this index to study the relationship between municipalities' voting power and the number of building permits granted in each municipality.

In order to address issues of endogeneity of the voting power index, I exploit two plausibly *exogenous* changes of delegates' allocation in some EPCIs. In the 2014-2019 period, *i*) the central government set a minimum population threshold for every EPCI, thus leading many EPCIs to increase their perimeter, and *ii*) the constitutional court declared some EPCIs' local agreements to allocate delegates among municipalities unconstitutional, which meant that these EPCIs had to reallocate delegates among municipalities. Both policy changes led to a variation in the balance of power. I exploit these changes as instruments for municipalities' voting power to estimate fixed effect instrumental variable models (FEIV).

I find that municipalities with higher voting within the inter-municipal council power grant more permits for single-family housing units and fewer building permits for apartment units. This suggests that municipalities can exploit their voting power to limit new high-density housing constructions, which are more likely to be perceived negatively by the local population. Next, I study how the effect of voting power varies with municipality housing density and homeownership rate. These variables serve to proxy local resistance to new development. Densely built municipalities are likely to exhibit higher housing demand, higher congestion costs and therefore fierce opposition to new construction (NIMBYism: "Not in My Back-Yard"). In addition, homeowners are likely to oppose new constructions to shield the value of their houses (Fischel, 2005). I find that the effect of voting power on single-family and multi-family units is stronger in both densely built and homeowners municipalities, yet the effect is only statistically significant for denser municipalities.

The remainder of the paper is organized as follows: In Section 2 I present the different strands of literature to which I refer highlighting the contribution of my paper. Section 3 introduces the French institutional background, highlighting the role of inter-municipal communities, their decision-making powers over urban development and the functioning of the council. Moreover, this section explains the

two sources of exogenous variation of voting power in the study period. Section 4 presents the data, the summary statistics of the main variables and the empirical strategy. In section 5 I present the main results and in section 6 I run a battery of robustness checks. Concluding comments follow.

2 Related literature

My paper relates to several strands of literature, among which three are particularly relevant to situate my contribution.

First, I refer to the literature on power indexes (Penrose, 1946, Banzhaf III, 1964), which studies the voting power of the members of a collective decision-making institution. These indexes have been used in empirical studies involving different institutions as the International Monetary Fund (Leech, 2002), the European Union (Kauppi and Widgrén, 2004, 2007, Zaporozhets et al., 2016) and French inter-municipal communities (Bisson et al., 2004, Abidi et al., 2020). Abidi et al. (2020) use the Banzhaf index and find that a 2010 national law that modified the delegates allocation per municipality increased power inequalities. Indeed, before 2010, municipalities were free to agree on a common rule to allocate delegates. Smaller municipalities generally obtained a higher representation than their relative size. After 2010, the national government set a fixed rule following the Jefferson apportionment method (more details in appendix B.1). Consequently, small municipalities lost some of their influence. My contribution to the literature is three-fold: First, I collect a larger dataset than any other study, which allows me to study many different federal-type organizations with the same decision-rule. Second, I exploit a plausibly exogenous shock in voting power among different inter-municipal communities to deal with endogeneity issues and clearly identify the impact of voting power on decision-making. To the best of my knowledge, no other paper did this. Finally, unlike any paper in the literature, I exploit voting power indexes to study urban issues. In particular, this paper studies whether a municipality's voting power can influence its housing supply.

Second, my paper speaks to the urban economics literature studying the factors limiting housing supply elasticity. I focus on local policy-making as local land use regulations can become widely popular when negative externalities are strong (Hilber and Robert-Nicoud, 2013, Gyourko and Molloy, 2015). A large body of the

literature assumes that people have a distaste for new construction (Glaeser et al., 2005). Yet, local preferences are likely to be heterogeneous. On the one hand, an “urban growth machine” (Molotch, 1976) that includes developers and landowners (Hilber and Robert-Nicoud, 2013, Schone et al., 2013) might try to influence local decision-makers to promote urban development. Urban growth is indeed functional in increasing profits and overall economic activity. On the other hand, homeowners will oppose new housing supply to protect their homes’ market value, which is often their most valuable asset (Fischel, 2005, Ortalo-Magné and Prat, 2014). Even renters can strongly oppose nearby urban development in expensive cities as they fear subsequent rents increase (Hankinson, 2018). However, the importance of local politics in urban development is still an understudied aspect of housing policy (Gabbe and Kahn, 2021). I contribute to this literature by zooming out from a municipality perspective to an inter-municipal perspective by assessing how the voting power of each municipality can affect the housing supply.

Finally, this paper contributes to the literature studying inter-municipal cooperation. While the reasons of inter-municipal cooperation have been widely discussed (Brasington, 2003, Di Porto et al., 2017), little has been done on its consequences (Brasington, 1999, Frère et al., 2014, Ferraresi et al., 2018, Luca and Modrego, 2021). The most closely related study is Tricaud (2021), which shows that those French municipalities forced to join an inter-municipal community by a national law saw a drastic increase in housing construction. This implies that they limited new constructions before the reform and lost control over the housing supply once they joined the EPCI. Tricaud (2021) focuses on the effect of *forced integration*. The municipalities resisting integration were likely to expect a greater loss in autonomy and high costs associated with it.³ This paper expands the scope of the analysis to French municipalities that are already integrated in an EPCI during the whole study period. By observing the variation of voting power due to exogenous shocks, I can capture and quantify the effect of voting power on housing supply, thus disentangling the mechanisms at play in inter-municipal communities.

³Tricaud (2021) finds that these municipalities were more likely to join an EPCI encompassing a big city. In other words, they were aware they would have had less influence in the council.

3 Institutional background

3.1 Inter-municipal cooperation and urban development

Since the French Revolution, France has been characterized by many municipalities compared to other countries. For this reason, mergers have been incentivized, but they did not have widespread success.⁴ Therefore, the central government pushed municipalities to cooperate to form EPCIs. The aim is to exploit economies of scale to provide public goods and to internalize externalities among municipalities. After the approval of the law of December 16, 2010 (*Loi de réforme des collectivités territoriales françaises*), all municipalities had to join an EPCI, a goal reached in 2014.⁵

Municipalities can transfer different decision-making powers to the EPCI. Among them, the decision-making power over urban planning plays a fundamental role. Even though, in most cases, the mayor of each municipality grants building permits, the general local land use regulations are set at the EPCI level. The main instrument to control urban development is the inter-municipal local land use plan (*Plan Local d'Urbanisme Intercommunal*). The latter has to be approved by the EPCI council with a majority, involves a long-term horizon, and deals with urban development, transportation networks, and environmental issues. EPCIs can also approve a local housing plan (*Plan Local d'Habitat*) which establishes the objectives for housing investments over six years, both for private and social housing. Finally, the EPCI can take control of building permit granting: In this case, it is not the mayors, but the president of the EPCI, that grants building permits.

The law of 24 mars 2014 (*Loi Accès au Logement et Urbanisme Rénové*) reinforced the role of the EPCI in urban planning, setting the automatic transfer of the decision-making power over the local land use plan to the EPCI. However, the law also gave the possibility to a minority of municipalities to oppose the automatic transfer of this decision-making power. The minority had to represent at least 20%

⁴Between 2014 and 2019, there has been a significant drop in the number of municipalities due to mergers. In January 2014, there were 36,681 municipalities. In January 2019, there were 34,968. However, this was not enough to bring the number of municipalities in France to other countries' standards. For example, a more populous country such as Germany had 10,848 municipalities in 2019.

⁵There are few exceptions such as some municipalities in the Paris region that were given 2 more years before integrating an EPCI.

of the municipalities in the EPCI and at least 20% of its population. Hence, even a relatively small coalition of municipalities could oppose the automatic transfer, and this point stresses the importance of voting power within the EPCI. In December 2019, 631 out of 1255 EPCIs (50,3%) had decision-making power over urban planning.⁶ In the last years there has been a tendency to approve a local land use plan, but this is still an ongoing process that often encounters a fierce opposition.

3.2 Procedure to determine the delegates allocation

Before 2014, EPCIs had much flexibility in deciding how to allocate delegates among municipalities. For instance, some EPCIs established an egalitarian criterion, allocating the same number of delegates to all municipalities without considering their relative size. In other cases, a strict population criterion was chosen so that the number of seats in one municipality was proportional to its population. In all cases, no municipality could obtain the majority of seats, and all municipalities had to be represented by at least one delegate.

The situation changed with the law of December 16, 2010, which fixed a general rule that was applied in 2014. According to this law, each EPCI's total number of delegates depended on its population, and the distribution of delegates within the EPCI followed Jefferson's apportionment method (for more details, see appendix B.1).⁷ As a result, each municipalities' delegates number depended fairly straightly on its population share in the EPCI leading to a power balance in favor of larger cities⁸ (Abidi et al., 2020). Finally, since 2014 citizens vote for their municipality's delegates at the municipal elections every six years. This strengthens the democratic link between the delegates' choices and their constituency's preferences.

⁶For more details, <http://www.club-plui.logement.gouv.fr/deploiement-des-plui-en-france-au-31-decembre-2018-a554.html>

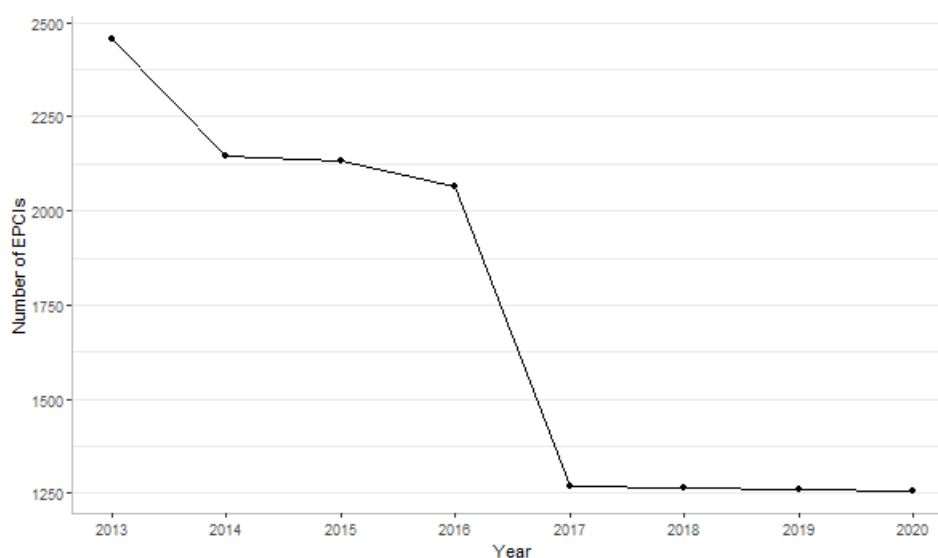
⁷The change in the delegates' apportionment method caused by the law could have been exploited as an exogenous variation of the voting power. However, data on the delegates' distributions before 2014 is not readily available. When it is available, the data is often not reliable as it can only be extrapolated from the minutes of the EPCIs' councils that can contain major mistakes (Abidi et al., 2020).

⁸Figure B.1 in the appendix shows the positive correlation between the municipality population share in the EPCI and the number of its delegates in 2014

3.3 Sources of exogenous change in representation

The first and major source of exogenous change originates from the 2015 Law⁹, with which the central government set a minimum population threshold for each EPCI. From 2016, all EPCIs needed to regroup a population of at least 15,000 inhabitants. In practice, this forced many EPCIs to expand by merging with other EPCIs or including new municipalities between 2016 and 2017. This led to a drastic decrease in the number of EPCIs, as shown in figure 2.1. In 2016, there were 2063 EPCIs, while in 2017, 1267. This change affected the representation of each municipality as new councils were formed.

Figure 2.1: Evolution of EPCI number



The second source of change arose from a change in the apportionment method. The 2010 Law gave the least dense types of EPCIs (*Communautés de Communes* and *Communautés d'agglomération*) the possibility to opt out of the general apportionment method in 2014. These EPCIs could base the delegates' allocation on a local agreement if a qualified majority in the council was reached. However, the constitutional court declared these local agreements unconstitutional on June 20, 2014 as they did not guarantee a proportionality between municipalities' population and the number of delegates. In practice, bigger municipalities could obtain a lower number of delegates per capita than smaller municipalities in the same EPCI.

⁹The *Loi portant nouvelle organisation territoriale de la République*

According to the Constitutional Court, this went against the principle of people's equality in elections, as citizens of bigger municipalities were less represented than citizens in smaller municipalities. The government reintroduced the possibility of setting a local agreement, though also adding some strict central guidelines.

The result of this policy change is that between 2014 and 2019, some EPCIs had to reallocate delegates to comply with the new rules only if two conditions were satisfied: *i)* the previous local agreement did not respect the aforementioned proportionality criterion and *ii)* elections were called in at least one municipality in the EPCI because the previous election results were canceled.

As an example, table C.1 shows the change in delegates' allocation in the EPCI *Pays de L'Or*. As in many EPCIs, a local agreement was stipulated to allocate delegates with the aim of balancing the voting power of big and small municipalities. However, after the Constitutional Court decision, the allocation had to change. Indeed, the general population criterion was not respected, and there has been an election in one municipality (*Palavas Les Flots*) leading to an increase in representation of the central municipality (Mauguio) and a loss in representation for smaller municipalities.

The previous example shows what has been the general effect of the reform: given that local agreements were mostly conceived to allocate more delegates to smaller municipalities, the reform in practice increased the voting power of bigger municipalities while only slightly decreasing the number of delegates of smaller municipalities (there were already few). In the analysis section, I show that the average effect of the reform on the voting power index is indeed positive.

Table 2.1: Delegates allocation in the EPCI *Pays de l'Or*

Municipality	Delegates number in 2014	Delegates number in 2015
Mauguio	10	16
La Grande Motte	8	8
Palavas Les Flots	7	6
Saint Aunes	4	3
Lansargues	3	3
Mudaison	3	3
Valergues	3	2
Candillargues	3	2

These central government reforms allow me to study plausible *exogenous* shocks in municipalities' representation in the inter-municipal council. However, some

caveats must be underlined. First, mergers and expansions altered the representation of each municipality but also the entire institutional setting of the newly born EPCIs. It is challenging to disentangle the two effects. Second, the Constitutional Court decision applied only to smaller EPCIs, so focusing only on these cases would decrease the external validity of the analysis. Third, it is challenging to clearly distinguish the effects of the two reforms, as many EPCIs were affected in those years by both. For this reason, in section 4.3 I argue that a fixed effect instrumental variable approach is ideal in order to capture both changes to instrument the change in voting power that most municipalities faced during this period.

4 Data and empirical strategy

4.1 Sample and variables of interest

My dataset includes French municipalities within the densest types of EPCI, the *métropoles*, the *communautés urbaines* or the *communautés d'agglomération*, between 2014 and 2019. I exclude municipalities in the *communautés de communes* as they are mostly located in rural areas where urban development is almost absent (see table B.1 in the appendix for a comparison among EPCI types). Further, I do not consider municipalities in the Corsica region, municipalities that merged, and municipalities that moved from a *communauté de communes* to a denser EPCI type during the 2014-2019 period. The resulting balanced data sample consists of 24,678 observations over the 2014-2019 period, that is, 2742 municipalities in a 9-year period. The total population size of my sample amounts to 43% of the total French population in 2019.

The data on building permits have been collected on the website of the French Ministry of Sustainable Development (`sit@del2` database). This database includes the building permits granted by all French municipalities each year. This data allows me to distinguish permits for single-family units and permits for multi-family units.¹⁰ In this paper, I focus on the granted building permits since this is a direct choice of each municipality mayor. Thus, the data is not biased by any delay between the project approval and its actual beginning. Furthermore, I also consider the

¹⁰I sum permits for single-family housing and permits for grouped single-family housing. This gives me a proxy for low-density development. A multi-family unit is defined as being part of a building with at least two residential units where some units do not have a private entrance.

building permits granted for public structures (research facilities, libraries, etc.) for additional analysis. However, for public structures, the data do not contain the number of permits but the surface in meter squared authorized.

All the socio-demographic variables at the municipality level have been collected from the censuses conducted by the French National Institute of Statistics and Economic Studies (INSEE), while the data on income *per capita* has been gathered on the French Ministry of Finance website. The area in squared kilometers and the coordinates of the centroid of each municipality have been collected from the *Institut National de l'Information Géographique et Forestière* (IGN). With the latter, I compute the Euclidean distance between the EPCI most populous municipality and the rest of the municipalities. Finally, I collected information about the decision-making powers of each EPCI from the database BANATIC, which is a national database providing information about EPCIs.

4.2 The Banzhaf Index

Municipalities' number of delegates in the inter-municipal council can be considered as a voting weight. Thus, municipalities that have more delegates have a higher voting weight than municipalities with fewer delegates. However, increasing a municipality's weight does not directly translate into higher voting power. In order to understand this point, let us consider, for instance, a 2-municipality EPCI in which one municipality has 90 delegates while the other has only 10 delegates. In this case, increasing the number of delegates of the latter by one will increase its voting weight but not its relevance. Indeed, the bigger municipality's delegates will always be necessary in order to reach a majority and make a decision.

This idea is at the heart of the conceptual framework initially proposed by Penrose (1946) and later developed by Banzhaf III (1964) to study collective decision-making. In particular, the Penrose index, also known as the non-normalized Banzhaf index, indicates how many times a municipality is decisive in a majority vote if all possible coalitions were to be considered equally likely to arise. A municipality is considered decisive if a hypothetical majority cannot be reached without its votes. In the same vein, the normalized Banzhaf index is computed as the ratio of the number of times in which a municipality is decisive in order to reach the majority over the number of winning coalitions.

The application to my case is straightforward: My dataset includes the number

of delegates per municipality in the EPCI councils. This data has been collected from the administrative acts of the *préfectures* of each French department.¹¹ I then coded an algorithm that follows the method developed by Leech (2003) using the software R to compute the Banzhaf index for each municipality in different years. The more frequently a municipality is decisive to reach the majority (50%+1 of votes), the higher its Banzhaf index value. In the main analysis, I employ the normalized Banzhaf index, but in a robustness check, I also consider the Penrose index.

By using the Banzhaf index, I obtain a proxy of each municipality's relative power, which depends both on the number of delegates, the total number of delegates in the EPCI, and their distribution among other municipalities. I argue that focusing, for instance, on the simple number of delegates would not be sufficient: a merger could lead a municipality to gain in terms of delegate number and to lose influence as it ends up in a bigger and more heterogeneous inter-municipality. Nevertheless, in the appendix, I consider different measures of municipalities' influence in the inter-municipality, such as the simple number of delegates and the ratio of delegates number over the sum of delegates in an EPCI.

Table 2.2 shows the summary statistics of the main variables. It is worth noticing a few facts. Firstly, the number of delegates per municipality shows a high variation and a right skewed distribution. This reflects the clustering of the population in few central municipalities. This partly explains why even the Banzhaf index is skewed to the right, with many municipalities having a voting power close or equal to zero. Secondly, 60% of municipalities are in an EPCI that had to expand due to the central government reform, while only 18% had to reallocate delegates following the constitutional court decision. This difference highlights how EPCIs' extensions are the major source change during this period. Thirdly, 54% of municipalities are part of an EPCI with decision-making power over urban planning and only 11% of the municipalities are in an EPCI with power over the granting of new building permits. This is a sign of how municipalities are still struggling to agree on some common rules for regulating urban development despite the central government effort to favor this process.

¹¹These documents are not always available on the website of the *préfectures*. When they were not available online, I contacted the *préfectures* by mail or by telephone to obtain the file.

Table 2.2: Summary statistics

	mean	sd	min	max
Total housing permits	44.5	192.5	0	7803
Single family	12.5	24.8	0	711
Multi-family	32.1	177.8	0	7473
Delegates	2.75	5.59	1	108
Banzhaf	0.037	0.15	0	1
Extension	0.60	0.49	0	1
Salbris	0.18	0.38	0	1
Population	6878.6	25250.3	20	870731
Area	15.3	20.6	0.11	758.2
Density	607.3	1565.8	1.33	26014.5
Distance from central city	10.1	6.56	0	71.7
Share homeowners	0.63	0.15	0.046	0.94
Income per capita	28722.2	8015.1	10735.2	131597.7
Urban	0.52	0.50	0	1
EPCI:Métropole	0.079	0.27	0	1
EPCI:Communauté urbaine	0.15	0.36	0	1
EPCI:Communauté d'agglomération	0.77	0.42	0	1
EPCI with competence PLUi	0.51	0.50	0	1
EPCI with competence Building permits	0.11	0.31	0	1

Notes: The variables refer to the 2014-2019 period. The socio-demographic variables were collected from the INSEE census while the income per-capita has been computed from the tax records data of the French Ministry of Finance. *Area* represents the municipality area in Km^2 . *Distance from central city* represents the Euclidean distance in Km from the highest population municipality in the EPCI to the centroid of the municipality.

4.3 Empirical strategy

The major empirical concern is the endogeneity of the Banzhaf index, as the number of delegates per municipality depends on its population share within the EPCI. Moreover, the decision to join an EPCI is endogenous, meaning that municipalities could decide to join an EPCI to maximize their voting power *and* to limit the number of new constructions. To deal with this, I exploit an *exogenous* variation of voting power over the 2014-2019 period. As explained in section 2.3, there have been two changes due to the central government interventions: EPCIs' extensions and changes in the apportionment method.

A possible choice to deal with endogeneity would be to exploit the fact that EPCIs with a population lower than 15,000 inhabitants were forced to increase in size

by either merging with other EPCIs or welcoming new municipalities. This could provide a good regression discontinuity design setting by comparing municipalities in an EPCI with slightly fewer and slightly more than 15,000 inhabitants before the reform. However, my dataset includes only EPCIs with more than 28,000 inhabitants. In any case, focusing on smaller EPCIs would not be so appealing: This would highly reduce the generality of the results as I would focus on small municipalities in primarily rural areas.

The best option is then to exploit the two policy changes by isolating the effect of the policy changes using an instrumental variables strategy. The first stage is:

$$\begin{aligned} Banzhaf_{it} = & \alpha_0 + \alpha_1 Extension_{it} + \alpha_2 Extension_{it} \times \Delta Municipalities_i + \\ & \alpha_3 Salbris_{it} + \lambda_i + \kappa_t + X'_{it}\psi + v_{it}, \end{aligned} \quad (D.1)$$

where the dependent variable is the Banzhaf index in municipality i and in year t . I employ three instruments: First, $Extension_{it}$ is a dummy equal to one in the subsequent years after a municipality joins a larger EPCI due to the national reforms. Even if the EPCIs in my sample were not forced to merge, they were *forced* to welcome new municipalities; Second, I interact $Extension_{it}$ with $\Delta Municipalities_i$, which is the change in the number of municipalities in the EPCI after the extension. This interaction allows for heterogeneity in the impact of EPCIs' extensions on municipalities' voting power. Indeed, below I show that the voting power change is larger when the municipalities join a large newly-formed EPCI; Third, I include the dummy $Salbris_{it}$, which is equal to one when an EPCI is affected by the constitutional court decision that led to a reallocation of delegates in some EPCIs. Finally, λ_i represents municipalities' fixed effects, κ_t time fixed effects, and X_{it} is a vector of control variables such as population, income, and homeownership rate¹² that will be used in the second stage regression. Finally, v_{it} is the error term.

The second stage is:

$$NewHousing_{it} = \beta_0 + \beta_1 \widehat{Banzhaf}_{it} + \gamma_i + \phi_t + X_{it}\delta + u_{it}, \quad (D.2)$$

¹²The French national institute of statistics (INSEE) provides annual data for all socio-demographic variables since 2006. However, each year's data is computed as the consolidated data for the midpoint of 5 years. For this reason, INSEE does not recommend relying on variations over short periods. To deal with this possible noise source, in section 5, I estimate a first difference model where I consider variations in all the variables between 2014 and 2019. Results do not change.

where $NewHousing_{it}$ is the number of building permits per 10,000 inhabitants granted in municipality i and in year t . Using a standardization of the dependent variable has an advantage in terms of the interpretation of results. Further, I can avoid making any assumptions about zero-valued observations. I estimate model D.2 using both total housing permits as well as multi-family and single-family housing permits as dependent variables to differentiate high-density and low-density development.

The variable of interest is $\widehat{Banzhaf}_{it}$, which is the fitted value from the first stage. β_1 can be interpreted as the marginal effect of the voting power on new housing. In fact, the effect of higher voting power on new housing construction is, *a priori*, ambiguous. Each municipal delegate's position over urban planning will depend on their constituencies' preferences. Consequently, municipal delegates could try to foster or limit urban development to maintain local support. Finally, γ_i captures all municipality constant heterogeneity, and ϕ_t captures any shock affecting all municipalities in a given year.

The standard conditions in a two-stage least squares (2SLS) estimation are that *i*) the coefficients on the instruments in equation D.1 are significantly different from zero (*relevance*) and that *ii*) my instruments are correlated with building permits only through the *Banzhaf* variable (*exclusion restriction*). In the results section, I will show that the former condition holds. The exclusion restriction condition is not testable. In the case of the *Salbris* variable, it is plausible to argue that the policy change only affected municipalities' weight in the council as it influenced only the distribution of delegates. For EPCIs mergers, however, the exclusion restriction condition is more tricky to defend. Indeed, EPCIs' expansions altered the representation of each municipality and the entire institutional setting of the newly born EPCIs. For instance, a municipality could find itself in a different EPCI with full competence over granting building permits. In this case, the effect of *Merger* on new constructions would also be transmitted through this regulatory change. Moreover, a municipality joining a new EPCI could have diverging political affiliations with the most important municipalities in the new EPCI. To deal with this, in the appendix, I run additional regressions where I include the competencies of the EPCIs to capture changes in regulations and a variable capturing the change in political alignment between each municipality and the president of the EPCI. More details on these robustness checks are given in section 6.

