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How does inflation affect different age groups? ⋆

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A B S T R A C T

We develop an overlapping-generations model with sticky wages and prices to study the socially optimal inflation rate in the long term. While sticky prices and firms' productivity growth would yield a positive optimal inflation rate, we show that sticky wages, in combination with empirically plausible changes in productivity over workers' lives, make moderate deflation optimal. We also study intergenerational conflicts and show that younger voters gain from lower inflation, whereas older voters prefer higher inflation.

1. Introduction

This paper analyzes how trend inflation affects different age groups. Moreover, we revisit the question of which trend inflation rate is optimal and ask how the answer to this question differs across age groups. For this purpose, we study an overlapping-generations model featuring wage and price stickiness, as well as two dimensions of productivity change: firm-level productivity growth and productivity variations over workers' lifetimes.

Under flexible prices and wages, these productivity dynamics would generate complex changes in relative prices. With sticky wages and prices, however, relative prices are distorted in ways that depend non-trivially on trend inflation. We show that while sticky prices alone imply a positive optimal inflation rate of about 2.5 % (as in Adam and Weber, 2019), the addition of sticky wages reverses this result under realistic age-productivity profiles: moderate deflation of roughly $-1.5\,\%$ becomes optimal, as negative inflation helps implement the rising real wages that workers would typically earn under flexible wages. This beneficial effect of deflation is amplified once aggregate productivity growth is included.

The life-cycle dimension of our framework also enables us to study intergenerational conflicts regarding the central bank's inflation target. Young workers experience steep productivity increases over time and thus benefit most from negative inflation rates, which generate increasing real wages even during spells of fixed nominal wages.[1] By contrast, retirees, who rely on capital income to finance consumption, tend to prefer high trend inflation rates as these lead to higher real interest rates.

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[1] Pallotti et al. (2023) provide empirical evidence that inflation affects different age groups differently. Bielecki et al. (2022) develop a new Keynesian model to examine the redistributive effects of monetary-policy shocks. Menna and Tirelli (2017) analyze optimal redistribution via seigniorage when the policy-maker cannot tax monopoly profits. In a two-generation OLG model with flexible prices and wages, Bullard et al. (2012) examine the implications of the Tobin effect on retirees and workers.

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Our model involves quite complex mechanisms regarding the consequences of inflation for aggregate variables and wealth accumulation over the life cycle. A key observation underlying these mechanisms is that positive inflation rates prompt workers to choose high wage markups to avoid facing low real wages in the future. This effect is particularly pronounced for young workers, who prefer real wages that rise strongly over time, in line with their anticipated high gains in individual productivity. This has several implications.

First, high wage markups under high inflation tend to reduce employment among young workers. Second, aggregate productivity rises with inflation due to a composition effect, as older, more productive workers work more than the young. Third, high inflation reduces young workers' labor income, hindering wealth accumulation and lowering the capital stock. Fourth, high inflation triggers large adjustments of nominal wages by young workers whenever they can reset them, leading to comparably large fluctuations in their real labor incomes and hours worked. Fifth, real interest rates tend to increase with inflation, mainly due to the lower levels of capital and the resulting higher marginal products of capital at higher inflation rates.

Our work contributes to the large literature on optimal inflation in the long run (see Schmitt-Grohé and Uribe, 2010; Ascari and Sbordone, 2014; Diercks, 2017, for surveys). A classic argument stresses that higher inflation is associated with higher nominal interest rates and thus larger opportunity costs of holding money (see e.g. Fischer, 1981; Lucas, 1981). As a consequence, the Friedman rule, i.e., permanent deflation that eliminates the opportunity costs of holding money, is optimal. By contrast, zero inflation is typically welfare-maximizing in the standard new Keynesian model in the limiting case where real money balances are zero, as a constant price level alleviates the distortions in relative prices under staggered price setting.

Our paper is also connected to several more recent strands of the literature. First, the consequences of a lower bound on nominal interest rates for the optimal rate of inflation are analyzed by Coibion et al. (2012) and Blanco (2021). While our analysis does not explicitly account for the zero lower bound, a straightforward extension of the model to include nominal bonds would imply equilibrium nominal interest rates that are a few percentage points above zero, even at the optimal inflation rate. Nevertheless, it is plausible that the presence of an effective lower bound, combined with the possibility of large aggregate shocks, would call for somewhat higher optimal inflation targets in our framework. In any case, given the ongoing transition toward cashless economies and the emergence of central bank digital currencies, the effective lower bound may become less constraining for monetary policy in the near future.

Second, our analysis connects to work exploring how trend inflation affects economies with ongoing productivity growth (Amano et al., 2009; Adam and Weber, 2019, 2023; Adam et al., 2022). Adam and Weber (2019) propose a model where goods prices are sticky and individual firms become more productive over time. In this case, a moderate positive rate of inflation is optimal because it allows for relative prices to reflect the relative productivities of different generations of firms even if nominal prices are never adjusted. We extend Adam and Weber's analysis by taking sticky wages and, in addition, productivity changes over workers' life cycles into account.

Our finding about negative optimal rates of inflation is related to an earlier result by Amano et al. (2009) that deflation can be optimal in the presence of sticky wages and aggregate productivity growth. Compared to them, we add a life-cycle dimension, which allows us to identify additional channels that make deflation or inflation desirable.[2] As we will show, these additional channels have quantitatively important consequences for the socially optimal level of inflation.

Third, while new Keynesian business cycle analysis often focuses on sticky goods prices, some authors argue that sticky wages may be even more important for understanding the dynamic effects of shocks (Erceg et al., 2000; Christiano et al., 2005; Amano et al., 2009; Broer et al., 2020; Auclert et al., 2023). By contrast, Basu and House (2016) highlight that the wage measure that is relevant for employment dynamics (e.g. the user cost of labor proposed by Kudlyak, 2014) is remarkably flexible. Gertler et al. (2020) criticize this view and argue that the measures of the user cost of labor employed by Kudlyak (2014) and Basu and House (2016) may be biased and that the true user cost of labor may be less cyclical than found by them. With the help of a micro data set on wages in Sweden, Björklund et al. (2019) show that nominal wage rigidity is important for understanding the real effects of monetary policy. Thus it may be plausible that sticky wages are relevant for the welfare effects of different levels of trend inflation as well.

Fourth, downward nominal wage rigidity (DNWR) is often argued to call for higher inflation rates (see Tobin, 1972, for example). Kim and Ruge-Murcia (2009) analyze a new Keynesian model and indeed find a rather small positive inflation rate of 0.35 % to be optimal. More recently, Abbritti et al. (2021) identify an optimal inflation target exceeding 2 % within a new Keynesian model incorporating DNWR and endogenous growth. To get an upper bound on the effects of DNWR in our framework, we construct a variant of our model in which nominal wage cuts are completely impossible. The combination of deflation and DNWR leads to real wages of individual workers that always increase over time. This has non-negligible consequences for older workers, whose individual labor productivity grows at low or even negative rates. We show that, in line with Riboni and Ruge-Murcia (2010) and Abbritti et al. (2021), DNWR leads to a higher optimal inflation rate. However, the optimal rate is still negative when we take aggregate productivity growth into account.

Our paper is organized as follows. The subsequent section lays out our model and specifies the parameter values for the numerical analysis. Section 3 highlights the effects of different trend inflation rates for markups, aggregate variables, and individual consumption. Moreover, we flesh out the intergenerational conflicts and identify the consequences of the level of steady-state inflation for welfare. Section 4 explores two extensions. In Section 4.1, we examine a variant of our model with downward nominal wage rigidity. Section 4.2 analyzes transition dynamics and discusses our results about politico-economic equilibria, where individuals vote on permanent changes in trend inflation. We present our conclusions in Section 5.

[2] Moreover, they do not consider individual firm productivity growth, which, together with sticky prices, tends to make positive inflation desirable.

2. Model

2.1. Set-up

We consider an overlapping-generations model with sticky prices and wages. The economy is populated by workers, retirees, intermediate-goods producers, perfectly competitive final-goods producers, and a monetary authority. There are T generations of workers, where age is denoted by $\tau = 1, 2, \ldots, T$. After reaching age T, individuals retire. They die with certainty after reaching age $T + TR$, where TR denotes the maximum duration of retirement.

In each period $t = 0, 1, 2, \ldots$, there is a generation of newborns of age $\tau = 1$. This generation is larger than the previous generation of newborns by factor n ($n > 0$). An individual of age $\tau = 1, 2, \ldots, T + TR$ has probability $S(\tau + 1)$ of surviving until the next period. As individuals die with certainty after age $T + TR$, the respective survival probability is zero: $S(T + TR + 1) = 0$.

We use N_t to describe the total size of the population. Our assumptions imply that N_t grows at rate n, i.e., $N_{t+1} = nN_t$ holds in every period. The initial size of the population, N_0, is normalized to one.

As the probability of a newborn still being alive at age τ ($\tau \geq 2$) is $\prod_{\tau'=2}^{\tau} S(\tau')$, the population shares $\psi(\tau)$ of individuals of age τ are constant over time and given by:

$$\psi(\tau) = \frac{n^{-(\tau-1)} \prod_{\tau'=2}^{\tau} S(\tau')}{\sum_{\tau''=1}^{T+TR} n^{-(\tau''-1)} \prod_{\tau'=2}^{\tau''} S(\tau')}, \tag{1}$$

where factor $n^{-(\tau-1)}$ takes into account the fact that an individual of age τ is a member of the generation that was born $\tau - 1$ periods ago, which is smaller by factor $n^{-(\tau-1)}$ than the current generation of newborns. The denominator in (1) ensures that the population shares of all generations that are currently alive sum to one, i.e., $\sum_{\tau=1}^{T+TR} \psi(\tau) = 1$. We use $\lambda = \sum_{\tau=1}^{T} \psi(\tau)$ to denote the share of workers in the population.

Worker i's utility in period t is

$$u(C_{i,t}, H_{i,t}) = \ln(C_{i,t}) - \eta \frac{H_{i,t}^{1+\kappa}}{1+\kappa}, \tag{2}$$

where η is a positive parameter and κ the inverse Frisch elasticity of the labor supply. $H_{i,t}$ denotes the number of hours worked, and $C_{i,t}$ denotes final-goods consumption. Utility in future periods is discounted by factor $\beta \in (0, 1)$.

Workers i's individual productivity is $G_{i,t}$, which is a function of age $\tau_{i,t}$:

$$G_{i,t} = g(\tau_{i,t}) \tag{3}$$

We deliberately abstract from productivity differences across workers of the same age, as these do not appear to be of primary importance for the questions addressed in this paper.[3] Effective labor $L_{i,t}$ and the number of hours worked by individual i, $H_{i,t}$, are related by $L_{i,t} = G_{i,t} H_{i,t}$. $W_{i,t}$ is the hourly nominal wage.

We consider Taylor-type wage rigidities, i.e., workers are only able to adjust their wages every J_w periods ($J_w \geq 1$). This is compatible with evidence in favor of periodic wage adjustment and, in particular, the fact that a large number of wages are adjusted after 12 months (Grigsby et al., 2021; Barattieri et al., 2014). Each cohort is split into J_w groups of equal sizes, where members of group $\gamma_w \in \{0, 1, \ldots, J_w - 1\}$ can adjust their wages in period $\gamma_w, \gamma_w + J_w, \gamma_w + 2J_w, \gamma_w + 3J_w, \ldots$. In addition, all young workers of age 1 can choose their wages freely.

There are two different assets that workers can hold: physical capital $K_{i,t}$ with a rental rate r_t and shares in a mutual fund $s_{i,t}$. The mutual fund owns the intermediate-goods producers and thus obtains their aggregate profits Π_t. The ex-dividend price of the mutual fund (henceforth: the stock price) is

$$Q_t = \sum_{s=1}^{\infty} \prod_{j=1}^{s} \frac{1}{1 + r_{t+j} - \delta} \Pi_{t+s}, \tag{4}$$

where δ is the depreciation rate. The aggregate supply of shares in the mutual fund is normalized to one.

In the steady state, both assets have identical returns as they are perfect substitutes. Later we will also examine unexpected shocks to the economy. In this case, the returns may be different ex post. Both assets are held in identical proportions by all individuals. This assumption does not affect our steady-state results but will be relevant for the effects of unanticipated shocks. Young workers of age $\tau = 1$ have zero assets when entering the economy.

Worker i's budget constraint is

$$C_{i,t} + K_{i,t+1} + s_{i,t+1} Q_t = (1 + r_t - \delta) K_{i,t} + \frac{W_{i,t}}{P_t} H_{i,t} + s_{i,t} \Pi_t + s_{i,t} Q_t + beq_{i,t}, \tag{5}$$

where $beq_{i,t}$ denote bequests, which are left accidentally by dying individuals. Like Bielecki et al. (2022), we assume that bequests are distributed equally across all agents who are at most 10 years before retirement.

