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Healthcare and Federalism: A Political Economy Approach

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Abstract

Healthcare is a good of extreme importance, as it plays a major role in building the human capital stock of every country, fundamental for economic development. For this reason, healthcare provision mechanisms and healthcare quality are always at the forefront of the political debate in several countries. The aim of the present work is to provide a theoretical framework to characterize the majority voting political equilibrium over a tax aimed at financing spending on publicly provided healthcare quality, in a world in which this type of services is also provided privately, via insurance contracts. To this purpose, we build a baseline model to determine the political equilibrium in a democratic country; the model is used to understand which features play the greatest role in ultimately shaping the equilibrium outcome in terms of healthcare quality and quantity. We find that, if the public healthcare provision system is redistributive, the Median Voter theorem applies. If the system does not entail redistribution, in equilibrium a coalition of middle income voters, favoring a tax increase, will be opposed by a coalition of poorer and richer individuals, favoring a tax decrease. In addition to this, we extend the framework to understand if and how things change when the country is organized as a federal system of tax collection and public spending, in which regions are autonomous and differ among themselves in terms of wealth and equality. We find two effects acting on each region's equilibrium healthcare spending and quality: the first is an income effect, for which richer districts choose higher quality levels, and the second is an income inequality effect, for which more unequal regions end up with a lower quality public sector. The latter effect is likely to be the strongest if the system is not redistributive. After having characterized the fiscal federalism political equilibrium, we perform an assessment of the means usually adopted to correct disparities across local entities. The framework is designed to address the Italian scenario particularly well.

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Contents

"Health is the greatest wealth" (Virgil)

1 Introduction

Health is one of the most important aspects of the life of every single human being: a state of illness is able to impede basically all the activities of everyday's life. For this reason, health plays a major role in economics as well. From a micro perspective, health influences every individual's preferences and decisions in terms of allocation of resources, together with his productivity; from a macro perspective, the medical status of a population as a whole has an immediate impact on the accumulation of human capital, which, today more than ever, is a fundamental component of economic development. Further from this, healthcare is nowadays a crucial good in the utility function of every economic agent. The branch of economics which takes the name of Health Economics studies the issues related to the scarcity and allocation of health and healthcare, the interactions between their demand and supply, and the market failures involved with their provision: the seminal works on the topic are indeed those of Arrow (1963), and Grossman (1973), the latter being the first to analyze the formation of the demand for good "health" both from a theoretical and an empirical point of view.

The crucial relevance of this particular good has, over time and at least in developed countries, put the organization of its system of provision at the center of national political debates. From a strictly theoretical point of view, in fact, healthcare is not a public good, as it does not comply with non-rivalry and non-excludibility in consumption. Nonetheless, over time and space, governments in all forms have engaged themselves in providing, in different ways and with different means, the population with a minimum level of medical assistance. One reason for this is indeed the particular value of such good; the main cause, however, has to be found in a certain number of market failures which are inevitably involved with healthcare provision, and which would lead to non-Pareto efficient -and "not fair" in terms of basic human rights- allocations of resources, if this type of good were to be distributed exclusively via competitive markets (Di Matteo, 2000). The first and most relevant of these market failures is asymmetric information, both from the physician's and the patient's side. On the one hand, in fact, providers usually have more information about medical treatments and practices than their patients do. In any healthcare system, the formers act as "gatekeepers" of the system itself, deciding the amount and characteristics of the treatment. As a result of pursuing their own self-interest, they may over-prescribe care, which results in inefficient resource allocations and overspending. On the other hand, patients may have better information on their health status than providers, giving rise to a situation of adverse selection. For obvious reasons, sick people may be more likely to purchase insurance coverage than healthy ones; under a system of private insurance, this boils down into having very high premiums, and into a situation in which the low-risk individuals subsidize medical spending for the high-risks; eventually, premiums will become so high that lower income individuals will be discouraged from buying insurance, giving rise to the so-called "uninsured problem" (Besley and Gouveia, 1996). This problem also characterizes a situation in which the risk of the insured is perfectly observable, but there are individuals whose health status is so bad that the cost they would have to pay is unbearable by themselves, given their income; in a competitive market framework, these individuals would be left with no care.

Together with adverse selection, healthcare provision is also prone to moral hazard; when this service is provided under the form of an insurance coverage, patients do not bear the direct costs of a treatment. In fact, they rarely face market prices for the services they use, because insurance reimbursements act like a subsidy at the margin for the services they purchase. As a consequence, they may tend to overuse them, giving rise to overspending and inefficiencies. This type of moral hazard is crucial for cost control (Pauly, 1968, and Feldstein, 1973).

Asymmetric information, however, is not the only issue of a market-based healthcare provision system: there is a role for externalities, as well. An externality is a spillover effect that is not taken into account in a market transaction, leading to an inefficient allocative outcome. Healthcare is likely to produce many positive externalities for the community as a whole, which would be foregone if care were provided solely by private market mechanisms: an easy example is given by immunization campaigns. Moreover, a population in poor health is less productive than a healthy one: this creates production externalities for the economy as a whole.

Last but not least, governmental involvement in the provision of medical services to its citizens is also justifiable by the need of preserving basic human rights and equity; in this context, its extent often depends on ideological tones.

Being not a public good, healthcare services are tradable on private markets. As already mentioned, however, what individuals buy on them is often not the provision of the service itself, but rather an insurance coverage against the risk of having to face considerable medical expenses. This stems from the particular nature of the good "health", namely its extreme randomness, and from the risk aversion which it is often assumed to characterize human beings (Hirschleifer and Riley, 1992).

Over time, most developed countries have strived to understand and implement more efficient systems for the provision of healthcare; across the world, the service is indeed provided in very different ways. There are countries in which the system is entirely public, with healthcare expenditure representing a consistent part of the public budget; in these countries, individuals can usually obtain the care for free (financed by the general taxation) or under the payment of tariffs (e.g. Scandinavian countries). In some of these systems, however, the public good may also come, in various extents and concerning different types of care which require the need of a specialist (i.e. dental care), together with private care, financed by out-of-pocket payments of households. In other countries, instead, the largest part of healthcare expenditure of households is represented by private insurance contracts, which cover all such types of expenses: the clearest example of this type of system is represented by the United States, where public healthcare is not universal and merely represents a subsidy aimed at helping people who can insure themselves only under difficult conditions (i.e. elderly, poor etc). The share of government spending in healthcare is therefore quite varying across countries.

Healthcare systems, nonetheless, do not only differ for the type and source of financing; another aspect which displays several differences across countries is in fact healthcare performance. This can obviously be considered as more or less directly depending on the financing of the system itself, as this clearly has an influence on the amount of investments in technologies and facilities which are crucial in a sector like health. To shed light on these differences, the World Health Organization has provided, in 2001, a ranking of worldwide healthcare systems based on different indicators: despite some disagreement (Benson, Blendon and Kim, 2001) this study can be considered as a starting point to investigate on the reasons behind these disparities in performance. Some of them have achieved considerable results in terms of economic outcomes, cost effectiveness and equity. Others, instead, still face great problems: resources get wasted and/or spent inefficiently, large shares of the population are left basically uncovered by medical assistance. The political debate over this topic, therefore, is still open and several questions remain unanswered.

In addition to this, the issue becomes even more relevant in those countries where the public system has undergone a process of structural change, adding a layer of complexity to the situation. One good example of this is Italy, which, in the last 20 years, has been reforming its own system of taxation and welfare, from a centralized to a decentralized one, with the ultimate goal of achieving fiscal federalism. This governmental organizative structure is indeed very popular among developed, but also less developed countries (Oates, 1999). Devolution of powers to local districts is often seen as a good way to improve public sectors' efficiency; moreover, these entities are also closer to the people, finding it easier to adapt the provision of goods to their needs. From a theoretical point of view, this is particularly true when such districts are non-homogeneous between and within themselves, in terms of income but also culture and ethnicity (Alesina, Baqir and Easterly, 1999). Furthermore, in a fiscal federation, risks are shared among constituencies, and eventually bring less harm on each of them (Persson and Tabellini, 1996). Decentralization, however, is not always an easy story. If local districts are required, for some reasons, to cooperate among themselves, there might be incentives to moral hazard (Persson and Tabellini, 1996): this is particularly true in countries like Italy, where cooperation between regions is needed to redistribute resources from richer to poorer regions, but how to maintain economic incentives to do well for the latter is still an open question. In addition, in a context of local public good provision, there might be a role for spillovers as well; in this case, decentralization will be economically preferable to a centralized system only under some conditions on tastes for public spending, and spillovers (Besley and Coate, 2002).

Starting from this literature on health and public good provision under a federal or centralized system, the object of the present work is to develop an analytical framework aimed at understanding which variables play a role in shaping the public healthcare system, in a political context of democracy, in which healthcare is produced both by the government and by private providers. The idea has his roots in a seminal paper by Epple and Romano (1996a), who build a model to characterize the majority voting equilibrium over a tax rate aimed at financing a particular good, provided both publicly and privately. In this first work, the good under analysis is education; in Epple and Romano (1996b), instead, healthcare is taken into account, and a mixture of public and private is allowed and proved to be Pareto-superior to any other alternative. A very similar work was conducted by Gouveia (1996). In our paper, we consider healthcare quality as the key variable of interest; as a consquence, public and private constitute two alternative and mutually exclusive roads. The presence of a private alternative modifies individuals' preferences over the tax rate, which become non-single peaked: this introduces a layer of complexity in the analysis, which we are able to overcome using the approach of Epple and Romano.

As will be clear from what follows, the results we obtain, coherently with these two previous works, are different according to a particular feature of the public provision system, i.e. its ability of redistributing resources across individuals, from the richest to the poorest. This characteristic proves to be peculiar in the analysis, as it drives individual preferences over tax rates. In a redistributive system of public good provision, in fact, where the good is financed with resources collected via a proportional income tax, poorer individuals will typically prefer a higher tax rate, as they understand they will receive more than they pay; richer individuals, on the other hand, will prefer a lower tax. Each individual's preferred tax rate will be therefore decreasing in his income. The opposite is true when the system of public provision does not involve redistribution of resources: poorer voters want lower taxes and the preferred tax rate will be increasing in income. Since the redistributive power of a system of public good provision depends on a multiplicity of factors and is not easy to assess or test, in this work we perform our theoretical analysis on two parallel roads, one considering a non-redistributive system and the other a redistributive one. As we will be showing, the presence of a private alternative to the publicly provided good is particularly relevant and interesting in the case of a non-redistributive system.

Having outlined the main features of the model and derived its main implications, the same framework is used to understand how the situation changes, and in which direction, if we go from a centralized to a decentralized system, in which regions autonomously collect their own taxes and provide the public good. Again, the analysis is performed along the two parallel roads of the redistributive and non-redistributive public good provision. We consider here a situation in which local constituencies are not homogeneous between themselves in terms of income distribution, with a particular focus on income levels and inequality. As shown below, with such a starting scenario, different regions end up with different equilibria in terms of public healthcare; these disparities depend more or less strongly on each of the two features of the income distribution, according to whether the public provision system entails or not redistribution of resources across citizens. In the last part of the paper, we also propose some mechanisms to correct such performance gaps, and we assess them from an economic point of view.

The main contribution of the paper is twofold; first, it is novel in focusing on healthcare quality, instead of quantity, as the key variable which is directly related to the amount of resources fueled into the public sector. Secondly, it includes in the analysis an alternative private market which, due to the peculiar public good under analysis, takes the form of an insurance market, in which the cost of healthcare is dependent on each individual's health risk level. The main implication of our model is that, when the public healthcare system of provision is non-redistributive, the equilibrium policy outcome in terms of overall quality depends on income inequality, and on the size of the middle class: when this is very large, i.e. when wealth is distributed more equally within the community, the tax rate and the level of quality of healthcare is higher than in the case of a more unequal country. Hence, the effects and benefits of fiscal federalism depend on the internal income distribution of each region: in a country in which districts differ in terms of wealth and inequality, richer and more equal countries end up with a grater level of services quality, with the equality effect being stronger than the income level effect.

1.1 The case of Italy

The framework designed by the model we are going to present in the following section is particularly well suited to apply to the current situation of the Italian public healthcare sector.

Italy has always had a universal system of healthcare provision: the Italian Constitution, in fact, defines health as "a fundamental right belonging to every citizen, and an interest for the community as a whole" (Art. 32, Italian Constitution). After decades of compulsory healthcare insurance, in 1978 the government created the National Healthcare Service, to provide a public universal healthcare coverage. From then on, Italian healthcare provision has been mainly public. Figure 1 in the Appendix displays trends and figures over the past 15 years: after years of relative "stability", total expenditure has started to considerably increase after 2001: this rise, however, can be almost entirely ascribed to public expenditure.

Being born with a system of centralized administration, financing and provision, since 1992 the National Healthcare System has undergone a process of progressive decentralization (Acts 502/92 and 517/93): functions and decisions have been transferred from the central government to local entities, in particular to Regions and Provinces, in an attempt to increase the level of accountability and, as a result, to improve the economic efficiency of the provision system as a whole. Furthermore, in order to contain the level of public healthcare expenditure, some innovative organizational features have been added to the picture, such as elements of competition between providers. The process, however, has been very gradual: in the early '90 in fact the planning and policy-making of the system was implemented centrally, with the "Piano Sanitario Nazionale" (National Healthcare Plan), which established, among other things, an upper bound for the transfer of resources from the government to Regions and Provinces, and minimum levels of care to be achieved everywhere in the country. Local entities therefore had a maximum threshold for expenditure to be covered with national resources, and were left to collect what remained with autonomous local taxation, something which clearly provided a strong incentive toward achieving considerable levels of efficiency. The effectiveness of such instrument was however undermined by not very strong sanctions for those Regions who did not respect the expenditure thresholds.

A further, final step toward decentralization was made in 2000 with the so-called "Fiscal Federalism" Act (56/2000), which gave Regions total financial independence in the provision of healthcare services, by abolishing transfers of resources prescribed by the National Healthcare Plan and giving local entities direct access to resources coming from local and national taxes, leading to a quasi-complete federal system of taxation and provision of such public good. In this framework, every region is, under some minimum conditions of quantity and quality, free to choose modes and levels of provision, expenditure, and the proper way of funding them.

Despite the clear economic incentive that fiscal federalism could bring to the provision of goods like healthcare, the introduction of this scheme has been one of the main topics of the political debate in the country in the past years, for the implications of this structure of financing and provision in terms of equity. Italian Regions are, in fact, very heterogeneous among themselves: they differ in terms of size, economic and demographic characteristics, structure of the working force, and, as a consequence, income distribution. Table 1 in the Appendix provides an overview of such situation.

Given such differences, the outcomes in terms of healthcare spending and performance differ considerably within the country. Health expenditure, in per-capita yearly values, (ISTAT data, 2007) goes from a minimum value of 1601 in Marche, up to a maximum of 1947 euros in Molise (Figure 2).

The relationship between resources, collected through taxes, into public healthcare, and average income of each Region is non-linear; as we can see from Figure 3, we have examples of high income Regions (Lombardia, Emilia Romagna) spending way less than low-income regions (Molise, Calabria). Income distribution does not differ only across regions, but also within regions: Gini coefficients range from a minimum of 0.263 for Abruzzo, the less unequal of the Italian Regions, to 0.335 for Sicilia. It is interesting to notice (Figure 5) how some less unequal regions, such as Friuli-Venezia Giulia, spend a greater amount of resources in public healthcare than more unequal regions do, either high income (Lombardia) or low income (Campania) ones: this suggest a potential role for income inequality in the determination of the taxes financing public healthcare, which we are going to analyze more in depth in what follows.

In these considerations, nonetheless, we have to be aware of the possibility, for health expenditure, of not being a good proxy for healthcare quality: deep disparities between regions as those we have shown suggest the possibility of having different levels of efficiency in public production in different regions. Figure 6 shows the correlation between three different proxies for public healthcare quality, namely the share of people satisfied, respectively, with medical care, nursing care and sanitary fittings of the public service, and health expenditure.

As we can see, the level of efficiency varies a lot within the country. Molise, for example, is the region with the highest level of expenditure, but its users' satisfaction of the service is among the lowest; on the contrary, Emilia Romagna performs very well in terms of satisfaction, even spending a relatively little amount of resources. Figure 7, which shows the correlation between average yearly per-capita income in each region and a proxy for healthcare quality, i.e. the share of people satisfied with medical care, seems to confirm the hypothesis that fiscal federalism is detrimental to some regions' welfare:

The Gini coefficient is a measure of statistical dispersion developed by the Italian statistician and sociologist Corrado Gini and published in his 1912 paper "Variability and Mutability". The Gini coefficient is usually defined with reference to the Lorenz curve, which plots the proportion of the total income of the population (y axis) that is cumulatively earned by the bottom x% of the population. The line at 45 degrees thus represents perfect equality of incomes. The Gini coefficient can then be thought of as the ratio of the area that lies between the line of equality and the Lorenz curve over the total area under the line of equality. It is then comprised between 0 and 1; a higher Gini Coefficient signals a higher level of disparity in income distribution.

as we can see, poorer regions also end up with a poorer healthcare sector, and this could eventually lead to an increase of the already relevant disparities between Regions. A similar effect may be suggested for income inequality on the level of quality of the public healthcare sector. As Figure 8 shows, Veneto, who has one of the lowest Gini coefficients of the whole set of regions, performs well above the mean; on the other hand, Sicilia is the most unequal region and one of the worst in terms of healthcare quality. The relationship, however, is way less strong than the one between average income and healthcare quality.

As we can see from these figures, the strong differences between Italian Regions boil down into diverging levels of quality of the publicly provided healthcare services; this effect is likely to be strengthened by the process of decentralization of powers to such local entities. To this purpose, reforms towards devolution and federalism have always come together with attempts to redistribute resources from richer to poorer Regions, in order to minimize disparities and to guarantee some minimum level of care everywhere (LEA, "Livelli Essenziali di Assistenza"), to preserve basic human rights. These attempts have usually taken the form of redistributive transfers, from the central government to some Regions or between Regions. However, these transfers also involve some drawbacks in terms of economic incentives; we are going to analytically discuss this problem more in depth in what follows. Furthermore, in order to understand the actual relevance of such transfers, it is important to assess their real redistributive power. Ferrario and Zanardi (2009) estimate that the impact of healthcare redistribution is about 8% of GDP, opposed to 38% of GDP which gets redistributed through the whole system of public expenditure. In this sense, transfers related to healthcare represent about 20% of the total amount of resources which get redistributed across regions; we can conclude by saying that healthcare, in Italy, has a strong inter-regional redistributive effect.

2 The model

In this section we present a very simple static model in order to analyze the characteristics of the equilibrium outcome of a majority voting in terms of fiscal policy, when taxes finance public spending on healthcare services provision, for which a private alternative is available. Our model follows the line of reasoning of Epple and Romano (1996a) (ER in what follows) and Gouveia (1996). We consider a country in which the population of voters is modeled as a continuum of rational (utility-maximizer) individuals, indexed by i, who differ in income, y_i, and in a health risk factor p_i, which represents their own probability of getting sick and being in need of healthcare services. Income is distributed according to a c.d.f $F(y_i)$, such that $y_i \in [\underline{y}, \overline{y}]$ for every i and $\int_{\underline{y}}^{\overline{y}} y_i dF(y_i) = \widehat{y} = E(y_i)$. Income distribution is skewed to the right, therefore the median income is lower than the mean: $y^m < \widehat{y}$, where y^m is defined by $F(y^m) = 0.5$. The health risk factor p_i is distributed according to the c.d.f $S(p_i)$, such that $\int_0^1 p_i dS(p_i) = \widehat{p}$; for the moment, we assume income and health factor to be jointly distributed according to $\Theta(y_i, p_i)$.

Individuals have preferences on two types of goods: a a consumption good, c_i and healthcare services, h. The utility function of agent i is $U(c_i, qh)$ where q is the quality level of healthcare services. In line with ER, we assume U satisfies $U_1 > 0$, $U_2 > 0, U_{11} < 0$ and $U_{22} < 0$, where U_1 denotes the first derivative with respect to c_i, U_2 the first derivative with respect to q, U_{11} the second derivative with respect to c_i and U_{22} the second derivative with respect to q; U_{12} and U_{21}, coherently, denote cross derivatives. Moreover, we assume $U_{12} > 0$: an increase in healthcare quantity/quality, and thus an improvement in health, increases the utility from the consumption of the bundle good. We also assume $U_{21} = 0$: any variation in consumption has no direct impact on the utility deriving from health.

In this model, a central government intervenes in the economy producing healthcare services. This public sector provides a fixed per-capita amount h of services, with quality level g, using revenues from a proportional income tax t, and facing a unitary cost of quality production γ. For the moment, we assume that the public sector provides healthcare to the whole population. The government's budget constraint (GBC) is given by:

$$\int_0^1 \gamma g h p_i dS(p_i) \leq \int_{\underline{y}}^{\overline{y}} t y_i dF(y_i) \tag{1}$$

Public health provision, however, is not the only channel for individuals to obtain care. There exists, in fact, a private insurance market, where individuals can subscribe an insurance contract to cover all expenses related to healthcare. The amount of per-capita healthcare services that can be obtained on the private market is also fixed to h; the quality level of the private services, however, is equal to m (we take it as exogenous). Private healthcare producers face a cost per unit of quality of the service equal to λ. Given all this, on the private market individuals can subscribe a contract structured as follows: a total amount of resources $I = \lambda mh$, sufficient to buy the service, is obtained in case of need, under the payment of a unitary (per-unit of insurance) premium π_i. As a result, each individual i pays an amount $\pi_i \lambda mh$ to buy the insurance. We assume actuarially fair premiums, therefore $\pi_i = p_i$ for every i.

Further from this discussion, individuals form preferences and vote over the tax rate t; differently from Gouveia and ER, however, we assume the amount of per-capita healthcare services, h, to be fixed both in the public and in the private sector. Our endogenous parameter, which will drive political and economic decisions, is therefore the level of quality of the public sector, g, as defined by the GBC in (1).

2.1 Individual decisions

Given the features of our model and the assumptions we just made, the political equilibrium in the representative country we are considering is the result of the following individual decisions, in chronological order:

1. political decision, i.e. vote over t (g);

2. economic decision, i.e. the choice between the private alternative (”going private”) and the publicly provided service (”staying public”): this boils down in having, in each individual’s utility function, either $q = g$ (publicly provided good) or $q = m$ (private insurance).

In the present model, differently from ER and Gouveia, it is meaningful to consider the two provision channels as mutually exclusive. Indeed, the choice between public and private depends on the relative level of quality of one sector with respect to the other; if an individual decides to buy a private insurance, he automatically discards the public healthcare system and satisfies his needs only with the insurance coverage, as the driver of the choice is the service's level of quality, which obviously cannot be "mixed" across suppliers.

We analyze the problem using backwards induction, i.e. starting from the last decision in chronological order.

2.1.1 Economic decision

At this stage, each individual has to choose a provision channel to obtain healthcare services; since we assumed rationality of every individual, the driver of this choice is utility maximization. To make the decision, therefore, a generic individual i compares the indirect utilities he will obtain in the two cases:

- $V_G(t, y_i) = U(y_i(1-t), gh)$ such that $g = \frac{t\widehat{y}}{\overline{p}\gamma h}$, if he chooses the publicly provided good;
- $V_I(t, y_i) = U(y_i(1-t) - \pi_i \lambda mh, mh)$, where $\pi_i = p_i$, if he chooses the private insurance.

The presence of a double heterogeneity (y_i and p_i) complicates our analysis. For the moment we concentrate on income heterogeneity, assuming that every individual faces the same health risk $\widehat{p}$: we are going to relax this assumption later on.

An individual i is indifferent between public and private when the following holds:

$$V_G(t, y_i) = V_I(t, y_i) \tag{2}$$

$$U(y_i(1-t), gh) = U(y_i(1-t) - \pi_i \lambda mh, mh) \tag{3}$$

From the above equation we are able to find a threshold tax level $\widetilde{t}(y_i)$, such that, if $t > \widetilde{t}(y_i)$, then $U(t, y_i, \gamma) > U(m, y_i, \lambda)$ and the public alternative will be preferred, and viceversa. Obviously, in this simple configuration of the model, $\widetilde{t}(y_i)$ uniquely defines the public sector's quality level. As we can see from (2), this threshold is individual-specific, being a function of the level of income. The following Lemma clarifies this relationship:

Lemma 1. $\widetilde{t}(y_i)$ *is increasing in income.*

Proof. Differentiation of (2) yields

$$\begin{aligned}
\frac{\partial \widetilde{t}(y_i)}{\partial y_i} &= \left.\frac{\partial t}{\partial y_i}\right|_{V_G(t,y_i)=V_I(t,y_i)} \\
-\frac{\frac{\partial (2)}{\partial y_i}}{\frac{\partial (2)}{\partial t}} &= \frac{(1-t)[U_1(y_i(1-t)-\lambda\widehat{p}mh, mh) - U_1(y_i(1-t), \frac{t\widehat{y}}{\gamma\widehat{p}})]}{y_i[U_1(y_i(1-t)-\lambda\widehat{p}mh, mh) - U_1(y_i(1-t), \frac{t\widehat{y}}{\gamma\widehat{p}})] + \frac{\widehat{y}}{\gamma\widehat{p}}} > 0.
\end{aligned}$$

□

Lemma 1 implies that richer individuals will require a higher quality level of the publicly provided sector, and hence higher taxes, in order to be convinced to satisfy their needs of healthcare within the public sector.

2.1.2 Political decision

Before deciding whether to choose private or public provision channel, individuals have to vote on fiscal policy, i.e. on the level of the tax rate that finances the public sector. This choice is, again, done in a utility-maximization perspective. The presence of the public alternative, however, may lead individuals' preferences over the tax rate to violate the single peakedness assumption. In fact, the problem individuals face is the following:

$$\begin{aligned}
&\max_t Max\left\{U\left(y_i\left(1-t\right), gh\right), U\left(y_i\left(1-t\right) - \pi_i \lambda mh, mh\right)\right\} \\
st.t\widehat{y} &\geq g\gamma\widehat{p}h
\end{aligned}$$

The Single-Peakedness assumption is crucial in the characterization of a majority voting political equilibrium, as it allows Black's Theorem to be applied (Black, 1948)

Note how, if there were no private alternative to the publicly provided service, the problem would have been:

$$\begin{aligned} &\max_t U(y_i(1-t), gh) \\ st.t\widehat{y} \quad &\geq g\gamma\widehat{p}h \end{aligned}$$

which would lead to the following first order condition:

$$-y_i U_1(y_i(1-t), \frac{t\widehat{y}}{\gamma\widehat{p}}) + \frac{\widehat{y}}{\gamma\widehat{p}} U_2(y_i(1-t), \frac{t\widehat{y}}{\gamma\widehat{p}}) = 0 \tag{4}$$

As we can see, this FOC is non-monotone in t; the problem would hence have an internal solution for t^* (Laffer curve). Taking into account the presence of the private alternative, however, leads utility to depend on the tax rate as in Figure 8 of the Appendix.

From this analysis, it follows that when the tax rate is lower than the threshold $\widetilde{t}$, individual i strictly prefers to go private: his preferred tax rate would be $t = 0$, as shown in Lemma 1. On the other hand, when $t > \widetilde{t}$, preferences form a Laffer curve. The figure clearly explains how the presence of the private alternative leads preferences over t to violate the single-peakedness condition; a Condorcet winner may fail to exist, as we cannot rely on this condition to legitimately apply the Median Voter theorem to find the majority voting political equilibrium.

2.2 Equilibrium

In order to analyze the problem and find the policy outcome of the majority voting, it is useful to focus our attention to $t^*(y_i)$, namely the tax rate that maximizes utility of individual i, trying to understand its behavior as income varies. Notice that, from (2) if individual i prefers the public alternative,

$$\frac{\partial t^*(y_i)}{\partial y_i} = -\frac{-U_1(.) - y_i(1-t)U_{11}(.) + (1-t)\frac{\widehat{y}}{\widehat{p}\gamma}U_{21}(.)}{y_i^2 U_{11}(.) - \frac{y_i\widehat{y}}{\widehat{p}\gamma}U_{12}(.) - \frac{y_i\widehat{y}}{\widehat{p}\gamma}U_{21}(.) + (\frac{\widehat{y}}{\widehat{p}\gamma})^2 U_{22}(.)}$$

As we can see, the relationship between $t^*(y_i)$ and y_i is not monotone, and its sign is unclear: it therefore depends both on preferences and of the system of public provision. A utility-maximizing tax rate t^* is increasing in income when healthcare services are a normal good, and the tax is analogous to a "tariff" each user has to pay to consume it. If, nonetheless, the system of public healthcare is structured in such a way that the provision of such good involves redistribution of resources from rich individuals to poor ones, despite normality of the good healthcare, t^* might actually become decreasing in income. Quite intuitively, these two scenarios yields different results in terms of political equilibrium.

