# Political Economy of Climate Change Adaptation*

Yasmine van der Straten†, Enrico Perotti‡, Frederick van der Ploeg§

Updated: October 28, 2024
First Version: February 15, 2024

**Abstract**

We study the evolution of voter support for public adaptation when political preferences are shaped by rising climate risk and economic inequality. Political support for tax-funded intervention to preserve habitable land evolves over time when households differ in age, income and beliefs. Support for public adaptation is initially low, rising as climate risk increases. We show that the political equilibrium experiences a tipping point in response to habitat loss if beliefs are not too dispersed, leading to a shift towards a more active adaptation policy. A steady rise in inequality may induce a second tipping point, but the policy impact depends on the balance between the gap in income and beliefs. Overall, public intervention is undermined by a *"tragedy of the horizon"* effect as cohorts internalize only partially its long-term benefits for future generations. This prevents public adaptation from converging to the social optimum even when political support is highest.

**Keywords** — Climate change adaptation, economic inequality, tragedy of the horizon, political tipping points.

**JEL codes** — D63, H23, Q54, Q58.

*For helpful comments, we thank Tim Besley, Beatrice Weder di Mauro, Benoit Crutzen, Helios Herrera, Paolo Fulghieri and Hans Peter Grüner. This paper further benefited from discussions with participants of the EJPE-CEPR-Bocconi Political Economy Conference 2024, the CEPR Paris Symposium 2023, the SURED Conference on Sustainable Resource Use and Economic Dynamics 2024, the Dutch Environmental and Resource Economics Day 2024 and the Seminars on Environmental Economics and Management of Sustainability.

† Amsterdam School of Business, University of Amsterdam. Plantage Muidergracht 12, 1018 TV Amsterdam, The Netherlands. Email: y.vanderstraten@uva.nl.

‡ Amsterdam School of Business, University of Amsterdam. Plantage Muidergracht 12, 1018 TV, Amsterdam, The Netherlands.

§ Department of Economics, University of Oxford. 10 Manor Road, OX1 3UQ, Oxford, United Kingdom. Also affiliated with the Amsterdam School of Economics, University of Amsterdam, Roetersstraat 11, 1018 WB Amsterdam, The Netherlands.

# I. Introduction

Climate change leads to a gradual rise in global temperatures, and destabilizes the weather system. Extreme weather events, such as severe storms, rising sea levels and desertification reduce habitatable land and the housing stock, and undermine living conditions. Yet coordinating a response to mitigate climate change is challenging, as policy choices suffer from time inconsistency problems (e.g., Besley and Persson, 2023; Hsiao, 2023). As the green transition picks up slowly, global warming is likely to continue in the coming decades. The sea level and the risk of extreme weather events will thus continue to rise in the near future, leading to a steady loss of safely habitable territory (Burzyński et al. (2019)). Individuals and corporations will adapt to a changing climate, either by taking own measures (e.g., Fried, 2022; Van der Straten, 2024) or through financial markets (Kahn et al., 2024). Yet most climate damage is best contained by large-scale investments in public adaptation to limit the impact of global warming. Such a collective effort is fiscally costly, and depends on political support.

We study the evolution of voter support for public adaptation as climate risk rises, in a context of rising economic inequality.[1] Dechezleprêtre et al. (2022) empirically identify that the three major predictors of whether people support a given climate policy are its impact on the own household, distributional impacts, and its perceived effectiveness.[2] We build on these insights and consider in our framework households that differ in age, income, and their beliefs on the effectiveness of collective intervention.[3]

Our focus lies on exploring in an overlapping generation model how majority coalitions around climate policy will evolve over time as both climate risk and inequality rise. We allow for climate shocks that damage the housing stock which lead to the degradation of land (e.g., through rising sea levels, cf. Van der Straten, 2024). Housing accounts for roughly two-thirds of global wealth and approximately a tenth of the global housing value is under threat from global warming.[4] Physical damages might be contained by investing in protective infrastructure, yet funding this investment poses political challenges. Insufficient adaptation to climate change leads to rising damages and a steady loss of the housing supply.

Our aim is to better understand how political coalitions respond over time to a rising climate threat. In each period, households vote for the party proposing an adaptation rate (defined as adaptation spending over aggregate income) closest to their preference.[5] Initially we study voting cast under a Rawlsian veil of ignorance, when young and old households vote before they know their income, though they are aware of rising inequality stemming from technological change. Over time, the equilibrium policy will adjust to the impact of a rising climate risk and growing inequality. The investment in public adaptation is the outcome of this electoral competition, where the majority coalition determines the equilibrium climate

[1] See Döttling and Perotti (2017), which is essential to describe our increasingly polarized views (e.g., Voorheis et al. 2015).

[2] Dechezleprêtre et al. (2022) explore international attitudes toward climate policies. Their results indicate that support for an active climate policy is influenced by its perceived effectiveness in reducing emissions, redistributive effects on lower-income households, and direct impact on people's own households.

[3] Pessimistic beliefs about the efficacy of climate measures is visible in survey evidence (Douenne and Fabre, 2022). Also Bernstein et al. (2022) show that differing beliefs about climate risk contribute to partisan sorting in housing markets. Specifically, voters with pessimistic views on climate risk are less likely to change their sorting behavior in response to climate change.

[4] See, e.g., "Homeowners face a $25trn bill from climate change" in The Economist, (April 11, 2024).

[5] This formulation may also stand for risk mitigation measures.

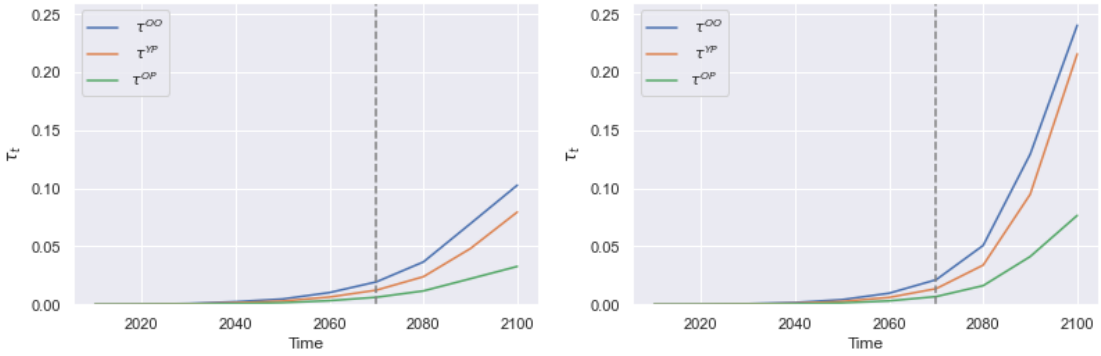



FIGURE 1: **Evolution of the political equilibrium**

*Key: The time paths of the adaptation rate preferred by the old optimists (blue line), the young pessimists (orange line) and the old pessimists (green line) for different RCP scenarios. The dashed, vertical line indicates the point in time at wish the political equilibrium tips. The left panel shows the evolution of the bounds under the RCP 4.5 scenario with modest mitigation and emissions peaking around 2050 and the right panel shows the evolution of the bounds under the RCP 8.5 scenario with almost no mitigation and emissions rising throughout the 21st century.*

policy. We focus on the case in which the old cohort is more politically active, and pessimistic voters constitute a majority in each cohort - which is most relevant empirically. The set of feasible coalitions is then either a political majority of the older cohort (who are not exposed to future climate risk), a coalition of old and young pessimists (who are not very supportive of an active policy), or a (more committed) coalition of young pessimists and old optimists.

We show that the young pessimists emerge as the pivotal group in the political equilibrium if beliefs about policy efficacy are sufficiently dispersed. Initially, as climate risk is limited, the pessimistic young have weak incentives to support public intervention. Consequently, the initial majority coalition consists of all pessimists who favour limited public adaptation. A consequence is a steady loss of habitat. Over time, as climate risk rises, support for public adaptation increases among all groups of voters.[6] However, the extent to which their political support increases depend on the value households (perceive to) have at risk. We show that this may induce a tipping point in the political equilibrium, as the majority coalition changes in response to habitat loss. The main insight is that the policy preferences of the pivotal group adjusts at a faster rate than those of their initial allies. Young households receive a larger benefit from adaptation since they own the habitat which is in need of protection. Then, as climate risk rises, this increases the value of residual habitat and hence the value of preventive measures. As the preferred adaptation rate of the pivotal group rises faster, it gradually moves closer to the rate proposed by old optimists, as shown in Figure 1. Provided that beliefs on the efficacy of public adaptation are not too dispersed, the winning coalition shifts once climate damages and the ensuing habitat loss become sufficiently large. This political tipping point leads to a discrete upwards jump in public adaptation investments.

While the political shift leads to a discrete policy shift, the adaptation choice still falls short of its

[6]Cain et al. (2020) and Demski et al. (2017) show how direct flood experiences reduce partisan polarization on climate priorities and increase support for mitigation policy as well as personal adaptation efforts; see also Rasmussen et al. (2021); MacInnis and Krosnick (2020).

socially optimal long term value. We refer to this difference between the ideal policy and what is chosen in the political process as the *adaptation gap*. The adaptation gap is in part due to pessimism about policy efficacy, but also due to the "tragedy of the horizon" effect that arises as households only care about the present and near future supply of habitat, but do not fully internalize the benefits of public adaptation for all future generations.

We extend our analysis to incorporate a rising income inequality, a crucial concomitant trend in the economy. Realistically, old households know their income level, which will affect their preferences over adaptation. The effect of a steady rise in inequality can be shown to lead to a rise in the preferred adaptation rate of the low-income old cohorts, since the net-benefits of public intervention are higher for low-income households. This may induce a second political tipping point, now leading to a majority coalition of the young pessimists and old low-income voters. Its effect on public adaptation policies is ambiguous, however. We show that the shift leads to less public investment in adaptation when inequality rises gradually, due the inclusion of pessimistic old low-income households in the new majority coalition has a backlash effect. Only if inequality rises at a sufficiently fast pace, its impact dominates the effect due to dispersion in beliefs. In this case the second tipping point leads to a discrete rise in support for public investment in adaptation. This latter result underscores the challenges for the political feasibility of climate policy in an increasingly polarized society. There is rising evidence that older voters with lower income in a ruling coalition may resist a robust climate adaptation policy. In contrast, young low income voters would be more favorable to reduce the adaptation gap. This underscores the importance of taking account of economic inequality in the fight against climate change.

The remainder of paper is structured as follows. We discuss the related literature in Section 2. In Section 3 we introduce the baseline framework. The conditions relevant for the definition of an equilibrium are derived in Section 4. In Section 5, we introduce the political economy framework and derive the political equilibrium. Section 6 provides a quantitative assessment of the evolution of the equilibrium over time. We derive the optimal policy in Section 7. We extend the model to allow for inequality in Section 8. Section 9 concludes.

## II. Related Literature

The normative literature on climate policy studies mitigation policies such as optimal carbon pricing (e.g., Nordhaus, 2008; Golosov et al., 2014; Dietz and Stern, 2015). Our paper is related to earlier work on adaptation to climate change (e.g., Lasage et al., 2014; Muis et al., 2015; Fried, 2022; Van der Straten, 2024), which has predominantly focused on private incentives to adapt to climate change. Fried (2022) studies investments in seawalls, stilts, or other forms of adaptation to cope with severe storms in the US. Fried (2022) treats damages from storms as idiosyncratic shocks, showing that the idiosyncratic risk component of climate damages significantly impacts adaptation and the welfare cost of climate change. Van der Straten (2024) studies how financial incentives shape private adaptation efforts. While price signals lead to efficient adaptation in frictionless markets, Van der Straten (2024) shows that

credit-constrained households have weaker incentives to adapt to climate change, indicating that pricing alone may be insufficient. We extend the framework of Van der Straten (2024) and study how political support for *public* adaptation evolves over time, highlighting that even when political support is highest public policy suffers from a tragedy of the horizon effect.

Hong et al. (2023) show that mitigation of emissions alone cannot deal with the effects of global warming on weather disasters (tropical cyclones) and the economy. They analyze how the private and public sectors should adapt to manage disaster risks to the capital stock when they learn about the adverse consequences of global warming for disaster arrivals. Hong et al. (2023) show that adaptation is more valuable under learning. We do not allow for learning, but we do allow for differences in subjective beliefs about the effectiveness of public adaptation. Since we allow for subjective beliefs about effectiveness of public adaptation, our results are related to recent studies on how climate risk belief affect coastal housing markets (e.g., Murfin and Spiegel, 2020, Baldauf et al., 2020, Bakkensen and Barrage, 2021). Bakkensen and Barrage (2021) show that heterogeneity in beliefs reconciles the mixed empirical evidence on whether flood risk is capitalized in house prices. They find that there is significant under-estimation of flood risks and sorting based on flood risk beliefs and amenity values.[7]

Our paper also relates to Bernstein et al. (2022), who show that differing beliefs about climate risk contribute to partisan sorting in housing markets. They show that voters with pessimistic views on climate risk are less likely to change their sorting behavior in response to climate change - which indicates that these households may ultimately bear the burden of climate change. Our paper illustrates that these households also frustrate the political process in which spending on public intervention is determined. Therefore, voters with pessimistic views may not only bear a larger burden themselves, but also increase the burden of climate change borne by society at large.

Our work is also related to the literature studying political economy considerations in a climate change context. Besley and Persson (2023) study the joint evolution of environmental values, technologies and policies. Their analysis indicates that the transitions of values and technologies create a dynamic complementarity which can either promote the green transition, or create a vicious circle - leading to a climate trap. Delfgaauw and Swank (2024) also develop a political-economy model of a climate trap. Our analysis differs from theirs as we focus on climate change adaptation policies and the interplay between age, beliefs, and income. Acemoglu and Autor (2011) show that secular stagnation with declining overall growth can lead to a more concentrated income distribution and greater polarization of society. This calls for a dynamic political economy approach, making explicit the differential impact of climate change across generations. Intuitively, more extreme weather events or sea rise will slowly induce more support for adaptation but also increase preference divergence across age cohorts. The literature studying political economy considerations in a climate change context has abstracted from how such differential impacts affect the political outcome. Our second contribution is therefore to highlight the importance of controlling economic inequality in containing the damage of climate change, as tension between inequality

[7] In a related study Ikefuji et al. (2022) use a hedonic pricing model to study how subjective perception of earthquake risks in five Japanese cities affect real estate prices in the short and in the long run.

and beliefs significantly affects the political feasibility of climate policy.

Since we compute the political equilibrium by considering possible coalitions of subgroups (old versus young, high and low income, optimists versus pessimists), this framework is more broadly related to Razin and Sadka (1999), Razin and Sadka (2000), Razin et al. (2002), and Razin (2021), who study the political economy of migration and pensions in an overlapping-generations model with high- and low-income households. We also use an OLG framework to study shifts in the political majority, i.e., political tipping, in response to gradually rising sea levels and the need for public intervention to supply public adaptation.

## III. Baseline Model

Time is discrete and denoted by $t \in \{0, 1, ..., \infty\}$. The economy is characterized by two overlapping generations, each consisting of a unit mass of households. Households are heterogeneous in terms of skills, which are exogenous, and use their wage income to finance consumption consisting of housing (in fixed supply) and a numeraire good (in abundant supply). At the start of each period, an extreme weather event occurs, which hits a fraction of households and damages their housing capital. All risk is idiosyncratic, and the economy's climate risk exposure rises deterministically over time due to gradual sea level rise. The government can reduce risk exposure of households by investing in public adaptation (e.g., building of seawalls, dykes, or stilts) which is financed by a flat-tax on labour income.

Political parties propose an adaptation rate and compete for votes in each period's electoral competition. Households have heterogeneous beliefs about the efficacy of public adaptation and vote for the party which proposes an adaptation rate closest to their preferred rate.

### *A. Households*

Households live for two periods and derive utility from consuming housing and a non-durable consumption good. When young, households purchase housing capital, denoted by $L$, from the old generation at an endogenous price $p$. Once old, households channel the proceeds from selling the house, as well as the return earned on their savings to the purchase of a numeraire good, denoted by $c$. There is an initial generation at $t = 0$endowed with the supply of houses, $\bar{L}_0$.[8]

#### *A*.1 Skills and Wages

Households have heterogeneous (and exogenous) skills, which determine household income. We denote two skill levels and denote high skills and income by $h$ and low skills and income by $l$. A fraction $\phi$ of households is high-income, denoted by $h$, where

**Assumption 1.** *The fraction of high-skill households, $\phi$, is less than or equal to 0.5.*

[8]As our focus is on habitat, we abstract from housebuilding.

Households supply one unit of labour. High-skill workers have income $y_{h,t} = q$ and low-skill workers have $y_{l,t} = w$, where the high-skill wage $q$ exceeds the low-skill wage $w$.[9].

### *A.2* Preferences

Households have quasi-linear preferences over housing and non-durable consumption, and care about the housing stock, $\bar{L}$ that they leave behind after their lifetime. Then, expected lifetime utility is given by

$$U\left(L_{i,t}, c_{i,t+1}, \bar{L}_{t+1}\right) = v\left(L_{i,t}\right) + c_{i,t+1} + f\left(\bar{L}_{t+1}\right), \tag{1}$$

where $v\left(L_{i,t}\right)$ is the utility for young household $i$ in period $t$ from owning $L_{i,t}$ units of housing with $v'(\cdot) > 0$ and $v''(\cdot) < 0$. The utility that an old household $i$ obtains in period $t+1$ from leaving behind a housing stock of size $\bar{L}_{t+1}$ for the next generation equals $f\left(\bar{L}_{t+1}\right)$ with $f'(\cdot) > 0$ and $f''(\cdot) < 0$.