[3] By including worker-specific, constant positive factors on the right-hand side of Eq. (3), a model variant can be formulated that accounts for productivity differences among workers of the same age. This modification yields identical conclusions regarding the effects of inflation. Details are available upon request.

Retirees have the same utility functions and budget constraints as workers but cannot work, i.e., $H_{i,t} = 0$. We deliberately refrain from modeling the details of retirement benefits and assume that retirees use their own asset holdings to finance consumption. All individuals are borrowing constrained. More specifically, each individual i's total asset holdings can never be negative.

Perfectly competitive final-goods producers combine intermediate goods produced by firms $f \in [0,1]$ to a final good according to the technology

$$Y_t = \left[\int_0^1 Y_{f,t}^{\frac{\epsilon-1}{\epsilon}} df\right]^{\frac{\epsilon}{\epsilon-1}}, \tag{6}$$

where ϵ is the elasticity of substitution ($\epsilon > 1$). Final goods can be used both for consumption and for investment. As is well known, the final-goods producers' optimization problem entails that the demand for firm f's intermediate good is

$$Y_{f,t} = \left(\frac{P_{f,t}}{P_t}\right)^{-\epsilon} Y_t, \tag{7}$$

where $P_{f,t}$ is the nominal price chosen by firm f and the price level P_t satisfies

$$P_t = \left[\int_0^1 P_{f,t}^{1-\epsilon} df\right]^{\frac{1}{1-\epsilon}}. \tag{8}$$

Each intermediate-goods producer f rents capital and hires the different varieties of labor to produce intermediate-good variety f. The production function is

$$Y_{f,t} = A_t X_{f,t} K_{f,t}^{\alpha} L_{f,t}^{1-\alpha}, \tag{9}$$

where A_t is aggregate productivity and $X_{f,t}$ firm-specific productivity. With slight abuse of notation, $K_{f,t}$ denotes the amount of capital rented by the firm and $L_{f,t}$ is the composite labor employed by firm f (more details on this later). In period t, intermediate-goods producers use $D_{t,t+s} := \prod_{j=1}^{s} \frac{1}{1+r_{t+j}-\delta}$ to discount profits in period $t+s$ ($s = 1, 2, \ldots$).

Aggregate productivity A_t evolves according to $A_t = aA_{t-1}$ with $a \geq 1$ and $A_0 = 1$. While our baseline scenario assumes constant aggregate productivity ($a = 1$), we also explore cases with aggregate productivity growth. Following Adam and Weber (2019), we assume that firm-specific productivity $X_{f,t}$ increases with firm age, i.e., $X_{f,t+1} = qX_{f,t}$ with $q > 1$. With constant probability $d \in (0,1]$, firm f exits the market at the end of each period and is replaced by a new firm. A new firm starts with $X_{f,t} = 1$.[4]

Like wages, prices are subject to Taylor-type rigidities. Firms can adjust their wages only every J_f periods ($J_f \geq 1$). Each generation of firms that newly enters the market consists of J_f groups of equal size. Firms in group $\gamma_f \in \{0, 1, \ldots, J_f - 1\}$ can adjust their prices in periods $\gamma_f, \gamma_f + J_f, \gamma_f + 2J_f, \gamma_f + 3J_f, \ldots$. In addition, all new firms can choose their prices freely.

We arrange all individuals on the interval $[0,1]$ and all workers on the subset $[0,\lambda]$. Then composite labor employed by firm f is given by

$$L_{f,t} = N_t \left[\int_0^{\lambda} L_{f,i,t}^{\frac{\theta-1}{\theta}} di\right]^{\frac{\theta}{\theta-1}},$$

where θ denotes the elasticity of substitution between different types of labor, and $L_{f,i,t}$ is the amount of labor from worker i that is hired by firm f.

Firm f's cost-minimization problem entails that firm f's demand for effective labor of type i is

$$L_{f,i,t} = \left[\frac{W_{i,t}}{G_{i,t} W_t}\right]^{-\theta} L_{f,t}/N_t, \tag{10}$$

$$W_t = \left[\int_0^{\lambda} \left(\frac{W_{i,t}}{G_{i,t}}\right)^{1-\theta} di\right]^{\frac{1}{1-\theta}}. \tag{11}$$

As a consequence, the demand for worker i's raw labor is

$$H_{i,t} = (G_{i,t})^{\theta-1} \left(\frac{W_{i,t}}{W_t}\right)^{-\theta} L_t/N_t, \tag{12}$$

where $L_t := \int_0^1 L_{f,t}\, df$. In addition, asset markets have to clear in every period t:

$$K_t = N_t \int_0^1 K_{i,t}\, di = \int_0^1 K_{f,t}\, df, \tag{13}$$

[4] Adam and Weber (2019) attribute the growth in $X_{f,t}$ to experience accumulation. In addition, they also consider a cohort trend according to which productivity is higher for firms that entered the market more recently compared to those that entered a long time ago. As the optimal inflation rate depends only on the ratio of the two corresponding growth rates, ignoring the cohort trend is without loss of generality and merely affects the interpretation of q.

$$N_t \int_0^1 s_{i,t}\, di = 1. \tag{14}$$

Final-goods market clearing implies

$$C_t + K_{t+1} = Y_t + (1-\delta)K_t. \tag{15}$$

The monetary authority conducts monetary policy in a way such that inflation is fixed at π. For example, monetary policy could be implemented via an interest-rate rule.

The equilibrium concept is standard. In every period, workers choose consumption, asset holdings for the next period, and, in periods where they can adjust wages, nominal wages subject to their budget constraints and borrowing constraints to maximize the present value of current and future per-period utility. Their individual state variables are age, wealth, the nominal wage inherited from the previous period (unless they are able to adjust the wage), and the number of periods that they have to wait until they can change the nominal wage again. The retirees' optimization problem is analogous, except that they do not supply labor; consequently, age and wealth are their only individual state variables. Final-goods producers select optimal bundles of intermediate goods, taking the prices of these intermediate goods as given. This leads to the demand for intermediate goods specified in (7). Intermediate-goods producers choose optimal amounts of capital and varieties of labor and, whenever possible, optimal prices of their goods in order to maximize the present value of their profits. The individual state variables are firm-specific productivity $X_{f,t}$ and, in periods where price adjustment is not possible, the previous period's price as well as the number of periods that they have to wait for the next opportunity to adjust the price. The optimal choices of labor entail (12). Moreover, asset markets and goods markets have to clear. More details on the firms' and workers' optimization problems, which lead to the optimal price and wage choices, can be found in Appendix A.

In order to analyze steady states, it is useful to recognize that aggregate real variables like aggregate output, capital and consumption grow at rate $na^{\frac{1}{1-\alpha}}$ in the long run. Thus we introduce detrended variables by dividing by $(na^{\frac{1}{1-\alpha}})^t$. Variables detrended in this way are marked by a line on top of them. Other variables, like the aggregate real wage index, grow at rate $a^{\frac{1}{1-\alpha}}$ in the steady state. We use $\sim$ for variables that have been detrended by dividing by $(a^{\frac{1}{1-\alpha}})^t$.

2.2. Aggregate output

In the following, we discuss how aggregate output is determined in equilibrium, which will be useful for the discussion of our results later. Combining (7) and (9), taking into account that $K_{f,t}/L_{f,t} = K_t/L_t$ holds for all firms f, and integrating yields

$$Y_t = A_t A_t^G K_t^\alpha L_t^{1-\alpha}, \tag{16}$$

where A_t^G is the inverse of the measure of price dispersion often used in new Keynesian models (Ascari and Sbordone, 2014, see e.g.):

$$A_t^G := \left(\int_0^1 \frac{1}{X_{f,t}} \left(\frac{P_{f,t}}{P_t} \right)^{-\varepsilon} df \right)^{-1}. \tag{17}$$

Because A_t^G measures how efficiently resources are allocated across intermediate-goods producers, we label A_t^G goods-market efficiency.

An equilibrium under flexible prices yields the maximum level of A_t^G, which can be seen as follows. Under flexible prices, all firms choose prices equal to $\varepsilon/(\varepsilon-1)$ times their marginal costs, which are proportional to the inverse of $X_{f,t}$. Hence, for each firm f, demand and thus output are proportional to $X_{f,t}^\varepsilon$ (see (7)). It is straightforward to show that a maximum value of A_t^G is achieved if this property holds.

Next we consider the relationship between aggregate hours worked $H_t := N_t \int_0^\lambda H_{i,t}\, di$ and composite labor L_t. With the help of (12), we obtain

$$L_t = \left(A_t^L\right)^{\frac{1}{1-\alpha}} H_t, \tag{18}$$

where we have introduced aggregate labor productivity A_t^L as

$$A_t^L := \left(\int_0^\lambda \left(G_{i,t}\right)^{\theta-1} \left(\frac{W_{i,t}}{W_t} \right)^{-\theta} di \right)^{-(1-\alpha)}. \tag{19}$$

Aggregate labor productivity describes how effectively a given aggregate number of hours H_t is allocated to the different types of labor.

As we have seen, flexible prices guarantee a maximum value of goods-market efficiency. One might expect, by analogy, that flexible nominal wages would likewise maximize aggregate labor productivity. However, this is not the case. Intuitively, aggregate labor productivity can be loosely interpreted as a measure of average labor productivity among workers. As we will see, positive inflation reduces the share of total hours supplied by young, unproductive workers under sticky wages. As a result, aggregate labor productivity rises above the level that would prevail under flexible wages.

The aggregate production function can be written as

$$Y_t = A_t A_t^G A_t^L K_t^\alpha H_t^{1-\alpha}. \tag{20}$$

Table 1
Parameter values.

Parameter	Value	Source
Aggregates		
a	1	baseline without agg. prod. growth
δ	0.025	Ascari et al. (2018)
Firms		
ε	7	firm markup $= \frac{1}{\varepsilon-1}$, Adam and Weber (2019), Nakamura and Steinsson (2008)
d	0.029	average of firm birth and exit rate (Adam and Weber, 2019)
α	$\frac{1}{3}$	capital share, standard value
q	$1.02^{0.25}$	firm productivity growth trend (see Appendix B)
Individuals		
θ	6	Ascari et al. (2018)
T	180	45 years working life
TR	140	maximum possible duration of retirement in years
n	$1.009^{0.25}$	population growth rate, OECD
$S(\tau+1)$		survival probabilities, Human Mortality Database (see Appendix C)
$g(\tau)$		worker's productivity growth (Hansen, 1993)
β	0.99	standard value
η	1	Dotsey et al. (1999), Golosov and Lucas Robert (2007)
κ	1	inverse of Frisch elasticity (Amano et al., 2009)
Nominal frictions		
J_f	2	Adam and Weber (2019), Coibion et al. (2012)
J_w	4	Amano et al. (2009), Barattieri et al. (2014), Grigsby et al. (2021)

Thus output depends not only on exogenous aggregate productivity A_t, capital K_t, and employment H_t but also on endogenous goods-market efficiency A_t^G and aggregate labor productivity A_t^L. We will call the product $A_t^G A_t^L$ aggregate efficiency in the following.

In a steady state, the aggregate production function can be conveniently expressed with the help of detrended variables:

$$\overline{Y} = A^G A^L \overline{K}^{\alpha} \hat{H}^{1-\alpha}, \tag{21}$$

where $\hat{H} := H_t / N_t$.

2.3. Parameter values

The model is parameterized on a quarterly basis. Table 1 gives an overview over all parameter values. To focus on the effects of age-dependent worker productivity, we initially consider constant aggregate productivity, i.e., $a = 1$. Later we will also examine the effects of aggregate productivity growth. The depreciation rate of capital δ is $2.5\,\%$ (Ascari et al., 2018). We set the elasticity of substitution, ε, to 7 (in line with Adam and Weber, 2019; Nakamura and Steinsson, 2008). The firm exit probability is estimated by Adam and Weber (2019) to be around $2.9\,\%$. This value corresponds to the average firm birth and exit rate in U.S. firm data from the Business Dynamics Statistics (BDS). Parameter q is central for the analysis in Adam and Weber (2023). If we abstracted from wage rigidity like Adam and Weber (2023), it would by and large determine the optimal inflation rate. As one of our paper's main findings is that deflation may be optimal, we deliberately choose a comparably large value for q, which tends to make it harder for our model to generate negative optimal inflation rates. As explained in more detail in Appendix B, we choose an annual growth rate of $2.0\,\%$.