In addition to the primary analysis with the number of building permits per

capita outcome variable, I estimate a conditional Poisson regression model using the count of building permits as dependent variable. Indeed, building permits represent a count variable, namely a non-negative discrete variable. In this case, a count data model is needed (Cameron and Trivedi, 2013). To control for endogeneity, I adopt the control-function approach outlined in Lin and Wooldridge (2019) and include the residuals from the estimation of Eq. D.1 into a second-stage conditional Poisson model. The results (in the appendix) are qualitatively similar to my primary analysis with the number of building permits per 10,000 inhabitants, below. However, this alternative approach raises some concerns, namely coefficient interpretability and goodness of fit.¹³

5 Baseline results

5.1 Ordinary Least Squares Results

Table 2.3 shows fixed effect OLS results from estimating model D.2 *without* instrumenting the Banzhaf index variable when I consider the sum of all building permits (column (1)), the number of single family permits (column 2) and multi-family permits (column (3)). I find the Banzhaf index has a negative and significant effect of the number of total permits. This effect is driven by the impact on multi-family permits while there is no impact on the number of single-family permits. This might suggest that delegates can push for less high-density development in their respective municipalities. A standard deviation increase in *Banzhaf* is associated with a decrease of 5.5 apartment permits per year in a municipality of 10,000 people. However, this estimation can be biased by the fact that during the period there have been changes in EPCIs' compositions due to municipalities' voluntary decisions (mostly voluntary departures or joining of municipalities and municipalities' mergers). These concerns justify the use an instrumental variable approach by exploiting the changes that are due solely to the policy changes discussed in section 3.3.

¹³For a discussion about these issues, see Schlenker and Walker (2016).

Table 2.3: OLS FE

	(1)	(2)	(3)
	Total permits	Single family	Multi-family
Banzhaf	-35.62*** (13.21)	1.325 (4.328)	-36.95*** (12.69)
log(Population)	-311.4*** (40.89)	-238.7*** (25.62)	-72.69*** (23.31)
log(Income per capita)	24.04** (11.63)	7.842 (7.282)	16.20** (7.504)
Share homeowners	102.7* (61.99)	26.33 (35.84)	76.41* (40.46)
Observations	24678	24678	24678
S.e. clustering	Municipality	Municipality	Municipality
Municipality FE	✓	✓	✓
Year FE	✓	✓	✓
R-squared	0.0225	0.0286	0.00600

Notes: This table reports OLS regressions of the number of building permits per 10,000 inhabitants on the Banzhaf index for French municipalities from 2014 to 2019. Standard errors clustered at the municipality level in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

5.2 IV Results

First stage I begin by discussing the estimation of the first stage displayed in table 2.4. The effect of EPCIs' extensions in the first column is negative as expected and statistically significant. Mergers and extensions led, on average, to a decrease in voting power. In the second column, I include the interaction term between the extension dummy and the number of municipalities in the newly formed EPCI. In order to have a meaningful interpretation of the coefficient on *Merger*, I subtract the population mean value of Δ *Municipalities* in the interaction term. This way, the coefficient on *Extension* represents its effect at the mean value of Δ *Municipalities*. The interaction term coefficient is negative, meaning that municipalities ending up in larger EPCIs have a bigger loss in voting power. Moreover, the R-squared increase from 0.04 to 0.234, meaning that the addition of the interaction term improves the fit of the regression. Finally, the coefficient on the *Salrbis* variable is positive, which is

consistent with the fact that the net gainers of the constitutional court decision were the larger municipalities in the EPCIs which obtained a representation proportional to their population size. In all regressions, the Kleibergen-Paap first stage Wald F statistics indicate that the instruments meet the criteria for being a strong instrument (Staiger and Stock, 1994).

Table 2.4: OLS FE - First stage

	(1)	(2)	(3)
	Banzhaf	Banzhaf	Banzhaf
Extension	-0.0146*** (0.00146)	-0.00527*** (0.000949)	-0.00495*** (0.000922)
Extension $\times \Delta$ Municipalities		-0.00120*** (0.000109)	-0.00120*** (0.000108)
Salbris			0.00416*** (0.00133)
Observations	24678	24678	24678
S.e. clustering	Municipality	Municipality	Municipality
Municipality FE	✓	✓	✓
Year FE	✓	✓	✓
R-squared	0.0408	0.234	0.235
F stat	12.88	16.27	14.85

Notes: This table reports the first stage regression where the dependent variable is the Banzhaf index for French municipalities from 2014 to 2019. Standard errors clustered at the municipality level in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Second stage Table 2.5 reports the estimates for model D.2 when I instrument the Banzhaf index by all the instruments. In column (1) the coefficient on Banzhaf index is negative but not significant. When I consider single-family houses as dependent variable, the coefficient turns positive and significant at the 10% level. Finally, when the dependent variable is multi-family permits, the coefficient on *Banzhaf* is negative, highly significant and higher compared the OLS regression shown in table 2.3. In terms of magnitude, a standard deviation increase of the Banzhaf index leads to an increase of 6.3 (16.7%) single-family permits per 10,000 inhabitants and a decrease of 11.9 (61%) apartment units per 10,000 inhabitants. These results suggest

that delegates limit high density development and promote low-density constructions in their municipalities. A possible reason is that multi-family buildings are more likely to be negatively perceived by the local population as they bring higher density urban development.¹⁴ Moreover, single-family units are mainly purchased by higher-income households, that are less likely to be considered as undesired newcomers.

Table 2.5: IV Results - Second stage

	(1)	(2)	(3)
	Total permits	Single family	Multi-family
Banzhaf	-37.30 (37.01)	42.21* (23.68)	-79.50*** (27.01)
log(Population)	-311.4*** (40.74)	-238.0*** (25.57)	-73.45*** (23.23)
log(Income per capita)	24.04** (11.63)	7.819 (7.287)	16.22** (7.501)
Share homeowners	102.8* (61.87)	24.90 (35.80)	77.90* (40.46)
Observations	24678	24678	24678
Municipality FE	✓	✓	✓
Year FE	✓	✓	✓

Notes: This table reports IV regressions of the number of building permits per 10,000 inhabitants on the Banzhaf index for French municipalities from 2014 to 2019. Standard errors clustered at the municipality level in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

5.3 Heterogeneity analysis

Interpreting the effect of voting power rests on the assumptions on delegates' behavior. Given that delegates are directly elected in municipal elections and they often hold two different offices (in the municipality *and* in the EPCI), the electoral

¹⁴Using a conjoint survey experiment in the US, Trounstein (2021) finds that, compared to single family housing, multifamily buildings are perceived as decreasing property values, increasing crime rates, lowering school quality, increasing traffic and decreasing desirability.

constraint is likely to bind their positions to local preferences. To explore this idea, I account for the heterogeneity of the main effect by running the main regression in sub-samples. I consider municipalities above and below the housing density (number of buildings/municipality’s area) and the median homeownership rate. These two variables proxy local resistance to new constructions. The idea is that more densely built communities are more likely to be adverse to new constructions as housing demand and congestion costs are high. Moreover, homeowners are averse to development as they want to protect the value of their house (Fischel, 2005). The idea is that, if delegates’ positions are actually “demand-driven”, then the effect of the voting power variable should be larger where resistance to new housing constructions is stronger.

Results for the heterogeneity analysis with respect to housing density are reported in table 2.6: as expected, the coefficient on *Banzhaf* is larger in denser municipalities when I consider both single-family and multi-family permits. However, the effect is significant for single-family permits (at the 5% level) and only slightly significant for multi-family permits (at the 10% level). The results are similar when in table 2.7 I analyze the heterogeneity of the effect with respect to the municipality’s homeownership rate. When I consider municipalities with a high homeownership rate, the Banzhaf index’s effect is larger for single-family and multi-family permits, although it is not significant.¹⁵ Overall, these results do not bring conclusive evidence of heterogeneity in the effect of municipalities’ voting power.

5.4 Additional results

In the previous section, I discussed the effect of voting power on new constructions, highlighting the difference between single-family and multi-family buildings. I interpret these results as “revealed preferences” of delegates and their constituency for/against low-density/high-density development. Here, I explore a different construction type to corroborate this idea. Table B.3 in the appendix reports the results of estimating model D.2 by using the permits granted for building for public purposes.¹⁶ I can distinguish buildings for cultural activities (libraries, theaters), social

¹⁵Note that when I consider municipalities below the median building density and above the homeownership rate, there are not many new constructions. This makes the estimation less precise, which becomes apparent by looking at the standard errors.

¹⁶Either public or private organizations manage these facilities.

Table 2.6: IV regression - Heterogeneity analysis

	< median density			> median density		
	(1) Total permits	(2) Single family	(3) Multi-family	(4) Total permits	(5) Single family	(6) Multi-family
Banzhaf	2.993 (1100.0)	28.20 (963.3)	-25.21 (482.4)	-2.096 (31.83)	44.39*** (14.23)	-46.48* (26.79)
log(Population)	-256.7*** (44.13)	-228.1*** (36.99)	-28.54** (13.68)	-416.5*** (71.82)	-259.1*** (31.59)	-157.5*** (50.83)
log(Income per capita)	14.66 (11.32)	9.122 (8.316)	5.534 (6.647)	42.97 (27.22)	4.016 (14.39)	38.95** (18.73)
Share homeowners	95.49 (69.82)	20.81 (50.17)	74.68** (32.69)	121.1 (106.0)	38.31 (53.77)	82.75 (82.45)
Municipality FE	✓	✓	✓	✓	✓	✓
Time FE	✓	✓	✓	✓	✓	✓
Observations	12342	12342	12342	12336	12336	12336

Notes: This table reports IV regressions of the number of building permits per 10,000 inhabitants on the Banzhaf index for French municipalities from 2014 to 2019. Standard errors clustered at the municipality level in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 2.7: IV regression - Heterogeneity analysis

	< median homeownership rate			> median homeownership rate		
	(1) Total permits	(2) Single family	(3) Multi-family	(4) Total permits	(5) Single family	(6) Multi-family
Banzhaf	-44.63 (30.02)	12.88 (12.81)	-57.51** (26.06)	487.9 (602.6)	821.5 (535.5)	-333.6 (271.2)
log(Population)	-212.2*** (68.06)	-160.5*** (30.77)	-51.63 (44.45)	-407.8*** (51.58)	-317.0*** (40.80)	-90.86*** (21.54)
log(Income per capita)	42.25** (18.54)	21.92** (10.72)	20.32* (11.96)	8.204 (14.76)	-5.205 (9.644)	13.41 (9.693)
Share homeowners	127.6 (102.3)	70.10 (54.35)	57.47 (61.56)	36.52 (79.77)	-46.66 (50.42)	83.18 (57.96)
Municipality FE	✓	✓	✓	✓	✓	✓
Time FE	✓	✓	✓	✓	✓	✓
Observations	12342	12342	12342	12336	12336	12336

Notes: This table reports IV regressions of the number of building permits per 10,000 inhabitants on the Banzhaf index for French municipalities from 2014 to 2019. Standard errors clustered at the municipality level in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

structures (childcare, vocational guidance, accommodation for the disabled, young workers' homes), teaching and research (schools, universities, institutes), health

(hospitals) and special structures (for instance power plants). These buildings are less likely to be perceived negatively by the local population. I find that voting power increases the surface (m² *per capita*) allowed for public buildings, and the effect is driven by health facilities and only slightly by transportation facilities. However, in all cases the coefficients are not significant.

6 Robustness Checks

In this section I present a battery of robustness checks in order to test the validity of my results. All tables and figures are relegated in the appendix.

Different measures of voting power. To test the robustness of my baseline results to different definitions of voting power, table B.4 shows the full regression where I consider different indexes. In column (1), (4) and (7) I employ the Penrose index, that is, the non-normalized Banzhaf index, which represents the number of times in which a municipality is decisive to reach majority over the sum of all possible coalitions in an EPCI. In column (2), (5) and (8), I consider the number of municipal delegates. In column (3), (6) and (9), I use the ratio between each municipality's delegates number and the total number of delegates within the EPCI. In all cases the main results are confirmed: When I consider the total number of permits, my proxies do not have an impact. In the case of single-family permits, the effect is positive and significant. Finally, the effect of all proxies is negative and significant when the dependent variable is the number of multi-family permits.

Political alignment. Political connections are likely to influence the distribution of new constructions. For instance, Magontier et al. (2021) find that Spanish municipalities aligned with the majority of municipalities in a coastal area tend to develop less land. This is interpreted as the fact that municipalities sharing the same ideology internalize the negative externalities generated by the development of coastal areas, thus reducing new buildings. In my case, the EPCIs extensions could have led to new political networks within the newly born EPCI influencing the granting of new building permits. Hence the *strict exogeneity* restriction would be violated, as my instrument would be correlated with the error term in the second stage. Therefore, I add to the analysis an additional variable, *Aligned*, which is equal to 1 when the municipality's mayor is part of the same political group of the mayor

of the central municipality of the EPCI, who in most cases is also the president of the EPCI.¹⁷ Table (B.2) shows that the coefficient on *Aligned* is negative, although not significant. The effect of the Banzhaf variable is still positive for single-family permits and negative for multi-family permits.

Change in regulations at the EPCI level. Consistently estimating the coefficient on the Banzhaf index requires the instruments to be correlated with building permits only through their effect on Banzhaf. My instrument *Merger* could violate this condition, as mergers did not only change the relative power of each municipality within the newly formed EPCI, but also the set of rules and urban regulations to which the municipalities need to abide. There could be, therefore, a direct effect on new construction. To deal with this potential omitted variable bias, in table B.8 I run the main regressions by including two new variables, a dummy equal to one if the EPCI has the competence over the regulations and zero otherwise; and a dummy equal to one if it is the president of the EPCI who grants building permits (details for the competences of EPCIs in section 3).¹⁸ As it is a fixed effect setting, I am exploiting the within-municipalities change in EPCIs rules. Also in this case, the main results remain unaltered.

First differenced regressions. Table B.6 reports the first differenced estimates where all variables represent the change in level between 2014 and 2019. In columns (1)-(3) I run a simple OLS while in columns (4)-(6) I instrument the variation of the Banzhaf index by using the same instruments as in model D.1. The aim of this robustness exercise is to avoid any measurement error bias caused by the census data collection process (details in section (4)) and to test a different specification. When I consider total housing permits and single family permits, the coefficient on the Banzhaf index is positive, although not significant. The same coefficient turns negative and highly significant when I consider multi-family permits. This confirms the results of the main analysis, highlighting how delegates influence in the council limits new high-density constructions.

¹⁷This analysis involves a loss in observations due to the fact that the data on political affiliation of local policymakers is collected only for municipalities with more than 1000 inhabitants.

¹⁸Unfortunately, data about inter-municipal regulations are not centralized, so that I can only identify if a municipality can set some regulations but not if it actually did it.

Municipalities forced to integrate an EPCI from 2010. Tricaud (2021) finds that those municipalities that were forced to join an ECPI before 2014 saw a drastic increase in building permits. I then test if the effect I find is driven by these municipalities as they are the most incentivized to use their voting power to avoid any additional construction. In table B.5 I report the results of my main analysis when I consider both those municipalities that were not forced to integrate and those municipalities that were forced to integrate. In order to distinguish the two groups, I use the same method of Tricaud (2021) who considers a municipality to have been forced if it was not already integrated in an EPCI in 2010. Indeed, in the subsequent period the central government law pushed all municipalities to cooperate. The effect of *Banzhaf* is in line with the main estimations and significant only for municipalities that were not forced to integrate an EPCI. When I consider only forced municipalities, the coefficient on *Banzhaf* is not significant. These results confirm that the main effect is not driven by any “forced” integration.

7 Conclusion

This paper investigates how the distribution of voting power in an inter-municipal council influences building permits granting in cooperating municipalities. With this purpose, I collected a new dataset including the number of delegates per municipality in French inter-municipal communities between 2014 and 2019. Using this data, I computed the Banzhaf index for each municipality, providing a measure of voting power. In order to deal with the endogeneity of the Banzhaf index, I exploit two different policy chances as plausible exogenous shocks on voting power by using an IV approach. Between 2014 and 2019, *i*) some EPCIs had to extend their perimeter and *ii*) some EPCIs had to change the allocation of delegates among municipalities.

This paper presents evidence that a higher voting power translates to more building permits for single-family housing and fewer multi-family permits. I also find that both effects are larger in high-density municipalities, although results are not conclusive. Finally, I do not find evidence for a variation of the effect of voting power with respect to the homeownership rate. Overall, these results suggest that delegates convey the preferences of their constituency in the inter-municipal council, as they limit high-density development which is more likely to be perceived negatively by the local population and increase low-density development which is more accepted.

Some limitations of the present study must be emphasized in the perspective of future research. First, voting power indexes rest on a critical assumption: the homogeneity of municipalities' delegates. Stated differently, it is assumed that delegates act in the same manner and compact in the inter-municipal council. This assumption is probably realistic in small municipalities, where few delegates represent a homogeneous community. On the contrary, bigger municipalities elect several delegates who are often part of different parties. One possible avenue for future research would be considering how the heterogeneity of delegates' ideologies and party affiliations affect the impact of the voting power variable. Second, another essential assumption to interpret the results is delegates' responsiveness to their constituencies' preferences. It would be insightful to explore this assumption's validity by analyzing how the effect of voting power on inter-municipal decision-making interacts with factors that could strengthen/distort the electoral constraint for delegates (such as the vote margin variable extensively used in the political economy literature). Third, the analysis carried out in this paper highlights the importance of voting power in decisions regarding a specific policy area, that is, urban planning. This study can be extended to other policies of interest for which bargaining will likely affect the final allocation of resources and local public goods.

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Appendix B

Municipalities' Voting Power and Housing Supply: Evidence from French Inter-municipal Cooperation

Contents

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B.1 Apportionment method

The total number of delegates in each EPCI depends on its population as shown in the following table:

EPCI Population	Delegates number
<3500	16
[3 500,4 999]	18
[5 000,9 999]	22
[10 000,19 999]	26
[20 000,29 999]	30
[30 000,39 999]	34
[40 000,49 999]	38
[50 000,74 999]	40
[75 000,99 999]	42
[100 000,149 999]	48
[150 000,199 999]	56
[200 000,249 999]	64
[250 000,349 999]	72
[350 000,499 999]	80
[500 000,699 999]	90
[700 000,1 000 000]	100
>1 000 000	130

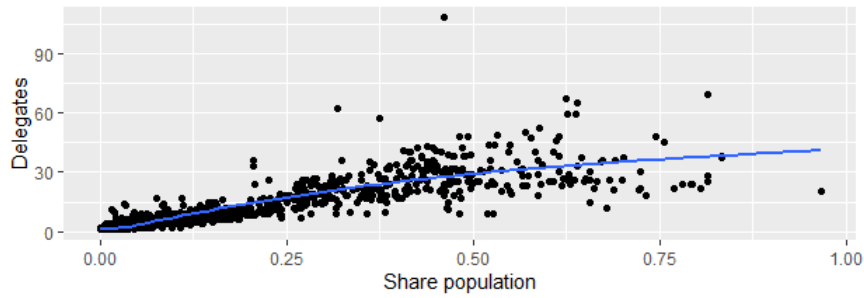
A vote could be called in the EPCI council to increase the total number of delegates of the EPCI by 10%. Delegates are then allocated following the Jefferson apportionment method:

1. The EPCI population is divided by the number of delegates to allocate, obtaining the so called divisor;
2. Each municipality population is divided by the divisor, and the resulting number is rounded down. This gives the number of delegates per municipality;
3. If the sum of the delegates allocated in the second step is lower than the number of delegates to allocate given in the above table, the remaining delegates are allocated one by one according to the highest average rule. The next delegate is allocated to the municipality with the highest $population/(delegates + 1)$ ratio.

4. If at the end of this process some municipalities still have no delegates, they are allocated one delegate.

As a result, the weight of each municipality in the EPCI council heavily depends on its population share, as showed in figure B.1.

Figure B.1: Correlation between population share and delegates number

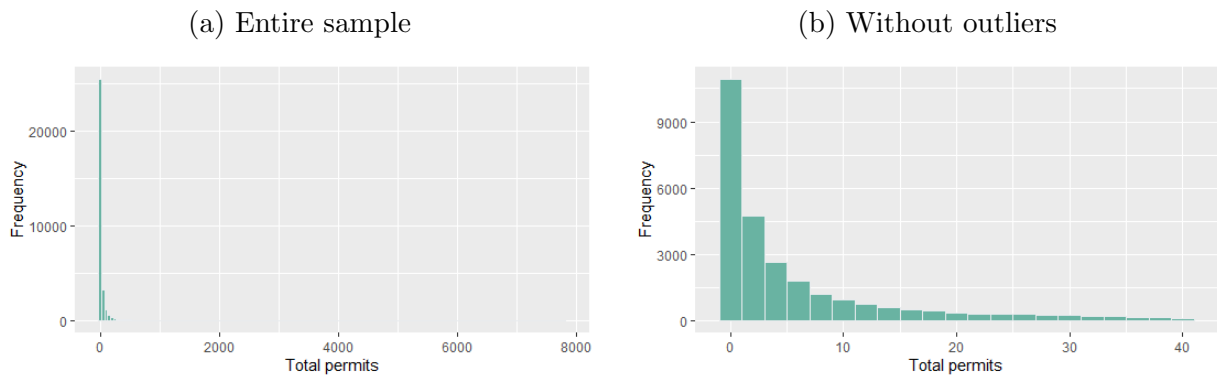


Notes: scatter plot where the variable on the x-axis is the population share of municipalities in the EPCI (population/total population EPCI) and on the y-axis is the number of delegates.

B.2 Additional figures and tables

B.2.1 Distribution of building permits

Figure B.2: Distribution of total building permits



Notes: Figure B.2a shows the distribution of the total number of building permits in the entire sample. Figure B.2b shows the same distribution excluding outliers, that is observations with total number of building permits higher than the 3 quartile.

Table B.1: Comparisons by EPCI type

	CC	CA	CU	ME
Total housing permits	4	26	33	175
Population	840	4328	6932	22469

Notes: This table shows the mean number of building permits (between 2014 and 2019) and the mean population in 2014 of all French municipalities by EPCI type. CC stands for *Communautés de Communes*, CA for *Communautés d'Agglomération*, CU for *Communautés Urbaines* and ME for *Métropoles*.

B.3 Robustness checks

Table B.2: IV regressions with Political alignment

	Total permits	Single family	Multi-family
	(1)	(2)	(3)
Banzhaf	-20.91 (34.08)	43.30*** (15.46)	-64.21** (28.81)
Aligned	-7.966 (6.638)	-2.635 (2.341)	-5.331 (5.905)
log(Population)	-377.4*** (63.85)	-246.1*** (27.97)	-131.3*** (44.66)
log(Income per capita)	58.37** (25.75)	8.449 (12.80)	49.92*** (18.50)
Share homeowners	125.4 (91.30)	38.33 (47.19)	87.11 (70.08)
Region FE	✓	✓	✓
Time FE	✓	✓	✓
Observations	14976	14976	14976

Notes: This table reports IV regressions of the number of building permits per 10,000 inhabitants on the Banzhaf index for French municipalities from 2014 to 2019. *Aligned* is a dummy variable equal to one if the municipality's mayor has the same political color of the president of the EPCI. Municipalities with less than 1000 inhabitants are excluded as data on their mayor's political affiliation are not published by law. Standard errors clustered at the municipality level in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.3: Effect on public buildings

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Public Buildings	Culture	Social	Research	Health	Transportation	Special Constructions
Banzhaf	0.778 (0.649)	-0.0179 (0.0379)	-0.0196 (0.0378)	0.0942 (0.0987)	0.637 (0.630)	0.0848 (0.126)	-0.000486 (0.0477)
log(Population)	-0.721 (0.729)	0.0196 (0.0370)	-0.00866 (0.0201)	0.0697 (0.0429)	-0.757 (0.730)	-0.0132 (0.00812)	-0.0310 (0.0451)
log(Income per capita)	0.0869 (0.142)	-0.0273 (0.0193)	0.0170** (0.00796)	-0.0492* (0.0293)	0.169 (0.138)	0.00142 (0.00521)	-0.0241 (0.0252)
Share homeowners	1.690 (1.386)	0.0386 (0.113)	-0.0260 (0.0361)	0.102 (0.137)	1.291 (1.352)	0.00996 (0.0367)	0.275 (0.303)
Observations	24678	24678	24678	24678	24678	24678	24678
Municipality FE	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓	✓

Notes: This table reports IV regressions of the number of building permits per 10,000 inhabitants on the Banzhaf index for French municipalities from 2014 to 2019. The dependent variables are the m^2 allowed for buildings for public purposes. Standard errors clustered at the municipality level in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.4: Different measures for municipalities' influence

	Tot permits			Single family			Multi-family		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Penrose Index	-21.74 (23.78)			31.90** (14.59)			-53.64*** (17.24)		
log(Population)	-311.3*** (17.06)	-311.6*** (17.07)	-311.1*** (17.05)	-237.8*** (10.47)	-237.6*** (10.48)	-238.3*** (10.46)	-73.54*** (12.37)	-74.05*** (12.38)	-72.78*** (12.36)
log(Income per capita)	24.05** (11.03)	23.94** (11.03)	24.17** (11.03)	7.803 (6.764)	7.943 (6.765)	7.671 (6.764)	16.25** (7.992)	16.00** (7.994)	16.50** (7.992)
Share homeowners	102.8*** (36.33)	102.8*** (36.32)	103.0*** (36.33)	24.44 (22.29)	24.78 (22.28)	24.65 (22.28)	78.38*** (26.33)	77.99*** (26.33)	78.32*** (26.33)
Delegates		-0.819 (0.814)			1.035** (0.499)			-1.855*** (0.590)	
Delegates/Delegates EPCI			-34.77 (33.56)			40.85** (20.59)			-75.62*** (24.32)
Municipality FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
Time FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	24678	24678	24678	24678	24678	24678	24678	24678	24678

Notes: This table reports IV regressions of the number of building permits per 10,000 inhabitants on the Banzhaf index for French municipalities from 2014 to 2019. Standard errors clustered at the municipality level in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.5: Municipalities forced to join an EPCI

	Forced			Not forced		
	(1)	(2)	(3)	(4)	(5)	(6)
	Total permits	Single family	Multi-family	Total permits	Single family	Multi-family
Banzhaf	2.368 (93.09)	65.21 (47.43)	-62.84 (73.89)	-39.16 (40.25)	41.69 (26.56)	-80.85*** (28.65)
log(Population)	-68.97 (138.7)	-113.1* (63.91)	44.15 (103.2)	-323.2*** (42.16)	-243.8*** (26.57)	-79.46*** (23.92)
log(Income per capita)	-32.56 (51.34)	-17.34 (30.79)	-15.22 (34.91)	27.10** (11.97)	9.171 (7.493)	17.93** (7.710)
Share homeowners	512.7 (408.8)	21.53 (173.8)	491.2* (266.0)	74.53 (59.85)	24.22 (36.39)	50.31 (38.71)
Observations	1068	1068	1068	23610	23610	23610
Municipality FE	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓

Notes: This table reports IV regressions of the number of building permits per 10,000 inhabitants on the Banzhaf index for French municipalities from 2014 to 2019. *Forced* indicates whether a municipality was not already part of an EPCI before 2010, therefore needing to join an EPCI after 2010 because of the policy change. Standard errors clustered at the municipality level in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.6: First difference regressions

	OLS			IV		
	(1)	(2)	(3)	(4)	(5)	(6)
Δ Banzhaf	Δ Permits -139.8* (83.94)	Δ Single family 6.317 (8.494)	Δ Multi-family -146.1* (84.83)	Δ Permits 8.894 (179.2)	Δ Single family 7.779 (11.66)	Δ Multi-family -385.4*** (144.8)
Δ Population	-0.0107 (0.0100)	-0.0000288 (0.000694)	-0.0106 (0.0103)	-0.00945 (0.00991)	-0.0000168 (0.000708)	-0.0126 (0.0104)
Δ Income per capita	0.000245 (0.000300)	-0.0000548 (0.0000583)	0.000300 (0.000290)	0.000280 (0.000307)	-0.0000545 (0.0000585)	0.000243 (0.000303)
Δ Share Homeowners	18.12 (38.95)	2.821 (8.617)	15.30 (37.13)	14.06 (40.23)	2.781 (8.632)	21.83 (37.64)
Observations	4113	4113	4113	4113	4113	4113

Notes: The dependent variable Δ Permits is the difference between the number of permits between 2019 and 2014. Similarly, Δ Banzhaf is the difference in the Banzhaf index between 2019 and 2014. All the other variables' variations represent their value change between 2014 and 2019. Robust standard errors in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.7: Regressions with dependent variables as a count

	FE OLS			FE Poisson		
	(1)	(2)	(3)	(4)	(5)	(6)
	Total housing permits	Single family	Multi-family	Total housing permits	Single family	Multi-family
Banzhaf	-334.9*** (34.35)	14.60** (6.434)	-349.5*** (32.87)	-0.770* (0.450)	1.408*** (0.339)	-0.944* (0.515)
log(Population)	-56.91*** (16.83)	-26.35*** (3.151)	-30.56* (16.10)	-2.393*** (0.389)	-3.436*** (0.254)	-1.741*** (0.567)
log(Income per capita)	12.47 (10.87)	0.227 (2.036)	12.24 (10.40)	0.402 (0.327)	-0.196 (0.176)	0.852 (0.540)
Share homeowners	3.210 (35.81)	2.578 (6.707)	0.632 (34.26)	-0.0901 (0.860)	-0.271 (0.551)	0.157 (1.205)
ν						
Observations	24678	24678	24678	23958	23946	12534
Municipality FE	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓

Notes: In this table the dependent variable is the number of building permits (count variable). In columns (1) to (3), I run IV regressions. In columns (4) to (6), each specification follows a control function approach by including a residual for predicted voting power from a first stage instrumental variables regression using the reforms described in section 3 as instruments. Robust standard errors in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table B.8: IV Fixed effect with EPCIs competences

	Total permits (1)	Single family (2)	Multi-family (3)
Banzhaf	-31.48 (37.15)	44.55* (23.60)	-76.04*** (27.29)
log(Population)	-311.5*** (40.74)	-238.0*** (25.57)	-73.51*** (23.23)
log(Income per capita)	23.86** (11.62)	7.723 (7.289)	16.13** (7.496)
Share homeowners	102.8* (61.86)	24.93 (35.80)	77.90* (40.46)
comp_PLUi	-0.311 (1.597)	-0.245 (1.180)	-0.0656 (0.950)
comp_permiss	5.373 (3.977)	2.496 (2.050)	2.877 (3.090)
Observations	24678	24678	24678
Municipality FE	✓	✓	✓
Year FE	✓	✓	✓

Notes: This table reports IV regressions of the number of building permits per 10000 inhabitants on the Banzhaf index for French municipalities from 2014 to 2019. *EPCI with competence PLUi* is a dummy equal to 1 if the municipality is in an EPCI with competence over the land use regulation. *EPCI with competence Building permits* is a dummy equal to 1 if the municipality is in an EPCI where the president of the EPCI grants building permits in the EPCI territory. Standard errors clustered at the municipality level in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Chapter 3

Beliefs in Merit, Trickle-Down Economics, and Preferences for Redistribution: An Experiment with the Top and Bottom 20%¹

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¹The draft corresponding to this chapter is coauthored with Gianluca Grimalda (Kiel Institute for the World Economy) and Maria Marino (Universitat de Barcelona).

1 Introduction

Economic inequality in the United States has been on the rise in the last decades at a faster rate than in other high-income countries (Chancel et al., 2021). The share of income accruing to the richest 10% of the US population rose from 34% to 48% between 1980 and 2017, while it increased from 30% to 34% in Europe (Blanchet et al., 2020). Very unequal societies pose increased risks of polarization (Stewart et al., 2020), disproportionate influence in politics by rich elites (Gilens and Page, 2014, Bartels, 2016, Cagé, 2020), falling social mobility and socio-economic opportunities (Corak, 2013), and other undesirable outcomes in health, life expectancy and erosion of social cohesion (Wilkinson et al., 2009). Inequality is also a threat to social cohesion. Individuals are likely to have a maximum level of inequality that they hold as tolerable (Alesina and Giuliano, 2011, Almås et al., 2020). If inequality exceeds such a threshold, the “social contract” on which societies rest may be under threat (Stiglitz, 2012).

Despite rising inequality in both the US and other high-income countries, demand for redistribution measured in surveys seems stagnant (Ciani et al., 2021). This pattern starkly contrasts with the predictions of the standard rational choice model of political competition in democracies (Meltzer and Richard, 1981). In this model, the income tax rate should be determined by the median voter in the income distribution. Since the median income is typically lower than the mean income, a self-interested median voter will benefit from a level of redistribution that is only limited by taxation’s negative effect on labor supply. Since the disincentivizing effect of taxation on labor supply is relatively small (Piketty et al., 2014), the equilibrium level of redistribution should lead to a much more egalitarian society than what we observe (Norton and Ariely, 2011). On the contrary, below-mean income earners often vote against redistribution (Kuziemko et al., 2015, Blanchard and Rodrik, 2021), or do not go to vote at all (Mahler et al., 2014). On the other hand, it is also surprising that many high-income earners favor some degrees of redistribution, seemingly in contrast with their self-interest (Fong, 2001, Broockman et al., 2019). It is clear that accounts based on self-interest alone are incapable of explaining such a puzzle.

In this paper, we draw on innovative experimental methods that enable us “to silence” self-interest while focusing on individuals’ sense of fairness when faced with standardized decisions of redistribution. In our experiments, participants from the

top and the bottom of the American income distribution (called *spectators*) decide how much money to redistribute from an individual earning more than \$100,000 to an individual earning less than \$10,000 (called *stakeholders*). Using conjoint analysis, we manipulate the attributes of both individuals and are thus able to tackle the following research questions: What can explain the poor's reluctance to impose high redistribution from the rich to the poor? What can explain the rich's willingness to redistribute toward the poor?

We mainly focus on two theoretical accounts. The first account stresses the rich's deservingness and the poor's undeservingness as factors of redistribution. It is well known that the belief in meritocracy leads Americans to praise the success of the rich and blame the lack of effort of the poor (McCall, 2013, Atkinson, 2016, Kim, 2021). The belief in the deservingness of the rich leads to lower demand for redistribution, as people tend to believe that higher incomes reflect higher effort (Krawczyk, 2010, Lefgren et al., 2016, Almås et al., 2020). A narrative symmetric to that of the "deserving rich" is that of the "undeserving poor" (Petersen et al., 2011, Brown-Iannuzzi et al., 2017, Alesina et al., 2018). According to this idea, the poor ultimately deserve their condition because of their lack of effort in productive activities or limited talent or skills.² Puzzlingly, despite the extensive emphasis in the literature on both aspects, a direct comparison of their relevance for preferences for redistribution has never been attempted.

A second account for the limited demand for redistribution refers to the "Trickle-down Hypothesis" (Aghion and Bolton, 1997, Stantcheva, 2021). According to this hypothesis, the increased income of the rich is deemed to be beneficial to society because the affluent can sustain economic growth and create employment. The rich (especially entrepreneurs) are seen as innovators whose discoveries benefit society as a whole. This view received strong support in a 2019 Cato report (Ekins, 2019).³ Shiller (2017) shows that the narrative on trickle-down economics is one of the most popular economic stories, even though there is scant, if not existent, evidence in favor of any trickle-down effect (Piketty et al., 2014, Gechert and Heimberger, 2022). In

²Although it is plausible that it is mainly rich people who believe in the "undeserving poor" idea, it is possible that a non-negligible portion of the poor also believe in this idea, especially if this belief is intermingled with racial antagonism (Gilens, 2009).

³65% of Americans agree that "we are all better off when people get rich" because "they invest their money in new businesses that create jobs and new technology". Moreover, the survey finds that "69% of Americans believe that people get rich by inventing new technologies or starting new businesses that improve people's lives".

spite of its intuitive appeal, the link between beliefs in the Trickle-down effect and people’s preferences for redistribution has rarely been investigated (Almås et al., 2020, Stantcheva, 2021, Hope et al., 2021).

We innovate the spectator-stakeholders framework by Almås et al. (2020) in three directions. *Firstly*, the spectators are representative of the bottom 20% and the top 20% of the income distribution. While some studies investigate redistributive preferences of the very rich (Cohn et al., 2021, Suhay et al., 2020), to the best of our knowledge, the same has not been done among the very poor. *Secondly*, the two stakeholders are a poor individual with an individual yearly income lower than \$10,000 and a rich individual with an individual yearly income higher than \$100,000. The rich stakeholder is always assigned the whole initial endowment of \$50, while the poor stakeholder is assigned \$1 so that the experimental condition is reminiscent of real-life inequality. Since we aim at disentangling beliefs of meritocracy from beliefs in trickle-down economics, the rich stakeholder is always an entrepreneur. *Thirdly*, and most importantly, we manipulate the characteristics of both the rich and the poor stakeholder by varying their real-life merit and potential for the rich’s entrepreneurial capacity “to trickle down” to the poor.

The first characteristic we manipulate is the number of working hours that the two *stakeholders* generally exert in their daily life. Indeed, one mechanism through which beliefs in meritocracy spur the legitimacy of inequality is the stylized perception of the deserving rich and the undeserving poor. The second characteristic we manipulate is whether the rich stakeholder founded or inherited the firm he or she owns. This second manipulation taps directly into the assessment of the entrepreneur’s own talent in setting up their own business. The third manipulation concerns whether the rich stakeholder’s firm provides work to less than 5 or more than 1,000 employees.

Our experimental approach enables us to measure the relevance of each theoretical account on a common scale, thus enabling us to assess their cogency. We expect that the higher the relevance of a certain characteristic for the stakeholders’ relative deservingness, the higher the share of experimental earnings that the decision-maker will allocate to stakeholders holding such a characteristic. For instance, if the merit hypothesis counts more than the trickle-down hypothesis, we should expect larger shares of the initial endowment to be left to a stakeholder who works many hours per day than to a stakeholder employing thousands of employees, *ceteris paribus*.

The remainder of the paper is organized as follows: Section 2 relates the paper

to the existing literature. Section 3 introduces the experimental design and presents our participant pools. Section 4 exposes our empirical strategy. Section 5 presents our results. Concluding remarks follow in section 6.

2 Related literature

Two strands of literature are particularly relevant to situate our contribution: the literature on demand for redistribution and the literature on the preferences of the economic elite. In this section, we briefly describe each strand, and we highlight our contributions in each case.

There is a voluminous literature on the determinants of redistribution. Such an area of inquiry has surged in reaction to the rapid increase of worldwide inequalities, which raised questions about redistributive policies (Chancel et al., 2021). So far, the existing literature relies on both large-scale questionnaires (Alesina et al., 2018, 2022, Stantcheva, 2021) as well as economic experiments (Tyran and Sausgruber, 2006, Ackert et al., 2007, Durante et al., 2014, Kerschbamer and Müller, 2020, Almås et al., 2020)⁴ to study the individual preferences towards redistribution in a variety of settings. In the experimental literature, several papers find that people tend to redistribute more when differences in initial earnings are driven by luck rather than individual effort (Grimalda et al., 2018, Almås et al., 2020, Andre, 2021). Thus, there is ample evidence of the pervasiveness of meritocratic preferences in many countries.

Our contribution to this literature is twofold: First, we focus on beliefs in meritocracy by comparing the merit of the poor and of the rich using *exactly* the same metric to measure individual effort, that is, the number of hours worked per day. We find, on the one hand, that when a low-income individual works more than 10 hours per day rather than less than 6 hours, participants tend to redistribute more towards him. On the other, when a high-income individual is described as a hard worker, people redistribute less. This is consistent with a meritocratic view of society. However, we highlight that the effect of the effort of the poor is much stronger. This suggests that Americans are more likely to praise the effort of the poor rather than the effort of the rich. Second, we add the dimension of trickle-down economics,

⁴For detailed reviews of the literature on preferences for redistribution, see Alesina and Giuliano (2011) and Mengel and Weidenholzer (2022).

which has been rarely analyzed in the literature (Stantcheva, 2021). We find no evidence of a change in redistributive choices caused by the trickle-down dimension, which is measured by the number of employees the rich stakeholder’s firm has. The trickle-down dimension has only an effect on rich liberals and moderates.

Our paper also speaks to a small and growing literature focusing on the preferences of the elite broadly defined, which encompasses political science, sociology, and economics fields (Page et al., 2013, Fisman et al., 2017, Cohn et al., 2021, Suhay et al., 2020). In particular, scholars focused on differences in beliefs in meritocracy between the elite and the rest of the population. Many studies show that affluent individuals endorse a stronger belief in meritocracy than the rest of the population⁵ (Kuusela, 2020, Atria et al., 2020, Suhay et al., 2020, Hecht, 2021), possibly because their entire education is based on the praise of individual achievements (Khan, 2011, Markovits, 2019, Piketty, 2020).⁶ Moreover, the opinions of the affluent can be biased by the motivated reasoning (Kunda, 1990), leading them to bolster their egos by focusing on their efforts and talents to explain their economic success (Suhay et al., 2020). This could suggest that high-income people are less inclined to redistribute because they see any economic success as the result of individual effort and talent.

Differently from any of the aforementioned studies, we compare the economic elite (in our case the top 20% of the income distribution) to a symmetrically opposite population, that is, individuals at the bottom of the income distribution (bottom 20%). This is an appealing exercise because we can compare the net losers (the rich) and the net gainers (the poor) of downward redistribution. We provide evidence that the richest individuals are more meritocratic. Indeed, the impact of the different merits dimensions of both the rich and poor stakeholders is stronger for rich spectators.

⁵An exception is Cohn et al. (2021), who do not find evidence of the rich being more meritocratic than the general population.

⁶As reported by Piketty (2020), the founder of Sciences Po in 1872 argued that “Obliged to submit to the law of the majority, the classes that call themselves superior can preserve their political hegemony only by invoking the law of the most capable. Because the walls of their prerogatives and tradition are crumbling, the democratic tide must be held back by a second rampart made up of brilliant and useful merits, of superiority whose prestige commands obedience, of capacities of which it would be folly for society to deprive itself”.

3 Experimental design and study sample

We now provide a description of the survey structure and a discussion of our sample. There are two types of participants in the experiment, stakeholders⁷ and spectators, who participated in two different surveys coded by us and distributed to participants by CINT.⁸

Stakeholders: We identify specific rich and poor *stakeholders* to match the profiles' description in Table 3.1. This way, we can ensure that our experimental choice does not incur deception because stakeholders with the desired characteristics are actually paid according to the spectator's decision in real life.

Among the poor, we identify both people working less than 6 hours and people working more than 10 hours per day. Differently from the poor, the rich are identified along three dimensions: They are described as either *i*) working less than 6 hours or working more than 10 hours; *ii*) having founded or inherited their business, or *iii*) owning a business with less than 5 employees or with more than 1000. To sum up, Table 3.1 displays all the possible profiles. We identify such profiles for rich and poor stakeholders by asking them a set of questions which are reported in appendix C.1.2.

Table 3.1: Attribute values for rich and poor stakeholders

The rich profile Income > \$100,000	The poor profile: Income < \$10,000
Works less than 6 hours during a week-day / Works more than 10 hours during a weekday	Works less than 6 hours during a week-day / Works more than 10 hours during a weekday
Inheritor and owner of a firm / Founder and owner of a firm	Does not own a business
The firm has less than 5 employees / The firm has more than 1000 employees	

Only rich stakeholders answer four general questions about the role of merit and luck in people's economic success (or lack of success), the evolution of inequalities, and of preferences for redistribution. By completing this task, they earn an initial

⁷As we write the present draft, the survey with stakeholders has not yet begun for technical problems. This, however, does not invalidate the results we report on spectators' choices.

⁸For information on CINT panels: <https://www.cint.com/>.

endowment of \$50. However, they are also told that the final amount of money that they will receive depends on the decision of another participant (the spectator).

The choice of the initial inequality source is inevitably *ad hoc*. We choose to explain the differences in initial endowments as the result of a task to reflect a difference in ability between rich and poor stakeholders, which possibly mirrors reality.⁹ Nonetheless, this explanation is common to all experimental conditions, so it should not influence the estimation of the treatment effects.

Spectators: We recruit a different sample to perform a redistribution task between two stakeholders identified in the first stage.¹⁰ The spectators are drawn from a sample of high-income individuals and low-income individuals (top and bottom 20%).

The spectators are informed that the high-income stakeholders earned the initial endowment by doing a job for us. Before choosing how much to redistribute between the two stakeholders, the spectator reads the profile of both stakeholders.¹¹ Different characteristics of the stakeholders are combined randomly for a total of 16 possible profiles that are administered in a within-subject design. That is, the spectator chooses 16 times for each possible combination of rich and poor profiles.¹² The profiles' order is randomized to rule out any order effect. The surveys' links, the list of questions, and an example of the redistributive task are reported in appendix C.1.

Our spectators' sample is made of 150 low-income and 150 high-income participants. We build the samples of rich and poor spectators to be representative of both income groups in terms of age, gender, region of residence, and ideology. For the first three characteristics, we exploit the 2020 US national census dataset. Regarding ideology, we leverage the data provided by the American National Election Studies in order to compute the share of each ideological group by income group. Table 3.2 reports the summary statistics of our sample compared to the whole pop-

⁹Of course, even this way, the initial distribution can be considered unfair as the poor stakeholder does not have the chance to complete the task for us.

¹⁰Decision-makers do not participate as stakeholders to rule out any self-interest or wishful thinking from their motivations.

¹¹We wrote the instructions in the simplest language possible by using www.rewordify.com. Moreover, an American colleague of ours proof-read the entire survey.

¹²Bansak et al. (2018) finds that even when respondents are exposed to 30 conjoint tables, there is no substantial survey satisficing, that is, respondents process the conjoint profiles in similar ways and provide similar, sensible results.

ulation, and we show that our sample is well-balanced. The only difference between our samples and the population of reference stems from the undersampling of older people, especially for the sample of rich individuals.

Table 3.2: Sample Characteristics

	Rich		Poor	
	Our sample	Population	Our sample	Population
<i>Gender</i>				
Male	0.64	0.64	0.35	0.36
Female	0.36	0.36	0.65	0.64
<i>Age</i>				
[18-35]	0.20	0.18	0.46	0.44
[36-55]	0.55	0.46	0.32	0.26
[56+]	0.25	0.35	0.22	0.29
<i>Region</i>				
South	0.37	0.34	0.43	0.42
Midwest	0.21	0.20	0.17	0.18
Northeast	0.19	0.21	0.15	0.15
West	0.23	0.25	0.24	0.25
<i>Ideology</i>				
Conservative	0.41	0.38	0.25	0.33
Moderate	0.24	0.20	0.41	0.33
Liberal	0.35	0.41	0.33	0.34

Notes: This table displays summary statistics from our samples alongside nationally representative statistics. For the latter, the statistics on *Gender*, *Age* and *Region* are computed from the 2020 US national census dataset. Regarding *Ideology*, we leverage the data provided by the American National Election Studies in order to compute the share of each ideological group by income group.

4 Empirical framework

Our aim is to disentangle the effect of the different attributes of the poor and rich stakeholders on spectators' redistribution decisions. With this aim, we pool the samples of both rich and poor spectators, and we estimate the following model:

$$\begin{aligned}
 tax_{it} = & \alpha_0 + \alpha_1 MP_{it} + \alpha_2 MR_{it} + \alpha_3 F_{it} + \alpha_4 T_{it} + \alpha_5 R_i + \alpha_6 R_i \cdot MP_{it} + \\
 & \alpha_7 R_i \cdot MR_{it} + \alpha_8 R_i \cdot F_{it} + \alpha_9 R_i \cdot T_{it} + \gamma X_{it} + \epsilon_{it},
 \end{aligned} \tag{3.1}$$

where tax_{it} is the percentage of the rich stakeholder's income transferred to the poor stakeholder by spectator i , who is shown a conjoint table t (with $t = 1, \dots, 16$). MP_{it} and MR_{it} are dummy variables equal to 1 if the poor and the rich stakeholders are described as working more than 10 hours during a normal working day; F_{it} is a dummy equal to 1 if the rich spectator founded the firm that he currently owns and T_{it} is a dummy equal to 1 if the same firm has more than 1000 employees. R_i is equal to one if spectator i is part of the top 20% of the income distribution and 0 if the spectator belongs to the bottom 20%. We also include the interactions between the attribute values dummies ($MP_{it}, MR_{it}, I_{it}, T_{it}$) and the income group dummy (R_i) to study how the marginal effect of each attribute varies with spectators' income group. X_{it} is a vector of control variables, including gender, age, region of residence, and political affiliation. Although our main specification includes the control variables, we also report and discuss results for regressions without control variables. Finally, ϵ_{it} is the error term. In the estimation, we cluster standard errors at the individual level to take serial correlation into account.

Coefficients $\alpha_1, \alpha_2, \alpha_3$ and α_4 represent the effects of each attribute value against the alternative value of the same attribute while holding equal the joint distribution of the other attributes (Bansak et al., 2021). This value is known in the literature as the average marginal component effect (AMCE).

In line with the copious experimental literature, which found that people in the US, as well as different Western countries, are deeply meritocratic, we expect that the attributes and values that highlight a stakeholder's merit will increase the final amount he will receive. This means that we expect α_1 to be positive, as the effort of the poor is rewarded by the spectator by redistributing more towards the poor. On the contrary, we expect α_2, α_3 and α_4 to be negative, as the different dimensions of the rich stakeholder's merit increase his entitlement over the endowment while decreasing spectators' propensity to redistribute.

We are also interested in the differences in the AMCE between poor and rich stakeholders. As discussed in section 2, there are reasons to believe that the elite is profoundly meritocratic. This is in line with an intense meritocratic education and belief among the elite (Khan, 2011, Kuusela, 2020, Atria et al., 2020, Suhay et al., 2020). Therefore, we expect α_6 to be positive while α_7, α_8 , and α_9 to be negative. In other words, we expect the impact of the poor and rich stakeholders' merits on redistribution choices to be stronger for rich spectators.

The main advantage of the conjoint analysis, that is, being able to test the rel-

ative importance of different individual characteristics, comes at a cost: multiple hypothesis testing (Liu and Shiraito, 2022). We employ three adjustment methods: the sharpened q-value approach (Anderson, 2008), the Bonferroni approach, and the Holm-Bonferroni approach.¹³ Table C.6 in the appendix reports all the p-values with the different adjustments and shows that the significance of the different AMCEs does not vary. The coefficient on *Founder X Rich* is the only one that turns insignificant with the Bonferroni correction, which is considered, however, an overly conservative approach.

5 Results

In this section, we first provide an overview of spectators' choices in the experiment and then turn to the analysis focusing on the AMCEs of the different profiles' characteristics. Finally, we run some heterogeneity analyses.

5.1 Summary statistics

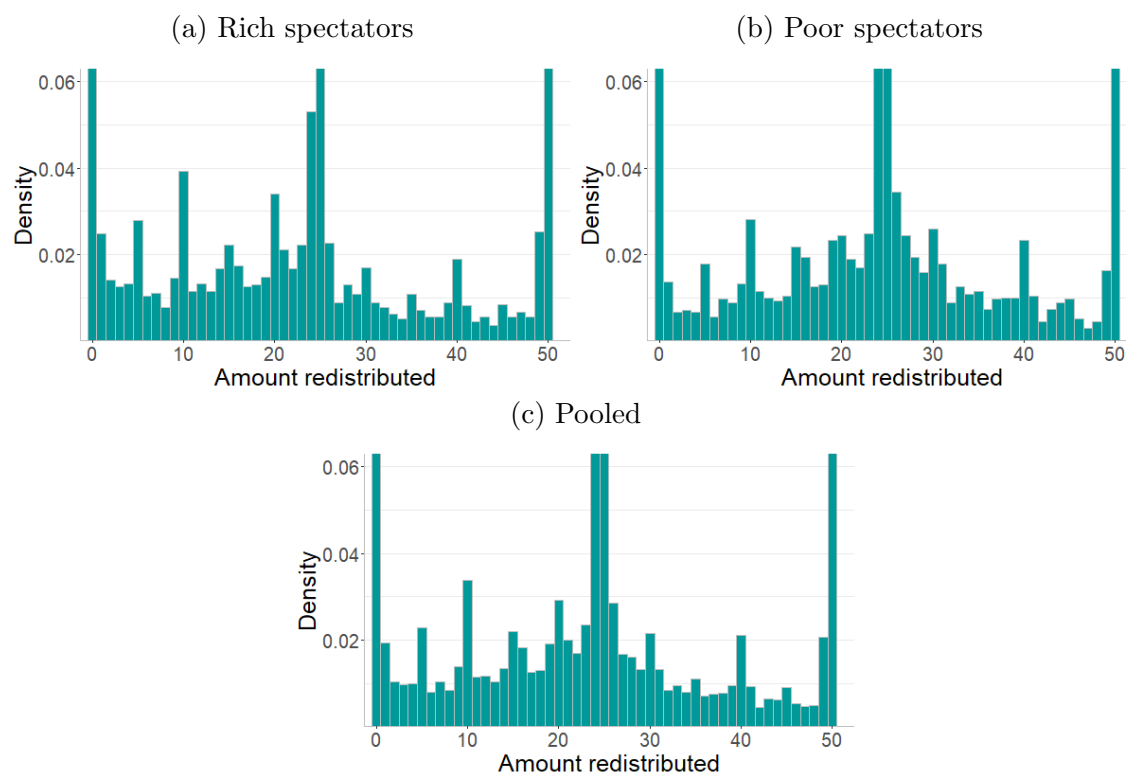
In Figure 3.1, we provide the distribution of the money transferred across all treatments by income group and by pooling all observations. In all cases, the distribution is trimodal, with a peak at 0, 50, and close to 24.5.¹⁴ In the pooled sample, in 10.5% of decisions, spectators choose to transfer nothing, in 10% of cases, they choose to transfer between \$24 and \$25, and in 10.8% of cases, participants transfer \$50.