## *B. Climate Change*

The probability that a given household is hit by a (climate-related) extreme weather event in period, $t$ is denoted by $\gamma_t$, and increases deterministically over time (cf. Van der Straten, 2024). By the law of large numbers, $\gamma_t$ is the fraction of households that suffers climate-related damages in any period $t$. The average loss to housing capital conditional on being hit by an extreme weather event is $\mu$ while the losses suffered by a given household, $i$, in period, $t$ are $\xi_{i,t}$. These losses are idiosyncratic, and $\xi_{i,t}$ is stochastic with distribution, $F\left(\xi_{i,t}\right)$, which is i.i.d. across households. We then have

$$\mathbb{E}_t\left(\xi_{i,t+1}\right) = \mathbb{E}_t\left(\xi_{i,t+1}\middle|\text{Hit by Extreme weather event}\right) \cdot \mathbb{P}\left(\text{Hit by Extreme weather event}\right) = \mu\gamma_{t+1}. \tag{2}$$

Housing capital of household $i$ after an extreme weather event is reduced to

$$L_{i,t+1} = \left(1 - \mu\gamma_{t+1}\right) L_{i,t}. \tag{3}$$

The aggregate supply of houses, $\bar{L}_{t+1}$, thus evolves endogenously according to

$$\bar{L}_{t+1} = \int_0^1 \left(1 - \xi_{i,t+1}\right) di L_t \tag{4}$$

$$\overset{\text{LLN}}{=} \left(1 - \mu\gamma_{t+1}\right) \bar{L}_t. \tag{5}$$

Hence, the materialization of climate risk translates into a decline in the supply of inhabitable houses over time (cf. Burzyński et al., 2019).

[9] As the economy is open, wages are exogenous. Through the factor price frontier they are ne a decreasing function of the world interest rate.

## C. Housing Market Dynamics

The housing market opens after any extreme weather events take place. Since destroyed housing capital has zero liquidation value, households with a mortgage risk default and pay the risky rate of return, $\hat{r} > r$, where the interest rate $r$ is exogenous. Net savings of a household $i$ in period $t$ is defined as

$$S_{i,t} \equiv y_{i,t} - p_t L_{i,t}, \tag{6}$$

where $S_{i,t} \geq 0$ indicates that household $i$ is a net lender and $S_{i,t} < 0$ implies it is a net borrower. Default occurs once losses become sufficiently large, i.e.,

$$p_{t+1} L_{i,t+1} \leq (1 + \hat{r})(-S_{i,t}). \tag{7}$$

The loan-to-value ratio is defined by

$$LTV_{i,t+1} \equiv \frac{(1 + \hat{r})(-S_{i,t})}{p_{t+1} L_{i,t}}. \tag{8}$$

This implicitly defines the threshold of losses above which a homeowner defaults by

$$\hat{\xi}_{i,t+1} = 1 - LTV_{i,t+1}, \tag{9}$$

while the probability of default is

$$\chi_{i,t} = \left(1 - F\left(\hat{\xi}_{i,t+1}\right)\right). \tag{10}$$

## D. Public Policy Intervention

Government intervention is called for to (i) prevent a sharp fall in supply of habitat and (ii) to alleviate any underinvestment in private protection (cf. Van der Straten, 2024). There are various measures available for government intervention, such as public adaptation (e.g., the Deltawork in the Netherlands after the flood of 1953), subsidizing private adaptation, and bailing out households in case of large adverse shocks. The first two policy measures are *preventive*. The third measure is a form of *corrective* action. Corrective action may not always be effective, however, as bailouts may trigger moral hazard.[10] We focus on the first measure.

### *D*.1 Public Adaptation

To protect households from idiosyncratic losses when an extreme weather event occurs, the government invests in public adaptation (e.g., building of seawalls or dykes). Since large-scale adaptation investments can take substantial time to realize, we assume that the pay-off is only realized in the next period. Define

[10] Another form of corrective action is the restoration of habitat. This may be more difficult than preventing its loss ex ante and we therefore assume that it is prohibitively costly to do.

$X_{G,t} \in [0,1)$ as the public choice of protection or public adaptation. It represents the percentage by which households' idiosyncratic losses from climate shocks are curbed in period $t+1$. For a given choice of public adaptation, the distribution of household losses $F(\xi_{i,t+1})$ is shifted to the left by $X_{G,t}\mu\gamma_{t+1}$:

$$\mathbb{E}_t\left(\xi_{i,t+1}\right) = \left(1 - X_{G,t}\right)\mu\gamma_{t+1}. \tag{11}$$

This embeds the assumption that public intervention cannot be targeted but instead reduces the losses of all households. For each household, the expectation of the housing capital that remains preserved after the extreme weather event is then

$$L_{i,t+1} = \left(1 - \left(1 - X_{G,t}\right)\mu\gamma_{t+1}\right) L_{i,t}. \tag{12}$$

Since adaptation preserves housing capital, it reduces the speed at which the supply of houses falls[11]

$$\bar{L}_{t+1} = \int_0^1 \left(1 - \xi_{i,t+1}\right) diL_t \tag{13}$$

$$\overset{\text{LLN}}{=} \left(1 - \left(1 - X_{G,t}\right)\mu\gamma_{t+1}\right)\bar{L}_t. \tag{14}$$

### *D*.2 Finance of Public Adaptation

Investments in public adaptation come at a cost, $\psi\left(X_{G,t}\right) = \frac{1}{2}\bar{L}_t X_{G,t}^2$, which is proportional to the aggregate housing stock, $\bar{L}$. Public adaptation is financed with a flat labour income tax, $\tau_t$, called the adaptation rate. The tax burden is shared among young and old households, and taxes cannot be targeted at a social group[12] The budget constraint for household $i$ in each period $t$ is

$$\left(1 - \tau_t\right) y_{i,t} \leq p_t L_{i,t} + S_{i,t}. \tag{15}$$

### *D*.3 Optimistic and Pessimistic Beliefs about the Efficacy of Public Intervention

The government invests in public adaptation before young households purchase housing capital. So, when choosing demand for housing capital, households take account of the benefits of public adaptation (i.e., curbing idiosyncratic losses in the next period).[13] We assume households have different views on the effectiveness of public adaptation, where $\theta_j \in \{\underline{\theta}; \bar{\theta}\}, j \in \{P, O\} \leq 1$ denote beliefs of a household of type $j$ about the effectiveness of public adaptation. Individuals with $\theta_P = \underline{\theta} > 0$ are pessimists, and those with $\theta_O = \bar{\theta} > \underline{\theta}$ are optimists.

**Assumption 2.** *Society is dominated by pessimists, so the fraction of pessimists is* $\omega > 0.5$.

[11]This indicates that adaptation does not increase the utility from owning housing capital in the current period. Rather, adaptation increases household utility by raising the stock of undamaged housing capital which can be sold in the next period.

[12]If neither spending nor taxes can be targeted to specific voter groups and politicians cannot appropriate tax revenues, policy preferences become monotonic in the parameter that distinguishes households with richer households wanting a smaller government as taxes are proportional to income (cf. Persson and Tabellini, 2002).

[13]For simplicity, we focus for the time being at the unconstrained case. The case of constrained household is more cumbersome due to the binding financial constraints.

Beliefs of households, $\theta_j$, are independent of household income, but capture the ideological beliefs or (perceived) quality of public institutions of a given household. E.g., if $\underline{\theta} = 0$, pessimists maximizes utility assuming that public adaptation is fully ineffective.[14] But, if $\bar{\theta} = 1$, optimists maximize utility assuming that public adaptation is fully effective and internalize the full benefits of public adaptation from reducing idiosyncratic losses. Households put more weight on public intervention as the housing stock diminishes due to climatic shocks.

**Definition 1.** *Households $j$'s beliefs scaled by the housing stock in period $t$ are $\tilde{\theta}_{j,t} \equiv \frac{\theta_j}{L_t}$.*

Then, the expectation of household $i$ with beliefs $j$ of losses suffered due to an extreme weather event are

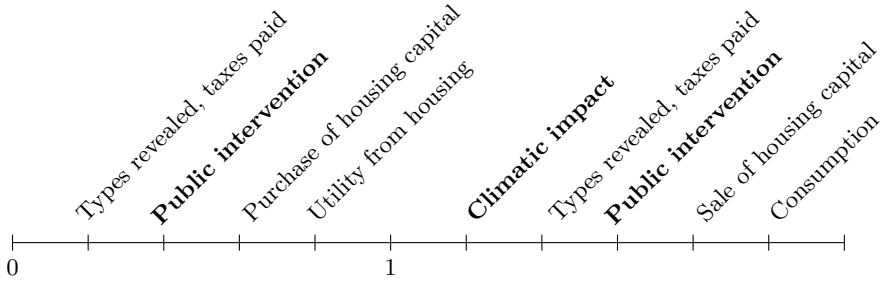
$$\mathbb{E}_{j,t}\left(\xi_{i,t+1}\right) = \left(1 - \tilde{\theta}_j X_{G,t}\right) \mu \gamma_{t+1} \tag{16}$$

and the expected housing capital that remains after the extreme weather event is

$$\mathbb{E}_{j,t}\left(L_{i,t+1}\right) = \left(1 - \left(1 - \tilde{\theta}_j X_{G,t}\right) \mu \gamma_{t+1}\right) L_{i,t}. \tag{17}$$

### *E. Timing of Events*

The time-line of each individual household in the baseline model is




where in period $t = 0$ the household is young, and in period $t = 1$ it is old.

## IV. Equilibrium

Households maximize expected utility subject to their budget constraints and limited liability constraint:

$$\max_{L_{i,t}, S_{i,t}, c_{i,t+1}} \mathbb{E}\left(U\left(L_{i,t}, c_{i,t+1}, \bar{L}_{t+1}\right)\right) = v\left(L_{i,t}\right) + \mathbb{E}_{j,t}\left(c_{i,t+1}\right) + f\left(\mathbb{E}_{j,t}\left(\bar{L}_{t+1}\right)\right) \tag{18}$$

$$\begin{aligned} s.t. \quad & \left(1 - \tau_t\right) y_{i,t} \leq p_t L_{i,t} + S_{i,t} \\ & c_{i,t+1} \leq \left(1 - \tau_{t+1}\right) y_{i,t+1} + \max\left\{p_{t+1}\left(1 - \xi_{i,t+1}\right) L_{i,t} + \left(1 + \hat{r}\right) S_{i,t}, 0\right\} \\ & L_{i,t}, c_{i,t+1} \geq 0, \end{aligned}$$

where $c_{i,t+1}$ denotes the consumption of household $i$ in period $t+1$.

[14] For example, Douenne and Fabre, 2022 use survey data to show that French households reject a carbon tax - and dividend policy, because these households overestimate their monetary losses after the protests of the Yellow Vests movement. Moreover, the authors show that these households do not perceive the policy as environmentally effective, and tend to discard positive information about it - which highlights their mistrust.

## A. Demand for Housing Capital

Housing demand is (due to the assumption of quasi-linear preferences) identical for each household, and determines the housing price.

**Lemma 1.** *Demand for housing in period $t$ equals*

$$L_t^* = L_{i,t}^* = v'^{-1}\left((1+r)p_t - \left(1 - \left(1 - \tilde{\theta}_j X_{G,t}\right)\mu\gamma_{t+1}\right)p_{t+1}\right). \tag{19}$$

*The resulting price of housing capital in period $t$ equals*

$$p_t = \frac{\left(1 - \left(1 - \tilde{\theta}_{j,t} X_{G,t}\right)\mu\gamma_{t+1}\right)p_{t+1} + v'(L_t^*)}{1+r}. \tag{20}$$

The price of housing capital equals the expected present discounted value of the benefits from owning housing capital. These benefits comprise the marginal benefit of owning housing, $v'\left(L_t^*\right)$, plus the revenue from selling the undamaged housing capital in the next period. This revenue falls in future climate risk, $\gamma_{t+1}$ (cf. Van der Straten, 2024), and increases in the level of public adaptation.

## B. Demand for Household Debt

Household debt follows residually. Households with net savings lend to others households while households with negative savings take out a mortgage.

## C. Equilibrium and Market Clearing

A competitive equilibrium is an allocation $\{c_{t+1}, L_t, S_t\}_{t=0}^T$ and prices $\{p_t, \tau_t\}_{t=0}^T$, so that in each period, $t$, given prices, households maximize lifetime utility and all markets clear.

**Housing market** Total housing demand equals total housing supply, so that $\int_0^1 L_{i,t}^* di = \bar{L}_t$. Using Lemma 1, housing market equilibrium requires

$$\bar{L}_t = \left(1 - \left(1 - X_{G,t-1}\right)\mu\gamma_t\right)\bar{L}_{t-1}. \tag{21}$$

**Financial market** Aggregate after-tax income of young households must in equilibrium equal aggregate investment in housing. Hence,

$$(1-\tau_t)\cdot\int_0^1 y_{i,t}^Y di = p_t\left(X_{G,t}\right)\bar{L}_t, \tag{22}$$

where aggregate gross labour income of the young is

$$\int_0^1 y_{i,t}^Y di = \phi q + (1-\phi)\, w. \tag{23}$$

**Government budget balance** Government tax revenues must equal the convex costs of public adaptation,

$$\tau_t \cdot \left( \int_0^1 y_{i,t}^Y di + \int_0^1 y_{i,t}^O di \right) = \frac{1}{2} X_{G,t}^2 \bar{L}_t, \tag{24}$$

where aggregate gross income of the old is the same as that of the young,

$$\int_0^1 y_{i,t}^O di = \int_0^1 y_{i,t}^Y di = \phi q + (1-\phi)\, w. \tag{25}$$

### *C*.1 Housing Market Clearing Condition

The housing market clearing condition pins down the equilibrium price of housing capital:

$$p_t^* = \frac{\left(1 - \left(1 - \int_0^1 \theta_{i,t} di X_{G,t}^*\right) \mu \gamma_{t+1}\right) p_{t+1} + v'(\bar{L}_t)}{1+r}. \tag{26}$$

While exposure to future climate risk curbs house prices (see Section 3.1), the materialization of climate risk puts *upward* pressure on the contemporaneous house prices, since the cut in supply of inhabitable houses increases the marginal benefit of owning a house. If beliefs about efficacy of public adaptation are correct ($\theta_j = 1, \forall j$), this general equilibrium effect dominates if households are sufficiently risk averse with respect to their consumption of housing,

$$\underbrace{-\frac{v''(\bar{L}_j) \cdot \bar{L}_j}{v'(\bar{L}_j)}}_{RRA} \geq 1. \tag{27}$$

In that case, climate disasters increase house prices (cf. Van der Straten, 2024).

Public adaptation reverses the effects of climate change on house prices, since it reduces the exposure to climate risk and the supply of inhabitable houses. However, if the efficacy of public adaptation is disputed (i.e. $\theta_j < 1, \forall j$), households' perceived exposure to climate risk is larger than their true exposure to climate risk. This strengthens the risk-exposure effect (which puts downward pressure on the price), while it leaves the supply effect (which puts upward pressure on the housing price) unchanged. As a result, the condition under which house prices rise with climate risk becomes more stringent. Specifically, if there is dispersion in the beliefs on the efficacy of public adaptation, the coefficient of relative risk aversion (RRA) must be higher than one for house prices increase with climate risk (see Appendix A.1).

### *C*.2 Financial Market Clearing

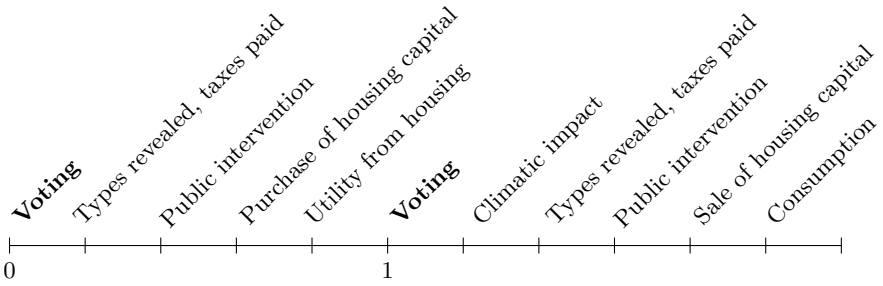
If labour income is insufficient to cover the purchase of a house, some agents need to borrow. Because at least one type of workers must have positive savings (cf. Döttling and Perotti (2017)), the volume of mortgage credit in the economy, $m$, is

$$m_t = \max\left\{0, \left(1 - \phi\left(\eta\right)\right) p_t \bar{L}_t - \left(1 - \tau_t\right) w\right\}. \tag{28}$$

If households are sufficiently risk averse, public adaptation curbs house prices. This price effect dominates the reduction in the fall of the housing stock, so public adaptation reduces the total amount spent on housing. However, because taxation reduces disposable income, the net effect of public adaptation on mortgage credit demand is ambiguous.

## V. Political Economy

Public adaptation is the outcome of electoral competition in which young and old households vote. Households are heterogeneous in terms of their beliefs about the efficacy of public adaptation and vote for the party which proposes a adaptation rate closest to their preferred policy. Households vote under a Rawlsian veil of ignorance, hence before types are revealed ($t = 0$) and before the impact of the climate shock ($t = 1$). The time-line is thus




### *A. Adaptation Rate Preferred by the Young*

A young household prefers a adaptation rate that maximizes its expected lifetime utility.

