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The Political Economy of Long-Term Care*

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Keywords: Long-Term Care, Redistribution, Political Economy, Parallel Financing of Private Goods

JEL-**Classification:** H24 · H31 · H42 · I11

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1 Introduction

In most developed countries social security systems are under strain and – due to population ageing – financial pressure is likely to become more pronounced in the near future. With increasing life expectancy more people live to a high age enlarging the pool of individuals prone to suffering from ailments associated with oldest age. Even though additional life years may largely be healthy years, demand for long-term care is expected to increase.[1] To meet this demand more care is to be supplied and financed.

As usual, there are two sources of financing such care, public and private. The peculiarity of long-term care, however, is that private financing does not imply that care is privately purchased. It may well refer to a situation where, for instance, the children care for their needy parents, that is, to an environment where care is provided informally. It is well documented that informal care introduces both, a financial and a psychological burden on informal carers. Financial strain comes in several ways, reduced labor market participation and lower wages (Heitmueller and Inglis, 2007), and forgone labor market opportunities (Bolin et al., 2008). Additionally, the demands of care giving could cause symptoms of depression and decrease both the energy required and the opportunity to engage in social activities (Hughes et al., 1999, and Schulz and Beach, 1999).

The burden on families with needy parents can be mitigated by extending publicly financed long-term care. This allows families to cut back on care purchased on the market or to reduce informal care giving (and, in turn, increase labor supply). Public spending on long-term care, thus, reduces need related income inequality resulting in a negative association of long-term care financing and income inequality. The following graph confirms this negative association for a set of 21 OECD countries.[2] We find a significant (p-value = 0.01) negative correlation of -0.53 between the Gini coefficient before taxes and transfers and public spending on long-term care. As the financing of public programs typically draws on progressive taxation, the negative relationship is stronger for the Gini

[1] A study for Germany, for instance, argues that demand for long-term care will triple from 1999 to 2050 (see Schulz et al., 2004).

[2] Data on long-term care and population are taken from OECD (2005) and OECD (2008), respectively.

coefficient after taxes and transfers (-0.65, p-value = 0.001).

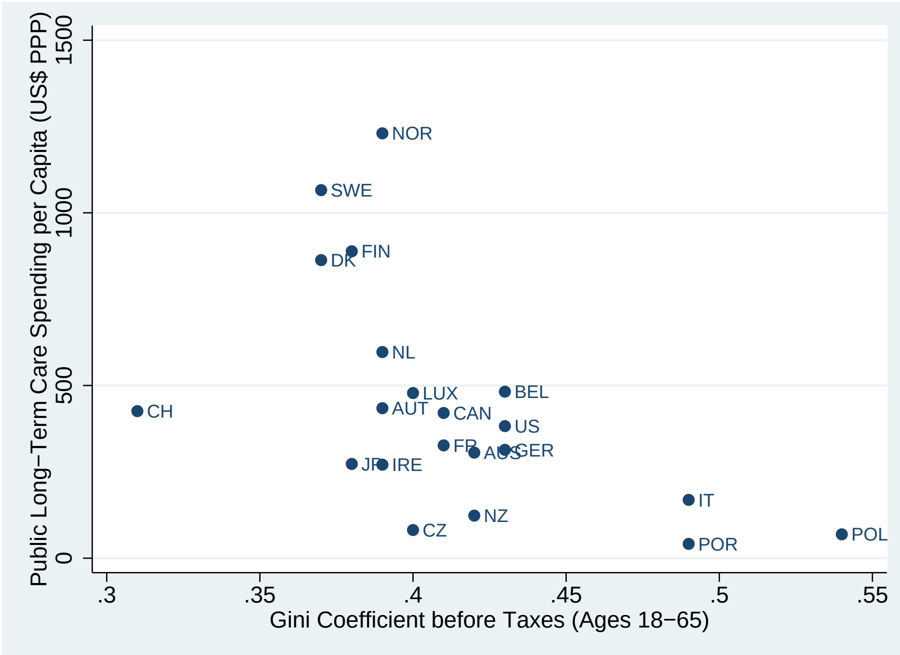

Figure 1: Income Distribution and Public Spending on Long-Term Care.

We assume a political economy perspective to explain the extent of income redistribution and public long-term care financing. To capture the most important dimensions we let the voting agents differ in income and need. We think of an agent as a family that comprises one parent and one perfectly altruistic child that can split its available time between work and informal care. Parents may or may not be in need of care and children are either productive or unproductive in the labor market. While publicly financed care delivery to disabled parents is uniform, financing is not uniform. We consider proportional income taxation to finance long-term care and a lump-sum transfer, where the latter is suited to redistribute income over and above the redistribution induced by the public long-term care program.

Obviously, less productive families will be in favor of higher income taxes than more productive workers as they benefit from income being redistributed from the rich to the poor. Children of needy parents prefer higher public spending on long-term care than children of healthy parents. Here, redistribution is from the healthy to the sick. Although this intuition is rather straightforward, the properties of the political equilibrium are not. As is well known, the median voter theorem may not apply in multi-dimensional issue spaces like ours – preferences may not be single-peaked. To tackle this problem we investigate *structure induced equilibria* as suggested in Shepsle (1979). We can show that a political equilibrium always exists and that it is unique for the empirically most relevant case, namely, when informal carers are active.

Our most important results are as follows. First, the negative association between income inequality and public spending on long-term care (as shown in the figure above) can be supported as a political equilibrium effect. Second, and perhaps somewhat surprising, increasing demand (or demographic change) may or may not increase public spending on long-term care. The reason is that public care becomes more expensive as it is claimed by more agents. A shift from publicly financed care to lump-sum transfers may allow better targeted income redistribution.

Our paper contributes to the slim political economy literature on public health care spending. Epple and Romano (1996) and Gouveia (1997) essentially consider one-dimensional problems allowing them to apply the median voter approach to determine the outcome of the political process in which a publicly financed private good is consumed alongside a private supplement. As public provision is uniform while financing is not, low income individuals enjoy a 'tax price' below the private alternative and therefore are in favor of a public system. Our contribution is two-fold: (i) we are the first to offer a theoretical political economy analysis of long-term care and (ii) we consider the two most important dimensions when it comes to long-term care or health care in general, namely, income and need. In contrast to Epple and Romano (1996) and Gouveia (1997) this allows us to distinguish between the median voter for public care and the median voter for income taxation. This distinction is crucial as median voters turn out to be different types, poor agents with needy parents for public care and poor agents with healthy parents for the tax rate, respectively. Note also that voting on two dimensions – public care and income redistribution – avoids the inherent bias when ignoring income redistribution. As was pointed out by Cremer and Gahvari (1997) leaving out income redistribution may induce public programs to implicitly assume this role. This typically implies that public programs are inflated. Finally, we capture the different modes of care, namely, public, private, and informal. This enables us to emphasize the tax base effect of informal care giving and thereby to incorporate an important characteristic of the market for long-term care. Although somewhat loosely, the current paper also relates to the large normative literature on the use of public expenditures for redistributive purposes like, for instance, Blackorby and Donaldson (1988), Besley and Coate (1991), Hoel and Sæther (2003), Marchand and Schroyen (2005), and Kuhn and Nuscheler (2010).

The paper is organized as follows. In Section 2 we introduce the economic setup. The equilibrium concept is described in Section 3 followed by an analysis of the agents' voting behavior in Section 4. This analysis includes the identification of the median voter's type for each policy issue. Section 5 fully characterizes the reaction functions of the respective median voters and demonstrates that a structure induced equilibrium always exists. A comparative static analysis is offered in Section 6 followed by some concluding remarks in Section 7.

2 The Model Economy

2.1 The Setup

We consider a population of one parent - one child families. The elderly are identical apart from disability (i.e., need for long-term care). We consider two degrees of dependency, $j = d, n$, where d stands for disabled and n for not disabled. While parents are economically inactive, the children participate in the labor market. The extent to which they do depends on productivity y_i, $i = p, r$, where p stands for poor and r for rich: $y_r > y_p > 0$. Productivity is understood as the maximum achievable income, that is, the income when all available time – which is normalized to one – is devoted to work. In total our population consists of four different types with shares as shown in Table 1. We assume throughout that family type is public information.[3]

Table 1: Family types.

		Income		
		p	r	Σ
Dependency	d	$\theta_{pd} = \theta\pi$	$\theta_{rd} = (1-\theta)\pi$	π
	n	$\theta_{pn} = \theta(1-\pi)$	$\theta_{rn} = (1-\theta)(1-\pi)$	$1-\pi$
	Σ	θ	$1-\theta$	1

In line with empirical evidence we let $\theta > 0.5$ so that the poor form a majority in our economy. This implies that median income is strictly smaller than average income, $y^m = y_p < \overline{y} \equiv \theta y_p + (1-\theta) y_r$. Additionally, we suggest $\pi > 0.5$. This is to be understood as the fraction of parents that will become dependent over their life-cycle and not as the fraction of needy parents at every instant in time. For the sake of interest, we let $\theta_{pd} < 0.5$. Otherwise this group could dictate all relevant variables (see Section 4 below). Note that this together with the assumptions on π and θ implies that no type has a majority.

The elderly consume their entire (exogenous) endowment to enjoy utility $\overline{u}$. Due to their frailty dependent parents incur a disutility $\overline{u} - u(c)$. Through the receipt of care $c \geq 0$ the disutility can be mitigated, $u' > 0$, but not eliminated so that a frail parent's utility is $u(c) < \overline{u}$. As usual we assume $u'' < 0$. In order to keep the problem tractable we concentrate on cases with $u''' = 0$.

We consider three sources of care for the elderly, namely, attention or informal care provided by the children a_{ij}, privately financed market care m_{ij}, and publicly financed care γ_j. While informal and market care can generally vary across all types public long-term care is uniform given dependency. More precisely, for dependent parents we have $\gamma_d = \gamma \geq 0$ and for independent parents $\gamma_n = 0$. The total amount of care is produced using a linear technology, that is, $c_{ij} = \gamma_j + m_{ij} + a_{ij}$.[4] The different forms of care are,

[3] We thereby abstract from information constraints in long-term care settings that have been studied elsewhere, see e.g., Jousten, Lipszyc, Marchand and Pestieau (2005) and Kuhn and Nuscheler (2010).