There are also significant differences between rich and poor spectators' choices. On average, rich spectators transferred \$20.9 (*s.d.* = 16.2) from the rich to the poor stakeholder, while poor spectators transferred \$25.9 (*s.d.* = 15.1 and $p < 0.01$ in a t-test for differences in means). In subsequent analyses, we show that this difference is statistically significant when we control for age, gender, region of residence, and ideology.

¹³For a review of the different approaches, see Arpinon and Espinosa (2022) and <https://blogs.worldbank.org/impac evaluations/overview-multiple-hypothesis-testing-commands-stata>.

¹⁴The sum of the two stakeholders' endowments was \$51, so equalizing the two endowments required a transfer of \$24.5, which is not extremely easy to choose given the slider.

Figure 3.1: Distribution of spectator choices, by income group and pooled



5.2 Main analysis

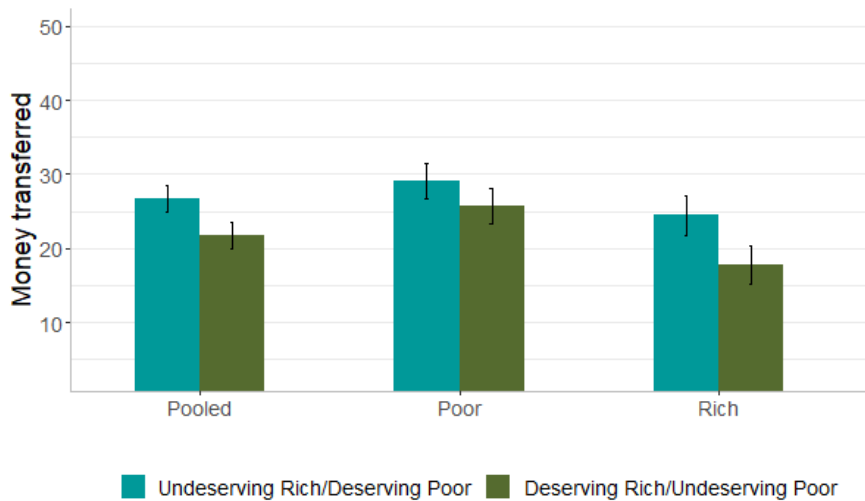
Figure 3.2 shows the average sum transferred in the two treatments with the most extreme profile characterization. In one treatment, the rich stakeholder is described as fully deserving across the three domains (working more than 10 hours per day, having founded a firm with more than 1000 employees), while the poor stakeholder is described as undeserving (working less than 6 hours per day). In the other treatment, the rich stakeholder is presented as undeserving across the three domains, while the poor stakeholder is described as deserving.¹⁵

Two results can be highlighted: First, all spectators redistribute significantly less when the poor stakeholder is undeserving and the rich stakeholder is deserving compared to the opposite case ($p < 0.01$ in a t-test for differences in means); second, the treatment effect is larger for rich spectators, with a difference in mean between

¹⁵We also test another characterization of the effort dimension where we focus on the source of people's income rather than the work hours. Table C.3 reports the results of the same comparison as above. The effect is close to what we find when we focus on work hours.

treatments of \$6.7 (13.4% of the rich stakeholder’s endowment) compared to \$3.3 (6.6%) for low-income spectators. In Appendix: Figure C.2, we also show that the treatment effect is strong for both liberals and conservatives. Overall, these results suggest that the meritocratic ideal is ubiquitous in American society, as it encompasses symmetrically opposite income groups as well as the entire political spectrum.

Figure 3.2: Money transferred by spectators in selected treatments, by spectator income group



Notes: Mean and 95% confidence interval of the amount transferred from the rich stakeholder (initially assigned \$50) to the poor stakeholder (initially assigned \$1). The spectator could transfer any amount between \$0 and \$50. “Poor” and “Rich” identify spectators, whose income is from the bottom and top 20% of the US income distribution, respectively.

We now turn to regression analysis. Table 3.3 reports the results of the regressions on the percentage of money redistributed when we consider rich stakeholders (columns 1-2), poor stakeholders (columns 3-4), and both groups pooled (5-6). We use Tobit regressions censored at 0 and 50 to address the possibility that, if allowed, some participants would have chosen to redistribute more than \$50 or less than \$0.¹⁶ We can highlight a set of five results: *i*) In all cases, the coefficient on the effort of the poor is the highest, and it is always statistically significant. In our complete estimation (column 6), we find that spectators redistribute 5.4 percentage

¹⁶In the appendix, we also provide the ordinary least square (OLS) estimations of the same model, and we show that results are qualitatively identical.

points more to a hard-worker poor compared to a poor stakeholder who works less than 6 hours per day; *ii*) The attributes of the rich stakeholder’ merit, that is, *Effort rich* and *Founder*, never have an impact on low-income spectators’ decisions. On the contrary, the same attributes have a significant impact on rich spectators’ choices. Spectators at the top of the income distribution redistribute 4.9 percentage points less when the rich stakeholder exerts a high effort and 2.4 points less when he founded the business he owns; *iii*) rich spectators redistribute systematically less, even when in column 6, we control for spectators’ gender, age, state of residence, and ideology. On average, rich spectators redistribute 9 percentage points less than poor spectators; *iv*) the effect of the different attributes that highlight the merit of the two stakeholders is always stronger for rich spectators. This implies that the affluent are more meritocratic than low-income spectators. *v*) although the trickle-down attribute has the expected negative sign, its coefficient magnitude is low, and it is never statistically significant.

5.3 Heterogeneity analysis

In this subsection, we analyze how the effect of stakeholders’ attributes varies with respect to spectators’ ideology and gender. We focus on ideology as the relationship between ideology and fairness preferences is fundamental to understanding people’s voting behavior (Almås et al., 2020). Regarding gender, differences in redistribution choices between men and women have been widely studied (Buser et al., 2020). Yet, not much is known about whether men and women put a different weight on meritocratic considerations. The figures and tables described in this section are relegated to the appendix.

Table C.1 reports the results of the heterogeneity analysis where we interact the stakeholders’ attributes dummies with spectators’ ideology, distinguishing between conservatives, moderates, and liberals. Column (3) shows the results for the pooled sample: The coefficients on the interaction terms are insignificant in all cases, with the only exception of the interaction between *Trickle* and *Liberal*. This effect seems to be driven by wealthy spectators, as the coefficient on the same interaction is significant only for wealthy stakeholders (in column 1). Moreover, the effect of the trickle-down attribute is significant and negative for also rich moderates. This indicates that the Trickle-Down hypothesis seems to be valid only for rich liberals and moderates, who redistribute less when the firm of the rich stakeholder has more

Table 3.3: Regression Results on amount of money transferred

	Rich		Poor		Pooled	
	(1)	(2)	(3)	(4)	(5)	(6)
Effort Poor	0.084*** (0.01)	0.084*** (0.01)	0.054*** (0.01)	0.054*** (0.01)	0.054*** (0.01)	0.054*** (0.01)
Effort Rich	-0.048*** (0.009)	-0.049*** (0.009)	-0.013 (0.009)	-0.013 (0.009)	-0.013 (0.009)	-0.013 (0.009)
Founder	-0.024*** (0.007)	-0.024*** (0.007)	-0.0019 (0.008)	-0.0019 (0.008)	-0.0019 (0.008)	-0.0019 (0.008)
Trickle-down	-0.00060 (0.006)	-0.00074 (0.006)	-0.00090 (0.008)	-0.00094 (0.008)	-0.00093 (0.008)	-0.0010 (0.008)
Rich					-0.095*** (0.03)	-0.10*** (0.04)
Effort Poor \times Rich					0.029 (0.02)	0.030 (0.02)
Effort Rich \times Rich					-0.035*** (0.01)	-0.035*** (0.01)
Founder \times Rich					-0.022* (0.01)	-0.022* (0.01)
Trickle-down \times Rich					0.00023 (0.010)	0.00024 (0.010)
Observations	2400	2400	2400	2400	4800	4800
Pseudo R-squared	0.018	0.10	0.011	0.042	0.043	0.097
Controls	X	✓	X	✓	X	✓

Notes: The table reports Tobit regression results. The dependent variable is the percentage of money transferred from the rich stakeholder to the poor stakeholder. *Effort Poor* is a dummy equal to one if the poor stakeholder works more than 10 hours per day; *Effort Rich* is a dummy equal to one if the rich stakeholder works more than 10 hours per day; *Founder* is a dummy equal to one if the rich stakeholder inherited the firm he/she owns; *Trickle-down* is a dummy equal to one if the rich stakeholder's firm has more than 1000 employees. Controls include: age, gender, region of residence and political affiliation. Standard errors clustered at the individual level in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

than 1000 employees. On the contrary, the attributes related to stakeholders' merit (hours worked and source of the firm's ownership) do not vary across ideologies.

Regarding gender differences, figure C.4 shows only a slight difference in money redistributed between male and female participants. Women redistribute slightly more (difference in means of 1.32, which is statistically significant), which is in line with many experimental studies finding that women exhibit a lower inequality acceptance Buser et al. (2020). Table C.2 reports the result from estimating equation 3.1 where we interact the different attributes with a dummy for spectators' gender. The interaction terms are never significant, suggesting that the attributes' effect does not vary with the spectators' gender. This result is in line with previous studies as Almås et al. (2020), which do not find gender differences in treatment effects where they compare the case in which the source of inequality between two stakeholders is either their effort or simple luck.

Robustness checks. We run a battery of robustness checks which are shown in the appendix. First, in table C.3, we exclude from our analysis those participants that did not find the survey clear (7.3% of the entire sample) to avoid any noise in their choices. Second, in table C.4, we exclude those participants who believe that the survey was biased (25% of the sample).¹⁷ Third, in table C.5, we estimate the main model by OLS. Finally, in table C.6 we report the p-values from estimating model 3.1 with different corrections for multiple hypothesis testing. *In all cases*, results do not change qualitatively and only slightly quantitatively.

6 Conclusion

In this paper, we investigate the relative importance of different dimensions of individual merit and of the trickle-down narrative to explain people's redistributive preferences. With this aim, we combine a spectator-stakeholder experimental setting (Almås et al., 2020) and a conjoint analysis (Bansak et al., 2021). A spectator decides how much to redistribute between two stakeholders who are described in different ways. We innovate in different ways, as *i*) our spectators are selected

¹⁷Among these people, 70.3% said that "The researchers preferred that I transferred a large amount of money from Person 1 to Person 2" and the remaining 29.7% said that "The researchers preferred that I transferred a low amount of money, or nothing, from Person 1 to Person 2".

among the top and bottom 20% of the income distribution, *ii*) the stakeholders are pairs of low-income and high-income individuals in real life, and *iii*) we vary the characteristics of the stakeholders that relate to their deservingness.

Our results indicate that the attribute which counts the most for all decision-makers is the effort exerted by low-income stakeholders. Participants tend to reward the poor stakeholder when he is a hard worker and redistribute more money towards him. In the meantime, *only* high-income spectators' choices are affected by the rich stakeholders' attributes. Indeed, rich spectators redistribute less when the high-income stakeholder works many hours per day and when he is a founder of a firm he owns. Further, rich spectators' choices are more influenced by the different stakeholders' attributes than low-income spectators, suggesting that they are more meritocratic. Finally, the trickle-down attribute has not a significant impact on redistribution choices. The trickle-down effect is significant economically and statistically significant for rich liberals and moderates.

Our results bear several implications: Often, the public debate hinges on the merits/demerits of both rich and poor people. Our results suggest that poor individuals' features can profoundly impact people's preferences for redistribution. Interestingly, Reagan's administration's tax and welfare benefits cuts in the 80s have been associated with public attacks on welfare recipients.¹⁸ In light of our results, these attacks might have been highly influential in pushing down people's preferences for redistribution. On the contrary, the left-wing rhetoric on the economic elite (top 1%) might be less effective in pushing people, especially poorer individuals, to vote for a higher redistribution, which might explain the low general preferences for redistribution in the face of surging inequalities.

The design used in this study can be extended in many ways: One first path is to explore the effect of different stakeholders' characteristics. For instance, a fruitful line of inquiry could explore the interaction between beliefs in meritocracy and race discrimination. Further, more needs to be done to understand how beliefs in the "trickle-down economics" affect people's preferences for redistribution. In this experiment, we highlighted the size of the firm of an entrepreneur and found

¹⁸A viral expression in this period was the "Welfare Queen". In a speech in 1976, Reagan stated "She has 80 names, 30 addresses, 12 Social Security cards and is collecting veterans' benefits on four non-existing deceased husbands. And she's collecting Social Security on her cards. She's got Medicaid, getting food stamps, and she is collecting welfare under each of her names. Her tax-free cash income alone is over \$150,000".

no significant effect of this attribute. However, other dimensions of the trickle-down economy could be explored, such as the innovation brought by an entrepreneur. In addition, it would be helpful to elicit participants' beliefs about the effort and talent of both rich and poor individuals. This would allow studying how participants react to the information provided through conjoint tables depending on their priors. Finally, replicating this experiment in European countries could help to shed light on the on-going debate on differences in preferences for redistribution between US and Europe (Alesina et al., 2004, Grimalda et al., 2018).

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Appendix C

Beliefs in Merit, Trickle-Down Economics, and Preferences for Redistribution: An Experiment with the Top and Bottom 20%

Contents

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Appendix

C.1 Surveys details

C.1.1 Link to surveys

- **Spectators:** <https://tinyurl.com/yp9kt87a>
- **Stakeholders:** <https://tinyurl.com/4c3fnj3d>

C.1.2 Survey - STAKEHOLDERS

Answer options are in *italic*, separated by a semicolon.

- Were you born in the United States? *Yes; No*
- Do you currently live in the United States? *Yes; No*
- “In which of these groups did your total PERSONAL income, from all sources, fall last year? That is, before taxes. Total income includes interests or dividends, rents, Social Security, other pensions, alimony or child support, unemployment compensations, public aid (welfare), armed forces or veteran’s allotment.” *\$0 - \$9,999; \$10,000 - \$14,999; \$15,000 - \$19,999; \$20,000 - \$29,999; \$30,000 - \$39,999; \$40,000 - \$49,999; \$50,000 - \$69,999; \$70,000 - \$89,999; \$90,000 - \$99,999; \$100,000 - \$149,999; \$150,000 - \$199,999; \$200,000 +*
- “How much do you work on a normal weekday?” *I normally work less than 4 hours; I normally work between 4 and 6 hours, I normally work between 6 and 8 hours; I normally work between 8 and 10 hours; I normally work between 10 and 12 hours; I normally work more than 12 hours.*

For rich profiles only (Personal income higher than \$100,000)

- Do you own a business? *Yes; No*
- We would like now to ask you how many employees does your business have. Please include full-time, part-time, temporary, unpaid, and family members working for this business. *0 to 5; 6 to 10; 11 to 50; 51 to 100; 101 to 250; 251 to 500; 501 to 1000; More than 1000*

- How did you initially acquire ownership of this business? *Founded; Inherited; Purchased or received transfer of ownership/gift*
- According to you, what are the reasons why some people are persistently poor in the United States?
- According to you, what are the reasons why some people are persistently rich in the United States?
- In the last 30 years income differences among the rich and the poor sharply increased in the US. Available studies suggest that most people did not demand for more income redistribution to offset this trend. Why do you think this has been the case?
- According to existing studies, many poor people do not demand more income redistribution from the rich to the poor. Why do you think this is the case?

C.1.3 Survey - SPECTATORS

- Are you responding to this survey on a cell phone? *Yes; No*
- Where you born in the United States? *Yes; No*
- Do you currently live in the United States? *Yes; No*
- What was your TOTAL household income, before taxes, last year (2021)? *Less than \$10,000; Between \$10,000 and \$14,999; Between \$15,000 and \$19,999; Between \$20,000 and \$29,999; Between \$30,000 and \$39,999; Between \$40,000 and \$49,999; Between \$50,000 and \$69,999; Between \$70,000 and \$89,999; Between \$90,000 and \$109,999; Between \$110,000 and \$149,999; Between \$150,000 and \$199,999; More than \$200,000*
- What is your gender? *Male; Female*
- What is your age?
- In political matters, people often talk of “Liberal” and “Conservative.” Generally speaking, how would you place your views on this scale? *Very liberal; Liberal; Moderate; Conservative; Very conservative*

➤ In which state do you live?

➤ **Description of the redistribution choice**

We now ask you to make different choices that might have real consequences for people in real life.

Some days ago, we recruited some people via an online website. These people are all from the US and have different personal traits. We matched them in pairs. Within each pair, one person (who will be called Person 1) did a job for us, while the other person (who will be called Person 2) did not do any job for us. Both were paid a participation fee.

Person 1 has been given \$50 on the top of the participation fee for the job she/he did, while Person 2 has been given \$1 on the top of the participation fee. They both have been told that a third person may transfer some money from Person 1 to Person 2 to determine their final earnings.

You will now have to choose how much money you want to transfer from Person 1 to Person 2. You can transfer any amount from \$0 to \$50. You will make many decisions for different pairs of people who differ in some traits.

One decision from all the decisions made by the participants in this study will be randomly selected by our computer and applied in reality. Please make your choices carefully, because one of them may decide the final earnings for two other people.

Please remember that your decisions are completely anonymous.

If everything is clear, please click on the "next" button.

➤ **Redistribution choice - see figure C.1**

➤ "How much do you work on a normal weekday?" *I normally work less than 4 hours; I normally work between 4 and 6 hours, I normally work between 6 and 8 hours; I normally work between 8 and 10 hours; I normally work between 10 and 12 hours; I normally work more than 12 hours.*

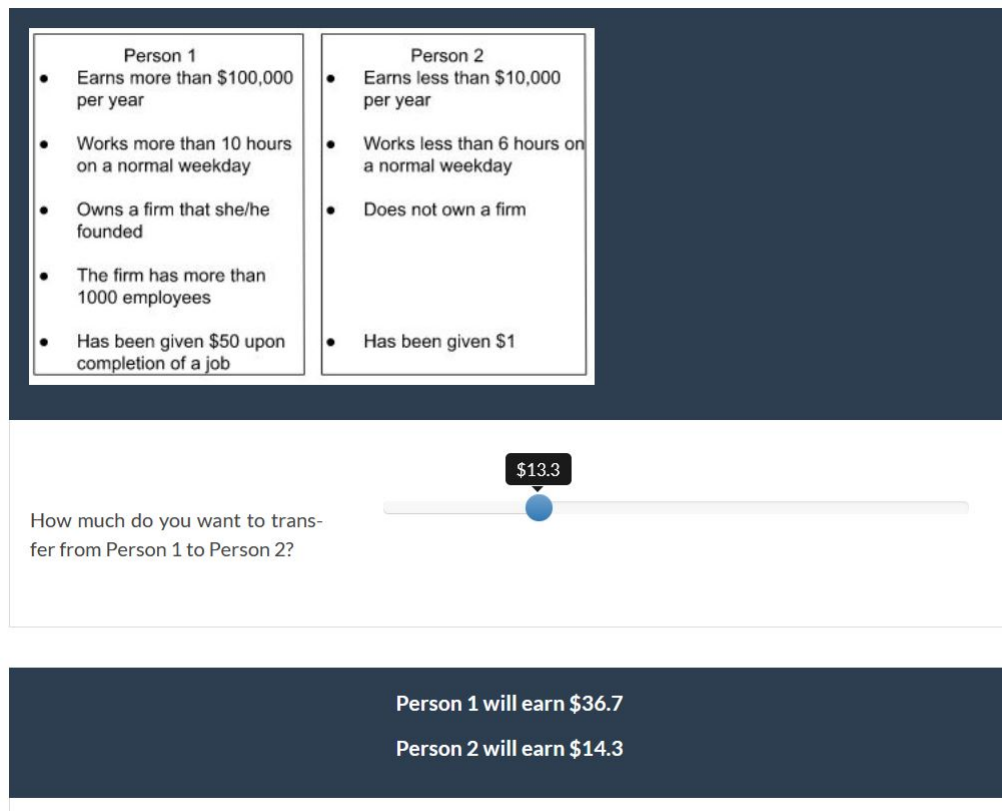
➤ Do you own a business? *Yes; No*

➤ We would like now to ask you how many employees does your business have. Please include full-time, part-time, temporary, unpaid, and family members

working for this business. *0 to 5; 6 to 10; 11 to 50; 51 to 100; 101 to 250; 251 to 500; 501 to 1000; More than 1000*

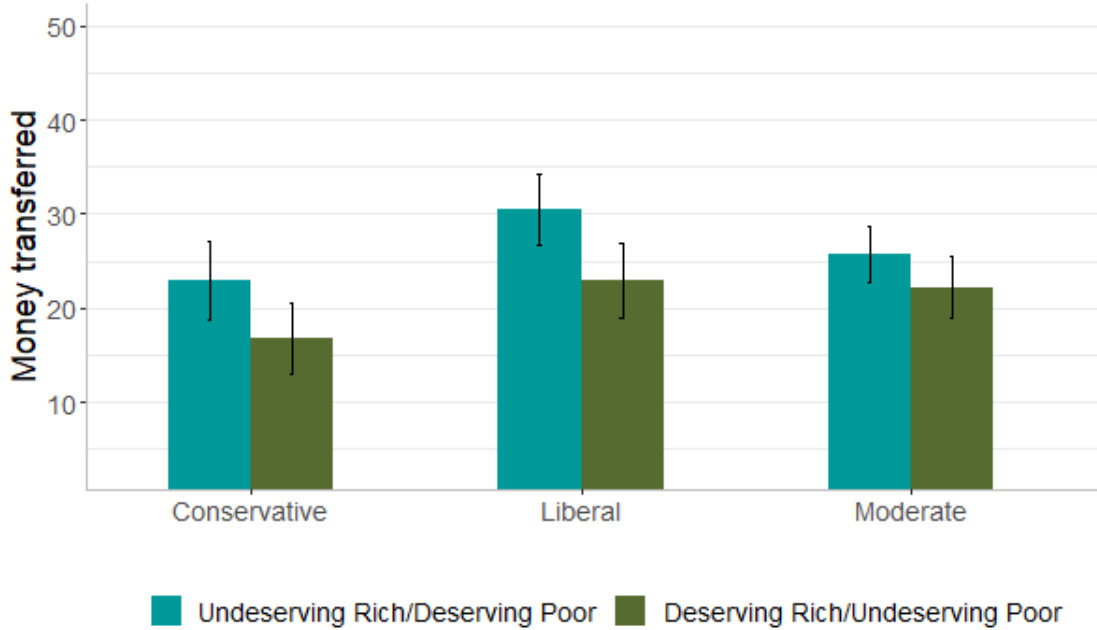
- How did you initially acquire ownership of this business? *Founded; inherited; purchased or received transfer of ownership/gift*
- Do you feel that this survey was biased? *Yes; No*
- (If Yes to the previous question) Which of the following statements is closest to the truth according to you? *The researchers preferred that I transferred a large amount of money from Person 1 to Person 2; The researchers preferred that I transferred a low amount of money, or nothing, from Person 1 to Person 2.*
- Was the survey clear to you? *Yes; No*
- (If Yes to the previous question) Please, explain us why it was not clear and give us some suggestions to improve it.

Figure C.1: Example of redistribution choice



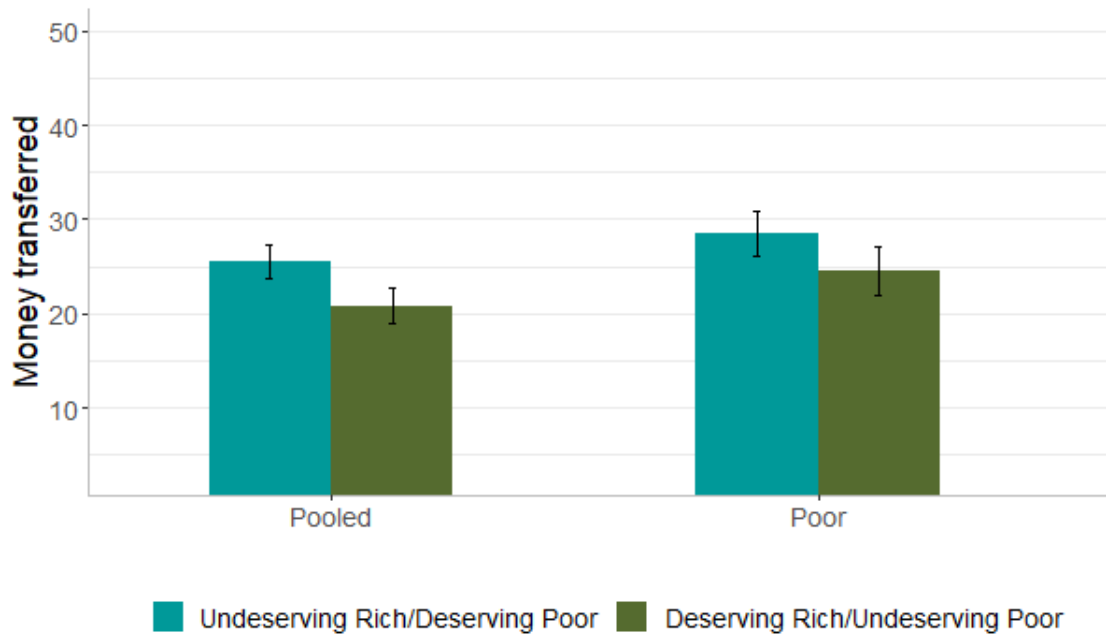
C.2 Additional figures and tables

Figure C.2: Money transferred in each treatment by ideology



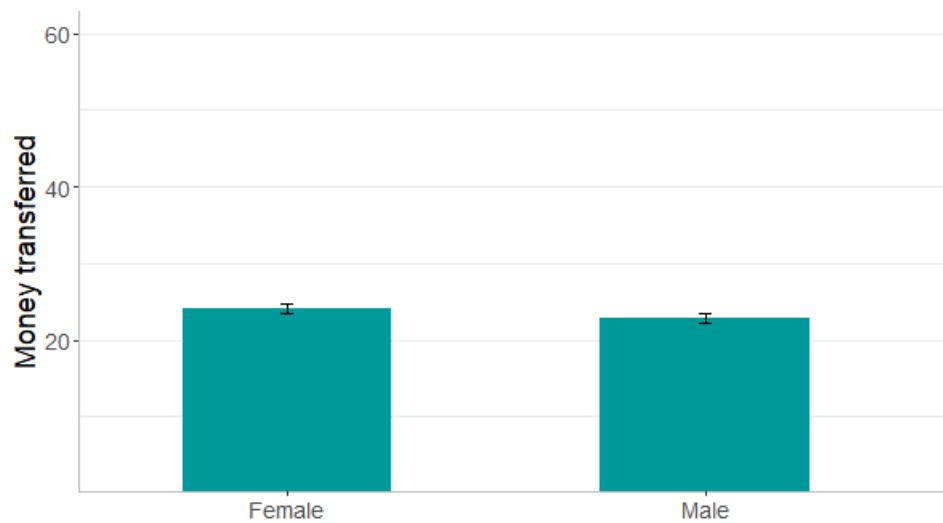
Notes: Mean and 95% confidence interval of the amount transferred from the rich stakeholder (initially assigned \$50) to the poor stakeholder (initially assigned \$1). The spectator could transfer any amount between \$0 and \$50. “Poor” and “Rich” identify spectators, whose income is from the bottom and top 20% of the US income distribution, respectively.