We set the elasticity of substitution between different types of labor, θ, to 6, which is in the range of values used in the literature, reaching from 4 to 21 (Christiano et al., 2005; Amano et al., 2009; Erceg et al., 2000). Our value corresponds to the value chosen by Ascari et al. (2018). We assume a working-life horizon of 45 years (180 periods) and that individuals start their working life at the age of 20. After retirement, at the age of 65, individuals live for at most another 35 years. To compute survival probabilities, we rely on the Human Mortality Database. In particular, we compute the average of the annual survival probabilities over the years 1999–2018, i.e., we exclude the Covid-19 pandemic. We obtain survival probabilities for quarters by interpolating annual data on mortality rates.[5] For the population growth rate n, we use OECD data to compute the average growth rate of the US population for 1999–2018. The average annual growth rate is $0.9\,\%$.

For the age-dependent labor productivity profile, we use standard estimates by Hansen (1993), which are commonly used in the macroeconomic literature (see e.g. Cooley and Henriksen, 2018; İmrohoroğlu and Zhao, 2022). We normalize the productivity profile such that 20-year-old workers start their working lives with an individual productivity level of 1. Fig. 1 shows the annualized growth rate of individual productivity. It is very high for young workers, declines as workers become older and turns negative for workers who are nearly fifty years old. As discussed in more detail in Appendix D, a re-evaluation of Hansen's findings with more recent data

[5] For details, see Appendix C.

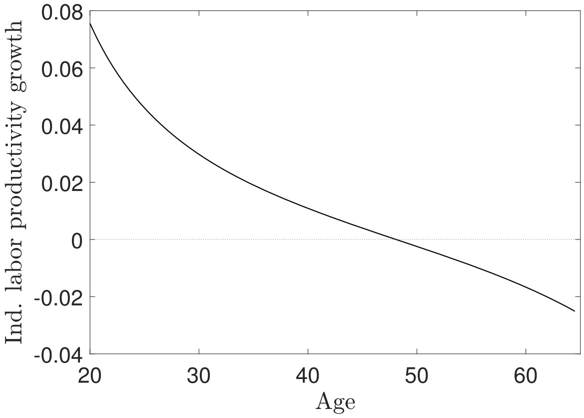

Fig. 1. Annualized growth rate of individual labor productivity as a function of age.

leads to a somewhat steeper productivity-age profile for younger workers. Using this alternative profile would strengthen our finding of mild deflation being optimal.

We would like to note that, in the presence of plausible values for aggregate productivity growth, a negative growth rate of individual productivity does not typically imply that a worker's marginal product of labor decreases over time. If the aggregate growth rate amounts to 2 %, the marginal product of labor would only decline for workers whose individual labor productivity has an annualized growth rate below −2 %, i.e., for workers who are very close to retirement.

We set the quarterly discount factor to 0.99. Concerning the parameters governing the disutility of labor in workers' utility, we set both η and κ to 1 (compare Dotsey et al., 1999; Golosov and Lucas Robert, 2007; Amano et al., 2009). A value of $J_f = 2$ implies that nominal prices adjust every two quarters on average (compatible with Adam and Weber, 2019; Coibion et al., 2012). To match the empirically observed duration of wage contracts, which is around one year, we set J_w to 4 (see Amano et al., 2009; Barattieri et al., 2014). Finally, we note that the algorithm that is used to compute the steady states is described in Appendix E.

3. Effects of different trend inflation rates

3.1. Overview

In the following, we present simulation results for steady states with different inflation rates and examine the consequences of different trend inflation rates for individual prices and wages as well as aggregate variables. We start with an analysis of the price markups of goods (Section 3.2) and proceed with a discussion of wage markups (Section 3.3). One key finding is that higher trend inflation tends to lead to substantially higher markups in the labor market. This has important consequences for aggregate employment and other aggregate variables, which are considered in Section 3.4. In Section 3.5, we discuss the implications of trend inflation for the life-cycle patterns in wages, consumption, and wealth. Finally, we will be able to discuss which levels of trend inflation are preferred by different age groups and which are optimal from a social welfare perspective.

3.2. Markups in goods markets

Before analyzing markups in goods markets and their relation to trend inflation in our full model, it is useful to consider the case of flexible prices. As firms' productivity increases at rate q with age, their relative prices decline at a net rate of $q^4 - 1 \approx 2.0\,\%$ annually under flexible prices. If the aggregate price level rises at the same rate, the decline in relative prices occurs even when all firms never adjust their nominal prices. Thus, with an inflation rate of 2.0 %, sticky goods prices are not distortionary, and the highest possible degree of goods-market efficiency (17) can be achieved even in the presence of sticky prices (see Adam and Weber, 2019).

These results are confirmed by Fig. 2, which reports simulations for different steady-state inflation rates under sticky goods prices. The left panel shows that, for a rate of inflation of 2.0 %, the markups selected by firms that can adjust their prices are equal to $\varepsilon/(\varepsilon-1)-1 = 1/6 \approx 16.7\,\%$, which is the markup they would choose under flexible prices. Because firms never adjust their prices when inflation is 2.0 %, the mean markups of all firms and the markups of adjusting firms are identical. The right panel further shows that goods-market efficiency is highest at this inflation rate.

For inflation rates above 2.0 %, firms have to take into account that their markups deteriorate during periods in which they cannot adjust their prices. Conversely, at lower inflation rates, markups rise over time during these periods. As a consequence, the markups chosen by adjusting firms are increasing functions of inflation. There are two opposing effects on mean markups. First, as discussed, newly selected markups increase with inflation. Second, the markups of firms unable to adjust their prices erode over time when inflation is high. On balance, both effects nearly offset each other, so mean markups decline only slightly with inflation when it is around 0 % (see the left panel of Fig. 2).

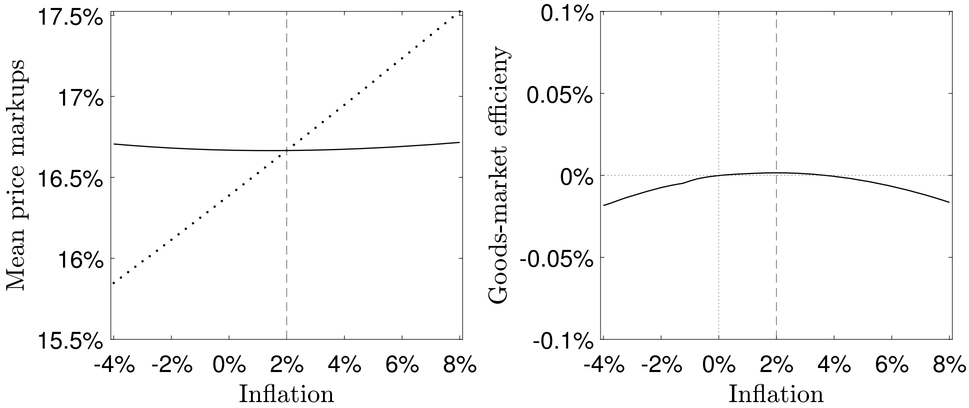

Fig. 2. The effects of different trend inflation rates on the mean markups of all firms (solid line) and of adjusting firms (dotted line) in the left panel, and on the deviation of goods-market efficiency A^G from the value achieved under $\pi = 0\,\%$ in the right panel. Vertical lines in both panels indicate an inflation rate of $2.0\,\%$.

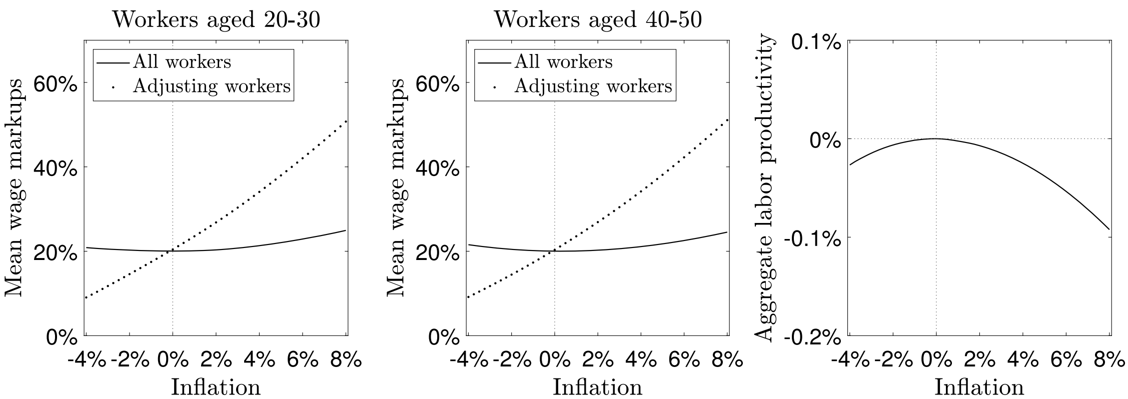

Fig. 3. Special case where workers' productivity does not change over the life cycle. Left panel: the effects of different trend inflation rates on the mean markups of all young workers and adjusting young workers (aged 20–30). Middle panel: the effects of different trend inflation rates on the mean markups of all middle-aged workers and adjusting middle-aged workers (aged 40–50). Right panel: relative deviation of aggregate labor productivity A^L from the level achieved under $\pi = 0\,\%$. Vertical lines indicate inflation rates of $0\,\%$.

3.3. *Wage markups*

If there were nominal rigidities only in goods markets but not in labor markets, the results discussed in the previous section would imply an optimal rate of inflation that is slightly higher than $2.0\,\%$ (in line with Adam and Weber, 2019).[6] To assess the implications of wage stickiness for our results, we begin by considering workers with constant productivity.

The left and middle panels of Fig. 3 show the mean markups for all workers and for those able to adjust their nominal wages, with trend inflation on the horizontal axis. The left panel focuses on young workers (aged 20–30), the right panel on middle-aged workers (aged 40–50). At an inflation rate of $0\,\%$, nominal wages remain unchanged even when workers have the opportunity to adjust them, resulting in time-invariant wage markups. Consequently, the markups of adjusting workers and the mean markups of all workers coincide. In particular, markups always equal those under flexible wages ($\theta/(\theta-1)-1 \approx 20\,\%$). For positive inflation rates, adjusting workers choose higher markups because they anticipate that inflation will erode their real wages in subsequent periods. Conversely, when inflation is negative, adjusting workers select relatively low wage markups. These patterns hold regardless of whether the group considered consists of young workers or middle-aged workers. According to the right panel of Fig. 3, aggregate labor productivity is highest when inflation is $0\,\%$. This is intuitive as the wage markups of all workers are identical in this case.

As a next step, we turn to the more complex case where workers' productivity depends on age. The results are displayed in Fig. 4. The left panel focuses on young workers (aged 20–30 years), who exhibit high labor-productivity growth. It shows the mean markups of all workers as well as of adjusting workers within this age group. The middle panel provides analogous graphs for middle-aged workers (aged 40–50), whose individual productivity growth levels off.

[6] The optimal inflation would be slightly higher than $2.0\,\%$ because of the monopolistic distortions in the goods markets, which are alleviated by higher trend inflation.

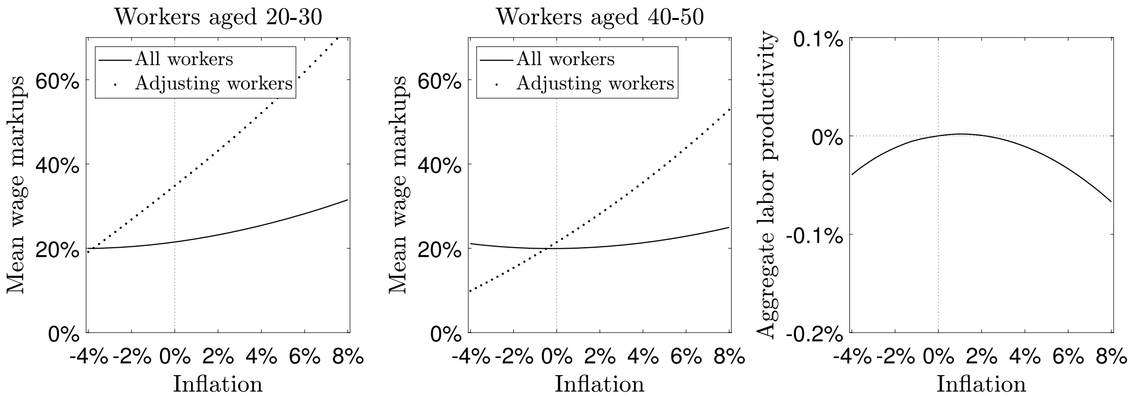

Fig. 4. General case where workers' productivity changes over the life cycle. Left panel: the effects of different trend inflation rates on the mean markups of all young workers and adjusting young workers (aged 20–30). Middle panel: the effects of different trend inflation rates on the mean markups of all middle-aged workers and adjusting middle-aged workers (aged 40–50). Right panel: relative deviation of aggregate labor productivity A^L from the level achieved under $\pi = 0\,\%$. Vertical lines indicate inflation rates of $0\,\%$.

