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Italy's demographic trap: voting for childcare subsidies and fertility outcomes

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Abstract

In this paper we study how population aging impacts the age distribution of the voting electorate and voters' choices over childcare subsidies. We build a computable general equilibrium framework populated by heterogenous agents who, over the course of their life-cycle, make endogenous and age-dependent fertility choices. The model is calibrated to match economic and population outcomes of the Italian economy. Child support favors young and fertile cohorts but can also impact all population subgroups through changes in prices, income taxation and population growth. A probabilistic voting model is used to measure voting outcomes over a range of childcare subsidy levels and tax policies. Our findings show that childcare subsidies have a positive impact on the total fertility rate and are welfare improving when financed with both capital and labor income taxation and in combination with lower pension contribution rates. A 10 percent increase in the level of subsidies can increase the population growth rate by an average of 0.47-0.70 percentage points. We find that voting choices of different population subgroups, while depending on the tax used to finance new expenditure, lead to lower levels of childcare subsidies, lower fertility rates and to a demographic 'trap'.‡

JEL codes: J11, J13, D72

Keywords: Endogenous fertility; childcare subsidies; aging population, voting

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1 Introduction

Italy is one of the fastest aging economies among OECD countries. Five-decades of declining fertility and increasing life expectancy rates have led to significant demographic change and shifts in the age structure of the population.[1] Moreover, fertility trends are expected to worsen due to the Covid-19 pandemic.[2]

The financial pressure that aging places on pay-as-you-go pension systems and other social protection programs as more individuals enter retirement has been documented widely in the economics literature. Family support policies and childcare subsidies are often used as a policy instrument to raise the total fertility rate by reducing the cost of child rearing, as well as increasing female participation in the labor force. Yet despite persistently low fertility rates, public expenditure on childcare subsidies in Italy remains below similar high-income European countries. For example, Italy spends 16 percent less on early childcare than the EU average, while countries of similar economic activity such as Germany and France spend 20 to 53 percent more, respectively. Meanwhile, Denmark, Sweden, Norway, Luxemburg and Iceland spend over twice the EU average (see figure 1).[3]

Aging can influence publicly provided financial support for children and families by changing the age composition of the voting electorate and voting preferences over childcare policies. If older populations provide less support for policies in favor of fertility, it can lead a low-fertility country into a 'trap' of aging and low-fertility.[4] Childcare subsidies are aimed at younger cohorts of the population who benefit from reduced childcare costs. Older cohorts may oppose them since they receive no direct benefits and are faced with a higher degree of income taxation. However, to the extent that childcare subsides impact fertility decisions and lead to population growth, indirect effects coming through changes in prices, taxation and pension outcomes can impact all population subgroups.

Aggregate data across OECD countries reveal a positive correlation between aggregate family benefits as a fraction of GDP and the long run fertility rate (figure 2).[5] Among European countries over the last decade, family benefits are negatively correlated with the share of the

[1] Total fertility rate dropped from an average of 2.6 in 1965 to 1.27 in 2019. There was only a brief improvement between 2004-2014.

[2] See Aassve, Cavalli, Mencarini, Plach, and Sanders (2021).

[3] OECD Family Database, Public spending on early childhood education and care, 2017 or latest data available.

[4] See Lutz, Skirbekk, and Testa (2006) for a discussion on low-fertility traps.

[5] Family benefits refer to child-related cash transfers and allowances, tax exemptions and benefits in kind such as public spending on childcare and early education.

elderly population aged 65 and over (figure 3) and changes in the mean age of women at first birth (figure 4). For Western European countries, these correlations are even stronger. They suggest that, on average, countries with an older population provide less support to families with children which in turn is associated with a higher increase of women's age at first birth and lower fertility rates.

In this study, we aim to investigate one explanation behind these observations that highlights the link between political support for publicly financing childcare programs and the age structure of the voting electorate, and how voting choices over childcare policies are determined in an economy with an aging population. We build a computable general equilibrium overlapping generations model with endogenous and age dependent fertility decisions in which childcare subsidies defray the cost associated with raising children. We assume that parents care about having children and they are viewed as a normal good in the utility function. Data from the Italian economy is used to parametrize the model and replicate closely the aging demographics of the Italian population. The model is used to estimate equilibrium outcomes and the welfare impact of increasing childcare subsidies that are financed by using a mix of taxes on labor and capital income and varying pension contribution rates. Agents of different cohorts vote with commitment on preferred policies while accounting for both direct and indirect general equilibrium effects of policy choices. We estimate a probabilistic voting model that is used to measure voting outcomes over a range of childcare subsidies and tax policies used to finance them.

Our findings indicate that, in the long run, childcare subsidies are welfare improving. They also have a positive impact on total fertility by prompting younger and more fertile cohorts to have more children. We find that a 10 percent increase in the level of childcare subsidies, can increase the population growth rate by an average of 0.47-0.70 percentage points. The size of welfare gains depends on the financing method and type of redistribution that takes place across generations. We find that welfare gains are larger when childcare subsidies are financed by a combination of an increase in labor or capital taxation and a reduction of the pension contribution rate. However, we also find that, regardless of the tax mix used for financing, the majority of the voting electorate does not support childcare subsidies.

Our paper is related to an earlier literature that examines the effects of family and childcare policies on population growth in both partial and general equilibrium models with endogenous fertility (see for example Reijnders (2018), Miyazawa (2016), Fanti and Gori (2012), Hashimoto and Tabata (2010), Day and Dowrick (2010), Apps and Rees (2004)).[6] Findings indicate that aggregate outcomes of increasing child subsidies can vary, but the overall impact on fertility is positive. A subset of these studies (for example Yasuoka and Goto (2011) and Van Groezen, Leers, and Meijdam (2003)) investigates fertility outcomes of childcare transfers in the context of pay-as-you-go pension systems and explores issues around their sustainability and financing.[7]. However, the bulk of this literature consists of theoretical two or three period models that are typically not suitable for quantitative analysis.[8]

Our research contributes to a recent quantitative macroeconomics literature that examines the impact of childcare related programs in heterogenous agent frameworks. One dimension of this literature looks at the labor force outcomes of female workers and shows that costs associated with child-rearing are an important determinant of the labor supply of married women (Attanasio, Low, and Sánchez-Marcos (2008), Hannusch (2018)). Expanding childcare subsidies has positive effects on female labor supply (Bick (2016)), can be welfare improving and an efficient policy (Domeij and Klein (2013), Ho and Pavoni (2020)). Another dimension of this literature explores fertility outcomes and shows that higher childcare subsidies both in the form of transfers and subsidizing childcare can increase fertility, e.g. Fehr and Ujhelyiova (2013). Studies that look at the macroeconomic effects of childcare transfers find positive long run economic growth and welfare gains, particularly when combined with public pension reform (Okamoto (2020), Oguro, Takahata, and Shimasawa (2011)). Guner, Kaygusuz, and Ventura (2020) also examine the macroeconomic outcomes of transfers to households with children in a life-cycle model with a high level of heterogeneity, although they abstain from modelling endogenous fertility. The expansion of existing US child benefit programs is found to have a positive impact on female labor supply and welfare gains for young households.

Our contribution to the literature is twofold. First, we analyze the effects of childcare

[6]A second dimension of this literature also deals with outcomes of labor force participation, particularly of women workers (Domeij and Klein (2013), Fehr and Ujhelyiova (2013), Bick (2016)).

[7]Several other papers (see for example Hirazawa, Kitaura, and Yakita (2010) and Cipriani and Pascucci (2020) also study the impact of population aging on endogenous fertility although there is no explicit examination of childcare subsidies.

[8]In related empirical literature, although identification issues and the lack of variation in child support policies can impede analysis, several studies find childcare subsidies to have a positive impact on average fertility rates. For example, Luci-Greulich and Thévenon (2013) use data from OECD countries and find a positive effect of childcare subsidies on average fertility, with in-cash benefits and childcare services having the strongest influence. Using a panel data from Israel and variation in Israel's child subsidy program, Cohen, Dehejia, and Romanov (2013) find that increases in child subsidies positively influence the probability of becoming pregnant for mothers of two or more children. Milligan (2005), using a quasi-experimental approach, shows that a transfer allowance available to all families with newborn children introduced in Quebec (1988-1997) had a strong effect on fertility outcomes.

subsidies by looking at a life-cycle model that explicitly considers age-dependent fertility choices. This framework allows us to study the fertility consequences of interactions between a mix of childcare subsidies and various income tax policies. Secondly, we use a a probabilistic voting system to estimate political support for child subsidies among voters of different age groups in an economy with aging demographics that match statistics of the Italian population. Age matters because it determines the stage along the life-cycle of an individual and therefore their labor productivity, propensity to save and future planning horizon. An expansion of childcare subsidies can give rise to an intergenerational conflict because of the differential impact of these transfers on voting members of the economy.

The paper is organized as follows. Section 2 provides a description of the model economy, its stationary equilibrium and the political process. It also provides a discussion of parameter values and the model calibration. The results of our policy experiments are discussed in section 3. Section 4 concludes with a discussion of our findings. Section 5 contains an appendix with figures and tables and section 6 outlines the solution algorithm.