Figure C.3: Money transferred by spectators in selected treatments with alternative merit dimension, by spectator income group



Notes: In this case the effort dimension is represented by the source of income of the two stakeholders instead of the number of work hours. For both the deserving rich and deserving poor, the attribute value is “Her/his income mostly comes from his/her work”. For the undeserving rich, the attribute value is “Her/his income mostly comes from inheritances, capital gains, dividends, housing rents and/or interests”. For the undeserving poor, the attribute value is “Her/his income mostly comes from inheritances, capital gains, dividends, housing rents and/or interests”. Mean and 95% confidence interval of the amount transferred from the rich stakeholder (initially assigned \$50) to the poor stakeholder (initially assigned \$1). The spectator could transfer any amount between \$0 and \$50. “Poor” and “Rich” identify spectators, whose income is from the bottom and top 20% of the US income distribution, respectively.

Figure C.4: Money transferred by spectators by spectator's gender



Notes: Mean and 95% confidence interval of the amount transferred from the rich stakeholder (initially assigned \$50) to the poor stakeholder (initially assigned \$1). The spectator could transfer any amount between \$0 and \$50.

Table C.1: Heterogeneity analysis - Ideology

	Rich	Poor	Pooled
	(1)	(2)	(3)
Effort Poor	0.065*** (0.02)	0.090** (0.04)	0.075*** (0.02)
Effort Rich	-0.032*** (0.01)	0.0043 (0.01)	-0.018* (0.009)
Founder	-0.0096 (0.009)	-0.035*** (0.01)	-0.020*** (0.008)
Trickle-down	0.022* (0.01)	0.0097 (0.01)	0.017* (0.009)
Liberal	0.15*** (0.06)	0.090 (0.06)	0.12*** (0.04)
Moderate	-0.052 (0.06)	0.016 (0.06)	-0.0070 (0.04)
Liberal × Effort Poor	0.031 (0.03)	-0.051 (0.04)	-0.0062 (0.02)
Moderate × Effort Poor	0.033 (0.04)	-0.047 (0.04)	-0.012 (0.03)
Liberal × Effort Rich	-0.031 (0.02)	-0.022 (0.02)	-0.023 (0.01)
Moderate × Effort Rich	-0.022 (0.02)	-0.024 (0.02)	-0.014 (0.01)
Liberal × Founder	-0.020 (0.02)	0.042** (0.02)	0.0077 (0.01)
Moderate × Founder	-0.029 (0.02)	0.047** (0.02)	0.014 (0.01)
Liberal × Trickle-down	-0.036** (0.01)	-0.029 (0.02)	-0.033*** (0.01)
Moderate × Trickle-down	-0.041*** (0.02)	-0.0020 (0.02)	-0.019 (0.01)
Rich			-0.10*** (0.03)
Observations	2400	2400	4800
Pseudo R-squared	0.11	0.042	0.090
Controls	✓	✓	✓

Notes: The table reports Tobit regression results. The dependent variable is the percentage of money transferred from the rich stakeholder to the poor stakeholder. *Effort Poor* is a dummy equal to one if the poor stakeholder works more than 10 hours per day; *Effort Rich* is a dummy equal to one if the rich stakeholder works more than 10 hours per day; *Founder* is a dummy equal to one if the rich stakeholder inherited the business he/she owns; *Trickle-down* is a dummy equal to one if the rich stakeholder's business has more than 1000 employees. Controls include: age, gender and region of residence. Standard errors clustered at the individual level in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table C.2: Heterogeneity analysis - Gender

	Rich	Poor	Pooled
	(1)	(2)	(3)
Effort Poor	0.070*** (0.02)	0.088*** (0.02)	0.076*** (0.01)
Effort Rich	-0.043*** (0.01)	-0.026 (0.02)	-0.037*** (0.009)
Founder	-0.015* (0.009)	-0.0047 (0.01)	-0.011 (0.007)
Trickle-down	0.0018 (0.009)	-0.0047 (0.01)	-0.00055 (0.007)
Female	-0.052 (0.05)	0.028 (0.05)	-0.011 (0.04)
Female × Effort Poor	0.040 (0.03)	-0.053* (0.03)	-0.015 (0.02)
Female × Effort Rich	-0.014 (0.02)	0.020 (0.02)	0.013 (0.01)
Female × Founder	-0.023 (0.02)	0.0043 (0.02)	-0.0022 (0.01)
Female × Trickle-down	-0.0065 (0.01)	0.0059 (0.02)	-0.00047 (0.010)
Rich			-0.11*** (0.03)
Observations	2400	2400	4800
Pseudo R-squared	0.12	0.041	0.090
Controls	✓	✓	✓

Notes: The table reports Tobit results. The dependent variable is the amount of money transferred from the rich stakeholder to the poor stakeholder. *Effort Poor* is a dummy equal to one if the poor stakeholder works more than 10 hours per day; *Effort Rich* is a dummy equal to one if the rich stakeholder works more than 10 hours per day; *Founder* is a dummy equal to one if the rich stakeholder founded the business he/she owns; *Trickle-down* is a dummy equal to one if the rich stakeholder's business has more than 1000 employees. Controls include: age, gender, region of residence and political affiliation. Standard errors clustered at the individual level in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

C.3 Robustness checks

Table C.3: Tobit regression on percentage of income redistributed with only participants who found the survey clear

	Rich		Poor		Pooled	
	(1)	(2)	(3)	(4)	(5)	(6)
Effort Poor	0.084*** (0.01)	0.084*** (0.01)	0.057*** (0.01)	0.057*** (0.01)	0.057*** (0.01)	0.057*** (0.01)
Effort Rich	-0.046*** (0.009)	-0.046*** (0.009)	-0.014 (0.009)	-0.014 (0.009)	-0.014 (0.009)	-0.014 (0.009)
Founder	-0.025*** (0.008)	-0.025*** (0.008)	-0.0015 (0.009)	-0.0015 (0.009)	-0.0015 (0.009)	-0.0015 (0.009)
Trickle-down	0.0017 (0.007)	0.0017 (0.007)	0.0024 (0.008)	0.0024 (0.008)	0.0024 (0.008)	0.0023 (0.008)
Rich					-0.098*** (0.04)	-0.094** (0.04)
Effort Poor × Rich					0.026 (0.02)	0.026 (0.02)
Effort Rich × Rich					-0.032** (0.01)	-0.032** (0.01)
Founder × Rich					-0.023** (0.01)	-0.023** (0.01)
Trickle-down × Rich					-0.00080 (0.01)	-0.00067 (0.01)
Observations	2240	2240	2192	2192	4432	4432
Pseudo R-squared	0.018	0.13	0.011	0.040	0.043	0.094
Controls	X	✓	X	✓	X	✓

Notes: The table reports Tobit results. Only participants who answered *Yes* to the question “Was the survey clear to you?”. The dependent variable is the amount of money transferred from the rich stakeholder to the poor stakeholder. *Effort Poor* is a dummy equal to one if the poor stakeholder works more than 10 hours per day; *Effort Rich* is a dummy equal to one if the rich stakeholder works more than 10 hours per day; *Founder* is a dummy equal to one if the rich stakeholder founded the business he/she owns; *Trickle-down* is a dummy equal to one if the rich stakeholder’s business has more than 1000 employees. Controls include: age, gender, region of residence and political affiliation. Standard errors clustered at the individual level in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table C.4: Tobit regression on percentage of income redistributed with only participants who found the survey biased

	Rich		Poor		Pooled	
	(1)	(2)	(3)	(4)	(5)	(6)
Effort Poor	0.094*** (0.02)	0.095*** (0.02)	0.049*** (0.01)	0.049*** (0.01)	0.049*** (0.01)	0.049*** (0.01)
Effort Rich	-0.057*** (0.01)	-0.057*** (0.01)	-0.018** (0.009)	-0.018** (0.009)	-0.019** (0.009)	-0.018** (0.009)
Founder	-0.031*** (0.009)	-0.031*** (0.009)	-0.0040 (0.008)	-0.0040 (0.008)	-0.0040 (0.008)	-0.0041 (0.008)
Trickle-down	0.00032 (0.007)	0.00042 (0.007)	0.0013 (0.009)	0.0013 (0.009)	0.0013 (0.009)	0.0012 (0.009)
Rich					-0.10** (0.04)	-0.089** (0.04)
Effort Poor × Rich					0.043* (0.02)	0.044** (0.02)
Effort Rich × Rich					-0.038*** (0.01)	-0.038*** (0.01)
Founder × Rich					-0.027** (0.01)	-0.027** (0.01)
Trickle-down × Rich					-0.0012 (0.01)	-0.00092 (0.01)
Observations	1776	1776	1808	1808	3584	3584
Pseudo R-squared	0.022	0.10	0.0098	0.056	0.047	0.100
Controls	X	✓	X	✓	X	✓

Notes: The table reports Tobit results. Only participants who answered *No* to the question “Do you feel that this survey was biased?”. The dependent variable is the amount of money transferred from the rich stakeholder to the poor stakeholder. *Effort Poor* is a dummy equal to one if the poor stakeholder works more than 10 hours per day; *Effort Rich* is a dummy equal to one if the rich stakeholder works more than 10 hours per day; *Founder* is a dummy equal to one if the rich stakeholder founded the business he/she owns; *Trickle-down* is a dummy equal to one if the rich stakeholder’s business has more than 1000 employees. Controls include: age, gender, region of residence and political affiliation. Standard errors clustered at the individual level in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table C.5: OLS regression on percentage of income redistributed

	Rich		Poor		Pooled	
	(1)	(2)	(3)	(4)	(5)	(6)
Effort Poor	0.073*** (0.01)	0.073*** (0.01)	0.050*** (0.01)	0.050*** (0.01)	0.050*** (0.01)	0.050*** (0.01)
Effort Rich	-0.042*** (0.007)	-0.042*** (0.007)	-0.010 (0.008)	-0.010 (0.008)	-0.010 (0.008)	-0.010 (0.008)
Founder	-0.021*** (0.007)	-0.021*** (0.007)	-0.0020 (0.008)	-0.0020 (0.008)	-0.0020 (0.008)	-0.0020 (0.008)
Trickle-down	-0.0018 (0.006)	-0.0018 (0.006)	-0.00059 (0.007)	-0.00059 (0.007)	-0.00059 (0.007)	-0.00059 (0.007)
Rich					-0.081** (0.03)	-0.081** (0.03)
Effort Poor \times Rich					0.023 (0.02)	0.023 (0.02)
Effort Rich \times Rich					-0.031*** (0.01)	-0.031*** (0.01)
Founder \times Rich					-0.019* (0.01)	-0.019* (0.01)
Trickle-down \times Rich					-0.0012 (0.009)	-0.0012 (0.009)
Observations	2400	2400	2400	2400	4800	4800
R-squared	0.018	0.11	0.0072	0.025	0.035	0.074
Controls	X	✓	X	✓	X	✓

Notes: The table reports OLS results. The dependent variable is the amount of money transferred from the rich stakeholder to the poor stakeholder. *Effort Poor* is a dummy equal to one if the poor stakeholder works more than 10 hours per day; *Effort Rich* is a dummy equal to one if the rich stakeholder works more than 10 hours per day; *Founder* is a dummy equal to one if the rich stakeholder founded the business he/she owns; *Trickle-down* is a dummy equal to one if the rich stakeholder's business has more than 1000 employees. Controls include: age, gender, region of residence and political affiliation. Standard errors clustered at the individual level in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table C.6: Main AMCEs: p-values with multiple testing adjustments

Variable	Unadjusted p-values	Sharpened q-value	Bonferroni	Holm
Effort Poor	0.0000209	0.00100	0.000188	0.000188
Effort Rich	0.137	0.130	1	0.549
Founder	0.818	0.486	1	1
Trickle-down	0.896	0.486	1	1
Rich	0.00533	0.0150	0.0480	0.0373
Effort Poor X Rich	0.114	0.129	1	0.568
Effort Rich X Rich	0.00427	0.0150	0.0385	0.0342
Founder X Rich	0.0505	0.0820	0.455	0.303
Trickle-down X Rich	0.981	0.486	1	0.981

Notes: The table reports the p-values when we do not adjust for multiple hypothesis testing (first column) as well as when we compute the Sharpened q-values (second column), the Bonferroni adjusted p-values (third column) and the Holm-Bonferroni adjusted p-values (fourth column).

Chapter 4

Is Redistribution Driven by Politicians' or Voters' Preferences? An Experiment with French Local Politicians

Contents

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⁰The working paper corresponding to this chapter is coauthored with Matthieu Pourieux (Université de Rennes 1,CREM).

1 Introduction

Inequalities have surged in most countries in the last decades (Piketty and Saez, 2014, Chancel et al., 2021) while redistributive policies have lagged behind (Kenworthy and McCall, 2008, Kuziemko et al., 2015). This empirical evidence contradicts the influential theoretical approach of the Meltzer and Richard model (Meltzer and Richard, 1981), which predicts an increase of both demand for and supply of redistribution in the face of increased inequalities. Such a discrepancy between theory and empirical evidence inspired scholars to focus on the low support for redistributive policies and, more generally, to investigate the drivers of citizens' demand for redistribution (Kuziemko et al., 2015, Blanchard and Rodrik, 2021). Yet, such a line of inquiry implicitly avoids analyzing the mapping from people's preferences to implemented policies, hence policymakers' responsiveness to citizens' demands. Given that the policy views of the majority might be ignored by policymakers (Bartels, 2009), understanding to what extent policymakers are responsive to people's preferences for redistribution can shed new light on the increasing inequalities/staggering redistribution conundrum.

In a well-functioning representation system, politicians are incentivized by democratic institutions to implement policies that are supported by the majority of citizens. This idea is at the heart of the Median Voter Theorem (Downs, 1957), which posits that political candidates' platforms will converge towards the median voter's policy preferences to win the election. However, as political enforcement is not guaranteed and institutions often fail, elected officials retain substantial discretionary power over policies they can use to reach their objectives. Consequently, politicians may be not only vote-maximizers but also utility maximizers (Persson and Tabellini, 2000). Stated differently, policymaking could be both demand-driven and supply-driven.

In this paper, we investigate to what extent policymakers' redistributive choices are driven by voters' and their own preferences. With this aim, the present study leverages an online experiment with a unique sample of participants, including 773 French local politicians and 661 French non-politicians. In a taxation-redistribution game (Durante et al., 2014), politicians and non-politicians choose a flat tax rate that applies to the initial earning distribution of a 9-voter group. One part of the total tax proceeds is lost, while the remainder is equally redistributed among the

group. This setting therefore reproduces the equality-efficiency trade-off (Okun, 1975) in a taxation-redistribution framework (Meltzer and Richard, 1981).

Participants choose under four different conditions generated from the combination of two treatments. The first treatment varies the participants' information about the median voter's preferred tax rate. The information is either given or not given. We elicit participants' beliefs about the median voter's preferred median tax rate in both cases. The second treatment varies the level of competition between participants. Participants either compete against one another or decide in a dictator-like setting. In the competition condition, winning depends on which participant in a randomly selected pair chooses the tax rate closest to the median voter's preference. In the dictator condition, the winner is selected at random. In both cases, the winner obtains a monetary gain, and the tax rate he chooses is applied to the 9-voter group.

The advantages of an experiment are essentially two-folded: It allows for a reduction in the complexity of the decision-making environment to focus only on its theoretically-relevant parts, and it enables the precise identification of the underlying decision mechanisms. In particular, we can directly observe to what extent voters' preferences and policymakers' ideology matter in the decision-making process. Moreover, our treatments allow us to study how the information set available to policymakers and the political competition they face can influence the impact of the two variables.

We highlight four results: First, the tax choice is influenced by the median voter's preferences no matter whether the information about such preferences is provided or not. In the information case, participants' choices are influenced by the information we provide. In the No-information case, participants' decisions are driven by their beliefs about the median voter. Further, the impact of the median voter's preference does not change between the case in which participants decide in a dictator-type setting and in the case in which they compete with another participant. This suggests that in all cases, participants hold an innate preference for granting people what they prefer.

Second, even though the correlation between the tax choice and the median voter's preference is strong, it is far from perfect even in this simple decision environment. When we provide information about the median voter's preferred tax rate, participants' tax choices deviate from this information. The average deviation is 24.67 percentage points. This deviation is highest when the information is about

a tax rate at the extremes, that is, a low tax rate (around 0%) and a high tax rate (around 100%). The deviation is minimum when we give information about a tax rate of around 50%. We find that the main drivers of such deviation are participants' beliefs about the median tax rate and the other competitor's tax choices, which are not always aligned with the information we give. This highlights the importance of participants' priors in explaining redistributive decisions.

Third, when no information about the median voter is given, participants' choices are strongly determined by ideology, with left-wing participants choosing a higher tax rate than right-wing participants. The ideology effect is strong, as it entails a 13.52 percentage points difference between an extreme left participant and an extreme right one. However, such an effect vanishes when information about the median voter's preference is provided. This result suggests that improving policymakers' information about voters' preferences may nullify the influence of partisan positions.

Fourth, politicians hold different views about the median voter's preference than non-politicians. Across all treatments, politicians believe that the median voter prefers a lower tax rate compared to non-politicians. This difference impacts tax choices: In the no-information case, politicians tend to choose a lower tax rate than non-politicians (difference in means of 4.6 percentage points), but their different beliefs entirely explain this gap. In the information case, the difference between politicians and non-politicians disappears.

The remainder of the paper is organized as follows: Section 2 relates the paper to the existing literature. Section 3 introduces the experimental design and presents our participant pools. Section 4 exposes our empirical strategy and main hypotheses. Section 5 presents our results. In Section 6 we report some additional analyses and run a battery of robustness checks. Concluding remarks follow in section 7.

2 Related literature

Our paper relates to several strands of literature, among which three are particularly relevant to situate our contribution: the literature on political representation, the literature on the determinants of redistribution, and the literature on political selection. This section briefly describes each strand and explains our contributions in each case.

The literature on political representation is voluminous. There is a consensus that politicians deviate from the median voter's preferences on many occasions (Gerber and Lewis, 2004, Stadelmann et al., 2013). Yet, the debate about the extent of such deviation and its mechanisms is far from settled. Addressing such an issue raises many empirical challenges. In particular, it is hard to find good proxies to compare what politicians do with what voters want on the same issue. Ideally, comparing the models' predictive accuracy would require observing policy changes in reaction to an exogenous shock in politicians' or voters' utility (i.e., a natural experiment). However, existing observational data provide only limited opportunities in this regard. More generally, disentangling the mechanisms at play in empirical work causes serious identification issues (Le Maux et al., 2019). For instance, politicians' lack of information about voters' preferences may hide that the median voter model is ultimately correct: it could simply be that politicians are wrong in their beliefs. Furthermore, a test of the median voter theorem is often complicated because it works well in a uni-dimensional policy space. On the contrary, the actual policy space is typically multi-dimensional. Finally, all the above mechanisms focus on an individual decision-making process. In contrast, the actual policy-making process involves many agents with different motivations (politicians, administrative staffs, experts, political parties, etc.).

Many studies rely on "ideology scores" such as the Americans of Democratic Action (ADA) score in order to bring a multidimensional policy space to a one-dimensional measure (Levitt, 1996, Lee et al., 2004, Gerber and Lewis, 2004). Other studies use specific institutional systems, like Switzerland, to assess whether there is a correspondence between politicians' roll call votes and voters' revealed preferences in referenda on the same issue (Portmann et al., 2012, Stadelmann et al., 2013, Potrafke, 2013). Alternatively, some studies rely on testing the implications of a theoretical model which builds on a median voter framework (e.g., Turnbull and Chang, 1998, Le Maux et al., 2019). Our contribution is to implement a novel method involving an experiment that reproduces the simplest version of the median voter theorem in a classical taxation-redistribution setting (Meltzer and Richard, 1981). Our experimental design allows us to directly assess whether politicians deviate from the median voter's preference on a single issue even when they have perfect information about what voters want. Moreover, we can exploit changes in the choice environment to study the drivers of such deviation while controlling for a rich set of individual characteristics. In particular, we consider the impact of

politicians' beliefs about what the median voter wants, which is usually ignored in empirical work (Liaquat, 2019).

Our paper also relates to the growing literature on the determinants of redistribution. Such an area of inquiry has surged in reaction to the rapid increase of worldwide inequalities, which raised questions about redistributive policies (Chancel et al., 2021). Such contextual elements are the first reason why we selected a taxation-redistribution framework. In addition, such a framework is a direct replication of early theoretical settings in political economy (Meltzer and Richard, 1981), which makes our results easier to interpret. Finally, the connection with ideological preferences is rather straightforward: in the early theoretical literature involving “ideology”, the left/right divide often translated into an equality/efficiency dilemma. This is also supported by experimental evidence according to which left-wing participants are more inclined towards reducing inequalities than right-wing participants, who are more sensitive to maximizing the total surplus (Fisman et al., 2017, Kerschbamer and Müller, 2020, Almås et al., 2020). So far, the existing literature have relied on both large-scale questionnaires (Alesina and Giuliano, 2011, Alesina et al., 2018, Stantcheva, 2021) as well as economic experiments (Tyran and Sausgruber, 2006, Ackert et al., 2007, Durante et al., 2014, Kerschbamer and Müller, 2020, Almås et al., 2020)¹ to study individual preferences towards redistribution. However, such literature focuses on the demand side of redistribution. Consequently, it overlooks the fact that there also is a supply side: policymakers may consider both citizens' preferences over taxation and redistribution as well as their own when making a decision. This paper focuses on the supply side of redistribution by recruiting actual policymakers as experimental subjects and assessing their reaction to citizens' demands.

Finally, our paper speaks to the literature on political selection. Following the critics addressed to the direct mapping of citizens' preferences to implemented policies which are entailed by the median voter theorem and building on an increasing number of studies showing that politicians' personal characteristics matter to policy-making (see Kuliomina, 2021, for a survey of the literature), many scholars became interested in why some specific fringes of the population decide to run for political candidacy (Besley, 2005, Braendle, 2016, Dal Bó et al., 2017, Dal Bó and

¹For detailed reviews of the literature on preferences for redistribution, see Alesina and Giuliano (2011) and Mengel and Weidenholzer (2022).

Finan, 2018). Implicitly, if representation is neither guaranteed by institutions nor by statistics, representative democracies are likely threatened. This literature focuses on an empirical description of political candidates and office holders, as well as on theoretical explanations for the selection process, with possible links to implemented policies (Gulzar, 2021). Most recently, several studies have sought to compare politicians with non-politicians using large-scale surveys and economic experiments (LeVeck et al., 2014, Enemark et al., 2016, Fisman et al., 2015, Sheffer et al., 2018, Heß et al., 2018). Our study documents behavioral differences in redistribution choices between a large sample of politicians and a representative sample of non-politicians in an identical choice environment. We analyze a dataset with far more observations than most existing studies involving politicians as experimental subjects. Furthermore, we restrict our attention to the subset of local politicians in order to avoid merging office holders from different levels (implying different selection processes) or adopting a loose definition of "political elite" (Kertzer and Renshon, 2022). In addition, local politicians are generally socio-demographically closer to non-politicians than upper-tiers politicians (Gulzar, 2021), which facilitates between-groups comparisons.

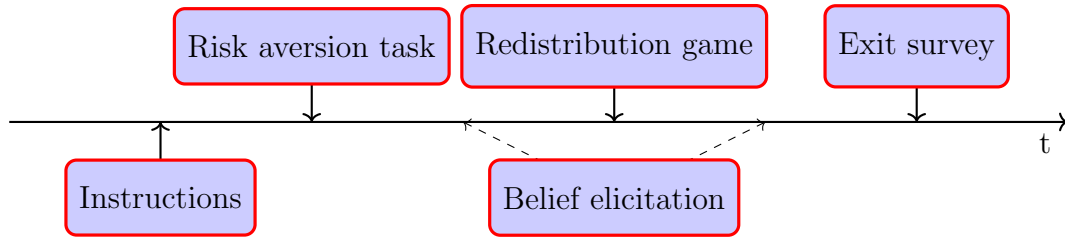
3 Online experiment

Figure 4.1 presents the experiment sequence, which is divided into three parts. After reading the preliminary instructions, participants are exposed to a risk-elicitation task (Part I). In a standard multiple price list setting (Harrison and Rutström, 2008), participants are asked to choose five times between a fixed payment and a lottery (more details D.1.1 in the appendix). Part II consists in the taxation/redistribution task in which participants choose a flat tax rate to be applied to a 9-voter group. In Part III, participants perform a belief elicitation task. The order of Part II and Part III is randomized to control for order effects. At the end of the experiment, participants answer a socio-demographic questionnaire, including questions about their political preferences.