For middle-aged workers, real wages would remain roughly constant under flexible wages. As a consequence, mean wages and mean newly adjusted wages are approximately identical at zero inflation, and the dispersion of markups is minimized within the group of middle-aged workers.

By contrast, young workers would experience real wage growth of about $4\,\%$ under flexible wages, consistent with the typical productivity growth rate in this age group (compare Fig. 1). At negative inflation rates of approximately $-4\,\%$, nominal wages of young workers would thus be adjusted by only small amounts. This inflation rate would therefore minimize markup dispersion within this group.

The panel on the right-hand side shows that aggregate labor productivity (19) is maximized at an inflation rate of around $1\,\%$. This is due to the fact that aggregate labor productivity does not only depend on markup dispersion within age groups but is influenced by a composition effect as well. For positive inflation rates, young workers choose high wage markups, which result in low numbers of hours worked. Because young workers have low levels of productivity, aggregate labor productivity A^L, which can be loosely interpreted as a measure of average productivity across all workers, is high as a result.[7]

It may be worth highlighting that the changes in aggregate labor productivity in response to changes in trend inflation are somewhat larger than the corresponding changes in goods-market efficiency. Moreover, mean wage markups are more strongly influenced by inflation than the markups in goods markets. First, this is due to the longer periods of fixed wages compared to the periods of fixed prices. Second, as discussed in Amano et al. (2009), the strong effect of inflation on wage markups is driven by an asymmetry in the utility function of workers. Wage markups that are too low compared to the markups under flexible wages lead to substantially larger utility losses than high markups.

The strong response of wage markups to inflation is a first indication that wage rigidities may be more important than price rigidities for understanding the consequences of trend inflation in our model. The marked rise in wage markups with inflation has sizable consequences for aggregate variables, as will be studied in more detail in the next section.

3.4. *Aggregate variables*

How key aggregate variables are affected by different trend inflation rates is shown in Fig. 5. Aggregate efficiency, which is shown in the left panel of the first row, is the product of goods-market efficiency (17) and aggregate labor productivity (19). We have seen that goods-market efficiency has its maximum at $0\,\%$ inflation (see Fig. 2) and aggregate labor productivity takes its highest value at inflation around $1\,\%$. Because aggregate labor productivity changes rather sharply around its maximum, while goods-market efficiency is relatively flat near its peak, the maximum of aggregate efficiency is located close to that of aggregate labor productivity-at an inflation rate slightly above $1\,\%$.

Section 3.3 has demonstrated that mean wage markups increase substantially with inflation. As a consequence, employment decreases quite strongly for higher rates of inflation (see the middle panel of the first row). The low levels of employment decrease the marginal product of capital and thus also the amount of capital rented by firms when inflation is high (see the left panel in the second row). The level of aggregate output as a function of inflation is dominated by the changes in employment and capital and hardly affected by the comparably modest changes in aggregate efficiency. As a result, aggregate output decreases substantially for higher inflation rates (see the third panel in the first row).

To lay the groundwork for our analysis of conflicts of interest over inflation across age groups, it is instructive to examine changes in real interest rates and aggregate profits (see the middle and right panels in the second row of Fig. 5). Overall, real interest rates

[7] As noted in Section 2.2, aggregate labor productivity under sticky wages can exceed the corresponding level under flexible wages.

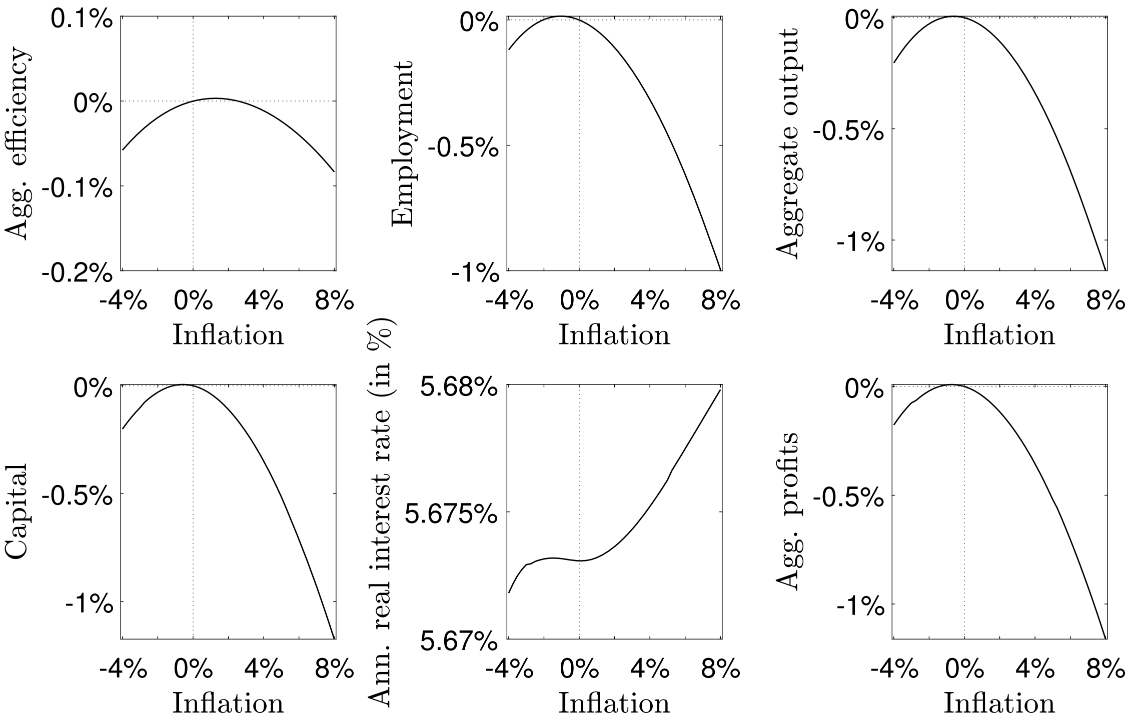

Fig. 5. Aggregate variables for different trend inflation rates. First row: aggregate efficiency, aggregate hours worked, output. Second row: aggregate capital, annualized real interest rate, profits. All variables except for real interest rates measured as relative deviations from the respective levels at 0 % inflation.

tend to increase with inflation. This is due to the effect that high inflation rates imply high wage markups and thus high real wages. High real wages make it attractive for firms to substitute labor for capital to some extent, which tends to drive up real interest rates as well. As we will see, higher real interest rates are particularly attractive for retirees as they only receive capital income. Finally, we also observe that aggregate profits move more or less in lockstep with aggregate output. This is plausible because mean goods-market markups are hardly affected by changes in inflation (see Fig. 2) and thus profits are approximately proportional to aggregate sales or aggregate output. Changes in profits will be important for understanding the impact of permanent changes in inflation on stock prices, which will be considered in Section 4.2.

3.5. Lifecycles

In the course of our analysis, we have emphasized that nominal wage rigidity is more important for understanding the consequences of trend inflation for aggregate economic variables than nominal price rigidity. There is a difference between sticky wages and sticky prices that we have not explored yet. Staggered wage adjustment causes fluctuations in individual real labor incomes and hours and thereby represents a source of fluctuations in instantaneous utility for individual workers whereas staggered price adjustment does not.

Fig. 6 shows the evolution of detrended real wages, wealth, and consumption for different age groups. We focus on two cases: deflation with an inflation rate of −3 % and moderate inflation of 3 %. The panels on the left display real wages as a function of age. At this point, it is worth remembering that each age cohort consists of $J_w = 4$ groups that differ according to the periods in which they can adjust wages. As a consequence, for each age, there are four different real wages. In some cases these wages are closer together, while in others they differ more markedly, which makes the graphs in the left panels appear thicker.

Under deflation, real wages grow at a rate of roughly 3 % when workers do not adjust their wages. As the productivity of workers aged 30 and below approximately increases at this rate, nominal wages are changed by only small amounts if workers have the opportunity to adjust them. As a result, the distribution of wages under deflation is relatively tight, conditional on age. For old workers, productivity grows at a rate substantially lower than 3 %, which leads to high wage dispersion among individuals of identical age.

Under a positive inflation rate of 3 %, wages are substantially more dispersed across members of younger age groups compared to deflation. This follows from the substantial drops in real wages during periods of constant nominal wages, which induce younger workers to change their wages by large amounts whenever adjustments are possible. By contrast, the dispersion of wages within groups of workers close to retirement is comparably low. This follows from the observation that positive inflation automatically lowers real wages, in line with old workers' declining individual productivities.

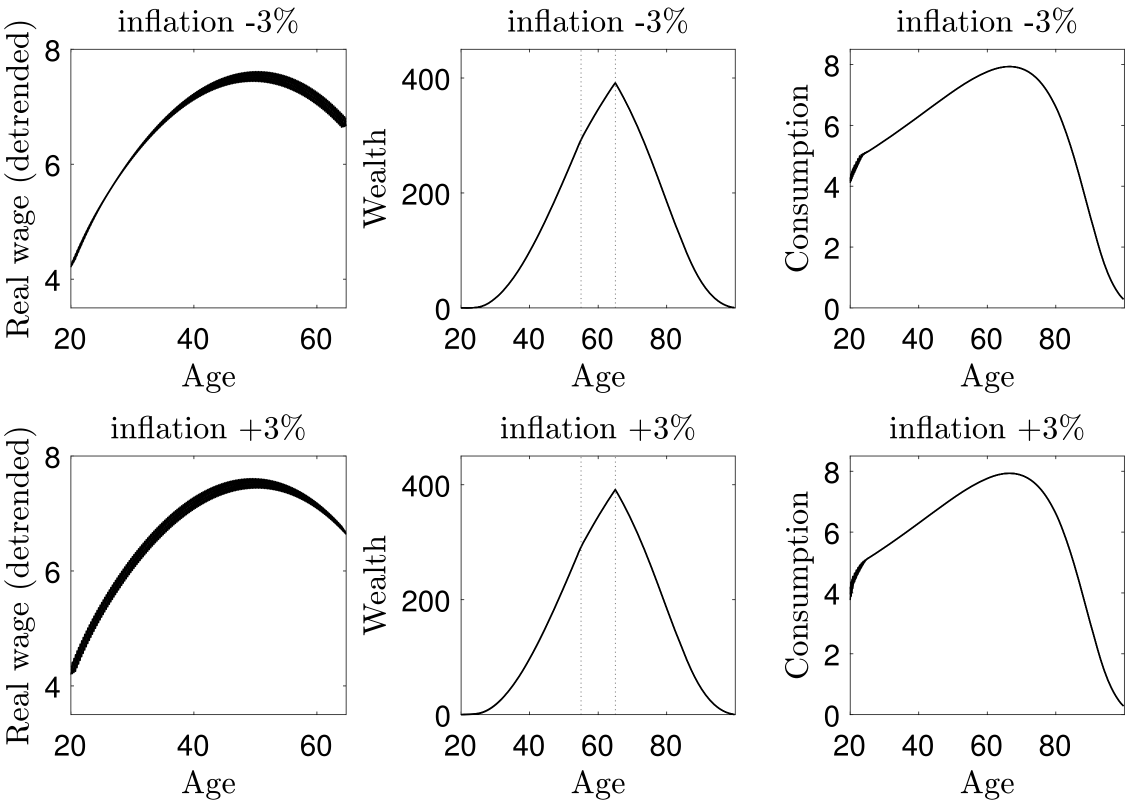

Fig. 6. Individual real wages, wealth, and consumption for different age groups. First row: −3 % inflation. Second row: +3 % inflation. The two vertical lines in the middle panels of both rows mark the maximum age at which individuals receive bequests and the retirement age.

The larger dispersion of real wages under inflation has important consequences for young workers, who cannot borrow in order to dampen the consequences of low current incomes for current consumption. The more dispersed real wages under high inflation lead to more dispersed real incomes and thus more dispersed levels of consumption.

Finally, Fig. 6 shows that inflation influences the levels of consumption for young workers. As has been demonstrated before, high inflation makes young individuals choose high wage markups as they have to factor in the declining real wages during periods of fixed nominal wages. High real wages tend to lead to low incomes and therefore somewhat lower levels of consumption.