We now introduce and prove the main results of majority voting.

Proposition 2. *If* $\frac{\partial t^*(y_i)}{\partial y_i} < 0$*, a majority voting equilibrium tax rate* t^* *exists, and it coincides with the median income voter's preferred outcome.*

Proof. Call y^m the median income. Assume first that $t^*(y^m) \geq \widetilde{t}(y^m)$, i.e. the median income voter is a public services user. Since t^* is decreasing in income, all the individuals with $y > y^m$ will prefer t^* to any $t > t^*$; in particular, the voter who is indifferent between public and private services, as $t^*(y_i)$ is decreasing in income, has income $y' > y^m$. As a result, all individuals with income $y > y'$ will prefer the private alternative to the public one; their utility is therefore maximized at $t = 0$. By the same reasoning, all voters with income $y < y^m$ will prefer t^* to any $t < t^*$. In fact, due to the redistributive feature of the public sector, these individuals have $t^*(y_i) > t^*$; moreover, we can be sure that they will prefer to go public, as for all $y'' \leq y^m$, $\widetilde{t}(y'') < t^*(y^m)$ (as we said, in fact, $\widetilde{t}(y_i)$ is increasing in income, $t^*(y_i)$ is decreasing, and y' satisfying $t^*(y') = \widetilde{t}(y')$ is such that $y' > y^m$). Further from this reasoning, $t^* = t^*(y^m)$ is thus able to win a majority voting. If we change our initial assumption and consider the case in which $t^*(y^m) < \widetilde{t}(y^m)$, we are in front of a situation in which the median income voter strictly prefers the private insurance contract to public healthcare, and will thus favor a zero tax rate. Due to the features of $t^*(y_i)$ and $\widetilde{t}(y_i)$, we know that all individuals with $y > y^m$ also strictly prefer the private alternative, and therefore $t^* = 0$; the same is true for all the individuals with income $y < y^m$ and $y > y'$, where y' satisfies $t^*(y') = \widetilde{t}(y')$; $t^* = 0$ is therefore preferred by more than the majority of the population, and will be the policy outcome of a majority voting in this context. $\square$

This result is identical to the one we obtain in case of no private alternative; as said, this happens because, under the assumption of diminishing-in-income utility-maximizer tax rates, the introduction of a private alternative is not able to change the voting equilibrium. The above proposition clarifies how the equilibrium outcome is shaped in the case in which public production of healthcare services entails some sort of redistribution, which leads poorer individuals to prefer a higher tax rate, and viceversa. When the system is redistributive, the presence or absence of a public alternative is not able to modify the voting equilibrium that would have been reached if there were no private market for the good: in fact, the availability of the alternative has the effect of leading a share of the population not to use the public service but rather to go private. As we saw, this decision is based solely on utility; Lemma 1, moreover, shows how this share of voters is composed by richer individuals, as their requirement on the tax rate in order to be convinced to stay public is more stringent. When the poorer individual among those going private is richer than the median voter, we are in a situation in which poorer individuals favor a tax increase, and are contrasted by richer voters who instead would prefer a tax decrease, either because of the redistributive flavor of the public provision, or because they know the will not be the users of the service they are financing via taxation. This situation, in terms of voting, is not different from that we would have had if the publicly provided service were the only available option, and the median voter's preferred policy outcome is still able to win over alternatives in a majority voting context.

The following propositions draws the equilibrium in the alternative case of a non-redistributive public provision system.

Proposition 3. *If* $\frac{\partial t^*(y_i)}{\partial y_i} > 0$*, the median income voter's preferred policy outcome is not a majority voting equilibrium.*

Proof. Call t^m the tax rate preferred by the median voter, who has income y^m. Given that $\frac{\partial t^*(y_i)}{\partial y_i} > 0$, all individuals with $y < y^m$ will prefer t^m to any $t > t^m$ and favor a tax reduction. If there were no private alternative, we would have that, analogously, all individuals with $y > y^m$ would prefer t^m to any $t < t^m$, favoring a tax increase, and t^m would be an equilibrium. However, at $t = t^m$, some of the individuals richer than the median voter will actually go for the private insurance, and favor a tax reduction; we have that more than half of the population would prefer a lower tax rate, hence t^m cannot be an equilibrium. □

The fact that, if $\frac{\partial t^*(y_i)}{\partial y_i} > 0$, more than half of the population favors a tax reduction when $t = t^m$ gives the proof of the following:

Corollary 4. *If $\frac{\partial t^*(y_i)}{\partial y_i} > 0$, if a majority voting equilibrium exists, it entails less public expenditure than the median voter's most preferred choice.*

Proposition 5. *If $\frac{\partial t^*(y_i)}{\partial y_i} > 0$, a majority voting equilibrium tax rate t^* exists, and it is such that:*

1. *$\exists y_h \in [\underline{y}, \overline{y}]$ such that $U(y_h(1-t^*), \frac{t^*\widehat{y}}{\gamma\widehat{p}}) = U(y_h(1-t^*) - \widehat{p}\lambda mh, mh)$, i.e. individual with income y_h is indifferent between public and private healthcare;*

2. *$\exists y_l \in [\underline{y}, \overline{y}]$ such that $t^* \in \arg\max_t U(y_l(1-t), \frac{t\widehat{y}}{\gamma\widehat{p}})$;*

3. *$y_h > y_l$;*

4. *$\rho = \int_{yl}^{y_h} dF(y_i) = 0.5$.*

Proof. The proof assumes existence of individuals with incomes y_h and y_l satisfying 1, 2 and 3 and aims to show that, in order for t^* to be a majority voting equilibrium, 4 has to be satisfied. Given that both t^* and $\widetilde{t}$ are increasing in income, individuals with income $y > y_h$ will prefer the private alternative and therefore a lower tax rate. Individuals with $y < y_l$, analogously, are poorer and have a lower bliss point for the tax rate. For the same token, individuals with income $y \in (y_l, y_h)$ would instead favor an increase in the tax rate; therefore, if $\rho > 0.5$, t^* would be defeated by a higher t in a majority voting, and the opposite situation would be verified in the case $\rho < 0.5$. □

As we can see from the above proven results, matters are different when the public provision of the healthcare service is not redistributive: in this case, in fact, in the absence of a private alternative the median income voter's preferred policy outcome would be the majority voting winning option, as exactly half of the population (the richest one) would favor a tax increase, while exactly the other half would instead prefer a tax decrease. When we introduce a private alternative, we drive the situation out of equilibrium: a share of the richer individuals that would have preferred an increase now chooses to buy the insurance, not consuming the publicly provided good and therefore voting for the lowest possible tax rate. In this situation, the equilibrium tax rate has therefore to be lower than the maximizer of the median voter's utility function. In particular, it has to be such that a coalition of middle-income individuals favors a tax increase, as they are rich enough to pay for the public system but poor enough not to switch to the private insurance, and it is contrasted by a coalition of very poor and very rich people favoring instead a decrease in t, the former because of a tight budget constraint and the latter because they do not want to pay for a service they will not use, as thet prefer to go private. It particular, each of these coalition has to contain 50% of the population for the tax rate to be an equilibrium policy outcome. The presence of the private alternative, as we see, draws a situation in which a middle class is in favor of higher spending in healthcare quality. Clearly, the performance of the public healthcare sector, directly depending on the amount of resources collected via general taxation and spent on it, will depend on the characteristics of such group of voters: the richer, on average, is the middle class, the better will be the public health services.

2.3 Relaxing the assumption on the GBC

The results of the above analysis come at the cost of a rather strong assumption: up to now, in fact, we have been assuming that the government, when it allocates the resources collected via the general taxation to the production of healthcare services, does not internalize the fact that not *all* the population is actually going to use them, given

This finding is analogous to the one by Epple and Romano (1996) and Gouveia (1996).

that a part of it will buy the insurance. As we can see from the GBC in (1), healthcare quality is produced as if every individual were to use the public sector. It is however more realistic to think that, when allocating resources to produce any good, the government itself takes into account the amount of demand it has to face, i.e. the number of users, which becomes, therefore, endogenous. This is the reason that leads us, in this section, to extend our analysis to a more general case in which the utility function of individual i is, again, given by:

$$U(c_i, qh)$$

and the government budget constraint is now:

$$\int_0^1 \gamma n g h p_i dS(p_i) \leq \int_{\underline{y}}^{\overline{y}} t y_i dF(y_i) \tag{5}$$

where n represents the share of public sector users, and can be defined as $\int_0^1 \mu_i dS\left(p_i\right)$, where

$$\mu_i = \begin{cases} 1 \text{ if } i \text{ uses public services} \\ 0 \text{ otherwise.} \end{cases}$$

In this section, again, we stick to our previous assumption: $p_i = \widehat{p}$ for every individual. Notice that, if we fix a pair (g', t'), we have that

$$n(g', t') = F(y')$$

where $F(.)$ is the c.d.f. of income and y' is such that

$$U(y'(1-t), g'h) = U(y'(1-t) - \widehat{p}\lambda mh, mh)$$

As a result, $n(g', t')$ includes all those individuals with income lower or equal than that of the individual indifferent between public and private at (g', t'). As a consequence, under this less restrictive assumption, t and g are not one the "linear" consequence of the other anymore: being $n(g',t')$ endogenous, a higher t does not necessarily lead to a higher *per capita* quality level g, as the increase in the tax rate may come together with an increase in the number of public services users.

Calling $g^*(t)$ the per-capita quality level of the publicly provided service, from (3) we have that $g^*(t) = \frac{t\widehat{y}}{n(g^*,t)}$ and

$$\begin{aligned}\frac{\partial g^*}{\partial t} &= \frac{\widehat{y}}{n(g^*,t)} - \frac{t\widehat{y}}{[n(g^*,t)]^2}\frac{\partial n(g^*,t)}{\partial t} \\ &= \frac{\widehat{y}}{n(g^*,t)}\left[1 - \frac{t}{n(g^*,t)}\frac{\partial n(g^*,t)}{\partial t}\right]\end{aligned}$$

Clearly, it may well be the case that, for some (g,t), $\frac{\partial n(g^*,t)}{\partial t} > \frac{n(g^*,t)}{t}$. We therefore face an irregular budget constraint, as the one provided in ER.

In order to analyze the problem more in depth, it is useful to sketch the map of the indifference curves for individual i in the plane $(g$,$t)$ (Figure 10). Clearly, now the relationship between g and t is slightly more complex, because of the endogeneity of n. We call $\widetilde{g}(y_i)$ the level of quality of the publicly provided sector at which individual i, with income y_i, is indifferent between the public and the private alternative. As $g < \widetilde{g}(y_i)$, the individual is not going to use the publicly provided service and the indifference curves will be flat for a given t. We then have a kink at $\widetilde{g}(y_i)$, where the indifference curve starts to be increasing in the plane; in fact, calling $M(g, y_i, t)$ the slope of the indifference curve when $g > \widetilde{g}(y_i)$, we get:

$$M(t, y_i, g) = -\frac{\frac{dU}{dg}}{\frac{dU}{dt}} = \frac{hU_2'(.)}{y_iU_1'(.)} > 0$$

Intuitively, when individual i is a public services user, as he pays more taxes he now also gets higher quality (and viceversa). The locus of the points $(g\,,t)$ that make an individual indifferent between public and private, again, satisfies:

$$U(y_i(1-t), gh) = U(y_i(1-t) - \pi_i \lambda mh, mh) \tag{6}$$

Differentiating this expression, we get:

$$\left.\frac{\partial t}{\partial g}\right|_{V_G(.)=V_I(.)} = \frac{hU_2'(y_i(1-t), gh)}{y_i[U_1(y_i(1-t), gh) - U_1(y_i(1-t) - \pi_i \lambda mh, mh)]} < 0 \tag{7}$$

The following Lemma, containing a result by ER, is analogous to Lemma (1) in the case of non-endogenous n, and will be helpful in deriving some of our results.

Lemma 6. *$\widetilde{g}(y_i)$ is increasing in y_i; therefore, richer individuals will require a higher quality level in order to choose the public alternative.*

Proof. Differentiation of (6) yields

$$\frac{\partial g}{\partial y_i} = \frac{\frac{\partial (6)}{\partial y_i}}{\frac{\partial (6)}{\partial g}} = -\frac{(1-t)[U_1'(y_i(1-t), gh) - U_1'(y_i(1-t) - \widehat{p}\lambda mh, mh)]}{hU_2'(y_i(1-t), gh)} > 0$$

due to our assumptions on $U(.)$. □

Elaboration of Lemma 6 leads to the following:

Corollary 7. *If at any (g',t') an individual with income y' weakly prefers private to public, so will do all those with incomes $y > y'$; if y' weakly prefers public, so will all $y < y'$.*

Proof. Let V' be an indifference curve (indirect utility level) passing through (t',g') of the individual with income y' that weakly prefers the private alternative. The kink of V' will be situated to the right of (t',g'). Lemma 6 therefore ensures that all $y > y'$ will have the kink of their indifference curve through (t',g') to the right of this point and will therefore also prefer the public alternative. By a similar argument it can be shown that if y' prefers the public provision, so will all $y > y'$. □

2.3.1 Equilibrium

As in the previous, simpler case, preferences fail to satisfy the single-peakedness condition in presence of a private alternative. In order to characterize the voting equilibrium, as explained in ER, we need to uncover the conditions that lead preferences to satisfy the single crossing property, a necessary condition for the Median Voter theorem to apply. Under the less restrictive assumption of endogenous n, as before, we distinguish the case in which public provision entails redistribution from the alternative one. To do this, we analyze the behavior of the slope of the indifference curve when $g > \widetilde{g}(y_i)$ with respect to income.

Calling $M(g, y_i, t)$ the slope of the indifference curve of individual with income i associated to the point (g, t) in the relative plane, differentiation of it with respect to y_i yields:

$$\begin{aligned}\frac{\partial M(g, y_i, t)}{\partial y_i} &= -\frac{1}{y_i^2}\frac{hU_2'(.)}{U_1'(.)} + \frac{h(1-t)U_{21}''(.)}{y_i U_1'(.)} - \frac{h(1-t)U_2'(.)U_{11}'(.)}{y_i[U_1'(.)]^2} \\ &= \frac{h}{y_i U_1'(.)}\left[-\frac{U_2'(.)}{y_i} + (1-t)U_{21}''(.) - \frac{(1-t)U_2'(.)U_{11}'(.)}{U_1'(.)}\right]\end{aligned}$$

Given that $U_{11}'(.) < 0$ by assumption, the sign of the expression is unclear; we therefore consider both the case in which $\frac{\partial M(g,y_i,t)}{\partial y_i} < 0$ (SDI, Slope Decreasing in Income) and in which $\frac{\partial M(g,y_i,t)}{\partial y_i} > 0$ (SRI, Slope Rising in Income). Intuitively, when SDI holds, the system is redistributive and viceversa. As before, the two situations lead to different majority voting equilibria, as defined in the following propositions.

Let us first consider the case in which SDI holds. Under this assumption, the Median Voter theorem can be applied, as shown by the following:

Lemma 8. *(ER) If SDI holds, the utility function $U(.)$ and its indifference curves in the plane (t,g) satisfy single-crossing, i.e. any indifference curve $V(y'(1-t), gh)$ crosses another indifference curve $V(y''(1-t), gh)$ at most once; if a crossing occurs, and $y'' > y'$, the indifference curve of y'' crosses crosses that of y' from above.*

Proof. We prove the first claim by contradiction. First of all, we have to rule out two cases: one is illustrated in Figure 11, by the solid curves; as we see, V'' crosses V' twice, one along the flat part and one along the upward-sloping one. To show the contradiction, let us consider the indifference curve of y' that has its flat part coinciding with that of V''; we call it $\widehat{V}'$. By (7), the corner of $\widehat{V}'$ is downwards and to the right of the corner of V', and therefore to the right of the corner of V''. But since we assumed that $y'' > y'$, this contradicts Lemma 6.

The other case to be ruled out is that in which the flat parts of the indifference curves of y' and y'' are distinct or overlap, and the upwards sloping parts cross many times, as this is clearly a violation of the assumption of SDI. Lemma 6 implies that the upward sloping portion V'', given $y'' > y'$, cannot intersect the flat part of V'. From this together with SDI, it follows that any crossing must be one in which V'' crosses V' from above. □

The result we just obtained helps us a lot in the derivation of the equilibrium level of healthcare quality g, as it allows us to write and prove the following:

Proposition 9. *If preferences satisfy* $\frac{\partial M(t,y_i,g)}{\partial y_i} < 0$*, a majority voting equilibrium over* (t, g) *exists, and it coincides with the median voter's preferred policy outcome.*

Proof. The proof is based on ER and Roberts (1977). Let (t^*, g^*) be the median voter's most preferred policy outcome which satisfies the GBC, and assume that $(t^*, g^*) >> 0$ and is unique. Call V^m the indifference curve (with corresponding level of indirect utility V^m) that crosses the GBC in (t^*, g^*) (see Figure 12). There cannot be any points on the GBC below V^m, because they would obviously be preferred to (t^*, g^*) by the median voter in a majority voting, and (t^*, g^*) would not be a bliss point. Consider next the points on the GBC above V^m and the horizontal line passing through (t^*, g^*) (point A); Lemma 6 ensures that all the voters with $y > y^m$ will prefer (t^*,g^*) to such point (dashed line). But, since y^m is the median income, (t^*,g^*) will be preferred by at least half of the population. Analogously, all the points on the GBC above V^m and below the line through t^* will be preferred by voters with $y < y^m$, by Corollary 7. We can therefore conclude that (t^*, g^*) forms a majority voting equilibrium. □

As we can see, the result we obtain in a majority voting over a tax rate aimed at financing a redistributive healthcare provision system, when the number of public users is endogenous in the GBC, is specular to its homologous under the more restrictive assumption of the previous paragraph. The above discussion, in fact, still applies: if richer individuals would normally prefer a lower taxation, the introduction of a private alternative attracting the richer share of the population does not "disturb" the majority voting equilibrium that would be reached if this alternative were not available.

As before, we now move to the case in which the system is not redistributive.

Proposition 10. *When SRI holds, the median income voter's preferred policy outcome is not a majority voting equilibrium.*

Proof. Calling V^m an indifference curve of the median income voter and $\overline{V}$ one of the highest income voter. We rule out the possibility that no individual prefers the private alternative (assumption A6 in ER) by saying that the highest income voter will always prefer to go private. Calling (g^m, t^m) the pair of policy outcomes preferred by the median voter, we have that all individuals with $y < y^m$ (50% of the population) will favor a tax rate lower than t^*, by Corollary 7 and SRI. However, also the highest income voter, and those voters who prefer to go private (having income near $\overline{y}$) will have such preference; therefore, t^* is defeated, in a majority voting, by some $t < t^*$. □

Analogously to the previous case, we can introduce the following corollary, whose proof has (implicitly) already been given in that of Proposition 10:

Corollary 11. *A majority voting equilibrium, if it exists, entails a tax rate lower than that preferred by the median voter and, consequently, less public expenditure on healthcare quality.*

Proposition 12. *If preferences satisfy* $\frac{\partial M(t,y_i,g)}{\partial y_i} > 0$ *(SRI), a majority equilibrium* (t^*, g^*) *exists if the following conditions are met:*

1. *There exists an individual with income* y_h *who is indifferent between between the public and the private alternative, i.e.* $U(y_h(1-t^*), g^*h) = U(y_h(1-t^*)-\widehat{p}\lambda mh, mh)$*;*

2. *There exists an individual with income y_l who weakly prefers public consumption at (t^*, g^*) to public consumption at any other point on the GBC, i.e. $U(y_h(1-t^*), g^*h) \geq U(y_h(1-t), gh)$ for every (g,t) where $g = \frac{t\widehat{y}}{n\gamma\widehat{p}h}$;*

3. *$y_l < y_h$ and*

4. *$\int_{y_l}^{y_h} dF(y_i) = 0.5$*

Proof. As we already did, we take the existence of individuals with incomes satisfying 1, 2 and 3 as given, and prove that 4 must hold for (t^*, g^*) to be an equilibrium. Consider the case in which $\rho > 0.5$. By Lemma 6 and Corollary 7, all individuals with $y > y_h$ will prefer the private alternative and therefore favor a tax decrease; so will all individuals with $y < y_l$, as a consequence of SRI. Individuals with income $y \in (y_l, y_h)$ will instead favor a tax increase. If $\rho > 0.5$, there exists a tax rate $t > t^*$ which would therefore defeat t^* in a majority voting. By the same token, if $\rho < 0.5$, more than the majority of the voting population would favor a tax decrease, and therefore there exists a tax rate $t < t^*$ which would be able to defeat t^*. □

Again, when we allow the government's supply of healthcare services to be able to adapt to demand when a private alternative is available, the results perfectly match those of the more simple case; when the system does not entail redistribution, the equilibrium level of quality of the public service depends on the characteristics of the middle class, the one favoring higher investments in it.

2.4 Endogeneity of the risk factor

As we explained above, in this model the private provision of healthcare services takes the form of an insurance coverage, namely a contract under which individuals pay a premium to receive, in case of need, the resources needed to pay the care offered by a private provider, facing a unitary production cost equal to λ to produce a unitary level of quality m. π represents the unitary premium, i.e. the expected share of the insured amount each individual consumes. Premiums are said to be actuarially fair when π coincides with the probability, for each individual, of using the insurance coverage; in this framework, therefore, an actuarially fair premium would be one in which $\pi_i = p_i$ for every i, where p_i is individual i's probability of being sick. Up to now, however, in order to simplify the analysis, we have assumed that every individual faces the same health risk: this is a pretty strong requirement, because it drives an important element of heterogeneity out of the analysis. The health risk factor, instead, might play a significant role in shaping the economic and political decisions and, thus, the majority voting outcome over fiscal policy. In this section, therefore, we want to relax this restrictive assumption and consider p_i as endogenous.

In literature there is widespread agreement (Winkleby et al., 1992; Deaton, 1999 and 2000) on a strong relationship between per-capita income and health risk status: factors often considered as positively correlated with income, such as education, family background and culture, might influence a person's behavior by leading her to undertake less risky or harmful-to-health actions and behaviors. In addition to this, health risk may be endogenous, as it is meaningful to think that richer people invest more in healthcare services: this obviously has a positive impact on current health status. Further from these discussions, hence, we introduce p_i in the analysis by modeling it as a very simple function of income:

$$\forall i,\ p_i = \widehat{p} + \alpha \frac{\widehat{y} - y_i}{\widehat{y}} \tag{8}$$

The distribution functions of y_i and p_i trivially coincide now: integration over $F(y_i)$ yields:

$$\int_0^1 p_i dF(y_i) = \int_0^1 (\widehat{p} + \alpha \frac{\widehat{y} - y_i}{\widehat{y}}) dF(y_i) = \widehat{p}.$$

We now proceed to solve the model again to understand if, and how, p_i modifies our results. Preferences of an individual who uses the publicly provided healthcare services are given by:

$$U(y_i(1-t), g)$$

where the GBC is, again, $g\gamma\widehat{p} = t\widehat{y}$. As we see, nothing changes in this case from the previous framework. Nonetheless, preferences of an individual who decides to underwrite the insurance contract on healthcare expenditure are as follows:

$$U\Bigg(y_i(1-t) - \lambda\Big(\widehat{p} + 1 - \frac{y_i}{\widehat{y}}\Big)mh, mh\Bigg)$$

As we can see, as compared to the simpler case in which p_i is constant across individuals, here income enters twice in the utility function. How does this change the political equilibrium? As we just pointed out, $t^*(y_i)$ locus of the bliss points of all individuals as income varies, when they choose the public good, does not change when we make p_i as endogenous. The same is not true, however, for the tax rate that makes individual i indifferent between public and private care, which we denote as $\widetilde{\widetilde{t}}(y_i)$, defined as:

$$\begin{aligned} U(y_i(1-t), g) &= U\Bigg(y_i(1-t) - \lambda\Big(\widehat{p} + 1 - \frac{y_i}{\widehat{y}}\Big)mh, mh\Bigg) \\ V_G(t, y_i) &= V_I(t, y_i) \end{aligned} \tag{9}$$

Proposition 13. *Modeling p_i as in* (8)*, when y_i increases, $\widetilde{\widetilde{t}}(y_i)$ increases at a higher speed.*

Proof. Differentiation of (9) yields:

$$\begin{aligned} \frac{\partial\widetilde{\widetilde{t}}(y_i)}{\partial y_i} &= -\frac{\frac{\partial(9)}{\partial y_i}}{\frac{\partial(9)}{\partial t}}\Bigg|_{V_G(.)=V_I(.)} \\ &= -\frac{(1-t)U_1(y_i(1-t)) - (1-t+\frac{\lambda mh}{\widehat{y}})U_1(y_i(1-t) - \lambda(\widehat{p}+1-\frac{y_i}{\widehat{y}})mh)}{-y_i[U_1(y_i(1-t)) - U_1(y_i(1-t) - \lambda(\widehat{p}+1-\frac{y_i}{\widehat{y}})mh)] + \frac{\widehat{y}}{\widehat{p}\gamma}U_2(\frac{t\widehat{y}}{\widehat{p}\gamma})} \end{aligned}$$

which, by Lemma 1, can be rewritten as:

$$\frac{\partial\widetilde{\widetilde{t}}(y_i)}{\partial y_i} = \frac{\partial\widetilde{t}(y_i)}{\partial y_i} + C$$

where

$$C = \frac{\frac{\lambda mh}{\widehat{y}}U_1(y_i(1-t) - \lambda(\widehat{p}+1-\frac{y_i}{\widehat{y}})mh)}{y_i[U_1(y_i(1-t) - \lambda(\widehat{p}+1-\frac{y_i}{\widehat{y}})mh) - U_1(y_i(1-t))] + \frac{\widehat{y}}{\widehat{p}\gamma}U_2(\frac{t\widehat{y}}{\widehat{p}\gamma})} > 0.$$

□

This proposition shows how, considering p_i as endogenous, richer individuals have, *ceteris paribus*, a double incentive in going private: their income is, by definition, higher, and the private insurance is cheaper to them, as they have a low p_i. As a result, they will demand a better service in order to stay public, as compared to the previous case; in equilibrium, therefore, we end up with a larger share of the population choosing private insurance.

To understand how equilibrium features change when p_i is individual-specific, let us analyze first the framework in the case $\frac{\partial t^*(y_i)}{\partial y_i} < 0$; we do it with the graphical representation in Figure 13. As we see, the curve of threshold tax rates $\widetilde{\widetilde{t}}(y_i)$ now rotates counter-clockwise: as a result, if in equilibrium the median voter's income is such that $t^*(y^m) > \widetilde{\widetilde{t}}(y^m)$, the equilibrium tax rate is again $t^* = t^*(y_i)$, but, as already mentioned, a larger share of the population now chooses the private sector (individuals with $y \in (y'', \overline{y}]$, as compared to the smaller interval $(y', \overline{y}]$ of the simpler framework, dashed line). However, it may well be the case that $t^*(y^m) > \widetilde{t}(y^m)$, but $t^*(y^m) < \widetilde{\widetilde{t}}(y^m)$; in this case, the median income voter is a private insurance user, and the equilibrium tax rate is clearly zero. Obviously, if $t^*(y^m) < \widetilde{t}(y^m)$, $t^*(y^m) < \widetilde{\widetilde{t}}(y^m)$ and the equilibrium tax rate is, again, zero. As we can see, therefore, the assumption that richer people are also less risky, in a framework in which public provision of healthcare services entails redistribution, leads to an increase in the number of private insurance subscribers and a decrease in the share of public healthcare users; depending on the parameters of the model, this effect might be so strong as to convince the median voter to choose private as well, which would obviously cause a collapse of the level of quality of the public sector.