[4] This is similar to Gouveia (1997) who also allows individuals to top up public care with a private

thus, perfect substitutes.[5] For parents neither the mode of care nor the financing of it matters. To ease presentation of the main ideas we let $u'(1) = 0$. This implies that parent utility cannot be improved over and above full time informal care.

When providing care, informal carers reduce their time spend on the labor market by the fraction $a_{ij} \in [0, 1]$.[6] Additionally, they incur disutility $v(a)$.[7] The marginal cost of informal care is strictly positive, $v' > 0$, and convex, $v'' > 0$. Again, for tractability reasons we let $v''' = 0$. Privately financed formal care and publicly financed care come at a cost of $p > 0$ per unit. In order to finance public long-term care expenses $\pi p \gamma$ the state has to levy taxes. We consider proportional income taxes with marginal tax rate $t \in [0, 1]$. In addition to financing public long-term care the tax revenue may be used to redistribute income using a lump-sum transfer $\tau \in \mathbb{R}$.[8]

Considering perfectly altruistic children and quasi-linear preferences this gives rise to the following utility function:[9]

$$U_{ij} \equiv U(x_{ij}, a_{ij}, m_{ij}) = x_{ij} - v(a_{ij}) + u_j(\gamma_j + m_{ij} + a_{ij}), \tag{1}$$

where $x_{ij} \equiv (1 - t)(1 - a_{ij})y_i + \tau - pm_{ij}$ is the child's consumption of a numeraire commodity. In the following subsection we derive the optimal provision of private care, be it formal or informal, for a given level of publicly financed care γ. At this stage we also take the tax and transfer system (t, τ) as given.

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supplement.

[5] There are several papers that suggest that different forms of care are indeed, at least to some extent, substitutable (see, e.g., Van Houtven and Norton, 2004, Charles and Sevak, 2005, and Stabile et al., 2006).

[6] The distortions in labor supply of informal care givers are for example found in Carmichael and Charles (1998), and Bolin, Lindgren and Lundborg (2008).

[7] As already argued in the introduction, the demands of caregiving could, for instance, cause symptoms of depression and could decrease both the energy required and the opportunity to engage in social activities (see, e.g., Hughes et al., 1999 and Schulz and Beach, 1999).

[8] As this transfer may turn out negative the financing of long-term care may well include a lump-sum component.

[9] The assumption of quasi-linear preferences is made for analytical tractability. It implies that all income effects are absorbed by the children.

2.2 Individual Optimization

pd-type. The first order conditions for informal and formal care, respectively, are given by

$$-(1-t)y_p - v'(a_{pd}) + u'(c_{pd}) = 0, \tag{2}$$

$$-p + u'(c_{pd}) = 0. \tag{3}$$

In general, four different scenarios are possible, an interior solution with $a^*_{pd} > 0$ and $m^*_{pd} > 0$ and three corner solutions where either formal care or informal care or both are zero. To ease presentation of our main ideas we focus on equilibria with specialization, that is, we restrict attention to cases where poor individuals with dependent parents refrain from purchasing market care, $m^*_{pd} = 0$. A sufficient condition for this to happen is

$$p > y_p + v'(1). \tag{4}$$

The optimal level of informal care is then given by

$$a^*_{pd} = \max\left\{0, \arg_a \{(1-t)y_p + v'(a) = u'(\gamma + a)\}\right\}. \tag{5}$$

Total differentiation of the first order condition for an interior solution of informal care (2) and using the implicit function theorem we find

$$\frac{\partial a^*_{pd}}{\partial t} = \frac{y_p}{v'' - u''} > 0, \tag{6}$$

$$\frac{\partial a^*_{pd}}{\partial \gamma} = \frac{u''}{v'' - u''} \in (-1, 0), \tag{7}$$

$$\frac{\partial a^*_{pd}}{\partial y_p} = -\frac{1-t}{v'' - u''} < 0, \tag{8}$$

where the denominator is strictly positive by the second order condition for utility maximization. A higher income tax rate makes informal care less costly and informal carers respond with higher care levels as is shown in equation (6). According to equation (7), an increase in public financing of long-term care *partially* crowds out informal care-giving.

Consider an increase in public care. Holding the level of informal care constant the marginal cost of informal care unambiguously exceeds the marginal revenue from care, that is, informal care giving should optimally be reduced. Full crowding out, however, will not occur as the marginal utility derived from care at the previous total care level would then be strictly larger than the marginal cost of informal care giving.[10] Finally, when the low income type becomes more affluent, the opportunity costs of informal care giving in terms of forgone earnings increase, leading to a reduction of care giving as is shown in equation (8).

rd-type. By replacing the index *'p'* by *'r'* in equations (2) and (3) we find the first order conditions of the rd-type for informal and formal care, respectively. As already mentioned above, we concentrate on equilibria with specialization. Therefore, we only consider cases with $a^*_{rd} = 0$ and $m^*_{rd} \geq 0$. Obviously, this would require $p = u'(c_{rd}) < (1-t)y_r + v'(0)$ to hold for all $t \in [0,1]$. As $v'(0)$ is likely to be small the condition may well be violated for $t = 1$. Empirical evidence provided by Stoller and Cutler (1993) and Carmichael, Charles and Hulme (2010) shows, however, that those with higher wages are less willing to provide informal care. This suggests that in addition to the gap in opportunity costs the disutility of informal care giving may differ across productivity types with more productive workers being less productive carers. To keep things simple we introduce a sufficiently high fixed cost of informal care provision on rich individuals yielding the desired specialization result.[11] The optimal level of formal care provision is then given by

$$m^*_{rd} = \max\Big\{0, \arg_m \{p = u'(\gamma + m)\}\Big\}. \tag{9}$$

Using the implicit function theorem we find that an increase in publicly financed long-term

[10] Our partial crowding out result receives firm support from empirical studies like, for instance, Pezzin, Kemper and Reschovsky (1996) and Stabile, Laporte and Coyte (2006).

[11] An alternative but clearly less convincing way to get specialization is to restrict the parameter space to sufficiently small income tax rates. In the concluding section we argue that, apart from complicating the analysis, nothing would change fundamentally when we allow rd-types to engage in informal care giving.

care *fully* crowds out privately financed market care

$$\frac{\partial m^*_{rd}}{\partial \gamma} = -1. \tag{10}$$

In Section 5 we study politico-economic equilibria and, for the most part, restrict attention to interior solutions where – given the tax rate and public provision of care – poor and rich children of dependent parents find it optimal to provide strictly positive amounts of care. Therefore, a characterization of (γ, t) constellations yielding interior solutions is warranted. Using (2) the boundary between interior and corner solutions for the informal caring pd-type is implicitly defined by $(1-t)y_p + v'(0) = u'(\gamma)$. This allows us to define the locus of all interior solutions yielding $a^*_{pd} = 0$ as a function of γ in (γ, t)-space

$$\widetilde{t}(\gamma) \equiv 1 + \frac{v'(0)}{y_p} - \frac{u'(\gamma)}{y_p}. \tag{11}$$

For the formal caring rd-type we have, using equation (3), $p = u'(\gamma)$. The slopes of the respective loci are

$$\left.\frac{\mathrm{d}t}{\mathrm{d}\gamma}\right|_{a^*_{pd}=0} = \widetilde{t}'(\gamma) = -\frac{u''}{y_p} \quad \text{and} \quad \left.\frac{\mathrm{d}t}{\mathrm{d}\gamma}\right|_{m^*_{rd}=0} = -\infty. \tag{12}$$

Due to our specialization assumption (4), we know that informal care of poor children is always cheaper than formal care purchased by rich children. As the utility of receiving parents does not vary with productivity, the set of (γ, t) combinations for which an interior solution arises for rich children, is a subset of those combinations where an interior solution for poor children obtains.[12] Figure 2 illustrates.

n-types. As parents of n-types do not derive utility from care their children are not prepared to incur any cost of providing care, be it formal or informal. The healthy parents simply enjoy their consumption utility $\overline{u}$ while their children consume their entire net income $(1-t)y_i + \tau$.

[12] This also implies that parents of unproductive children enjoy a higher level of care, $a^*_{pd} \geq m^*_{rd}$.

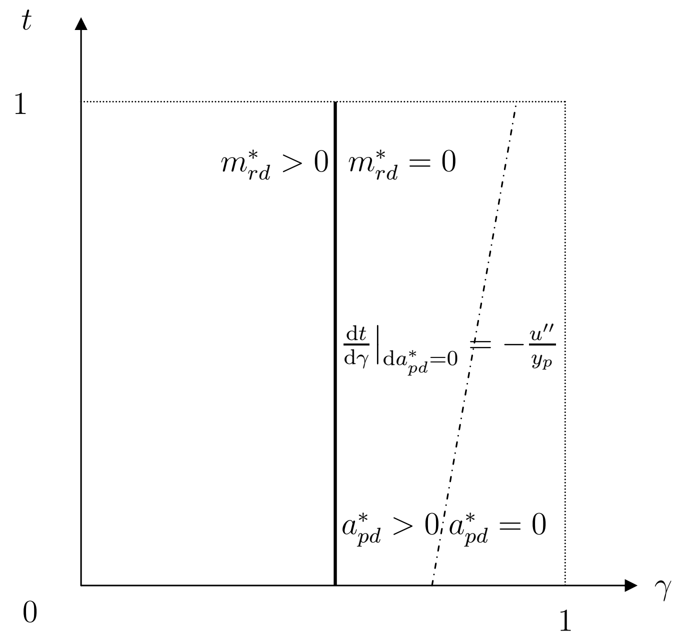

Figure 2: Optimal Private Long-Term Care Provision.