**Proposition 1.** *The preferred adaptation rate of a young household $i$ with beliefs $\theta_j$ is*

$$\tau_t^{Yj*} = \frac{1}{\bar{L}_t} \cdot \frac{1}{\phi q + (1-\phi)\, w} \cdot \left( \frac{\theta_j \mu \gamma_{t+1} \left( p_{t+1} + \frac{\partial f\left(\mathbb{E}_{j,t}\left(\bar{L}_{t+1}\right)\right)}{\partial\, \mathbb{E}_{j,t}\left(\bar{L}_{t+1}\right)} \right)}{(1+r)} \right)^2 . \tag{29}$$

**Proof:** See Appendix A1.2.

The preferred adaptation rate of the young is high if beliefs about the efficacy of public adaptation ($\theta_j$)is high, since then they internalize a larger part of public adaptation benefits. Additionally, the young's preferred adaptation rate is high if the marginal utility of the expected future housing stock is high $\left( \frac{\partial f\left(\mathbb{E}_{j,t}\left(\bar{L}_{t+1}\right)\right)}{\partial\, \mathbb{E}_{j,t}\left(\bar{L}_{t+1}\right)} \right)$, because then households internalize to a larger extent the effect that climate change has on the welfare of the next generation.

The young's preferred adaptation rate falls in the level of individual income, as the tax is proportional to income, but rises in aggregate labour income, as this increases their capacity to bear the tax-burden. Furthermore, the young's preferred adaptation rate rises as climate risk ($\gamma_{t+1}$) becomes higher and the supply of houses ($\bar{L}_t$) become smaller, since both increase the need for protection and hence increase the

support public adaptation. Finally, the young's preferred choice of adaptation rate rises in the expected future loss of habitat, since this increases the house prices ($p_{t+1}$) and hence value that is potentially lost upon a climatic impact.

### *B. Adaptation Rate Preferred by the Old*

Old households pay taxes and care about the supply of houses, $\bar{L}$, that remains after their lifetime ends. Hence, an old household, $i$ with beliefs $j \in \{O, P\}$, maximizes expected utility.

**Proposition 2.** *The preferred adaptation rate by the old with beliefs $\theta_j$ is*

$$\tau_t^{Oj*} = \frac{1}{\bar{L}_t} \cdot \frac{1}{\phi q + (1-\phi)\, w} \cdot \left( \theta_j \mu \gamma_{t+1} \frac{\partial f\left(\mathbb{E}_{j,t}\left(\bar{L}_{t+1}\right)\right)}{\partial\, \mathbb{E}_{j,t}\left(\bar{L}_{t+1}\right)} \right)^2 . \tag{30}$$

**Proof:** See Appendix A1.3.

As for the young, the old's preferred adaptation rate is high if efficacy of adaptation is believed to be high, the aggregate housing stock is low, aggregate labour income is low, climate risk is high, and the marginal utility obtained from the expected future stock of housing is high. Furthermore, comparing Propositions 2 and 3 indicates that the adaptation preferred by the old is less than that of the young as they have less to gain from public adaptation.

### *C. Feasible Coalitions*

To win elections, parties must receive the majority of the votes. Voters differ along two dimensions: age (young versus old) and beliefs (optimists versus pessimists). None of the groups is large enough to constitute a majority, hence voters must form a coalition to ensure that their preferred policy is implemented. The preferred adaptation rates of the different groups are stated in Table 1. The adaptation rates follow from Propositions 1 and 2, where $\theta_O = \bar{\theta}$, $\theta_P = \underline{\theta}$ and $y_{i,t} = \phi q + (1-\phi)\, w$.

Because $\tau^{YO*} > \tau^{OO*}$ and $\tau^{YP*} > \tau^{OP*}$, we rule out a coalition of young optimists and old pessimists, as these groups are too ideologically dispersed.We rule out the young forming a majority by assuming that there are more old people in society. This implies that young optimists are never part of a successful coalition, since Assumption 2 ensures that a coalition of young optimists and old optimists never constitutes a majority. We assume that coalitions choose a adaptation rate that maximizes their joint utility subject to their budget constraints and expected amount of housing left after the climate disaster.

**Proposition 3.** *If there are fewer young than old households, pessimists constitute a majority ($\omega > 0.5$), and each coalition maximizes joint utility. The set of feasible coalitions is then either (i) a coalition of old optimists and young pessimists with preferred adaptation rate,*

$$\tau_t^{YP,OO*} = A \cdot \left( \frac{\left[ \omega \underline{\theta} p_{t+1} + \left( \omega \underline{\theta} + (1-\omega)\bar{\theta} \right) \cdot \frac{\partial f\left(\mathbb{E}_{YP,OO,t}\left(\bar{L}_{t+1}\right)\right)}{\partial\, \mathbb{E}_{YP,OO,t}\left(\bar{L}_{t+1}\right)} \right]}{(1+\omega r)} \right)^2 , \tag{31}$$

*or (ii) a coalition of young pessimists and old pessimists with preferred adaptation rate,*

$$\tau_t^{YP,OP*} = A \cdot \left( \frac{\underline{\theta} \cdot \left[ \frac{1}{2} p_{t+1} + \frac{\partial f\left(\mathbb{E}_{P,t}\left(\bar{L}_{t+1}\right)\right)}{\partial \mathbb{E}_{P,t}\left(\bar{L}_{t+1}\right)} \right]}{\left(1 + \frac{1}{2} r\right)} \right)^2, \tag{32}$$

*or (iii) a coalition of old optimists and old pessimists with preferred adaptation rate,*

$$\tau_t^{OO,OP*} = A \cdot \left[ \left(\omega \underline{\theta} + (1-\omega)\bar{\theta}\right) \cdot \frac{\partial f\left(\mathbb{E}_{OO,OP,t}\left(\bar{L}_{t+1}\right)\right)}{\partial \mathbb{E}_{OO,OP,t}\left(\bar{L}_{t+1}\right)} \right]^2. \tag{33}$$

*Common terms in the adaptation rates are defined by* $A \equiv A\left(\bar{L}_t, \gamma_{t+1}, \phi\right) = \frac{(\mu\gamma_{t+1})^2}{\bar{L}_t} \cdot \frac{1}{[\phi q + (1-\phi)w]}$.

**Proof:** See Appendix A1.4.

The adaptation rate chosen by each coalition falls in the housing stock ($\bar{L}_t$) and aggregate labour income ($\phi q + (1-\phi)\, w$), but rises in climate risk ($\gamma_{t+1}$), future house prices ($p_{t+1}$), and the marginal utility from the expected future stock of housing $\left( \frac{\partial f\left(\mathbb{E}_t\left(\bar{L}_{t+1}\right)\right)}{\partial\, \mathbb{E}_t\left(\bar{L}_{t+1}\right)} \right)$. Furthermore, the adaptation rate proposed by a coalition of old optimists and young pessimists and by a coalition of old optimists and pessimists rises in the share of optimists, $1-\omega$.

## *D. Political Tipping*

Proposition 3 suggests that the political equilibrium depends on (i) whether old optimists prefer to form a coalition with young pessimists or old pessimists, and (ii) whether young pessimists prefer to form a coalition with old optimists or old pessimists. Define by $\Theta \equiv \bar{\theta}/\underline{\theta}$ the dispersion in beliefs between optimists and pessimists. We assume that beliefs of optimists and pessimists are sufficiently dispersed, i.e.

**Assumption 3.** $\Theta > \frac{p_{t+1} \cdot \left[ \frac{\partial f\left(\mathbb{E}_{O,t}(\bar{L}_{t+1})\right)}{\partial\, \mathbb{E}_{O,t}(\bar{L}_{t+1})} \right]^{-1} + \frac{\partial f\left(\mathbb{E}_{P,t}(\bar{L}_{t+1})\right)}{\partial\, \mathbb{E}_{P,t}(\bar{L}_{t+1})} \cdot \left[ \frac{\partial f\left(\mathbb{E}_{O,t}(\bar{L}_{t+1})\right)}{\partial\, \mathbb{E}_{O,t}(\bar{L}_{t+1})} \right]^{-1}}{1+r}$.

Under Assumption 3, the adaptation rate preferred by old optimists is larger than the one preferred by young pessimists ($\tau^{OO*} > \tau^{YP*}$). To understand the need for sufficiently dispersed beliefs, we must recognize that young pessimists gain an additional advantage from public adaptation compared to old households. This is because young households still need to sell their housing capital, and public adaptation increases the remaining amount that can be sold. Consequently, the preferred adaptation rate of a young household with beliefs $j$, is higher than the one preferred by an old household with the same beliefs. Then, to ensure that the adaptation rate preferred by young pessimists is smaller than the one preferred by old optimists, the beliefs of optimists and pessimists must be sufficiently dispersed. If this is not the case , a coalition of the old always dominates.

The condition in Assumption 3 becomes more stringent over time as climate risk rises for two reasons. First, a rise in climate risk leads to habitat loss, which increases house prices, and this raises the preferred adaptation rate of only the young pessimists.[15] Second, a rise in climate risk curbs the expected future

[15] Due to the concavity of the utility function of housing, $v(\bar{L}_t)$, house prices rises faster than the (expected) housing stock falls. As a result, the total value of the (expected) future housing stock increases in climate risk.

stock of houses. But, the expectation formed by optimists is higher than the expectation formed by pessimists. This is because public adaptation scales with the level of climate risk, and optimists perceive public adaptation as more effective.

**Proposition 4.** *Under Assumption 3, the preferred adaptation rates satisfy*

$$\tau_t^{YO*} > \tau_t^{OO*} > \tau_t^{YP*} > \tau_t^{OP*} \tag{34}$$

*and*

$$\tau_t^{OO,YP*} > \tau_t^{OO,OP*} > \tau_t^{YP,OP*}. \tag{35}$$

**Proof:** See Appendix A1.5.

**Corollary 1.** *Under Assumption 3, old optimists prefer a coalition with young pessimists.*

Assumption 3 provides a sufficient condition to ensure that old optimists prefer to form a coalition with the young rather than the old pessimists. The reason is that the adaptation rate preferred by old optimists, $\tau_t^{OO*}$, satisfies $\tau_t^{OO*} > \tau_t^{OO,YP*} > \tau_t^{OO,OP*}$. Given that utility of old optimists is concave in the adaptation rate and rises for $\tau_t \leq \tau_t^{OO*}$, forming a coalition with young pessimists provides higher utility for old optimists than a coalition with old pessimists. As a result, young pessimists emerge as the pivotal group in the political economy equilibrium. The equilibrium hinges on whether young pessimists prefer to form a coalition with old optimists or old pessimists. The strict ranking of preferences ensures that this equilibrium is unique, and both internally and externally stable.

**Proposition 5.** *Let there be less young than old, pessimists then represent a majority ($\omega > 0.5$), and Assumption 3 is satisfied. Also, assume that*

$$\Theta < \frac{\omega}{(1-\omega)} \cdot \left( \left[ \frac{\partial f\left(\mathbb{E}_{YP,OO,t}\left(\bar{L}_{t+1}\right)\right)}{\partial \mathbb{E}_{YP,OO,t}\left(\bar{L}_{t+1}\right)} \right]^{-1} \cdot \left( \frac{(1+\omega r)}{\omega} \cdot \sqrt{\left( \frac{B}{\underline{\theta}^2} + \frac{1}{\left(1+\frac{1}{2}r\right)^2} \cdot \left( \frac{1}{2} p_{t+1} + \frac{\partial f\left(\mathbb{E}_{P,t}\left(\bar{L}_{t+1}\right)\right)}{\partial \mathbb{E}_{P,t}\left(\bar{L}_{t+1}\right)} \right)^2 \right)} - p_{t+1} \right) - 1 \right) \tag{36}$$

*holds. The political economy equilibrium is then characterized by a coalition of young pessimists and old optimists. The adaptation rate proposed by this coalition equals*

$$\tau_t^{YP,OO*} = A \cdot \left( \frac{\left[ \omega\underline{\theta} p_{t+1} + \left(\omega\underline{\theta} + (1-\omega)\bar{\theta}\right) \cdot \frac{\partial f\left(\mathbb{E}_{YP,OO,t}\left(\bar{L}_{t+1}\right)\right)}{\partial \mathbb{E}_{YP,OO,t}\left(\bar{L}_{t+1}\right)} \right]}{\left(\frac{1}{2}\left(1+\omega r\right)\right)} \right)^2. \tag{37}$$

*If condition (36) on the dispersion of beliefs is not satisfied, the political economy equilibrium is characterized by a coalition of young and old pessimists with adaptation rate*

$$\tau_t^{YP,OP*} = A \cdot \left( \frac{\underline{\theta} \cdot \left[ \frac{1}{2} p_{t+1} + \frac{\partial f\left(\mathbb{E}_{P,t}\left(\bar{L}_{t+1}\right)\right)}{\partial \mathbb{E}_{P,t}\left(\bar{L}_{t+1}\right)} \right]}{\left(1+\frac{1}{2}r\right)} \right)^2. \tag{38}$$

**Proof:** See Appendix A1.6.

Hence, if beliefs are not too dispersed, an equilibrium exists in which the political equilibrium tips from a coalition of all the young and old pessimists to a coalition of young pessimists and old optimists. This latter coalition favours a higher adaptation rate.

## VI. Quantitative Assessment of Political Equilibrium Tipping

To illustrate the equilibrium effects of rising climate risk on the political equilibrium, we use the illustrative parameter values stated in Table 1 (cf. Van der Straten, 2024).[16] We focus on the Netherlands, since it has a long history in flood risk management and faces an increase in its exposure to flood risk as sea levels rise. We run our model for the periods 2010-2040, 2040-2070, and 2070-2100. We conduct counterfactual analysis to demonstrate the effects of different scenarios of sea level rise, based on low (RCP 2.6), medium (RCP 4.5), and high (RCP 8.5) greenhouse gas concentration trajectories (IPCC, 2013).[17] [18]

| Parameter | Description | Value | Source |
|---|---|---|---|
| $\mu$ | Conditional expectation of losses to housing capital | 1 | Normalization |
| $\bar{L}$ | Housing stock | 1 | Normalization |
| $\phi$ | Fraction of high skilled labour | 0.20 | Van der Mooren and De Vries (2022) |
| $\omega$ | Fraction of pessimists | 0.51 | |
| $q$ | Wage of high-income households | 0.167 | Van der Straten (2024) |
| $r$ | Rate of interest | 0.718 | Van der Straten (2024) |
| $w$ | Wage of low-income households | 0.089 | Van der Straten (2024) |

TABLE 1: **Parameter Values.**

We let $\gamma_t$ represent the fraction of the currently flood-safe houses that a future rise in sea levels would put at risk of flooding) (cf. Van der Straten, 2024). The relationship between this fraction and various levels of sea level rise follows from Bosker et al. (2019)[19] and we use the projections of global mean sea level rise from IPCC (2013).[20]. The evolution of the share of flood-safe houses that future sea level rise would put at risk of flooding ($\gamma_t$) under the different RCP trajectories is shown in Figure 2. It indicates that more severe global warming scenarios put more houses at risk of flooding. Finally, we assume that $v(L) = ln(L)$ and $f\left(\bar{L}\right) = ln\left(\bar{L}\right)$.

[16] These are reported for the Netherlands as of 2010, or based on the terminal values in Van der Straten (2024).

[17] The Representative Concentration Pathways (RCP) trajectories describe different climate futures depending on the volume of future greenhouse gas emissions (IPCC, 2014). Under the RCP 2.6 (RCP 4.5 respectively RCP 6.0) trajectory, emissions peak in 2020 (2040 respectively 2080) and the rise in global mean temperatures is likely to stay between 0.3 to 1.7 (1.1 to 2.6 respectively 1.4 to 3.1) ∘C, relative to the reference period. This translates into a rise in global mean sea levels from 2100 of 0.26 to 0.55 (0.32 to 0.63 respectively 0.33 to 0.63) meters. Under RCP 8.5, emissions continue to rise throughout the $21^{st}$ century and global mean temperatures are likely to rise by approximately 2.6 to 4.8 ∘C. This translates into a rise in global mean sea levels of 0.45 to 0.82 meters.

[18] The rate of interest over a period of 30 years is $r$. This corresponds to $(1 + 0.718)^{1/30} - 1 = 1.18\%$ per year.

[19] Bosker et al. (2019) provides estimates of the number of the currently flood-safe houses that a future rise in sea levels would put at risk of flooding in a best-, medium-, and worst-case scenario with sea levels rising by 24, 100 or 150 cm respectively based on Dutch elevation data.

[20] The Climate Scenario Tables provide projections of global mean sea level rise for every decade from 2000 to 2100 with 1986-2005 as the reference period.

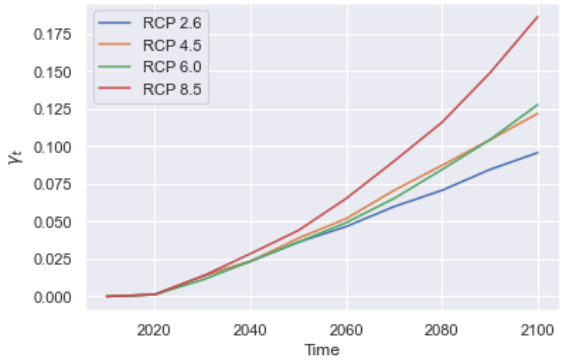



FIGURE 2: **Evolution of the share of flood-safe houses that future sea level rise puts at risk of flooding ($\gamma_t$) under the RCP 2.6, RCP 4.5, RCP 6.0 and RCP 8.5 trajectories**

## *A. Results*

Here we give the results for an initial stage without public adaptation, $X_{G,t} = 0$. We conduct counterfactual analysis for different Representative Concentration Pathway (RCP) trajectories. Since projections of global mean sea level rise are only available up to 2100, we assume that a steady state is reached in 2100 and solve the model backwards from then on.