2 Model Description

2.1 Demographics

The model economy is populated by heterogeneous individuals who live finite but stochastic lifetimes. Age is indexed by $j = 1, 2, .., J$ and the measure of each age cohort is denoted by μ_j. The conditional probability of survival from age j to age $j+1$ is given by s_j. Life begins with a fertile period that lasts until age j_F, during which individuals make decisions to bear children. Let b denote the age-specific fertility schedule. The population growth rate g depends on the number of children being born to each cohort j and the total number of individuals alive from the previous period as follows:

$$(1+g) = \sum_{j=1}^{j_F} b_j \mu_j + \sum_{j=1}^{J-1} s_j \mu_j$$

The life-cycle is divided into a working period and a retirement period. Retirement is mandatory at age j_R. All accidental bequests, denoted by χ are transferred lump-sum to living members of the economy.

2.2 Preferences

Preferences are defined over a composite consumption good c and number of children b. We adopt the view that children are valued as a normal good in the utility function. This can be thought of as a weak form of altruism, since parents do not consider directly the well-being of their offspring but still care about having children.[9] The expected lifetime utility is given as follows:

$$E_0 \left\{ \sum_{j=1}^{J} \beta^{j-1} \Pi\{s_i\}_{i=1}^{j} u(c_j, b_j) \right\}$$

and the period utility function takes the form:

$$u(c,b) = \lambda \frac{c^{1-\sigma} - 1}{1-\sigma} + (1-\lambda) \frac{\left(\frac{b}{\eta} + \kappa\right)^{1-\nu} - 1}{1-\nu}$$

where σ denotes the coefficient of relative risk aversion, λ stands for the relative weight of children in the utility function, η is an age-dependent scaling parameter and ν determines the curvature of the utility for children. κ allows for the utility function of children to be defined when $b = 0$.[10]

We follow Erosa, Fuster, and Restuccia (2016) and assume that during the fertile years, agents receive in an age dependent fertility opportunity θ that impacts both the choice of having a child and the number of children. The fertility opportunity is stochastic and declines with age in order to capture biological constraints associated with having children. For age groups older than j_F, $\theta_j = 0$. The total number of children an agent can accumulate evolves according to: $n_j = n_{j-1} + b_j$ for $j \leq j_F$.

2.3 Income and savings

Individuals are endowed with one unit of time which can be shared between work and child-care activities. Age specific differences in average productivity are captured by parameter γ, while one effective unit of labor earns the average wage rate w. There are two explicit costs associated with raising children. First, child rearing reduces work time by a fixed amount $0 \leq q \leq 1$ per child. Second, child related care takes up a fraction δ of consumption expenditure. We assume

[9] See Zhang and Zhang (2005) and Van Groezen et al. (2003) for a discussion.

[10] $\kappa = 10^{-4}$.

that both these costs occur within the time period in which children are born.[11]

Households can smooth consumption over time and finance retirement via private savings which earn the average rate of return r. In addition to savings, retirement income consists of pensions p that are generated via a pay-as-you-go pension system. A contribution rate τ_S is levied on working income and all earnings are distributed lump-sum to currently living retirees.

2.4 Taxation and subsidies

To defray the costs of childcare, public subsidies s_y are allocated proportionally to the number of children born in each period. The government levies proportional taxes τ_L on labor income, τ_K on capital income and τ_C on consumption to finance public subsidies and other government programs denoted by G.[12]. The government budget constraint, depicted in section 2.7, remains balanced in each period.

2.5 Production

Firms operate in a competitive market and produce output via a constant returns to scale technology $Y = AF(K, L)$, where Y, K, and L denote aggregate output, capital and labor input, respectively. A denotes total factor productivity. Capital depreciates at a constant rate $d \in (0, 1)$. Labor and capital are rented out from individuals in competitive markets and their return equals marginal products: $r = F_K - d$ and $w = F_L$. We assume that production takes the Cobb-Douglass form: $Y = AK^{\alpha}L^{1-\alpha}$, where α denotes the capital income share.

2.6 Individual problem

Individual state at the beginning of each period is described by the triplet $\{j, a, n\}$. Given childcare subsidies s_y, tax policies and the individual state at the beginning of each period, agents decide on the optimal level of consumption, savings and number of children. Following these decisions, agents consider policy alternatives and vote on preferred future policies designed to increase the level of childcare subsidies.

[11]This is done for computational simplicity and since one model period captures the first 5 years of a child's life.

[12]The government also finances a welfare program that provides a minimum level of consumption for all members of the model. For simplicity, we omit this program from the exposition of the government budget constraint.

The value function of an individual during fertile years takes the form:

$$v\left(j, a_j, n_{j-1}\right) = \theta_j \max\left\{v_{(b>0)}, v_{(b=0)}\right\} + \left(1-\theta_j\right) v_{(b=0)} \tag{1}$$

where:

$$v = \max_{c_j, b_j, a_{j+1}} \left\{u\left(c_j, b_j\right) + \beta s_j v\left(j+1, a_{j+1}, n_j\right)\right\} \tag{2}$$

The value function over the remainder of the life-cycle if given by:

$$v\left(j, a_j\right) = \max_{c_j, a_{j+1}} \left\{u\left(c_j\right) + \beta s_j v\left(j+1, a_{j+1}\right)\right\} \tag{3}$$

subject to the sequential budget constraints:

$$\left(1+\tau_C\right) c_j + a_{j+1} = \omega_j + \left(1 + \left(1-\tau_K\right) r\right) a_j + s_y \mathbb{1}_{(b>0)} b_j - \delta \mathbb{1}_{(b>0)} b_j c_j \tag{4}$$

where $\mathbb{1}$ is the indicator function and ω_j is given by:.

$$\omega_j = \begin{cases} \left(1-\tau_S\right)\left(1-\tau_L\right)\left(1-b_j q\right)\gamma_j w + \chi & \text{if } 1 \leq j \leq j_F \\ \left(1-\tau_S\right)\left(1-\tau_L\right)\gamma_j w + \chi & \text{if } j_F + 1 \leq j \leq j_R - 1 \\ p + \chi & \text{if } j_R \leq j \leq J \end{cases} \tag{5}$$

2.7 Competitive equilibrium

We first define the competitive equilibrium when policies are exogenous. For a given set of time-invariant productivity parameters $\{\gamma_j\}_{j=1}^{j_R-1}$, demographic parameters $\{s_j\}_{j=1}^{J}$, $\{\theta_j\}_{j=1}^{j_F}$, child-rearing cost parameters $\{q, \delta\}$ and government policy variables $\{s_y, \tau_L, \tau_K, \tau_C, \tau_S, G\}$, a competitive equilibrium consists of a set of age-specific value functions $v_j(x)$, decision rules $b = b(x)$, $c = c(x)$, $a' = a(x)$, factor prices $\{r, w\}$, accidental bequest transfers χ, and the measure of agents' over the state space $\phi(x)$, such that:

1. Individuals and firms solve their optimization problem and factor prices equal marginal products.

2. Transfers from accidental bequests are given as:

$$\chi = \sum_x \left[a(x)\left(1 - s_{j-1}\right)\right]\phi(x)$$

3. Labor and capital markets clear:

$$K = \sum_x \left[a(x) + \chi\right]\phi(x)$$

$$L = q\sum_x \left[b(x)\gamma_j\right]\phi(x)$$

4. The government budget constraint is balanced:

$$\sum_x \left[\tau_C c(x) + \tau_K r a(x)\right]\phi(x) + \tau_L(1-\tau_S)w\sum_x \left(1 - qb(x)\right)\gamma_j\phi(x) = G + s_y\sum_x b(x)\phi(x)$$

5. The pension system is balanced:

$$p\sum_{j=j_R}^{J}\mu_j = \tau_S y_S$$

where average income y_S is given by:

$$y_S = \left(1-\tau_L\right)w\sum_x \left(1 - qb(x)\right]\gamma_j\phi(x)$$

6. The aggregate resource constraint is balanced:

$$\sum_x c(x)\phi(x) + K' + G = Y + (1-d)K$$

7. The distribution of individuals across states is stationary.

$$\phi' = \phi(x)$$

2.8 Voting with commitment

Agents vote on alternative policy vectors $\zeta = [s_y, \tau_L, \tau_K]$ to choose their preferred future plan ζ'. We assume that voting choices will replace the current policy once-and-for-all, that is, the government can commit to a policy choice ζ' that remains constant for all future periods.

While commitment is a strong assumption, we follow this approach because we want to keep fixed the age distribution of voters in the steady state. Since our model has endogenous fertility, a different set of policies impacts the age structure of the population through changes in the total fertility rate. Our objective is to highlight the likelihood that an older population shows support for various childcare policies, and thus want to keep our voting measures constant.

Preferences are based on evaluating the expected utility U_i for each voter aged-i associated with policy ζ. We assume that agents have perfect foresight and take into account the consequences of alternative policies on transitional outcomes. We restrict our policy space along two dimensions. First, the minimum level of subsidies $\underline{s_y}$ is chosen to match the subsidy ratio to GDP observed in the data, and second, the minimum level of average labor taxes $\underline{\tau_L}$ is also pinned to the corresponding value in the data. $\underline{\tau_K}$ is the equilibrium capital tax rate associated with these policies. We then consider subsidies that are higher than the minimum level in the policy space and combinations of capital and labor income taxes that keep a balanced government budget. In other words, we look at tax rates that are higher than current levels and consider financing that involves increases either in τ_L, or τ_K, or both τ_L and τ_K, in response to increases in childcare subsidies.[13]

The age composition of the voting population is important for several reasons. First, it determines the state of the individual: the level of assets, work status, productivity and the number of children. Second, it defines how individuals are affected by alternative policies. Young fertile individuals who choose to have children are affected directly since they are eligible to be the recipients of the childcare subsidies. Other voters are affected indirectly through changes in prices, capital taxes, aggregate fertility and pension outcomes. Third, the tax mix can also have a differential impact among groups, for example, younger generations earn income primarily from labor while older generations earn income primarily from pensions and accumulated assets.