3 Equilibrium Concept

3.1 The Economic Equilibrium

In an economic equilibrium the public budget needs to be balanced. In the previous section we analyzed informal care decisions and with it labor supply enabling us to calculate the revenue from proportional income taxation. This yields the following budget constraint

$$t\Big(\bar{y} - \theta_{pd} a_{pd}(\gamma, t) y_p\Big) = \tau + \pi p \gamma. \tag{13}$$

Due to the tax-base effect $\theta_{pd}\frac{\partial a^*_{pd}}{\partial t} y_p > 0$ originating in informal care giving of pd-types the public budget constraint displays a Laffer curve. Higher income taxes reduce the opportunity costs of informal care and with it increase the provision of such care. This, in turn, reduces labor supply and thereby taxable income.

By the government budget constraint, only two of the three policy instruments, (γ, t, τ), can be set freely. Below we consider that society votes on the tax rate t and on financing of public long-term care γ. The lump sum transfer τ is then residually determined through equation (13). The policy space is thus given by the unit square, i.e., $(\gamma, t) \in [0,1] \times [0,1]$. We can now define what constitutes an economic equilibrium in our environment:

Definition 1 *For a given tax rate t and a given level of publicly financed long-term care γ an economic allocation, $\{c_{ij}, x_{ij}\}_{i=p,r}^{j=d,n}$, is an equilibrium if the following conditions are satisfied:*

(i) The consumer problem is solved for each agent, i.e. individuals maximize their utility given by equation (1).

(ii) The government's budget constraint is balanced, i.e. equation (13) holds.

(iii) The markets for the numeraire commodity and for long-term care are competitive and always clear.

The indirect utility function of an ij-type can be used to express the agent's preferences for t and γ in an economic equilibrium. For families with disabled parents we have

$$V_{pd}(\gamma, t) = (1-t)(1-a_{pd}^*)y_p + t\left(\bar{y} - \theta_{pd} a_{pd}^* y_p\right) - \pi p \gamma - v(a_{pd}^*) + u(c_{pd}^*) \tag{14}$$

$$V_{rd}(\gamma, t) = (1-t)y_r + t\left(\bar{y} - \theta_{pd} a_{pd}^* y_p\right) - \pi p \gamma - p m_{rd}^* + u(c_{rd}^*) \tag{15}$$

and for those without disabled parents

$$V_{in}(\gamma, t) = (1-t)y_i + t\left(\bar{y} - \theta_{pd} a_{pd}^* y_p\right) - \pi p \gamma + \bar{u} \qquad \text{for} \qquad i = p, r. \tag{16}$$

Note that a_{pd}^* and c_{pd}^* are functions of both t and γ, and m_{rd}^* and c_{rd}^* are functions of γ.

3.2 Structure Induced Equilibrium

In the political process, individuals vote over the tax rate, $t \in [0,1]$, and the level of public long-term care provision, $\gamma \in [0,1]$, and they do so sincerely. All agents alive cast a ballot over t and γ.[13] Then, agents' preferences over the two policy parameters are aggregated through a political system of majoritarian voting. Every agent has zero mass, so that no individual vote can change the outcome of the election.

As a median voter equilibrium may fail to exist in multi-dimensional settings, we analyze structure-induced equilibria where agents vote simultaneously but separately on the issues at stake (Shepsle, 1979).[14]

Definition 2 *A structure induced equilibrium is characterized by the following conditions:*

(i) The electorate, i.e. pn-, pd-, rn- and rd-agents (and their parents), constitute the only committee (the Committee of the Whole).

(ii) Each jurisdiction is a single dimension of the issue space, that is, one jurisdiction has the power to set the income tax rate, t, and another one the level of public long-term care financing, γ.

(iii) Both jurisdictions are assigned to the Committee of the Whole.

(iv) Amendments to the proposal are permitted only along the dimension that falls in the jurisdiction of the committee, i.e., if the proposal regards γ, only amendments on γ are permitted, and if it regards t, only amendments on t are permitted.

Think of this political structure as follows. There is a government that perfectly represents the preferences of the electorate (the Committee of the Whole, (i)) but delegates policy issues to (perfectly representative) ministries. In our case, the ministry of finance is responsible for setting the tax rate, while the ministry of health and long-term care is accountable for public long-term care spending, (ii). The ministry of health and long-term care proposes some level of publicly financed long-term care for a *given* tax rate.

[13] We do not distinguish between child and parent voting behavior. This amounts to assuming that parents are perfectly altruistic towards their children (just like their children who fully internalize parent utility).

[14] Our presentation of the equilibrium concept closely follows Galasso (2008, p. 2161).

Similarly, the ministry of finance suggests a tax rate for a *given* level of public long-term care, (iv). Proposals can be thought of as the best responses (or reaction functions) of the ministries – that are rooted in the preferences of the median voter of the issue at stake, (iii). Their intersection characterizes the structure-induced equilibrium of the voting game where policy proposals of the ministries are mutual best responses to one another. The structure-induced equilibrium, thus, introduces issue-by-issue voting and thereby facilitates the application of the median voter approach in multi-dimensional issue space environments while preserving the flavor of the median voter theorem.

In what follows, we analyze the voting game, which determines the tax rate and the amount of public long-term care. In Section 4 we first calculate every voter's ideal point over the tax rate for every given level of public long-term care $t(\gamma)$ and, then, over the level of public long-term care for every given tax rate $\gamma(t)$. Then, for each value of γ, we identify the median voter over t, and for each value of t, the median voter over γ. In Section 5 we analyze the median voters' reaction functions and their intersection – the structure induced equilibrium of the voting game.

4 Voting

4.1 Income Taxation

pd-types. Their most preferred tax rate is found by solving the following program

$$\max_{t} \quad V_{pd}(\gamma, t) \quad \text{s.t.} \quad 0 \leq t \leq 1, \tag{17}$$

where $V_{pd}(\gamma, t)$ is as defined in equation (14). This gives rise to the following first order condition

$$\begin{aligned} \frac{\partial V_{pd}(\gamma,t)}{\partial t} + \mu_{pd}^t - \lambda_{pd}^t = & - (1-a_{pd}^*)y_p + \bar{y} - \theta_{pd}a_{pd}^*y_p - t\theta_{pd}y_p\frac{\partial a_{pd}^*}{\partial t} \\ & + \left(u_{pd}' - (1-t)y_p - v_{pd}'\right)\frac{\partial a_{pd}^*}{\partial t} + \mu_{pd}^t - \lambda_{pd}^t = 0, \end{aligned} \tag{18}$$

where μ_{pd}^t is the Lagrange multiplier on the non-negativity constraint and λ_{pd}^t the one for the requirement that the income tax rate must not exceed 100 per cent.[15] By the first order condition of the *pd*-type for informal care, equation (2), the remainder of the second line of the above derivative vanishes. Collecting terms and using the tax elasticity of informal care giving, $\varepsilon_{a_{pd},t} = \frac{\partial a_{pd}^*}{\partial t}\frac{t}{a_{pd}^*} > 0$, the first order condition simplifies to

$$-(1-a_{pd}^*)y_p + \bar{y} - \theta_{pd}a_{pd}^*y_p(1+\varepsilon_{a_{pd},t}) + \mu_{pd}^t - \lambda_{pd}^t = 0. \tag{19}$$

Evaluating the partial derivative (18) at $t = 0$ we find

$$\left.\frac{\partial V_{pd}(\gamma, t)}{\partial t}\right|_{t=0} = -(1-a_{pd}^*)y_p + \bar{y} - \theta_{pd}a_{pd}^*y_p > -y_p + \bar{y} > 0. \tag{20}$$

In Appendix A.1 we show that the indirect utility function of the *pd*-type is convex in t. Together with (20) this implies a most favored tax rate of one.[16] Intuition is straightforward. For a given γ an increase in income taxes unambiguously increases the lump-sum transfer. As poor individuals are – independent of the tax rate and independent of the extent of informal care provision – net recipients of the tax scheme they prefer the highest feasible tax rate, $t_{pd}^*(\gamma) = 1$.

pn-types. For a given level of public long-term care, γ, the most preferred tax rate of *pn*-types is found by maximizing the type's indirect utility function (16) with respect to the tax rate subject to the tax rate being bounded by the unit interval. This gives rise to the following first order condition

$$-y_p + \bar{y} - \theta_{pd}a_{pd}^*y_p(1+\varepsilon_{a_{pd},t}) + \mu_{pn}^t - \lambda_{pn}^t = 0. \tag{21}$$

The first term expresses the cost to the agents, due to the contribution into the welfare scheme. The second and third term represent the increase in the lump-sum transfer net of

[15] The superscript t is used to indicate the multipliers for the most preferred tax. Accordingly, we use γ when considering the most preferred publicly financed long-term care level.

[16] Note that the *pd*-type's preferences are nevertheless single peaked with the peak occurring at a corner solution. The preferences of the remaining types are single peaked as well. In the Appendix A.1 we show that their indirect utility function is strictly concave in t.

the marginal reduction in the tax base originating in the marginal increase of the income tax rate. For poor agents the latter effect may outweigh the former implying $t^*_{pn}(\gamma) \geq 0$.

r-types. Rich individuals choose their most preferred tax rate $t_{rj}(\gamma)$ by maximizing indirect utility (15) for $j = d$ and (16) for $j = n$, respectively, with respect to t under the usual constraints. The first-order condition of this problem is given by

$$-y_r + \bar{y} - \theta_{pd} a^*_{pd} y_p (1 + \varepsilon_{a_{pd},t}) + \mu^t_{rj} - \lambda^t_{rj} = 0 \qquad \text{for} \qquad j = n, d. \tag{22}$$

Unsurprisingly, rich agents oppose a positive tax rate as they are net contributors to the welfare scheme, implying $t^*_{rj}(\gamma) = 0$ for $j = n, d$.

It is now straightforward to order every individual's vote over the proportional income tax, for a given public provision of long-term care, and to identify the median voter's type.