The alternative situation in which $\frac{\partial t^*(y_i)}{\partial y_i} > 0$, instead, is described in Figure 14: $\widetilde{t}(y_i)$ represents the locus of threshold tax rates when $p_i = \widehat{p}$ for every i. As we can see, making p_i endogenous and modeling it as in (8) has, again, the effect of increasing the share of people who prefer to obtain healthcare via private insurance. However, in a situation in which an equilibrium of the "ends against the middle" type arises from a majority voting, the middle class who favors a tax increase is now poorer than before: as we can observe from the figure, when $t^* = t^*(y_l)$ the individual with income y_h now strictly prefers the private alternative; the indifferent individual for this level of equilibrium tax rate has income $y'_h < y_h$, therefore $\int_{y_l}^{y'_h} dF(y_i) < 0.5$ and $t^* = t^*(y_l)$ is not an a majority voting equilibrium policy outcome anymore. The new equilibrium is instead given by $t^{*\prime} = t^{*\prime}(\widetilde{y_l})$, defined (consistently with Proposition 5) as $\int_{\widetilde{y_l}}^{\widetilde{y_h}} dF(y_i) = 0.5$, where $\widetilde{y_h}$ is such that $t^{*\prime} = \widetilde{t}(\widetilde{y_h})$ and both $\widetilde{y_h}$ and $\widetilde{y_l}$ are smaller than their respective counterparts in the case of exogenous p_i, so that $t^{*\prime} < t^*$. In equilibrium, therefore, we end up with a smaller amount of resources to finance public healthcare quality, which will therefore be poorer; this is again a consequence of the fact that more people find it convenient to go private, so that the middle class, who favors a tax increase, is now poorer than in the baseline case. We can conclude by saying that, also in the case in which public provision of healthcare services does not entail redistribution, modeling p_i as a negative function of income and the private alternative as an insurance contract makes our previous results, i.e. an equilibrium tax rate lower than the one prevailing with no private alternative, more "extreme" and strong, as the voting policy outcome becomes even smaller. As an overall result, it is possible to claim that the assumption of health risk negatively correlated to income leads to a scenario in which a higher share of the (richer) population chooses private healthcare; as a consequence, the public service ends up with a lower level of quality.

2.5 Partial insurance

For matters of simplicity, in the baseline model we have considered so far, each individual faces a dichotomous economic decision, in which two mutually exclusive choices are possible: being a public services user or buying an insurance coverage. Mutual exclusion follows directly from the fact that we consider healthcare quality, and not quantity, as the "good" whose provision can be either private or public, and it is rather counterintuitive to think about a "mixture" of private and public quality. Nonetheless, in the attempt of making the model more realistic, in this section we want to allow for the possibility, available in many countries, for people to take different economic decisions on different types of healthcare services. Even in countries with large welfare systems and in which the majority of the population uses public healthcare, it is common for people to buy an insurance to cover all the "extraordinary" health expenses, i.e. those related to the most serious health issues (the so-called "extras-only" contracts), for which very often the help of experts and well-known physicians is perceived as crucial, and public services are seen as not being "good enough". To include this possibility in our framework, we therefore draw a distinction between the two types of healthcare services, and allow the economic choice on each of them to be independent from the one on the other. We consider a scenario in which total healthcare services quantity is given by

$$h = h_1 + h_2$$

where h_1 is the amount of basic services, and h_2 represents instead extraordinary care. The ordinary health risk factor, i.e. the average probability of having to use ordinary healthcare, is now $\widehat{p}_1$, while the extraordinary risk is $\widehat{p}_2$; intuitively, $\widehat{p}_2 < \widehat{p}_1$ and $\widehat{p}$ is a weighted average of the two. All the other characteristics of the previous model are left unchanged.

Allowing for the possibility of having a partial insurance, each individual's economic decision is now threefold: everyone in fact can either obtain h from the public system, buy it through the private insurance, or go for mixture of the two, i.e. obtain h_1 via government provision and h_2 within the insurance scheme.

In order to analyze the political equilibrium in this modified scenario, it is useful to order preferences of each individual across the three possibilities.

Let us consider, as a starting point, the decision between being a full public services user and buying a partial insurance coverage on h_2. An individual i, whith income y_i, using publicly provided healthcare, would have utility equal to $U(y_i(1-t), \frac{t\widehat{y}}{\widehat{p}\gamma})$; the same individual could instead choose to buy a partial insurance on non-ordinary care, getting utility equal to $U(y_i(1-t) - \lambda\widehat{p}_2 mh, \frac{t\widehat{y}}{\widehat{p}\gamma h}h_1 + mh_2)$. The tax rate that makes this individual indifferent between the two alternatives is now defined as the one satisfying the following equality:

$$\begin{aligned} U\Big(y_i(1-t), \frac{t\widehat{y}}{\widehat{p}\gamma}\Big) &= U\Big(y_i(1-t) - \lambda\widehat{p}_2 mh_2, \frac{t\widehat{y}}{\widehat{p}\gamma h}h_1 + mh_2\Big) \\ V_G(y_i, t) &= V_P(y_i, t) \end{aligned} \tag{10}$$

This expression defines a threshold tax rate $t_P(y_i)$ which drives the economic decision: for each $t > t_P(y_i)$, individual i strictly prefers the public alternative to the partial insurance, and viceversa. The following is analogous to Lemma 1:

Lemma 14. *$t_p(y_i)$ is increasing in income.*

Proof. Differentiation of (10) yields:

$$\begin{aligned} \frac{\partial t}{\partial y_i} \Bigg|_{V_G(.)=V_P(.)} &= -\frac{\frac{\partial(10)}{\partial y_i}}{\frac{\partial(10)}{\partial t}} \\ &= -\frac{(1-t)[U_1(y_i(1-t)) - U_1(y_i(1-t) - \lambda\widehat{p}_2 mh)]}{-y_i[U_1(y_i(1-t)) - U_1(y_i(1-t) - \lambda\widehat{p}_2 mh_2)] + \frac{t\widehat{y}}{\widehat{p}\gamma}[U_2(\frac{t\widehat{y}}{\widehat{p}\gamma}) - \frac{h_1}{h}U_2(\frac{t\widehat{y}}{\widehat{p}\gamma h}h_1 + mh_2)]} \end{aligned}$$

If we assume, without loss of generality, that $U_2\Big(\frac{t\widehat{y}}{\widehat{p}\gamma}\Big) - \frac{h_1}{h}U_2\Big(\frac{t\widehat{y}}{\widehat{p}\gamma h}h_1 + mh_2\Big) > 0$, given our previous assumptions on the utility function, we have:

$$\frac{\partial t}{\partial y_i}\Bigg|_{V_G(.)=V_P(.)} = \frac{\partial t_P(y_i)}{\partial y_i} > 0$$

$\square$

The above Lemma gives us a condition that helps us understand how preferences on the economic alternatives are shaped and ordered across alternatives. Notice that, by finding a threshold tax rate that drives the decision between public and partially private we are implicitly considering as given a ranking of alternatives, according to which each individual chooses the full insurance when the equilibrium tax rate is very low, and moves first to partial and then to public services as it grows. The following Lemma legitimates this:

Lemma 15. *As the share of the basic (and publicly provid ed) healthcare, h_1, goes up, the threshold tax rate increases.*

Proof. Differentiation of (10) yields:

$$\frac{\partial t_P(y_i)}{\partial h_1} = \frac{\partial t}{\partial y_i}\bigg|_{V_G=V_P} = -\frac{\frac{\partial(10)}{\partial h_1}}{\frac{\partial(10)}{\partial t}}$$

$$= -\frac{-\frac{ty}{p\gamma}\frac{h_2}{(h_1+h_2)^2}U_2\left((\frac{t\widehat{y}}{\widehat{p}\gamma h}h_1+mh_2)\right)}{-y_i[U_1(y_i(1-t))-U_1(y_i(1-t)-\lambda\widehat{p}_2mh_2)]+\frac{t\widehat{y}}{\widehat{p}\gamma}[U_2(\frac{t\widehat{y}}{\widehat{p}\gamma})-\frac{h_1}{h}U_2(\frac{t\widehat{y}}{\widehat{p}\gamma h}h_1+mh_2)]}$$

which is positive if, again, we are willing to assume that $U_2\left(\frac{t\widehat{y}}{\widehat{p}\gamma}\right)-\frac{h_1}{h}U_2\left(\frac{t\widehat{y}}{\widehat{p}\gamma h}h_1+mh_2\right)>0$. Therefore, the value of the threshold is minimum when $h_1=0$. □

The above Lemma confirms that the order of preferences, as the tax rate increases, is of the 'full-partial-public" type.

Given the above Lemma, we can thus define $t_F(y_i)$ as the threshold tax rate that drives the decision between partial and full insurance, i.e. the one satisfying:

$$\begin{aligned} U\left(y_i(1-t)-\lambda\widehat{p}_2mh_2,\frac{t\widehat{y}}{\widehat{p}\gamma h}h_1+mh_2\right) &= U\left(y_i(1-t)-\lambda\widehat{p}mh,mh\right) \\ V_P(y_i,t) &= V_I(y_i,t) \end{aligned} \tag{11}$$

If $t<t_F(y_i)$, the full insurance is strictly preferred to the partial. Quite intuitively, Lemmas 1 and 14 also apply to $t_F(y_i)$.

Having established an order between alternatives, we are now ready for the characterization of the political equilibrium: we do it by separating the two cases, leading to the two different types of equilibria, we analyzed above.

When $\frac{\partial t^*(y_i)}{\partial y_i} < 0$, as we saw, in equilibrium the median income voter is decisive also when the private alternative is available, and her tax rate is the majority voting policy outcome. If $t^*(y_m) < t_F(y_i)$, i.e. the median voter strictly prefers the full insurance to the other two alternatives, the preferred tax rate will be zero: as we can see from Figure 15, being y^m the median income voter, more than half of the population will go for the full option and prefer $t^* = 0$ to any other policy alternative. On the other extreme, when $t^*(y^m) > t_P(y_i)$, the majority-voting policy outcome is $t^*(y^m)$, where

$$t^*(y_i) = \arg\max_t U\Big(y_i(1-t), \frac{t\widehat{y}}{\widehat{p}\gamma}\Big)$$

The most interesting case, however, is the one in which $t_F(y_i) < t^*(y^m) < t_P(y_i)$. In this case, in fact, the median voter is a public services user, although only for a type of healthcare services; therefore, it will prefer a positive tax rate $t^{*\prime}(y^m)$, defined as

$$t^{*\prime}(y_m) = \arg\max_t U\Big(y^m(1-t) - \lambda\widehat{p}_2 h_2, \frac{t\widehat{y}h_1}{\widehat{p}\gamma h} + mh_2\Big)$$

Proposition 16. *If* $\frac{\partial t^*(y_i)}{\partial y_i} < 0$ *and the median voter would prefer, if available, a partial private insurance, the majority voting equilibrium tax rate is lower in the presence than in the absence of a partial alternative.*

Proof. Consider the problem:

$$\max_t U\Big(y_i(1-t) - \lambda\widehat{p}_2 h_2, \frac{t\widehat{y}h_1}{\widehat{p}\gamma h} + mh_2\Big) \tag{12}$$

whose first order condition, defining $t^{*\prime}(y_i)$, is:

$$-y_i U_1\Big(y_i(1-t)\Big) + \frac{\widehat{y}h_1}{\widehat{p}\gamma h} U_2\big(\frac{t\widehat{y}h_1}{\widehat{p}\gamma h} + mh_2\Big) = 0 \tag{13}$$

differentiating it, we get:

$$\frac{\partial t^{*\prime}(y_i)}{\partial h_2} = -\frac{\frac{\partial(13)}{\partial h_1}}{\frac{\partial(13)}{\partial t}} = -\frac{y_i \lambda \widehat{p}_2 U_{11}(.) - y_i\left(m - \frac{t\widehat{y}}{\widehat{p}\gamma}\frac{h_1}{h^2}\right)U_{12} - \frac{\widehat{y}}{\widehat{p}\gamma}\frac{h_1}{h^2}U_2(.) + \frac{\widehat{y}h_1}{\widehat{p}\gamma h}\left(m - \frac{t\widehat{y}}{\widehat{p}\gamma}\frac{h_1}{h_2}\right)U_{22}}{y_i^2 U_{11}(.) - \frac{\widehat{y}h_1}{\widehat{p}\gamma h}U_{12}(.) - \frac{\widehat{y}h_1}{\widehat{p}\gamma h}y_i U_{21}(.) + (\frac{\widehat{y}h_1}{\widehat{p}\gamma h})^2 U_{22}(.)} < 0$$

given our assumptions. Therefore, $t^{*\prime}$ decreases as the share of the total services covered by the private insurance decreases, and in particular it is maximum when $h_2 = 0$, i.e. when the public service is chosen, which proves our proposition. $\square$

As we can see, when we allow individuals to buy a partial insurance coverage on extraordinary healthcare expenses, people who prefer this option to the full insurance will vote for a positive tax rate, but lower than the one they would have preferred if only the full were available. If we stick to our previous assumption of a central government not adapting public services' supply to the real demand (simple GBC), the introduction of the partial insurance boils down into a decrease in public healthcare quality when the public provision of such good is redistributive. This result is quite intuitive: as the range of options involving the private market increase, the latter becomes more attractive, and voters will be more willing to transfer resources from the public (taxes) to the private.

Let us now consider the situation in which $\frac{\partial t^{*\prime}(y_i)}{\partial y_i} > 0$. In this situation we can have two alternative cases when we introduce partial insurance. If, in fact, the individual with income y_l as defined by Proposition 4 strictly prefers the partial insurance contract to the use of exclusively public healthcare, then the equilibrium tax rate is $t^{*\prime} = t^{*\prime}(y_l')$ such that $t^{*\prime} = t_F(y_h')$ and y_l', y_h' satisfy $\int_{y_l'}^{y_h'} dF(y_i) = 0.5$. As we can see from the figure, $y_l' < y_l$ and $y_h' < y_h$, so $t^{*\prime} < t^*$. Figure 16 shows this result.

If, instead, the individual with income y_l consumes only the publicly provided services, assuming that $t^{*\prime}(y') > t^*(y_l)$ where y' is such that $t_P(y') = t^*(y')$, the majority voting policy outcome would be the same indifferently from the presence or absence of the partial insurance contract (Figure 17). As we can see, in the case of a non-redistributive public sector, the consequences of the introduction of the possibility of partial insurance are unclear; consistently with the redistributive framework, however, if the outcome of the majority voting changes from the baseline framework, it decreases.

3 Comparative statics: how to change the equilibrium features

Up to now, we have presented the main features of the baseline model for the determination of the equilibrium quality level of public healthcare in presence of a private alternative, which takes the form of an insurance contract; we have characterized the equilibrium of a majority voting and, moreover, we have tried to remove the most restricting assumptions, in an attempt to make the model a better proxy for what happens in reality. In the present section, we want to understand what are the variables playing the greatest role in determining the equilibrium level of public health provision, whose modification might therefore be able to change the features of the political equilibrium. This is crucial in a situation in which the level of healthcare quality resulting from a majority voting is considered unsatisfactory for some reasons, or Pareto-inefficient; these variables may be used as a tool to modify the equilibrium.

3.1 Lower bound for public healthcare

In the baseline model, we have assumed that individuals freely vote on the tax rate: ideally, they are able to choose any level for t and, consequently for the level of quality of public health, g; in theory, they could even choose $t = 0$, which would lead to a zero level of quality of the good. It seems, however, quite reasonable to assume that a minimum level of g has to be provided, both for equity reasons and for economic convenience (economies of scale, see below); a clear example of such policy is given by the Italian LEA (Minimum Level of Assistance, see Introduction). In this subsection we want to understand if and when the introduction of such lower bound for g modifies the features of equilibrium.

To the purpose of the analysis, we therefore assume that the central government establishes a minimum level of quality to be produced; we call this threshold $\overline{g}$. Such an imposition directly boils down into having a lower bound for the tax rate, $\overline{t} = \frac{\gamma \overline{g} \widehat{p}}{\widehat{y}}$. We now try to understand how these treshold have an impact on t^* and g^*, the equilibrium policy outcomes of interest.

Consider first the case in which preferences are such that $\frac{\partial t^*(y_i)}{\partial y_i} < 0$, i.e. public provision of healthcare involves a redistributive component. As we saw, in this situation the Median Voter theorem applies and the median income voter's preferred policy outcome is the equilibrium tax rate. Now suppose we want to impose a lower threshold $\overline{g}$ for the quality level of the public services, representing a minimum value that must be reached: this introduces a new constraint for the economic/political problem, namely $g \geq \overline{g}$. In this case, the analysis is pretty straightforward: in fact, two situations can verify. In one, we have $\overline{t} < t^*(y^m)$; the previously-found equilibrium tax rate already satisfies the new constraint on quality, and the outcome of the majority voting obviously does not change. On the other hand, if $\overline{t} > t^*(y^m)$, then in order for the minimum level of quality to be reached, the tax rate in equilibrium has to increase up to $\overline{t}$. Given preferences and the redistributive aspect of the provision system, this policy outcome is able to win over alternatives in a majority voting: in fact, all individuals with $y < y^m$ will favor an increase in the tax rate, while all individuals with $y > y^m$ will prefer a decrease, which is not possible due to the new constraint. Notice how the latter situation includes the case in which $t^*(y^m) < \widetilde{t}(y^m)$, i.e. when the median voter chooses the private alternative: with no boundaries on the equilibrium level of public sector's quality level, in this situation we would have had $t^* = 0$, but after the introduction of a lower bound $\overline{g}$, we get $t^* = \overline{t}$.

The analysis of the effects of the introduction of a minimum level of quality is indeed more interesting in the case in which the public provision system is non-redistributive, i.e. when preferences are such that $\frac{\partial t^*(y_i)}{\partial y_i} > 0$; as said, this situation yields an equilibrium of the "ends against the middle" type. As already explained, two voters are crucial in the determination of such type of equilibrium: the one with income y_l , which weakly prefers t^* , the equilibrium tax rate, to all the other t satisfying the GBC, and the one with income y_h, which is indifferent between choosing the public or the private provision of healthcare at t^*: $t^* = \widetilde{t}(y_i)$. According to who these individuals are, i.e. according to the income distribution, we can have two different situations.

Proposition 17. *Let* $\frac{\partial t^*(y_i)}{\partial y_i} > 0$, y_l *and* y_h *characterize the political equilibrium according to Proposition* 1*; moreover, there exists a lower bound for the tax rate* $\overline{t} = \frac{g\gamma\widehat{p}h}{\widehat{y}}$, *where*

$\overline{g}$ is the minimum level of quality for publicly provided healthcare that has to be reached. Then:

1. *if $\overline{t} \leq t^*(y_l)$, the equilibrium tax rate is still $t^* = t^*(y_l)$;*
2. *if $\overline{t} > t^*(y_l)$, $\overline{t}$ is the new equilibrium tax rate, and the share of people preferring the public service increases.*

Proof. A graphical representation of the two situations will make the proof simpler. In Figure 18, Panel A, we have the situation of point 1. As we can see, the introduction of the lower bound (green line) does not modify the portion of the graph where the equilibrium creates, i.e. that between y_l and y_h; in particular, the tax rate preferred by y_l does not change, and neither does $t^* = t^*(y_l)$.

In Panel B, instead, we have the situation of point 2. As we can see, the tax rate that would be preferred by y_l without the lower bound for quality is, this time, smaller than $\overline{t}$; therefore, with this additional constraint on t the equilibrium tax rate coincides with $\overline{t}$ itself. As before, in fact, $\frac{\partial t^*(y_i)}{\partial y_i} < 0$ and Lemma 1 guarantee that all $y < y_l$ will favor a tax decrease (income substitution effect). Now, however, at $t^{*\prime} = \overline{t}$, the individual with income y_h as defined by Proposition 3 strictly prefers public care and is thus not indifferent anymore; the indifferent individual is now the one with income y' such that $\overline{t} = \widetilde{t}(y')$, which, by Lemma 1, is richer than y_h. Therefore, the share of people using the private services is now $(y', y]$, smaller than $(y_h, y]$. □

As we can see, the most relevant consequence of the introduction of a minimum level of quality, to be achieved with resources collected via taxation, is the increase in the share of public services users; the presence of the lower bound makes, under some condition, public healthcare better and thus more attractive.

Clearly, the presence of a minimum threshold level for public healthcare services' quality is desirable, other than plausible. Nonetheless, it is useful to analyze the implications of using this tool in terms of welfare: this can be of help also in determining a "good" size for the threshold itself. Consider the "social" problem, i.e. the maximization of the total welfare of the country:

$$\max_t Max\Big\{\int_{\underline{y}}^{\overline{y}} U\Big(y_i(1-t), \frac{t\widehat{y}}{\widehat{p}\gamma}\Big)dF(y_i); \int_{\underline{y}}^{\overline{y}} U(y_i(1-t) - \widehat{p}\lambda mh, mh)dF(y_i)\Big)\Big\}$$

which is analogous to:

$$\max_t Max\Big\{U\Big(\widehat{y}(1-t), \frac{t\widehat{y}}{\widehat{p}\gamma}\Big); U\Big(\widehat{y}(1-t) - \widehat{p}\lambda mh, mh\Big)\Big\}$$

The solution to the problem is given by:

$$\begin{cases} t^*(\widehat{y}) \text{ if } t^*(\widehat{y}) \geq \widetilde{t}(\widehat{y}) \\ 0 \qquad \text{otherwise.} \end{cases}$$

From what we have said up to now, it is clear how, if the mean voter would strictly prefer the public alternative if she could choose the equilibrium tax rate, but the distribution of income is such that $y^m < \widehat{y}$, two situations can arise: when the system is redistributive ($\frac{\partial t^*(y_i)}{\partial y_i} < 0$), being the median voter poorer than the mean voter, the former would choose a tax rate higher (in the case in which $t^*(y^m) \geq \widetilde{t}(y^m)$) or equal (in the case in which $t^*(y^m) \leq \widetilde{t}(y^m)$) than the one of the latter; the introduction of a lower bound for healthcare quality would not lead to any Pareto-improvement. On the other hand, if the system is not redistributive ($\frac{\partial t^*(y_i)}{\partial y_i} < 0$) and the individual with income y_h is richer than the mean (which means, in other words, that the mean voter strictly prefers the public alternative), the introduction of a threshold $\overline{t} = t^*(\widehat{y})$ would increase the equilibrium level of taxes from $t^*(y_l)$ to $\overline{t}$, and this would lead to a Pareto improvement; obviously, the same does not hold if $y_h < \widehat{y}$, as in this case the community as a whole would be better off with $t^* = 0$.

3.2 Economies of scale

In the line of reasoning we have been developing until here, for the sake of easiness, we have been considering a very simple budget constraint, in which the total cost of healthcare services depends linearly on a cost per unit of healthcare quality, γ, and on the healthcare quality level, g. As any type of production process, also healthcare provision, nonetheless, entails some fixed costs (administrative, bureaucratic etc). Their presence and incidence on the total cost directly influences the efficiency of the system as a whole: indeed, they have an impact on the size of the public healthcare sector and on its level of quality. In order to analyze the framework when such fixed costs are made explicit, we introduce them in the GBC, which becomes:

$$\widehat{p}\gamma gh + k = t\widehat{y}$$

where k is a fixed cost for the production of the good, which only interests the public sector: the private production function is untouched by this change. Clearly, the presence of k induces a lower bound for the tax rate: in fact, t has to be greater than or equal to $\frac{k}{\widehat{y}} = t_0$. We can show how the presence of k modifies the political equilibrium of a majority voting. In fact, the following Lemmas will show how the reference tax rates for the characterization of the political equilibrium, namely the equilibrium rate t^* and the threshold $\widetilde{t}$, change as k is introduced in the model. For the sake of the analysis, let us rewrite the equation representing indifference, for individual i, between private and public healthcare:

$$U\Big(y_i(1-t), \frac{t\widehat{y} - k}{\gamma\widehat{p}}\Big) = U\Big(y_i(1-t) - \pi_i \lambda mh, mh\Big) \tag{14}$$

Lemma 18. *The threshold tax rate is increasing in k.*

Proof. Differentiation of (14) yields:

$$\frac{\partial t}{\partial k}\Big|_{V_G(.)=V_I(.)} = -\frac{\frac{\partial(14)}{\partial k}}{\frac{\partial(14)}{\partial t}} = \frac{\frac{1}{\widehat{p}\gamma}U_2(.)}{y_i[U_1(y(1-t) - \lambda\widehat{p}mh, mh) - U_1(y(1-t), gh)]} > 0$$

□

From this, it follows that, calling $\widetilde{t}(y_i)$ the threshold tax rate in the case with no fixed costs and $\widetilde{t}'(y_i)$ the one defined by (14), we have $\widetilde{t}'(y_i) > \widetilde{t}(y_i)$; this is going to modify some features of equilibrium. The above Lemma clarifies how, in the presence of some fixed costs, the level of quality that the public sector is able to produce, for a given t, is lower than in the case of no fixed costs; each individual will therefore require a higher tax rate to be persuaded to choose the public service. In what follows, we analyze the consequences of this. Nonetheless, the threshold tax rate is not the only feature of the model that changes, when a fixed cost of public production is added to the framework. In fact:

Lemma 19. *t^* is increasing in k.*

Proof. Let us call $t^{*\prime}$ the tax rate solving the following problem:

$$\max_t U\left(y_i(1-t), \frac{t\widehat{y}-k}{\gamma\widehat{p}}\right)$$

and therefore satisfying:

$$-y_i U_1(.) + \frac{\widehat{y}}{\gamma\widehat{p}} U_2(.) = 0 \tag{15}$$

Differentiation of (15) yields:

$$\frac{\partial t^{*\prime}}{\partial k} = -\frac{\frac{\partial(15)}{\partial k}}{\frac{\partial(15)}{\partial t}} = -\frac{\frac{y_i}{\gamma\widehat{p}}U_{12}(.) - \frac{\widehat{y}}{\gamma\widehat{p}}U_{22}(.)}{y_i^2 U_{11}(.) - \frac{y_i\widehat{y}}{\widehat{p}\gamma}U_{21}(.) - \frac{y_i\widehat{y}}{\widehat{p}\gamma}U_{12}(.) + (\frac{\widehat{y}}{\widehat{p}\gamma})^2 U_{22}(.)} > 0.$$

□

In this section, we try to understand how, given the results of these Lemmas, the presence of k modifies the results we obtained above. In It is useful to keep the cases of $\frac{\partial t^*(y_i)}{y_i} < 0$ and $\frac{\partial t^*(y_i)}{y_i} > 0$ separated.

If $\frac{\partial t^*(y_i)}{y_i} < 0$, as we said, a majority voting leads to a tax rate which coincides with the one preferred by the median voter, and which will therefore be greater than zero if y^m is such that $\widetilde{t}(y^m) > t^{*m}$, and zero otherwise. Let us assume for now that, with no fixed costs, $\widetilde{t}(y^m) \geq t^{*m}$. When we introduce fixed costs in a context in which the median voter theorem applies, two cases can verify:

1. $t^{*\prime} \geq \widetilde{t}'(y^m)$;

2. $t^{*\prime} < \widetilde{t}'(y^m)$.

Proposition 20. *If $\frac{\partial t^*(y_i)}{y_i} < 0$ and $t^{*\prime} \geq \widetilde{t}'(y^m)$, a majority voting equilibrium exists, and it is given by $t^{*\prime} = t^{*\prime}(y^m) > t^*$.*

Proof. (trivial) If, after the introduction of a positive fixed cost k, the median voter still prefers the public alternative, Proposition 2 ensures that her utility-maximizing tax rate $t^{*\prime}(y^m) = t^{*\prime}$ is still a majority voting equilibrium; clearly, $t^{*\prime} > t^*$ because $\frac{dt^{*\prime}}{dk} > 0$. □

Proposition 21. *If $\frac{\partial t^*(y_i)}{y_i} < 0$ and $t^{*\prime} < \widetilde{t}'(y^m)$, a majority voting equilibrium exists, and it is given by $t^{*\prime} = t_0$.*

Proof. If, after the introduction of $k > 0$, the median voter strictly prefers the private alternative to the publicly provided good, by Lemma 1, so will do all $y > y^m$; therefore, the tax rate preferred by the median voter is again a majority voting equilibrium outcome, and given the median voter's economic choice of going private, it will be the lowest possible tax rate, which is $t_0 > 0$ if $k > 0$. □

Until here, we have been assuming that, without fixed costs, $t^*(y^m) \geq \widetilde{t}(y^m)$. Let us now revert this assumption and consider instead the case in which $t^*(y^m) < \widetilde{t}(y^m)$, i.e. when, without fixed costs, the equilibrium tax rate is zero because half of the population plus one (the median voter) is going to choose the private service. What happens to this equilibrium if we move to a scenario with fixed costs of public production? Again, the overall result depends on which of the two effects (on $t^*(y_i)$ and on $\widetilde{t}(y_i)$) is stronger in equilibrium. If, after the introduction of the fixed cost, $t^{*\prime}(y^m) \geq \widetilde{t}(y^m)$ (which happens if the effect on $t^*(y^m)$ is stronger, see Figure 19), the new equilibrium tax rate will be $t^{*\prime} = t^{*\prime}(y^m)$. If, instead, after the introduction of the fixed costs we still have $t^{*\prime}(y^m) < \widetilde{t}'(y^m)$, i.e. the median voter still strictly prefers to go private, the tax rate will go up from $t = 0$ to $t = t_0$, but the overall level of quality will still be equal to zero.