### *A.1* Evolution of the Housing Stock and House Prices

The supply of inhabitable houses falls exogenously in the model with climate risk, leading to a reduction in the housing stock by approximately half at the end of the century in the RCP 8.5 trajectory (see left panel of Figure 3). In accordance with Van der Straten (2024), the supply effect dominates the discount effect due to climate risk exposure, translating into a sharp rise of house prices over time (right panel, Figure 3).

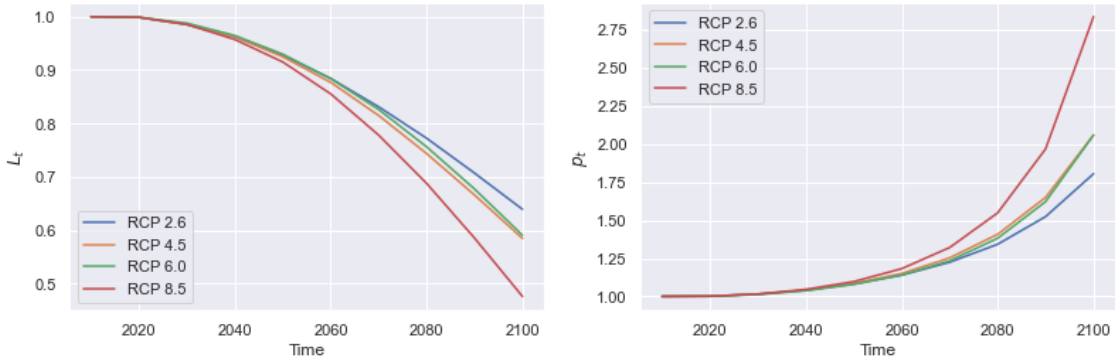



FIGURE 3: **Evolution of the housing stock and housing prices**

KEY: THE STEADY-STATE OF SUPPLY OF INHABITABLE HOUSES (LEFT PANEL, INDEXED TO 1 IN 2010) AND HOUSE PRICES (RIGHT PANEL, INDEXED TO 1 IN 2010) FOR DIFFERENT RCP TRAJECTORIES.

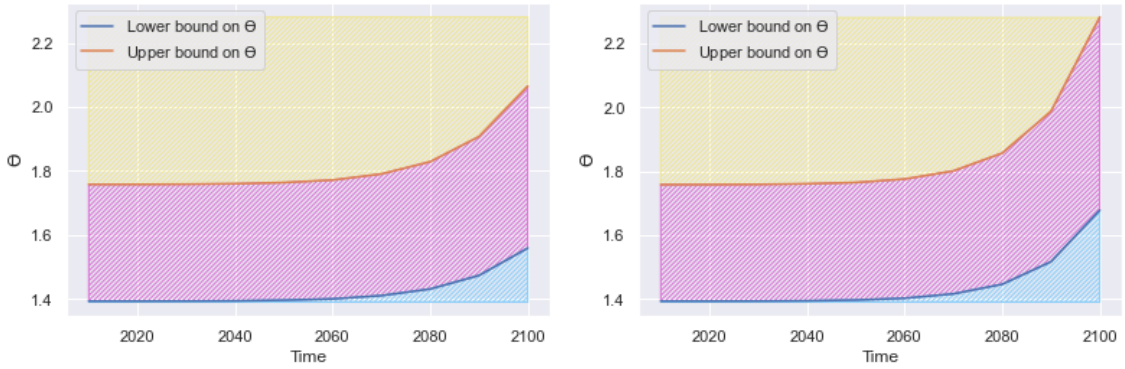



FIGURE 4: **Evolution of the political equilibrium**

KEY: JOINT EVOLUTION OF THE UPPER (PROPOSITION 5) AND LOWER (ASSUMPTION 3) BOUNDS ON DISPERSION IN BELIEFS FOR WHICH A COALITION OF YOUNG PESSIMISTS AND OLD OPTIMISTS PREVAILS (PINK-SHADED AREA).THE LEFT PANEL SHOWS THE EVOLUTION OF THE BOUNDS UNDER RCP 4.5 AND THE RIGHT PANEL SHOWS THE EVOLUTION OF THE BOUNDS UNDER RCP 8.5.

### *A*.2 Evolution of the Political Equilibrium

Figure 4 plots the time paths of the upper and lower bounds on the dispersion in beliefs (i.e. $\Theta$) for which a coalition of young pessimists and old optimists prevails for various RCP trajectories. Assumption 3 provides the lower bound on $\Theta$, and gives the smallest dispersion in beliefs for which old optimists prefer to form a coalition with young rather than old pessimists. The blue-shaded area highlights the values of $\Theta$ for which Assumption 3 is *not* satisfied. Here the dispersion in beliefs is not high enough to ensure that the adaptation rate of old optimists is higher than the one preferred by young pessimists. Old optimists are then better off if they form a coalition with the old pessimists. On the other hand, the pink- and yellow-shaded areas highlight the values of $\Theta$ for which Assumption 3 *is* satisfied. Here the dispersion in beliefs is sufficiently high to ensure that the preferred adaptation rate of old optimists is higher than the one of young pessimists. Old optimists are then strictly better off if they form a coalition with young pessimists.

Proposition 5 provides the lower bound for $\Theta$, and gives the maximum dispersion in beliefs for which young pessimists prefer to form a coalition with old optimists, rather than old pessimists.[21] The yellow-shaded area shaded highlights the values of $\Theta$ for which the condition in Proposition 5 is *not* satisfied. Here the utility of young pessimists is higher if they form a coalition with old pessimists. The pink- and blue-shaded area highlights the values of $\Theta$ for which the condition in Proposition 5 *is* satisfied. In this region, the utility of young pessimists is strictly higher if they form a coalition with old optimists.

The region for which Assumption 3 is satisfied becomes smaller as climate risk becomes more pressing, both over time and as we move to a more severe climate change scenario. The reason is that the ensuing habitat loss, which increases house prices, raises the preferred adaptation rate of young pessimists relative to that of the old. The dispersion in beliefs must be increasingly larger to ensure that the adaptation rate preferred by old optimists remains higher than that of young pessimists. Moreover, as the increase in

[21] If utility of young pessimists, $\mathbb{E}_t(U^{YP})$ is symmetric around the optimal adaptation rate, $\tau_t^{YP*}$, the bound in Proposition 5 can be approximated by $\tau_t^{YP,OO} - \tau_t^{YP*} \leq \tau_t^{YP*} - \tau_t^{YP,OP}$. We use this approximation in Figure 4.

house prices increases the preferred adaptation rate of young pessimists, they will become more likely to favour a coalition with old optimists rather than old pessimists. This weakens the condition in Proposition 5, so the upper bound on the dispersion in beliefs increases. The region in which a coalition of young pessimists and old optimists prevails thus widens as climate risk becomes more urgent, both over time and as we move to a more severe climate change scenario. As the pink-shaded area widens over time and for a more severe climate change scenario, the panels (each representing a distinct RCP trajectory) indicate that it becomes more likely for a coalition of young pessimists and old optimists to prevail as climate risk becomes more urgent. Note that the likelihood of a coalition of the old (highlighted by the blue-shaded area) also increases as climate risk becomes more urgent. However, a coalition of the old only prevails for a sufficiently low dispersion in beliefs.

### *A*.3 Political Tipping in Adaptation Rates

Using the insights from Figure 4, we focus on a value for the dispersion in beliefs, $\Theta$, such that the political equilibrium tips from a coalition of pessimists to a coalition of young pessimists and old optimists at the earliest point in time.[22] Figure 5 plots the time paths of the proposed adaptation rates of each coalition. The adaptation rates increase as climate risk rises over time, and rise more steeply the more severe the RCP trajectory. Moreover, the adaptation rate proposed by a coalition of young pessimists and old optimists is strictly higher than the adaptation rate proposed by a coalition of pessimists.

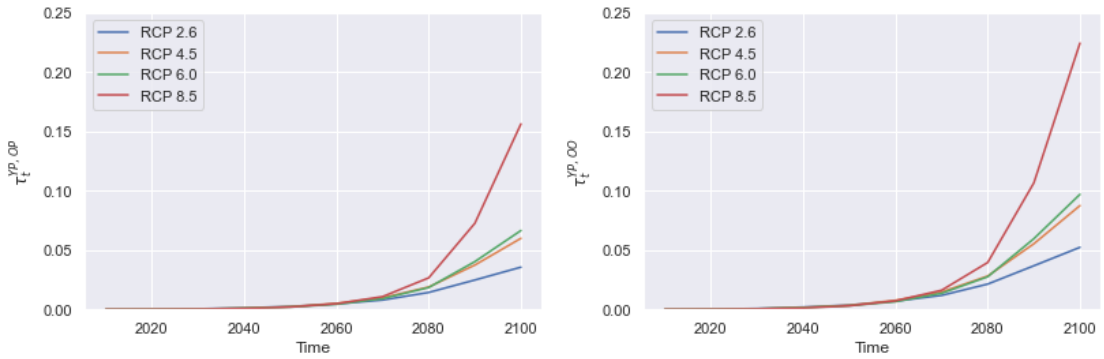



FIGURE 5: **Adaptation rates proposed by different coalitions**

KEY: THE ADAPTATION RATE PROPOSED BY A COALITION OF PESSIMISTS (LEFT PANEL) AND A COALITION OF YOUNG PESSIMISTS AND OLD OPTIMISTS (RIGHT PANEL) FOR DIFFERENT RCP TRAJECTORIES.

Under this specification of beliefs, the political equilibrium tips from a coalition of only pessimists to a coalition of young pessimists and old optimists around 2070. Figure 6 depicts the evolution of the adaptation rate prevailing in the economy over time when the political equilibrium tips with each panel representing a distinct RCP trajectory.

[22]Specifically, we set $\Theta = 1.775$ and accordingly $\bar{\theta} = 0.85$ and $\underline{\theta} = 0.48$.

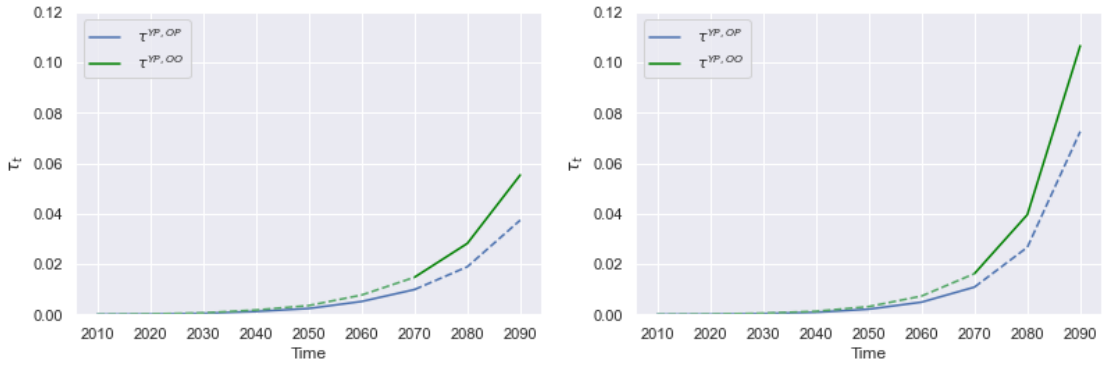



FIGURE 6: **Political tipping**

KEY: THE PREVAILING ADAPTATION RATE IN THE ECONOMY OVER TIME OVER TIME WHEN THE POLITICAL EQUILIBRIUM TIPS AROUND 2070, UNDER RCP 4.5 (LEFT PANEL) AND RCP 8.5 (RIGHT PANEL).

## VII. Comparison of Political Equilibria and Optimal Policy

To compare the political economy equilibrium to the social optimum, we determine the optimal public policy where $X_{G,t}$ is chosen to maximize a utilitarian social welfare, in which the benefits of public adaptation are fully internalized, i.e. $\theta_j = 1 \forall j$:

$$\begin{aligned} \max_{X_{G,t}} \sum_{t=0}^{\infty} \left(\frac{1}{1+r}\right)^t \left((1+r)\left((1-\tau_t)\Big[\phi q + (1-\phi)w\Big]\right) + v(\bar{L}_t) + f(\bar{L}_{t+1})\right) \\ s.t. \qquad \frac{1}{2} X_{G,t}^{2*} \bar{L}_t = \tau_t \cdot [\phi q + (1-\phi)\, w] \\ \bar{L}_j = \bar{L}_t \prod_{\iota=t}^{j-1} \left(1 - (1 - X_{G,\iota})\, \mu \gamma_{\iota+1}\right). \end{aligned} \tag{39}$$

**Proposition 6.** *The socially optimal level of public adaptation equals*

$$\begin{aligned} X_{G,t}^{FB*} = \frac{\mu_L \gamma_{t+1}}{(1+r)} \cdot \sum_{j=t+1}^{\infty} \left(\frac{1}{1+r}\right)^{j-t} \left[-\frac{1}{2}(1+r) X_{G,j}^2 + v'(\bar{L}_j)\right] \prod_{\iota=t+1}^{j-1} \left(1 - (1 - X_{G,\iota})\, \mu_L \gamma_{\iota+1}\right) \\ + \frac{\mu_L \gamma_{t+1}}{(1+r)} \cdot \left(f'\left(\bar{L}_{t+1}\right) + \sum_{j=t+1}^{\infty} \left(\frac{1}{1+r}\right)^{j-t} \left(f'(\bar{L}_{j+1})\right) \prod_{\iota=t+1}^{j} \left(1 - (1 - X_{G,\iota})\, \mu_L \gamma_{\iota+1}\right)\right). \end{aligned} \tag{40}$$

**Proof:** See Appendix A1.7.

A comparison between the socially optimal adaptation rate with the preferred adaptation rate of the young and old reveals that households do not fully internalize the benefits of public adaptation. The socially optimal adaptation rate is thus higher (see Figure **??**). Since the old do not own housing capital, they do not take into consideration that public adaptation increases the remaining amount that can be sold. While the young internalize in part the effect of adaptation on the evolution of the housing stock due to its capitalization in house prices (Van der Straten, 2024), they do not internalize the effect of public adaptation on the utility that *other* generations obtain from the expected future stock of houses (as captured by $f(\bar{L}_{j+1}), j \in [t, \infty]$). In contrast, in the social optimum the effect of adaptation on the

utility obtained by *each* subsequent generation is internalized. Hence, the private choice of adaptation does not equal the social optimum, even if beliefs about the efficacy of public adaptation are correct $(\theta_j = 1, \forall j)$.

### *A. Public Adaptation Gap*

To quantify the public adaptation gap, we plot and compare the socially optimal adaptation rate with the adaptation rate that the prevailing coalition proposes over time. We use the same characterization of dispersion in beliefs as before, so that the coalition of the pessimists prevails from 2010 - 2070 and then tips to a coalition of young pessimists and old optimists from 2070 onward. Part of this adaptation gap is due to pessimism about the efficacy of public adaptation. However, even if the political process would take the efficacy of public adaptation into consideration to its full extent, an adaptation gap remains. This occurs as households care about the present and near future supply of habitat, but do not internalize the benefits of public adaptation for all future generations.

To decompose the adaptation gap, we determine the socially optimal adaptation rate in the case in which the beliefs about the efficacy of public intervention are taken into account (see Appendix A.7.) In this case, the adaptation gap is fully explained by the "tragedy of the horizon" effect. The adaptation gap is depicted in Figure 7 with each panel representing a distinct RCP trajectory. While pessimism about the efficacy of public adaptation explains approximately half of the adaptation gap, a large adaptation gap remains due to the tragedy of the horizon effect. The adaptation gap widens as climate risk rises over time.

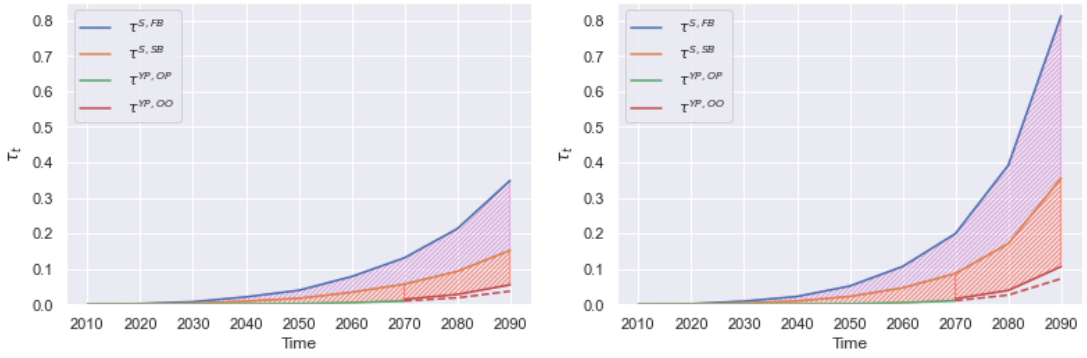



FIGURE 7: **Decomposition of the public adaptation gap**

KEY: EVOLUTION OF THE TIME PATH OF THE ADAPTATION GAP (ORANGE- AND PURPLE-SHADED AREA) AND THE ADAPTATION GAP IN THE CASE IN WHICH THE BELIEFS ABOUT THE EFFICACY OF PUBLIC INTERVENTION ARE TAKEN INTO ACCOUNT (ORANGE-SHADED AREA). THE RESULTS ARE SHOWN UNDER RCP 4.5 (LEFT) AND RCP 8.5 (RIGHT PANEL).