Lemma 1 *The most preferred income tax rates can be ordered as follows:* $0 = t^*_{rn}(\gamma) = t^*_{rd}(\gamma) \leq t^*_{pn}(\gamma) \leq t^*_{pd}(\gamma) = 1$. *The median voter is the type-ij agent who divides the electorate into halves. As the poor form a majority the median voter is a pn-type implying* $t^m(\gamma) \equiv t^*_{pn}(\gamma)$.

4.2 Public Long-Term Care

pd-types. Poor individuals with needy parents find their most preferred level of publicly financed long-term care by maximizing their indirect utility function (14) with respect to γ taking the income tax rate t as given. The corresponding first order condition is

$$\begin{aligned}\frac{\partial V_{pd}(\gamma, t)}{\partial \gamma} + \mu^\gamma_{pd} - \lambda^\gamma_{pd} &= -t\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial \gamma} - \pi p + u'_{pd} + \mu^\gamma_{pd} - \lambda^\gamma_{pd} \\ &\quad + (u'_{pd} - v'_{pd} - (1-t) y_p) \frac{\partial a^*_{pd}}{\partial \gamma} \\ &= -t\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial \gamma} - \pi p + u'_{pd} + \mu^\gamma_{pd} - \lambda^\gamma_{pd} = 0, \end{aligned} \tag{23}$$

where the term in brackets vanishes due to the optimally chosen amount of informal care giving as characterized by equation (2). Like above, the Lagrange multiplier for the non-negativity constraint is given by μ^{γ}_{pd}, while λ^{γ}_{pd} is the one for upper bound on γ (which was assumed to be one). There are three effects left remaining. The first two terms capture the effect of a marginal increase in the level of publicly financed care on the lump-sum transfer, that is, $\frac{\partial \tau}{\partial \gamma} = -t\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial \gamma} - \pi p$. The first term measures the benefit arising from the increase in income tax revenue. As public long-term care and informal care are (partially) substitutable an increase in public long-term care reduces informal care giving and thereby increases labor supply and with it taxable income. For a given tax rate, revenue from income taxation unambiguously increases. With a given income tax rate, however, improved public long-term care needs to be financed by lump-sum taxation (the second term) or, to put it differently, by a reduction in lump-sum transfers. Finally, the third term measures the increase in parent utility derived from better public care. Which of the two constraints on γ is binding – if any – will generally depend on the parameters.

rd-types. The first order condition for rich individuals with needy parents is structurally identical to the one for *pd*-types and is observed by differentiating (15) with respect to γ[17]

$$- t\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial \gamma} - \pi p + u'_{rd} + \mu^{\gamma}_{rd} - \lambda^{\gamma}_{rd} = 0. \tag{24}$$

The first order condition for privately purchased care (3) tells us that $u'_{rd} = p$. The first three terms in the above equation are thus strictly positive implying $\lambda^{\gamma}_{rd} > 0$, that is, we are in a corner solution with $\gamma^*_{rd} = 1$. This is intuitive as publicly financed long-term care is always (weakly) less expensive than privately purchased care (the tax price πp is smaller than p). Comparison of the first order conditions (23) and (24) then implies a weakly smaller most preferred level of public long-term care of *pd*-types as compared to *rd*-types, $\gamma^*_{pd} \leq \gamma^*_{rd}$. Due to the larger extent of privately provided or financed care public care is worth less for *pd*-types.[18]

[17] Note, that the term $u'_{rd} - p = 0$ vanishes by the first-order condition for optimal provision of formal care, equation (3).

[18] Formally this can be seen by evaluating the indirect utility function of the *pd*-type at the most

n-types. Children without dependent parents only care about their own consumption and therefore do not derive any direct utility from (public) long-term care. As the following first order condition shows, n-types may nevertheless favor a strictly positive level of public care to no public care:

$$-t\theta_{pd}y_p\frac{\partial a^*_{pd}}{\partial \gamma} - \pi p = 0 \qquad \text{for} \qquad i = p, r. \tag{25}$$

If the marginal increase in revenue from income taxation (first term) exceeds the marginal cost of public care (second term) even n-types will vote for a strictly positive level of care.[19] Note, however, that due to the missing positive effect on their parents' utility the most preferred public care level of n-types always falls short of those types with needy parents. This allows us to our next lemma:[20]

LEMMA 2 *The most preferred levels of public long-term can be ordered as follows:* $0 \le \gamma^*_{pn}(t) = \gamma^*_{rn}(t) \le \gamma^*_{pd}(t) \le \gamma^*_{rd}(t) = 1$. *As* $\pi > 0.5$, *individual-pd will be the median voter, that is,* $\gamma^m(t) \equiv \gamma^*_{pd}(t)$.

5 Equilibrium Outcomes

In the previous section we identified the median voter's type for each policy dimension. Independent of the dimension under consideration the median voter was found to be poor. While the one for public long-term care, γ, has needy parents the one for income taxation, t, has not. As argued in Section 3, the corresponding first order conditions (21) and (23) can be interpreted as reaction functions for t and γ, where $t^m(\gamma) \equiv t^*_{pn}(\gamma)$ and $\gamma^m(t) \equiv \gamma^*_{pd}(t)$. Their intersection yields the structure induced equilibrium. Before we analyze the equilibrium outcome we study the properties of the reaction functions.

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preferred level of public long-term care of the rd-type: $\left.\frac{\partial V_{pd}(\gamma,t)}{\partial \gamma}\right|_{\gamma=\gamma^*_{rd}(t)} = u'_{pd} - u'_{rd} \le 0$.

[19] Due to quadratic utility $\partial^2 a^*_{pd}/\partial\gamma^2 = 0$. But, then, the first order condition (25) is independent of γ and, thus, either non-positive or strictly positive. In the former case we have $\gamma^*_{in} = 0$ and in the latter $\gamma^*_{in} = 1$.

[20] In Appendix A.1 we show that preferences of all types are single-peaked.

Using equation (21) we can write the reaction function for the income tax rate as

$$t^m(\gamma) = \max\Big\{0, \min\big\{ \arg_t\{\bar{y} - y_p - \theta_{pd} a^*_{pd} y_p (1 + \varepsilon_{a_{pd},t}) = 0\}, 1\big\}\Big\}. \tag{26}$$

This function is well defined for all levels of γ. Applying the implicit function theorem, the slope of the median voter's reaction function in the (γ, t)-space is found to be

$$\frac{\mathrm{d}t^m(\gamma)}{\mathrm{d}\gamma} = \frac{\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial \gamma}}{-2\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial t}} = -\frac{u''}{2y_p} > 0 \tag{27}$$

for the interior part of the strategy space. Hence, the median voter's most preferred income tax rate is an increasing function of the level of publicly financed long-term care. The larger such care, the smaller informal care. This increases the tax base and makes positive income-taxation more attractive. The following lemma summarizes how the reaction function shifts when the parameters of the economic environment change.

Lemma 3 *For an interior solution and for a given share of public long-term care, γ, the most preferred tax rate by the median voter, $t^m(\gamma)$, is*

(i) decreasing with the share of children with dependent parents, $\frac{\mathrm{d}t^m(\gamma)}{\mathrm{d}\pi} < 0$,

(ii) decreasing with the share of low income agents, $\frac{\mathrm{d}t^m(\gamma)}{\mathrm{d}\theta} < 0$,

(iii) independent of the price of formal care, $\frac{\mathrm{d}t^m(\gamma)}{\mathrm{d}p} = 0$,

(iv) increasing with the income of the rich, $\frac{\mathrm{d}t^m(\gamma)}{\mathrm{d}y_r} > 0$,

(v) increasing or decreasing with the income of the poor, $\frac{\mathrm{d}t^m(\gamma)}{\mathrm{d}y_p} \lesseqgtr 0$.

While the formal proof is relegated to the Appendix the intuition for the results is rather straightforward. (i) With more poor children with needy parents the tax-base effect of income taxation is more pronounced rendering income taxation less attractive. (ii) An increase in the share of low income agents has two effects. First, average income drops reducing the marginal revenue from income taxation. Second, as in (i) above, the tax base effect is amplified. (iii) Quasi-linearity of the utility function implies that the price of formal care does not affect the marginal utility from consumption. Accordingly, the most preferred tax rate of the median voter is independent of price. (iv) Average income increases fostering the incentives to tax income. (v) Average income also increases with the income of the poor calling for higher income taxes. But as income inequality decreases redistributive taxation is needed less. Additionally, a higher income of the poor enlarges the tax-base effect. However, due to the higher costs of informal care provision less informal care is provided which, in turn, opposes the negative tax base effect. So, the overall effect is generally indeterminate.

Along similar lines we use equation (23) to write the reaction function $\gamma^m(t)$ as

$$\gamma^m(t) = \max\left\{0, \min\left\{\arg_\gamma\left\{-t\theta_{pd}y_p\frac{\partial a^*_{pd}}{\partial \gamma} - \pi p + u'_{pd} = 0\right\}, 1\right\}\right\}. \tag{28}$$

This provides us with a well defined function for all values of t. With the help of the implicit function theorem, the slope of $\gamma^m(t)$ in (γ, t)-space for the interior part is

$$\frac{\mathrm{d}\gamma^m}{\mathrm{d}t} = \frac{\theta_{pd}y_p\frac{\partial a^*_{pd}}{\partial \gamma} - u''\frac{\partial a^*_{pd}}{\partial t}}{u''\left(1 + \frac{\partial a^*_{pd}}{\partial \gamma}\right)} = -\frac{(1-\theta_{pd})y_p}{v''} < 0. \tag{29}$$

The median voter's most preferred level of publicly financed care thus decreases in the income tax rate. There are two opposing effects. The first effect is a tax base effect. Higher income taxes reinforce the tax base effect and with it the marginal benefit of substituting informal care giving with public care. At the same time a higher tax rate reduces the opportunity costs of informal care. An increase in such care results in lowering the marginal utility of public care. As the above equation shows, the latter (negative) effect dominates. Additional properties of the reaction function are summarized in our next lemma.