To capture electoral competition and deal with the multi-dimensional policy space, our political process is a probabilistic voting model as in Lindbeck and Weibull (1987) (see also Persson and Tabellini (2002), Song, Storesletten, and Zilibotti (2012)) that maps individual voting choices to policy decisions. In a probabilistic voting framework, electoral platforms of two competing politicians converge in equilibrium to policies that maximize a weighted average of each generation's utility. The weights are determined by each group's size in the total population and their relative political influence. We use age dependent voting turnout rates

[13] A more detailed description is provided in appendix 2.

denoted by ρ to capture relative differences in the voting power of each cohort. Therefore, the share of effective voter weights by age are given by: $\tilde{\mu}_i = \rho_i * \mu_i$ where μ_i denotes the age distribution of voters in the steady state.

The politico-economic competitive equilibrium is defined as follows:

1. A set of functions $\tilde{v}_i(x)$, $\tilde{c}_i(x)$, $\tilde{b}_i(x)$, $\tilde{a}_i(x)$, $\tilde{\phi}$, $\tilde{r}$, $\tilde{w}$ that satisfy the definition of a competitive equilibrium, as in subsection 2.7.

2. A political objective function given by:

$$\zeta^* = \arg\max_{\{s_y \in [\underline{s_y}, \bar{s_y}], \tau_L \geq \underline{\tau_L}, \tau_K \geq \underline{\tau_K}\}} \sum_{i=1}^{J} \tilde{\mu}_i U_i(c, n, a)$$

2.9 Parameters and calibration

Table 1 provides a summary of parameters used to solve the model numerically. The benchmark economy is calibrated to match long run moments of the Italian economy and demographics statistics in 2018-2019. Each model period corresponds to 5 years in real time. A typical individual enters the economy at age 20 and can live up to 95 years old. The fertility period lasts until age 40.

Productivity parameters γ_j and survival probabilities s_j are collected from ISTAT (2018), the National Institute of Italian Statistics. The average tax rates on consumption (τ_C) and labor income (τ_L) are obtained from the calculations of McDaniel (2020) for OECD countries (values are for 2019). Production parameters α, d and A are set to match the long run investment and consumption to output ratios, as well as the annual average yields on long term government bonds in Italy since 2014 (a value of 2.12%). The social security contribution rate (τ_S) is set to match the average replacement rate of pension income. The level of childcare benefits s_y is set to match the GDP percent of family benefits. Similarly, we fix the level of government expenditure (G) to produce the observed government spending to GDP ratio in the data. Table 2 summarizes these outcomes.

We set the fraction of consumption allocated to child expenditure δ equal to 0.3 in line with the modified OECD household equivalence scale which evaluates that each child expenditure counts as 30% of the first adult.[14] Values for the age specific fertility shock are approximated from the estimations of Sommer (2016), where the probability of not being able to conceive is estimated at 8% at age 20, 23% by age 30, and 57.5% at age 40 (and 95% at age 45). Since the

[14]See http://www.oecd.org/els/soc/OECD-Note-EquivalenceScales.pdf

model period accounts for 5 years, we set θ_j equal to 0.86, 0.76, 0.65 and 0.52 for age-cohorts 20-24, 25-29, 30-34 and 35-40, respectively. The remaining fertility and preference parameters, $(\beta, \sigma, \lambda, \nu, q, \eta_j)$, are calibrated *simultaneously* to match the wealth profile and demographic targets in the data. Their values are also displayed in table 1. Note that the coefficient of relative risk aversion σ is typically between 1 and 4 in the macroeconomics literature and set to 2.51 in our model.

The steady state of the model is characterized by a constant and positive population growth rate, constant life-expectancy at birth and a time-invariant distribution of age. This means that in equilibrium, the model cannot capture any cohort effects pertaining to total fertility rates. Therefore, we model demographics to the data as closely as we can, focusing on the proportion of the working and retired populations. The relative size differences in age cohorts are important because they will ultimately determine voting outcomes on childcare policies. Figure 5 depicts the age distribution of the population in the model and the data.

Table 3 provides a summary of the model's demographic outcomes. Since the growth rate of the Italian population has been negative since 2015, we aim to achieve a population growth rate close to 0 while maintaining the observed shares of the population in age group 20-64, age group 65 and older and the corresponding old-dependency ratio. Furthermore, the total fertility rate refers to the average number of children born per woman in the data and to the average number of children born to each individual in the model.

Figure 6 depicts the life-cycle wealth profile in the model vis-a-vis the one in the data, in terms of relative wealth compared to age cohort 44-55. Our chosen preference parameters in the model produce outcomes that are very close to those observed in the data. In addition, figure 7 displays the proportion of total births by age group for women between the ages of 18 to 40.[15] The corresponding profile in the model is slightly smoother than the data, but follows a similar pattern.

All these outcomes combined, show that our model is able to replicate key moments in the data. Therefore, we can use it to perform policy experiments and examine the long run impact and voting outcomes of alternative childcare policies.

[15] OECD (2021), Fertility rates (indicator). doi: 10.1787/8272fb01-en (Accessed on 17 August 2021)

3 Results

3.1 Policy experiments

In this section we present individual and aggregate outcomes of the benchmark economy. To assess the long run effects of an increase in childcare subsidies, we examine stationary equilibria under alternative labor and capital tax financing options. Welfare effects are measured by computing the consumption equivalent variation, that is the percentage change of consumption at each age that is required to leave a young agent indifferent between various policies and the reference economy. We then estimate the political support over a range of subsidies and labor/capital tax combinations, conditional on a fixed age-distribution of voters and taking into account the transitional outcomes of each choice.

We compare the steady states of four policy options to finance the rise in public expenditure. The first two policies, labeled policy A and B, examine the impact of raising childcare subsidies in the benchmark model by adjusting capital and labor income tax rates, respectively, to balance the government's budget constraint. Therefore, they represent two borderline cases of the voting experiments, where raising subsidies is financed entirely with increases in either income tax.

In the next two cases we adjust the pension contribution tax τ_S so that the pension income replacement rate is equal to the value in the benchmark economy. We do this to redistribute some of the gains that may accrue to retirees due to a higher population growth rate and the structure of a pay-as-you-go pension system.[16] Therefore, we also examine the policy mix of raising childcare subsidies and reducing the pension contribution rate when increased public expenditure is financed by taxing capital income (policy A1) and by taxing labor income (policy B1).

Finally, our voting experiments focus on estimating policy choices ζ that would result from a one-time increase in the level of childcare subsidies over the range of 0 to 15 percent that is financed by income taxation. The upper limit of this range would bring the level of subsidies in Italy comparable to the EU average. When comparing the steady states of specific policies, we show the results for a 10 percent increase in s_y, which is chosen as an in-between point of the voting outcomes.

[16] See next section for more details.

3.2 Long run effects

Figure 8 displays the age distribution of capital assets and consumption in the benchmark economy. Individual savings increase with age and reach a peak at retirement while consumption is relatively smooth over the life-cycle. Average consumption is lower during fertile years, reflecting higher costs associated with having children. The age profile of average births, as shown in figure 6, follows a hump-shape that reaches a peak for the age cohort 30 to 34.

Table 4 presents the long run results of raising childcare subsidies following the four policy scenarios. We expect a change in the level of subsidies to generate both a direct effect due to its impact on the total fertility rate and indirect general equilibrium effect due to the change in the age structure of the population and response of average prices. Since childcare support is proportional to the number of offspring being born in each period, higher subsidies reduce the relative price of having children and generate a substitution effect in favor of more children. At the same time, there is also a positive income effect due to higher subsidies and a negative income effect due to a decrease in disposable income that results from higher taxation.

Figure 9 depicts the average number of children born to each cohort in the benchmark economy and the economy under policy A, where higher subsidies are financed by increasing capital taxation. Despite any negative income effects induced by higher capital taxes, the new steady state is associated with an increase in the optimal number of children born to all cohorts and a higher total fertility rate. It is also associated with an increase in the average number of children born to younger cohorts relative to older cohorts. This relative change in the distribution of births by age is depicted in figure 10. In other words, one of the direct effects of childcare support is having relatively more children at a younger age since younger cohorts have a higher likelihood of receiving a fertility shock.

Table 4 shows the remaining demographic and aggregate effects of policy A. Due to an increase in the total fertility rate, the long run equilibrium of the model economy with higher subsidies is associated with a higher population growth rate and a lower old-dependency ratio. Following these demographic shifts, the size of the labor force and employment in the new steady state is higher since labor supply is inelastic and labor is fully employed. As mentioned earlier, the economy operates a pay-as-you-go pension system, which translates increases in the growth rate of the population (and the labor force) to a higher internal rate of return to enforced pension contributions. Consequently, a rise in childcare subsidies is also associated with higher pension benefits and a higher pension replacement rate. An increase in expected pension benefits over retirement crowds out individual savings, leading to a new steady state with a lower level of accumulated capital. In addition, private savings are also lower due to an increase in the capital income tax rate. Finally, the new equilibrium is associated with a higher interest rate and lower wages resulting from the respective changes in aggregate capital and labor.