3.6. *Preferences over trend inflation rates*

Having discussed the consequences of inflation for various economic variables, we are now in a position to analyze which inflation rates would be preferred by different age groups. We will discuss an analysis of transition dynamics in Section 4.2. At this point, we propose the following thought experiment. Consider an economy in a steady state with zero inflation. For each individual in this economy, we then ask which inflation rate from −4 % to +8 % would deliver the highest utility if the individual could, for given individual wage and wealth, move to an economy that is in the steady state with this different trend inflation rate but is identical with regard to all other exogenous parameters. For each age group, we then compute the median preferred inflation rate.

The preferred inflation rates as a function of age are displayed in Fig. 7.[8] In line with our previous analysis, 20-year-old workers prefer deflation with negative inflation rates of −1.5 %. Because workers' productivity growth is a decreasing function of age, older workers tend to prefer higher inflation rates. Individuals older than 60 years, who are retirees or at least close to retirement, are mainly interested in high real interest rates. As real interest rates are highest for high inflation rates, they prefer the highest inflation rate that we consider in this exercise.

To sum up, the figure highlights strong conflicts of interest across age groups. A careful analysis reveals that the median of the preferred inflation rates for all voters is 0.25 % and thus slightly positive.

[8] In principle, the preferred inflation rates can differ across the four groups within an age cohort. Thus we display the median preferred inflation rate.

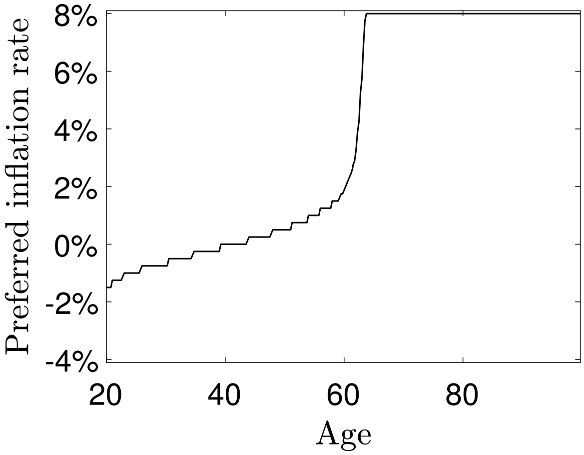

Fig. 7. Median preferred inflation rates for different age groups (individual state variables drawn from distribution in the steady state with 0 % inflation). Inflation rates under consideration: −4.00 %, −3.75 %, −3.50 %, …, 7.75 %, 8.00 %.

Table 2
Optimal steady-state inflation rates and the consumption-equivalent welfare losses implied by 0 % inflation rather than the optimal inflation rates. Two welfare measures are considered: the expected lifetime utility of individuals who enter the economy at the youngest possible age and the mean instantaneous utility of all individuals currently alive.

	lifetime utility at $\tau = 1$		avg. current utility	
Scenario	Opt. infl.	Welf. loss	Opt. infl.	Welf. loss
Baseline model	−1.50 %	−0.04 %	−1.00 %	−0.02 %
No sticky wages $J_w = 1$	2.50 %	−0.01 %	2.50 %	−0.00 %
No sticky prices $J_f = 1$	−1.75 %	−0.05 %	−1.00 %	−0.02 %
Const. firm prod. $q = 1$	−1.50 %	−0.04 %	−1.00 %	−0.02 %
No ind. lab. prod. growth $g(\tau) = 1$	0.25 %	−0.00 %	0.25 %	−0.00 %
agg. prod. gr. (low) $a = 1.01^{0.25(1-\alpha)}$	−2.50 %	−0.10 %	−2.00 %	−0.06 %
agg. prod. gr. (intmed.) $a = 1.02^{0.25(1-\alpha)}$	−3.25 %	−0.19 %	−2.75 %	−0.14 %
High Frisch elas. $\kappa^{-1} = 2$	−1.50 %	−0.02 %	−1.00 %	−0.01 %
Low elas. sub. labor $\theta_H = 4$	−1.00 %	−0.01 %	−0.50 %	−0.00 %
No population growth $n = 1$	−1.50 %	−0.03 %	−0.75 %	−0.01 %

3.7. Welfare

As a next step, we study socially optimal levels of inflation. For this purpose, we compare steady states and apply two different welfare measures. As a first measure, we employ the lifetime utility of the youngest individuals, who enter the economy. The socially optimal inflation rate in this case is identical to the inflation rate that is preferred by workers aged 20 in the previous thought experiment. Thus, according to our first welfare measure, deflation with an inflation rate of −1.5 % is socially optimal.

Our second welfare measure corresponds to the mean of the instantaneous utilities of all individuals who are alive in a particular period. This measure of welfare is similar in spirit to the unconditional expectation of a representative consumer's utility (or, equivalently, the unconditional loss), which is often used in new Keynesian models (see e.g. Rotemberg and Woodford, 1997, for an early contribution).

Table 2 shows the socially optimal inflation rates for both welfare measures and different variants of our model, where we consider a grid of inflation rates with a step size of 0.25 percentage points. The welfare loss refers to zero inflation as opposed to the socially optimal level and is measured in consumption equivalents. Our first observation is that our second welfare measure tends to lead to higher optimal trend inflation. This is plausible because, in line with our previous analysis, younger individuals typically prefer lower negative inflation rates than older individuals. The second welfare measure puts more weight on the utility of older individuals, which results in higher optimal rates of inflation.

Moreover, we note that the welfare losses are comparably small. For example, in what we consider the most plausible scenario—aggregate productivity growth of 2 %—the consumption-equivalent welfare loss from choosing 0 % inflation rather than the optimal rate is just under 0.2 %. It may be worth noting that the gains from different stabilization policies that are found in the literature are typically even smaller. For example, Schmitt-Grohé and Uribe (2007) find that the welfare gains from optimal interest-rate smoothing amount to less than one-thousandth of one percent of consumption.

A previous version of our paper, which employed Calvo pricing, implied substantially larger welfare effects because, in that framework, some prices and wages remain unadjusted for longer periods and thus become more misaligned.[9] In contrast, in the current version with Taylor pricing all nominal wages adjust annually and all prices every two quarters. Since in practice a non-negligible share of prices and wages remain fixed for longer, our model likely provides a lower bound on the welfare effects, while a Calvo model provides an upper bound. Importantly, the earlier Calvo-based version yielded very similar optimal inflation rates. A general conclusion is that the modeling choice regarding nominal rigidity affects the magnitude of welfare effects but has little impact on the optimal inflation level.[10]

In Table 2, we also provide the findings for a scenario without wage stickiness. In this case, we obtain results analogous to Adam and Weber (2019), who find that positive inflation rates are optimal under sticky prices if individual firms become more productive over time and firms' relative prices should decrease accordingly. The socially optimal inflation rate in the case considered here is even a bit higher than the growth rate of firm productivity. This is due to the fact that higher inflation leads to lower mean markups and thus alleviates the distortions from monopolistic competition (compare Fig. 2).[11] A point worth noting is that, in the absence of wage stickiness, the welfare losses from zero inflation, measured in consumption equivalents, are particularly small.

Table 2 also shows that scenarios that abstract from sticky goods prices or from increases in firm productivity with firm age lead to optimal rates of inflation that are equal or lower than those in the main variant of our model. This is to be expected as in these variants of our model the effects in Adam and Weber (2019) that lead to positive optimal inflation rates are absent. It may be worth stressing that the differences in optimal trend inflation between these variants and our main model are comparably small. Hence the finding in Amano et al. (2009) that wage stickiness is more important than price stickiness for understanding the effects of trend inflation extends to our framework with age-dependent worker productivity.

A unique feature of our analysis of trend inflation is the age-dependent productivity of workers. Table 2 shows that this feature has non-negligible effects. The particularly high productivity growth for young workers causes optimal inflation to be substantially lower in our main model compared to the scenario where productivity does not depend on the age of a worker.

Next we examine the consequences of aggregate growth for optimal inflation. We follow Amano et al. (2009) by choosing an annual growth rate of aggregate productivity of 2 %. Aggregate growth makes worker productivity increase more strongly over time. As a result, optimal inflation rates are even lower, namely around −3 % as the automatic increases in real wages that are brought about by deflation become more important. We also consider an aggregate productivity growth rate of 1 % because the long-term growth rate has declined in many economies and may well remain low in the future (see e.g. Kose and Ohnsorge, 2023). This leads to an optimal inflation rate of −2.5 % or −2.0 %, respectively.

Moreover, it appears important to assess the robustness of our findings to changes in two key parameters that affect wages and hours worked, namely the Frisch elasticity and the elasticity of substitution for different types of labor. Table 2 shows that the optimal inflation rates are hardly affected by a higher Frisch elasticity. Under a lower elasticity of substitution between different kinds of labor, optimal inflation is somewhat higher. Moreover, welfare losses from an inflation rate of zero percent are comparably small. This appears plausible because a less elastic labor demand makes low real wages after longer periods of fixed nominal wages less costly for young workers.

We also check the relevance of population growth for our results about welfare. If the average of instantaneous utilities is used as a welfare measure, the optimal inflation rate is somewhat higher for a constant than for a growing population. This is plausible as the absence of population growth lowers the share of young people who benefit from negative inflation rates.

4. Extensions

4.1. Downward nominal wage rigidity

According to a classic argument (see Tobin, 1972), moderate inflation may be desirable as it "greases the labor market's wheels" in the presence of downward nominal wage rigidity (DNWR). We therefore examine the robustness of our findings when DNWR is introduced. To sharpen the analysis, we focus on the following polar case, which provides us with an upper bound on the effects of DNWR in our model. As before, nominal wages can only be adjusted every J_wth quarter. However, when they are adjusted, they may rise but never fall–so nominal wages of individual workers cannot decline.

Fig. 8 plots the frequency of wage adjustment for different trend inflation rates. At sufficiently low inflation, the downward constraint on nominal wages becomes binding for some older workers, reducing the overall frequency of adjustment. Thus DNWR implies two empirically plausible patterns: The frequency of wage adjustment increases with inflation and is typically higher for young individuals than for older workers. It may be noteworthy that, at a commonly observed inflation rate of 2 %, the constraint is

[9] Most papers analyzing the effects of trend inflation employ Calvo pricing, with Amano et al. (2009) being a notable exception. They report somewhat larger welfare effects because their comparisons are between the optimal inflation rate and a benchmark rate of 2 %, whereas our paper uses 0 % as the benchmark.

[10] Amano et al. (2007), who examine a new Keynesian model with sticky goods prices and flexible wages, also find that suboptimal levels of inflation cause higher welfare losses under Calvo pricing compared to Taylor pricing.

[11] The monopolistic distortion in goods markets is shut off by Adam and Weber (2019) with the help of a sales subsidy.

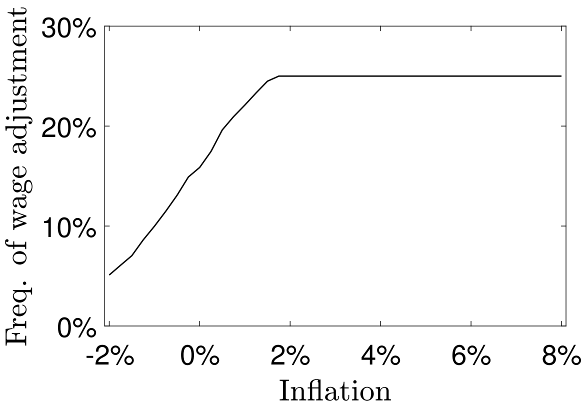

Fig. 8. The frequency of wage adjustment under downward nominal wage rigidity as a function of trend inflation.