As we can see, the introduction of an additional fixed cost in the baseline frameworks acts by decreasing the overall level of efficiency of the public sector, making it less appealing to all voters: they will therefore be willing to finance it less via taxation. Clearly, as total costs increase and the tax rate decreases, the effect on public healthcare quality is detrimental.

We now move to the framework with no public sector redistribution. In the alternative situation in which $\frac{\partial t^*(y_i)}{y_i} > 0$, as opposed to the previous one, the median income voter's preferred policy outcome is not a majority voting equilibrium anymore, but we get a result of the "ends against the middle" type. Let us now analyze the equilibrium features.

Proposition 22. *If $\frac{\partial t^*(y_i)}{y_i} > 0$, three situations can verify as k increases:*

1. *If the increase in $\widetilde{t}(y_i)$ and the increase in $t^*(y_i)$ are such that $t^{*\prime}(y_l) = \widetilde{t}'(y_h)$, the equilibrium tax rate does not change;*

2. *If the increase in $\widetilde{t}(y_i)$ is very small compared to the increase in $t^*(y_i)$, the equilibrium tax rate increases;*

3. *If the increase in $\widetilde{t}(y_i)$ is very small compared to the increase in $t^*(y_i)$, the effect on the equilibrium tax rate is ambiguous.*

Proof. The statement(s) can more easily be proved graphically. Figure 20 shows the equilibrium features in the case $k = 0 ::$ as we can see, y_h is the income of the individual indifferent between public and private at $t = t^*(y_l)$, and such that $\rho = \int_{y_l}^{y_h} dF(y_i) = 0.5$. As k becomes strictly positive, Lemma 18 guarantees that the curve $\widetilde{t}(y_i)$ shifts upward. Ceteris paribus, individuals now will require a higher level of tax rate to choose the public good. This effect pushes towards a decrease in the equilibrium tax rate, because as the curve goes up $\widetilde{t}(y_h)$ will be higher than before, and we end up having $\widetilde{t}'(y_h) > t^*(y_l)$; given that $\frac{\partial \widetilde{t}(\partial y_i)}{y_i} > 0$ and $\frac{\partial t^*(y_i)}{\partial y_i} > 0$, in order to have $\widetilde{t}(y_h) = t^*(y_l)$ and $\rho = 0.5$ incomes y_h and y_l have to be lower than in the case with no fixed costs. However, given that the curve $t^*(y_i)$ shifts upwards as well, individuals who choose public will also have a higher utility-maximizing tax rate, something that instead pushes towards an overall increase in t^*. Therefore, if the two shifts are such that $t^{*\prime}(y_l) = \widetilde{t}'(y_h)$, the indifferent individual (whose income is y_h) remains the same and the tax rate prevailing in equilibrium is $t^{*\prime}(y_l) > t^*(y_l)$ (red curves in Fig. 20, Panel A). If, instead, the increase in $\widetilde{t}(y_i)$ is smaller, we have a situation in which y_h now strictly prefers to stay public; the new indifferent individual will have income $y'_h > y_h$, but then $\int_{y_l}^{y'_h} dF(y_i) > 0.5$ and $t^{*\prime}(y_l)$ cannot be a majority voting equilibrium, as at this level of the tax rate more than half of the population strictly prefers a tax increase. Therefore, the overall equilibrium will be pinned down by two new individuals, $\widetilde{y_l}$ and $\widetilde{y_h}$, such that $t^{*\prime}(\widetilde{y_l}) = \widetilde{t}'(\widetilde{y_h})$ and $\int_{\widetilde{y_l}}^{\widetilde{y_h}} dF(y_i) = 0.5$. Clearly, $\widetilde{y_l} > y_l$; the equilibrium tax rate, and the level of quality, will be $t^{*\prime}(\widetilde{y_l}) > t^*(y_l)$ (see Figure 20, Panel B). On the other hand, if the increase in $\widetilde{t}(y_i)$ is larger than that in $t^*(y_i)$, the indifferent individual will have $y''_h < y_h$, so that $\int_{y_l}^{y'_h} dF(y_i) < 0.5$ and the majority of the population will favor a tax decrease at $t^{*\prime} = t'(y_l)$. The equilibrium will be then defined by incomes $\widehat{y_l}$ and $\widehat{y_h}$ such that $t^{*\prime}(\widehat{y_l}) = \widetilde{t}(\widehat{y_h})$ and $\int_{\widehat{y_l}}^{\widehat{y_h}} dF(y_i) = 0.5$. Since $\widehat{y_l} < y_l$ but $t^{*\prime}(y_i) > t^*(y_i)$, the effect on the equilibrium is undefined. (see Figure 20, Panel C). $\square$

It is clear, from this analysis, how the overall effect of the introduction of a fixed cost of production on the tax rate in equilibrium depends on the relative influence of the latter, respectively, on the threshold and on the equilibrium rates: it can increase, decrease or stay the same. Nonetheless, this is not enough to say what is the overall impact of such additional cost on the level of quality in equilibrium: whenever the tax rate goes down or stays unchanged the level of quality falls, as the system is provided with an equal or smaller amount of resources, but has to face an additional cost. If the tax rate increases, however, we have two opposite effects on quality. On the one hand, a higher t^* leads to more investment in the public sector; on the other hand, again, k is an additional charge that needs to be paid. The outcome in terms of q^* will depend on the relative strength of those dynamics: in order to have an increase in quality, the tax rate has to increase noticeably after the introduction of k, something that we cannot measure as it depends on voters' preferences. The issue of economies of scale is particularly relevant in a federalist framework, which we analyze in the following chapter.

The results provided in this sections have to be read with a "comparative statics" approach: clearly, adding a fixed cost has an effect on equilibrium because it increases the total cost, *ceteris paribus*. What we want to underline here, nonetheless, is the particular influence of an increase in the *fixed* cost on the equilibrium, as compared to that of the *variable* cost, which we analyze in the following subsection.

3.3 Efficiency of production

A peculiar aspect of the production processes carried out by public entities is given by the bureaucratic procedures these organizations have to follow, to satisfy all those principles which are the reason itself of their existence. Bureaucratic procedures, however, often lead to the rise of slack times and wastes of resources; in other words, a lower level of efficiency as compared to that of private entities. In this section, therefore, we want to allow for the possibility of the above statement to be true, and try to understand whether and how a lower level of efficiency in public production of goods influences fiscal policy under majority rule and in presence of a private alternative, and also how a possible improvement of the production process can change the equilibrium. To do this, we use the per-unit of quality cost of public production of healthcare, γ, as a measure of efficiency.

Lemma 23. *As the public sector becomes more efficient, for a given income, the tax rate that makes an individual indifferent between public and private services decreases.*

Proof. An increase in efficiency is isomorphic to a decrease in γ. Consider an individual i, with income level y_i, and the indifference tax rate, $\widetilde{t}(y_i)$, defined by:

$$U\Big(y_i(1-t), \frac{t\widehat{y}}{\gamma\widehat{p}}\Big) = U\Big(y_i(1-t) - \widehat{p}\lambda mh, mh\Big) \tag{16}$$

We want to understand how $\widetilde{t}(y_i)$ behaves as γ varies. Differentiation of (16) yields:

$$\frac{\partial\widetilde{t}(y_i)}{\partial\gamma} = \frac{\partial t}{\partial\gamma}\Big|_{V_G=V_I} = -\frac{\frac{\partial(16)}{\partial\gamma}}{\frac{\partial(16)}{\partial t}} = \frac{\frac{t\widehat{y}}{\widehat{p}\gamma^2}U_2\Big(\frac{t\widehat{y}}{\gamma\widehat{p}}\Big)}{y_i[U_1(y_i(1-t), -\widehat{p}\lambda mh) - U_1(y_i(1-t)) + \frac{\widehat{y}}{\widehat{p}\gamma}U_2(\frac{t\widehat{y}}{\gamma\widehat{p}})]} > 0$$

which completes the proof. □

Lemma (23) helps us to analyze the behavior of the indifference tax rate for each individual i: as the system becomes more efficient, individuals understand that, for a given amount of tax rate (and therefore of resources), a higher level of quality will be possible, and thus require a lower t to remain users of the public sector. The threshold tax rate, however, is not the only element that varies as the level of efficiency of the public sector changes. Also the most-preferred individuals' tax rates, in fact, is likely to be influenced by the change in γ. The direction of the change, however, depends on the preference of the voters. In fact, differentiation of the FOC relative to the usual maximization problem of individual i yields:

$$\frac{\partial t^*(y_i)}{\partial \gamma} = \frac{\partial t}{\partial y_i}\bigg|_{V_G=V_P} = -\frac{\frac{d(16)}{\partial \gamma}}{\frac{\partial(16)}{\partial t}} = -\frac{\frac{y_i \widehat{y} t}{\widehat{p}\gamma^2}U_{12}(.) - \frac{\widehat{y}}{\widehat{p}\gamma^2}U_2 - \frac{t\widehat{y}}{\widehat{p}^2\gamma^3}U_{22}(.)}{y_i^2 U_{11}(.) - \frac{y_i\widehat{y}}{\widehat{p}\gamma}U_{21}(.) - \frac{y_i\widehat{y}}{\widehat{p}\gamma}U_{12}(.) + (\frac{\widehat{y}}{\widehat{p}\gamma})^2 U_{22}(.)} \tag{17}$$

This expression is positive if and only if $ty_iU_{12} - \frac{t\widehat{y}}{\widehat{p}\gamma}U_{22} - U_2 > 0$; it is then useful to analyze separately the case in which this condition holds, and the opposite.

If $\frac{\partial t^*(y_i)}{\partial \gamma} > 0$, an improvement in the level of efficiency of the public sector boils down into a decrease in the each voter's preferred tax rate: every individual internalizes the fact that public healthcare production is now cheaper, hence a smaller amount of resources is needed to produce the same level of quality, and prefers to divert income on the consumption bundle.

As we have been doing up to now, in order to understand the effects of a variation in efficiency, it is useful to separately analyze the two types of equilibria we found. Consider first preferences satisfying $\frac{\partial t^*(y_i)}{\partial y_i} < 0$. As we can see from Figure 21, Panel A, an improvement in efficiency of the public sector may translate to an improvement in the quality of public healthcare, when the median voter was initially a private healthcare consumer (i.e. when $t^*(y^m) > \widetilde{t}(y^m)$); in fact, as γ decreases, by Lemma 23 the curve $\widetilde{t}(y_i)$ shifts downwards to $\widetilde{t}'(y_i)$, and by the assumption we made on the sign of (17) the same happens to the curve $t^*(y_i)$; if, after the shift, $t^{*\prime}(y^m) > \widetilde{t}'(y^m)$, the tax rate increases from $t^* = 0$ to the new $t^{*\prime} = t^{*\prime}(y^m)$. When, on the other hand, the median voter was already a public healthcare user (Figure 21, Panel B), the median voter's preferred tax rate still prevails at equilibrium. However, the downward shift of $t^*(y_i)$ leads him to pick up a lower tax rate compared to before. Hence, as we can see, if the public sector' production process improves in efficiency, a system in which public spending in healthcare quality is zero can move to a situation in which resources are fueled, via taxation, from the private to the public.

If, on the other hand, preferences are such that $\frac{\partial t^*(y_i)}{\partial y_i} > 0$, the situation is slightly different; again, as we see in Figure 22, both the curves $\widetilde{t}(y_i)$ and $t^*(y_i)$ shift down to $\widetilde{t}'(y_i)$ and $t^{*\prime}(y_i)$ as γ goes down; the overall effect on the tax rate depends on the relative size of these two shifts. In fact, if $\widetilde{t}' y_h) = t^{*\prime}(y_l)$, the majority voting-winning tax rate is still the one preferred by the individual with income y_l; due to the downward shift of the curves, however, her preferred tax rate will now be $t^{*\prime}(y_l) < t^*(y_l)$ (Panel A). If, instead, after the decrease in γ we are in a situation in which $\widetilde{t}'(y_h) > t^{*\prime}(y_l)$ (Panel B), the individual with income y_h will not be indifferent between the two ways of provision anymore, but will instead strictly prefer private. There exists a $y_h' < y_h$ that satisfies $\widetilde{t}'(y_h') = t^{*\prime}(y_l)$; however, $\int_{y_l}^{y_h'} dF(y_i) < 0.5$, and the tax rate preferred by y_l will not be an equilibrium anymore as more than half of the population would favor a tax decrease. Therefore, equilibrium will be characterized by two y_l'' and y_h'' such that $t^{*\prime}(y_l'') = \widetilde{t}(y_h'')$ and $\int_{y_l''}^{y_h''} dF(y_i) = 0.5$, and the new tax rate will be $t^{*\prime} = t^{*\prime}(y_l'') < t^* = t^*(y_l)$ because $y_l'' < y_l$ and $y_h'' < y_h$. Last, we can also have a situation in which, after the change, we have that $\widetilde{t}'(y_h) < t^{*\prime}(y_h)$, so that the individual with income y_h will now strictly prefer public care (Panel C) and the indifferent individual will be richer than . The situation, then, is completely opposed to the one we just analyzed: the equilibrium will be characterized by two new individuals, with incomes $\widetilde{y_l}$ and $\widetilde{y_h}$, such that $\int_{\widetilde{y_l}}^{\widetilde{y_h}} dF(y_i) = 0.5$ and $t^{*\prime}(\widetilde{y_l}) = \widetilde{t}(\widetilde{y_h})$. As $\widetilde{y_l} > y_l$ and $\widetilde{y_h} > y_h$, however, in this case the overall effect on the tax rate following an efficiency increase will be ambiguous in sign; the increase from y_l to $\widetilde{y_l}$ will push toward an increase, while the downward shift of the curve t^* will push toward a decrease. Overall, however, the level of quality in equilibrium will be greater than or equal to the one preceding the fall in γ.

In the alternative situation in which $\frac{\partial t^*(y_i)}{\partial \gamma} < 0$, an improvement in the efficiency of the public sector translates into an increase of the bliss point of each individual over the tax rate. This is a possibility that occurs if such an amelioration makes healthcare so attracting that individuals are willing to give away a part of consumption to achieve a higher level of it.

Under this assumption, if $\frac{\partial t^*(y_i)}{\partial y_i} < 0$, the situation is represented in Figure 23: as γ goes down, the curve $\widetilde{t}(y_i)$ shifts downwards while the curve $t^*(y_i)$ goes down. As we see, the equilibrium tax rate goes from t^* to $t^{*\prime}$, which can be slightly lower, slightly higher or equal to t^*; the striking result is, nonetheless, the strong increase in the amount of people choosing the public service, as the income of the indifferent voter goes from $\widetilde{y_i}$ to $\widetilde{y_i'}$. Quality increases as a result.

If, on the other hand, $\frac{\partial t^*(y_i)}{\partial y_i} < 0$, we can see in Figure 25 how a downward shift of $\widetilde{t}(y_i)$ and an upward shift of $t^*(y_i)$ undoubtedly lead the pivotal voter, y_l, to be richer now: he will therefore prefer a tax rate $t^{*\prime} > t^*$, which gives us the equilibrium policy outcome. The increase is greater than in the median voter case, therefore the positive effect on quality will be greater; moreover, also in this case the share of public service users will increase as this sector becomes more attractive.

Further from what we just explained, what is crucial for understanding the effects on the equilibrium of a change in efficiency is the behavior of the preferred tax rate as γ varies. To clarify the discussion, therefore, it is meaningful to try to shed light on the determinants of the sign of $\frac{dt^*(y_i)}{d\gamma}$, we can consider a particular type of utility function and try to study how the values of the parameters determine the behavior of the tax rate as efficiency of the public sector varies. In particular, we consider a CES utility function, of the type:

$$U(y_i, t, q) = \Big[(y_i(1-t))^\alpha + (qh)^\alpha\Big]^{1/\alpha}$$

where, as before, either $q = g$ and $\widehat{p}\gamma gh = t\widehat{y}$, or $q = m$. That the maximization problem individual i faces is hence the following:

$$\max_t Max\Big\{\Big[(y_i(1-t))^\alpha + (gh)^\alpha\Big]^{1/\alpha}; \Big[(y_i(1-t) - \lambda\widehat{p}mh)^\alpha + (mh)^\alpha\Big]^{1/\alpha}\Big\}$$

given the usual GBC $ty_i = \widehat{p}\gamma gh$. The problem has two possible solutions: $t^* = 0$ if individual i strictly prefers the private service, and $t^* = \frac{(\widehat{p}\gamma)^{\frac{\alpha}{\alpha-1}}}{1+(\widehat{p}\gamma)^{\frac{\alpha}{\alpha-1}}} > 0$ if he prefers the public one. Clearly, when $t^* = 0$ variations in γ do not affect the tax rate; when $t^* > 0$, instead, we have:

$$\frac{\partial t^*}{\partial \gamma} = \frac{\alpha}{\alpha-1}\frac{1}{\gamma}\frac{(\widehat{p}\gamma)^{\frac{\alpha}{\alpha-1}}}{1+(\widehat{p}\gamma)^{\frac{\alpha}{\alpha-1}}}\left[1-\frac{(\widehat{p}\gamma)^{\frac{\alpha}{\alpha-1}}}{1+(\widehat{p}\gamma)^{\frac{\alpha}{\alpha-1}}}\right] \tag{18}$$

As we can see, the utility-maximizing tax rate for every individual is decreasing in γ if and only if $\alpha \in (0,1)$, i.e. when the elasticity of substitution between the two goods is $\varepsilon = \frac{1}{1-\alpha} > 1$. This is consistent with what explained above: when consumption can be "easily" substituted with consumption, as the public sector becomes less efficient (i.e. when γ increases), individuals will prefer to divert resources from taxation, and thus from public healthcare, to consumption. On the other hand, when α is negative or greater than one, the elasticity is $\varepsilon < 1$; consumption and healthcare are not very substitutable, so voters will prefer to pay more in taxes to compensate the higher cost of production; note that when $\alpha > 1$, we have $\varepsilon < 0$, and consumption and healthcare are not substitutable.

4 Federalism

Up to this point, our aim has been that of understanding the equilibrium features of public healthcare provision. As we saw, the majority voting political equilibrium over a tax rate, whose revenues finance the production of a public good, which also has an alternative available on private insurance markets, can be characterized in two ways, depending on the particular assumptions on the preferences of each individual and, in turn, on the redistributive power and aims of the public sector. In fact, we can have a situation in which, due to particular features of the utility function, the public provision of healthcare entails redistribution of resources: poorer individuals prefer a higher tax rate, and viceversa. As shown in the previous discussion, in this case, the median income voter's preferred policy outcome is the political equilibrium one: the presence of the private alternative to such public good does not lead preferences to violate single-peakedness However, if preferences are such that poorer individuals prefer instead a lower tax rate (i.e. the public provision system is not redistributive), we have a different situation: individuals' most preferred tax rate is increasing in income, and at the same time, for a given level of the tax rate, a certain portion of richer individuals will prefer the private alternative and a zero tax rate. The private alternative hence introduces a "jump" in preferences over the tax schedule, which leads them to violate single peakedness, and the median voter theorem does not apply anymore. As we saw, however, even in this case is it possible to explicitly characterize the political equilibrium, one in which a coalition of middle income voters, who are willing to pay more in taxes because of income effects and because they will actually use the public good, is opposed to a coalition of poor and rich voters instead favoring a tax decrease, the former because of a strict budget constraint, and the latter because they will prefer to consume the private alternative.

It is clear, from the analysis we have conducted, that both types of equilibria depend on some features of the population of voters we are considering: in particular, what seems to matter is the type and characteristics of the income distribution. This is particularly relevant not only in a cross-country perspective of analysis, i.e. when we compare different countries with similar systems for public healthcare provision, but also if we use a within-country approach, for example because the system of tax collection and public good provision is decentralized to local agencies, administering regions which differ in terms of income distribution. In this sense, in countries with a federal fiscal system, we can expect to observe different levels of NHS quality across regions, if latter are not homogeneous. The aim of this section is therefore to understand whether, and to what extent, this can be true. In particular, how does the equilibrium, and the political outcome in terms of healthcare quality, change when we move from a centralized to a decentralized (federal) fiscal system?

For the purpose of this analysis, in this section we assume the country to be made of 3 geographic regions: region A, region B and region C. These regions are not homogeneous: we assume in fact different income distributions in each of them (from now on, the subscript $j \in \{A, B, C\}$ will denote regions). In particular, we want to allow them to differ both in terms of income levels (average and total) and of income inequality. Consistently with the literature, we assume income in region j to be distributed as a Pareto:

$$F\left(y_{i,j};\alpha_j,\beta_j\right) = \begin{cases} 1-\left(\frac{\beta_j}{y_{i,j}}\right)^{\alpha_j} \text{ if } y_{i,j} \geq \beta_j \\ 0 \text{ otherwise.} \end{cases}$$
$$f\left(y_i;\alpha,\beta\right) = \begin{cases} \alpha_j \frac{\beta_j^{\alpha_j}}{y_{i,j}^{\alpha_j+1}} \text{ if } y_i \geq \beta_j \\ 1 \text{ otherwise.} \end{cases}$$

where α_j is a *scale* parameter (Pareto Index, Pareto 1896), which drives the degree of "dispersion" of the observations around the mean, and β_j is a location parameter, in particular representing the minimum value of income in the distribution; we can therefore consider β_j as a proxy for the overall level of income, and α_j as a proxy for income inequality. The PDF's of the three distributions are displayed in Figure 25 in the Appendix.

We assume the 3 regions to be different in the following way: $\beta_A > \beta_B > \beta_C$, $\alpha_A = \alpha_C > \alpha_B$; in words, A is the richer region and C is the poorer, and in these two regions inequality is higher than in B. Given these assumptions on the distribution, denoting with $\widehat{y_j}$ the average income in region j, and with y_j^m the median, the following hold:

$$\widehat{y}_A = \frac{\alpha_A\beta_A}{\alpha_A-1} > \widehat{y}_B = \frac{\alpha_B\beta_B}{\alpha_B-1} > \widehat{y}_C = \frac{\alpha_C\beta_C}{\alpha_C-1}$$
$$y_B^m = 2^{\frac{1}{\alpha_B}} > y_C^m = 2^{\frac{1}{\alpha_C}}$$

Moreover, if we assume $\frac{\beta_A}{\beta_B} > 2^{\frac{1}{\alpha_B}-\frac{1}{\alpha_A}}$,

$$y_A^m > y_B^m \ .$$

In our analysis, we assume that each region collects its proportional income tax t_j and autonomously provides its citizens with a system of healthcare services. Again, we consider the amount of per-capita services to be fixed at h; the quality of the service, g, is instead dependent on the quantity of resources that each region's public sector is able to collect via taxation. For the moment, we consider the three regions as acting independently, i.e. with no transfers between them or from the central government; we will remove this assumption in what follows.

4.1 Redistributive public sector

In order to characterize and compare the levels of quality reachable by the regions when they "run alone" in a federal system, we have to make a fundamental assumption on the relationship between individuals' preferences over the tax rate, and personal income. In this section we assume $\frac{\partial t^*(y_i)}{\partial y_i} < 0$: the bliss point tax rate of each individual is decreasing in her own income, therefore the system of public provision entails redistribution. As we saw in the case of a centralized system of taxation, under this assumption a majority voting equilibrium exists and the chosen tax rate coincides with that preferred by the median voter. In order to understand the properties of the majority voting political equilibrium, we should assess the impact of the income distribution features on the GBC. When fiscal federalism hold, we have that:

$$t_j \widehat{y}_j = \widehat{p} \gamma g_j \tag{19}$$

By writing (19) in this way, we are implicitly assuming an identical distribution of health risk across regions, normalizing $p_i = \widehat{p}\ \forall i$, and an identical level of efficiency of production between them. As $t_j^* = t_j(y_j^m)$, in each region, when the public provision system is redistributive, the equilibrium level of healthcare quality depends on y_j^m and on $\widehat{y}_j$; the first has a negative effect on g, as $\frac{\partial t^*}{\partial y_i} < 0$, while the second has a positive effect. In order to compare g_A^*, g_B^* and g_C^* we should therefore assess which of the two effects is stronger.

To this purpose, it is useful to write g_j as:

$$g_j = g(\widehat{y}_j, y_j^m)$$

Being g_j a function of average and median income, it directly depends on the parameters of the income distribution, α_j and β_j. In order to understand the effects of these on the function, we use a total differential expression to study the determinants of such relationship. We start with a_j

$$\frac{\partial g_j}{\partial \alpha_j} = \frac{\partial g_j}{\partial y_j^m}\frac{\partial y_j^m}{\partial \alpha_j} + \frac{\partial g_j}{\partial \widehat{y}_j}\frac{\partial \widehat{y}_j}{\partial \alpha_j}$$

Note that:

$$\frac{\partial g_j}{\partial y_j^m} = \frac{\partial g_j}{\partial t_j}\frac{\partial t_j}{\partial y_j^m}$$

Since $\frac{\partial g_j}{\partial t_j} = \frac{\widehat{y}_j}{\widehat{p}\gamma} > 0$, $\frac{\partial t_j}{\partial y_j^m} < 0$ by assumption and $\frac{\partial y_j^m}{\partial \alpha_j} = -\frac{2^{\frac{1}{\alpha_j}}\log 2}{\alpha_j^2} < 0$, the first addend of the total differential expression of g_j is positive. To study the sign of the second addend, we look for the sign of the following expression:

$$\begin{aligned}
\frac{\partial g_j}{\partial \widehat{y}_j} &= \frac{\partial g_j}{\partial t_j}\frac{\partial t_j}{\partial \widehat{y}_j} + \frac{\partial g_j}{\partial \widehat{y}_j} \\
&= \frac{\widehat{y}_j}{\widehat{p}\gamma}\left[\frac{\frac{y_j^m t_j}{\widehat{p}\gamma}U_{12}(.) - \frac{1}{\widehat{p}\gamma}U_2(.) - \frac{t_j\widehat{y}}{(\widehat{p}\gamma)^2}U_{22}(.)}{(y_j^m)^2U_{11}(.) - \frac{y_j^m\widehat{y}}{\widehat{p}\gamma}U_{12}(.) - \frac{y_j^m\widehat{y}}{\widehat{p}\gamma}U_{21}(.) + (\frac{\widehat{y}}{\widehat{p}\gamma})^2U_{22}(.)}\right] + \frac{t_j}{\widehat{p}\gamma}
\end{aligned}$$

As we can see, the sign of the expression in square brackets is unclear. In fact, if the numerator is positive, being the denominator negative and given that $\frac{\partial \widehat{y}_j}{\partial \alpha_j} = -\frac{\beta_j}{(\alpha_j-1)^2} < 0$, the second addend of the total differentiation is positive and we can conclude that $\frac{\partial g_j}{\partial \alpha_j} > 0$; otherwise, the second addend is negative, and in order to establish the sign of the variation of g_j with respect to α_j we have to study the magnitudes of the partial differentials.

Let us now study the variation of g_j with respect to β_j:

$$\frac{\partial g_j}{\partial \beta_j} = \frac{\partial g_j}{\partial y_j^m}\frac{\partial y_j^m}{\partial \beta_j} + \frac{\partial g_j}{\partial \widehat{y}_j}\frac{\partial \widehat{y}_j}{\partial \beta_j}$$

Since $\frac{\partial \widehat{y}_j}{\partial \beta_j} = \frac{\alpha_j}{\alpha_j-1} > 0$ and $\frac{\partial y_j^m}{\partial \beta_j} = 2^{\frac{1}{\alpha_j}} > 0$, the first addend of the total differentiation is negative; the second addend is now negative when the numerator of the expression $\frac{\partial t_j}{\partial \widehat{y}_j}$

is positive, otherwise we again have to study the magnitude of the differentials. The lack of certainty about the sign of the partial differentials therefore allows many situations to be possible in a federal taxation and provision system with redistributive features:

1. If $\frac{\partial g_j}{\partial \widehat{y}_j} > 0$, then $\frac{\partial g_j}{\partial \alpha_j} > 0\,, \frac{\partial g_j}{\partial \beta_j} < 0$; given that $\alpha_A = \alpha_C > \alpha_B$ and $\beta_A > \beta_B > \beta_C$, we have $g_A < g_C$, $g_B < g_C$, and the relationship between g_A and g_B is unclear;

2. If $\frac{\partial g_j}{\partial \widehat{y}_j} < 0$, two alternative cases are possible:

   (a) $\frac{\partial g_j}{\partial \alpha_j} < 0\,, \frac{\partial g_j}{\partial \beta_j} > 0$; we have $g_A > g_C$, $g_B > g_C$, and the relationship between g_A and g_B is unclear;

   (b) $\frac{\partial g_j}{\partial \alpha_j} > 0\,, \frac{\partial g_j}{\partial \beta_j} > 0$; we have $g_A > g_B$, $g_A > g_C$, and the relationship between g_B and g_C is unclear.