3.1 Taxation-redistribution task

There are two types of participants in the main task: voters and policymakers. Voters form groups of nine people, each randomly receiving one out of nine possible

Figure 4.1: Sequence of the experiment



Notes: The dashed lines indicate randomization in the order of the belief task.

initial endowments. Each group is then matched with one policymaker. Policymakers are informed that the voters' group is drawn from a sample representative of the general French population. They are also informed that the endowment distribution proportionally reproduces the French income distribution in 2017 (see figure D.1 in the appendix). Each policymaker chooses a flat tax rate to be applied to the group of voters with which he is matched. Once the tax rate is applied, and tax receipts are collected, a fraction of the total tax receipts is lost while the remainder is equally redistributed among the nine voters.² In order to ease comprehension, a graphical representation of the mechanism is displayed to participants (figure D.2 in the appendix). Moreover, participants could verify the payoff table both in the initial instructions and before each decision (figure D.3 in the appendix).

Each voter states his preference over the tax rate, and the computer computes the median preference within each group (hereafter the “median tax rate”). Our sample of French politicians only participated as policymakers, while non-politicians played first as policymakers and *only after* as voters. This allows us to compare the behavior of politicians and non-politicians on the same issue.

Furthermore, each participant chooses one out of four possible scenarios from combining two between-subjects treatments.

²Specifically, a citizen j 's payoff is defined as:

$$\pi_j = y_j(1 - \tau) + \tau(1 - e) \frac{1}{9} \sum_i^9 y_i$$

where y_j is the citizen's endowment, τ is the tax rate, 9 is the number of citizens in the group and e is the efficiency loss parameter. The efficiency loss parameter $e = 6.8\%$ has been computed so that the monetary gain of the poorest citizen would have been equal to the total efficiency loss, that is $|\partial \pi_i(y_L) / \partial \tau| = |\partial \sum_i^9 \pi_i / \partial \tau|$. Since the redistributed sum consists of a lump-sum transfer to all citizens, it is equivalent to a *publicly provided private good*.

One treatment involved a variation of the information set policymakers received before making a decision. In the *Information* case, policymakers decide while having information about the median tax rate. We employ the strategy method (Selten, 1965), so that participants choose a tax rate 11 times: one per each possible median tax rate between 0% and 100%, by an increment of 10%. In the *No Information* case, policymakers did not receive any information about the median tax rate.

The other treatment involves a variation of political competition. Policymakers are anonymously paired (*stranger matching*) and are informed that no information regarding their partner's identity or choices would have been communicated to them. In the *Competition* treatment, the chosen tax rate that is the closest to the population's median tax rate is selected. Moreover, the participant whose decision was implemented could earn an additional payoff of 50 euros that was randomly assigned. The objective of this treatment is to introduce a platform competition among participants and thus to render the design more salient. In the *Dictator* case, the tax rate proposed by one of the two participants is randomly selected at the end of the game with equal probabilities. Therefore, the tax decision does not influence the probability of applying the tax rate and receiving the payoff. In other words, participants play as "impartial" decision-makers.

Table 4.2 shows the distribution of participants by each of the 4 possible scenarios. Although there are no relevant differences in the number of participants between the *Dictator* and *Competition* treatments, a greater difference arises between the *Information* and the *No Information* case. This difference likely stems from the fact that there are more choices to be made in the *Information* treatment and therefore the experiment is longer. Indeed, on average, the *Information* treatment took 32 minutes to be completed, while the treatments without information took only 20 minutes. Thus, tighter time constraints could lead to a selection into treatment. In figure D.2.3, we show that, based on observables, there are no significant differences among participants across treatments.

Figure 4.2: Distribution of participants by treatment

	(a) Politicians		(b) Non-Politicians	
	No information	Information	No Information	Information
Dictator	34%	18%	27%	21%
Competition	29%	19%	29%	23%

3.2 Belief elicitation task

In part III, we elicit participants' beliefs about the median tax rate and the decision of the participants with whom they were matched. In order to ease comprehension of such a task, we exploited a token allocation task similar to the tasks discussed in Delavande et al. (2011). Figure D.4 in the appendix shows an example of this decision. Each participant has to allocate 10 tokens to the 11 possible tax rates chosen by the median voter and the competitor with whom he is matched. All participants were informed that each token thus represents a probability of 10%.

This allocation task has the advantage of allowing respondents to conceptualize probabilities better and, by giving a fixed number of tokens, ensures that the probabilities add up to one Delavande et al. (2011). Moreover, we can retrieve the probability distribution and compute the mean, the mode, and the standard deviation of participants' beliefs.

3.3 Experimental Setting

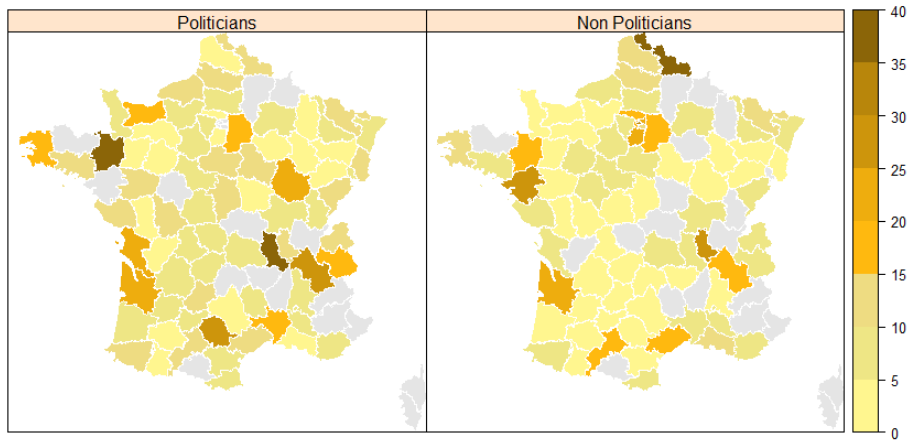
The experiment was conducted on Limesurvey³ from November 2020, 2nd to December 2020, 30th. Overall, 1528 people participated in the experiment, of whom 801 were French local politicians and 727 French citizens. On average, it took 24 minutes for participants to complete the experiment. In our analysis, we exclude 71 participants who completed it in less than 4 minutes for short treatments (*No Information*) and less than 9 minutes for long treatments (*Information*). We also exclude one politician from Martinique⁴ and 18 participants that used the phone to login even though it was not allowed.⁵ Finally, we exclude 4 politicians who did not answer the question about their mandate. The final sample includes 773 politicians and 661 citizens. Figure 4.3 depicts the geographical distribution of the response rate by experimental groups (politicians and non-politicians). We observe that both samples are representative of the whole French territory.

³Horton et al. (2011) argues that Limesurvey provides a good survey tool for online experiments as it has a good interface, sophisticated tools, and a sizeable non-academic base.

⁴Our survey was addressed to people from mainland France (*France métropolitaine*).

⁵Due to display issues of some information when using cell phones, participants were *specifically* asked to use either a computer or a tablet.

Figure 4.3: Number of participants per department



Notes: In the gray shaded departments no answers were given.

In order to contact politicians, we sent an official invitation by mail to both associations of local politicians (*Associations d'élus*) and to the town halls of all French municipalities.⁶ The invitation was accompanied by a formal demand to forward it to politicians. Any local politician could participate to the experiment. Our sample includes 159 mayors, 180 vice-mayors, and 434 local councilors. Table 4.1 shows the main institutional characteristics of our politicians sample.

⁶The mails of all municipalities were collected by web-scraping.

Table 4.1: Politicians sample

<i>Number of mandates</i>	
One	0.52
Two	0.27
Three	0.14
More than three	0.076
<i>Current office</i>	
Mayor	0.21
Vice-mayor	0.23
Local councillor	0.56
<i>Additional offices</i>	
Intermunicipal councillor only	0.98
Higher layer	0.020
<i>Municipality's population</i>	
Less than 1000	0.46
Between 1000 and 3500	0.30
More than 3500	0.24

Notes: French local politicians can also serve as intermunicipal councilor in the intermunicipal community (*Établissement Publique de Coopération Intercommunale*), which is an organization of different municipalities that cooperate to jointly provide some public goods.

The sample of non-politicians was reached through a survey institute (*Panelabs*) and was constructed to represent the whole French population older than 20 years according to the criteria of gender, age, socio-economic status, and location.

Table 4.2 displays the summary statistics of the individual characteristics obtained from the end-of-experiment questionnaire for politicians and non-politicians. Politicians are slightly older, more educated, and richer than non-politicians. There are more male politicians (60%) than female politicians (40%), while the proportions are exactly inverted for non-politicians (40% male and 60% female). Regarding political preferences, non-politicians seem slightly more right-wing and support more extreme-right parties than politicians.

Of all invitations sent and accessed, only 13% were completed in the politicians sample and 63% in the non-politicians sample. This could raise concerns about a possible selection bias driven by the politicians' strong time constraints. However, the secretaries who received our mail likely accessed the questionnaire to check its validity, which means that 13% is a very conservative lower bound for the actual

Table 4.2: Summary statistics

	Politicians (N = 773)	Non-politicians (N = 661)
Age	51.8	48.0
<i>Gender</i>		
Male	0.61	0.39
Female	0.38	0.61
<i>Education</i>		
Higher education	0.64	0.52
High school diploma	0.33	0.48
<i>Occupation</i>		
Craftmen, Retailer and entrepreneur	0.083	0.042
Employee	0.16	0.27
Executive	0.33	0.11
Farmer	0.048	0.0030
Inactive	0.039	0.100
Intermediate professions	0.11	0.15
Laborer	0.027	0.053
Retired	0.19	0.26
No answer	0.022	0.0076
<i>Gross Annual Income</i>		
Less than 10k	0.038	0.086
Between 10k and 20k	0.14	0.17
Between 20k and 30k	0.28	0.28
Between 30k and 40k	0.19	0.19
Between 40k and 50k	0.13	0.094
More than 50k	0.16	0.10
No answer	0.067	0.077
Ideology	4.67	5.54
<i>Party Preferences</i>		
Extreme Left	0.088	0.074
Left	0.26	0.20
Center	0.15	0.16
Right	0.13	0.089
Extreme Right	0.034	0.14
None	0.33	0.34

Notes: “Ideology” is a numerical variable between 0 (extreme left) and 10 (extreme right). For the classification of party preferences, see table D.1.

completion rate. In order to check for a possible selection bias in the politicians' sample, in Table B.1, we compare our politicians' sample with all French local politicians. There are no significant differences with respect to age and gender between the two groups. Our sample seems to include more politicians with executive jobs. Moreover, our politicians' sample is more skewed towards populous municipalities.

A set of instructions was provided at the beginning of the experiment. Participants were informed of the average length of the experiment (25 minutes), that anonymization was strictly guaranteed, and that 50 cents would have been donated to a charity of their choice only if the survey was completed.⁷ Moreover, they were informed that participating would allow them to earn an additional payoff whose amount would depend on the decisions made during the experiment. Specifically, they were told that 1 out of 50 participants would effectively receive their payoff at the end of the experiment⁸. This payoff could be either kept or donated to a charity, a choice they made conditional on being paid before knowing whether they were selected. Participants who chose to be paid (17 % of politicians and 85 % of non-politicians) and randomly picked by the computer received a bank transfer at the end of the survey period (beginning of January).

4 Empirical strategy

We aim to study the determinants of participants' tax choices. First, we analyze the tax choice in the *No Information* case while pooling the politician's and non-politicians' samples. The model writes

$$\begin{aligned} \tau_i = & \beta_1 \text{Dictator}_i + \beta_2 \text{Politician}_i + \beta_3 \text{BeliefMedian}_i + \\ & \beta_4 \text{Dictator}_i \times \text{BeliefMedian}_i + \beta_5 \text{Ideology}_i + \gamma X_i + \theta Z_i + \epsilon_i, \end{aligned} \quad (4.1)$$

⁷The list of charities included the "*Institut Pasteur*", which is a non-profit private organization supporting the study of biology, diseases and vaccines, the "*Restos du Cœur*", which is a charity that provides food to people in need and "*Médecins sans Frontières*", an organization providing medical support to people in conflict zones. The fact that participants had the choice between keeping their experimental gains or giving them to a charity was common knowledge from the beginning of the experiment. However, the list of charities was presented only at the end of the experiment.

⁸Charness et al. (2016) documents that paying only a group of participants is at least as effective as paying all the participants. Clot et al. (2018) finds that paying all participants in a dictator game does not affect the results.

where τ_i is the tax rate chosen by participant i , $Dictator_i$ is a dummy indicating whether the participant played as dictator (= 1) or in competition (= 0), $BeliefMedian_i$ is the mean belief about the median tax rate,⁹ $Ideology_i$ is a numerical variable between 0 (=extreme left) and 10 (=extreme right). We also include the interaction between the belief about the median voter's preference and the *Dictator* treatment to capture the impact of the lack of political competition on the influence of voters' preferences. X_i is a vector of personal characteristics including age, gender, gross annual income, education level and region of residence. Further, we control for a set of experiment-specific controls, such as the mean belief about the tax choice of the other participant with whom i is matched, a risk aversion index¹⁰ and a dummy for whether each participant played the belief-elicitation task before or after the redistribution task. Finally, ϵ_i is the error term, which is assumed to be normally distributed. Given the censored nature of the dependent variable, we employ Tobit regressions censored at 0% and 100%.¹¹

Second, we analyze the tax choice when participants have information about the median tax rate. In this case each participant makes 11 decisions. The model writes:

$$\begin{aligned} \tau_{it} = & \beta_1 Dictator_i + \beta_2 Politician_i + \beta_3 Info_{it} + \beta_4 Dictator_i \times Info_{it} + \\ & \beta_5 Ideology_i + \gamma X_i + \theta Z_i + \epsilon_{it}, \end{aligned} \quad (4.2)$$

where τ_{it} is the tax rate chosen by participant i when the information given is $Info = [0, 10, 20 \dots 100]$ for each choice $t = [0, 1, \dots, 11]$. In this case, we cluster standard errors at the individual level to account for serial correlation.

Models (1) and (2) allow us to study the relative importance of voters' preferences and participants' ideology. We can highlight a set of behavioral conjectures: First, we expect β_3 to be positive, as it represents the effect of the median tax rate, both in the form of participants' beliefs (model 1) and the information we provide (model 2), in the competition treatment (that is, when the dictator dummy is equal to zero). Indeed, the competition should push participants to converge to the median voter's preferred tax rate. Second, we expect β_4 to be negative, as deciding as a dictator will

⁹Substituting the mean belief with either the mode or the median belief does not change the results (see table D.8 in the appendix).

¹⁰The risk aversion index is computed as the number of times a participant chooses the sure outcome rather than the lottery in the multiple price list task shown in section D.1.1

¹¹In the appendix, we run the same regressions using OLS, and we obtain the same results. In the rest of this paper, we will only report results from the Tobit analysis.

reduce the importance of the median voter’s preferences. In other words, without political competition, decisions should be less driven by voters’ preferences. Finally, we expect β_4 to be negative, as it is well established that right-wing people tend to be more efficiency-oriented (Fisman et al., 2017, Kerschbamer and Müller, 2020, Almås et al., 2020).

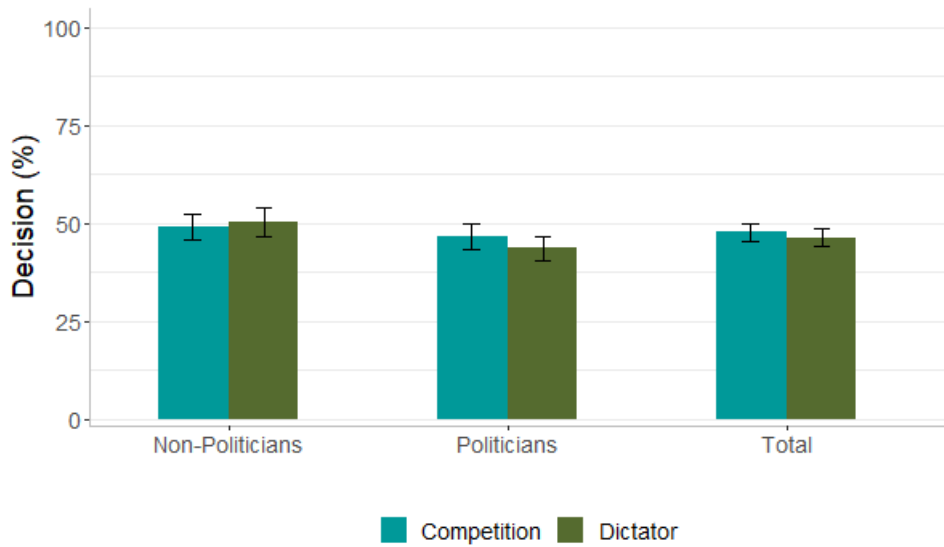
5 Results

In this section, we first propose a descriptive presentation of participants’ decisions, before turning to the regression analysis exposed above.

5.1 Descriptive analysis

Figure 4.4 reports the difference in the tax choice between the *Dictator* and the *Competition* treatment for politicians, non-politicians, and both groups pooled when no information about the median voter is given. Two results can be highlighted: First, there is no difference between the two treatments for either politicians and non-politicians (in all cases, $p > 0.1$ in a t-test for differences in means). Second, politicians choose a lower tax rate than non-politicians, possibly suggesting that the former are more efficiency-oriented than the latter. If we pool the observations from the two treatments, the difference in mean between politicians’ and non-politicians’ tax choices is 4.6 percentage points ($p < 0.01$).

Figure 4.4: Treatment effect when no information about the median voter is given



Notes: Mean and 95% confidence interval of the tax rate choice by group and by treatment. In all cases, the t-test for differences in the mean between the *Competition* and *Dictator* treatments reports a $p\text{-value} > 0.05$, meaning that the difference is not statistically significant.

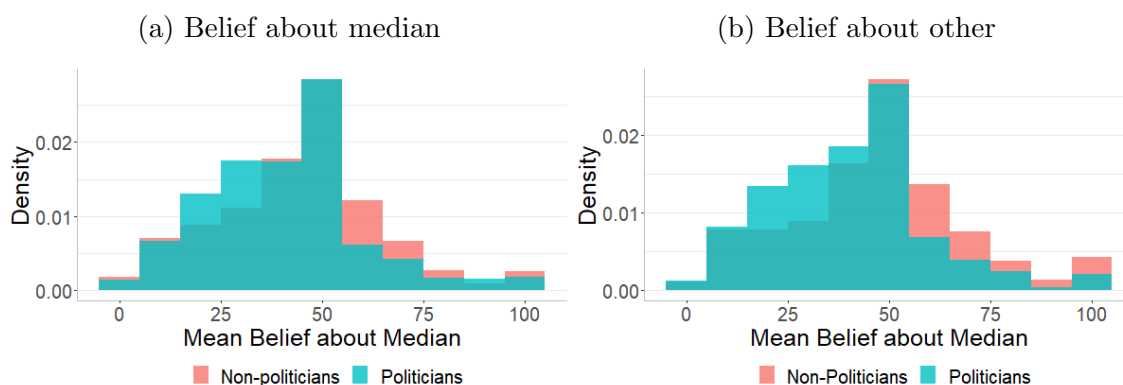
Another difference between politicians and non-politicians arises when we analyze their beliefs. Figure 4.5 plots the distribution of the beliefs about the median tax rate and the competitor's tax choice for both politicians and non-politicians when we take into consideration the mean of their subjective probability distribution.¹² In both figures, beliefs are fairly normally distributed¹³. However, politicians' beliefs are more right-skewed, meaning that they believe that both the median voter and the competitor choose a lower tax rate than what non-politicians believe. The difference between the two distributions is significant (the Kolmogorov-Smirnov test: $p < 0.05$).

We now turn to the *Information* case. Figure 4.6 shows the correlation between the information about the Median voter and the chosen tax rate, both for the *Dictator* and the *Competition* treatments. The correlation between the chosen

¹²In figure D.5 and D.6 in the appendix we show that using the mode or the median of the probability distribution does not change the shape of the beliefs' distribution.

¹³Moreover, in figure D.7 in the appendix, we plot the correlation between the beliefs about the median tax rate and the other participants' choices. The correlation is positive and strong, with a Pearson's correlation coefficient of 0.78, which is also strongly significant ($p\text{-value} < 0.01$). Thus, participants believe that the other participant chooses a tax rate close to the median tax rate.

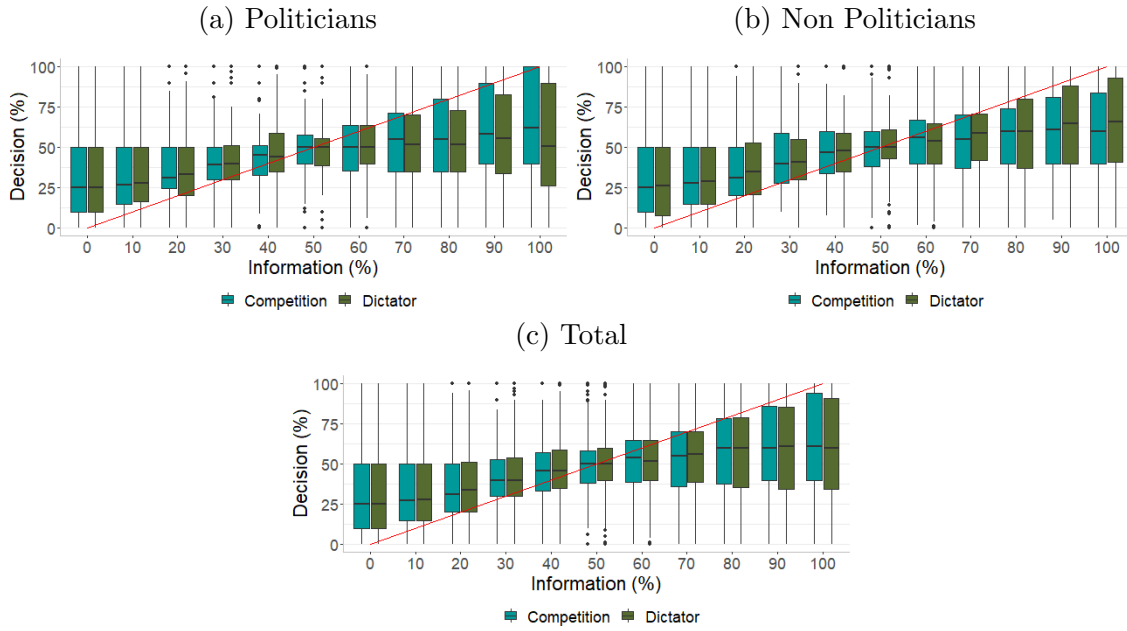
Figure 4.5: Distribution of beliefs



Notes: When plotting the beliefs about the other participant distribution, we use only data for the *No Information* treatment. Indeed, beliefs about the other participant's choice were elicited 11 times in the *Information* case and therefore the distribution plot could be misleading. In all cases, the Kolmogorov-Smirnov test for differences in distributions of politicians' and non-politicians' beliefs reports a $p\text{-value} < 0.05$, meaning that the difference is statistically significant.

tax rate and the information is positive and significant in both groups and for both treatments. However, contrary to the Median Voter Theorem's prediction, such a correlation is hardly perfect. Participants do deviate from the median voter even in the competition treatment, especially when the median voter has extreme views on taxation (tax closer to 0 % and 100 %). Finally, politicians deviate more when they play as dictators compared to non-politicians.

Figure 4.6: Treatment effect in the *Information* treatment



Notes: The red line represents the hypothetical relationship between decision and information in case of perfect correlation.

5.2 Regression analysis on tax choice

We first regress participants' tax choices on the *Dictator* treatment variable and the *Politician* dummy, and then we add all the other variables as in equation (1). In column (1) of table 4.3 the coefficient on *Politician* is negative and significant while the coefficient on the *Dictator* treatment is negative and not significant. However, the former coefficient becomes insignificant when we add the beliefs about the median tax rate. Thus, differences between politicians and non-politicians are driven by their different beliefs about what the median voter prefers. The effect of *Belief about Median* is positive and strongly significant. In column (3), the coefficient on the interaction term between the *Dictator* treatment and the beliefs about the median shows the expected negative sign, but it is not significant. In column (4), we introduce the ideology variable: We find that the more right-wing the participant is, the lower the tax rate he chooses. The coefficient on ideology is -1.352 , indicating a difference of 13.52 percentage points in tax choices at the two opposites of the political spectrum. Finally, all the previous results do not change when we intro-

duce the socio-demographic controls. At the same time, the correlation between the tax choice and the beliefs about the median decreases when we add the experiment-specific controls. In section 6, we will complement the present analysis by exploring the factors that impact the deviation between the tax choice and the median voter's preferences.

Table 4.3: Tobit regressions in the *No Information* treatment

	Dependent variable: Tax rate					
	(1)	(2)	(3)	(4)	(5)	(6)
Politician	-4.545** (1.831)	-0.552 (1.565)	-0.602 (1.574)	-1.322 (1.582)	-0.730 (1.675)	0.232 (1.706)
Dictator	-1.093 (1.830)	0.254 (1.508)	3.174 (4.340)	4.366 (4.218)	3.910 (4.266)	2.009 (4.191)
Belief about Median		0.780*** (0.0496)	0.813*** (0.0641)	0.863*** (0.0618)	0.865*** (0.0630)	0.556*** (0.0891)
Dictator \times Belief about Median			-0.0676 (0.0989)	-0.0878 (0.0945)	-0.0850 (0.0938)	-0.0433 (0.0919)
Ideology				-1.372*** (0.361)	-1.431*** (0.360)	-1.352*** (0.353)
Socio-demographic controls	X	X	X	X	✓	✓
Experiment-specific controls	X	X	X	X	X	✓
Pseudo-R ²	0.000865	0.0449	0.0450	0.0520	0.0540	0.0592
Observations	855	855	855	779	779	779

Notes: Socio-demographic controls include: age, gender, income, education level, region of residence. Experiment-specific controls include: belief about competitor's choice, a risk aversion index and a dummy for whether the belief elicitation task has been played before or after the redistribution game. In columns (4) to (6) we exclude participants who did not answer to the question about ideology. Robust standard errors in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table 4.4 reports the results of the Tobit regression for the case where participants had information about the median tax rate. First, we find no significant differences between politicians and non-politicians in all cases. Second, the coefficient on *Information* is positive and strongly significant, suggesting that participants consider voters' preferences. Third, the coefficient on the interaction *Dictator* \times *Information* shows the expected negative sign even in this case, but it is not significant. Thus, we do not observe any difference in the correlation between the tax choice and the median preference between the dictator and the competition treatment. Fourth, contrary to the case with no information, the ideology variable does not signifi-

cantly relate to the tax choice, suggesting that providing the information about voters' preferences erodes partisan biases. Finally, the previous results are not affected by the introduction of the socio-demographic controls, while the coefficient on *Information* almost halves when we add experiment-specific controls in column (5).