The public pension system in Italy is a notional defined contribution plan (NDC) designed to treat the public pay-as-you-go defined benefit system as a defined contribution system (for a discussion see (Börsch-Supan, 2005)). It is based on notional accounts that record individual contributions and link them to pension benefits over the retirement period. The balance on these accounts is artificial since no capital accumulation takes place. The balance also earns a rate of return that is not generated by market investments but rather is set by the pension system, which in Italy is tied to real GDP growth.[17]

Therefore, similarly to the pay-as-you-go system, pension benefits are drawn out of contributions of current workers. At the macro level, the implicit rate of return to a PAYG system is the same as the "natural" rate of return to a NDC system. As a result, there is little distinction between a defined benefits public plan and a notional defined contribution plan, although the latter may generate stronger incentives that can facilitate pension reform. In terms of our model, the real growth of GDP is determined by the population growth rate. As implied above, an increase in the population growth rate increases the rate of return to the NDC system as well as the internal rate of the PAYG system, thereby increasing pension benefits.

We next look at the equilibrium outcomes of policy B, in which the burden of new expenses is levied on labor income. In terms of qualitative responses, the stationary equilibrium under this policy is similar to the steady state of policy A. Furthermore, a young individual would prefer to be born in the steady state under either policy A or B, as illustrated by the negative measures of the consumption equivalent variation in table 4.

As shown above, a common outcome of these two policies is an increase in pension benefits and the pension replacement rate, which benefits the current retired population. At the same time, while young generations who make fertility decisions benefit from an increase in childcare support, they are also faced with higher rates of income taxation. One way to ameliorate the

[17] OECD Pensions at a Glance (2019): https://www.oecd.org/els/public-pensions/oecd-pensions-at-a-glance-19991363.htm

burden of increased taxation for working households is to reduce the pension contribution tax rate. The impact of reducing the contribution rate in a pay-as-you-go social security system will be offset by an increase in the size of the labor force and the internal rate of return to individual contributions.

Simulation results of increasing childcare subsidies while also reducing the pension contribution rate are depicted in table 4 when the residual tax rate is levied on capital (policy A1) and labor (policy B1). We reduce τ_S from 17.5% to approximately 16%, a reduction that leaves the pension replacement rate *roughly equal* to the steady state value of 65.49%. In both cases, the response of aggregate capital is much smaller than previous policies since lower pension benefits incentivize private savings and capital accumulation. Aggregate capital declines by 0.44% and 0.18% in the long run equilibrium of policy A1 and B1, respectively, compared to a decrease of 1.87% and 2.2% for policies A and B, respectively.

Overall, an increase in childcare support by 10%, increases the population growth rate in our simulations from 0.47 to 0.70 percentage points. The small response in the growth rate is not surprising, since the level of childcare subsidies is low and is a small fraction of overall childcare costs. Furthermore, all policies examined are associated with a small increase of aggregate output, primarily due to higher employment levels. Similarly, the capital-output ratios are lower than in the benchmark model, although negative responses are much smaller for policies A1 and B1.

Finally, table 4 presents the welfare outcomes of each policy in terms of the consumption equivalent variation. We find that childcare subsidies are welfare improving in all the cases that we examined. The highest welfare gains come from policy A1 which lowers the pension contribution tax rate and finances childcare subsidies with relatively higher capital income taxes.

3.3 Voting outcomes

In this section, we examine the outcomes of the probabilistic voting model. Voters are allowed to consider policy candidates ζ from a non-uniform grid consisting of 300 combinations of (s_y, τ_L, τ_K), as outlined in subsection 2.8. To capture the intergenerational conflict among current voters, the government budget constraint is kept balanced, and the burden of taxation is not allowed to be passed on to future generations.

Welfare outcomes of voters in the benchmark economy may differ substantially from the long run equilibrium associated with higher subsidies described in subsection 3.2, since they experience the short run adjustment of aggregate variable, prices and pensions. Furthermore, to model the adjustment of pensions over the transitional period, we consider the structure of the Italian pension system. To account for the fact that pension regulations treat different groups of workers according to the law in place the year they entered the labor market, pensions of voting agents are calculated using the contribution rate τ_S in the benchmark economy. Accordingly, we do not look at voting outcomes for policies A1 and B1, given that they would require changing the contribution tax rate for current voters.

In the voting experiments we look at two additional scenarios. In the first case, we assume that the rate of return to pension contributions of voting agents is tied to the steady state growth rate of the population, (i.e. the growth rate of GDP). Based on this, retired voters receive the same pensions as in the steady state. However, for agents born during the transition, pensions are calculated using demographic parameters of the period in which they are born. In the second case, we assume that the internal rate of return to pension contributions depends on the size of the labor force and varies in each period of the transition for all agents. Under this scenario, pensions of retired voters gradually increase following an increase in the population growth rate.

Voting results reveal that, conditional on the age distribution of the population in the benchmark economy, and the policy space that we consider, the majority of the voting electorate prefers to live in the low subsidy/low population growth rate-economy. To illustrate the differential impact on voting cohorts, in the next subsection 3.4, we display the short run welfare outcomes for each voter over two subsidy choices, a 10% increase labeled "lower subsidies" and a 15% increase labeled "higher subsidies".[18] Both are presented for cases when the tax burden is levied on capital income (Policy A), labor income (Policy B), both capital and labor, and considering the two transitional scenarios. Note that none of these reforms receives sufficient political support, and the steady state policy is an equilibrium outcome.

3.4 Welfare outcomes

The transitional period of both subsidy levels is characterized by a gradual fall of wages and a gradual increase of the interest rate. Figure 11 depicts the percent deviation from the steady state of the average wage and interest rate as well as the adjustment of the population growth

[18]We depict these two subsidy levels because the differential impact on voting members may not be monotonic.

rate.[19]

To simplify our discussion, we focus on three types of voting agents: old/retired, young/fertile and middle-aged voters. Figure 12 shows measures of the consumption equivalent variation for each voting member and two subsidy levels financed by using capital taxes as in policy A.[20] In both scenarios with respect to how pensions are computed during the transitional period, older voting cohorts are worse off compared to their steady state outcomes. The rise in interest rates, which increases earnings from accumulated assets of older cohorts, does not compensate for increases in the capital tax rate. Retired voters are also worse off in the second scenario, when the return to pension contributions is allowed to gradually increase.

As shown in section 3.1, the qualitative responses of aggregate variables and prices are the same under policy B, when labor taxes are used to finance childcare subsidies. The measures of the consumption equivalent variation for voters of policy B are depicted in figures 13. Overall, there is a small and positive impact on the outcomes of older voters, since in both transitional scenarios they experience higher asset returns but are unaffected by declining work incomes. The impact is small because the adjustment of the interest rate is slow and older voters are only alive at the beginning of the transitional period. Furthermore, given our framework, a decline in aggregate capital is associated with lower bequest transfers. As before, when pension returns are pegged to steady state growth parameters, pension income remain the same, while when pension returns are allowed to vary, pensions income increases over the transition.

To summarize, older and retired voters oppose childcare subsidies when financed with capital taxes, however, they are nearly indifferent to financing using a labor tax.

Next, we turn our attention to the outcomes of young generations, who are also impacted from several factors. First, during the fertile period, the young are the main beneficiaries of childcare subsidies. Second, the demographic transition is associated with lower average wages due to an increase in the size of the working population. As a result, pension contributions are smaller, regardless of how subsidies are financed. Third, given that the young are at the saving stage of their life cycle, a higher interest rate encourages more asset accumulation.

The preferences of younger cohorts over the tax mix depend on the magnitude of these opposing effects. On the one hand, since work earnings are the main source of income for young groups, they would prefer policies that tax capital more. On the other hand, since interest rates

[19] The example depicted here is for policy A, when childcare subsidies are financed using capital taxation.

[20] Note that if the consumption equivalent variation is negative, agents are better off during the transition.

increase and wages decline over the transition, younger cohorts, who are characterized by high savings rates, would prefer to tax more heavily labor income.

Future pensions of the young are lower in both transition scenarios. In the first case, when the rate of return to pensions equals to the steady state population growth rate, pensions are lower due to smaller contributions that follow a decline in the average wage. In the second case, the rate of return to pensions varies according to the population growth rate over the transition. In this case, pensions are lower even though the internal rate of return to contributions increases, however, these increases are slow and cannot compensate young voters for the reduction in their work earnings. The latter effect is even more pronounced when labor taxes are used to finance childcare subsidies.

The outcomes for middle-aged and near retirement individuals are in between the experiences of young and retired agents in each scenario. To summarize, apart from young cohorts in their childbearing years, we observe that most of the voting electorate oppose childcare subsidies when they are financed by capital taxation. However, when the burden of taxation is levied on labor income, young and middle-aged cohorts have mixed outcomes, while, as mentioned earlier, outcomes of older cohorts are marginally affected. When returns to pensions of voting members remain constant as in the first scenario, both young and middle-aged oppose child subsidies. However, when returns to pension contributions are allowed to increase, as in the second scenario, middle-aged cohorts are better off than the steady state. They can now enjoy higher pensions both because of higher returns and because the bulk of their contributions were made in the steady state with higher wages. Nonetheless, since the negative impact on younger cohorts is higher, even in this case, childcare subsidies generate insufficient support from current voters.

Finally, figure 14 depicts short run welfare outcomes for the mix policy of increasing both capital and labor taxes. Considering our previous findings, results depicted on this graph are not surprising, and show that higher levels of subsidies are opposed by nearly the entire electorate.