The above analytical discussion allows us to present and explain the main findings on the study of regional spending in healthcare quality and its determinants. In particular, two effects seem to be active on such key variable. The first is the one we can call "income effect", driven by differences in the parameter β across regions, which determines the amount of resources that can be spent on public production in each district: it becomes relevant when $\frac{\partial g_j}{\partial \beta_j} > 0$. The second is an "inequality effect", which drives instead the degree of redistribution: it is particularly strong when $\frac{\partial g_j}{\partial \alpha_j} > 0$. When the income effect is strong (2.b, 2.c), the poorer region ends up with a lower level of healthcare quality spending; when the inequality effect is stronger (1 and 2.c), instead, the more unequal regions are those in which g is higher, and the ordering of public spending among these two is driven by the magnitude of the additional income effect. Even if unclear in sign, these results are interesting because they show how the interaction of the two drivers of diversity between regions, i.e. the income level and the income inequality, can lead to different scenarios, particularly relevant in determining the "fortune" of the poor and unequal region C.

4.2 Non-redistributive public sector

Having analyzed the situation in which the public healthcare system entails redistribution, i.e. when $\frac{\partial t_j}{\partial y_j} < 0$, we are now ready to study what happens in the alternative case in which $\frac{\partial t_j}{\partial y_j} > 0$. As we saw in the previous chapters, in this case the pivotal voter, i.e. the one whose preferred policy outcome is able to defeat all the alternatives in a majority voting, is not the individual with income y^m, but the one with income y_l as defined in Proposition 5. In such a situation, a coalition of middle-income voters favors a tax/quality increase, while all the others, poorer and richer, would prefer a tax decrease, the former because of a stricter budget constraint, the latter because they are not going to use the public service but rather to buy the private insurance. Having explained the equilibrium features in the case in which taxes are collected and voted upon, and public healthcare is produced at the country level, we now want to investigate on the region-specific equilibrium levels of healthcare quality in the case of a federal taxation and provision system. We consider the same regions as above, A, B and C, and we again try to understand the features of equilibrium level of quality.

In order to understand how the equilibrium varies with different values for the distribution parameters α_j and β_j, it is useful to re-write the equations characterizing the political equilibrium in region j :

$$\begin{cases} -y_{j,l}U_1(y_{j,l}(1-t_l), \frac{t\widehat{y}_j}{\widehat{p}\gamma}) + \frac{\widehat{y}_j}{\widehat{p}\gamma}U_2(y_{j,l}(1-t_l), \frac{t\widehat{y}_j}{\widehat{p}\gamma}) = 0 \\ U(y_{j,h}(1-t_j), \frac{t\widehat{y}_j}{\widehat{p}\gamma}) = U(y_{j,h}(1-t_j) - \lambda\widehat{p} \\ \int_{y_{j,l}}^{y_{j,h}} dF(y_{i,j}) = 0.5 \end{cases}$$

The third of the above equation can be rewritten as:

$$\left(\frac{\beta_j}{y_{j,l}}\right)^{a_j} - \left(\frac{\beta_j}{y_{j,h}}\right)^{a_j} = \frac{1}{2} \tag{20}$$

Equation (20) will be fundamental in the determination of the dynamics involving the parameters together with y_h, y_l.

To understand how the level of public health expenditure varies across regions, recall again that $g_j = \frac{t_j \widehat{y}_j}{\widehat{p}\gamma}$ and, by assumption, $\widehat{y}_A > \widehat{y}_B > \widehat{y}_C$. In order to understand how g_j varies across regions, we therefore need to understand the behavior of t_j.

Using, again, the total differentiation expression, we have:

$$\frac{\partial g_j}{\partial \alpha_j} = \frac{\partial g_j}{\partial y_{j,l}} \frac{\partial y_{j,l}}{\partial \alpha_j} + \frac{\partial g_j}{\partial \widehat{y}_j} \frac{\partial \widehat{y}_j}{\partial \alpha_j} \tag{21}$$

$$\frac{\partial g_j}{\partial \beta_j} = \frac{\partial g_j}{\partial y_{j,l}} \frac{\partial y_{j,l}}{\partial \beta_j} + \frac{\partial g_j}{\partial \widehat{y}_j} \frac{\partial \widehat{y}_j}{\partial \beta_j} \tag{22}$$

we need to study the sign of $\frac{\partial y_{j,l}}{\partial \alpha_j}$ and $\frac{\partial y_{j,l}}{\partial \beta_j}$. From equation (20), we can see that an increase in α_j leads to a decrease in the LHS of the equation: in fact, as α_j goes up, both $y_{j,l}$ and $y_{j,h}$ go up, but since the latter is larger than the former, the effect of an increase in the exponent leads to an overall contraction of the expression $(\frac{\beta_j}{y_{j,l}})^{a_j} - (\frac{\beta_j}{y_{j,h}})^{a_j}$. To maintain the political equilibrium, such expression has however to be equal to $\frac{1}{2}$; therefore, an increase in α_j is followed by a decrease in $y_{j,l}$ and an increase in $y_{j,h}$. We can therefore conclude that $\frac{\partial y_{j,l}}{\partial \alpha_j} < 0$. In order to study the sign of $\frac{\partial y_{j,l}}{\partial \beta_j}$, we can conduct a similar reasoning: as β_j goes up, the LHS of (20) goes up, as the effect of the increase is stronger on $(\frac{\beta_j}{y_{j,l}})^{a_j}$ than on $(\frac{\beta_j}{y_{j,h}})^{a_j}$; to maintain the equality, both $y_{j,h}$ and $y_{j,l}$ have to increase, therefore $\frac{\partial y_{j,l}}{\partial \beta_j} > 0$.These results are, in some ways, quite intuitive: as the distribution becomes more dispersed across the mean, we need a larger interval in order to "capture" exactly half of the population; by the same token, when the overall level of income is higher, also the two pivotal voters, with incomes $y_{j,l}$ and $y_{j,h}$, will be richer.

Having studied the signs of the partial differentials, we have all the elements to understand how g_j changes with the parameters of the distribution. As $\frac{\partial g_j}{\partial y_{j,l}} > 0$ and $\frac{\partial g_j}{\partial \widehat{y}_j} > 0$, since $\frac{\partial y_{j,l}}{\partial \alpha_j} < 0$ and $\frac{\partial \widehat{y}_j}{\partial \alpha_j} < 0$, from (21) we can conclude that $\frac{\partial g_j}{\partial \alpha_j} < 0$; analogously, from (22) we see that, since $\frac{\partial y_{j,l}}{\partial \beta_j} > 0$ and $\frac{\partial \widehat{y}_j}{\partial \beta_j} > 0$, $\frac{\partial g_j}{\partial \beta_j} > 0$. We therefore see how, in case of a federal non-redistributive system of public healthcare, both the income level and the inequality effects are present and active on the determination of g. This discussion enables us to summarize our results in the following proposition.

Proposition 24. *In equilibrium, either $g_B > g_A > g_C$, or $g_A > g_B > g_C$.*

In a system in which the equilibrium is of the "ends against the middle" type, therefore, region C, poorer and unequal, will end up with the lowest level of public health spending; the total amount of taxable incomes is lower than in the other regions, moreover the "middle class" relevant for the determination of the equilibrium tax rate, due to the features of the income distribution, has to be poorer. On the other side, the best-performing region could be either A or B: in particular, if inequality effect is the strongest, $g_B > g_A$. This is a result of the fact that, being B more homogeneous in terms of individual wealth, the middle class favoring a high public spending on healthcare services is on average richer than in the other, more unequal, regions.

4.3 Endogeneity of $\widehat{p}$

Having clarified what is the relationship between the relative performances of public healthcare of each region and the specific income distribution, in this section we proceed, as we did in Section 2, by considering the health risk factor p as an endogenous variable. This probability of illness plays a role in the political equilibrium because it directly determines the cost of private insurance to individuals, i.e. of the alternative to the public good; as we already saw, this is particularly relevant in the case of non-redistributive public healthcare provision.

Coherently with our previous discussion, we consider each region's average risk factor, as a function of income: the latter negatively influences the former. Again, we model it as follows:

$$\widehat{p}_j = \widehat{p} + \alpha(\frac{\widehat{y} - \widehat{y}_j}{\widehat{y}})$$

where α is a constant, $\widehat{y}$ and $\widehat{p}$, as before, are country averages. Further from our previous assumptions, $\widehat{p}_A < \widehat{p}_B < \widehat{p}_C$.

When the public system of healthcare provision entails redistribution, as we saw, different scenarios are possible. We recall them here and elaborate on them, one at the time.

1. If $\frac{\partial g_j}{\partial \widehat{y}_j} > 0$, then $\frac{\partial g_j}{\partial \alpha_j} > 0$, $\frac{\partial g_j}{\partial \beta_j} < 0$; given that $\alpha_A = \alpha_C > \alpha_B$ and $\beta_A > \beta_B > \beta_C$, we have $g_A < g_C$, $g_B < g_C$, and the relationship between g_A and g_B is unclear. However, endogeneizing p, we can end up having $g_A > g_B > g_C$.

2. If $\frac{\partial g_j}{\partial \widehat{y}_j} < 0$, two alternative cases are possible:

   (a) $\frac{\partial g_j}{\partial \alpha_j} < 0$, $\frac{\partial g_j}{\partial \beta_j} > 0$; we have $g_A > g_C$, $g_B > g_C$, and the relationship between g_A and g_B is unclear; again, endogeneity of p can lead to $g_A > g_B > g_C$.

   (b) $\frac{\partial g_j}{\partial \alpha_j} > 0$, $\frac{\partial g_j}{\partial \beta_j} > 0$; we have $g_A > g_B$, $g_A > g_C$, and the relationship between g_B and g_C is unclear; endogeneity of p, again, can lead to $g_A > g_B > g_C$.

When, instead, the public system does not entail redistribution, we showed that the more equal region ends up with the highest level of healthcare quality. Even in this case, however, the introduction of region-specific average risk factors may revert this result; $p_A < p_B$ in fact pushes towards A having a higher level of quality than B, for a given amount of tax revenues.

As we can see, including the risk factor in the analysis as an endogenous variable positively and directly correlated with income gives more strength to the income levels effect, increasing its relevance with respect to income inequality effect, leading to a result that merely depends on the size of the fiscal base and in which the richer a region, the higher its level of healthcare spending.

4.4 Minimum levels of quality and redistributive transfers

Even in countries where public services are financed via local taxation and provided by local agencies, the central government may give regions some directions on minimum levels of services or quality for basic rights and need to be satisfied. If strong differences in income levels and distribution exist across regions, however, leaving local districts free to choose their own tax policy may lead to under-provision or poor performance in some of them. When this is the case, the central government may impose some minimum levels in terms of quality or quantity, or redistribute resources across the country.

In this section, we want to analyze the political economy dynamics of a government intervention aimed at reducing across-regions inequality, via redistributive transfers from richer to poorer regions. Let us consider a situation in which the center imposes a minimum level of healthcare quality, $\overline{g}$; given our previous discussion about majority voting equilibrium tax rates, let us assume that $g_A > \overline{g}$, $g_B > \overline{g}$, and $g_C < \overline{g}$. Further from this, the transfer has to take resources from A and B and reallocate them to C. The amount of resources C has to receive in order to be able to reach $\overline{g}$ is given by:

$$T = \widehat{p}\gamma\overline{g}h - t_C\widehat{y}_C$$

T has to be provided jointly by A and B; the share of the transfer each of the two has to bear is proportional to average income:

$$T = \alpha_A T + \alpha_B T, \text{ where } \alpha_A = \frac{\widehat{y}_A}{\widehat{y}_A + \widehat{y}_B} \text{ and } \alpha_B = \frac{\widehat{y}_B}{\widehat{y}_A + \widehat{y}_B}\ .$$

The introduction of the redistributive transfer modifies the budget constraint of each region, and therefore the majority voting equilibrium. For regions A and B, the resource constraints are:

$$\begin{aligned} t_A\widehat{y}_A - \alpha_A T &= \widehat{p}\gamma g_A h \\ t_B\widehat{y}_B - \alpha_B T &= \widehat{p}\gamma g_B h \end{aligned}$$

As we can see, T is endogenous for region C, as it depends on the amount of resources this region is able to autonomously collect, $t_C\widehat{y}_C$; it is instead exogenous for regions A and B. However, as we see, the utility of these two regions depend on the choice of region C, giving rise to a strategic game in which the 3 districts simultaneously choose their tax rates via majority voting, taking into account other's preferences. In order to understand what happens in equilibrium, let us start from region C. Given the transfer, its budget constraint is the following:

$$t_C \widehat{y}_C + T = \widehat{p}\gamma g_C h$$

which, given the expression for T, simply becomes

$$g_C = \overline{g}$$

In region C, the maximization problem for each individual becomes:

$$\max_{t_C} Max\{U(y_i(1-t_C), \overline{g}), U(y_i(1-t_C) - \widehat{p}\lambda mh, mh)\}$$

whose FOC is:

$$-y_i U_1(y_i(1-t), \overline{g}) = 0 \tag{23}$$

This FOC has a corner solution: given that $U_1 > 0$ and $U_{11} < 0$, $t^* = 0$ for every citizen.

Let us now consider the decisions of A and B. We analyze the problem from the point of view of region A: it applies to B in an identical way. Given the decision of C, the budget constraint for A is the following:

$$t_A \widehat{y}_A = \widehat{p}\gamma g_A h + \alpha_A T$$

and therefore the maximization problem for each individual is the following:

$$\max_{t_A} Max\Big\{U\Big(y_i(1-t_A), \frac{t_A \widehat{y}_A - \alpha_A T}{\widehat{p}\gamma}\Big), U\Big(y_i(1-t_A) - \widehat{p}\lambda mh, mh\Big)\Big\}$$

As we can see from this expression, the effect of the transfer on the budget constraint of A is very similar to a fixed cost of healthcare production. Further from what we derived in Section 3, the consequences of its presence therefore depend on the features of the production system, and on preferences (redistributive vs. non-redistributive). When the system is redistributive, i.e. when $\frac{\partial t^*}{\partial y} < 0$, we saw that the addition of a fixed "burden" to the GBC leads to an increase in both $t^*$and $\widetilde{t}$, which lead to an increase in taxes needed to cover the additional charge of the transfer, without any increase in healthcare performance. In the alternative case in which the system does not entail redistribution, i.e. when $\frac{\partial t^*}{\partial y} > 0$, the overall effect depends on the relative increases in t^* and $\widetilde{t}$; obviously, if t^* does not increase, the quality level of A worsens after the introduction of the transfer.

Further from this discussion, we can conclude that, quite intuitively, an imposition of such a burden on the richer regions, under the form of a transfer to be paid to the poorer region, translates into an increase in fiscal pressure in the "transferring" regions; moreover, given that in both cases, the curve $\widetilde{t}_j(y_i)$ shifts upwards (see subsection 3.2), less people will be public services users. This result may open a wide debate on the desirability of such transfers: their original purpose is to give help to poorer regions, but eventually they lead to a sort of "free-riding" from this region, which hence looses all the incentives toward fiscal effort for the production of the good, to the expenses of the richer ones, which are forced to pay more to keep their own level of quality unchanged, or to loose in terms of quality. This can undoubtedly lead to a sharp loss of national welfare.

Despite this discussion, however, inequality between regions still seems to ask for a correction of the initial status quo. The question, at this point, becomes the following: is it possible to structure the transfer in such a way as to minimize the disincentives for the recipient and the burden of the givers? In an attempt of giving an answer, let us consider a transfer computed this way:

$$T = \widehat{p}\gamma\overline{g}h - \tau\widehat{y}_C$$

where τ is set from the central government and is, therefore, exogenous. When the transfer is structured in this way, region C has less incentives to reduce the fiscal effort: since τ is fixed, the transfer only depends on the region's average income. The problem for C becomes:

$$\max_{t_C} Max\Big\{U\Big(y_i(1-t_C), \frac{(t_c-\tau)\widehat{y}_C}{\widehat{p}\gamma} + \overline{g}\Big), U(y_i(1-t_C) - \widehat{p}\lambda mh, mh)\Big\}$$

leading to the following FOC:

$$-y_iU_1\Big(y_i(1-t_C),\frac{(t_C-\tau)\widehat{y}_C}{\widehat{p}\gamma}+\overline{g}\Big)+\frac{\widehat{y}_C}{\widehat{p}\gamma}U_2\Big(y_i(1-t_C),\frac{(t_C-\tau)\widehat{y}_C}{\widehat{p}\gamma}+\overline{g}\Big)=0$$

The above expression has, in this case, an internal solution for t_C. An injection of resources under the form of an horizontal transfer is analogous to the opposite of a fixed cost, and will therefore have the effect of decreasing the tax rate and increasing the proportion of the total population who prefers the public sector to the private one. However, this time the tax rate in C can be strictly positive: if this is the case, then the burden on the giving regions is lighter than in the previous case, leading to less strong modifications in tax rates and levels of quality. We can see how, by structuring T as not directly dependent from the real t_C, the central government may be able to preserve equity without completely destroying economic incentives for the receiving region. The effects in terms of welfare of such a scheme depend on τ and on the other variables of the model, but the overall desirability of this framework lies on the tradeoff between pure utility maximization and the importance attached to the basic rights of equity pertaining to all citizens; here, however, we abstract from this type of analysis.

4.5 Cost efficiency and monitoring in perequative transfers

Up to now, we have taken the level of efficiency, proxied by the unitary cost of production γ, as exogenous and constant across regions. This is quite of a restrictive assumption: disparities of quality of public service provision across jurisdictions is often a result not only of differences in aggregate preferences and income distribution, but also in the ability of the local governments to effectively use resources collected via general taxation in the production of a particular good. Such differences, which translate into various levels of production costs, might be intrinsic to each region (e.g. because the provision of a particular good involves the use of resources not directly owned by that region, or because regions have different technologies for the production of such good), or might be the result of different degrees of effort the regions put when they produce the public good. The central government, in an attempt to provide redistributive transfers to decrease across-regions inequality, may accomplish its goal by linking the redistributive transfers to the intrinsic cost of each region, subsidizing those with high levels and taking resources from the more efficient ones.

To formally analyze this possibility and its consequences on the political equilibrium, consider the following expression for the unitary production cost of public healthcare quality:

$$\gamma_j = \chi_j - e_j \text{ for every } j \in \{A, B, C\}$$

where χ_j is the intrinsic production cost of region j, and e_j is the effort in production; exerting effort hence decreases the total cost. Effort, nonetheless, has its own cost in terms of disutility. Suppose in fact that the amount of effort is constant across individuals in each region (i.e. it is decided by each local agency): utility of individual i in country j will be given by:

$$U(y_i, t_j, e_j) = U(y_i(1 - t_j), g_j) - \varphi(e_j)$$

The disutility-of-effort function φ is such that $\varphi(0) = 0$, $\varphi' > 0$, $\varphi'' > 0$.

Let us assume the following timing for the political/economic decisions of the agents: in the first period, individuals in each region vote over the tax schedule, in the second period the government allocates the redistributive transfers across regions, and in the third each local district decides on the amount of effort to be exerted in public production.

Objective of the government is to maximize the aggregate utility function of the country. In order to simplify the analyses, we consider only region A (rich) and region C (poor):

The analysis can be extended to a framework in which we consider all 3 regions, and in which A and B are net givers and C is net receiver; nothing changes substantially, except the discussions on the political equilibrium in A and B, given that they have different income distributions.

$$\max E\Big[\phi U_A(y_A(1-t_A), g_A)\Big] + E\Big[\phi U_B(y_B(1-t_B), g_B)\Big]$$

The function ϕ is a weighting function; $\phi' > 0$, $\phi'' < 0$, so that convexity leads low utilities to get more weight, in a search for equality. Each region faces a transfer, T_j, so that j's budget constraint is given by $t_j\widehat{y}_j + T_j = \widehat{p}\,(\chi_j - e_j)\,g_j$. Clearly, $T_A = -T_B$; if $T_j > 0$, the region is a net receiver, otherwise it is a net giver. As the government wants to achieve equality across regions, he will set T_A and T_B such that

$$U_A\Bigg(y_C(1-t_C), \frac{t_A\widehat{y}_C}{\widehat{p}(\chi_C - e_C)} + T_C\Bigg) = U_B\Bigg(y_C(1-t_C), \frac{t_C\widehat{y}_C}{\widehat{p}(\chi_C - e_C)} + T_C\Bigg) \qquad (24)$$

Let us suppose, for the moment, that the government is perfectly able to observe χ_j. Then, the redistributive transfer will be a function of the variables that drive the wedge between g_A and g_B: $T_C = -T_A = f(\widehat{y}_A, \widehat{y}_C, \chi_A, \chi_C)$. Assuming that the center takes its decision on T_j after the voting on the tax rate, and that $\chi_A > \chi_C$, we have that $T_A < 0$ and $T_B < 0$; the government is therefore able to reallocate resources across countries, in such a way as to reduce inequality in healthcare services. Moreover, $f'_{\chi_C} > 0$; the transfer is larger, the poorer is region's technology.

Having established how the center decides about the redistributive transfers, we can analyze the "reaction" of the regions in terms of effort exerted in production: we consider each region acting as a single unit on this decision, as if it were taken by the local government itself. Consider region j, where again $j \in \{A, B\}$. The problem it has to face is the following:

$$\max_{e_j} U(\widehat{y}_i(1-t_j), g_j) - \varphi(e_j)$$

$$s.t.\ g_j \;=\; \frac{t_j\widehat{y}_j}{\widehat{p}(\chi_j - e_j)} + T_j$$

The problem yields the following FOC:

$$\frac{t_j\widehat{y}_j}{\widehat{p}(\chi_j - e_j)^2}U_2(\widehat{y}_i(1-t_j), \frac{t_j\widehat{y}_j}{\widehat{p}(\chi_j - e_j)} + T_j) - \varphi'(e_j) = 0 \tag{25}$$

We now want to analyze which are the variables that influence the amount of exerted effort.

Proposition 25. *In a federal system with perfect information on cost structure and redistributive transfers across regions, regions with higher inherent cost levels may have incentives in exerting more effort if a transfer is present.*

Proof. Differentiating the FOC, we get:

$$\frac{de_j}{d\chi_j} = -\frac{\frac{d(25)}{d\chi_j}}{\frac{d(25)}{de_j}} = -\frac{-\frac{2t_j\widehat{y}_j}{\widehat{p}(\chi_j-e_j)^3}U_2\left(.\right) - \left[\left(\frac{t_j\widehat{y}_j}{\widehat{p}(\chi_j-e_j)^2}\right)^2 - \frac{t_j\widehat{y}_j}{\widehat{p}(\chi_j-e_j)^2}f'_{\chi_j}\right]U_{22}\left(.\right)}{\left(\frac{t_j\widehat{y}_j}{\widehat{p}(\chi_j-e_j)^2}\right)^2 U_{22}\left(.\right) + 2\frac{t_j\widehat{y}_j}{\widehat{p}(\chi_j-e_j)^3}U_2\left(.\right) - \varphi''\left(e_j\right)}$$

$$= 1 + \frac{\varphi''\left(e_j\right) - \frac{t_j\widehat{y}_j}{\widehat{p}(\chi_j-e_j)^2}f'_{\chi_j}U_{22}\left(.\right)}{\frac{t_j\widehat{y}_j}{\widehat{p}(\chi_j-e_j)^3}\left(2U_2\left(.\right) + \frac{t_j\widehat{y}_j}{\widehat{p}(\chi_j-e_j)}U_{22}\left(.\right)\right)}$$

The above expression, as we can see, is not monotone in sign: at the denominator of the fraction, $U_2(.) > 0$ and $U_{22}(.) < 0$. It is indeed positive, nonetheless, if the region we are taking into account has a high enough χ_j (which is meaningful if the region is a receiver, i.e. if $T_j > 0$), and a low e_j. □

What the above proposition is suggesting, in other words, is that the introduction of a transfer linked to the level of technology of each region may give incentives to districts with a poor technology, which would have exerted a very low level of effort without the transfer (for example because of very low marginal returns on effort, compared to marginal costs, due to high intrinsic cost) to engage and invest more in the production of the public good. This could seem counterintuitive; however, it might be due to the non-linearity of the marginal utility from healthcare services and of the disutility/cost of effort, whose relative effect could change with the level of initial resources each country has. Intuitively, a very poor region with a bad technology is able to reach, without the transfer, only a sub-optimal level of public care quality; if the transfer is independent on effort, the region may want to work more because, after the transfer, the net marginal utility of effort is positive. As a result, the transfer may end up having the overall effect of "increasing the bliss point" of region j over e_j.

The above proposition and its result are very relevant in assessing the degree of help provided by the redistributive transfers; in case of perfect information, we see that not only are they able to help the poor region achieving a minimum level of quality in public service provision, but they may also work as an incentive tool to push them in putting more effort in production, which, over time, may prove helpful in improving the sector as a whole, for example by increasing investments which may eventually lead to an improvement in technology. This consequence is likely to improve the quality of the public sector as a whole, and in turn to make such region less dependent on transfers in the future. This, as already said, might not be true for every receiving district.

The above discussion clarifies the main implications of the introduction of transfers linked to each region's inherent cost levels. Obviously, the possibility of implementing this sort of redistribution relies heavily on the assumption of perfect information on χ_j from the point of view of the government. This, however, may well be unrealistic. In fact, the distance, both physical and organizational, between the center and the local agencies might make it impossible, for the government, to discern the role of technology and that of effort on the region's total cost. To complement our analysis, therefore, we now consider the case in which the center is only able to observe γ_j rather than χ_j.

The redistributive transfers T_A, T_C, are, again, such that $T_A = -T_C$. Nonetheless, given imperfect information on the structure of γ_j, we now have $T_j = f\left(\gamma_j, \gamma_{-j}, \widehat{y}_j, \widehat{y}_{-j}\right)$. If we assume, as before, that $\chi_A < \chi_B$, ceteris paribus $T_A < 0$ and $T_C > 0$ both in the case of a redistributive system ($\frac{\partial t^*(y_i)}{\partial y_i} < 0$) and of a non-redistributive one ($\frac{\partial t^*(y_i)}{\partial y_i} > 0$), given what we proved above, i.e. $g_A > g_C$ in both cases. Moreover, we have that $f'_{\chi_j} = -f'_{e_j} > 0$, $f''_{e_j} = f''_{\chi_j} = -f''_{e_j,\chi_j} = -f''_{\chi_j,e_j} < 0$. The timing of the decision is equal to the case of perfect information: first, the citizens vote over the tax rate, then the government sets the transfers, then the regions choose the amount of effort to be put in public production. Differently from before, now regions internalize, in their choice, the direct dependence of the transfers on this variable. The problem each region has to face is the following:

$$\max_{e_j} U\left(\widehat{y}_j\left(1-t_j\right), \frac{t_j\widehat{y}_j}{\widehat{p}\left(\chi_j-e_j\right)} + f\left(\chi_j,\chi_{-j},e_j,e_{-j},\widehat{y}_j,\widehat{y}_{-j}\right)\right) - \varphi\left(e_j\right)$$

where the subscript $-j$ denotes other region's variables. The above maximization problem yields the following FOC:

$$\frac{t_j\widehat{y}_j}{\widehat{p}\left(\chi_j-e_j\right)^2}U_2\left(.\right) + f'_{e_j}U_2\left(.\right) - \varphi'\left(e_j\right) = 0 \tag{26}$$

Where f'_{e_j} denotes the partial derivative of the function f with respect to the variable e_j. From the above equation, we can investigate on the parameters that have an impact on the amount of effort exerted by each region.