## VIII. Extension: Low- and High-Income Households

We provide an extension of our analysis in which old households know their income level and adjust their preferences over adaptation based on their income and beliefs. This distinction matters for voting outcomes and consequently affects the political equilibrium that prevails.

## A. Old Households' Choice of Adaptation Rate

An old household, with beliefs $j \in \{O, P\}$ and income $y \in \{q, w\}$ maximizes

$$\max_{\tau_t} \mathbb{E}\left(U\left(c_{y,t},, \bar{L}_{t+1}\right)\right) = \mathbb{E}_t\left(c_{y,t}\right) + f\left(\mathbb{E}_{j,t}\left(\bar{L}_{t+1}\right)\right) \tag{41}$$

$$s.t. \quad c_{y,t} \leq (1-\tau_t)\, y + \max\left\{p_t\left(1-\xi_{y,t}\right) L_{h,t-1} + (1+\hat{r})\, S_{yt-1}, 0\right\}$$

$$\tau_t \geq 0.$$

**Proposition 7.** *The optimal adaptation rate of an old household with beliefs $\theta_j$ and income $y$ is*

$$\tau_t^{Oyj*} = \frac{1}{\bar{L}_t} \cdot \left[\phi q + (1-\phi)\, w\right] \cdot \left(\frac{\theta_j \mu \gamma_{t+1} \frac{\partial f\left(\mathbb{E}_{j,t}\left(\bar{L}_{t+1}\right)\right)}{\partial\, \mathbb{E}_{j,t}\left(\bar{L}_{t+1}\right)}}{y}\right)^2 \tag{42}$$

*If the wage gap is smaller than the dispersion in beliefs (scaled by the marginal utilities of the future housing stock), i.e.,*

$$\frac{q}{w} < \frac{\bar{\theta}}{\underline{\theta}} \cdot \frac{\frac{\partial f\left(\mathbb{E}_{O,t}\left(\bar{L}_{t+1}\right)\right)}{\partial\, \mathbb{E}_{O,t}\left(\bar{L}_{t+1}\right)}}{\frac{\partial f\left(\mathbb{E}_{P,t}\left(\bar{L}_{t+1}\right)\right)}{\partial\, \mathbb{E}_{P,t}\left(\bar{L}_{t+1}\right)}} \tag{43}$$

*then we have*

$$\tau^{OOl*} > \tau^{OOh*} > \tau^{OPl*} > \tau^{OPh*}.$$

*Otherwise, we have*

$$\tau^{OOl*} > \tau^{OPl*} > \tau^{OOh*} > \tau^{OPh*}.$$

**Proof:** See Appendix A1.8.

Since current adaptation does not benefit the old households themselves, the difference in the preferred adaptation rates of high- respectively low-income households is fully explained by the difference in wages. Then, as low-income, old households bear an smaller fraction of the investment costs associated with public adaptation, they favour a higher adaptation rate than high-income households.

## B. Feasible Coalitions

Income is a distinguishing factor among old households, influencing the preferred adaptation rate of the old. As a consequence, the size of old household groups is smaller compared to the baseline model and coalitions must include (at least) three groups of households to form a majority. The wage gap, which determines the relative ordering of the adaptation rates preferred by the various groups of old households (see Proposition 7), also affects the set of feasible coalitions. In particular, a rise in economic inequality, as reflected by an increase in the wage gap, $q/w$, increases the adaptation rate preferred by the low-income,

old pessimists relative to the adaptation rate preferred by the high-income, old optimists.[23] This occurs as the disproportionate reduction in their income causes the fraction of the investment costs borne by the low-income households to become increasingly smaller. Consequently, if the wage gap is sufficiently large, the adaptation rate preferred by low-income, old pessimists is higher than the one preferred by the high-income, old optimistic households ($\tau_t^{OPl*} > \tau_t^{OOh*}$) We again focus on a realistic subset of coalitions - those that emerge if young pessimists are pivotal - and we make the following assumption.

**Assumption 4.** *If inequality is sufficiently small (see Proposition 7), beliefs between optimists and pessimists must be sufficiently dispersed:*

$$\Theta > \underbrace{\frac{p_{t+1} \cdot \left[\frac{\partial f\left(\mathbb{E}_{O,t}\left(\bar{L}_{t+1}\right)\right)}{\partial \mathbb{E}_{O,t}\left(\bar{L}_{t+1}\right)}\right]^{-1} + \frac{\partial f\left(\mathbb{E}_{P,t}\left(\bar{L}_{t+1}\right)\right)}{\partial \mathbb{E}_{P,t}\left(\bar{L}_{t+1}\right)} \cdot \left[\frac{\partial f\left(\mathbb{E}_{O,t}\left(\bar{L}_{t+1}\right)\right)}{\partial \mathbb{E}_{O,t}\left(\bar{L}_{t+1}\right)}\right]^{-1}}{(1+r)}}_{Assumption\ 3} \cdot \underbrace{\frac{q}{\phi q + (1-\phi)w}}_{Inequality\ multiplier} . \tag{44}$$

*If economic inequality is sufficiently large (see Proposition 7), beliefs between optimists and pessimists must be not too dispersed. Specifically, the dispersion in beliefs must be smaller than the above expression.*

Assumption 4 ensures that the adaptation rate preferred by the high-income, old optimists is larger than the adaptation rate preferred by the young pessimists if economic inequality is low ($\tau_t^{OOh*} > \tau_t^{YP*}$), and smaller if economic inequality is high ($\tau_t^{OOh*} < \tau_t^{YP*}$). This again ensures that the young pessimists emerge as the pivotal group for determining the political equilibrium.[24]

**Proposition 8.** *If the young are less in number than the old, pessimists are in the majority ($\omega > 0.5$), high-income households are a minority ($\phi < 0.5$), and economic inequality is sufficiently low, then*

$$\tau_t^{YO*} > \tau_t^{OOl*} > \tau_t^{OOh*} > \tau_t^{YP*} > \tau_t^{OPl*} > \tau_t^{OPh*} \tag{45}$$

*and the young pessimists are pivotal. The set of feasible coalitions is then:*

*(i)* ***"High Ambition Coalition"****: Low-income, old optimists ($(1-\phi)(1-\omega)$), high-income, old optimists ($\phi(1-\omega)$) and young pessimists ($\omega$), i.e. young pessimists and old optimists.*

*(ii)* ***Mixed Coalition*** *($2(\omega - \phi\omega) + \phi$): high-income, old optimists ($\phi(1-\omega)$), young pessimists ($\omega$), and low-income, old pessimists ($(1-\phi)\omega$). We refer to this as the "mixed coalition".*[25]

*(iii)* ***"Low Ambition Coalition"*** *($2\omega$): Young pessimists ($\omega$), low-income, old pessimists ($(1-\phi)\omega$), and high-income, old pessimists ($\phi\omega$), i.e. young pessimists and old pessimists.*[26]

[23] If economic inequality declines, this does not lead to a change in the relative ordering of the preferred adaptation rates of the old, unless economic inequality is very large at the onset. If the latter is the case, the political equilibrium tips between the same coalitions as outlined below, although in reverse order.

[24] In both cases a coalition of the old is never large enough to be pivotal.

[25] Under Assumption 2, i.e. $\omega > 0.5$ , a successful mixed coalition is always larger - and thus politically more powerful than a successful high ambition coalition. Moreover, under Assumption 3, a successful mixed coalition is always larger than the low-ambition coalition.

[26] Under Assumption 2, i.e. $\omega > 0.5$ , a successful low-ambition coalition is always larger than a successful high ambition coalition. Hence, a successful high-ambition coalition always has the least political power.

*If economic inequality is sufficiently high, then*

$$\tau_t^{YO*} > \tau_t^{OOl*} > \tau_t^{OPl*} > \tau_t^{YP*} > \tau_t^{OOh*} > \tau_t^{OPh*} \tag{46}$$

*and, the young pessimists are pivotal. The set of feasible coalitions is then:*

*(i)* ***"High Ambition Coalition"*** *$(1-\phi+\omega)$: low-income, old optimists $((1-\phi)(1-\omega))$, young pessimists $(\omega)$, and low-income, old pessimists $(\omega(1-\phi))$, i.e. young pessimists and low-income old.*

*(ii)* ***Mixed Coalition*** *$(2(\omega-\phi\omega)+\phi)$: high-income, old optimists $(\phi(1-\omega))$, young pessimists $(\omega)$, and low-income, old pessimists $((1-\phi)\omega)$ households. We refer to this as the "mixed coalition".*[27]

*(iii)* ***"Low Ambition Coalition"*** *$(\omega\phi)$: Young pessimists $(\omega)$, high-income, old optimists $((1-\omega)\phi)$, and high-income, old pessimists $(\phi\omega)$, i.e. young pessimists and high-income, old.*[28]

*Finally, if Assumption 4 is not satisfied, the high-income, old optimists emerge as pivotal group and the political equilibrium is always characterized by the prevailing of the mixed coalition.*

**Proof:** See Appendix A1.9.

Proposition 8 highlights that the rise in economic inequality changes the composition of the high- and low-ambition coalition. The composition of the mixed coalition remains unchanged. Additionally, if Assumption 4 is not satisfied, the political equilibrium is always characterized by the mixed coalition prevailing. We summarize the preferred adaptation rates of the various coalitions in Appendix A.10.

### *C. Evolution of the Political Equilibrium and Equilibrium Tipping*

While some coalitions are politically feasible, the political equilibrium that emerges depends on the preferences of young pessimists. The equilibrium hinges on whether the young pessimists prefer to form the high ambition coalition, the mixed coalition or the low ambition coalition. We want to evaluate the viability of the high-ambition coalition, so we determine the condition under which young pessimists prefer to form this coalition, rather than the mixed coalition.

As in the baseline model, if beliefs are not too dispersed, an equilibrium exists in which the economy tips to political equilibrium characterized by the prevailing of the high-ambition coalition. In Appendix A.11, we provide an implicit definition the upper bound on the dispersion of beliefs for which the young pessimists prefer to form the high-ambition coalition, rather than the mixed coalition.

To study the evolution of the political equilibrium over time, we simulate the model. We use a comparable parameterization as for the baseline model.[29] With regards to wages, we start from a case in which the wage of high- and low-income workers is equal, and reduce the wage of low-income workers disproportionately

[27] For $\phi < \omega$, a successful high ambition coalition is always larger and thus politically more powerful than a successful mixed coalition.

[28] Note that the low-ambition coalition could constitute a majority under Assumption 1 and Assumption 2, but not necessarily.

[29] For this simulation, we again have $\bar{\theta} = 0.85$ but set $\underline{\theta}$ slightly higher, at 0.52. Then, the dispersion of beliefs, $\Theta$, is equal to 1.63.

over time (see Van der Straten (2024)). To study the effect of rising inequality on the political equilibrium, we let the inequality multiplier increase gradually over time, picking up speed temporarily during the mid of the century. The evolution of the multiplier, to which we fit an S-curve, is plotted in Figure 9 in Appendix A2.A and the evolution of the income variables is summarized in Table 2.[30]

The evolution of the political equilibrium is displayed in Figure 10, in Appendix A2.A. The panels reveal that the coalition of young pessimists and old optimists prevails until 2060, after which the political equilibrium shifts to the mixed coalition prevails. Once inequality is sufficiently high (see Proposition 7), the political equilibrium tips to one in which the coalition of young pessimists and low-income, old prevails (green region). This occurs around 2080 in the model simulations.

Figure 8 plots the tipping of the prevailing adaptation rate over time. While the adaptation rate increases due to the political shift from a mixed coalition to a coalition of young pessimists and old optimists, Figure 8 reveals that it declines due to the tipping from a coalition of young pessimists and old optimists to a coalition of young pessimists and low-income old. The political backlash occurs due to tension between beliefs and income. Specifically, the high-income old optimists are replaced by the low-income old pessimists in the new majority coalition. If inequality rises gradually, the difference in income between the groups of old households is not sufficient to offset the inclusion of a larger number of pessimists in the majority coalition. Hence, political tipping leads to *less* spending on public intervention in this case.

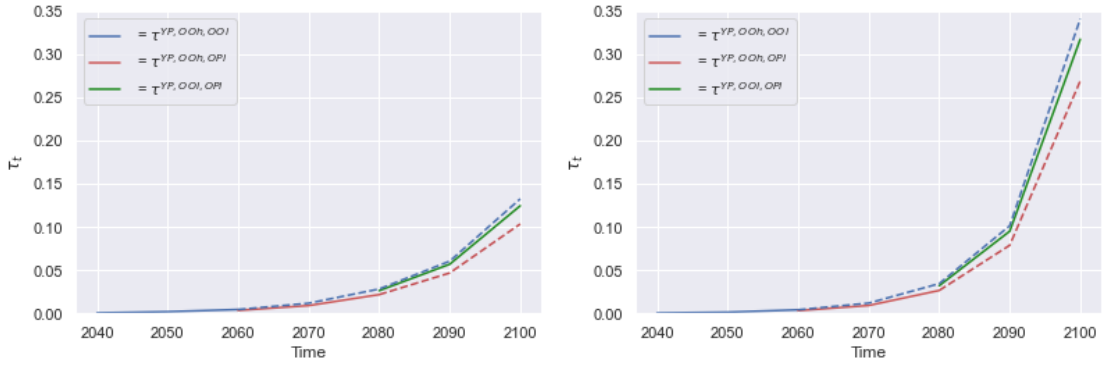



FIGURE 8: **Tipping of the adaptation rate**

KEY: THE TIME PATH FOR THE ADAPTATION RATE WHEN THE POLITICAL EQUILIBRIUM TIPS AROUND 2050, AND 2080, UNDER RCP 4.5 (LEFT PANEL) AND RCP 8.5 (RIGHT PANEL).

**Escalating inequality** The results in Appendix A2.B and especially shown in Figure 12 show that the effect of the tipping point on the adaptation rate depends crucially on the rate of increase in economic inequality. Specifically, if economic inequality rises at an accelerating rate, the effect of income on the adaptation rate dominates the effect due to pessimistic beliefs. Then, the second tipping point leads to *more* public intervention. Nevertheless, the increase in the scale of public intervention is much lower than the increase due to the first tipping point. Thus, our findings indicate that economic inequality has a significant impact on the political feasibility of climate policy, highlighting the importance of controlling

[30]We also show the results in the case the rise in the inequality multiplier accelerates in Appendix A2.2B

economic inequality in containing the damage of climate change.

### *D. Preferences for Adaptation of the Young and Inequality*

In our extension, old households know their income level and adjust their preferences accordingly, while the young remained under the Rawlsian veal of ignorance. However, as inequality rises, the young may view it more likely that they will be of the low-income type. While this does not change the composition of the political equilibrium that emerges, it does affect the speed at which the political equilibrium tips. As young households view it more likely that they are of the low-income type, their preferred adaptation rate increases.[31] Consequently, the difference between the preferred adaptation rate of the young pessimists and that of the old optimists becomes lower (while the difference between the preferred adaptation rate of the young pessimists and old pessimists increases). Then, for relatively lower levels of climate risk, the young pessimists prefer to form a coalition with the old optimists.

**Corollary 2.** *If young households view it more likely that they are of the low-income type, this brings the first political tipping point forwards in time.*

The timing of the second tipping point depends solely on the size of the wage gap relative to the dispersion in beliefs, however. Hence, the timing of the second tipping point remains unaffected.

**Corollary 3.** *If young households view it more likely that they are of the low-income type, the likelihood of the second tipping point increases, but its timing remains unaffected.*

## IX. Conclusion

A cost-benefit analysis of flood protection and other public adaptation projects requires a careful analysis of how political majorities can be obtained for such projects and how these change over time. We have studied the evolution of voter support for public adaptation when political preferences are affected by rising climate risk and growing economic inequality. The equilibrium policy reflects the impact of these increasingly pressing trends. Global warming strengthens the incentives for voters to make compromises and to form coalitions to get action on climate adaptation. Moreover, the rise in economic inequality increases the reliance of the economy on public investments into protective infrastructure.

We considered voters that differ in age and income, and we distinguished between pessimistic about the efficacy of climate adaptation and those that are not, highlighting that pessimism about the efficacy of public adaptation reduces the politically feasible adaptation rate. If beliefs of optimists and pessimists are sufficiently dispersed, the pessimistic young turn out to be pivotal. Then, if climate risk is sufficiently

[31] Suppose the young's perceived probability of being of the low-income type is $(1-\phi+\epsilon)$ with $\epsilon \in (0,\phi)$. Then, the preferred adaptation rate of a young household with beliefs $\theta_j$ becomes

$$\tau_t^{YP*} = \frac{(\mu\gamma_{t+1})^2}{\bar{L}_t} \cdot \frac{[\phi q + (1-\phi)\, w]}{[(\phi-\epsilon)q + (1-\phi+\epsilon)\, w]^2} \cdot \left( \frac{\theta_j \cdot \left( p_{t+1} + \frac{\partial f(\mathbb{E}_{YP,t}(\bar{L}_{t+1}))}{\partial\, \mathbb{E}_{YP,t}(\bar{L}_{t+1})} \right)}{(1+r)} \right)^2$$

low, the pessimistic young have weak incentives to support investment in public adaptation and the winning coalition favours limited investment in public adaptation. This suggests that voters against climate policies increase the burden of climate change borne by society at large as they frustrate the political process which determines spending on public intervention.