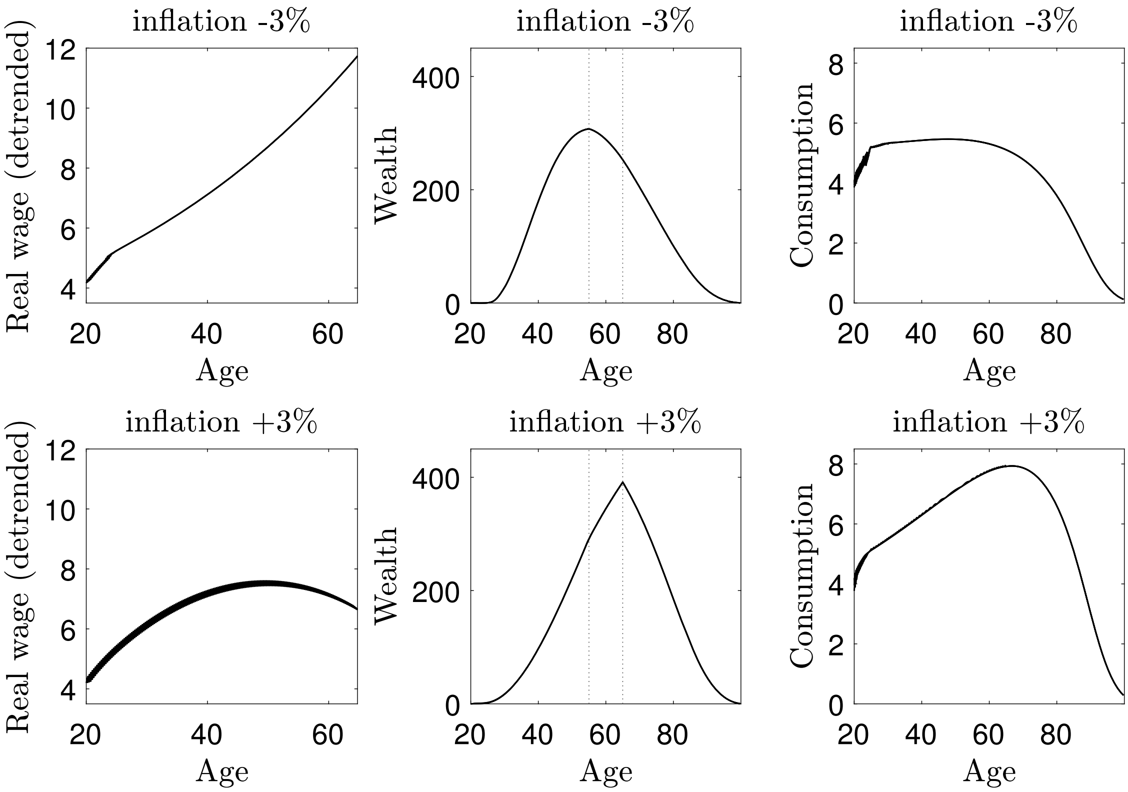

Fig. 9. Individual real wages, wealth, and consumption for different age groups under DNWR. First row: −3 % inflation. Second row: +3 % inflation. The two vertical lines in the middle panels of both rows indicate the maximum age at which individuals receive bequests and the retirement age.

never binding. This implies that, at this inflation rate, the J_w selected in Section 2.3 yields an empirically plausible one-year duration of fixed nominal wages, even in the presence of DNWR.

When inflation is negative, DNWR causes real wages to increase invariably as workers grow older. Under negative inflation rates, DNWR thus represents a particularly serious constraint for old workers, whose individual productivities decrease with age. The differential effects of deflation and inflation on real wages for different age groups can be seen from the two panels on the left-hand side of Fig. 9, which show detrended real wages for different age groups. The top panel on the left displays the results for an inflation rate of −3 %, the bottom panel displays our findings for a rate of 3 %.

Inflation does, in fact, grease the wheels of the labor market. Compared to deflation, age-specific detrended wages align more closely with individual productivity, which follows a hump-shaped pattern over the life cycle. As before, each cohort is divided into four groups that adjust wages in a staggered manner. At an inflation rate of +3 %, the four wage paths differ markedly, as real wages decline during spells of fixed nominal wages and newly adjusted wages are always higher than those set earlier. By contrast, at a

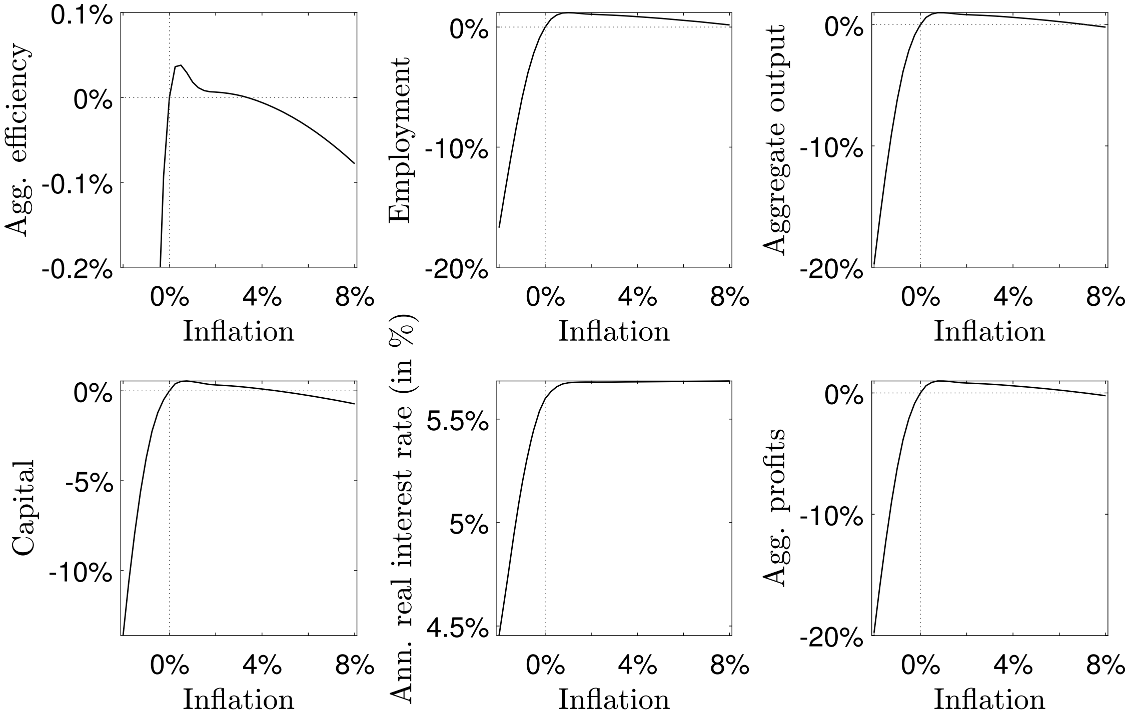

Fig. 10. Aggregate variables for different trend inflation rates under DNWR. First row: aggregate efficiency, aggregate hours worked, output. Second row: aggregate capital, annualized real interest rate, profits. All variables except for real interest rates measured as relative deviations from the respective levels at 0 % inflation.

deflation rate of −3 %, nominal wages for older workers become fixed. Because these wages remain unchanged for long periods, workers in all four groups set them to nearly identical values.

The high real wages for older workers under deflation result in a low demand for their labor and therefore comparably low labor incomes. This implies that workers reach their peak wealth earlier in life because they start dissaving already before retirement (see the top middle panel). Moreover, the maximum wealth they attain during their lives is considerably lower.

The two panels on the right-hand side enable a comparison of age-specific consumption levels for inflation rates of −3 % and +3 %. They reveal that, compared to inflation, deflation entails low consumption of middle-aged and old workers and thus the consumption profiles are relatively flat. As we will see, this is a result of the low real interest rates under deflation.

As a next step, we examine the effects of different levels of inflation for aggregate variables. As can be confirmed by comparing Fig. 10 with Fig. 5, DNWR has no consequences for aggregate variables when inflation is around 2 % or higher. As discussed before, lower inflation makes DNWR a binding constraint for older workers. For negative rates of inflation, this constraint affects middle-aged workers as well. Thus deflation has a number of detrimental effects. First, it entails low levels of aggregate efficiency. The labor of older workers is too costly, which leads to inefficiently low levels of employment in this group. Second and as a consequence, aggregate employment is low. Third, low labor incomes result in lower savings and therefore a low level of capital. Fourth, low levels of efficiency, employment and capital result in low levels of output and profits. Fifth, the low levels of aggregate efficiency and employment lead to low real interest rates. The low real interest rates are responsible for the low growth of consumption over individuals' lives.

Finally, we analyze preferences over steady-state inflation rates as in Section 3.6. According to Fig. 11, the general pattern that workers, in particular young ones, prefer low inflation and that retirees prefer high inflation is robust to the introduction of DNWR. In line with the additional adverse effects of low and negative rates of inflation under DNWR, workers prefer higher rates of inflation than without DNWR. The median preferred inflation rate is thus higher and amounts to 1.25 %. Both welfare measures that were examined in the previous section, i.e., the lifetime utility of the youngest individuals as well as the mean of the instantaneous utilities of all individuals, lead to moderate positive inflation rates of 0.75 % or 1.00 %, respectively (see Table 3). However, in the arguably more plausible case with aggregate productivity growth of 2 %, optimal inflation is negative.

Hence our main finding that the combination of sticky wages and age-specific productivity of workers makes mild deflation optimal in a framework that would otherwise call for moderate positive inflation rates is robust to the inclusion of DNWR. While a framework with idiosyncratic shocks to worker productivity might tend to make higher rates of inflation desirable, one also has to take into account that, in another dimension, we have stacked the deck against deflation by introducing a very strict form of DNWR, where nominal wage cuts are completely impossible. Milder forms of DNWR would plausibly entail lower socially optimal rates of inflation.

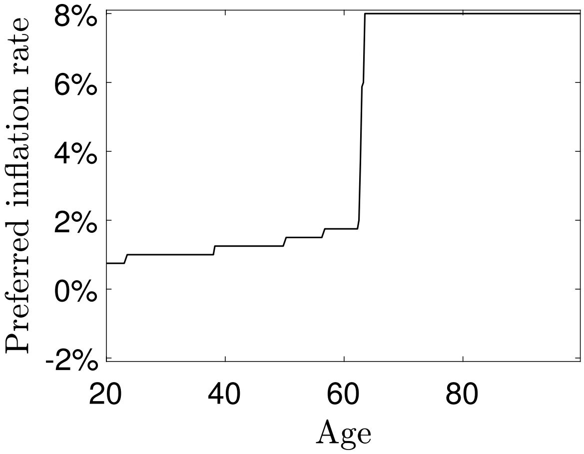

Fig. 11. Median preferred inflation rates for different age groups under DNWR (individual state variables drawn from distribution in the steady state with 0 % inflation). Inflation rates under consideration: −3.00 %, −2.75 %, −2.50 %, …, 7.75 %, 8.00 %.

Table 3
Optimal steady-state inflation rates and the consumption-equivalent welfare losses implied by 0 % inflation rather than the optimal inflation rates. Two welfare measures are considered: the expected lifetime utility of individuals who enter the economy at the youngest possible age and the mean instantaneous utility of all individuals currently alive.

	lifetime utility at $\tau = 1$		avg. current utility	
Case	Opt. infl.	Welf. loss	Opt. infl.	Welf. loss
Baseline model	−1.50 %	−0.04 %	−1.00 %	−0.02 %
DNWR	0.75 %	−0.54 %	1.00 %	−0.78 %
DNWR, $a = 1.01^{0.25(1-\alpha)}$	−0.25 %	−0.00 %	0.00 %	0.00 %
DNWR, $a = 1.02^{0.25(1-\alpha)}$	−1.25 %	−0.14 %	−1.00 %	−0.12 %

4.2. Politico-economic equilibrium

In this section, we discuss transition dynamics in the economy as well as the inflation rate that would be selected by the political process.[12] We focus on the case without DNWR and with Calvo price and wage stickiness. In particular, we consider the following situation. The economy is in a steady state before period 0. At the beginning of period 0, a change in trend inflation is put to a vote, where the central bank's change in policy would be so strong such that the new level of trend inflation would be attained immediately. After this change, there would be no further changes in inflation and the economy would eventually converge to the new steady state. The possibility to change trend inflation is completely unexpected before period 0.

We call a politico-economic equilibrium a situation where a majority of individuals prefer the status quo to both an increase and a decrease in trend inflation in period 0. Our simulations reveal an additional effect why even older workers and retirees may oppose higher positive inflation rates: rising inflation tends to lower stock prices, harming those who depend on capital income. That an increase in inflation can cause a drop in stock prices is plausible as higher inflation is associated with higher real interest rates and lower profits (see Fig. 5).

5. Conclusions

This paper has revisited the question of which level of inflation central banks should target. Our model incorporates sticky prices and firm-specific productivity growth. Taken together, these factors have been shown to lead to positive optimal inflation rates of around 2 % (Adam and Weber, 2019; Adam et al., 2022). Our contribution is to add age-specific worker productivity. Once age-specific productivity and sticky wages are considered, inflation influences employment patterns across age groups, average productivity, income fluctuations, lifetime wealth accumulation, and the aggregate capital stock. We have demonstrated that age-specific worker productivity lowers the socially optimal rate of trend inflation. Overall, this effect may outweigh the forces that make positive inflation optimal, implying that low–and even moderately negative–inflation can be desirable. This conclusion is reinforced when aggregate productivity growth is taken into account.

[12] For details, see a previous version of the paper.