Proposition 26. *In a federalist system with redistributive transfers and imperfect information of the central government on the structure of the costs, regions with higher inherent costs may have lower incentives in exerting effort in the production of the public good.*

Proof. Differentiation of (26) yields:

$$\frac{de_j}{d\chi_j} = -\frac{\frac{d(26)}{d\chi_j}}{\frac{d(26)}{de_j}} = -\frac{\left(-\frac{2t_j\widehat{y}_j}{\widehat{p}(\chi_j-e_j)^3} + f''_{e_j,\chi_j}\right)U_2\left(.\right) + \left(\frac{t_j\widehat{y}_j}{\widehat{p}(\chi_j-e_j)^2} + f'_{e_j}\right)\left(-\frac{t_j\widehat{y}_j}{\widehat{p}(\chi_j-e_j)^2} + f'_{\chi_j}\right)U_{22}\left(.\right)}{\left(\frac{2t_j\widehat{y}_j}{\widehat{p}(\chi_j-e_j)^3} + f''_{e_j}\right)U_2\left(.\right) + \left(\frac{t_j\widehat{y}_j}{\widehat{p}(\chi_j-e_j)^2} + f'_{e_j}\right)^2U_{22}\left(.\right) - \varphi''\left(e_j\right)}$$

$$= 1 + \frac{\varphi''\left(e_j\right)}{\left(\frac{2t_j\widehat{y}_j}{\widehat{p}(\chi_j-e_j)^3} + f''_{e_j}\right)U_2\left(.\right) + \left(\frac{t_j\widehat{y}_j}{\widehat{p}(\chi_j-e_j)^2} + f'_{e_j}\right)^2U_{22}\left(.\right) - \varphi''\left(e_j\right)}$$

Differently from the case of perfect information, the above expression is not clear in sign; it is in fact positive if and only if

$$\left(\frac{2t_j\widehat{y}_j}{\widehat{p}\left(\chi_j-e_j\right)^3} + f''_{e_j}\right)U_2\left(.\right) + \left(\frac{t_j\widehat{y}_j}{\widehat{p}\left(\chi_j-e_j\right)^2} + f'_{e_j}\right)^2U_{22}\left(.\right) > 0$$

therefore it can also be negative. □

The result of the above proposition might not seem very strong: the transfer can lead to a distortion of the economic incentives of the receiving regions, the worse their technology, just like in the case of perfect information. Nonetheless, what matters in the case of perfectly observable cost structure is the relationship between χ_j and e_j. In this last case, instead, having a high χ_j and a low e_j is not enough to guarantee that the transfer does not lead regions to decrease the amount of exerted effort; what matters, together with preferences and technology, is also the structure of the transfer itself, i.e. f'_{e_j} and f''_{e_j}.

The above findings are not clear enough to spot a precise effect of transfers in imperfect information on the overall performance of the public sector; it could however be noticed that the absence of transparency on the structure of the costs might lead poorer regions, those with higher inherent costs and recipients of the transfers, to exert less effort in the presence of such transfers, because they know that they are however going to be compensated for the higher γ_j, no matter its origin. This is harmful to the overall country welfare, as it increases the pressure on the richer region, without clear improvements in the quality of the less rich one. The inability of the central government to perfectly observe the cost structure of the regions involved in this type of transfer of resources may therefore not only prove unsuccessful in terms of equity and equality, but also cause distortions to economic incentives of the single local entities.

4.6 Discussion

The analysis we have performed until here sheds light on the possible effects of fiscal federalism in a context in which the provision of a public good comes together with a privately produced alternative. As we saw, economic theory usually considers federalism as welfare enhancing, in that it is capable to better shape the public services to the tastes of the users/voters, if we assume them to be more similar, the closer they live. Despite this, in a framework like the current Italian one, in which regions are different in terms of average income and inequality, the superiority of decentralization may be put under question. Poorer and more unequal regions, in fact, may be left behind, because they have a smaller fiscal base, and the distribution of income is such that the preferred tax rate will be low: as a result, only a small amount of resources will be invested in the public sector. This is particularly true in the case in which the system is not redistributive.

On the other hand, the best performing regions will either be the richer ones or the less unequal, according to which effect (income or income distribution) is stronger. Of course, this result is not properly desirable, as poorer regions will clearly be worse off in a decentralized system and left behind in a "trap" in which average and total income is low, inequality is high and the public sector is poor in quality and inefficient. This justifies the search for tools able to smooth the negative effects of decentralization, which we can observe, by a great extent, in the Italian history of reforms toward fiscal federalism. As we saw, however, they are only in theory a definitive solution to the problem; in practice, they in fact lead to distortions of those same economic incentives that should "push" weaker regions to exert effort, in order to be able to come out of their "trap", and a correction of this situation is relatively hard to be achieved. We can see how difficult it is to say, even in theory, which system is the most appropriate to a context similar to the one we have modeled. A tradeoff emerges between having an equal level of public good quality everywhere in the country, and having instead high-performance regions together with low-performance ones: the debate is clearly political, other than economic.

4.6.1 Italian Public Healthcare: redistributive or not?

Until here, our theoretical analysis has been carried out along two parallel roads: the case in which the public healthcare provision system entails redistribution, i.e. poor people are "net winners" and will therefore favor a tax increase, while richer people would rather prefer a lighter fiscal pressure, and the case in which the system is not redistributive, where voters (and tax-payers) receive a greater service, the higher the level of taxes they pay. As we saw, the results of the analysis are quite different in the two cases. It would be therefore meaningful, at this point, to perform an assessment of the Italian National

Healthcare System, our starting point for the discussion, in order to determine its type in terms of redistributive features. Unfortunately, this is easier said than done. In the literature we can find several measures and indicators for redistribution; however, as already mentioned in the Introduction, in a decentralized system one should always be careful in distinguishing between redistribution *across* regions and *within* regions (Levaggi, 2010). While the former is more accurately measurable by a simple account of revenues, expenditures and transfers, the effect of the latter on income distribution is more prone to the action of confounding factors. The problem is two-sided. On the revenues side, taxes should be progressive in order for the system to entail redistribution, and one should be able to take into account the effects of tax evasion; this is quite hard, and taxation is hardly completely progressive. From the expenditure side, the problem is even more complex: in order to study the redistribution character of a provision system, one should have information on the actual users of the service, and to compare the intensity of their use with their real needs. Up to now, this has not been possible. In fact, even if we have data on each single healthcare services user and the services he chooses to consume, and we could link these to information about income, education and social capital in an attempt to understand how resources are used, this would however not allow to clarify whether their consumption is actually linked to an existing need. Existing studies on redistribution, in fact, show that the redistributive impact of in-kind transfers (which represent the greatest share of healthcare expenditure in Italy) is very limited. Income and education are indeed the most relevant elements in the determination of the intensity of healthcare services use; this could alter the redistributive effect of in-kind transfers towards richer users.

5 Conclusion

Object of the present work has been the characterization and the theoretical analysis of a majority voting political equilibrium over a proportional income tax rate, in a context in which such tax is addressed to finance quality of public healthcare. As we saw, in the case in which a private alternative for such service is available and the system of public provision is not redistributive, the Median Voter theorem cannot be applied due to a violation of one of its fundamental assumptions. A political equilibrium, however, still exists, and it can be shown to depend, directly, on the size and characteristics of the middle class , and, in turn, on the distribution of income. In equilibrium, in fact, a coalition of middle income voters, who are willing to use public healthcare and hence favor a tax decrease (i.e. an improvement in quality) are opposed to a coalition of "end" voters who instead want a tax decrease, either because they are too poor to pay or too rich to prefer public over private. As explained, in this scenario the tax rate prevailing in a majority voting is the one preferred by the poorer voter among the middle 50%, when voters are ranked according to their income. As a consequence of this, the more dispersed across the mean (i.e. more unequal) is the distribution of income, the poorer the decisive voter will be: hence lower will also be the quality level that the public healthcare sector is able to reach. As we argued, this issue becomes relevant in a context of a country where a federal system of taxation and public good provision is in place: we showed how, under certain conditions, the differences in outcome formation in terms of healthcare quality between regions depend not only on regions' total and average income, but also on the degree of inequality in each of them.

The motivation for such work has been given by the current Italian situation. The country has in fact been undergoing a process of decentralization of powers to local entities; its regions, however, are sharply different under several perspectives, and according to many, fiscal federalism might even happen to widen the disparities in terms of average income and economic growth. Given that federalism is still an ongoing process in the country, this work has been purely theoretical; indeed, an interesting area for further research could be to implement an empirical testing of the model on Italian data.

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Appendix: Figures and Tables

Figure 1: Healthcare Expenditure, Italy 1995-2009

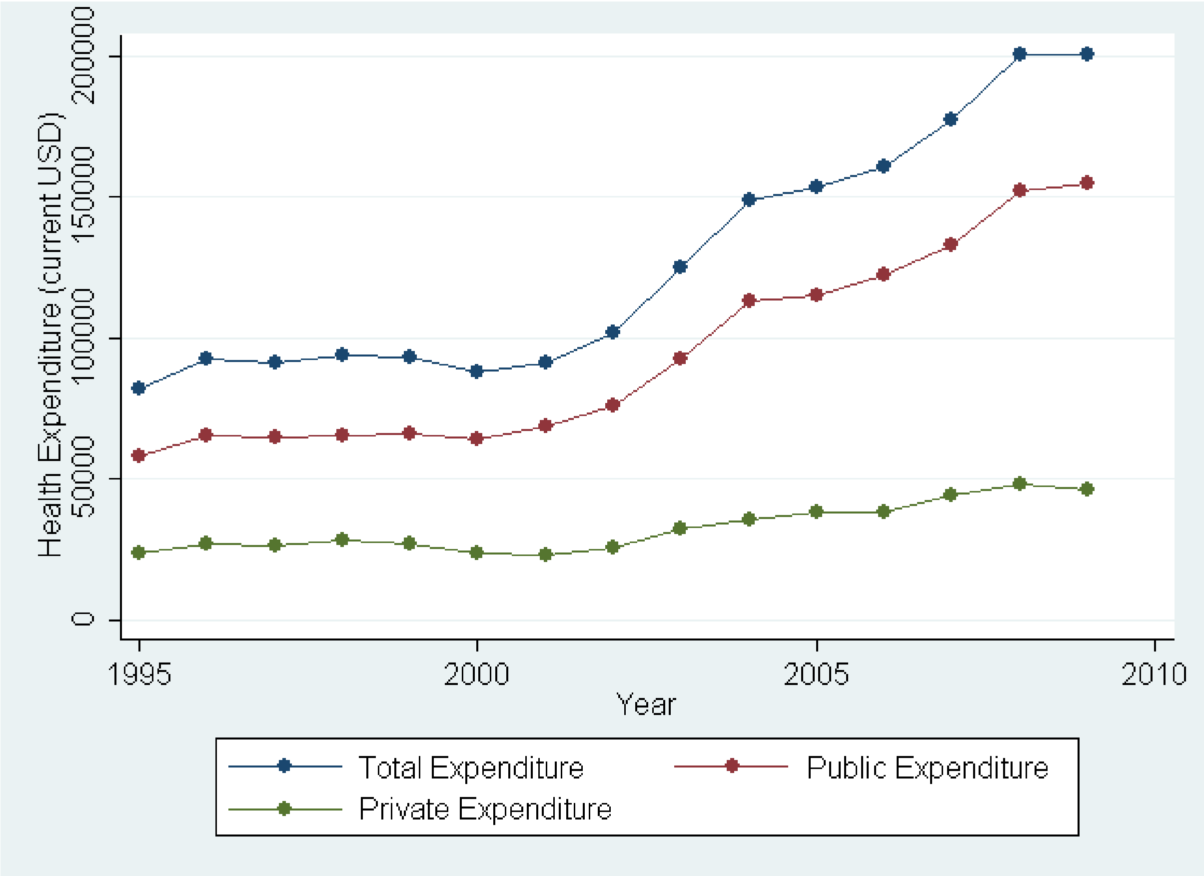


Table 1: Italian Regions' Characteristics

Region	Average per capita Income	Gini Coefficient	Share of People over 65	Public Healthcare Expenditure	Working Activity Rate	Unemployment Rate
Piemonte	30,615	0.291	22.7	1,709	51.39	4.23
Valle d'Aosta	33,663	0.310	20.6	1,914	54.58	3.18
Lombardia	33,077	0.295	19.9	1,633	54.44	3.43
Trentino-Alto Adige	34,927	0.289	18.1	1,904	56.42	2.74
Veneto	31,939	0.266	19.5	1,638	53.83	3.34
Friuli-Venezia Giulia	30,224	0.265	23.1	1,714	51.25	3.41
Liguria	28,883	0.290	26.8	1,881	48.09	4.82
Emilia-Romagna	33,611	0.297	22.6	1,697	54.84	2.86
Toscana	32,150	0.283	23.3	1,687	50.94	4.30
Umbria	30,337	0.280	23.2	1,657	50.62	4.56
Marche	31,902	0.289	22.5	1,601	51.29	4.17
Lazio	30,911	0.324	19.6	1,925	50.49	6.38
Abruzzo	26,494	0.263	21.3	1,730	47.22	6.22
Molise	25,494	0.319	21.9	1,947	44.14	8.10
Campania	24,939	0.327	15.7	1,663	40.47	11.23
Puglia	25,950	0.310	17.8	1,641	42.09	11.17
Basilicata	23,507	0.289	20.0	1,653	42.65	9.55
Calabria	23,849	0.314	18.5	1,808	40.00	11.24
Sicilia	22,044	0.335	18.2	1,666	40.66	12.96
Sardegna	26,770	0.292	18.4	1,634	47.13	9.88
Italia	**29,606**	**0.314**	**20**	**1703**	**49**	**6**

(Source: ISTAT, *Indicatori socio-sanitari regionali*)

Figure 2: Income per Region, per capita

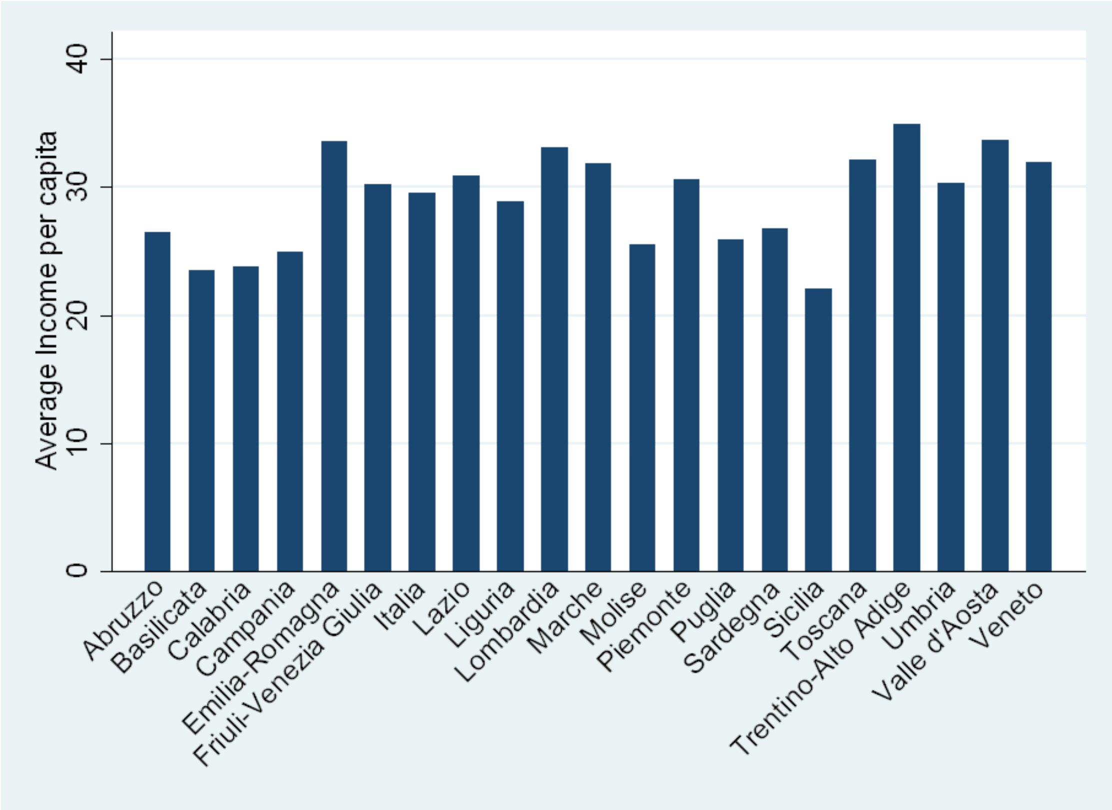


Figure 3: Average Income and Healthcare Expenditure, per capita

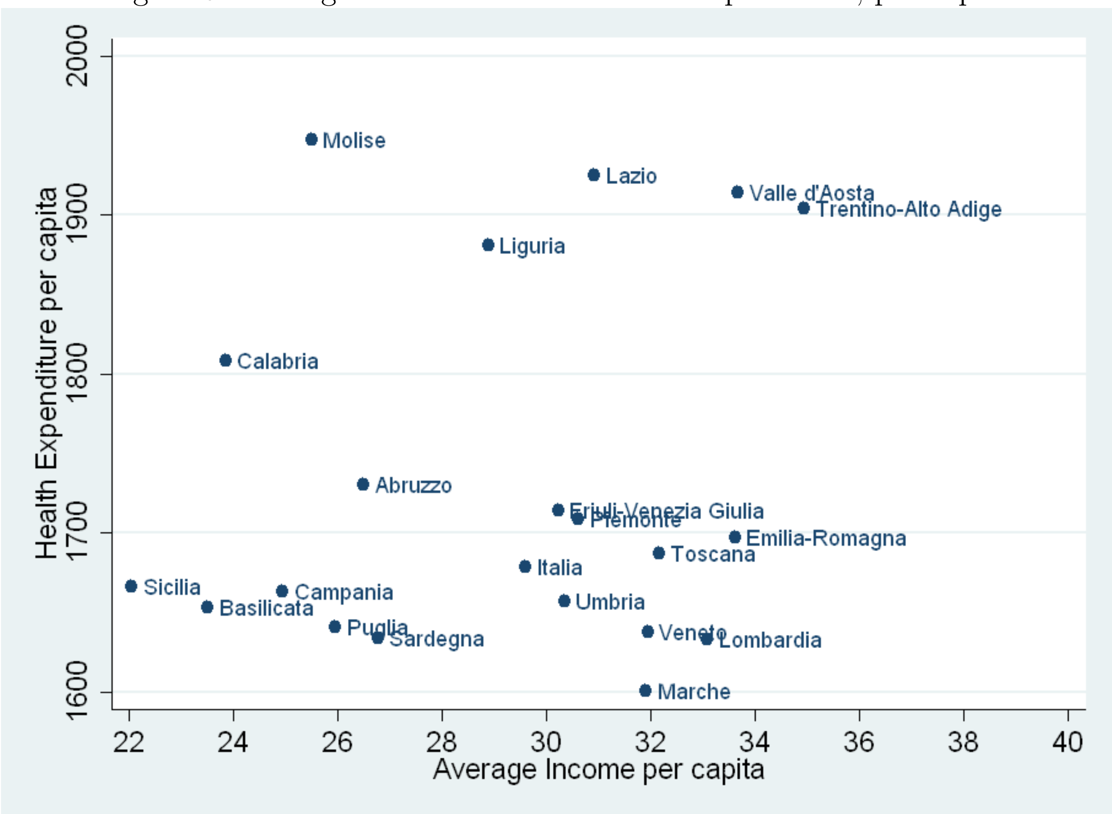


Figure 4: Average per capita Income and Gini coefficient

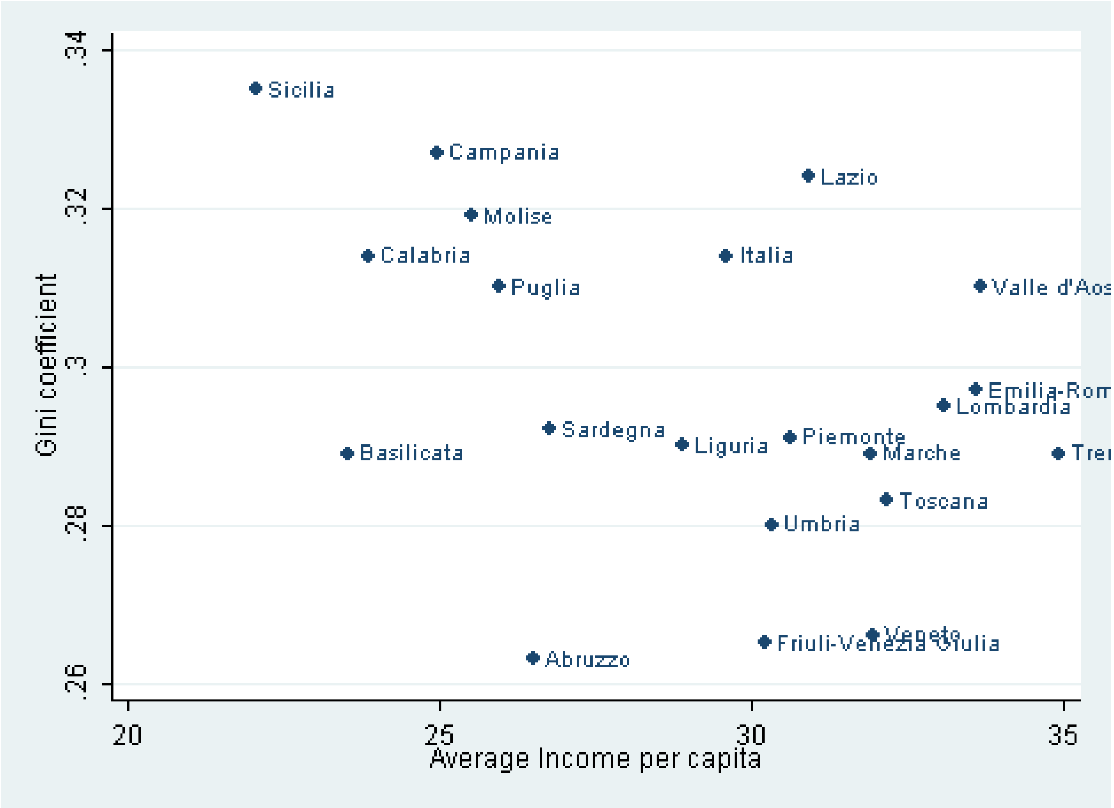


Figure 5: per capita Healthcare Expenditure and Gini coefficient

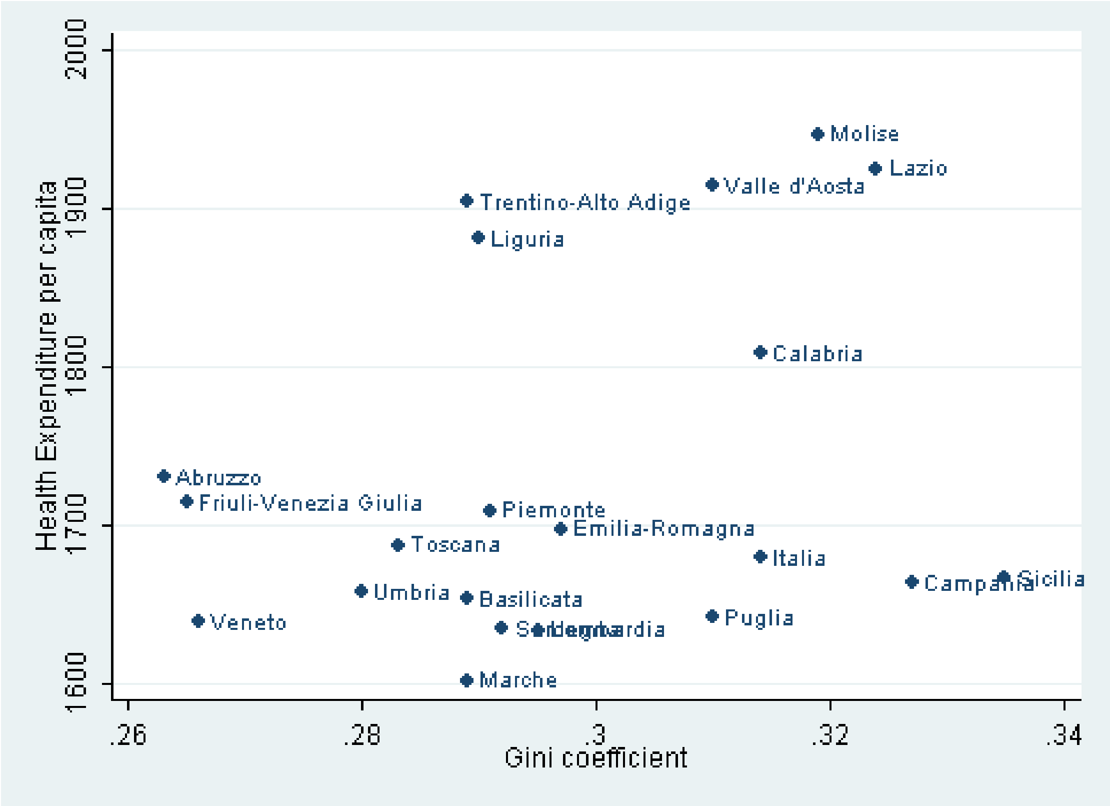


Figure 6: Share of people satisfied with medical care and per capita Healthcare Expenditure

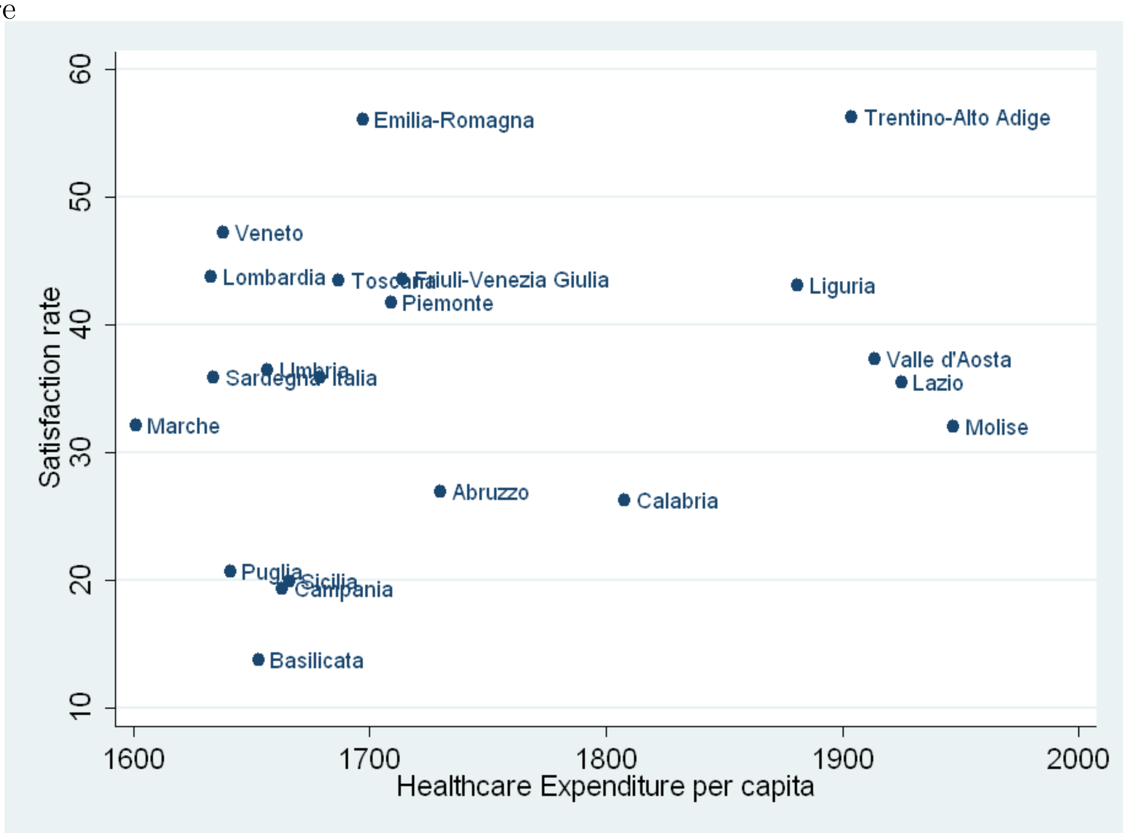


Figure 7: Share of people satisfied with medical care and Average per capita Income