4 Conclusion

In this paper, we have documented a demographic trap that arises from policies that increase childcare subsidies in economies with an aging population. Our investigation is based on a quantitative life-cycle model with endogenous fertility. Data from the Italian economy is used to calibrate the model since Italy is one of the fastest aging economies among OECD countries. The model accounts for age-dependent fertility choices, given that there is an association between an increase in the mean age of women at first birth and lower fertility rates in Italy as well as in several other low-fertility OECD countries. A probabilistic voting model with commitment is used to estimate political support and preferred policy outcomes over a range of subsidies and income taxes.

As a first result, we have shown that an economy with an older population does not support policies that reduce the cost of having children and increase the total fertility rate, regardless of the type of financing and despite the fact that such policies are welfare improving in the long run. The trap mentioned in the title refers to the preference of the majority of the voting electorate to live in the low subsidy/low population growth rate-economy. This is the result of a myopic perspective on policy alternatives driven by belonging to a generation, instead of considering long term effects of budget decisions.

Our framework has some limitations. Due to the dimensionality problem, we cannot take into account other channels that may affect the fertility rate. For example, our model omits heterogeneity with respect to any productivity differences and other characteristics. We also do not consider uncertainly or income risk, which has been shown to delay fertility decisions and reduce the total fertility rate (Sommer (2016)). Nonetheless, the model calls for an increase in childcare subsidies to raise the lowering fertility rate in Italy and other aging economies.

The scarce awareness of the public opinion about this demographic trap motivates our contribution, and its policy implications go in at least two directions. On the one hand, the set of policies we have considered to finance childcare subsidies reflect political issues currently debated in Italy and the study allows us to shed light on the impact of budget measures on different generations. For example, a proposal currently under discussion is increasing taxes on real estate, which would disproportionally affect older generations. On the other hand, besides the long- and short-run effects highlighted trough the model, higher subsidies would have wider effects that are worth mentioning.

First, in Italy -like in other low-fertility European countries- there is evidence that couples would desire two children, while a majority of them stop after the first, most commonly because of the postponement of the first child (Régnier-Loilier, Vignoli, and Dutreuilh (2011)). Second, there are effects of increasing childcare subsidies not considered in our model but that are foreseeable, both in terms of financing the public budget and outcomes of the labor market. As far as the former, a younger population does not affect only public pension expenditures (like in the model) but also decreases expenditures of the public health system. Finally, increasing childcare subsides is a key gender equality policy that may produce a more balanced labor force participation (Profeta (2020)).

5 Appendix 1: Figures and tables

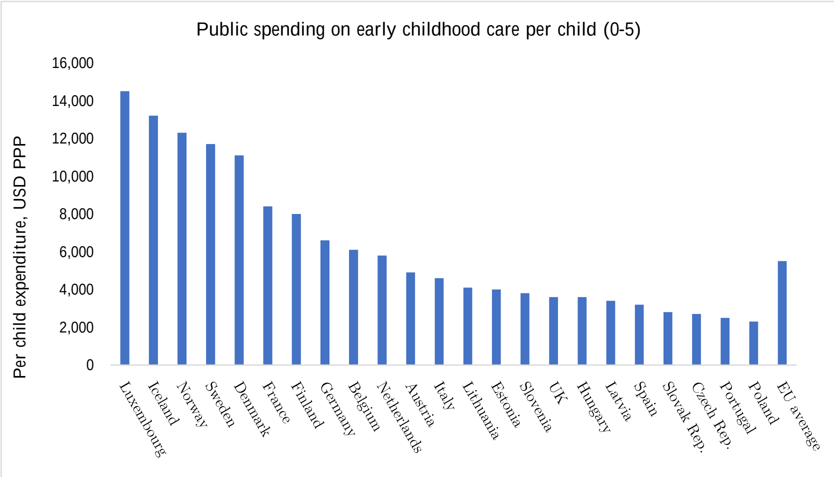


Figure 1: Public expenditure on early childcare per child aged 0-5, in USD PPP, 2017 or latest available

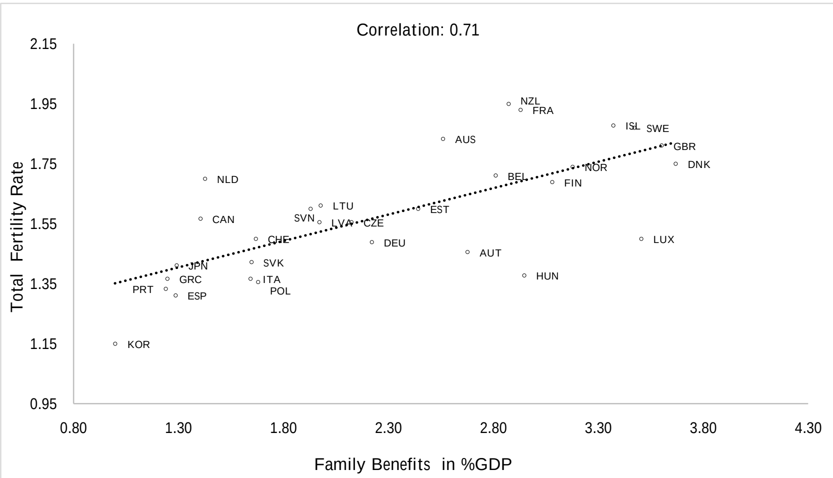
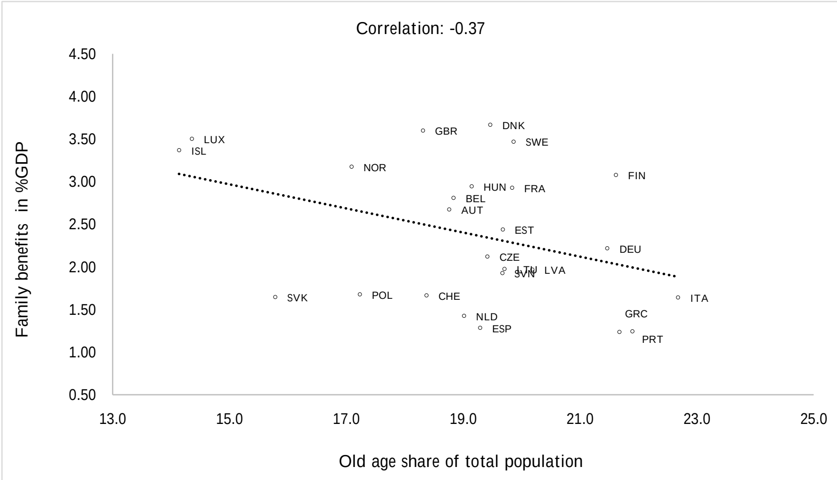


Figure 2: displays the correlation between the average family benefits in per cent GDP and the total fertility rate over the period 2010-2018. Data from OECD countries excluding two outliers: Ireland and the US.



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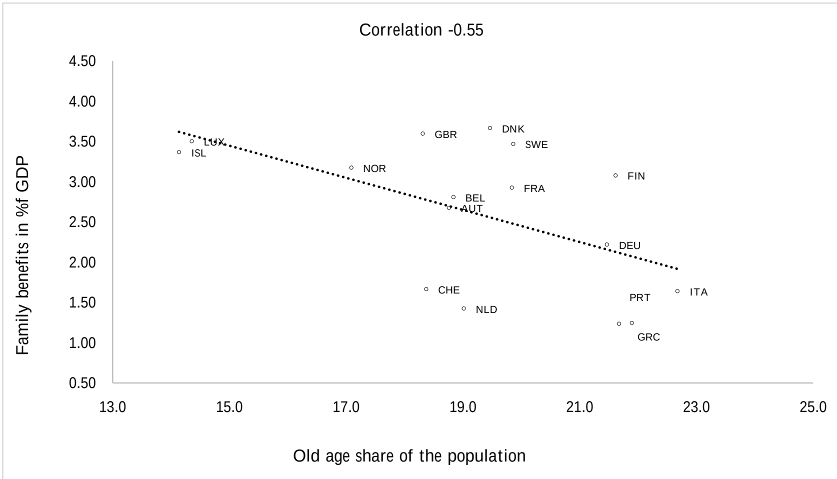
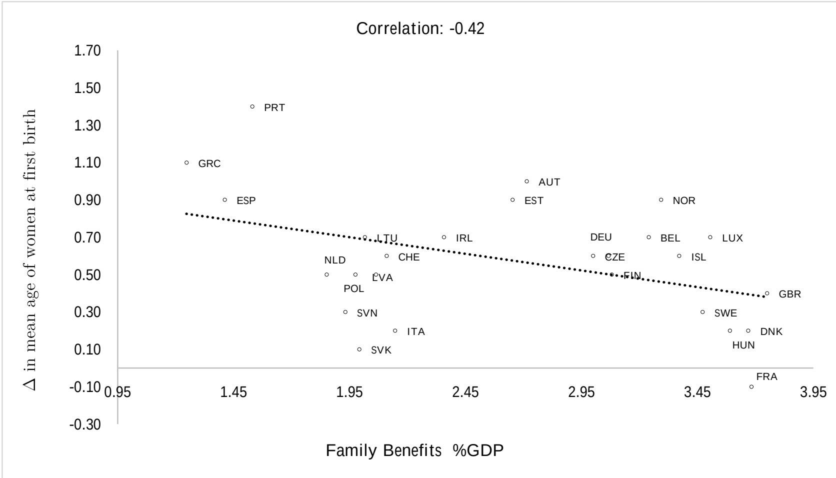


(b)

Figure 3: displays the correlation between the average family benefits in per cent GDP over the period 2010-2018 and the share of the elderly population aged 65 and over. Panel (a) is data from EU countries (excluding Ireland) and panel (b) is data from Western European countries.