LEMMA 4 *For an interior solution and for a given tax rate, t, the most preferred level of public long-term care by the median voter, $\gamma^m(t)$, is*

(i) decreasing in the share of children with dependent parents, $\frac{\mathrm{d}\gamma^m(t)}{\mathrm{d}\pi} < 0$,

(ii) increasing in the share of low income agents, $\frac{d\gamma^m(t)}{d\theta} > 0$,

(iii) decreasing in the price of formal care, $\frac{d\gamma^m(t)}{dp} < 0$,

(iv) independent of the income of the rich, $\frac{d\gamma^m(t)}{dy_r} = 0$,

(v) increasing in the income of the poor, $\frac{d\gamma^m(t)}{dy_p} > 0$.

Again, there is a clear economic intuition behind our results. (i), (ii) An increase in the share of dependent parents, or, in the share of low income agents, strengthens the negative tax base effect as the number of informal carers increases. This, in turn, makes public care more attractive as it partially crowds out informal care giving. (iii) Obviously, the more expensive formal care, the less attractive it is. (iv) An increase in the income of the rich increases tax revenue and with it consumption. Due to quasi-linearity the marginal utility from consumption is unchanged ruling out a feedback effect on informal care giving. Consequently, the most preferred level of public care remains unchanged. (v) Similar to (i) and (ii) an increase in the income of the poor inflates the tax base effect and with it the benefits of a public substitute.

Following Shepsle (1979), the structure-induced equilibrium of this voting game corresponds to the intersection of the reaction functions $t^m(\gamma)$ and $\gamma^m(t)$. The next proposition states that such an equilibrium always exists and when it is unique.

PROPOSITION 1 *There exists a structure induced equilibrium of the voting game over the proportional income tax and the level of public long-term care, with outcome* (γ^{eq}, t^{eq}). *The equilibrium is unique if a positive amount of informal care is provided in equilibrium,* $a^{eq} \equiv a^*_{pd}(\gamma^{eq}, t^{eq}) > 0$. *In contrast, multiple equilibria may occur if* $a^{eq} = 0$.[21]

Figure 3 illustrates the structure induced equilibrium for interior solutions with $(\gamma^{eq}, t^{eq}) \in (0,1) \times (0,1)$ and $a^*_{pd}(\gamma^{eq}, t^{eq}) > 0$. In our comparative static analysis in the next section we concentrate on those.

[21] To come up with a formal proof of the proposition is not difficult but somewhat tedious and is therefore left for the appendix.

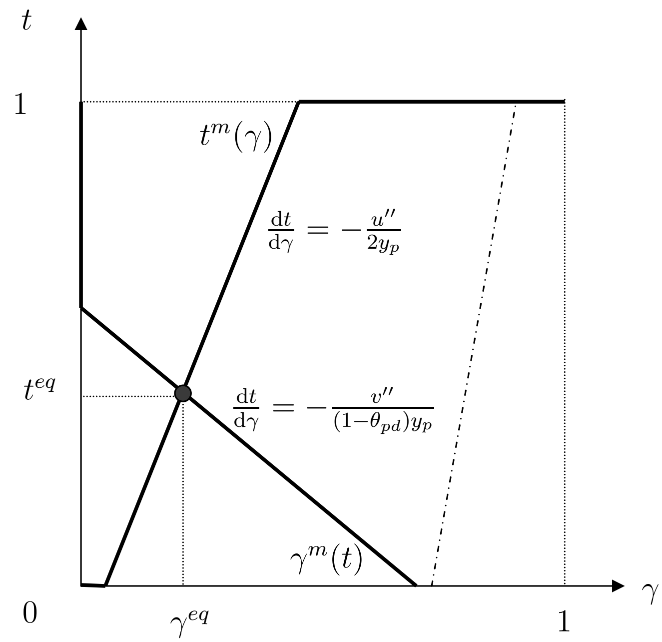

Figure 3: Political Equilibrium.

6 Comparative Statics and Empirical Evidence

In this section we return to the pattern identified in Figure 1 and analyze the impact of income inequality on public long-term care spending. We then investigate the implications of demographic change for the financing of long-term care. As already mentioned above, we concentrate on structure induced equilibria with active informal carers and policy variables from the interior of the unit square.

6.1 Income Inequality and Long-Term Care

To analyze the connection between income inequality and the financing of long-term care we need to vary the income distribution while holding average income constant. Such a mean preserving spread requires $\mathrm{d}y_p = -\frac{1-\theta}{\theta}\mathrm{d}y_r$. In the Appendix we investigate the changes in the two income levels in isolation and find that the effect of an increase in the income of the rich on γ is unambiguously negative while the effect of a decrease in the income of the poor is indeterminate. As a result the effect of a mean preserving spread on public care cannot be signed. While, by Lemma 4, the reaction function $\gamma^m(t)$ unambiguously shifts to the left when considering a mean preserving spread with $\mathrm{d}y_p < 0$ and $\mathrm{d}y_r > 0$ the reaction function $t^m(\gamma)$ may shift up (then the total effect on γ^{eq} is negative) or down (indeterminate).

Empirical evidence suggests that it is sufficient to investigate changes in y_r while holding y_p constant. The argument goes as follows. A rise in y_r has two effects (i) it increases average income and (ii) enlarges the Gini coefficient before taxes and transfers. (i) Average income as measured by GDP is positively associated with public long-term care spending (correlation 0.44, p-value = 0.046). (ii) Income inequality increases calling for more redistributive measures. This may imply both, heavier income taxation and more public spending on long-term care. Thus, regarding public care the two effects work in opposite directions so that it is an empirical question which of the two dominates. Figure 1 nicely shows that it is the latter effect that dominates, that is, the Gini coefficient before taxes and transfers is *negatively* associated with public spending on long-term care (−0.53, 0.013) even though the relationship is mitigated by income effects.[22] This allows us to state our next proposition.

> PROPOSITION 2 *An increase in the pre-tax Gini coefficient originating in the rich becoming wealthier* ($\mathrm{d}y_r > 0$) *and the income of the poor staying unchanged* ($\mathrm{d}y_p = 0$) *rises the income tax rate and reduces public financing of long-term care.*

When the rich become wealthier average income increases and with it the tax base. This makes income taxation more desirable as marginal tax revenues increase yielding higher income taxes in equilibrium. With higher income taxes, however, informally provided care becomes less costly letting such care expand. But as publicly financed care is a substitute to informal care the former is lower when income inequality is higher. Figure 4

[22] In fact, a naive regression – based on the 21 countries of Figure 1 – of public long-term care expenses per capita on per capita GDP and the Gini coefficient before taxes and transfers shows no significant correlation between long-term care and GDP, while the association between the Gini coefficient and long-term care is negative (p-value = 0.061).

below illustrates. While the reaction function for public care is invariant to changes in y_r (see Lemma 4 (iv)) the reaction function for the tax rate shifts up. Our theoretical model thus offers a political economy explanation for an empirically observed pattern. Note also that this pattern not only emerges for the Gini coefficient before taxes and transfers but also for the one after taxes and transfers. The former observation emphasizes the need for long-term care related income redistribution, the latter highlights that public long-term care is also a means to redistribute income.

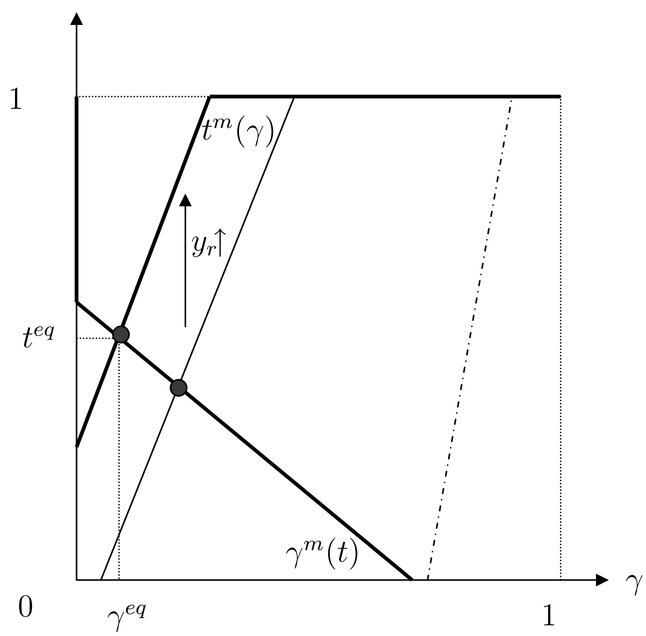

Figure 4: An Increase in the Pre-Tax Gini-Coefficient.

6.2 Demographic Change and Long-Term Care

An increase in the share of agents having parents to take care of has three effects (Figure 5 below illustrates). First, it increases the distortionary effect of positive income taxation as there are more agents that reduce their labor supply in order to provide long-term care. This induces the median voter over the tax rate to reduce proportional income taxation for every given γ (the reaction function $t^m(\gamma)$ shifts down). Second, publicly financed long-term care turns more costly as it is claimed by more agents. This induces the median voter over public care to cut back on public long-term care financing for every given tax rate (the reaction function $\gamma^m(t)$ moves to the left). Both effects diminish the role of the state in the economy and make the welfare scheme less appealing. Third, the higher share of care-giving children strengthens the positive tax base effect of public long-term care provision (the slope of the reaction function $\gamma^m(t)$ becomes flatter).