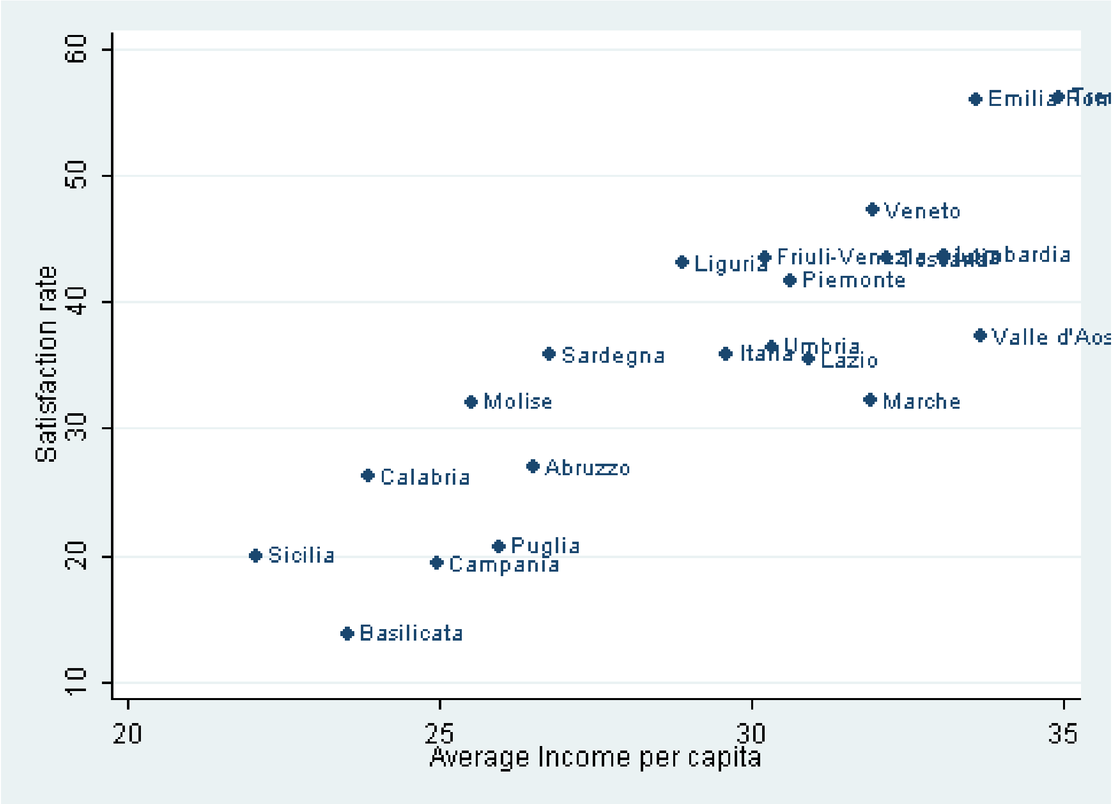


Figure 8: Share of people satisfied with medical care and Gini coefficient

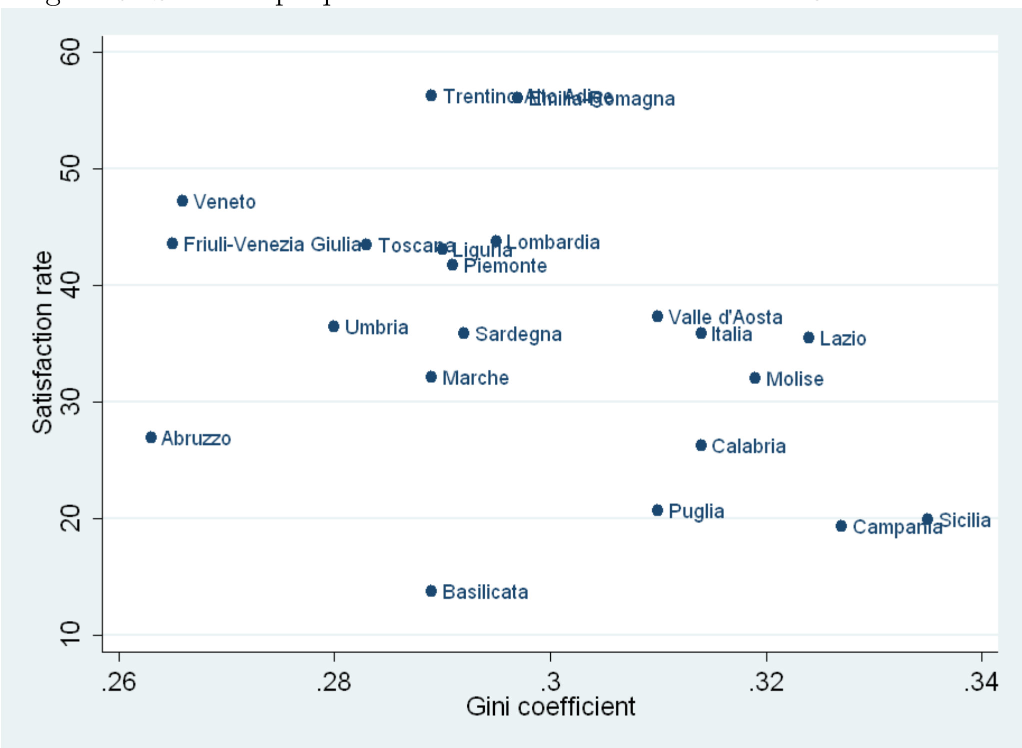
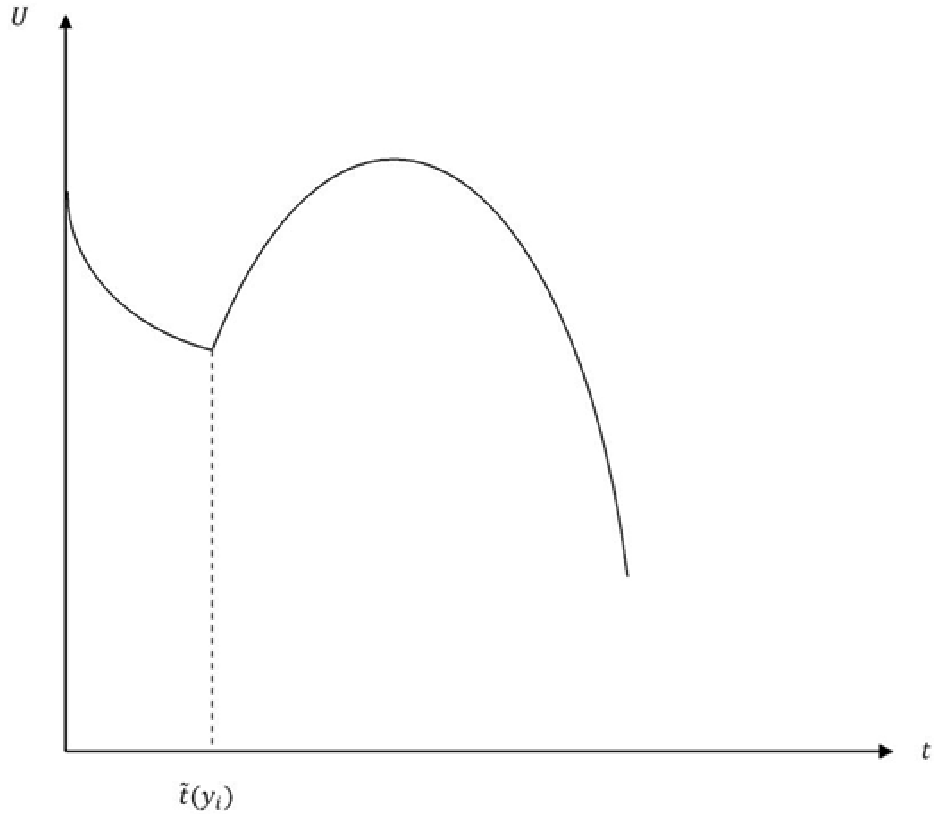


Figure 9:



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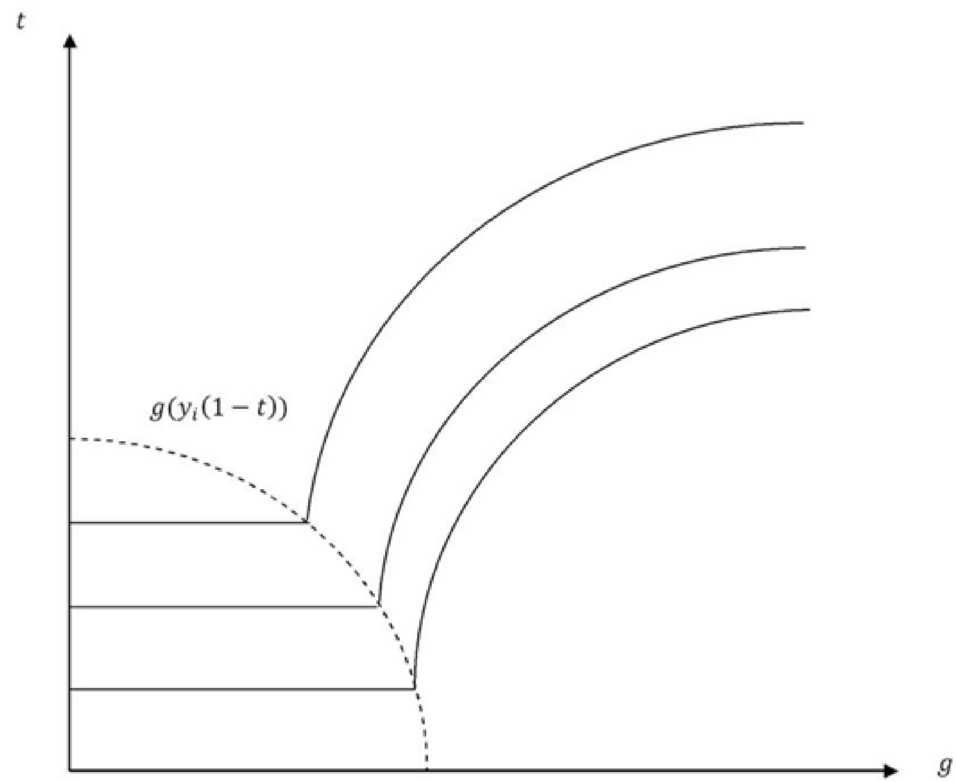

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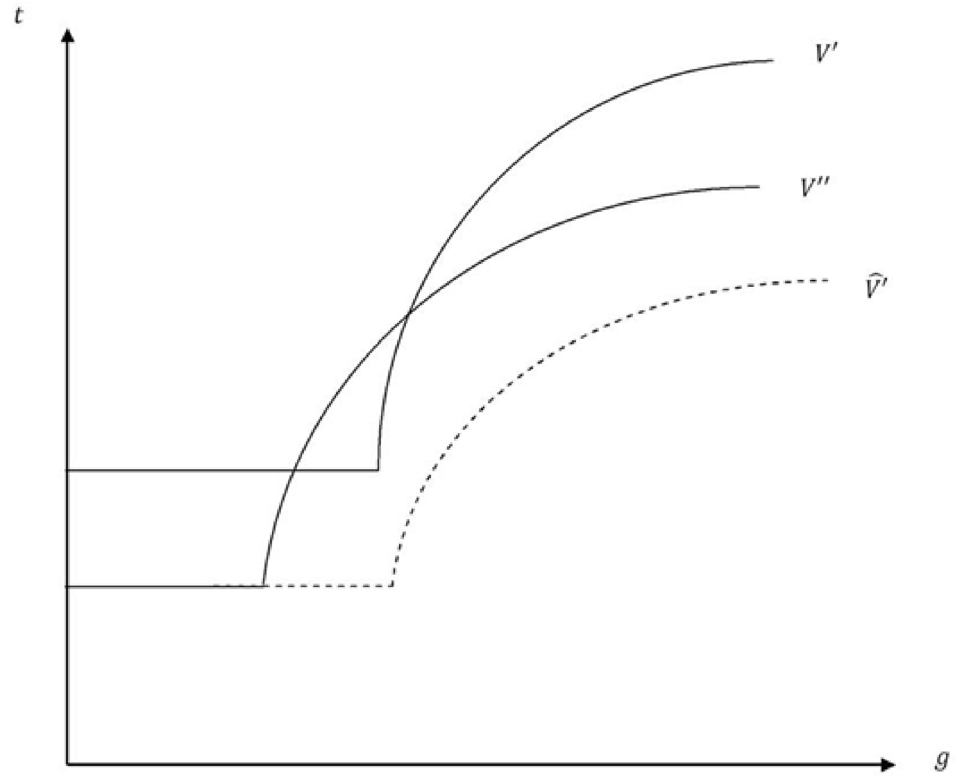

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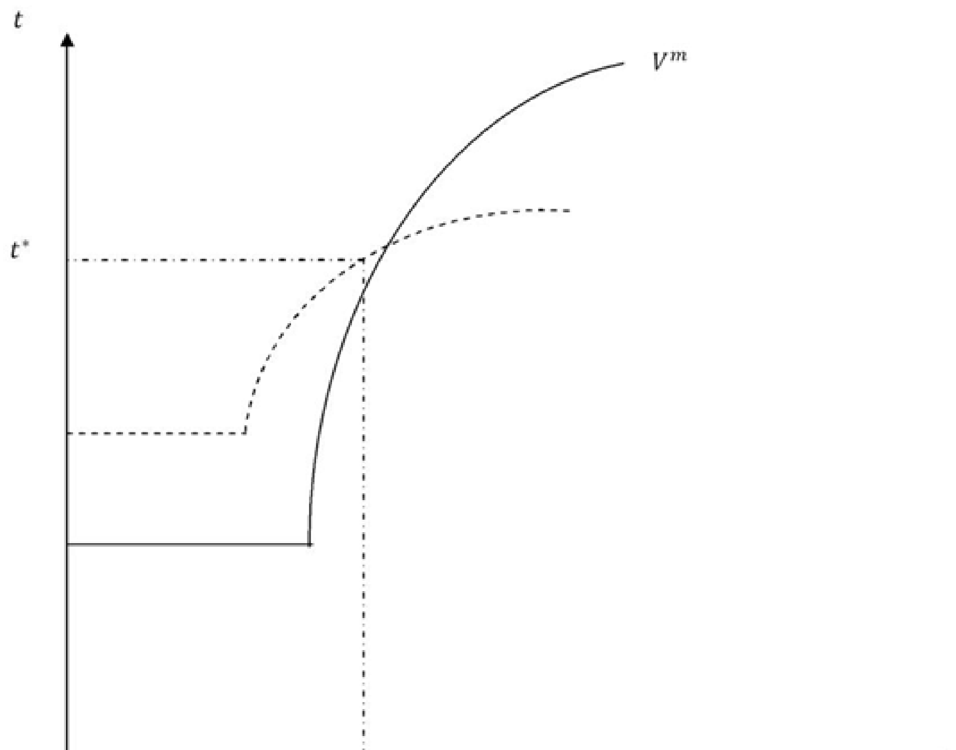


Figure 13:

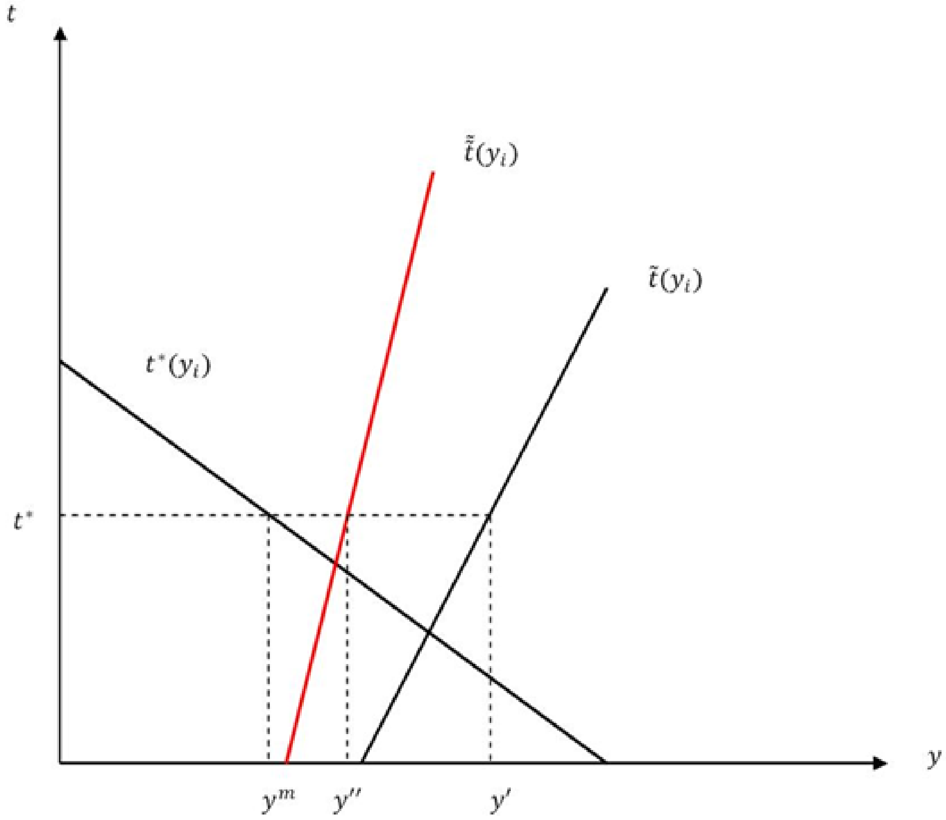
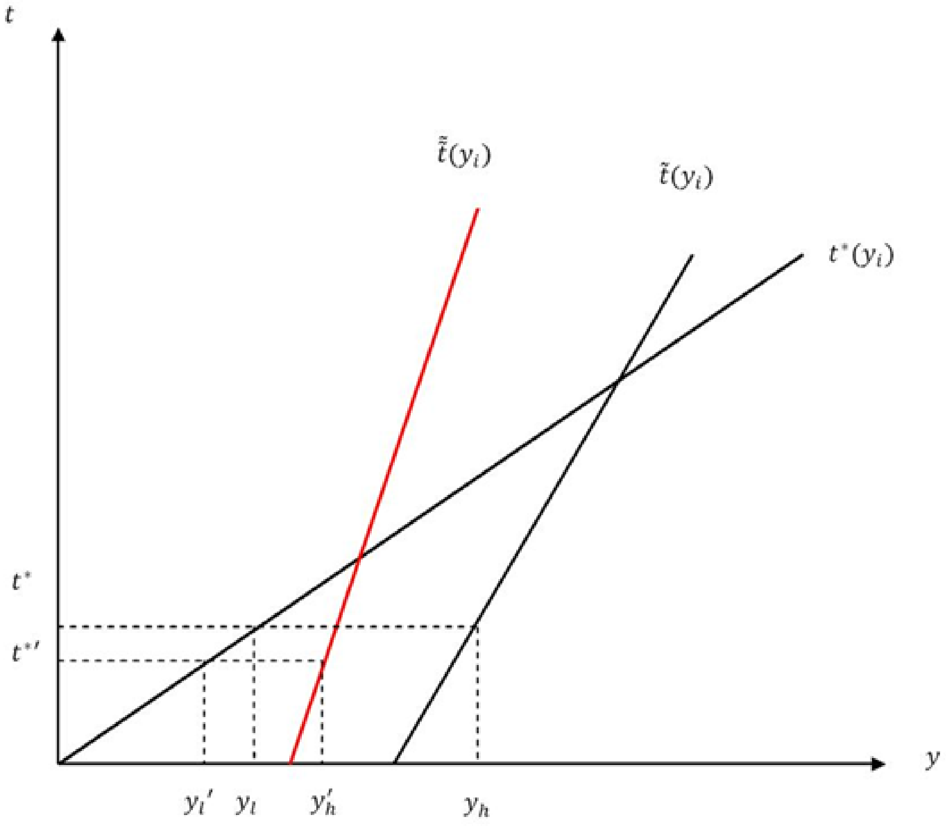


Figure 14:



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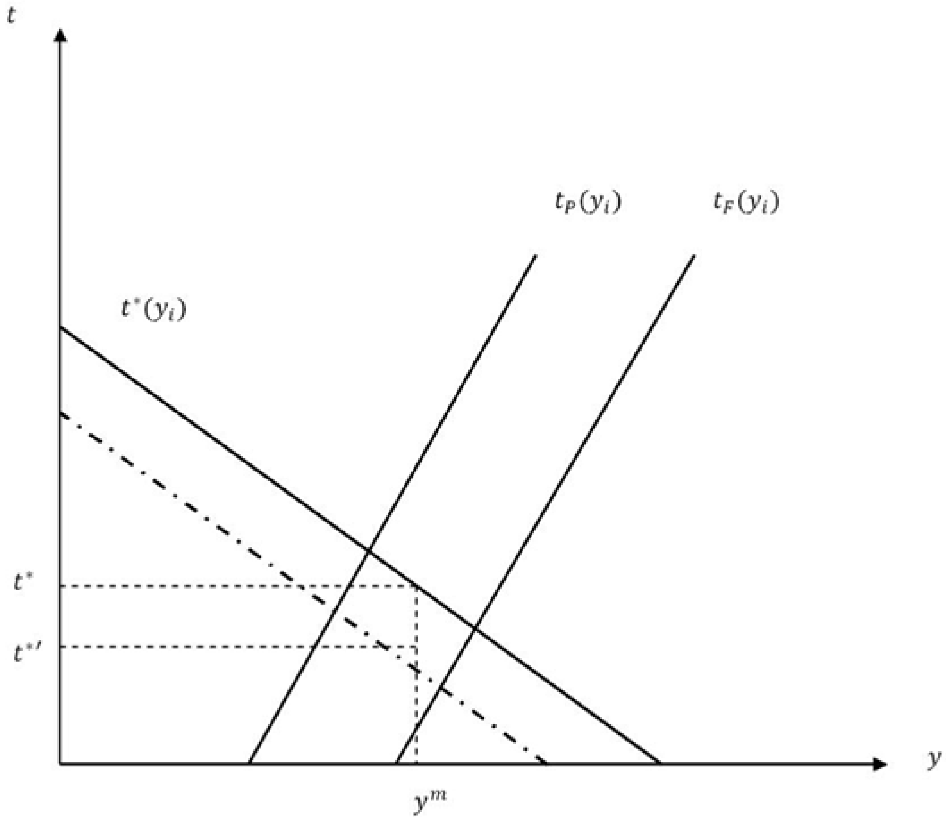


Figure 16:

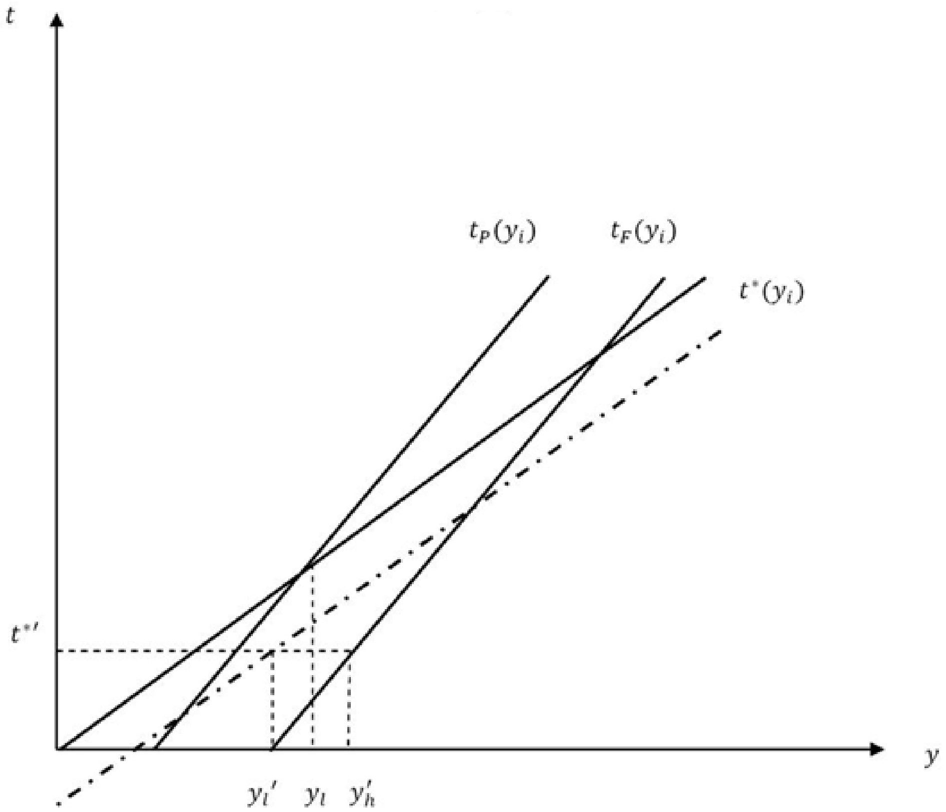


Figure 17:

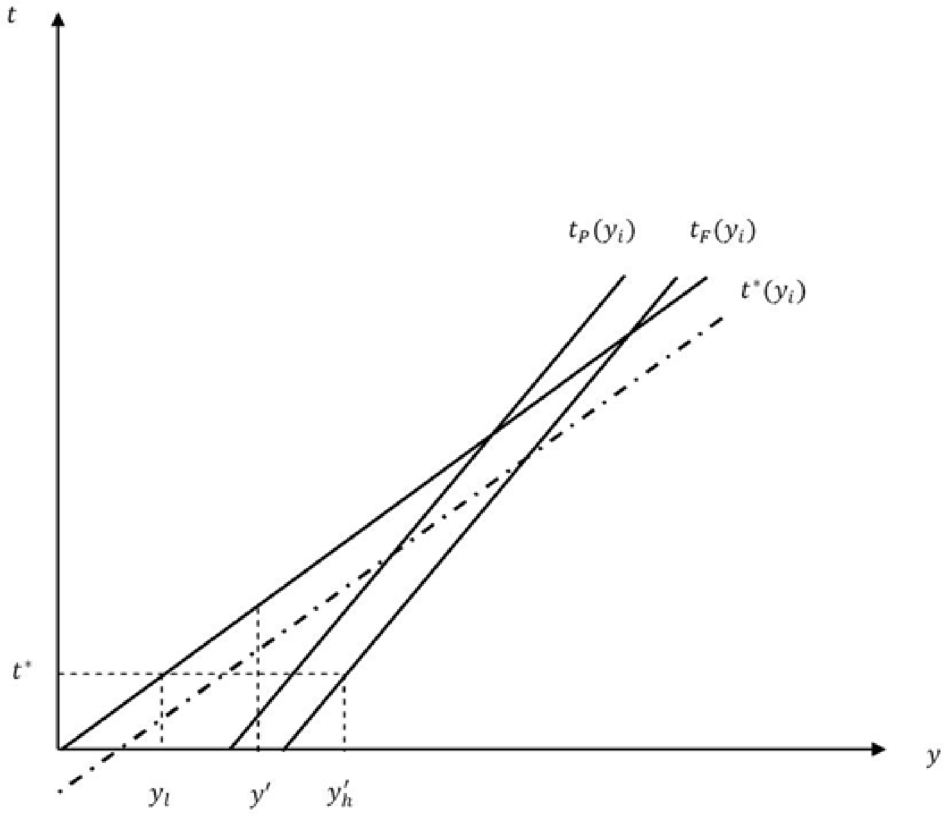
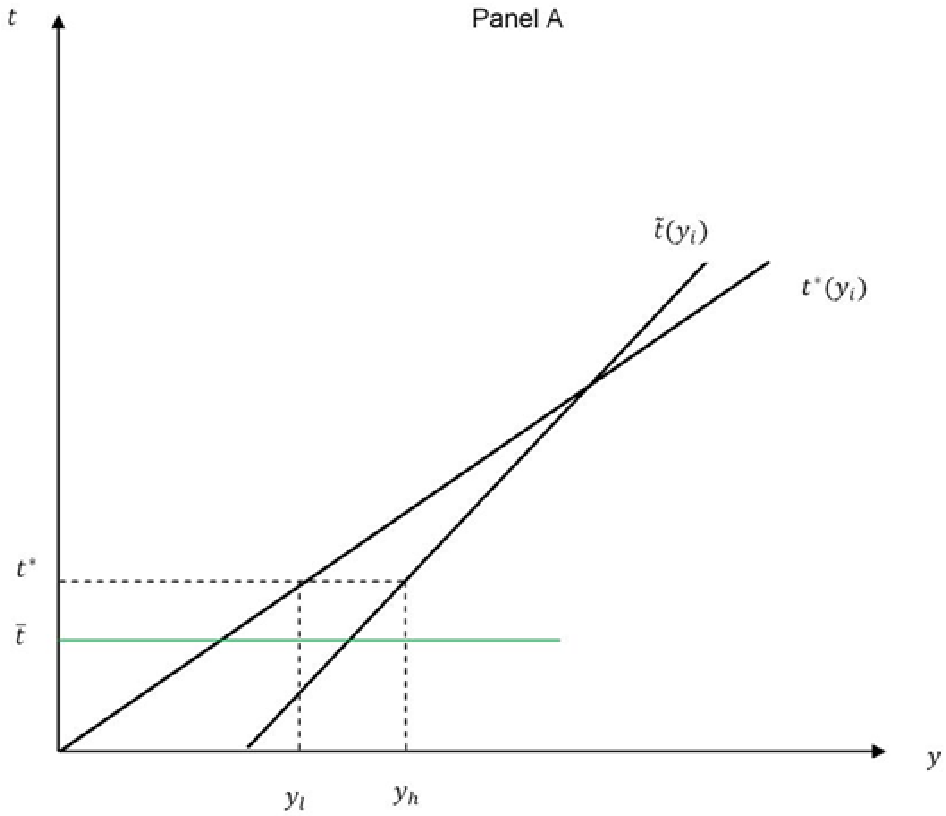