Young workers, whose productivity rises rapidly, benefit most from deflation. Under deflation, real wages increase during spells of constant nominal wages, which smooths the fluctuations in real wages, hours worked, and labor incomes that are caused by infrequent nominal wage adjustment. Compared to inflation, deflation also yields higher average real labor incomes for young workers. The reason is that positive inflation rates make young workers set high wage markups because they anticipate that inflation will erode the real value of their wages during periods of fixed nominal wages. On average, these high markups result in lower real labor incomes than under deflation. While young workers benefit from deflation, older workers and retirees prefer relatively high levels of inflation because inflation tends to yield higher real interest rates and thus higher capital incomes. We thus find strong conflicts of interest across generations.

It is plausible that the political process produces an inflation target close to the median voter's preferred inflation rate. We have shown that this rate of inflation exceeds the socially optimal level. Our analysis has therefore uncovered a source of inflation bias distinct from the traditional one associated with time-inconsistent policies (Kydland and Prescott, 1977; Barro and Gordon, 1983). This bias is further amplified by the fact that younger people, who benefit from lower inflation, participate in political processes less frequently than older people (see Appendix F).

At a higher level, a general lesson from our paper is that wage rigidities may be more important for understanding the long-run effects of inflation than price rigidities.[13] It is therefore natural to ask how alternative ways of modeling wage rigidities might affect our results. One possibility is wage indexation, which could produce automatic upward adjustments in real wages and thereby weaken the case for negative inflation rates. In our model, nominal wages are adjusted once per year, consistent with the empirical evidence (Grigsby et al., 2021). Only a counterfactual indexation mechanism allowing for wage adjustment at higher frequencies would alter our results. Moreover, while some form of wage indexation is used in several countries, its scope appears to be relatively limited. For instance, in the Euro area only about 3 % of private-sector employees have wages automatically indexed to inflation (Koester and Grapow, 2021). A second possibility is downward nominal wage rigidity, which could in principle justify higher inflation. Yet in an extension of our model, we show that our results continue to hold qualitatively even under an extreme form of such rigidity.

At present, no central bank targets a negative inflation rate. There are two main reasons. First, official measures of inflation are biased upwards. Recent estimates by Braun and Lein (2021) suggest that this bias is sizable, namely 2.6 percentage points on average and even 3.7 percentage points in the wake of large shocks to relative prices. With such a bias, the optimal inflation rate implied by our analysis would correspond to an observed rate near zero. Second, central banks are concerned about the effective lower bound for nominal interest rates. Positive inflation targets entail higher nominal interest rates and thereby keep them at a safer distance from this bound. However, as argued before, the ongoing shift toward cashless societies may render the effective lower bound less relevant in the future. As a consequence, the case for low and possibly even negative inflation targets may be more compelling in the future.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used ChatGPT-5 in order to polish the language. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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Appendix A. Bellman equations

A.1. Overview

In the following, we specify the optimization problems of intermediate-goods producers and households in a steady state. The optimization problems for the transition dynamics are straightforward extensions. Obviously, the optimization problems during a transition have to take into account that detrended aggregate variables as well as the distributions of wages and prices change over time.

A.2. Optimization problem of the intermediate-goods producers

Recall that variables with a "∼" are variables that are detrended by dividing them by $(a^{\frac{1}{1-\alpha}})^t$ and variables with a line on top of them are detrended by $(na^{\frac{1}{1-\alpha}})^t$. Accordingly, we write $\overline{Y} = Y_t(na^{\frac{1}{1-\alpha}})^{-t}$ and $\widetilde{w} = w_t(a^{\frac{1}{1-\alpha}})^{-t}$, where w_t is the composite real wage W_t/P_t. Moreover, we introduce $p_{f,t} = \frac{P_{f,t}}{P_t}$.

[13] Wage-tenure contracts might alleviate some of the distortions in real wages caused by age-specific productivity if they allowed for wage adjustments at intervals shorter than one year. However, contracts with age-dependent rather than tenure-dependent wages would be needed to alleviate the distortions studied in our model effectively. Such contracts appear uncommon and may even raise legal concerns due to age discrimination.

In a steady state, detrended profits $\overline{\Pi}_{i,t}$ can be written as

$$\overline{\Pi}_{i,t} = p_{f,t}^{-\varepsilon}\overline{Y}\left(p_{f,t} - \frac{1}{X_{f,t}}\frac{r^{\alpha}\widetilde{w}^{1-\alpha}}{\alpha^{\alpha}(1-\alpha)^{1-\alpha}}\right), \tag{A.1}$$

where $\frac{1}{X_{f,t}}\frac{r^{\alpha}\widetilde{w}^{1-\alpha}}{\alpha^{\alpha}(1-\alpha)^{1-\alpha}}$ is firm f's marginal cost, provided that it uses an optimal capital-labor ratio:

$$\frac{\overline{K}_f}{\hat{L}_f} = \frac{\alpha}{1-\alpha}\frac{\widetilde{w}}{r}, \tag{A.2}$$

where $\hat{L}_f := L_{ft}/N_t$.

If a firm can choose its optimal price in a particular period, its value function $V_{adj}^F(X_{f,t})$ satisfies:

$$\begin{aligned} V_{adj}^F(X_{f,t}) = \max_{p_{f,t}} \Bigg\{ & p_{f,t}^{-\varepsilon}\overline{Y}\left(p_{f,t} - \frac{1}{X_{f,t}}\frac{r^{\alpha}\widetilde{w}^{1-\alpha}}{\alpha^{\alpha}(1-\alpha)^{1-\alpha}}\right) + (1-d)\frac{na^{\frac{1}{1-\alpha}}}{1+r_{t+1}-\delta}V_{nadj}^F(p_{f,t+1}, X_{f,t+1}, J_f - 1)\Bigg\} \\ \text{s.t. } & X_{f,t+1} = qX_{f,t}, \\ & p_{f,t+1} = p_{f,t}/\pi \end{aligned} \tag{A.3}$$

where "adj" stands for the possibility to adjust ones price. The subscript "nadj" describes situations where firms cannot adjust their prices. If a firm cannot adjust its nominal price in period $t+1$, its relative price is the previous period's relative price, divided by inflation: $p_{f,t+1} = \frac{p_{f,t}}{\pi}$. The third argument of V_{nadj}^F denotes the number of periods that the firm has to wait before being able adjust its price again.

For firms that can adjust their prices only after $\tau_{a,f,t} = 1, 2, \ldots, J_f - 1$ periods, the value function satisfies

$$\begin{aligned} V_{nadj}^F(p_{f,t}, X_{f,t}, \tau_{a,f,t}) = {} & p_{f,t}^{-\varepsilon}\overline{Y}\left(p_{f,t} - \frac{1}{X_{f,t}}\frac{r^{\alpha}\widetilde{w}^{1-\alpha}}{\alpha^{\alpha}(1-\alpha)^{1-\alpha}}\right) + (1-d)\frac{na^{\frac{1}{1-\alpha}}}{1+r-\delta}V_{nadj}^F(p_{f,t+1}, X_{f,t+1}, \tau_{a,f,t+1}) \\ \text{s.t. } & X_{f,t+1} = qX_{f,t}, \\ & p_{f,t+1} = p_{f,t}/\pi \\ & \tau_{a,f,t+1} = \tau_{a,f,t} - 1 \end{aligned} \tag{A.4}$$

Finally, we have to impose

$$V_{nadj}^F(p_{f,t}, X_{f,t}, 0) = V_{adj}^F(X_{f,t}). \tag{A.5}$$

A.3. Individuals' decision-making problem

As both assets are perfect substitutes, it is useful to introduce $\widetilde{\Omega}_{i,t}$, which is individual i's detrended level of real wealth at the beginning of period t.

If it is possible to adjust the nominal wage in period t, the worker's problem is

$$\begin{aligned} & V_{adj}^W(\tau_{i,t}, \widetilde{\Omega}_{i,t}) = \max_{\widetilde{C}_{i,t}, \widetilde{w}_{i,t}, \widetilde{\Omega}_{i,t+1}} \left\{ \ln(\widetilde{C}_{i,t}) - \eta\frac{H_{i,t}^{1+\kappa}}{1+\kappa} + \beta S(\tau_{i,t+1})V_{nadj}^W\left(\tau_{i,t+1}, \widetilde{w}_{i,t+1}, \widetilde{\Omega}_{i,t+1}, J_w - 1\right)\right\} \\ & \text{s.t.} \\ & \quad \widetilde{w}_{i,t+1} = \frac{\widetilde{w}_{i,t}}{a^{\frac{1}{1-\alpha}}\pi}, \\ & \quad \tau_{i,t+1} = \tau_{i,t} + 1, \\ & \quad \widetilde{C}_{i,t} + a^{\frac{1}{1-\alpha}}\widetilde{\Omega}_{i,t+1} = (1+r-\delta)\widetilde{\Omega}_{i,t} + \widetilde{w}_{i,t}H_{i,t} + \widetilde{beq}_i, \\ & \quad \widetilde{\Omega}_{i,t+1} \geq 0, \\ & \quad H_{i,t} = \left(G_{i,t}^H\right)^{\theta-1}\left(\frac{\widetilde{w}_{i,t}}{\widetilde{w}}\right)^{-\theta}\hat{L}. \end{aligned} \tag{A.6}$$

Note that, in periods where worker i cannot change the wage, the value function V_{nadj}^W depends on the number of periods until the wage can be adjusted again, which is $J_w - 1$ in the period following the period where the wage is adjusted.

Workers who can adjust their nominal wages only after $\tau_{a,i,t}$ periods face the following problem:

$$V^W_{nadj}(\tau_{i,t}, \widetilde{w}_{i,t}, \widetilde{\Omega}_{i,t}, \tau_{a,i,t}) = \max_{\widetilde{C}_{i,t}, \widetilde{\Omega}_{i,t+1}} \left\{ \ln(\widetilde{C}_{i,t}) - \eta \frac{H_{i,t}^{1+\kappa}}{1+\kappa} + \beta S(\tau_{i,t+1}) V^W_{nadj}\left(\tau_{i,t+1}, \widetilde{w}_{i,t+1}, \widetilde{\Omega}_{i,t+1}, \tau_{a,i,t+1}\right) \right\}$$

s.t.

$$\begin{aligned} &\widetilde{w}_{i,t+1} = \frac{\widetilde{w}_{i,t}}{a^{\frac{1}{1-\alpha}} \pi}, \\ &\tau_{i,t+1} = \tau_{i,t} + 1, \qquad \tau_{a,i,t+1} = \tau_{a,i,t} - 1, \\ &\widetilde{C}_{i,t} + a^{\frac{1}{1-\alpha}} \widetilde{\Omega}_{i,t+1} = (1 + r - \delta)\widetilde{\Omega}_{i,t} + \widetilde{w}_{i,t} H_{i,t} + \widetilde{beq}_i, \qquad \widetilde{\Omega}_{i,t+1} \geq 0, \\ &H_{i,t} = \left(G^H_{i,t}\right)^{\theta-1} \left(\frac{\widetilde{w}_{i,t}}{\widetilde{w}}\right)^{-\theta} \hat{L}. \end{aligned} \tag{A.7}$$

Note that

$$V^W_{nadj}(\tau_{i,t}, \widetilde{w}_{i,t}, \widetilde{\Omega}_{i,t}, 0) = V^W_{adj}(\tau_{i,t}, \widetilde{\Omega}_{i,t}). \tag{A.8}$$

For a worker i who reaches the retirement age T in period t, the value function in the subsequent period is given by the value functions of retirees, i.e.,

$$V^W_{nadj}(T+1, \widetilde{w}_{i,t+1}, \widetilde{\Omega}_{i,t+1}, \tau_{a,i,t}) = V^W_{adj}(T+1, \widetilde{\Omega}_{i,t+1}) = V^R(T+1, \widetilde{\Omega}_{i,t+1}). \tag{A.9}$$

The retirees' value function is the outcome of the optimization problem:

$$V^R(\tau_{i,t}, \widetilde{\Omega}_{i,t}) = \max_{\widetilde{C}_{i,t}, \widetilde{\Omega}_{i,t+1}} \left\{ \ln \widetilde{C}_{i,t} + \beta S(\tau_{i,t+1}) V^R(\tau_{i,t+1}, \widetilde{\Omega}_{i,t+1}) \right\}$$

s.t.

$$\begin{aligned} &\tau_{i,t+1} = \tau_{i,t} + 1, \\ &\widetilde{C}_{i,t} + a^{\frac{1}{1-\alpha}} \widetilde{\Omega}_{i,t+1} = (1 + r - \delta)\widetilde{\Omega}_{i,t}, \\ &\widetilde{\Omega}_{i,t+1} \geq 0, \end{aligned} \tag{A.10}$$

where we have taken into account that retirees do not receive bequests.