PROPOSITION 3 *An increase in the share of disabled parents leads to lower income taxation. The overall effect on public provision of long-term, by contrast, is ambiguous:*

$$\frac{dt^{eq}}{d\pi} < 0 \qquad \textit{and} \qquad \frac{d\gamma^{eq}}{d\pi} \gtreqless 0 \quad \textit{if} \quad 2 \lesseqgtr \frac{u''}{u'_{pd}}(\theta_{pd} - 1)a^*_{pd}(1 + \varepsilon_{a_{pd},t}).$$

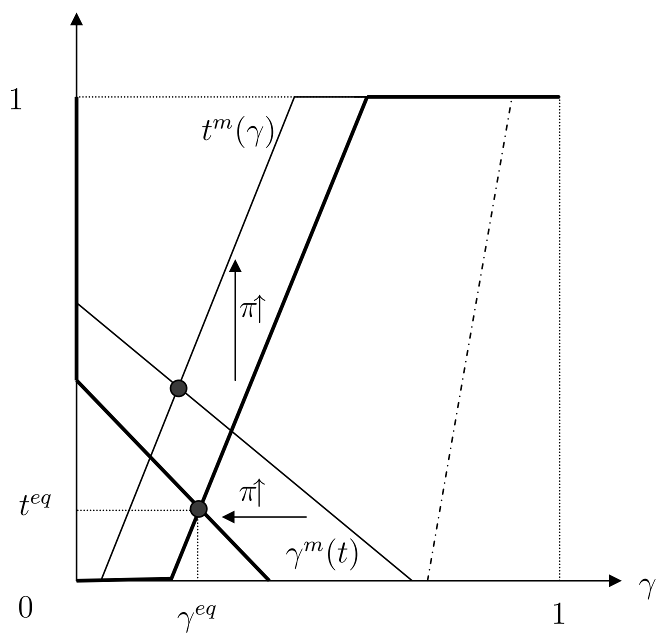

Figure 5: A Rise in the Share of Dependent Parents.

The proposition offers a surprising result. Demographic change that presumably comes along with more demand for long-term care not necessarily leads to more public spending on care for the elderly. The political process may well give private sources of financing a more prominent role. If the tax response of informal care giving is sufficiently inelastic there may be no scope to substitute informal care by publicly financed care so that the latter may even fall when the population ages.

7 Conclusion

Tax revenue can be spent in several ways and we considered two, income redistribution and public spending on long-term care. We investigated how individual heterogeneity in terms of income and need translates into different preferences over income taxation and publicly financed care. The structure induced equilibrium suggested by Shepsle (1979) is used to aggregate political preferences. Through issue by issue voting this equilibrium concept allowed us to apply the median voter approach in a multi-dimensional context.

The comparative static analysis offered some remarkable results. First, income inequality as measured by the Gini coefficient before taxes and transfers and public spending on long-term care are connected. Our model predicts a negative association, that is, high income inequality is paralleled by low public spending and vice versa – a pattern that is supported by data from OECD countries. This result points to both, the necessity to address need related income inequality and to public long-term care spending being a means to redistribute income. Second, population ageing – or increasing demand for long-term care – not necessarily implies an increase in public spending on long-term care. We found that the political process may bring about more private financing instead. This is well in line with the OECD initiative 'ageing in place' that aims at strengthening care arrangements at home, including informal care (OECD, 2005).

These results deserve further discussion. One of our central assumptions was specialization, that is, private financing of long-term care was considered informal for poor agents and formal for rich ones. Allowing rich agents to engage in informal care giving would introduce a second tax base effect which would increase the marginal benefit from public care. The reaction function $\gamma^m(t)$ would shift to the right. With two informal care giving types the tax base would unambiguously be smaller reducing the marginal revenue from income taxation – the reaction function $t^m(\gamma)$ moves down. The total effect results in more public care. The effect on income taxation cannot be signed.

In many developed countries population not only ages but also shrinks. The share of individuals without children is on the rise. Obviously, voting incentives of childless but disabled individuals are distinctly different from those of needy parents who were considered perfectly altruistic towards their children. For them there is a trade-off between public care and taxation. Without children only public care matters and agents demand the maximum level, i.e., $\gamma = 1$. They are indifferent between all possible (t, τ) combinations that yield the required tax revenue. Healthy elderly individuals without children consume their exogenous endowment and do not bother about public care or taxation. Assuming that in case of indifference individuals do not vote we know that the median voter for income taxation will still be a pn-type. The median voter for public care, however, may no longer be a type pd-agent but an rd-agent. This is the case when the rich families with needy parents form a majority with the needy individuals without children. Then the political process would result in maximal public care ($\gamma = 1$) and maximal income taxation ($t = 1$). This is a rather extreme result as it requires a sufficiently small share of one child - one parent families.[23]

A Technical Appendix

A.1 Proofs

Single-Peakedness. The second-order conditions of equations (18), (21), and (22) amount to

$$\frac{\partial^2 V_{in}(\gamma,t)}{\partial t^2} = -2\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial t} \leq 0 \quad \text{for} \quad i = p, r$$
$$\frac{\partial^2 V_{rd}(\gamma,t)}{\partial t^2} = -2\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial t} \leq 0, \qquad \frac{\partial^2 V_{pd}(\gamma,t)}{\partial t^2} = 2y_p \frac{\partial a^*_{pd}}{\partial t} - 2\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial t} \geq 0.$$

[23]Let σ denote the share of one child - one parent families. Then we get the gerontocracy like result from above if $\sigma < \frac{2\pi-1}{2\pi\theta}$.

Note that due to quadratic utility $\frac{\partial^2 a^*_{pd}}{\partial t^2} = \frac{\partial^2 a^*_{pd}}{\partial \gamma^2} = \frac{\partial^2 a^*_{pd}}{\partial t \partial \gamma} = 0$. For type-$pd$ agents the indirect utility function is convex. However, since the first derivative with respect to the income tax rate, t, evaluated in $t = 0$ is positive, these agents simply prefer higher t to lower t, and preferences are still single-peaked, with a maximum in $t = 1$.

The second-order conditions of equations (25), (23) and (24) amount to

$$\frac{\partial^2 V_{in}(\gamma, t)}{\partial \gamma^2} = 0 \quad \text{for} \quad i = p, r$$
$$\frac{\partial^2 V_{rd}(\gamma, t)}{\partial \gamma^2} = u'' \left(1 + \frac{\partial m^*_{rd}}{\partial \gamma}\right) \leq 0, \qquad \frac{\partial^2 V_{pd}(\gamma, t)}{\partial \gamma^2} = u'' \left(1 + \frac{\partial a^*_{pd}}{\partial \gamma}\right) \leq 0.$$

Derivation of equation (27). Total differentiation of equation (21) yields

$$-2\theta_{pd} \frac{\partial a^*_{pd}}{\partial t} y_p \mathrm{d}t - \theta_{pd} y_p \left[\frac{\partial a^*_{pd}}{\partial \gamma} + \frac{\partial^2 a^*_{pd}}{\partial t \partial \gamma} t\right] \mathrm{d}\gamma = 0.$$

Solving for $\frac{\mathrm{d}t}{\mathrm{d}\gamma}$ and plugging in equations (6) and (7) we get the result.

Proof of Lemma 3. With the implicit function theorem, the qualitative statements of the lemma can easily be quantified. We have

$$(i) \quad \frac{\mathrm{d}t^m(\gamma)}{\mathrm{d}\pi} = -\frac{\theta a^*_{pd} y_p (1 + \varepsilon_{a_{pd},t})}{2\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial t}} < 0,$$
$$(ii) \quad \frac{\mathrm{d}t^m(\gamma)}{\mathrm{d}\theta} = -\frac{y_r - y_p + \pi y_p a^*_{pd}(1 + \varepsilon_{a_{pd},t})}{2\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial t}} < 0,$$
$$(iv) \quad \frac{\mathrm{d}t^m(\gamma)}{\mathrm{d}y_r} = \frac{1 - \theta}{2\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial t}} > 0,$$
$$(v) \quad \frac{\mathrm{d}t^m(\gamma)}{\mathrm{d}y_p} = -\frac{\theta - 1 - \theta_{pd} a^*_{pd}(1 + \varepsilon_{a_{pd},t}) + \theta_{pd} y_p \frac{1-2t}{v'' - u''}}{2\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial t}} \lesseqgtr 0,$$

where expression (iv) made use of equation (8). We see that the first three terms combined are unambiguously negative, while the last may be non-positive (for $t \geq 0.5$) or positive (for $t < 0.5$). Obviously, a sufficient condition for the total effect to be negative is $t \geq 0.5$.

Proof of Lemma 4. With the implicit function theorem, the qualitative statements of the lemma can easily be quantified. We have

$$(i) \quad \frac{\mathrm{d}\gamma^m(\gamma)}{\mathrm{d}\pi} = \frac{t\theta y_p \frac{\partial a^*_{pd}}{\partial \gamma} + p}{u''(1 + \frac{\partial a^*_{pd}}{\partial \gamma})} < 0, \quad (ii) \quad \frac{\mathrm{d}\gamma^m(\gamma)}{\mathrm{d}\theta} = \frac{t\pi y_p \frac{\partial a^*_{pd}}{\partial \gamma}}{u''(1 + \frac{\partial a^*_{pd}}{\partial \gamma})} > 0,$$

$$(iii) \quad \frac{\mathrm{d}\gamma^m(\gamma)}{\mathrm{d}y_r} = \frac{\pi}{u''(1 + \frac{\partial a^*_{pd}}{\partial \gamma})} < 0, \quad (v) \quad \frac{\mathrm{d}\gamma^m(\gamma)}{\mathrm{d}y_p} = -\frac{-t\theta_{pd} \frac{\partial a^*_{pd}}{\partial \gamma} + u'' \frac{\partial a^*_{pd}}{\partial y_p}}{u''(1 + \frac{\partial a^*_{pd}}{\partial \gamma})} > 0.$$

Proof of Proposition 1. To show that an equilibrium exists we have to carefully analyze the characterization of the two reaction functions as defined in equations (26) and (28). We proceed in three steps drawing on a graphical representation of the reaction functions (see Figure 6 below). (i) We investigate the most preferred income tax rate by the median voter $t^m(\gamma)$ followed by (ii) an analysis of the most preferred level of public care by the median voter $\gamma^m(t)$. (iii) Continuity then gives the desired existence result.