Our political economy analysis highlights the possibility of political tipping, which occurs when the prevailing coalition changes due to gradual climate change. The rise in climate risk increase support for public adaptation, as the value of habitat and hence the value of preventive measures increase. The preferred adaptation rate of the young pessimists increases at a higher rate, since the youth own the habitat which is to be protected by public investment. When the beliefs on the efficacy of public adaptation are not too dispersed, the political equilibrium eventually tips from a coalition of only pessimists to a coalition of young pessimists and old optimists. This coalition will spend more on climate change adaptation, thus leading to less inefficient investments in flood protection.

While political tipping increases public adaptation, the political process does not manage to internalize its broader societal value. The outcome of the political process yields an adaptation rate that is lower than the social optimum. This is in part due to pessimism about the efficacy of public adaptation. Moreover, the political process only takes account of the present and near future, and hence fails to internalize the benefits of public adaptation for all future generations. This "tragedy of the horizon" effect inevitably associated with the political process undermines public investments in flood protection, and prevents adaptation from catching up with the long-term social optimum. This highlights how political distortions frustrate flood protection ambitions, and thus the goal of adapting efficiently to climate change.

In an extension, we consider the role of income inequality. We show that a steady rise in inequality ultimately induces a second political tipping point, towards a coalition of low-income old and all the young pessimists. When inequality increases gradually, this tipping point reduces the politically feasible level of flood protection, which illustrates the significant impact economic inequality on the political feasibility of climate policy. Moreover, this finding highlights the importance of redistribution policies in the efforts to protect the economy against climate change.

Finally, while we have taken the beliefs of households as given in our analysis, sea level rise itself may change the beliefs of voters. This may also lead to a step increase in investments in adaptation projects. The interplay between household beliefs and the progression of climate change is left for future research.

## References

Acemoglu, D. and D. Autor (2011): "Skills, tasks and technologies: Implications for employment and earnings," in *Handbook of Labor Economics*, Elsevier, vol. 4, 1043–1171.

Bakkensen, L. A. and L. Barrage (2021): "Going underwater? Flood risk belief heterogeneity and coastal home price dynamics," *The Review of Financial Studies*.

Baldauf, M., L. Garlappi, and C. Yannelis (2020): "Does climate change affect real estate prices? Only if you believe in it," *Review of Financial Studies*, 33, 1256–1295.

Bernstein, A., S. B. Billings, M. Gustafson, and R. Lewis (2022): "Voting with their sandals: partisan residential sorting on climate change risk," *Journal of Financial Economics*, 146, 989–1015.

Besley, T. and T. Persson (2023): "The political economics of green transitions," *The Quarterly Journal of Economics*, 138, 1863–1906.

Bosker, M., H. Garretsen, G. Marlet, and C. van Woerkens (2019): "Nether Lands: Evidence on the price and perception of rare natural disasters," *Journal of the European Economic Association*, 17, 413–453.

Burzyński, M., C. Deuster, F. Docquier, and J. De Melo (2019): "Climate Change, Inequality, and Human Migration," *Journal of the European Economic Association*.

Cain, B. E., E. R. Gerber, and I. Hui (2020): "Getting bipartisan support for sea level rise adaptation policies," *Ocean & Coastal Management*, 197, 105298.

Dechezleprêtre, A., A. Fabre, T. Kruse, B. Planterose, A. S. Chico, and S. Stantcheva (2022): "Fighting climate change: International attitudes toward climate policies," *National Bureau of Economic Research*.

Delfgaauw, J. and O. Swank (2024): "The political climate trap," *Journal of Environmental Economics and Management*, 102935.

Demski, C., S. Capstick, N. Pidgeon, R. G. Sposato, and A. Spence (2017): "Experience of extreme weather affects climate change mitigation and adaptation responses," *Climatic Change*, 140, 149–164.

Dietz, S. and N. Stern (2015): "Endogenous growth, convexity of damage and climate risk: how Nordhaus' framework supports deep cuts in carbon emissions," *Economic Journal*, 125, 574–620.

Döttling, R. and E. C. Perotti (2017): "Secular trends and technological progress," *CEPR Discussion Paper No. DP12519*.

Douenne, T. and A. Fabre (2022): "Yellow vests, pessimistic beliefs, and carbon tax aversion," *American Economic Journal: Economic Policy*, 14, 81–110.

Fried, S. (2022): "Seawalls and stilts: A quantitative macro study of climate adaptation," *The Review of Economic Studies*, 89, 3303–3344.

Golosov, M., J. Hassler, P. Krusell, and A. Tsyvinski (2014): "Optimal taxes on fossil fuel in general equilibrium," *Econometrica*, 82, 41–88.

Hong, H., N. Wang, and J. Yang (2023): "Mitigating disaster risks in the age of climate change," *Econometrica*, Forthcoming.

Hsiao, A. (2023): "Sea Level Rise and Urban Adaptation in Jakarta," *Technical Report*.

Ikefuji, M., R. J. Laeven, J. R. Magnus, and Y. Yue (2022): "Earthquake risk embedded in property prices: Evidence from five Japanese cities," *Journal of the American Statistical Association*, 117, 82–93.

IPCC (2013): "Annex II: Climate System Scenario Tables," in *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

——— (2014): *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Kahn, M. E., A. Ouazad, and E. Yönder (2024): "Adaptation Using Financial Markets: Climate Risk Diversification through Securitization," *National Bureau of Economic Research*.

Lasage, R., T. I. Veldkamp, H. De Moel, T. Van, H. Phi, P. Vellinga, and J. Aerts (2014): "Assessment of the effectiveness of flood adaptation strategies for HCMC," *Natural Hazards and Earth System Sciences*, 14, 1441–1457.

MacInnis, B. and J. A. Krosnick (2020): *Climate insights 2020: Surveying American public Opinion on climate change and the environment (natural disasters)*, Resources for the Future.

Muis, S., B. Güneralp, B. Jongman, J. C. Aerts, and P. J. Ward (2015): "Flood risk and adaptation strategies under climate change and urban expansion: A probabilistic analysis using global data," *Science of the Total Environment*, 538, 445–457.

Murfin, J. and M. Spiegel (2020): "Is the risk of sea level rise capitalized in residential real estate?" *Review of Financial Studies*, 33, 1217–1255.

Nordhaus, W. (2008): "A question of balance: economic models of climate change," .

Persson, T. and G. Tabellini (2002): *Political economics: explaining economic policy*, MIT press.

Rasmussen, D., R. E. Kopp, R. Shwom, and M. Oppenheimer (2021): "The political complexity of coastal flood risk reduction: lessons for climate adaptation public works in the US," *Earth's Future*, 9.

Razin, A. (2021): "Globalization, Migration, and Welfare State," *Springer Books*.

Razin, A. and E. Sadka (1999): "Migration and pension with international capital mobility," *Journal of Public Economics*, 74, 141–150.

——— (2000): "Unskilled migration: a burden or a boon for the welfare state?" *Scandinavian Journal of Economics*, 102, 463–479.

Razin, A., E. Sadka, and P. Swagel (2002): "The aging population and the size of the welfare state," *Journal of Political Economy*, 110, 900–918.

Van der Mooren, F. and R. De Vries (2022): *Steeds meer hoogopgeleiden in Nederland: wat voor beroep hebben ze?*, Centraal Bureau van de Statistiek.

Van der Straten, Y. (2024): "Flooded House or Underwater Mortgage? The Implications of Rising Climate Risk and Adaptation on Housing, Income, and Wealth," *Tinbergen Institute Discussion Paper TI 2023-014/IV*.

Voorheis, J., N. McCarty, and B. Shor (2015): "Unequal incomes, ideology and gridlock: How rising inequality increases political polarization," *Ideology and Gridlock: How Rising Inequality Increases Political Polarization (August 21, 2015)*.

# A1. Proof of Propositions

## A. Proof of Proposition A1

**Proposition A1.** *Suppose climate risk in period $t$, $\gamma$ rises in all future periods by a factor $\zeta > 1$, so that $\{\zeta\gamma_{t+1}, ..., \zeta\gamma_{\infty}\}$. Then, house prices rise in this factor $\zeta$ if*

$$-\frac{\frac{\partial v'(\bar{L}_j)}{\partial \bar{L}_j} \cdot \mathbb{E}\left(\bar{L}_j\right)}{v'\left(\bar{L}_j\right)} \cdot \frac{\sum_{\iota=t}^{j-1} X_{G,\iota}\gamma_{\iota+1} \cdot \prod_{\iota'=t,\iota'\neq\iota}^{j-1}\left(1-\left(1-\zeta X^*_{G,\iota'}\right)\mu\gamma_{\iota'+1}\right)}{\sum_{\iota=t}^{j-1}\int_0^1 \theta_{j,\iota}diX_{G,\iota}\gamma_{\iota+1} \cdot \prod_{\iota'=t,\iota'\neq\iota}^{j-1}\left(1-\left(1-\int_0^1 \theta_{i,\iota'}di\zeta X^*_{G,\iota'}\right)\mu\gamma_{\iota'+1}\right)} \geq 1. \quad \text{(A1)}$$

*This condition is more stringent than the condition under $\theta_j = 1, \forall i, j$.*

The price of housing capital in a given period, $t$, is given by

$$p^*_t = \frac{\left(1-\left(1-\int_0^1 \theta_{i,t}diX^*_{G,t}\right)\mu\gamma_{t+1}\right)p_{t+1} + v'(\bar{L}_t)}{(1+r)} \quad \text{(A2)}$$

Forward substitution gives

$$p^*_t = \sum_{j=t}^{\infty}\left(\frac{1}{1+r}\right)^{j-t+1}\left[v'\left(\bar{L}_j\right)\right]\prod_{\iota=t}^{j-1}\left(1-\left(1-\int_0^1 \theta_{i,t}diX^*_{G,t}\right)\mu\gamma_{\iota+1}\right) \quad \text{(A3)}$$

where

$$\bar{L}_j = \bar{L}_t\prod_{\iota=t}^{j-1}\left(1-\left(1-X^*_{G,t}\right)\mu\gamma_{\iota+1}\right) \quad \text{(A4)}$$

Suppose climate risk, $\gamma$, increases in all future periods, i.e. $\{\gamma_{t+1}, ..., \gamma_{\infty}\}$ by some factor $\zeta > 0$, i.e. $\{\zeta\gamma_t, ..., \zeta\gamma_{\infty}\}$. Then, the price of house capital is given by

$$p_t = \sum_{j=t}^{\infty}\left(\frac{1}{1+r}\right)^{j-t+1}\left[v'\left(\bar{L}_j\right)\right]\prod_{\iota=t}^{j-1}\left(1-\left(1-\int_0^1 \theta_{i,\iota}diX^*_{G,\iota}\right)\mu\zeta\gamma_{\iota+1}\right) \quad \text{(A5)}$$

Then, the FOC of $p_t$ with respect to $\zeta$ is given by

$$\begin{aligned}\frac{\partial p_t}{\partial\zeta} = &\sum_{j=t}^{\infty}\left(\frac{1}{1+r}\right)^{j-t+1}\frac{\partial v'(\bar{L}_j)}{\partial\bar{L}_j}\cdot\frac{\partial\bar{L}_j}{\partial\zeta}\cdot\prod_{\iota=t}^{j-1}\left(1-\left(1-\int_0^1\theta_{i,\iota}diX^*_{G,\iota}\right)\mu\zeta\gamma_{\iota+1}\right) \\ &+ v'\left(\bar{L}_j\right)\cdot\frac{\partial}{\partial\zeta}\left(\prod_{\iota'=t}^{j-1}\left(1-\left(1-\int_0^1\theta_{i,\iota'}diX^*_{G,\iota'}\right)\mu\zeta\gamma_{\iota'+1}\right)\right)\end{aligned} \quad \text{(A6)}$$

where

$$\frac{\partial\bar{L}_j}{\partial\zeta} = -\mu\bar{L}_t\sum_{\iota=t}^{j-1}(1-X_{G,\iota})\gamma_{\iota+1}\prod_{\iota'=t,\iota'\neq\iota}^{j-1}\left(1-\left(1-X^*_{G,\iota'}\right)\mu\zeta\gamma_{\iota'+1}\right) \quad \text{(A7)}$$

and

$$\frac{\partial}{\partial\zeta}\left(\prod_{\iota'=t}^{j-1}\left(1-\left(1-\int_0^1\theta_{i,\iota'}\,di\,X^*_{G,\iota'}\right)\mu\gamma_{\iota'+1}\right)\right) \tag{A8}$$
$$=-\mu\sum_{\iota=t}^{j-1}\left(1-\int_0^1\theta_{i,\iota}diX_{G,\iota}\right)\gamma_{\iota+1}\cdot\prod_{\iota'=t,\iota'\neq\iota}^{j-1}\left(1-\left(1-\int_0^1\theta_{i,\iota'}diX^*_{G,\iota'}\right)\mu\zeta\gamma_{\iota'+1}\right)$$

Define

$$\mathbb{E}\left(\bar{L}_j\right)=\bar{L}_t\cdot\prod_{\iota=t}^{j-1}\left(1-\left(1-\int_0^1\theta_{i,\iota}di\zeta X^*_{G,\iota}\right)\mu\gamma_{\iota+1}\right) \tag{A9}$$

Then, this becomes

$$\frac{\partial p_t}{\partial\zeta}=-\mu\sum_{j=t}^{\infty}\left(\frac{1}{1+r}\right)^{j-t+1}\frac{\partial v'(\bar{L}_j)}{\partial\bar{L}_j}\cdot\mathbb{E}\left(\bar{L}_j\right)\cdot\sum_{\iota=t}^{j-1}(1-X_{G,\iota})\gamma_{\iota+1}\cdot\prod_{\iota'=t,\iota'\neq\iota}^{j-1}\left(1-\left(1-X^*_{G,\iota'}\right)\mu\zeta\gamma_{\iota'+1}\right) \tag{A10}$$
$$+\,v'\left(\bar{L}_j\right)\cdot\sum_{\iota=t}^{j-1}\left(\int_0^1\theta_{i,\iota}diX_{G,\iota}\right)\gamma_{\iota+1}\cdot\prod_{\iota'=t,\iota'\neq\iota}^{j-1}\left(1-\left(1-\int_0^1\theta_{i,\iota'}diX^*_{G,\iota'}\right)\mu\zeta\gamma_{\iota'+1}\right)$$

This is positive if

$$-\frac{\frac{\partial v'(\bar{L}_j)}{\partial\bar{L}_j}\cdot\mathbb{E}\left(\bar{L}_j\right)}{v'\left(\bar{L}_j\right)}\cdot\frac{\sum_{\iota=t}^{j-1}(1-X_{G,\iota})\gamma_{\iota+1}\cdot\prod_{\iota'=t,\iota'\neq\iota}^{j-1}\left(1-\left(1-X^*_{G,\iota'}\right)\mu\zeta\gamma_{\iota'+1}\right)}{\sum_{\iota=t}^{j-1}\left(1-\int_0^1\theta_{i,\iota}diX_{G,\iota}\right)\gamma_{\iota+1}\cdot\prod_{\iota'=t,\iota'\neq\iota}^{j-1}\left(1-\left(1-\int_0^1\theta_{i,\iota'}diX^*_{G,\iota'}\right)\mu\zeta\gamma_{\iota'+1}\right)}\geq 1 \tag{A11}$$

This condition is more stringent than Condition 1 if

$$\frac{\bar{L}_j}{\mathbb{E}\left(\bar{L}_j\right)}\geq\frac{\sum_{\iota=t}^{j-1}(1-X_{G,\iota})\gamma_{\iota+1}\cdot\prod_{\iota'=t,\iota'\neq\iota}^{j-1}\left(1-\left(1-X^*_{G,\iota'}\right)\mu\zeta\gamma_{\iota'+1}\right)}{\sum_{\iota=t}^{j-1}\left(1-\int_0^1\theta_{i,\iota}diX_{G,\iota}\gamma_{\iota+1}\right)\cdot\prod_{\iota'=t,\iota'\neq\iota}^{j-1}\left(1-\left(1-\int_0^1\theta_{i,\iota'}diX^*_{G,\iota'}\right)\mu\zeta\gamma_{\iota'+1}\right)} \tag{A12}$$

Substituting the expressions for $\bar{L}_j$ and $\mathbb{E}\left(\bar{L}_j\right)$ and rewriting gives

$$\sum_{\iota=t}^{j-1}\left(\frac{\left(1-\int_0^1\theta_{i,\iota}diX_{G,\iota}\right)\gamma_{\iota+1}}{\left(1-\left(1-\int_0^1\theta_{i,\iota}diX^*_{G,\iota}\right)\mu\zeta\gamma_{\iota+1}\right)}\right)\geq\sum_{\iota=t}^{j-1}\left(\frac{(1-X_{G,\iota})\gamma_{\iota+1}}{\left(1-\left(1-X^*_{G,\iota}\right)\mu\zeta\gamma_{\iota+1}\right)}\right) \tag{A13}$$

which is always satisfied as $\theta\leq 1,\forall i$.