Figure 18:


Panel A
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t^*
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y_l
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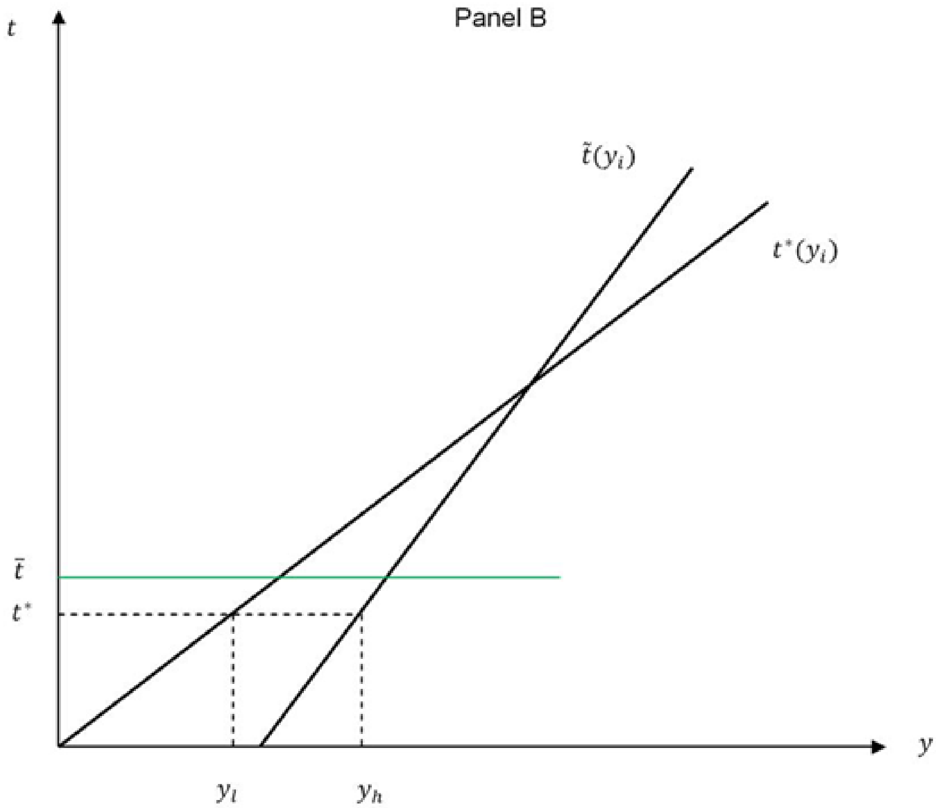

Panel B
t
$\tilde{t}(y_i)$
$t^*(y_i)$
$\bar{t}$
t^*
y_l
y_h
y

Figure 19:

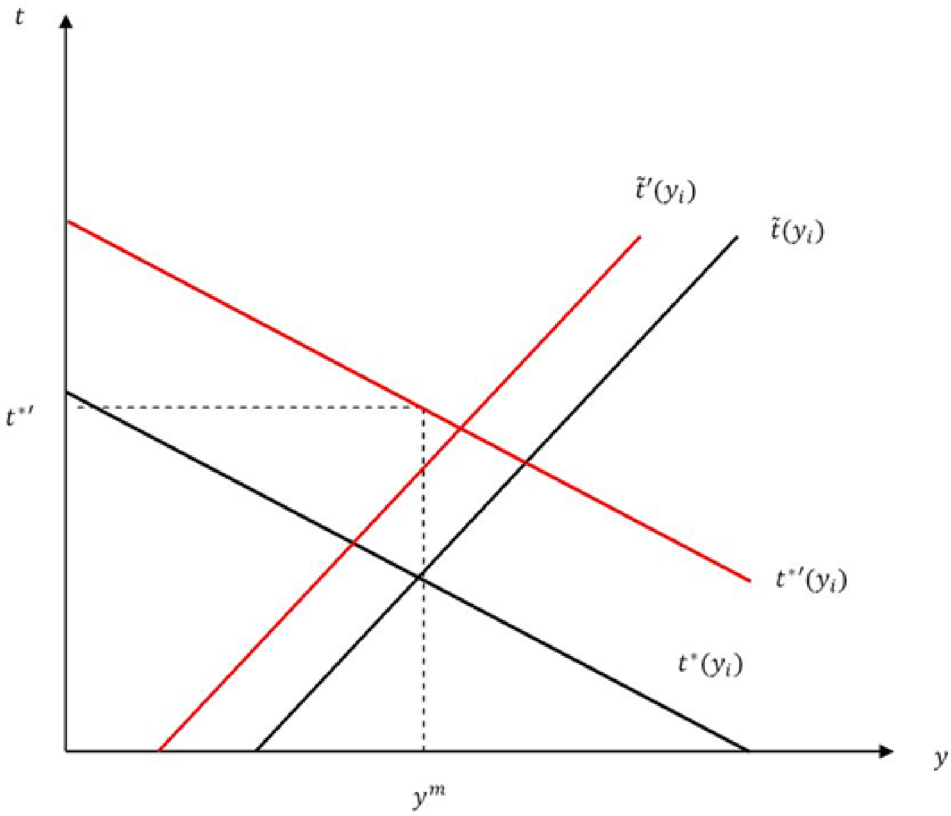
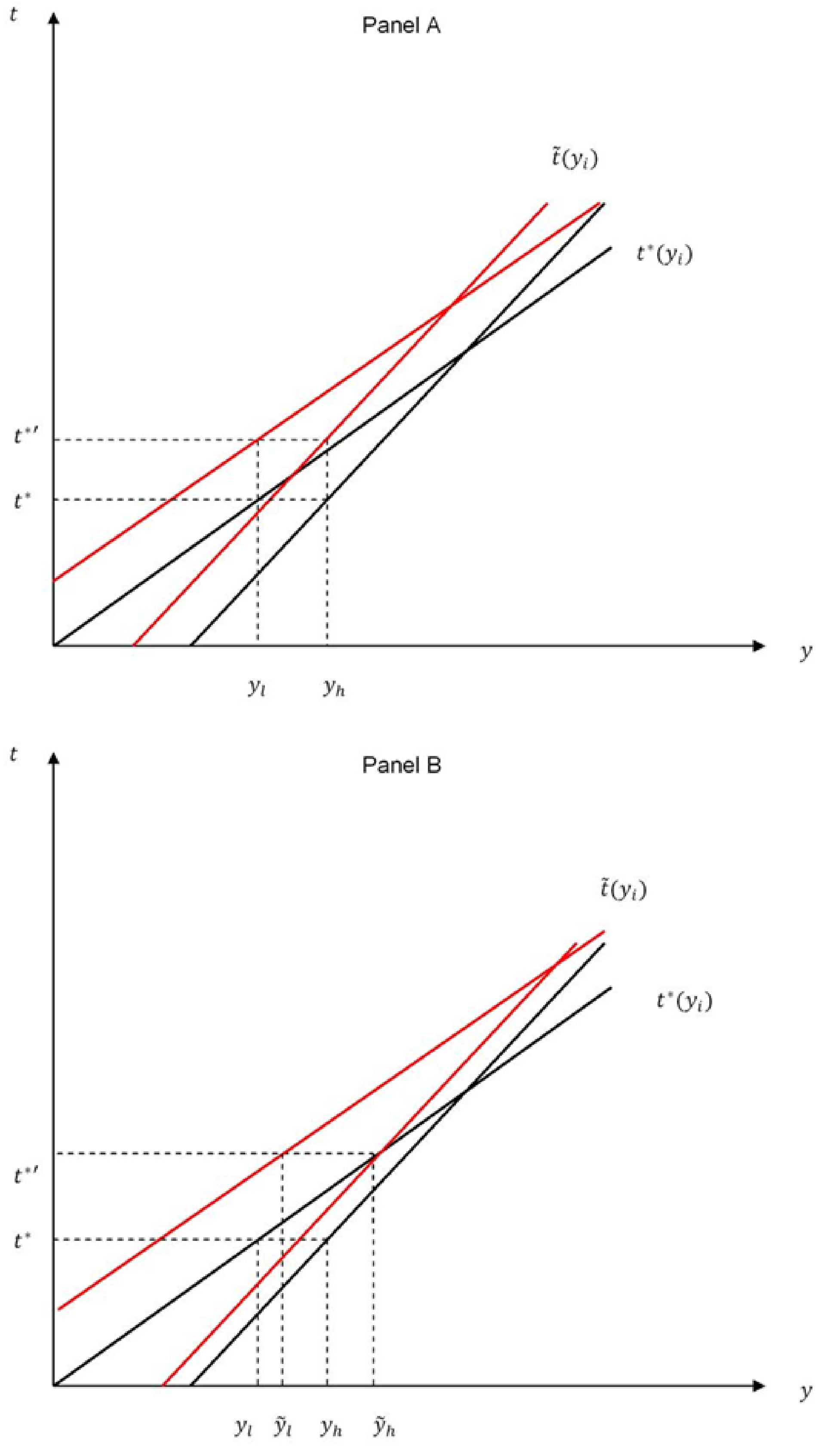


Figure 20:


Panel A
t
$\tilde{t}(y_i)$
$t^*(y_i)$
$t^{*\prime}$
t^*
y
y_l
y_h
Panel B
t
$\tilde{t}(y_i)$
$t^*(y_i)$
$t^{*\prime}$
t^*
y
y_l
$\tilde{y}_l$
y_h
$\tilde{y}_h$

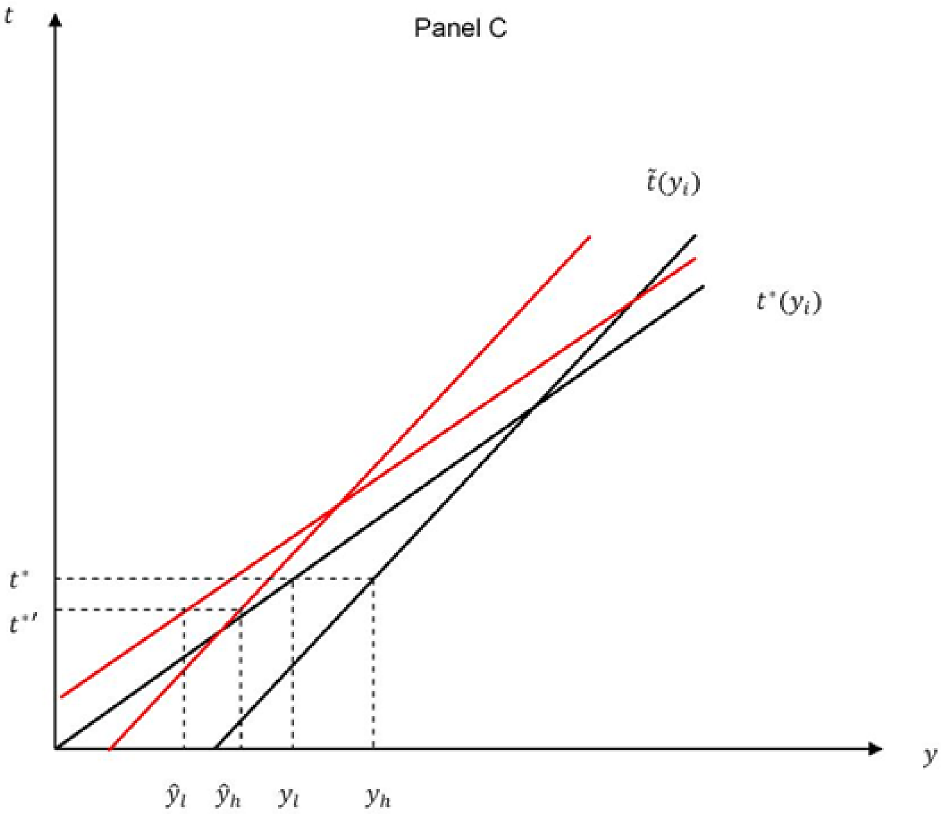
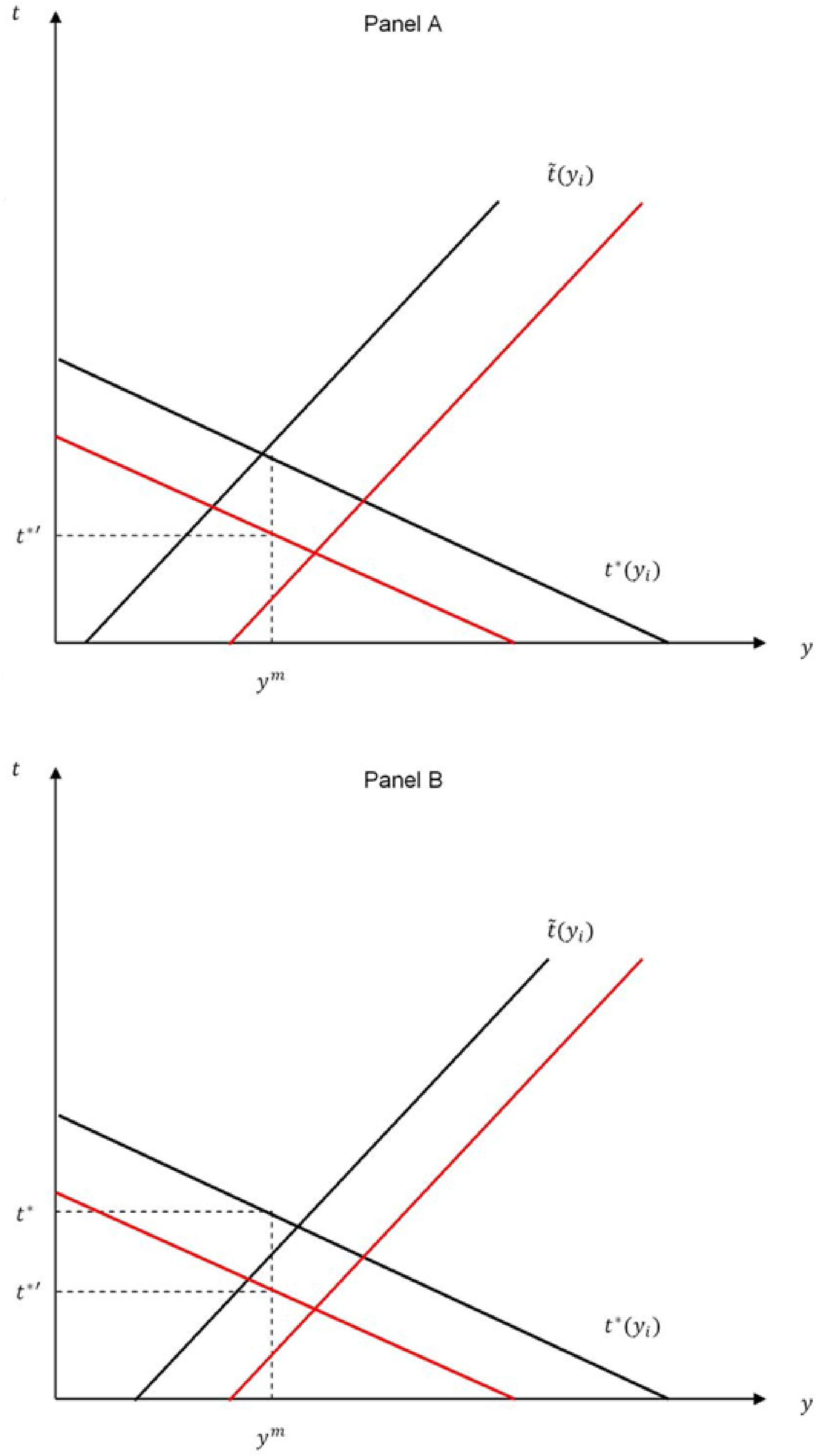
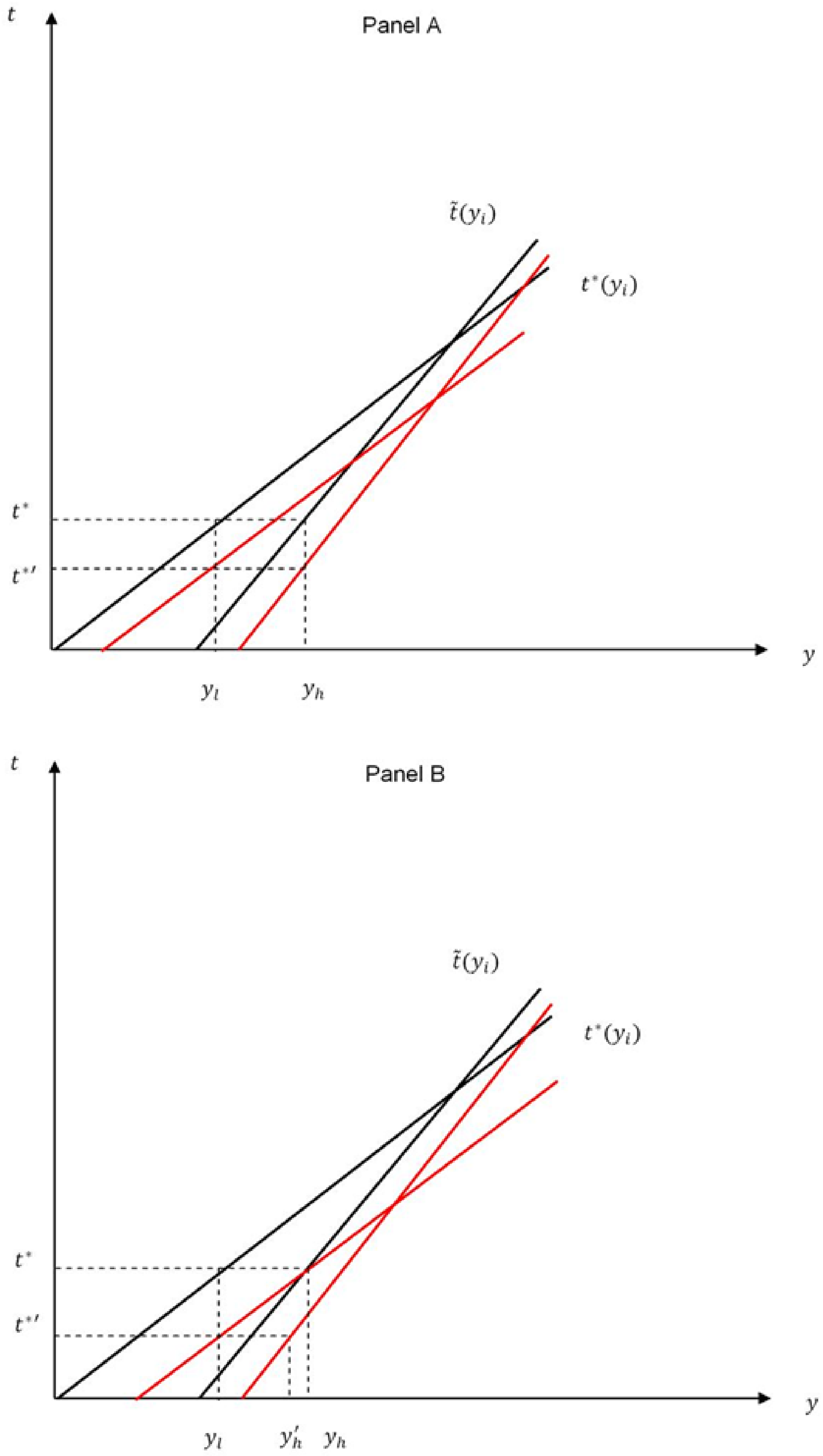

Panel C
t
$\tilde{t}(y_i)$
$t^*(y_i)$
t^*
$t^{*\prime}$
y
$\hat{y}_l$
$\hat{y}_h$
y_l
y_h

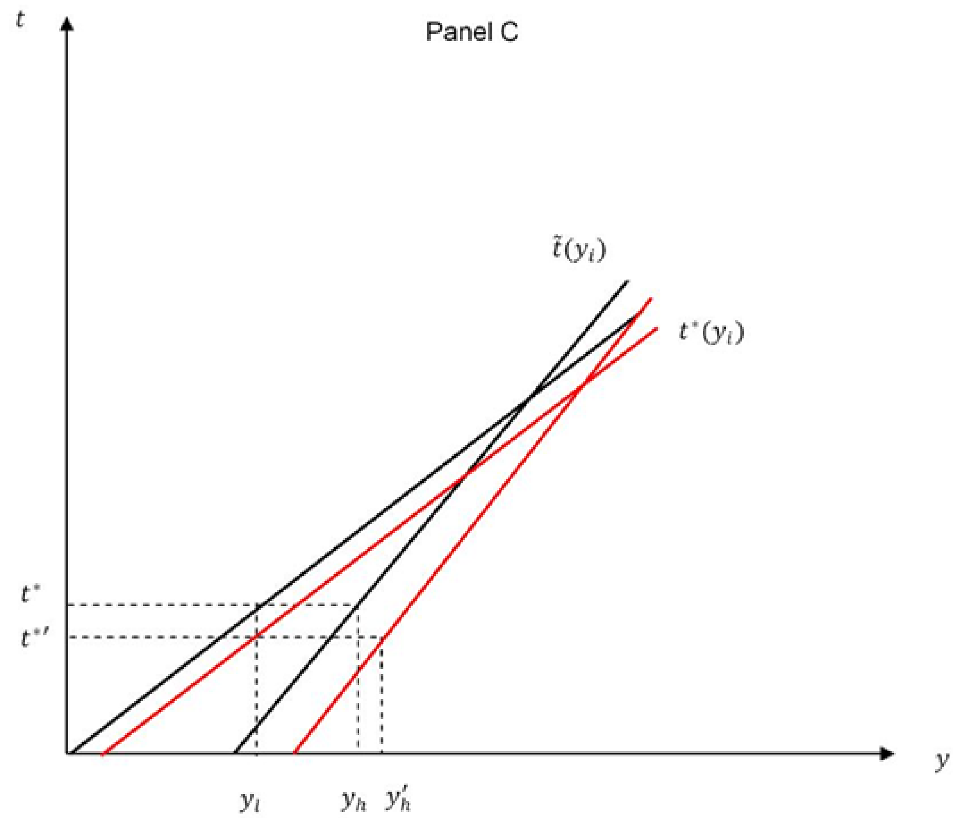
Figure 21:



Panel A
t
$\tilde{t}(y_i)$
$t^{*\prime}$
$t^*(y_i)$
y
y^m
Panel B
t
$\tilde{t}(y_i)$
t^*
$t^{*\prime}$
$t^*(y_i)$
y
y^m

Figure 22:


Panel A
t
$\tilde{t}(y_i)$
$t^*(y_i)$
t^*
$t^{*\prime}$
y
y_l
y_h
Panel B
t
$\tilde{t}(y_i)$
$t^*(y_i)$
t^*
$t^{*\prime}$
y
y_l
y_h'
y_h



Panel C
t
$\tilde{t}(y_i)$
$t^*(y_i)$
t^*
$t^{*\prime}$
y
y_l
y_h
y_h'

Figure 23:

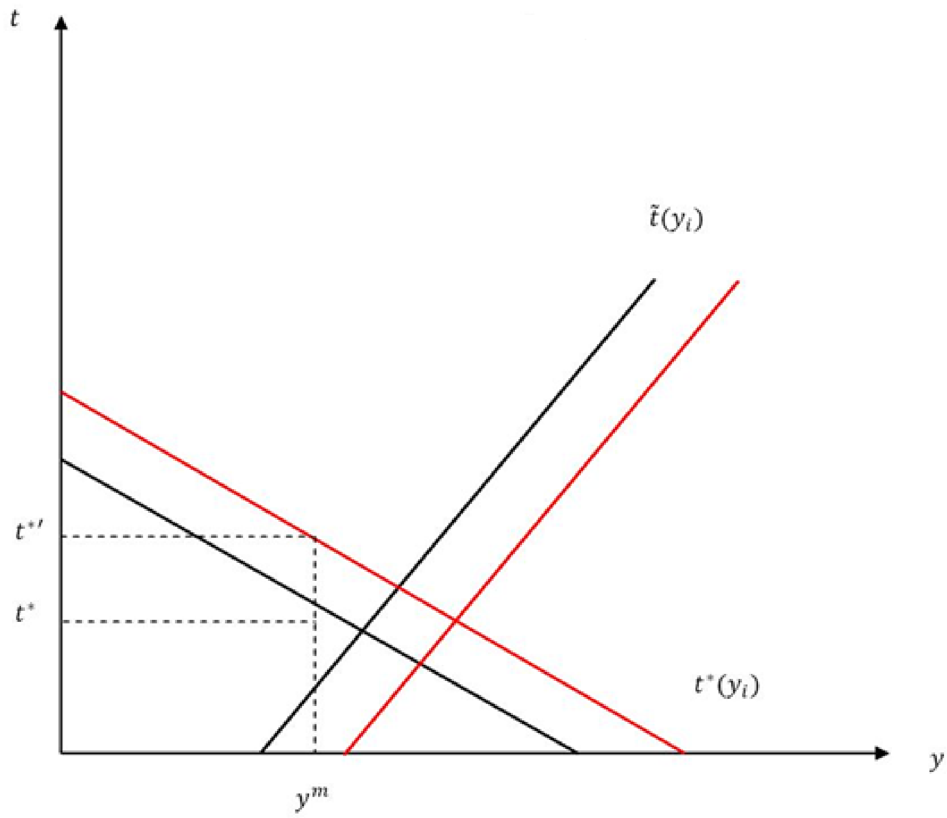


Figure 24:

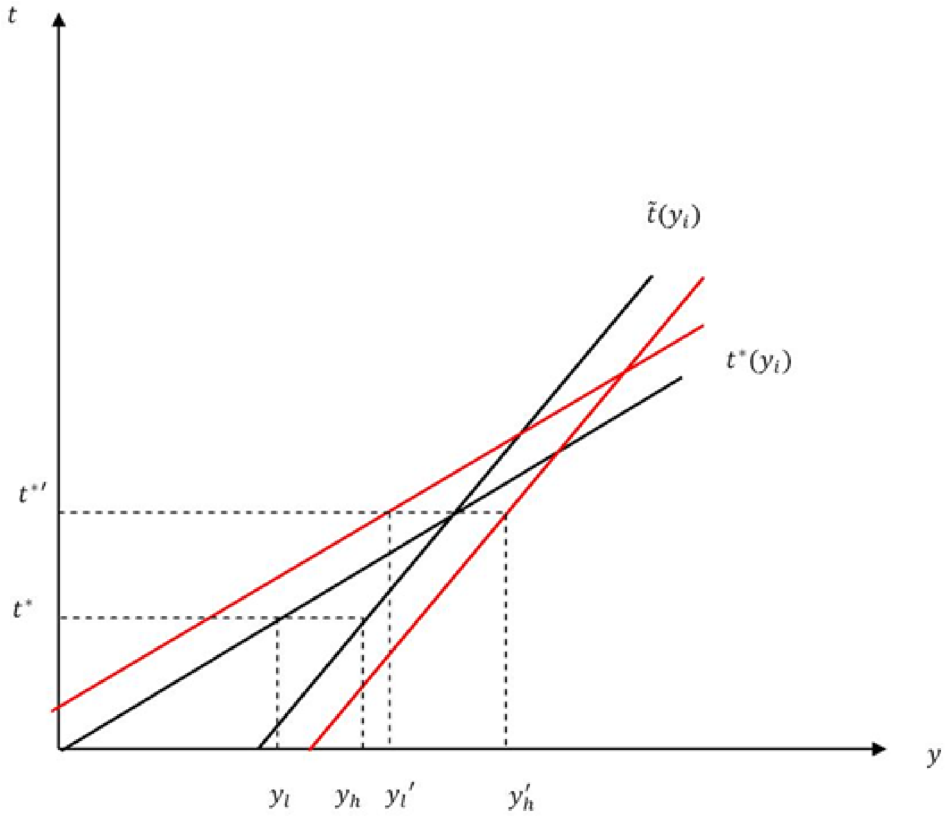


Figure 25: Distribution of incomes in the 3 regions