The initial condition for newborn households is

$$\widetilde{\Omega}_{i,t} = 0 \qquad \textit{for } \tau_{i,t} = 1.$$

The future value function of individuals in the final periods of their lives is normalized to zero.

Finally, we state an expression for bequests:

$$\widetilde{beq}_i = \begin{cases} \frac{1}{\sum_{\tau'=1}^{T-40} \psi(\tau')} \int_0^1 \psi(\tau_{i'})\left(1 - S(\tau_{i'})\right)\widetilde{\Omega}_{i'}\, di' & \textit{if } \tau_i \leq T - 40 \\ 0 & \textit{if } \tau_i > T - 40, \end{cases} \tag{A.11}$$

where the integral in the above expression stands for the detrended aggregate wealth left by individuals who die. The term $\sum_{\tau'=1}^{T-40} \psi(\tau')$ represents the number of individuals who receive bequests, measured as a fraction of the total population. Recall that all individuals who are at most 10 years, i.e., 40 quarters, from retirement receive bequests. □

Appendix B. Choice of parameter q

As has been explained in Footnote 4, the growth rate of firm-specific productivity q in our model corresponds to the ratio of the experience gross growth rate and the cohort gross growth rate in Adam and Weber (2019). Adam and Weber (2019) do not report estimates of this ratio explicitly. However, they calculate several possible values for optimal inflation from which values for q can be inferred.

In their baseline estimation of optimal inflation rates, they find a mean of the optimal inflation rate of 1.1 % (see p. 728 of their article). When wages are flexible and a sales subsidy eliminates the state-steady distortions due to monopolistic competition (as in their model), the optimal steady-state inflation rate equals q. Thus $q = 1.011^{1/4}$ would be in line with the value that they obtain implicitly in their baseline estimation. An alternative value for q can be obtained as follows. Adam and Weber use BDS employment data to infer q. In particular, they compute the ratio of average employment in establishments that are not new over the average employment in all establishments. They obtain a ratio of 1.07. As mentioned on p. 727 in their paper, the employment ratio raised to the power of $1/(\varepsilon - 1)$ gives the value of q (where we use the notation adopted in the present paper).[14] A low value for the elasticity

[14] This relationship between the employment ratio and q holds in our paper as well.

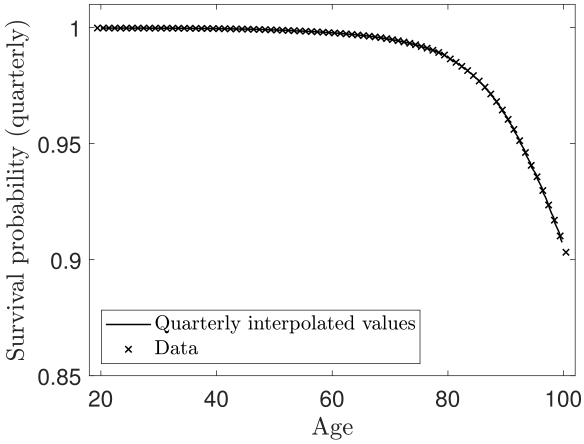

Fig. C.12. Survival probabilities by age: Data vs. interpolated values.

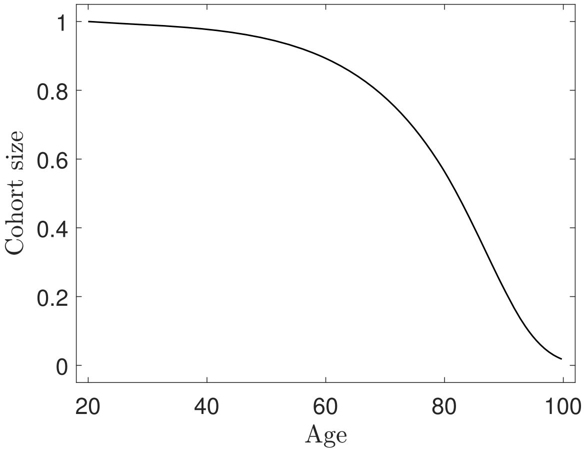

Fig. C.13. The evolution of cohort sizes over lifetime. The size of the newborn cohort is normalized to 1.

of demand ε that they consider is 3.8, which results in $q \approx 1.024^{1/4}$. Moreover, we have conducted an additional own analysis of BDS data that, in a way similar to Adam and Weber, identifies q from employment data. This analysis that also uses more recent data leads to annual growth rates of firm-specific productivity below 1 %.[15]

As mentioned in Adam and Weber (see the discussion around Eq. (6) on p. 707), an upper bound has to be imposed on q (in our notation) to ensure the existence of a well-defined steady state. In our paper, this implies that q has to satisfy

$$q < \left(\frac{1}{1-d}\right)^{1/(1-\varepsilon)} \approx 1.005. \tag{B.1}$$

We select $q = 1.02^{1/4}$, which is slightly below the largest admissible value. As mentioned in the main text, we deliberately choose a large value, as large values of q push the optimal inflation rate in our model upwards. In Section 3.6, we also examine $q = 1$ as a robustness exercise. As discussed there, the value of q has only a small effect on the level of optimal trend inflation in our model (see Table 2).

Appendix C. Survival probabilities

C.1. Data source

We use life tables for the U.S. population to compute the quarterly survival probabilities for the model parametrization. The human mortality database contains detailed data for our variable of interest, which is the probability of an individual aged x to die before turning x + 1.[16] In the human mortality database, this variable is *q(x)*.

[15] The details are available upon request.
[16] See https://www.mortality.org/Home/Index.

Following Bielecki et al. (2022), we consider average death probabilities between 1999 and 2018 of the whole population. In the model, the youngest working cohort is 20, and all individuals die with certainty at the end of age 99.75. We use data on age groups between 19 and 100 to calculate interpolated quarterly survival probabilities.

C.2. Computation of quarterly survival probabilities

In the model, households work from the age of 20.00 until the age of 64.75. When they turn 65, they retire. They die with certainty after the age of 99.75. This implies 180 periods of working life and 140 periods of retirement if a household survives until the maximum age of 99.75. In every period of their lives, households face a positive death probability, which implies a specific probability of surviving until the next quarter. As the model period is one quarter, we have to interpolate the data, which is only available on an annual basis, to obtain missing values.

C.3. Results

The resulting survival probabilities are depicted in Fig. C.12. In the left graph, the solid line corresponds to the quarterly survival probabilities obtained from our interpolation procedure, while the x-points are the average constant quarterly survival probabilities $\tilde{\bar{s}}_x$, which we obtain from the data. In the right graph the interpolated survival probabilities are translated into annual survival probabilities (solid line) and the x-points are the original data points. The annualized survival probabilities are the product of quarterly survival probabilities in between two birthdays. In the graphs, the values of the survival probability at age x can be interpreted as the probability to survive until age x + 1.
Note that for illustrative reasons, the survival probability in the last period of life is not set to zero in the graphs.

For the case without population growth, the evolution of cohort sizes is displayed in Fig. C.13, where we have normalized the initial cohort size to one. When individuals are close to reaching the age of 100, less than 2 % of their age cohort is still alive.

Appendix D. Updated estimate of age-dependent productivities

As stated in the main part of the paper, we use standard values from Hansen (1993) to pin down the age-specific productivities of workers. As his analysis relies on BLS data from 1979 to 1987, we have updated his analysis to more recent data, namely the years 2013–2019.

The findings for male workers are displayed in Fig. D.14. As can be seen, our updated version leads to a hump-shaped productivity-age profile as well. Compared to the original results, the profile is steeper for younger workers, which would tend to strengthen our finding that deflation may be desirable.

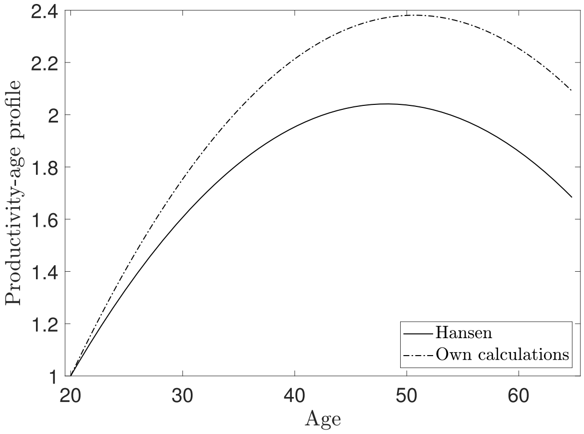

Fig. D.14. Individual labor productivity for different age groups, where the productivity of workers aged 20 years have been normalized to one. Solid line: second-order polynomial fitted to the estimates in Hansen (1993). Dash-dotted line: second-order polynomial fitted to our updated version of the estimates.

Appendix E. Algorithm

In this section, we describe how we compute the steady states of our model. The different steps are the following:

1. Fix a value of π.
2. Guess values of r, $\widetilde{w}$, $\widetilde{Y}$.
3. Solve firms' optimization problem via value-function iteration and simulate firm behavior to obtain the distribution of $p_{f,t}$ for all generations of firms.

4. Use the joint distribution of $X_{f,t}$ and $p_{f,t}$ to determine goods-market efficiency A^G via Eq. (17).
5. Determine the aggregate profits of firms.
6. Determine the aggregate demand for capital $\widetilde{K}$ and labor L by computing the individual demands for all intermediate-goods firms, for given prices $p_{f,t}$.
7. Use backward induction to determine the policy functions for all age groups of retirees and workers.
8. Simulate the behaviors of workers and retirees to obtain the distribution of individual wages $\widetilde{w}_{i,t}$ and capital supply $\widetilde{K}_{i,t}$.
9. Update guess on r, $\widetilde{w}$, $\widetilde{Y}$:
   - Use individual wages to determine the detrended real wage for composite labor (see Eq. (11)).
   - Determine detrended aggregate output $\widetilde{Y}$ using Eq. (15). Aggregate consumption $\widetilde{C}$ is determined by aggregating individual consumption choices.
   - Update r upwards or downwards, depending on whether the demand or the supply of capital are larger.
10. Compare the updated r, $\widetilde{Y}$ and $\widetilde{w}$ with the previous guesses. If the changes are larger than a critical value or if the difference between the demand and supply of capital is larger than a critical value, go back to 3.

Appendix F. Inflation bias

It may be interesting to contrast the results of Section 3.6 with those found in Section 3.7. Section 3.6 showed that the median preferred inflation rate is mildly positive. By contrast, the welfare-maximizing inflation rate found in Section 3.7 is typically negative. If the political process tends to implement the median preferred inflation rate, then it will result in a rate that is higher than the socially optimal one. Thus our paper identifies a new source of inflation bias which is complementary to the traditional one that is due to time-inconsistent policies (Kydland and Prescott, 1977; Barro and Gordon, 1983).

This effect becomes more pronounced when one considers that the political process tends to overrepresent older individuals. Fig. F.15 shows that voter turnout in U.S. nationwide elections varies strongly by age, with those near retirement substantially more likely to vote than the young. Weighting age groups by both their population shares and their turnout rates raises the median preferred inflation by roughly 25 basis points. In our main scenario, the median preferred rate is $0.5\,\%$ rather than $0.25\,\%$. Under aggregate productivity growth of $2\,\%$, it is $-0.5\,\%$ instead of $-0.75\,\%$. Hence, this new source of inflation bias–implying inflation above the social optimum–may be amplified when younger individuals are underrepresented in the political process.

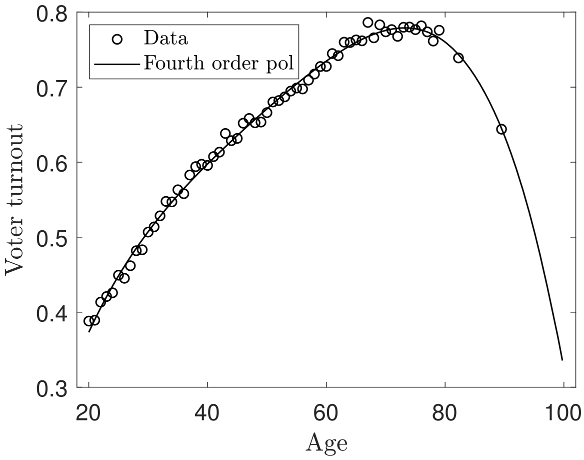

Fig. F.15. Voter turnout in nationwide elections in the United States as a function of age. Source: Current Population Survey provided by the U.S. Census Bureau from 2010 to 2018, own calculations.

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