## *B. Proof of Proposition 1*

Young households favour a adaptation rate that maximizes their expected lifetime utility:

$$\max_{\tau_t}\mathbb{E}\left(U\left(L_{i,t},c_{i,t+1},\bar{L}_{t+1}\right)\right)=v\left(L_{i,t}\right)+\mathbb{E}_t\left(c_{i,t+1}\right)+f\left(\mathbb{E}_t\left(\bar{L}_{t+1}\right)\right) \tag{A14}$$
$$s.t.\quad(1-\tau_t)\,y_{i,t}\leq p_tL_{i,t}+S_{i,t}$$
$$c_{i,t+1}\leq(1-\tau_{t+1})\,y_{i,t+1}+\max\left\{p_{t+1}\left(1-\xi_{i,t+1}\right)L_{i,t}+(1+\hat{r})\,S_{i,t},0\right\}$$
$$\tau_t\geq 0$$

where $c_{i,t+1}$ is consumption of household $i$ in period $t+1$ and $\mathbb{E}_t$ denotes expectations formed at date $t$.

Given the probability of default, the expectation of household $i$'s consumption in period $t+1$, $c_{i,t+1}$, as formed at date $t$, becomes:

$$\mathbb{E}_t\left(c_{i,t+1}\right) = G\left(\hat{\xi}_{i,t+1}\right)\left(p_{t+1}\left(1-\mathbb{E}\left(\xi_{i,t+1}|\xi_{t+1}\leq\hat{\xi}_{i,t+1}\right)\right)L_{i,t}+(1+\hat{r})S_{i,t}\right) \tag{A15}$$

No arbitrage requires that the expected payoff of holding household debt to be equal to the riskless return earned on savings:

$$(1+r)(-S_{i,t}) = G\left(\hat{\xi}_{i,t+1}\right)(1+\hat{r})(-S_{i,t})+\left(1-G\left(\hat{\xi}_{i,t+1}\right)\right)p_{t+1}\left(1-\mathbb{E}\left(\xi_{i,t+1}|\xi_{i,t+1}>\hat{\xi}_{i,t+1}\right)\right)L_{i,t} \tag{A16}$$

where the expected payoff of holding household debt is equal to the repayment of the loan with interest in case the household does not default and the revenue from selling the collateral in case of default.

Then, the expectation of household $i$'s consumption in period $t+1$, $c_{i,t+1}$, as formed at date $t$, becomes

$$\mathbb{E}_t\left(c_{i,t+1}\right) = (1+r)(S_{i,t})+p_{t+1}\left(1-\mathbb{E}\left(\xi_{i,t+1}\right)\right)L_{i,t} \tag{A17}$$

Using that $\mathbb{E}\left(\xi_{i,t+1}\right) = \left(1-\tilde{\theta}_j X_{G,t}\right)\mu\gamma_{t+1}$ , the household optimization problem can be written as

$$\begin{aligned}\max_{\tau_t}\mathbb{E}\left(U\left(L_{i,t},c_{i,t+1},\bar{L}_{t+1}\right)\right) &= (1+r)\left(\left(1-\tau_t\right)y_{i,t}-p_t L_{i,t}\right) \\ &\quad + p_{t+1}\left(1-\left(1-\tilde{\theta}_j X_{G,t}\right)\mu\gamma_{t+1}\right)L_{i,t}+v\left(L_{i,t}\right)+f\left(\mathbb{E}_t\left(\bar{L}_{t+1}\right)\right) \\ s.t. \quad \tau_t &\geq 0\end{aligned} \tag{A18}$$

The FOC for $\tau_t$ is given by

$$\begin{aligned}&-(1+r)y_{i,t}+\tilde{\theta}_j\mu\gamma_{t+1}p_{t+1}L_{i,t}\cdot\frac{\partial X_{G,t}}{\partial\tau_t}+\frac{\partial f\left(\mathbb{E}_t\left(\bar{L}_{t+1}\right)\right)}{\partial\,\mathbb{E}_t\left(\bar{L}_{t+1}\right)}\cdot\frac{\partial\,\mathbb{E}_t\left(\bar{L}_{t+1}\right)}{\partial\tau_t}+ \\ &\underbrace{\left[-(1+r)p_t\cdot+p_{t+1}\left(1-\left(1-\tilde{\theta}_j X_{G,t}\right)\mu\gamma_{t+1}\right)+\frac{\partial v(L_{i,t})}{\partial L_{i,t}}\right]}_{=0}\cdot\frac{\partial L_{i,t}}{\partial\tau_t}=0\end{aligned} \tag{A19}$$

where

$$\frac{\partial X_{G,t}}{\partial\tau_t} = \sqrt{\frac{[\phi q+(1-\phi)w]}{\tau_t\bar{L}_t}}\geq 0 \tag{A20}$$

and

$$\frac{\partial L_{i,t}}{\partial\tau_t} = -\tilde{\theta}_j\mu\gamma_{t+1}p_{t+1}\cdot\frac{\partial X_{G,t}}{\partial\tau_t}\cdot\underbrace{\left(\frac{\partial v'^{-1}}{\partial L_{i,t}}\right)^{-1}}_{<0}>0 \tag{A21}$$

i.e. a higher adaptation rate reduces the idiosyncratic losses suffered in the wake of an extreme weather event. Given prices, this increases demand for housing.

Now, using that

$$\frac{\partial \mathbb{E}_t\left(\bar{L}_{t+1}\right)}{\partial \tau_t} = \theta_j \mu \gamma_{t+1} \cdot \frac{\partial X_{G,t}}{\partial \tau_t} \tag{A22}$$

and that in equilibrium $L_{i,t} = \bar{L}_t$, the FOC can be rewritten as

$$\theta_j \mu \gamma_{t+1} \left( p_{t+1} + \frac{\partial f\left(\mathbb{E}_t\left(\bar{L}_{t+1}\right)\right)}{\partial \mathbb{E}_t\left(\bar{L}_{t+1}\right)} \right) \cdot \sqrt{\frac{[\phi q + (1-\phi)\, w]}{\tau_t \bar{L}_t}} = (1+r) y_{i,t} \tag{A23}$$

Then, the optimal choice of adaptation rate of a young household with beliefs $\theta_j$ is

$$\tau_t^{Y*} = \frac{1}{\bar{L}_t} \cdot [\phi q + (1-\phi)\, w] \cdot \left( \frac{\theta_j \mu \gamma_{t+1} \left( p_{t+1} + \frac{\partial f\left(\mathbb{E}_t\left(\bar{L}_{t+1}\right)\right)}{\partial \mathbb{E}_t\left(\bar{L}_{t+1}\right)} \right)}{(1+r) y_{i,t}} \right)^2 \tag{A24}$$

## *C. Proof of Proposition 2*

Old households maximize their expected utility, as given by

$$\begin{aligned} \max_{\tau_t} \mathbb{E}\left(U\left(c_{i,t}, , \bar{L}_{t+1}\right)\right) &= \mathbb{E}_t\left(c_{i,t}\right) + f\left(\mathbb{E}_{i,t}\left(\bar{L}_{t+1}\right)\right) \\ s.t. \quad c_{i,t} &\leq (1-\tau_t)\, y_t + \max\left\{ p_t\left(1-\xi_{i,t}\right) L_{i,t-1} + (1+\hat{r})\, S_{i,t-1}, 0 \right\} \\ \tau_t &\geq 0 \end{aligned} \tag{A25}$$

where $c_{i,t}$ is consumption of household $i$ in period $t$ and $\mathbb{E}_t$ denotes expectations formed at date $t$.

Using similar steps as in Proof of Proposition 1, the maximization problem can be rewritten as

$$\begin{aligned} \max_{\tau_t} \mathbb{E}\left(U\left(c_{i,t+1}, \bar{L}_{t+1}\right)\right) &= (1-\tau_t)\, y_t + (1+r) S_{i,t-1} \\ &\quad + p_{t+1}\left(1 - \left(1 - \tilde{\theta}_j X_{G,t-1}\right) \mu \gamma_t\right) L_{i,t-1} + f\left(\mathbb{E}_t\left(\bar{L}_{t+1}\right)\right) \\ s.t. \quad \tau_t &\geq 0 \end{aligned} \tag{A26}$$

and the optimal choice of adaptation rate of an old household with beliefs $\theta_j$ is given by

$$\tau_t^{O*} = \frac{1}{\bar{L}_t} \cdot [\phi q + (1-\phi)\, w] \cdot \left( \frac{\theta_j \mu \gamma_{t+1} \frac{\partial f\left(\mathbb{E}_t\left(\bar{L}_{t+1}\right)\right)}{\partial \mathbb{E}_t\left(\bar{L}_{t+1}\right)}}{y_{i,t}} \right)^2 \tag{A27}$$

## D. Proof of Proposition 3

We assume that coalitions choose a adaptation rate that maximizes their joint utility function. Consider first the coalition of young pessimists and old optimists. This coalition maximizes

$$\max_{\tau_t} \mathbb{E}\left(U\left(YP,OO\right)\right) = \omega \cdot \left(v\left(L_{YP,t}\right) + \mathbb{E}_t\left(c_{YP,t+1}\right)\right) + (1-\omega)\cdot\left(\mathbb{E}_t\left(c_{OO,t}\right)\right) + f\left(\mathbb{E}_{YP,OO,t}\left(\bar{L}_{t+1}\right)\right) \tag{A28}$$

$$\begin{aligned} s.t. \quad & (1-\tau_t)\, y_{YP,t} \leq p_t L_{YP,t} + S_{YP,t} \\ & c_{YP,t+1} \leq (1-\tau_{t+1})\, y_{YP,t+1} + \max\left\{p_{t+1}\left(1-\xi_{YP,t+1}\right) L_{YP,t} + (1+\hat{r})\, S_{YP,t}, 0\right\} \\ & c_{OO,t} \leq (1-\tau_t)\, y_{OO,t} + \max\left\{p_t\left(1-\xi_{OO,t}\right) L_{OO,t-1} + (1+\hat{r})\, S_{OO,t-1}, 0\right\} \\ & \tau_t \geq 0 \end{aligned}$$

Using the no-arbitrage condition as in Proof of Proposition 1, the expectation of a young pessimists' consumption in period $t+1$, $c_{YP,t+1}$, as formed at date $t$, becomes

$$\begin{aligned} \mathbb{E}_t\left(c_{YP,t+1}\right) = {} & (1+r)\left((1-\tau_t)\, y_{YP,t} - p_t L_{YP,t}\right) \\ & + p_{t+1}\left(1-\left(1-\tilde{\theta}_{YP} X_{G,t}\right)\mu\gamma_{t+1}\right) L_{YP,t} + (1-\tau_{t+1})\, y_{YP,t+1} \end{aligned} \tag{A29}$$

and the expectation of an old optimists' consumption in period $t$, $c_{OO,t}$, as formed at date $t$, becomes

$$\mathbb{E}_t\left(c_{OO,t}\right) = (1-\tau_t)\, y_{OO,t} + (1+r) S_{OO,t-1} + p_t\left(1-\left(1-\tilde{\theta}_{OO} X_{G,t-1}\right)\mu\gamma_t\right) L_{OO,t-1} \tag{A30}$$

The FOC for $\tau_t$ is given by

$$\begin{aligned} & \omega\left(-(1+r) y_{YP,t} + \tilde{\theta}_{YP}\mu\gamma_{t+1} p_{t+1} L_{YP,t} \cdot \frac{\partial X_{G,t}}{\partial \tau_t}\right) + (1-\omega)\left(-y_{OO,t}\right) \\ & + \frac{\partial f\left(\mathbb{E}_{YP,OO,t}\left(\bar{L}_{t+1}\right)\right)}{\partial\, \mathbb{E}_{YP,OO,t}\left(\bar{L}_{t+1}\right)} \cdot \frac{\partial\, \mathbb{E}_{YP,OO,t}\left(\bar{L}_{t+1}\right)}{\partial \tau_t} = 0 \end{aligned} \tag{A31}$$

where

$$\mathbb{E}_{YP,OO,t}\left(\bar{L}_{t+1}\right) = \left(1-\left(1-\int_0^1 \tilde{\theta}_j X_{G,t} di\right)\mu\gamma_{t+1}\right)\bar{L}_t \tag{A32}$$

and

$$\frac{\partial\, \mathbb{E}_{YP,OO,t}\left(\bar{L}_{t+1}\right)}{\partial \tau_t} = \left(\omega\underline{\theta} + (1-\omega)\bar{\theta}\right)\mu\gamma_{t+1} \cdot \frac{\partial X_{G,t}}{\partial \tau_t} \tag{A33}$$

Then, this becomes

$$\begin{aligned} & \frac{\partial X_{G,t}}{\partial \tau_t}\left[\omega\underline{\theta}\mu\gamma_{t+1} p_{t+1} + \left(\omega\underline{\theta} + (1-\omega)\bar{\theta}\right)\mu\gamma_{t+1} \cdot \frac{\partial f\left(\mathbb{E}_{YP,OO,t}\left(\bar{L}_{t+1}\right)\right)}{\partial\, \mathbb{E}_{YP,OO,t}\left(\bar{L}_{t+1}\right)}\right] \\ & \quad = \omega \cdot (1+r) y_{YP,t} + (1-\omega)\cdot y_{OO,t} \end{aligned} \tag{A34}$$

Using that

$$\frac{\partial X_{G,t}}{\partial \tau_t} = \sqrt{\frac{[\phi q + (1-\phi)\, w]}{\tau_t \bar{L}_t}} \tag{A35}$$

The adaptation rate preferred by a coalition of young pessimists and old optimists is given by

$$\tau_t^{YP,OO*} = \frac{(\mu\gamma_{t+1})^2}{\bar{L}_t} \cdot \frac{1}{[\phi q + (1-\phi)\, w]} \cdot \left( \frac{\left[\omega\underline{\theta} p_{t+1} + \left(\omega\underline{\theta} + (1-\omega)\bar{\theta}\right) \cdot \frac{\partial f\left(\mathbb{E}_{YP,OO,t}\left(\bar{L}_{t+1}\right)\right)}{\partial\, \mathbb{E}_{YP,OO,t}\left(\bar{L}_{t+1}\right)}\right]}{(1+\omega r)} \right)^2 \tag{A36}$$

Using similar steps as above, the adaptation rate preferred by a coalition of old optimists and old pessimists is given by

$$\tau_t^{YP,OP*} = \frac{(\underline{\theta}\mu\gamma_{t+1})^2}{\bar{L}_t} \cdot \frac{1}{[\phi q + (1-\phi)\, w]} \cdot \left( \frac{\left[\frac{1}{2} p_{t+1} + \frac{\partial f\left(\mathbb{E}_{P,t}\left(\bar{L}_{t+1}\right)\right)}{\partial\, \mathbb{E}_{P,t}\left(\bar{L}_{t+1}\right)}\right]}{\left(1+\frac{1}{2} r\right)} \right)^2 \tag{A37}$$

and the adaptation rate preferred by a coalition of old optimists and old pessimists is given by

$$\tau_t^{OO,OP*} = \frac{(\mu\gamma_{t+1})^2}{\bar{L}_t} \cdot \frac{1}{[\phi q + (1-\phi)\, w]} \cdot \left[ \left((1-\omega)\bar{\theta} + \omega\underline{\theta}\right) \cdot \frac{\partial f\left(\mathbb{E}_{OO,OP,t}\left(\bar{L}_{t+1}\right)\right)}{\partial\, \mathbb{E}_{OO,OP,t}\left(\bar{L}_{t+1}\right)} \right]^2 \tag{A38}$$

## *E. Proof of Proposition 4*

To ensure that the adaptation rate preferred by old optimists is larger than the adaptation rate preferred by young pessimists (i.e. $\tau^{OO*} > \tau^{YP*}$), it must hold that

$$\bar{\theta} \cdot \left( \frac{\partial f\left(\mathbb{E}_{O,t}\left(\bar{L}_{t+1}\right)\right)}{\partial\, \mathbb{E}_{O,t}} \right) > \underline{\theta} \cdot \left( \frac{p_{t+1} + \frac{\partial f\left(\mathbb{E}_{P,t}\left(\bar{L}_{t+1}\right)\right)}{\partial\, \mathbb{E}_{P,t}}}{(1+r)} \right) \tag{A39}$$

or equivalently

$$\frac{\bar{\theta}}{\underline{\theta}} > \left( \frac{p_{t+1} \cdot \left[\frac{\partial f\left(\mathbb{E}_{O,t}\left(\bar{L}_{t+1}\right)\right)}{\partial\, \mathbb{E}_{O,t}}\right]^{-1} + \frac{\partial f\left(\mathbb{E}_{P,t}\left(\bar{L}_{t+1}\right)\right)}{\partial\, \mathbb{E}_{P,t}} \cdot \left[\frac{\partial f\left(\mathbb{E}_{O,t}\left(\bar{L}_{t+1}\right)\right)}{\partial\, \mathbb{E}_{O,t}}\right]^{-1}}{(1+r)} \right) \tag{A40}$$

which is the condition given in Assumption 3. Then, the relative ordering of the adaptation rates follow directly from Assumption 3.