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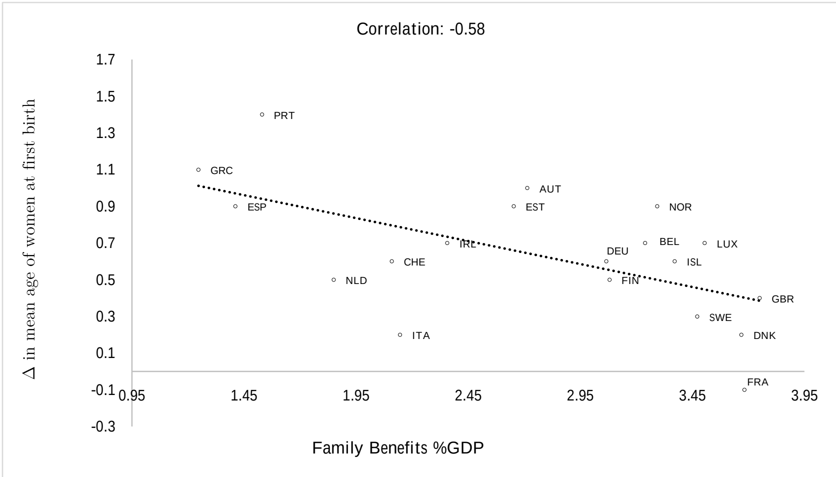


(b)

Figure 4: displays the correlation between the average of family benefits in per cent GDP and the change in the mean age of women at first birth over the period 2010-2018. Panel (a) is data from EU countries (excluding Ireland) and panel (b) is data from Western European countries.

Table 1: Model Parameters

Parameter	Description	Value/Source
Demographics		
J	maximum age	15 (95 years old)
j_R	retirement age	10 (65 years old)
j_F	maximum fertility age	4 (40 years old)
$\{s_j\}_{j=1}^{J}$	conditional surv. prob.	I.stat (2018)
Preferences		
β	subjective discount factor	1.00
σ	CRRA coefficient	2.51
λ	relative weight of children	0.30
ν	children utility curvature	2.51
Fertility parameters		
q	fraction of time spent child rearing	0.23
δ	fraction of cons. spent on children	0.30 (OECD)
$\{\theta_j\}_{j=1}^{j_F}$	age-specific fertility opportunity	$\{0.86, 0.76, 0.65, 0.52\}$
$\{\eta_j\}_{j=1}^{j_F}$	age-specific scaling parameter	$\{0.10, 0.25, 0.36, 0.27\}$
Production		
A	total factor productivity	1.20
α	capital share of output	0.30
d	capital depreciation rate	4.23%
Productivity		
$\{\gamma_j\}_{j=1}^{j_R-1}$	age-specific productivity	I.stat (2018)
Government		
τ_L	average labor income tax	14.05% McDaniel (2020)
τ_C	consumption tax	21.82% McDaniel (2020)
τ_S	pension contribution rate	17.50%
Voting		
$\{\rho_j\}_{j=1}^{J}$	age-specific voting turnout	European Social Surveys (2018)

Table 2: Aggregate outcomes

	Data	Model
Aggregate variables as % of GDP		
Consumption	59.4	59.4
Investment/output	19.5	19.8
Government exp./output	18.9	19.0
Childcare spending	1.50	1.50
Prices		
Annual interest rate	2.12	2.12
Pensions		
Replacement rate	68.6	65.5

Table 3: Demographic outcomes

	Data	Model
Population growth rate	≈ 0	0.27
Total fertility rate	1.27	1.036
Population aged 65+	27.68	27.73
Population aged 20-64	72.32	72.27
Old dependency ratio	38.37	38.37

Note: Total population has been normalized to include only individuals aged 20 to 95, which corresponds to the model specifications. Therefore, the dependency ratio is the size of age group 65+ relative to age group 20-64.

Table 4: Demographics and aggregate outcomes

	Benchmark	Policy			
	economy	A	B	A1	B1
Population variables (%)					
Growth rate	0.27	0.87	0.97	0.74	0.79
Aged 65+	27.73	24.01	23.24	24.74	24.39
Aged 15-64	72.27	75.99	76.76	75.26	75.61
Dependency ratio	38.37	31.59	30.28	32.87	32.26
Aggregate Variables (%growth)					
Capital (K)	-	-1.87	-2.20	-0.44	-0.18
Labor (N)	-	+0.89	+1.06	+0.71	+0.79
Output (Y)	-	+0.05	+0.07	+0.36	+0.49
(K/Y)	-	-1.93	-2.27	-0.80	-0.68
Pensions					
Benefits (%growth)	-	+2.91	+3.40	+0.75	+0.93
Replacement rate (%)	65.49	75.24	76.49	65.40	65.48
Prices					
Interest rate (%annual)	2.12	2.75	2.88	2.38	2.34
Wage rate (%growth)	-	-0.83	-0.98	-0.34	-0.29
Tax rates (%)					
Labor	14.05	14.05	15.55	14.05	15.45
Capital	8.60	10.35	8.60	9.91	8.60
Pension contribution	17.50	17.50	17.50	15.98	15.97
Welfare outcomes					
Consumption equivalent variation (%)	-	-0.549	-0.335	-1.212	-1.052