(i) $t^m(\gamma)$. We note that the slope of the reaction function for interior solutions and $t \in (0,1)$ is given by equation (21), that is, $\frac{\mathrm{d}t^m(\gamma)}{\mathrm{d}\gamma} = -\frac{u''}{2y_p}$, while equation (12) shows that the slope of the locus $\widetilde{t}(\gamma)$ is twice as steep, namely, $\frac{\mathrm{d}\widetilde{t}(\gamma)}{\mathrm{d}\gamma} = -\frac{u''}{y_p}$. As a result the two schedules may or may not intersect. The latter case is depicted in Panel (a) of Figure 6. The first order condition for t, given by equation (21), holds with equality featuring $\mu^t_{pn} = \lambda^t_{pn} = 0$. Whenever one of the two multipliers assumes a value strictly greater than zero, the most preferred tax rate does not change with changes in γ implying horizontal segments. Panel (b) shows the case where the two schedules intersect. Rewriting the first order condition (21) for the interior part, we find

$$-y_p + \bar{y} - \theta_{pd} a^*_p y_p (1 + \varepsilon_{a_p,t}) = -y_p + \bar{y} - \theta_{pd} a^*_p y_p - t\theta_{pd} \frac{\partial a^*_p}{\partial t} y_p = 0.$$

At the point of intersection of the schedules $(\widehat{\gamma}, \widehat{t}\,)$, by definition, we have $a^*_{pd} = 0$. For all tax rate - public care combinations in the shaded area labeled A (excluding the schedule

$\widetilde{t}(\gamma)$) we additionally get $\frac{\partial a_p^*}{\partial t} = 0$, so that the above equation reduces to $-y_p + \bar{y} > 0$. Thus, there is an incentive to demand a higher tax rate t. Incentives change when the tax rate exceeds $\widetilde{t}(\gamma)$. In area B (excluding the schedule $\widetilde{t}(\gamma)$) informal carers are active and the last two terms of the first order condition from above do not vanish. But this implies a reaction function's slope of $-\frac{u''}{2y_p}$. This reaction function would lie strictly above the one depicted for $\widehat{t}$ violating concavity of the indirect utility function. Note that the slope of the reaction function in the interior of the unit square, $-\frac{u''}{2y_p}$, is constant for $a_{pd}^* > 0$. To summarize, there is an incentive to increase t up to $\widetilde{t}(\gamma)$ but not beyond it so that the reaction function coincides with $\widetilde{t}(\gamma)$ for all $t \geq \widehat{t}$.

(ii) $\gamma^m(t)$. To ease presentation let us define $\widetilde{\gamma}(t) \equiv \widetilde{t}^{-1}(t)$. From equation (29) we know that the reaction function is downward sloping. This equation, however, only applies to interior solutions where, following equation (23),

$$-t\theta_{pd}y_p\frac{\partial a_{pd}^*}{\partial \gamma} - \pi p + u'(a_{pd}^* + \gamma) = 0$$

holds with both multipliers zero. Panel (c) shows the respective graph. Once the reaction function hits the schedule $\widetilde{\gamma}(t)$, at point (γ', t') in Panel (d) we get $a_{pd}^* = 0$ and $\frac{\partial a_{pd}^*}{\partial \gamma} = 0$ so the first term vanishes and the first order condition becomes

$$\pi p = u'(\gamma).$$

Since $\frac{\partial a_{pd}^*}{\partial \gamma} < 0$ there needs to be a discrete jump in γ^m in order to obey the first order condition unless $\lim\limits_{\gamma \to \widetilde{\gamma}(t)} \frac{\partial a_{pd}^*}{\partial \gamma} = 0$. As $u'' < 0$ the condition $\pi p = u'(\gamma)$ implies a strictly smaller γ than γ' and the corresponding public care level is denoted $\gamma'' = u'^{-1}(\pi p)$. We thus know that the reaction function is described by (23) with $\mu_{pd}^{\gamma} = \lambda_{pd}^{\gamma} = 0$ for $t > t'$ and by γ'' for $t < t''$. Should the interval $[t'', t']$ be a singleton – which is the case if $\lim\limits_{\gamma \to \widetilde{\gamma}(t)} \frac{\partial a_{pd}^*}{\partial \gamma} = 0$ – then we have fully described the reaction function. For $t'' < t'$, however, we need to determine the most preferred public care level for all $t \in [t'', t']$.

In what follows we show for all $t \in [t'', t']$ that $\gamma^m(t) = \widetilde{\gamma}(t)$. We do this in two steps. For some $t \in [t'', t']$ we first show that it is optimal to reduce γ whenever $\gamma > \widetilde{\gamma}(t)$. We then show that a value $\gamma < \widetilde{\gamma}(t)$ would violate concavity of the utility function. Consider $\gamma > \widetilde{\gamma}(t) \geq \gamma''$, i.e. all tax rate - public long-term care combinations in the shaded area A. We are in a corner solution with $a^*_{pd} = 0$ so that the most preferred public care level is characterized by $-\pi p + u' = 0$. We know that this equation holds at γ''. Due to $u'' < 0$ and $\gamma > \gamma''$ we have $-\pi p + u'(\gamma) < 0$ so that it pays off to implement a lower public care level. Now suppose $\gamma < \widetilde{\gamma}(t)$, i.e. all tax rate - long-term care combinations in the shaded area B. We would then be in the parameter range where $a^*_{pd} > 0$ so that the condition $u'(a^*_{pd} + \gamma) - t\theta_{pd} y_p \frac{\partial a^*_p}{\partial \gamma} = \pi p$ needs to be satisfied. As the left hand side of this equation is strictly decreasing in t and the right hand side is constant, there is a unique tax rate that satisfies this equation. But we already know from above that this is the case at a value of t larger than t'. Again, note that the slope of the reaction function is constant in the interior of the unit square provided that informal carers are active.

(iii) As is evident from (i) and (ii) above the reaction functions are continuous so that the two curves necessarily intersect. While for $a^{eq} = 0$ multiple equilibria may occur, the structure induced equilibrium is unique if $a^{eq} > 0$.

A.2 Comparative Statics

t^{eq} and γ^{eq} are implicitly determined trough equations (26) and (28)

$$
\begin{aligned}
-y_p + \bar{y} - \theta_{pd} y_p a^*_{pd} - t\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial t} &= 0 \qquad (30) \\
-t\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial \gamma} - \pi p + u'_{pd} &= 0 \qquad (31)
\end{aligned}
$$

Total differentiation of the above equations yields

$$
\begin{aligned}
-2\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial t} \mathrm{d}t - \theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial \gamma} \mathrm{d}\gamma &= \Delta^t \\
\left[-\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial \gamma} + u'' \frac{\partial a^*_{pd}}{\partial t} \right] \mathrm{d}t + u'' \left[1 + \frac{\partial a^*_{pd}}{\partial \gamma} \right] \mathrm{d}\gamma &= \Delta^\gamma
\end{aligned}
$$

$$\text{with} \quad \begin{aligned} \Delta^t &= \theta a^*_{pd} y_p (1+\varepsilon_{a_{pd},t}) \mathrm{d}\pi + (y_r - y_p + \pi y_p a^*_{pd}(1+\varepsilon_{a_{pd},t}))\mathrm{d}\theta - (1-\theta)\mathrm{d}y_r \\ \Delta^\gamma &= \pi \mathrm{d}p + \left[t\theta y_p \frac{\partial a^*_{pd}}{\partial \gamma} + p\right] \mathrm{d}\pi + t\pi y_p \frac{\partial a^*_{pd}}{\partial \gamma}\mathrm{d}\theta \end{aligned}$$

The above equations can be rewritten as the following linear system

$$\begin{bmatrix} -2\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial t} & -\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial \gamma} \\ -\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial \gamma} + u'' \frac{\partial a^*_{pd}}{\partial t} & u''\left[1 + \frac{\partial a^*_{pd}}{\partial \gamma}\right] \end{bmatrix} \begin{bmatrix} \mathrm{d}t \\ \mathrm{d}\gamma \end{bmatrix} = \begin{bmatrix} \Delta^t \\ \Delta^\gamma \end{bmatrix}.$$

The determinant of the Hessian is given by

$$|\mathcal{H}| = -2\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial t} u'' \left[1 + \frac{\partial a^*_{pd}}{\partial \gamma}\right] + \theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial \gamma} \left[(\theta_{pd} - 1)\frac{y_p u''}{u'' - v''}\right] > 0.$$

Changes in π. Using Cramer's rule, we get with respect to changes in the price for long-term care p

$$\begin{aligned} \frac{\mathrm{d}t^{eq}}{\mathrm{d}\pi} &= \frac{\begin{vmatrix} \theta a^*_{pd} y_p (1+\varepsilon_{a_{pd},t}) & -\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial \gamma} \\ t\theta y_p \frac{\partial a^*_{pd}}{\partial \gamma} + p & u''\left[1 + \frac{\partial a^*_{pd}}{\partial \gamma}\right] \end{vmatrix}}{|\mathcal{H}|} \\ &= \frac{u''\left[1 + \frac{\partial a^*_{pd}}{\partial \gamma}\right] \theta a^*_{pd} y_p (1+\varepsilon_{a_{pd},t}) + \theta y_p \frac{\partial a^*_{pd}}{\partial \gamma} u'_{pd}}{|\mathcal{H}|} < 0 \end{aligned}$$

as $t\theta y_p \frac{\partial a^*_{pd}}{\partial \gamma} + p = \frac{u'_{pd}}{\pi}$ by equation (31).

$$\begin{aligned} \frac{\mathrm{d}\gamma^{eq}}{\mathrm{d}\pi} &= \frac{\begin{vmatrix} -2\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial t} & \theta a^*_{pd} y_p (1+\varepsilon_{a_{pd},t}) \\ -\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial \gamma} + u'' \frac{\partial a^*_{pd}}{\partial t} & t\theta y_p \frac{\partial a^*_{pd}}{\partial \gamma} + p \end{vmatrix}}{|\mathcal{H}|} \\ &= \frac{-2u'_p \theta y_p \frac{\partial a^*_{pd}}{\partial t} - (1-\theta_{pd}) \frac{\partial a^*_{pd}}{\partial \gamma} y_p \theta a^*_{pd} y_p (1+\varepsilon_{a_{pd},t})}{|\mathcal{H}|} \end{aligned}$$