Table 4.4: Tobit regressions in the *Information* treatment

	Dependent variable: Tax rate				
	(1)	(2)	(3)	(4)	(5)
Politician	-0.682 (1.780)	-0.681 (1.780)	-1.970 (1.967)	-2.492 (2.270)	-1.269 (1.980)
Dictator	-0.597 (1.782)	0.790 (2.406)	0.744 (2.559)	0.744 (2.509)	0.917 (2.199)
Information	0.300*** (0.0189)	0.313*** (0.0259)	0.304*** (0.0276)	0.304*** (0.0276)	0.169*** (0.0284)
Dictator × Information		-0.0278 (0.0382)	-0.0466 (0.0411)	-0.0459 (0.0411)	-0.0416 (0.0367)
Ideology			-0.626 (0.557)	-0.667 (0.529)	-0.726 (0.442)
Socio-demographic controls	X	X	X	✓	✓
Experiment-specific controls	X	X	X	X	✓
Pseudo-R ²	0.0123	0.0124	0.0115	0.0159	0.0347
Observations	6369	6369	5577	5577	5577

Notes: Socio-demographic controls include: age, gender, income, education level, region of residence. Experiment-specific controls include: belief about competitor's choice, a risk aversion index and a dummy for whether the belief elicitation task has been played before or after the redistribution game. In columns (3) to (5) we exclude participants who did not answer to the question about ideology. Standard errors clustered at the individual level in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

6 Additional results and robustness checks

Deviations from the median. Our framework also allows us to study the deviation of participants' choices from the median voter's preference. To do this, we build an additional dependent variable which represents, in the *No-Information* case, the absolute distance between the chosen tax rate and participants' beliefs about the

median tax rate and, in the *Information* case, the absolute distance between the chosen tax rate and the information. Table 4.5 reports the results: The dictator variable has a positive sign in both cases, suggesting that participants deviate more when there is no political competition. Nevertheless, the coefficient is never significant. Additionally, when no information is provided, politicians tend to deviate less from their beliefs about the median voter than non-politicians. Ideology has an impact only when participants have no information, with right-wing participants deviating less. This result is driven by the fact that left-wing participants tend to choose a much higher tax rate while not holding different beliefs compared to right-wing participants¹⁴. Further, in all cases, participants deviate more when they believe the competitor is also deviating. Finally, in the information case, the distance between the tax choice and the information increases when the participants' beliefs about the median are not aligned with the information we give

We document that participants tend to deviate even when they have perfect information about the median voter's preferences. As shown in figure (4.6), this deviation is higher when the information provided is at the extremes (median tax close to 0% and 100%). The information we give through the strategy method can be considered a signal that can counter participants' priors about what voters want. Consequently, the information pertaining to a really low or really high tax rate can be considered unreliable. In addition, participants could be skeptical about whether the competitor will converge to such an extreme median tax rate. In order to corroborate these hypotheses, in table D.5, we study the deviation between the chosen tax rate and the information we provide for each piece of information. As expected, the coefficient on both *Belief about Median* and *Belief about Other* is strongest at the extremes and lowest at the mid-point.

Politicians and non-politicians. Table 4.6 reports the results of the main regressions when we consider the politicians' and the non-politicians' samples separately. This allows us to study the different impacts of the variables of interest on the tax choice for both samples. The results are aligned with the ones from the pooled sample. The only difference is that politicians are more ideology-driven than non-politicians. In appendix D.2.4, we also run the main regressions focusing on the politicians' sample and introducing politicians-specific variables such as the popula-

¹⁴The correlation between *Ideology* and *Belief about the median* is only -0.0021.

Table 4.5: Tobit regressions - Deviation from the Median

	Tax rate - Belief about median	Tax rate - Information
	(1)	(2)
Dictator	1.820 (1.140)	1.481 (1.197)
Politician	-2.636** (1.291)	1.396 (1.319)
Ideology	-0.633** (0.269)	0.249 (0.278)
Belief about Median	-0.0632* (0.0382)	
Belief about Median - Belief about Other	0.308*** (0.0758)	
Information		0.0121 (0.0190)
Info - Belief about Median		0.310*** (0.0345)
Info - Belief about Other		0.357*** (0.0327)
Socio-demographic controls	✓	✓
Experiment-specific controls	✓	✓
Pseudo-R ²	0.0109	0.0362
Observations	779	5577

Notes: Socio-demographic controls include: age, gender, income, education level, region of residence. Experiment-specific controls include: belief about competitor's choice, a risk aversion index and a dummy for whether the belief elicitation task has been played before or after the redistribution game. Robust standard errors in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

tion of their municipality, their political experience (being proxied by the number of former mandates), and their current mandate (mayor, vice-mayor or councilman). We find that none of these variables affects politicians' choices.

Table 4.6: Tobit regressions - Politicians and Non-politicians

	Politicians		Non-politicians	
	(1)	(2)	(3)	(4)
Dictator	4.484 (5.083)	0.893 (2.195)	0.240 (4.909)	1.336 (2.619)
Belief about Median	0.600*** (0.120)		0.551*** (0.102)	
Dictator \times Belief about Median	-0.126 (0.113)		0.0184 (0.105)	
Ideology	-1.324*** (0.407)	-0.685 (0.434)	-0.960** (0.407)	-0.120 (0.460)
Information	0.168*** (0.0283)		0.202*** (0.0362)	
Dictator \times Information	-0.0416 (0.0367)		-0.0666 (0.0435)	
Information	X	✓	X	✓
Socio-demographic controls	✓	✓	✓	✓
Experiment-specific controls	✓	✓	✓	✓
Pseudo R ²	0.0593	0.0347	0.0513	0.0334
Observations	614	5577	573	4114

Notes: Socio-demographic controls include: age, gender, income, education level, region of residence. Experiment-specific controls include: belief about competitor's choice, a risk aversion index and a dummy for whether the belief elicitation task has been played before or after the redistribution game. Robust standard errors in parentheses in column (1) and (3). Standard errors clustered at the individual level in parentheses in column (2) and (4). * significant at 10%, ** significant at 5%, *** significant at 1%.

Party preferences. In the main analysis, we exploit an ideology measure on an 11-point scale. This way of measuring ideological preferences is convenient as it translates to a numerical variable. However, it has been questioned as it pushes respondents to choose a mid-point and involves the identification of an abstract con-

cept as left and right (King et al., 2004, Kroh, 2007). For this reason, we rerun the main regressions using an alternative measure based on party preferences.¹⁵ Table D.1 in the appendix reports the results: We find that participants who declared to feel closer to right-wing parties choose a lower tax rate both in the *No-information* and *also* in the *Information* treatment.¹⁶ However, the coefficient on the party preference is always lower and less statistically significant in the *Information* case, confirming that providing the information lowers the impact of ideological preferences.

Self-interested participants The effect of the *Dictator* treatment depends on the salience of the monetary gain. Participants might not mind the possibility of obtaining a payoff, especially given that a non-negligible number of participants decided to donate the payoff to a charity (especially among politicians). In table D.6 in the appendix, we show the results from the main regressions when we consider the subsample of participants that decided to keep the gratification for themselves instead of donating it to a charity. This entails a higher interest in the monetary gain and, therefore, a higher probability of following the median voter in the competition treatment. However, even in this case, the *Dictator* treatment does not affect participants' decisions.

Additional robustness checks In the appendix, we display a battery of robustness checks to address different issues: First, we run the main regressions by excluding the participants who were not consistent in the risk-aversion task and, therefore, who were possibly not paying much attention during the experiment. Second, we exclude those participants who took less than 10 minutes to finish the survey (table (D.6)). Third, we run the main regressions using the medians and participants' beliefs to test whether our results are driven by our definition of beliefs (table D.8). Finally, we run the main regressions by OLS instead of Tobit (table D.7). In all the above specifications, results do not change.

¹⁵The classification of each party in the different ideological blocks is described in table D.1.

¹⁶Also, participants who state no political preference tend to choose a lower tax rate than left-wing participants. On the 11-point scale, these participants tend to choose 5, meaning they consider themselves moderate.

7 Conclusion

This paper provides new evidence on the drivers of policymakers' redistributive decisions by focusing on the role of voters' preferences and policymakers' own ideology. We employ a novel method based on an online redistribution experiment with 773 local French politicians and 661 French non-politicians. In our experiment, participants choose a tax rate to be applied on 9 people with different endowments, which involves an equality-efficiency trade-off. The decision environment varies in the information about the median voter's preferences and the degree of political competition. Thus, we can explore how imperfect information, participants' beliefs, and political competition influence tax choice.

We provide four main findings: *i*) Participants do consider voters' preferences. When the information about the median voter is provided, the latter strongly impacts tax choices. When participants decide without any information about the median voter, the tax choice is influenced by their beliefs about the median voter's preferences. The two effects remain strong and significant also when participants play as dictators. *ii*) Yet, the correlation between tax choice and voters' preferences is far from perfect. Participants deviate from the median preference even when provided with precise information. We find that participants' priors mainly drive this deviation about voters' preferences and the decision of the competitor with whom they are matched. *iii*) The impact of participants' ideology is strong and significant only in the no-information case, while it decreases and becomes insignificant in the information treatment. *iv*) Politicians differ in their beliefs about voters' preferences compared to non-politicians, as politicians believe the median voter prefers a lower tax rate. This drives a difference in tax choice in the no-information treatment.

Our results bear important implications. We observe that deviations between policymakers' tax choices and the median voter's preferences are possible even in a stylized choice environment where we "silence" many factors that can distort the democratic link between voters and policymakers (as lobbies, political parties, etc.). The convergence of participants' decisions towards the median preference relies on the quality of the information about such preferences, with choices being driven by the decision-maker's beliefs when the information is missing or not considered reliable. The importance of reliable information is crucial in light of recent research that showed that politicians and, in general, the "elite", have biased beliefs about voters' preferences (Liaqat, 2019, Pereira, 2021). From a research agenda perspective,

improving our understanding of the drivers of belief formation among policymakers and their impact on daily policies appears to be a fruitful line of inquiry. Finally, providing information about voters' preferences diminish the impact of participants' own ideology.

The experimental method employed in this paper can be replicated in other countries, with different samples and some design modifications. For instance, it would be interesting to gather a sample of upper-tiers politicians and study whether they are more or less responsive to citizens' preferences compared to local politicians and whether they hold different beliefs about voters' preferences. Furthermore, an extension to our design would be to introduce a self-interest dimension in participants' choices by making them part of the income distribution in the experiment and having the tax rate influence their pay-off.

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Appendix D

Is Redistribution Driven by Politicians' or Voters' Preferences? An Experiment with French Local Politicians

Contents

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D.1 Experiment details

D.1.1 Risk aversion task

In this task, you will make 5 decisions. Each decision consists in choosing one out of two options:

1. 100% chance of receiving 7 UME.
2. 50% chance of receiving 0 UME and 50% chance of receiving another amount of UME.

The computer will draw one of the 5 decisions to determine your gratification in this survey. If for this decision you chose option 1, you will receive 7 UME. If you chose option 2, the computer will draw randomly the amount that you will obtain: either 0 UME or the amount shown for this decision.

You can now make the 5 decisions below.

1. Please indicate if you wish to receive 7 UME with a probability of 100% or if you wish to have 50% chances to receive 0 and 50% to receive 12 UME.
2. Please indicate if you wish to receive 7 UME with a probability of 100% or if you wish to have 50% chances to receive 0 and 50% to receive 14 UME.
3. Please indicate if you wish to receive 7 UME with a probability of 100% or if you wish to have 50% chances to receive 0 and 50% to receive 16 UME.
4. Please indicate if you wish to receive 7 UME with a probability of 100% or if you wish to have 50% chances to receive 0 and 50% to receive 18 UME.
5. Please indicate if you wish to receive 7 UME with a probability of 100% or if you wish to have 50% chances to receive 0 and 50% to receive 20 UME.

D.1.2 Taxation-Redistribution task

During this game, you will make decisions about different people. You will never get to know the identity of these people. In the meantime, they will never know your identity.

You will make decisions about a group of 9 people. These people have been selected within a representative sample of French population by panellabs, the leading provider of quantitative data for French researchers. These people are real and can be any resident of Metropolitan France. At the end of the survey and according to the decisions you will take, these 9 people will receive a certain bonus expressed in euros. This bonus will be paid to them by bank check at the end of the survey.

At the beginning of this game, a total of 473 UMEs will be distributed among these 9 people (identified by letters from A to I). Each of these individuals will therefore receive an initial amount in UMEs. The 9 initial amounts have been calculated to reflect the distribution of annual pre-tax income of French households (INSEE 2017 data).

Thus, the first decile indicates that 10% of French households earned less than 7,310 euros per year in 2017. The equivalent of this amount in the survey is 17 MEU. The fifth decile indicates that half (50%) of French households earned less than 21,120 euros per year in 2017 and the other half of French households earned more than 21,120 euros per year in 2017. The equivalent of this sum in the survey is 49 UME. The ninth decile indicates that 90% of French people earned less than 42,370 euros per year in 2017. The equivalent of this sum in the survey is 100 UMEs.

The table below shows all the income deciles of French households and the possible initial amounts in UME.

Figure D.1: French income distribution and correspondent distribution of initial endowments

Déciles revenus des ménages (euros)	7 310	12 050	15 480	18 360	21 120	24 100	27 720	32 810	42 370
Montants initiaux possibles (UME)*	17	28	37	43	49	57	65	77	100

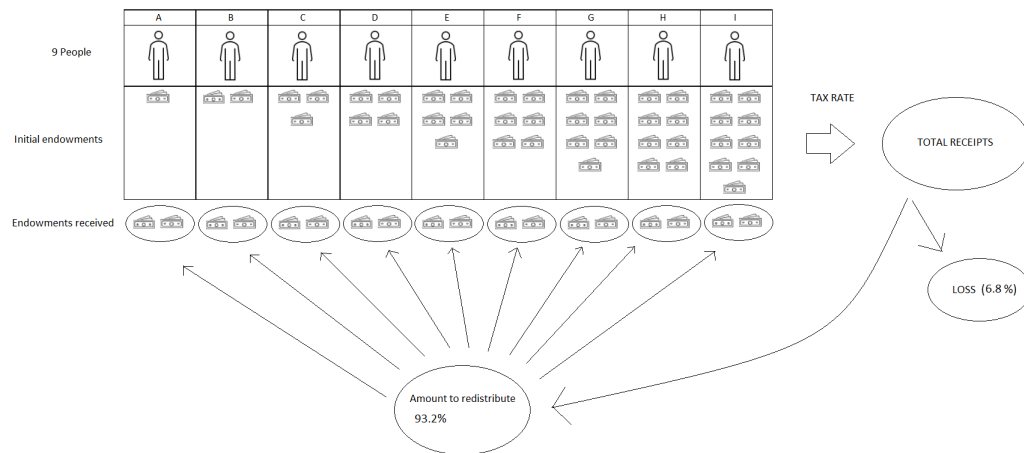
Each initial amount will be allocated to one person at random. Thus, one person will receive 17 UMEs, another will receive 28 UMEs, a third will receive 37 UMEs, etc.

You will be able to choose a tax rate expressed in percentages. The rate can range from 0% (no tax) to 100% (maximum tax).

- The rate chosen will be applied to the initial amount for each of the 9 people. A portion of each initial amount will be deducted. Each person will keep the amount not deducted;
- The amounts deducted will add up to a total amount;
- Then, a part of this total amount will be removed and will not be given to anyone. This part is fixed and amounts to 6.8% of the total amount;
- The rest of the total amount (93.2%) will then be divided equally among the 9 people.

Here is a schematic representation of the decision:

Figure D.2: Schema for comprehension of main task



The table below shows the amounts obtained by each of the 9 individuals for several possible rates. The first line corresponds to the initial situation. This situation is therefore identical to the final situation with a rate of 0% (second line). The final amounts obtained for different rates are presented in the following rows. The last column of the table shows the sum of the amounts. Thus, for a rate of 10% this corresponds to $20.2 + 30.1 + 38.2 + 43.6 + 49 + 56.2 + 63.4 + 74.2 + 94.9 = 469.8$ ECU.

Figure D.3: Payoff table

	A	B	C	D	E	F	G	H	I	Total
Montant initial	17	28	37	43	49	57	65	77	100	473
Taux = 0%	17	28	37	43	49	57	65	77	100	473
Taux=10%	20.2	30.1	38.2	43.6	49	56.2	63.4	74.2	94.9	469.8
Taux=20%	23.4	32.2	39.4	44.2	49	55.4	61.8	71.4	89.8	466.6
Taux=30%	26.59	34.29	40.59	44.79	48.99	54.59	60.19	68.59	84.69	463.31
Taux=40%	29.79	36.39	41.79	45.39	48.99	53.79	58.59	65.79	79.59	460.11
Taux=50%	32.99	38.49	42.99	45.99	48.99	52.99	56.99	62.99	74.49	456.91
Taux=60%	36.19	40.59	44.19	46.59	48.99	52.19	55.39	60.19	69.39	453.71
Taux=70%	39.39	42.69	45.39	47.19	48.99	51.39	53.79	57.39	64.29	450.51
Taux=80%	42.59	44.79	46.59	47.79	48.99	50.59	52.19	54.59	59.19	447.31
Taux=90%	45.78	46.88	47.78	48.38	48.98	49.78	50.58	51.78	54.08	444.02
Taux=100%	48.98	48.98	48.98	48.98	48.98	48.98	48.98	48.98	48.98	440.82

D.1.3 Belief elicitation task

Before making your decisions, you will now be asked to evaluate the likelihood of a series of events. You will receive 10 tokens. You will have to divide all of these 10 tokens between the different possible events. Each token represents a 1 in 10 chance (i.e., a 10% probability). If you place a lot of tokens on an event, it means that you think it is very likely that this event is true. If you place few tokens on an event, it means that you think it is unlikely that the event is true. Finally, if you place half your tokens on an event, it means that you think there is a 1 in 2 chance that the event is true. Placing these tokens will not result in a bonus. The goal is simply to indicate what you think. However, we ask that you be as accurate as possible when placing your tokens. In Part II, you will decide on a rate that affects the amount of money earned by a group of 9 people. Each of the 9 people was asked individually what rate they would like to see implemented. Each of the 9 people has positioned a cursor similar to yours to indicate this wish. Unlike your slider, the slider they were presented with went from 10 to 10, so each person had a choice of 0%, 10%, 20%, etc. up to 100%. The computer then calculated the “median wish”, i.e. the rate at which half of the people wanted a higher or equal rate and half wanted a lower or equal rate. The events you are now going to evaluate as more or less likely concern this “median wish” and will be of the form: “According to you, the median wish is ...%”. Example: if you place all your 10 tokens on the event “According to you, the median wish is 50%”, it means that you are sure that the median wish is 50%. On the contrary, if you place none of your 10 tokens on the event “According to you, the median wish is 50%”, it means that you are sure that the median wish is not 50%. Finally, if you place 5 tokens on the event “In your opinion, the median wish is 50%”, it means that you think that there is as much chance that the median wish is 50% as there is that it is not 50%.

Figure D.4: Belief elicitation task

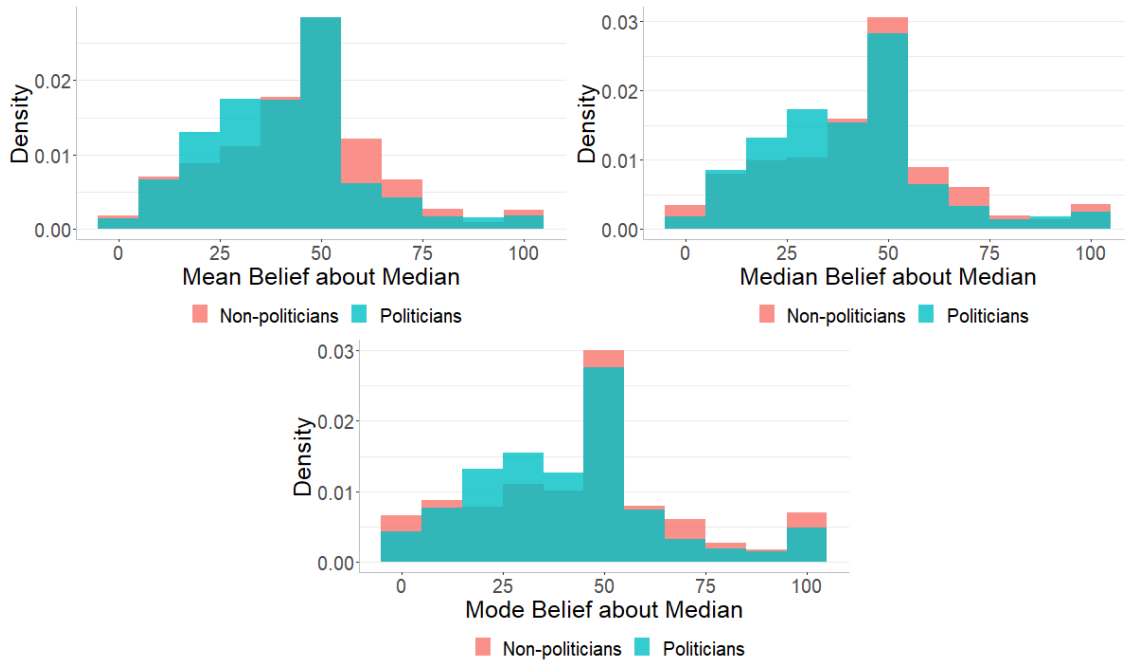
	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Jetons	7	...	2	1

Notes: “According to you, the median preference is:”

D.2 Additional figures and tables

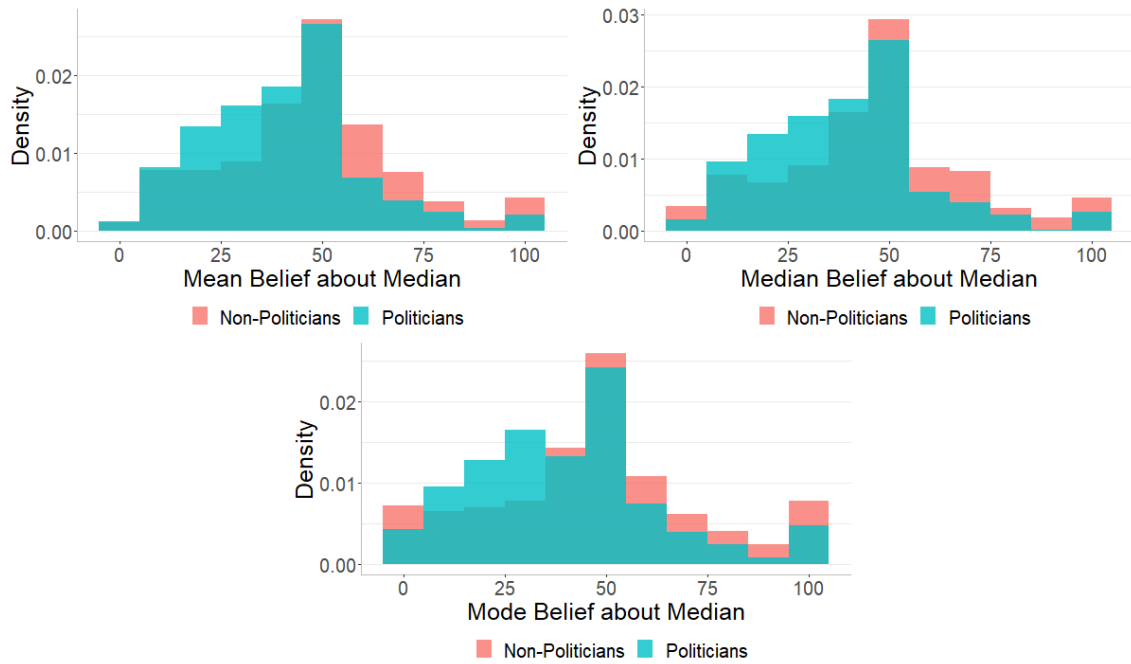
D.2.1 Beliefs

Figure D.5: Distribution of beliefs about the median tax rate



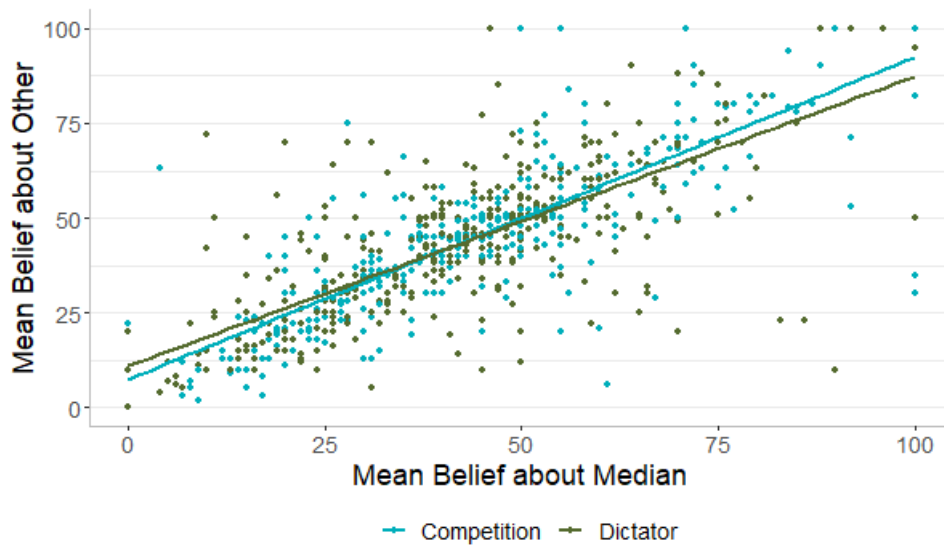
Notes: In all cases, the Kolmogorov-Smirnov test for differences in distributions of politicians' and non-politicians' beliefs reports a $p\text{-value} < 0.05$, meaning that the difference is statistically significant.