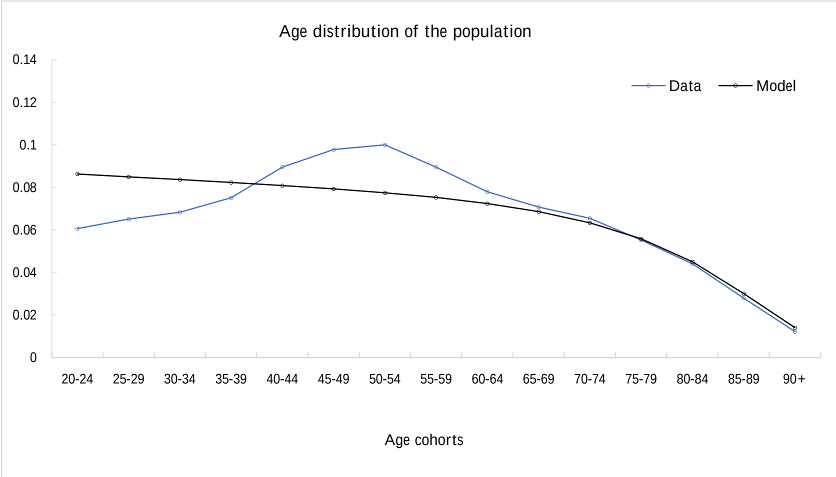


Figure 5

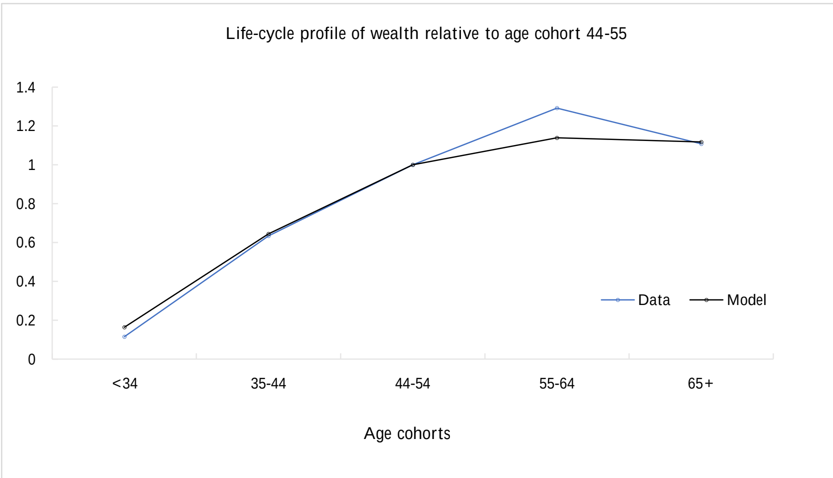


Figure 6

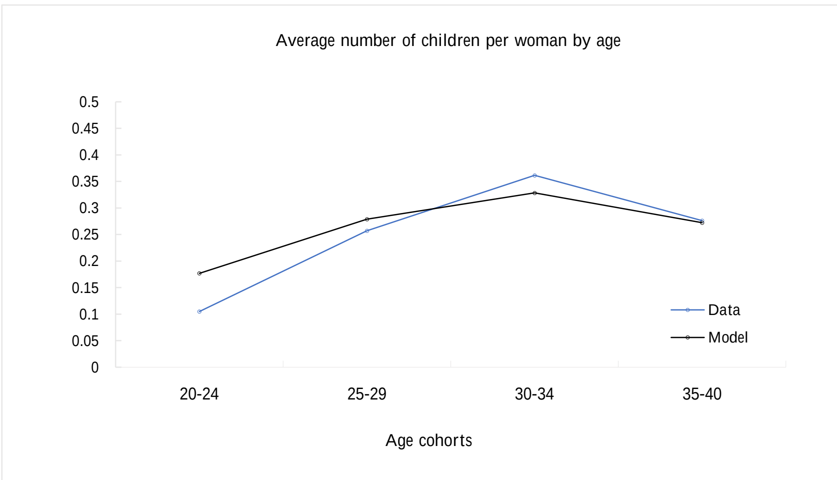


Figure 7

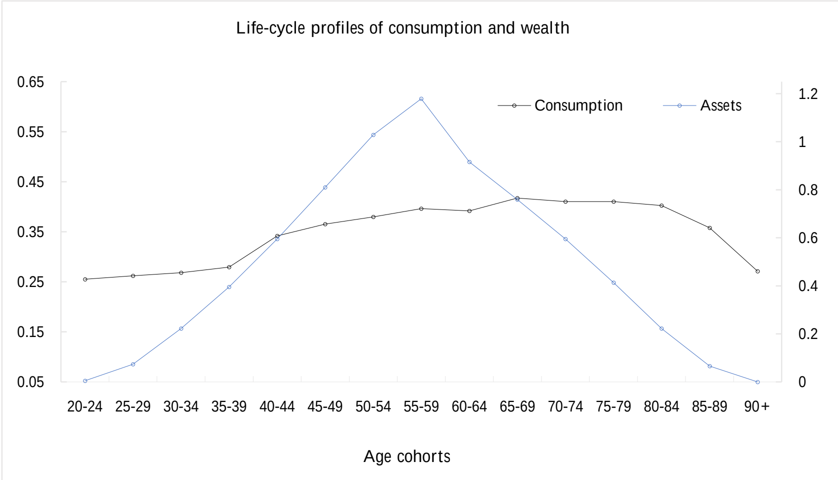


Figure 8

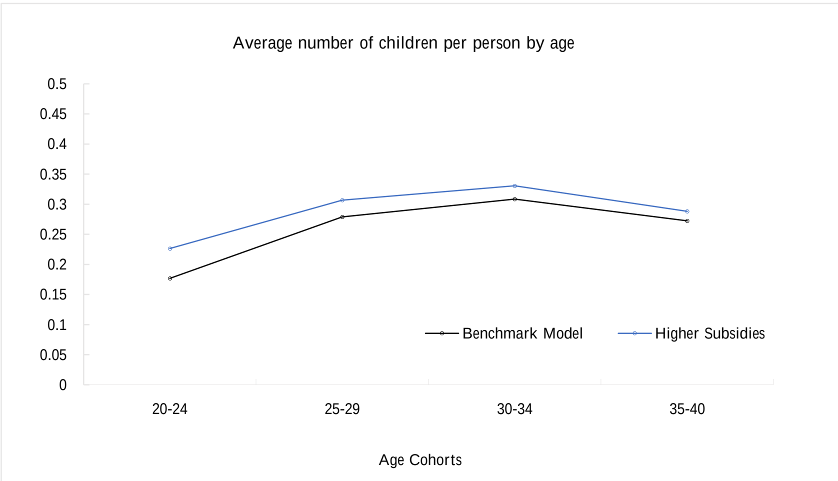


Figure 9

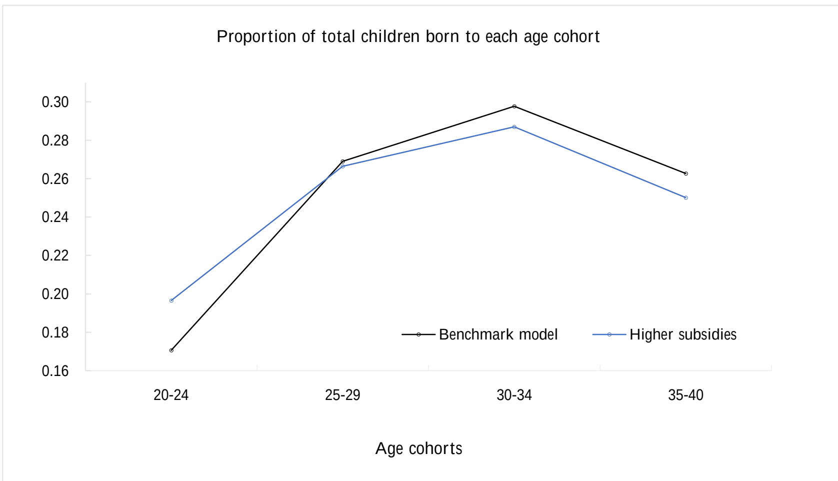
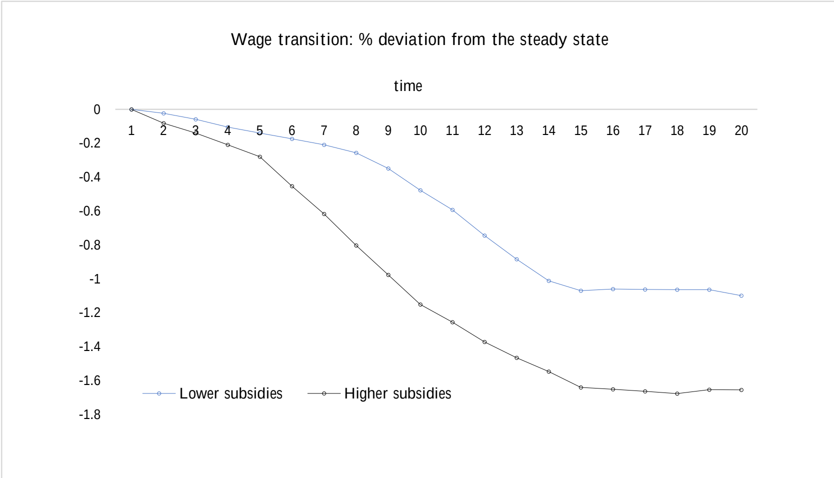


Figure 10



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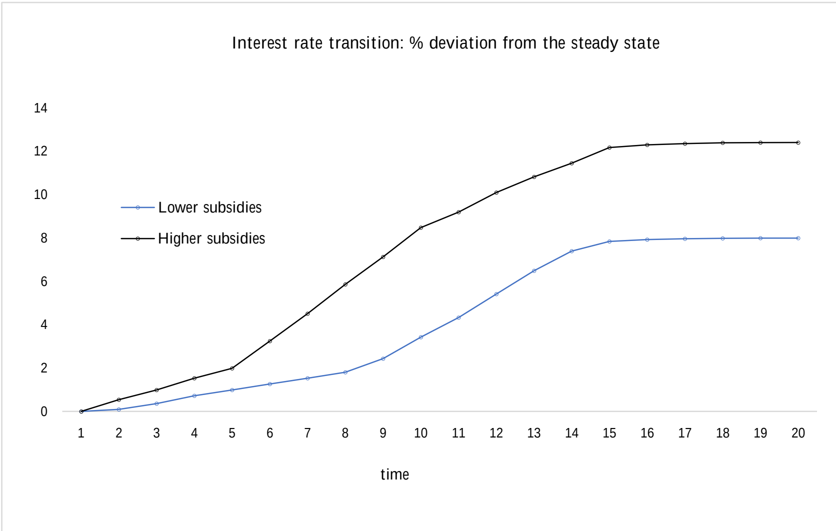

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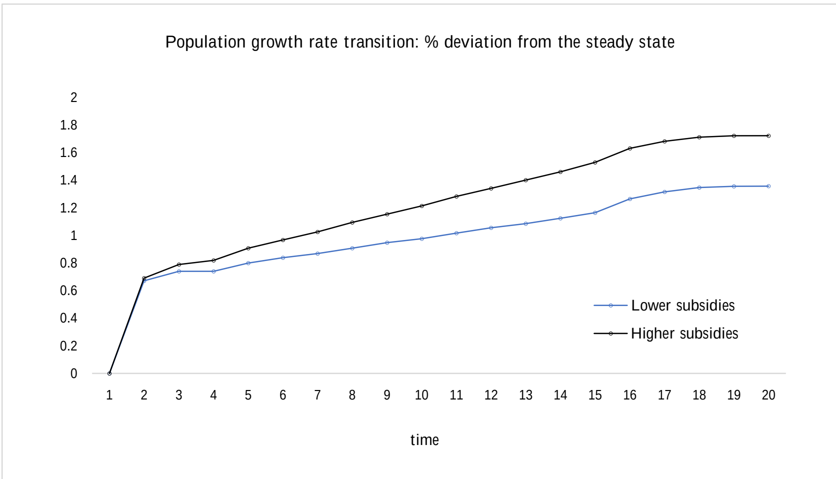
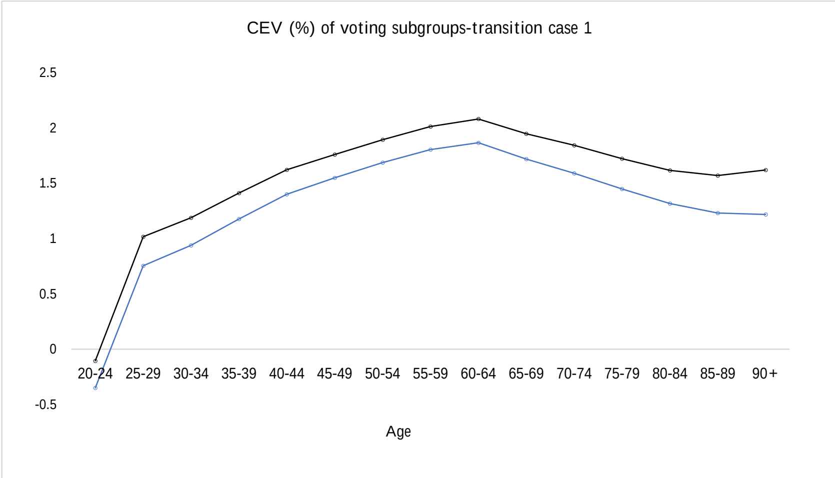


(c)

Figure 11: The transitional path of wages (a), interest rate (b) and the population growth rate (c) when subsidies are finance using capital taxation.