The above expression is positive if

$$2 < \frac{u''}{u'_{pd}}(\theta_{pd} - 1) a^*_{pd} (1 + \varepsilon_{a_{pd},t}).$$

Changes in θ.

$$\frac{\mathrm{d}t^{eq}}{\mathrm{d}\theta} = \frac{\begin{vmatrix} y_r - y_p + \pi y_p a^*_{pd}(1+\varepsilon_{a_{pd},t}) & -\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial \gamma} \\ t\pi y_p \frac{\partial a^*_{pd}}{\partial \gamma} & u'' \left[1 + \frac{\partial a^*_{pd}}{\partial \gamma}\right] \end{vmatrix}}{|\mathcal{H}|}$$

$$= \frac{\frac{y_r - y_p}{\theta} u'' \left(1 + \frac{\partial a^*_{pd}}{\partial \gamma}\right) + t\pi\theta_{pd} y_p^2 \left(\frac{\partial a^*_{pd}}{\partial \gamma}\right)^2}{|\mathcal{H}|} \gtrless 0$$

$$\frac{\mathrm{d}\gamma^{eq}}{\mathrm{d}\theta} = \frac{\begin{vmatrix} -2\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial t} & y_r - y_p + \pi y_p a^*_{pd}(1+\varepsilon_{a^*_{pd},t}) \\ -\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial \gamma} + u'' \frac{\partial a^*_{pd}}{\partial t} & t\pi y_p \frac{\partial a^*_{pd}}{\partial \gamma} \end{vmatrix}}{|\mathcal{H}|}$$

$$= \frac{-2\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial t}\left(t\pi y_p \frac{\partial a^*_{pd}}{\partial \gamma}\right) - \frac{y_r - y_p}{\theta} y_p (1-\theta_{pd}) \frac{\partial a^*_{pd}}{\partial \gamma}}{|\mathcal{H}|} > 0.$$

Changes in p.

$$\frac{\mathrm{d}t^{eq}}{\mathrm{d}p} = \frac{\begin{vmatrix} 0 & -\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial \gamma} \\ \pi & u'' \left[1 + \frac{\partial a^*_{pd}}{\partial \gamma}\right] \end{vmatrix}}{|\mathcal{H}|} = \frac{\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial \gamma} \pi}{|\mathcal{H}|} < 0$$

$$\frac{\mathrm{d}\gamma^{eq}}{\mathrm{d}p} = \frac{\begin{vmatrix} -2\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial t} & 0 \\ -\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial \gamma} + u'' \frac{\partial a^*_{pd}}{\partial t} & \pi \end{vmatrix}}{|\mathcal{H}|} = \frac{-2\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial t} \pi}{|\mathcal{H}|} < 0$$

Changes in y_r.

$$
\begin{aligned}
\frac{\mathrm{d}t^{eq}}{\mathrm{d}y_r} &= \frac{\begin{vmatrix} -(1-\theta) & -\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial \gamma} \\ 0 & u'' \left[1 + \frac{\partial a^*_{pd}}{\partial \gamma}\right] \end{vmatrix}}{|\mathcal{H}|} = \frac{-(1-\theta) u'' \left[1 + \frac{\partial a^*_{pd}}{\partial \gamma}\right]}{|\mathcal{H}|} > 0 \\
\frac{\mathrm{d}\gamma^{eq}}{\mathrm{d}y_r} &= \frac{\begin{vmatrix} -2\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial t} & -(1-\theta) \\ -\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial \gamma} + u'' \frac{\partial a^*_{pd}}{\partial t} & 0 \end{vmatrix}}{|\mathcal{H}|} = \frac{(1-\theta)\left[-\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial \gamma} + u'' \frac{\partial a^*_{pd}}{\partial t}\right]}{|\mathcal{H}|} < 0.
\end{aligned}
$$

Changes in y_p.

$$
\begin{aligned}
\frac{\mathrm{d}t^{eq}}{\mathrm{d}y_p} &= \frac{\begin{vmatrix} \theta - 1 - \theta_{pd} a^*_{pd}(1 + \varepsilon_{a_{pd},t}) + \theta_{pd} y_p \frac{1-2t}{v''-u''} & -\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial \gamma} \\ -t\theta_{pd} \frac{\partial a^*_{pd}}{\partial \gamma} + u'' \frac{\partial a^*_{pd}}{\partial y_p} & u'' \left[1 + \frac{\partial a^*_{pd}}{\partial \gamma}\right] \end{vmatrix}}{|\mathcal{H}|} \\
&= \frac{u'' \left(\left(1 + \frac{\partial a^*_{pd}}{\partial \gamma}\right) \left(\theta - 1 - \theta_{pd} a^*_{pd}(1 + 2\varepsilon_{a_{dp},t})\right) + \theta_{pd} a^*_{pd} \varepsilon_{a_{pd},y_p} \right) - t y_p \left(\theta_{pd} \frac{\partial a^*_{pd}}{\partial \gamma}\right)^2}{|\mathcal{H}|},
\end{aligned}
$$

where $\varepsilon_{a_{pd},y_p} = -\frac{\partial a^*_{pd}}{\partial y_p} \frac{y_p}{a^*_{pd}}$.

$$
\begin{aligned}
\frac{\mathrm{d}\gamma^{eq}}{\mathrm{d}y_p} &= \frac{\begin{vmatrix} -2\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial t} & \theta - 1 - \theta_{pd} a^*_{pd}(1 + \varepsilon_{a_{pd},t}) + \theta_{pd} y_p \frac{1-2t}{v''-u''} \\ -\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial \gamma} + u'' \frac{\partial a^*_{pd}}{\partial t} & -t\theta_{pd} \frac{\partial a^*_{pd}}{\partial \gamma} + u'' \frac{\partial a^*_{pd}}{\partial y_p} \end{vmatrix}}{|\mathcal{H}|} \\
&= \frac{2\theta_{pd} y_p \frac{\partial a^*_{pd}}{\partial t} (1 - t(1-\theta_{pd})) \frac{\partial a^*_p}{\partial \gamma} - \left(\theta - 1 - \theta_{pd} a^*_{pd}(1 + \varepsilon_{a_{pd},t}) + \theta_{pd} y_p \frac{1-2t}{v''-u''}\right) \left((1-\theta_{pd}) y_p \frac{\partial a^*_{pd}}{\partial \gamma}\right)}{|\mathcal{H}|}.
\end{aligned}
$$

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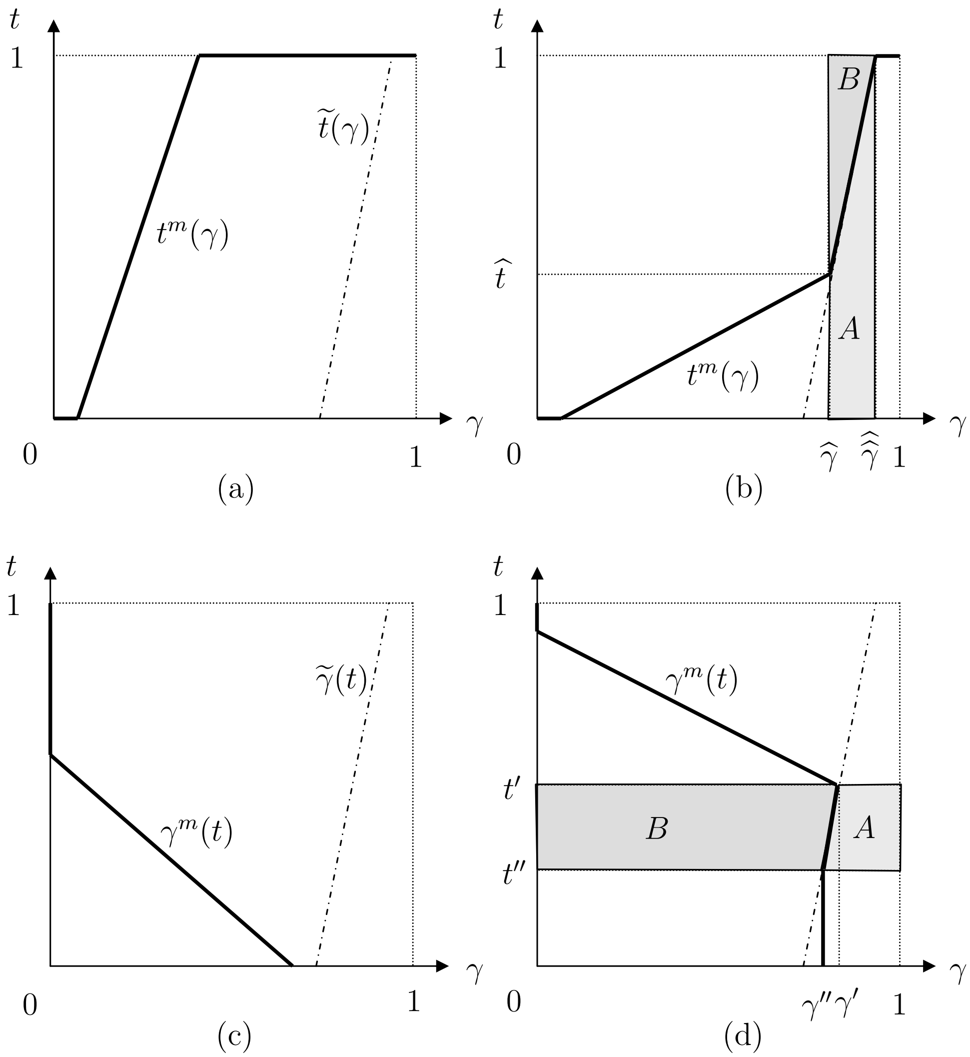

Figure 6: The Reaction Functions $t^m(\gamma)$ and $\gamma^m(t)$ with Active Informal Carers (left) and Active or Inactive Informal Carers.