Figure D.6: Distribution of beliefs about the other participant's tax choice



Notes: Here we use only data for the *No Information* treatment. Indeed, beliefs about the other participant's choice were elicited 11 times in the *Information* case and therefore the distribution plot could be misleading. In all cases, the Kolmogorov-Smirnov test for differences in distributions of politicians' and non-politicians' beliefs reports a $p\text{-value} < 0.05$, meaning that the difference is statistically significant.

Figure D.7: Correlation between beliefs about the median tax rate and other participant



Notes: Here we use only data for the *No Information* treatment. Indeed, beliefs about the other participant's choice were elicited 11 times in the *Information* case and therefore the correlation plot could be misleading. The politicians and non-politicians samples are pooled.

D.2.2 Ideological classification of political parties

Table D.1: Political parties on the left, center and right

Ideology	Political party
Extreme Left	<i>Parti Communiste, La France Insoumise, Lutte Ouvrière/Nouveau Parti Anticapitaliste</i>
Left	<i>Parti Socialiste, Europe-Ecologie les Verts, Nouvelle Donne, Générations, Place Publique Parti Radical de Gauche/Mouvement Radical Social-Libéral</i>
Center	<i>La République en Marche, Mouvement démocrate</i>
Right	<i>Les Républicains, Union des démocrates et indépendants</i>
Extreme Right	<i>Rassemblement National, Action Française, Debout la France</i>

D.2.3 Additional summary statistics

Table D.2: Summary statistics by treatment

	No Information		Information	
	Competition	Dictator	Competition	Dictator
Age	50.1	50.1	50.0	50.0
<i>Gender</i>				
Male	0.51	0.53	0.51	0.49
Female	0.49	0.47	0.49	0.51
<i>Education</i>				
Higher education	0.60	0.58	0.58	0.58
High school diploma	0.39	0.40	0.40	0.41
<i>Occupation</i>				
Craftmen, Retailer and entrepreneur	0.060	0.075	0.069	0.047
Employee	0.22	0.20	0.22	0.21
Executive	0.25	0.21	0.21	0.22
Farmer	0.012	0.045	0.036	0.011
Inactive	0.065	0.066	0.059	0.080
Intermediate professions	0.13	0.12	0.12	0.14
Laborer	0.041	0.039	0.033	0.044
Retired	0.20	0.23	0.23	0.24
No answer	0.014	0.018	0.020	0.0073
<i>Gross Annual Income</i>				
Less than 10k	0.060	0.061	0.072	0.044
Between 10k and 20k	0.15	0.19	0.13	0.14
Between 20k and 30k	0.30	0.26	0.28	0.26
Between 30k and 40k	0.19	0.17	0.18	0.23
Between 40k and 50k	0.11	0.10	0.12	0.13
More than 50k	0.12	0.15	0.13	0.12
No answer	0.067	0.073	0.076	0.073
Risk aversion index	8.17	9.16	8.71	8.60
Ideology	5.04	4.94	5.18	5.19
<i>Party Preferences</i>				
Extreme Left	0.067	0.095	0.076	0.087
Left	0.23	0.23	0.26	0.20
Center	0.17	0.15	0.15	0.15
Right	0.12	0.12	0.099	0.11
Extreme Right	0.082	0.080	0.063	0.10
None	0.33	0.32	0.35	0.35

D.2.4 Analysis with the politicians sample

Table D.3: Tobit regressions - Politicians sample

	(1)	(2)
Dictator	-1.153 (5.662)	3.750 (3.411)
Belief about Median	0.522*** (0.130)	
Dictator × Belief about Median	-0.0109 (0.132)	
Ideology	-1.828*** (0.503)	-1.488** (0.752)
Mayor	-1.566 (2.820)	5.673* (3.420)
Vice-mayor	-0.354 (2.463)	4.826 (3.630)
<i>Municipality Pop.</i> (Baseline: Less than 1000)		
Between 1000 and 3500	3.455 (2.342)	-1.415 (2.912)
More than 3500	-0.718 (2.410)	-3.132 (3.262)
<i>Experience</i> (Baseline: 1 mandate)		
2 mandates	0.693 (2.436)	0.210 (3.314)
More than 3 mandates	-0.332 (3.055)	-3.806 (4.167)
Information		0.129*** (0.0438)
Information × Dictator		-0.0752 (0.0532)
Information	X	✓
Socio-demographic controls	✓	✓
Experiment-specific controls	✓	✓
Pseudo R ²	0.0705	0.0400
Observations	445	2783

Notes: Socio-demographic controls include: age, gender, income, education level, region of residence. Experiment-specific controls include: belief about competitor's choice, a risk aversion index and a dummy for whether the belief elicitation task has been played before or after the redistribution game. Robust standard errors in parentheses in column (1) and (3). Standard errors clustered at the individual level in parentheses in column (2) and (4). * significant at 10%, ** significant at 5%, *** significant at 1%.

D.3 Robustness checks

Table D.4: Tobit regressions with party preferences

	Tax rate	
	(1)	(2)
Politician	1.178 (1.661)	0.665 (1.835)
Dictator	0.732 (4.394)	0.736 (2.084)
Belief about Median	0.479*** (0.0852)	
Dictator \times Belief about Median	-0.0197 (0.0993)	
<i>Party preference</i> (Baseline: Left)		
Center	-2.898 (2.106)	-1.812 (2.201)
None	-4.286** (1.951)	-3.279* (1.987)
Right	-6.607*** (2.053)	-5.087** (2.403)
Information		0.171*** (0.0266)
Dictator \times Information		-0.0232 (0.0339)
Information	X	✓
Socio-demographic controls	✓	✓
Experiment-specific controls	✓	✓
Pseudo R ²	0.0539	0.0364
Observations	855	6369

Notes: Socio-demographic controls include: age, gender, income, education level, region of residence. Experiment-specific controls include: belief about competitor's choice, a risk aversion index and a dummy for whether the belief elicitation task has been played before or after the redistribution game. Robust standard errors in parentheses in column (1). Standard errors clustered at the individual level in parentheses in column (4). * significant at 10%, ** significant at 5%, *** significant at 1%.

Table D.5: Tobit regression for each given information

	Dependent variable: Tax rate										
	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Politician	4.566 (2.844)	3.035 (2.230)	1.997 (1.899)	-0.381 (1.664)	-0.625 (1.399)	-1.524 (1.673)	1.359 (1.493)	2.023 (1.781)	1.976 (2.188)	1.825 (2.626)	5.312 (3.772)
Dictator	0.382 (2.521)	-0.136 (2.048)	2.104 (1.717)	1.809 (1.466)	1.141 (1.297)	0.416 (1.456)	0.267 (1.315)	0.759 (1.516)	2.517 (1.876)	1.806 (2.306)	4.795 (3.296)
Ideology	-0.347 (0.603)	-0.226 (0.485)	0.0462 (0.409)	0.178 (0.334)	0.226 (0.303)	0.380 (0.359)	0.229 (0.328)	0.501 (0.374)	0.770* (0.464)	0.524 (0.558)	0.884 (0.812)
Info - Belief Median	0.297*** (0.0913)	0.318*** (0.0749)	0.344*** (0.0675)	0.375*** (0.0682)	0.340*** (0.0660)	0.325*** (0.0604)	0.168*** (0.0521)	0.123** (0.0533)	0.150*** (0.0579)	0.162** (0.0657)	0.246** (0.0988)
Info - Belief Other	0.452*** (0.0659)	0.324*** (0.0585)	0.305*** (0.0568)	0.299*** (0.0580)	0.211*** (0.0551)	0.199*** (0.0574)	0.259*** (0.0480)	0.244*** (0.0434)	0.290*** (0.0422)	0.354*** (0.0428)	0.455*** (0.0530)
Socio-dem. controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Exp.-specific controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pseudo-R ²	0.0367	0.0327	0.0376	0.0339	0.0245	0.0246	0.0228	0.0207	0.0239	0.0252	0.0314
Observations	507	507	507	507	507	507	507	507	507	507	507

Notes: Socio-demographic controls include: age, gender, income, education level, region of residence. Experiment-specific controls include: belief about competitor's choice, a risk aversion index and a dummy for whether the belief elicitation task has been played before or after the redistribution game. Robust standard errors in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%.

Table D.6: Tobit regression - Different robustness checks

	No-charity		Inconsistent		Too fast	
	(1)	(2)	(3)	(4)	(5)	(6)
Dictator	2.329 (5.749)	0.917 (2.199)	2.654 (4.233)	0.917 (2.199)	1.791 (4.589)	0.369 (2.222)
Politician	-0.0769 (2.234)	-1.269 (1.980)	0.260 (1.735)	-1.269 (1.980)	1.343 (1.984)	-1.011 (2.023)
Ideology	-0.869** (0.406)	-0.726 (0.442)	-1.331*** (0.358)	-0.726 (0.442)	-1.744*** (0.418)	-0.748 (0.455)
Belief about Median	0.592*** (0.117)		0.549*** (0.0907)		0.596*** (0.110)	
Dictator \times Belief about Median	-0.0285 (0.117)		-0.0543 (0.0927)		-0.0716 (0.106)	
Information		0.169*** (0.0284)		0.169*** (0.0284)		0.161*** (0.0293)
Dictator \times Information		-0.0416 (0.0367)		-0.0416 (0.0367)		-0.0331 (0.0370)
Information	X	✓	X	✓	X	✓
Socio-demographic controls	✓	✓	✓	✓	✓	✓
Experiment-specific controls	✓	✓	✓	✓	✓	✓
Pseudo R ²	0.0530	0.0347	0.0602	0.0347	0.0713	0.0354
Observations	576	5577	760	5577	592	5379

Notes: Socio-demographic controls include: age, gender, income, education level, region of residence. Experiment-specific controls include: belief about competitor's choice, a risk aversion index and a dummy for whether the belief elicitation task has been played before or after the redistribution game. Robust standard errors in parentheses in column (1) and (3). Standard errors clustered at the individual level in parentheses in column (2) and (4). * significant at 10%, ** significant at 5%, *** significant at 1%.

Table D.7: Tobit regressions with median beliefs

	Tax rate		Deviation from median	
	(1)	(2)	(3)	(4)
Dictator	0.338 (1.485)	-1.120 (1.562)	1.322 (1.320)	1.381 (1.198)
Politician	-0.214 (1.576)	-0.926 (1.879)	-3.084** (1.517)	1.864 (1.332)
Ideology	-1.330*** (0.357)	-0.557 (0.420)	-0.868*** (0.311)	0.273 (0.276)
Belief about Median	0.487*** (0.0684)	0.274*** (0.0534)		
Belief about Other	0.349*** (0.0639)	0.337*** (0.0346)		
Information		0.179*** (0.0216)		
Belief about Median - Belief about Other			0.334*** (0.0698)	
Information - Belief about Median				0.313*** (0.0337)
Information - Belief about Other				0.346*** (0.0310)
Information	X	✓	X	✓
Individual controls	✓	✓	✓	✓
R ²				
Observations	779	5577	779	5577

Notes: Controls include: age, gender, income, education level, region of residence, risk aversion index, and a dummy for whether the belief elicitation task has been played before or after the redistribution game. In column (4) and (5) we exclude participants who did not answer to the question about ideology. Robust standard errors in parentheses in column (1) and (3). Standard errors clustered at the individual level in parentheses in column (2) and (4). * significant at 10%, ** significant at 5%, *** significant at 1%.

Table D.8: OLS regressions

	Tax rate		Deviation from median	
	(1)	(2)	(3)	(4)
Dictator	0.441 (1.390)	-1.008 (1.459)	1.950* (1.046)	1.333 (1.070)
Politician	-0.221 (1.480)	-1.001 (1.593)	-2.278** (1.123)	1.498 (1.116)
Ideology	-1.201*** (0.329)	-0.561 (0.377)	-0.688*** (0.251)	0.190 (0.254)
Belief about Median	0.496*** (0.0729)	0.246*** (0.0510)		
Belief about Other	0.325*** (0.0665)	0.326*** (0.0338)		
Information		0.170*** (0.0203)		
Belief about Median - Belief about Other			0.270*** (0.0718)	
Information - Belief about Median				0.304*** (0.0315)
Information - Belief about Other				0.327*** (0.0305)
Information	X	✓	X	✓
Individual controls	✓	✓	✓	✓
R ²	0.387	0.279	0.0517	0.275
Observations	779	5577	779	5577

Notes: Controls include: age, gender, income, education level, region of residence, risk aversion index and a dummy for whether the belief elicitation task has been played before or after the redistribution game. In column (4) and (5) we exclude participants who did not answer to the question about ideology. Robust standard errors in parentheses in column (1) and (3). Standard errors clustered at the individual level in parentheses in column (2) and (4). * significant at 10%, ** significant at 5%, *** significant at 1%.

General Conclusion

The rise of economic inequalities has attracted much attention in the academic and public debate, at least from the release of *Capital in the Twenty-First Century* by Thomas Piketty. While there begins to be a general acknowledgment of the relevance of the inequalities rise, much still needs to be done to fully understand the different drivers of this evolution. Moreover, it is still unclear how individuals process the inequality subject and how they form their opinions on redistributive policies aimed at reducing inequalities. This dissertation tries to fill this gap by analyzing the spatial determinants of economic inequalities, focusing on housing wealth inequalities, and the determinants of redistribution by using theoretical, empirical, and experimental methods.

Chapter 1 investigates the interconnection between credit market imperfections, individual residential choices, and the wealth distribution dynamics. We develop a model in which agents choose how much to consume, the inheritance left to their children, and where to reside. Credit markets are imperfect, with a downpayment requirement that limits low-wealth agents' ability to obtain a mortgage. When prices in a location are too high and agents are borrowing constrained, their ability to pay is capped. Moreover, given that the only source of heterogeneity is the inheritance received by agents' parents, agents who receive a lower inheritance are more likely to be borrowing-constrained.

We first show that, when we assume no wealth inequalities, the economy experiences *symmetry-breaking* (Matsuyama, 2006), leading an initially homogeneous population to split into different wealth classes. Hence, inequalities arise endogenously. When the wealth distribution is heterogeneous, the borrowing constraint gives rise to *spatial wealth sorting*. The mechanism is relatively intuitive: Wealthier agents are less likely to be constrained, hence they can outbid the rest of the population in the most attractive areas. Moreover, wealthy agents pay less than they would do without borrowing constraints, as the latter creates downward pres-

sure on prices. Thus, wealthy individuals are two-time winners. Moreover, we show that inheritances are location-dependent. Hence, more affluent agents live in the best locations, leave a higher inheritance, and their children also locate in the best places. Spatial sorting and wealth inequalities maintain in the transitional path, and the wealth ranking does not change. In the long run, two steady states can arise: Either no agent is constrained, and there are no wealth inequalities, or the economy is characterized by persistent inequality, with wealthy individuals living in the most attractive places.

Our model has important policy implications: First, it highlights the role of borrowing constraints in generating spatial sorting and inequalities. If policymakers aim to reduce inequalities, one direct way would be to decrease the impact of the borrowing constraint. However, this measure could be undesirable, as borrowing constraints are implemented to manage financial market failures and are not a policy instrument to regulate land markets. Our model also has taxation implications: In our framework where the price people can pay is capped by the borrowing constraint, the capitalization mechanism is distorted. The Henry George Theorem, according to which a single land tax is sufficient to finance local public goods, is not verified as there is a deviation between the shadow price of land and its equilibrium value. We show that, in the presence of borrowing constraints, a tax schedule on inherited wealth (land/housing asset) and income must be implemented to cover public expenditures and achieve optimal solutions involving no long-run inequality. Hence, in our model, land taxation and inheritance taxation are interconnected, differently from most of the literature.

Chapter 2 focuses on another fundamental driver of real estate values, housing supply. In particular, I study the institutional characteristics that can impact the supply of new housing units. In France, decisions on urban development are taken by councils of municipal delegates at the inter-municipal level. The number of delegates of each municipality depends on its population share in the inter-municipal community. This chapter investigates how each municipality's voting power in the inter-municipal council affects the granting of new building permits. With this objective, I build an original dataset comprising the number of delegates per municipality in France's most dense inter-municipal communities. I then compute the Banzhaf index for each municipality, which provides a measure of voting power. Furthermore, I exploit two institutional changes in the 2014-2019 period that led to *i*) the merger of several inter-municipal communities and *ii*) the change of the

delegates allocation in some inter-municipal communities. I can therefore exploit an instrumental variable approach, where these plausibly exogenous institutional changes instrument the Banzhaf index.

I find that municipalities with higher voting within the inter-municipal council power grant more permits for single-family housing units and fewer building permits for apartment units. This difference in effects suggests that low-density development is more positively perceived than high-density development by the local population, thus pushing delegates to promote the former and limit the latter. Next, I study also how the effect of voting power varies with municipality housing density and homeownership rate. These variables serve to proxy local resistance to new development. Densely built municipalities are likely to exhibit higher housing demand, higher congestion costs and therefore fierce opposition to new construction (NIM-BYism: “Not in My BackYard”). In addition, homeowners are likely to oppose new constructions to shield the value of their houses (Fischel, 2005). I find that the effect of voting power on single-family and multi-family units is stronger in both densely built and homeowners municipalities, yet the effect is only statistically significant for denser municipalities.

These results have some important implications. The distribution of voting power within each inter-municipal community is essential in explaining the evolution of housing supply. Stated differently, two cities with the same characteristics will follow different development trajectories depending on their relative influence within the inter-municipal community. This might create additional distortions in the supply elasticity so that homeowners residing in municipalities with high voting power will be able to shield the value of their properties.

Chapter 3 delves into people’s preferences for redistribution by focusing on the role of beliefs on meritocracy and trickle-down economics. We conduct an online experiment with American participants from the top and the bottom 20% of the income distribution. Participants decide how much to redistribute between a stakeholder with a real-life income higher than \$100,000, who is always assigned \$50 in the experiment, and a stakeholder with a real-life income lower than \$10,000 in the experiment, who is always assigned \$1. We employ a conjoint analysis to describe both stakeholders’ real-life effort (hours worked per day). Moreover, the rich stakeholder is described as either the inheritor or the founder of a firm to highlight his talent (self-made narrative). Finally, the firm owned by the rich stakeholder can have less than 5 or more than 1000 employees (trickle-down narrative).

We find that the attribute impacting redistributive choices the most is the real-life effort of the poor stakeholder. When the poor stakeholder is described as working more than 10 hours per day, participants redistribute more towards him (5.4% more on average). The attributes of the rich stakeholder (his real-life effort and his talent) only affect the choices made by participants from the top of the income distribution. Indeed, wealthy participants redistribute less when the high-income stakeholder works more than 10 hours per day and when he founded the firm he owns. In all cases, the attributes highlighting the merits of the poor and the rich affect wealthy spectators more than low-income ones, suggesting that the former are more meritocratic than the latter. Finally, the trickle-down characteristic does not impact redistribution choices, except for rich liberals.

Our results have several implications: Often, the public debate hinges on the merits/demerits of both rich and poor people. Our results suggest that poor individuals' features can profoundly impact people's preferences for redistribution. Interestingly, Reagan's administration's tax and welfare benefits cuts in the 80s have been associated with public attacks on welfare recipients. These attacks might have been highly effective in pushing down people's preferences for redistribution. On the contrary, the left-wing rhetoric on the economic elite (top 1%) might be less effective in pushing people, especially poorer individuals, to vote for a higher redistribution. This asymmetry in communication styles could explain why redistribution preferences did not increase.

The last chapter of this dissertation investigates the competing impact of citizens' preferences for redistribution and policymakers' ideology on redistributive choices. The literature on political representation is voluminous, yet, every paper faces many hurdles in studying this critical research question. This chapter proposes an experimental method to explore such a line of inquiry: We conduct an online experiment with actual French local politicians and French non-politicians. Participants choose a tax rate to be applied on nine people, which generates tax revenues that will be redistributed equally among the group. However, one part of the total tax revenues is lost (leaky bucket argument), so the tax choice involves a simple efficiency-equality trade-off. The choice environment differs with respect to the degree of information about the median voter's preferred tax rate and the degree of political competition.

We provide four main findings: *i*) Participants do consider voters' preferences. When the information about the median voter is provided, the latter strongly impacts tax choices. When participants decide without any information about the

median voter, the tax choice is influenced by their beliefs about the median voter's preferences. The two effects remain strong and significant also when participants play as dictators. *ii*) Yet, the correlation between tax choice and voters' preferences is far from perfect. Participants deviate from the median preference even when provided with precise information. We find that participants' priors mainly drive this deviation about voters' preferences and the decision of the competitor with whom they are matched. *iii*) The impact of participants' ideology is strong and significant only in the no-information case, while it decreases and becomes insignificant in the information treatment. *iv*) The main difference between politicians and non-politicians is their beliefs about voters' preferences. Politicians believe the median voter prefers a lower tax rate than what non-politicians believe. This difference in beliefs drives a difference in tax choice in the no-information treatment.

The results of chapter 4 highlight that policymakers consider voters' preferences, and the electoral motif is not the only motive that counts, contrary to the standard Public Choice approach. Even when there is nothing at stake and participants decide as *impartial decision makers*, they tend to follow what the median voter prefers. In this case, the median preference has to be considered instead as a signal of voters' preferences. Yet, beliefs are essential drivers of the deviations between redistributive policies and voters' preferences. This becomes even more insightful, given that politicians tend to have different beliefs about citizens than the general population. These beliefs have also been shown to be biased. Finally, our study suggests that providing policymakers with precise information is vital for a well-functioning democratic link.

In conclusion, the first part of this dissertation analyzes inequalities from a spatial perspective and shows that there are forces that can push the world to experience economic inequality. Chapters 1 and 2 contribute to the urban and public economics literature by studying factors that impact housing wealth values. The second part of this dissertation gives a perspective on the factors that can impact redistribution by using experimental methods, focusing on the demand for redistribution (Chapter 3) and policymakers' decisions on redistribution (Chapters 4).

I believe there are many exciting research opportunities ahead: Regarding the model in chapter 1, relaxing some of its assumptions can give additional perspectives on housing wealth inequalities. For instance, one possible extension would be to study the effect of localized housing bubbles on the urban equilibrium and long-run inequalities. The study of chapter 2 could be extended by analyzing with

GENERAL CONCLUSION

more detailed data the ideological positions of municipal delegates and the political connections that are likely to arise in the inter-municipal community. These connections might affect the spatial distribution of urban development and public goods. Moreover, it would be interesting to study how municipalities' voting power impacts other policy variables, such as public expenditures and tax rates. The experimental study in chapter 3 can be extended in many ways: For example, comparing American and European respondents could help to explain differences in inequality acceptance on the two sides of the Atlantic ocean. Furthermore, different characteristics of the stakeholders could be added to the study. For instance, race discrimination against a poor stakeholder could decrease the amount redistributed. Finally, the experimental design in 4 can be used to explain different types of political elite (higher-tier politicians) and could be extended to include self-interest in the game.

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Titre : Sources Spatiales des Inégalités et Déterminants de la Redistribution

Mots clés : Inégalités, patrimoine immobilier, redistribution

Résumé : Les inégalités de richesse ont augmenté dans plusieurs pays. Le patrimoine immobilier étant une composante majeure de la richesse totale, il est fondamental d'étudier ce qui détermine sa valeur pour comprendre la dynamique de la répartition de la richesse. De plus, étant donné le niveau élevé des inégalités, une compréhension plus approfondie des déterminants de la redistribution est nécessaire. Cette thèse se développe selon ces deux axes de recherche. Le chapitre 1 étudie l'impact des contraintes d'emprunt et des choix résidentiels des ménages sur les inégalités de richesse. Nous trouvons que les contraintes d'emprunt peuvent générer des inégalités et un tri spatial des individus qui peuvent persister à long terme. Dans le chapitre 2, j'étudie l'impact du pouvoir de vote des communes dans les conseils intercommunaux sur l'offre de logements. Je trouve que les communes avec un pouvoir de vote plus élevé ont tendance

à construire moins de logements multifamiliaux et plus de logements unifamiliaux. Le chapitre 3 analyse les préférences en matière de redistribution des résidents américains appartenant aux 20% supérieurs et inférieurs de la distribution des revenus. Nous constatons que les participants redistribuent davantage lorsque les individus pauvres (bénéficiaires de la redistribution) sont décrits comme des travailleurs acharnés, tandis que les caractéristiques des personnes aisées n'influencent que les décisions des participants à haut revenu. Le chapitre 4 analyse comment les choix de redistribution des décideurs politiques sont influencés par leur propre idéologie et par les préférences des électeurs en utilisant une expérience en ligne avec des élus locaux français. Les résultats soulignent l'importance des préférences des électeurs dans les choix fiscaux et les raisons pour lesquelles les décisions des décideurs politiques s'écartent de ces préférences.

Title: Spatial Sources of Inequalities and Determinants of Redistribution

Keywords: Inequalities, Housing Wealth, Redistribution

Summary: Wealth inequalities surged in several countries. Since housing wealth is a significant component of total wealth, it is fundamental to study what determines its value to comprehend the dynamics of the wealth distribution. Moreover, given the high level of inequalities, a deeper understanding of the determinants of redistribution is necessary. This dissertation develops along these two research lines. Chapter 1 investigates the impact of borrowing constraints and households' residential choices on wealth inequalities. We find that borrowing constraints can generate inequalities and individuals' spatial sorting that can persist in the long run. In chapter 2, I study the impact of French municipalities' voting power in the intermunicipal councils on housing supply.

I find that municipalities with a higher voting power tend to build less multi-family and more single-family housing. Chapter 3 analyzes preferences for redistribution of US residents from the top and bottom 20% of the income distribution. We find that participants redistribute more when poor individuals (beneficiaries of redistribution) are described as hard workers, while the characteristics of the affluent influence only high-income participants' decisions. Chapter 4 analyses how policymakers' redistributive choices are impacted by their own ideology and by voters' preferences using an online experiment with French local politicians. The results highlight the importance of voters' preferences in tax choices and why policymakers' decisions deviate from these preferences.