(a)



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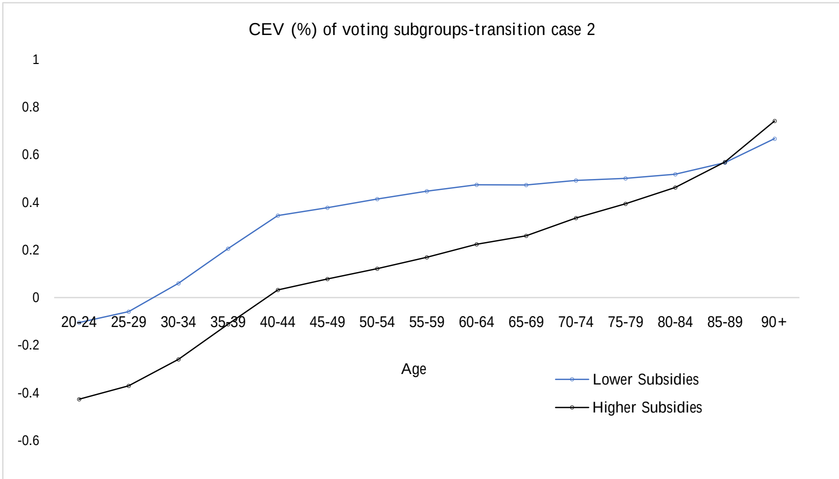


Figure 12: CEV measures in (%), $\Delta\tau_L = 0$, $\Delta\tau_K > 0$. The rate of return to pension contributions is constant in panel (a) and gradually increases in panel (b).

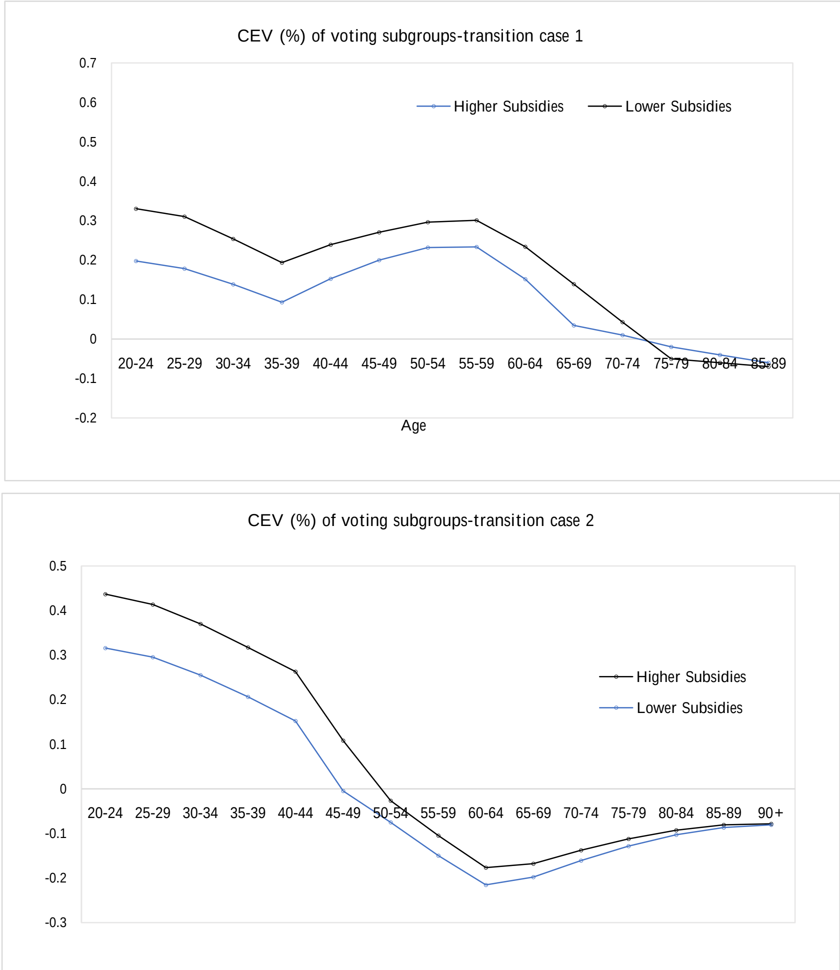
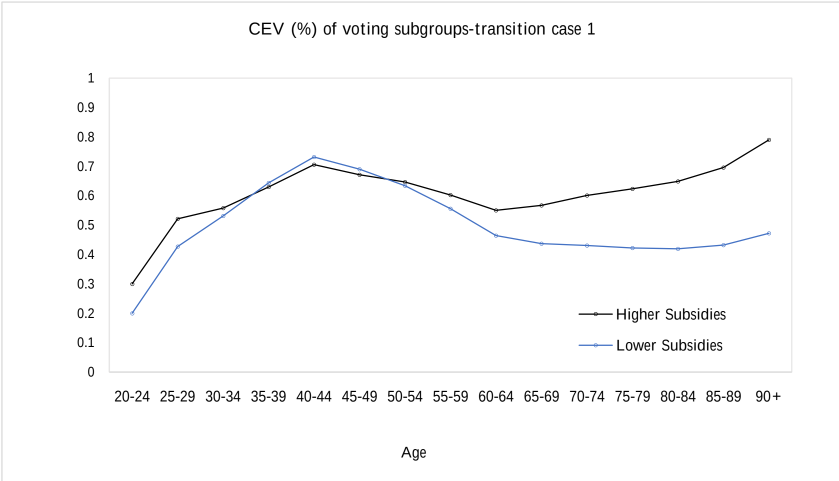
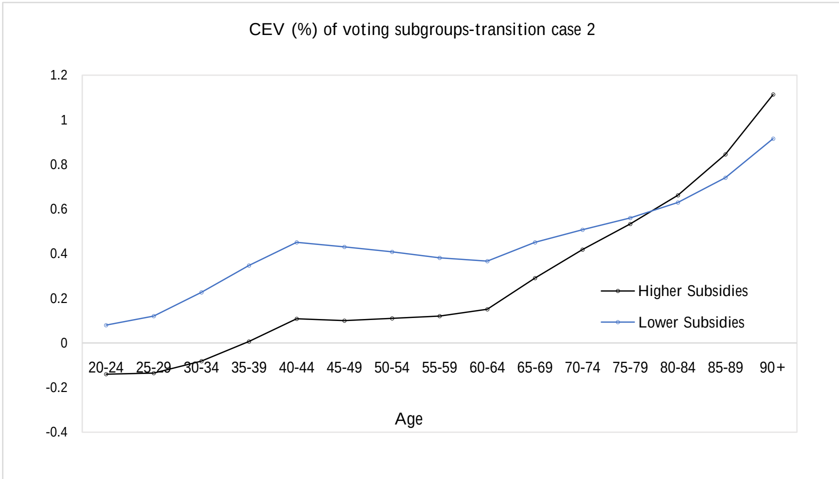


Figure 13: CEV measures in (%), $\Delta\tau_L > 0$, $\Delta\tau_K = 0$. The rate of return to pension contributions is constant in panel (a) and gradually increases in panel (b).



(a)



(b)

Figure 14: CEV measures in (%), $\Delta\tau_L > 0$, $\Delta\tau_K > 0$. The rate of return to pension contributions is constant in panel (a) and gradually increases in panel (b).

6 Appendix 2: Computational algorithm and policy transitions

The model is solved numerically, since there are no analytical solutions. Agents' decision rules are computed backwards, starting from the last period of life, while the stationary distribution of agent types is obtained by iterating on individual policy functions.

The voting process examines the impact of new policies ζ on voter outcomes over the transition period between two steady states, which we assume lasts for $T-1 = 50$ periods. Assuming that period 1 indicates the initial steady state of the economy and period T the final steady state, we take the following steps to compute the transition path:

1. Guess $\{r_t, L_t, \phi_t\}_t^{T-1}$ while assuming that bequest transfers χ follow a slow and linear adjustment. Compute $\{w_t, K_t, p_t\}_t^{T-1}$

2. Compute backwards the policy functions and value functions for all generations.

3. Use policy functions to compute the L, r and ϕ for $t = 2, ..., T-1$ and iterate this way until convergence.

4. Compute voting outcomes and the optimal policy ζ^*. Compute the initial steady state with the new policy values.

The policy space is a non-uniform grid constructed in the following way: We identify the level of subsidies $\underline{s_y}$ required to give an average subsidy to GDP ratio equal to 1.5%, which is the value in the data. We examine 20 subsidies which are higher than $\underline{s_y}$ in the range of 0% to 15%. We also set $\underline{\tau_L}$ equal 14.05% (also the value in the data) and look at up to 20 choices of τ_L in the range of 14.05% to 16.20%.[21] The capital tax is computed as a residual in each case. We only consider policies where: $\Delta s_y \geq 0$, $\Delta \tau_L \geq 0$ and $\Delta \tau_K \geq 0$, and disregard any policies that reduce either of the tax rates. In total, our policy grid consists of about 300 combinations.

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[21] $\tau_L = 0.162$ is the steady state value required to finance a 15% increase in s_y, using only labor income taxation.

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