## *F. Proof of Proposition 5*

Young pessimists prefer to form a coalition with old optimists rather than old pessimists if

$$\mathbb{E}_t\left(U_{YP}\left(\tau^{YP,OO*}\right)\right) > \mathbb{E}_t\left(U_{YP}\left(\tau^{YP,OP*}\right)\right) \tag{A41}$$

Using that

$$v'\left(L_{YP,t}\right) = (1+r)p_t - \left(1 - \left(1 - \tilde{\theta}_j X_{G,t}\right)\mu\gamma_{t+1}\right) p_{t+1}$$

and assuming $v\left(L_{i,t}\right)=ln\left(L_{it}\right)$, the relevant condition becomes

$$\begin{aligned}&\underbrace{v\left(L_{YP,t}\left(\tau^{YP,OO*}\right)\right)-v\left(L_{YP,t}\left(\tau^{YP,OP*}\right)\right)}_{(i)>0}\\&+\underbrace{f\left(\mathbb{E}_{P,t}\left(\bar{L}_{t+1}\left(\tau^{YP,OO*}\right)\right)\right)-f\left(\mathbb{E}_{P,t}\left(\bar{L}_{t+1}\left(\tau^{YP,OP*}\right)\right)\right)}_{(ii)>0}\\&>(1+r)\underbrace{\left(\tau^{YP,OO*}-\tau^{YP,OP*}\right)}_{(iii)>0}y_{YP,t}\end{aligned}\tag{A42}$$

Substituting the expressions for $\tau^{YP,OO*},\tau^{YP,OP*}$ gives

$$\begin{aligned}&\left(\frac{\left[\omega\underline{\theta}p_{t+1}+\left(\omega\underline{\theta}+(1-\omega)\bar{\theta}\right)\cdot\frac{\partial f\left(\mathbb{E}_{YP,OO,t}\left(\bar{L}_{t+1}\right)\right)}{\partial\mathbb{E}_{YP,OO,t}\left(\bar{L}_{t+1}\right)}\right]}{(1+\omega r)}\right)^2-\left(\frac{\underline{\theta}\cdot\left[\frac{1}{2}p_{t+1}+\frac{\partial f\left(\mathbb{E}_{P,t}\left(\bar{L}_{t+1}\right)\right)}{\partial\mathbb{E}_{P,t}\left(\bar{L}_{t+1}\right)}\right]}{\left(1+\frac{1}{2}r\right)}\right)^2\\&<\frac{1}{A}\cdot\frac{\Delta v\left(L_{YP,t}\right)+\Delta f\left(E_{P,t}\left(\bar{L}_{t+1}\right)\right)}{(1+r)[\phi q+(1-\phi)w]}\end{aligned}\tag{A43}$$

where

$$\Delta v\left(L_{YP,t}\right)=v\left(L_{YP,t}\left(\tau^{YP,OO*}\right)\right)-v\left(L_{YP,t}\left(\tau^{YP,OP*}\right)\right)$$

and

$$\Delta f\left(E_{P,t}\left(\bar{L}_{t+1}\right)\right)=f\left(\mathbb{E}_{P,t}\left(\bar{L}_{t+1}\left(\tau^{YP,OO*}\right)\right)\right)-f\left(\mathbb{E}_{P,t}\left(\bar{L}_{t+1}\left(\tau^{YP,OP*}\right)\right)\right)$$

Denote by $B\equiv B\left(\Delta v\left(L_{YP,t}\right),\bar{L}_t,\Delta f\left(E_{P,t}\left(\bar{L}_{t+1}\right)\right),\gamma_{t+1}\right)=\frac{\Delta v(L_{YP,t})+\Delta f\left(E_{P,t}\left(\bar{L}_{t+1}\right)\right)}{(1+r)}\cdot\frac{\bar{L}_t}{(\mu\gamma_{t+1})^2}$.
This allows us to rewrite the condition as

$$\begin{aligned}&\frac{\omega^2}{(1+\omega r)^2}\cdot\left(p_{t+1}+\left(1+\frac{(1-\omega)}{\omega}\cdot\frac{\bar{\theta}}{\underline{\theta}}\right)\cdot\frac{\partial f\left(\mathbb{E}_{YP,OO,t}\left(\bar{L}_{t+1}\right)\right)}{\partial\mathbb{E}_{YP,OO,t}\left(\bar{L}_{t+1}\right)}\right)^2\\&<\frac{B}{\underline{\theta}^2}+\frac{1}{\left(1+\frac{1}{2}r\right)^2}\cdot\left(\frac{1}{2}p_{t+1}+\frac{\partial f\left(\mathbb{E}_{P,t}\left(\bar{L}_{t+1}\right)\right)}{\partial\mathbb{E}_{P,t}\left(\bar{L}_{t+1}\right)}\right)^2\end{aligned}\tag{A44}$$

Then, young pessimists prefer to form a coalition with old optimists if

$$\frac{\bar{\theta}}{\underline{\theta}}<\frac{\omega}{(1-\omega)}.\tag{A45}$$

$$\left(\left[\frac{\partial f\left(\mathbb{E}_{YP,OO,t}\left(\bar{L}_{t+1}\right)\right)}{\partial\mathbb{E}_{YP,OO,t}\left(\bar{L}_{t+1}\right)}\right]^{-1}\left(\frac{(1+\omega r)}{\omega}\sqrt{\left(\frac{B}{\underline{\theta}^2}+\frac{1}{\left(1+\frac{1}{2}r\right)^2}\left(\frac{1}{2}p_{t+1}+\frac{\partial f\left(\mathbb{E}_{P,t}\left(\bar{L}_{t+1}\right)\right)}{\partial\mathbb{E}_{P,t}\left(\bar{L}_{t+1}\right)}\right)^2\right)}-p_{t+1}\right)-1\right)$$

Otherwise, we have that

$$\mathbb{E}_t\left(U_{YP}\left(\tau^{YP,OO*}\right)\right)<\mathbb{E}_t\left(U_{YP}\left(\tau^{YP,OP*}\right)\right)\tag{A46}$$

and a coalition of young pessimists and old optimists prevails.

## G. Proof of Proposition 6

In the social optimum, the benefits of public adaptation are fully internalized, i.e. $\theta_j = 1, \forall j$. Then, the optimal choice of public adaptation is determined by maximizing a utilitarian social welfare function, i.e.

$$\max_{X_{G,t}} \sum_{t=0}^{\infty} \left(\frac{1}{1+r}\right)^t \left((1+r)\left((1-\tau_t)\Big[\phi q + (1-\phi)w\Big]\right) + v(\bar{L}_t) + f(\bar{L}_{t+1})\right) \tag{A47}$$

$$s.t. \qquad \frac{1}{2} X_{G,t}^{2*} \bar{L}_t = \tau_t \cdot [\phi q + (1-\phi)\, w]$$

$$\bar{L}_j = \bar{L}_t \prod_{\iota=t}^{j-1} \left(1 - (1 - X_{G,\iota})\, \mu \gamma_{\iota+1}\right).$$

The first order condition for $X_{G,t}$ is

$$(1+r) X_{G,t}^{*} \bar{L}_t = \mu \gamma_{t+1} \bar{L}_t \cdot f'\left(\bar{L}_{t+1}\right) \tag{A48}$$

$$+ \sum_{j=t+1}^{\infty} \left(\frac{1}{1+r}\right)^{j-t} \left(\left[-\frac{1}{2}(1+r) X_{G,j}^2 + v'(\bar{L}_j)\right] \frac{\partial \bar{L}_j}{\partial X_{G,t}} + f'(\bar{L}_{j+1}) \cdot \frac{\partial \bar{L}_{j+1}}{\partial X_{G,t}}\right)$$

Using that

$$\frac{\partial \bar{L}_j}{\partial X_{G_t}} = \mu_L \gamma_{t+1} \bar{L}_t \prod_{\iota=t+1}^{j-1} \left(1 - (1 - X_{G,\iota})\, \mu_L \gamma_{\iota+1}\right) \tag{A49}$$

The socially optimal public choice of adaptation becomes

$$X_{G,t}^{*}|_{\theta_j=1 \forall j} = \frac{\mu_L \gamma_{t+1}}{(1+r)} \cdot \underbrace{\sum_{j=t+1}^{\infty} \left(\frac{1}{1+r}\right)^{j-t} \left[-\frac{1}{2}(1+r) X_{G,j}^2 + v'(\bar{L}_j)\right] \prod_{\iota=t+1}^{j-1} \left(1 - (1 - X_{G,\iota})\, \mu_L \gamma_{\iota+1}\right)}_{p_{t+1}|\theta_j=1 \forall j} \tag{A50}$$

$$+ \frac{\mu_L \gamma_{t+1}}{(1+r)} \cdot \left(f'\left(\bar{L}_{t+1}\right) + \sum_{j=t+1}^{\infty} \left(\frac{1}{1+r}\right)^{j-t} \left(f'(\bar{L}_{j+1})\right) \prod_{\iota=t+1}^{j} \left(1 - (1 - X_{G,\iota})\, \mu_L \gamma_{\iota+1}\right)\right)$$

**Decomposing the Adaptation Gap** We solve for the social optimum in the case in which the dispersion in the beliefs on the efficacy of public adaptation is taken into consideration, i.e. $\theta_j < 1, \forall j$:

$$\max_{X_{G,t}} \sum_{t=0}^{\infty} \left(\frac{1}{1+r}\right)^t \left((1+r)\left((1-\tau_t)\Big[\phi q + (1-\phi)w\Big]\right) + v(\bar{L}_t) + f(\mathbb{E}\left(\bar{L}_{t+1}\right))\right) \tag{A51}$$

$$s.t. \qquad \frac{1}{2} X_{G,t}^{2*} \bar{L}_t = \tau_t \cdot [\phi q + (1-\phi)\, w]$$

$$\mathbb{E}\left(\bar{L}_j\right) = \bar{L}_t \prod_{\iota=t}^{j-1} \left(1 - \left(1 - \int_0^1 \theta_i di X_{G,\iota}\right) \mu \gamma_{\iota+1}\right).$$

In this case, the of public adaptation is given by

$$X^*_{G,t} = \frac{\mu_L \gamma_{t+1} \cdot \int_0^1 \theta_i di}{(1+r)} \cdot \tag{A52}$$
$$\sum_{j=t+1}^{\infty} \left(\frac{1}{1+r}\right)^{j-t} \left[-\frac{1}{2}(1+r)X^2_{G,j} + v'(\bar{L}_j)\right] \prod_{\iota=t+1}^{j-1} \left(1 - \left(1 - \int_0^1 \theta_i di X_{G,\iota}\right) \mu_L \gamma_{\iota+1}\right)$$
$$+ \frac{\mu_L \gamma_{t+1} \cdot \int_0^1 \theta_i di}{(1+r)} \cdot$$
$$\left(f'\left(\mathbb{E}\left(\bar{L}_{t+1}\right)\right) + \sum_{j=t+1}^{\infty} \left(\frac{1}{1+r}\right)^{j-t} \left(f'(\mathbb{E}\,\bar{L}_{j+1})\right) \prod_{\iota=t+1}^{j} \left(1 - \left(1 - \int_0^1 \theta_i di X_{G,\iota}\right) \mu_L \gamma_{\iota+1}\right)\right)$$

## *H. Proof of Proposition 7*

Old households maximize their expected utility, as given by

$$\max_{\tau_t} \mathbb{E}\left(U\left(c_{y,t},, \bar{L}_{t+1}\right)\right) = \mathbb{E}_t\left(c_{y,t}\right) + f\left(\mathbb{E}_{j,t}\left(\bar{L}_{t+1}\right)\right) \tag{A53}$$
$$s.t. \quad c_{y,t} \leq (1-\tau_t)\, y + \max\left\{p_t\left(1-\xi_{y,t}\right) L_{y,t-1} + \left(1+\hat{r}\right) S_{y,t-1}, 0\right\}$$
$$\tau_t \geq 0$$

where $c_{y,t}$ is the consumption of an old household with income $y \in \{w, q\}$ in period $t$ and $\mathbb{E}_t$ denotes expectations formed at date $t$.

Using similar steps as in Proof of Proposition 2, the optimal choice of adaptation rate of an old household with beliefs $\theta_j$ and income $y$ is given by

$$\tau_t^{Ojy*} = \frac{1}{\bar{L}_t} \cdot [\phi q + (1-\phi)\, w] \cdot \left(\frac{\theta_j \mu \gamma_{t+1} \frac{\partial f\left(\mathbb{E}_t\left(\bar{L}_{t+1}\right)\right)}{\partial\, \mathbb{E}_t\left(\bar{L}_{t+1}\right)}}{y}\right)^2 \tag{A54}$$

We determine the relative ordering of the adaptation rates preferred by the different types of old households. Specifically, as $q > w$, we have that $\tau^{OOl*} > \tau^{OOh*}$ and $\tau^{OPl} > \tau^{OPh*}$. Moreover, as $\bar{\theta} > \underline{\theta}$, we have that $\tau^{OOh*} > \tau^{OPh*}$ and $\tau^{OOl} > \tau^{OPl*}$. If it additionally holds that

$$\frac{q}{w} < \frac{\bar{\theta}}{\underline{\theta}} \cdot \frac{\frac{\partial f\left(\mathbb{E}_{O,t}\left(\bar{L}_{t+1}\right)\right)}{\partial\, \mathbb{E}_{O,t}\left(\bar{L}_{t+1}\right)}}{\frac{\partial f\left(\mathbb{E}_{P,t}\left(\bar{L}_{t+1}\right)\right)}{\partial\, \mathbb{E}_{P,t}\left(\bar{L}_{t+1}\right)}} \tag{A55}$$

then, the relative ordering of the adaptation rates preferred by old households is given by

$$\tau^{OOl*} > \tau^{OOh*} > \tau^{OPl*} > \tau^{OPh*} \tag{A56}$$

Otherwise, this becomes

$$\tau^{OOl*} > \tau^{OPl*} > \tau^{OOh*} > \tau^{OPh*} \tag{A57}$$

## *I. Proof of Proposition 8*

From Proposition 7, we know the relative ordering of the adaptation rates of the old households, both if economic inequality is low, and if it is high. In accordance with the baseline model, we focus on the case in which the young pessimists are pivotal.

**Low Economic Inequality** If economic inequality is low, the young pessimists are pivotal if

$$(\phi \cdot q + (1-\phi) \cdot w) \cdot \bar{\theta} \cdot \left( \frac{\partial f\left(\mathbb{E}_{O,t}\left(\bar{L}_{t+1}\right)\right) / \partial \mathbb{E}_{O,t}}{q} \right) > \underline{\theta} \cdot \left( \frac{p_{t+1} + \frac{\partial f\left(\mathbb{E}_{P,t}\left(\bar{L}_{t+1}\right)\right)}{\partial \mathbb{E}_{P,t}}}{(1+r)} \right) \tag{A58}$$

or equivalently

$$\frac{\bar{\theta}}{\underline{\theta}} > \left( \frac{p_{t+1} \cdot \left[ \frac{\partial f\left(\mathbb{E}_{O,t}\left(\bar{L}_{t+1}\right)\right)}{\partial \mathbb{E}_{O,t}} \right]^{-1} + \frac{\partial f\left(\mathbb{E}_{P,t}\left(\bar{L}_{t+1}\right)\right)}{\partial \mathbb{E}_{P,t}} \cdot \left[ \frac{\partial f\left(\mathbb{E}_{O,t}\left(\bar{L}_{t+1}\right)\right)}{\partial \mathbb{E}_{O,t}} \right]^{-1}}{(1+r)} \right) \cdot \frac{q}{(\phi \cdot q + (1-\phi) \cdot w)} \tag{A59}$$

which is the condition given in Assumption 4 (i). Hence, under Assumption 4(i), we have that

$$\tau^{YO*} > \tau^{OOl*} > \tau^{OOh*} > \tau^{YP*} > \tau^{OPl*} > \tau^{OPH*} \tag{A60}$$

Alternatively, if the condition in Assumption 4(i) is not satisfied, we have that

$$\tau^{YO*} > \tau^{OOl*} > \tau^{YP*} > \tau^{OOh*} > \tau^{OPl*} > \tau^{OPH*} \tag{A61}$$

**High Economic Inequality** If economic inequality is high, the young pessimists are pivotal if

$$(\phi \cdot q + (1-\phi) \cdot w) \cdot \bar{\theta} \cdot \left( \frac{\partial f\left(\mathbb{E}_{O,t}\left(\bar{L}_{t+1}\right)\right) / \partial \mathbb{E}_{O,t}}{q} \right) < \underline{\theta} \cdot \left( \frac{p_{t+1} + \frac{\partial f\left(\mathbb{E}_{P,t}\left(\bar{L}_{t+1}\right)\right)}{\partial \mathbb{E}_{P,t}}}{(1+r)} \right) \tag{A62}$$

or equivalently

$$\frac{\bar{\theta}}{\underline{\theta}} < \left( \frac{p_{t+1} \cdot \left[ \frac{\partial f\left(\mathbb{E}_{O,t}\left(\bar{L}_{t+1}\right)\right)}{\partial \mathbb{E}_{O,t}} \right]^{-1} + \frac{\partial f\left(\mathbb{E}_{P,t}\left(\bar{L}_{t+1}\right)\right)}{\partial \mathbb{E}_{P,t}} \cdot \left[ \frac{\partial f\left(\mathbb{E}_{O,t}\left(\bar{L}_{t+1}\right)\right)}{\partial \mathbb{E}_{O,t}} \right]^{-1}}{(1+r)} \right) \cdot \frac{q}{(\phi \cdot q + (1-\phi) \cdot w)} \tag{A63}$$

which is the condition given in Assumption 4 (ii). Hence, under Assumption 4(ii), we have that

$$\tau^{YO*} > \tau^{OOl*} > \tau^{OPl*} > \tau^{YP*} > \tau^{OOh*} > \tau^{OPH*} \tag{A64}$$

Alternatively, if the condition in Assumption 4(i)i is not satisfied, we have that

$$\tau^{YO*} > \tau^{OOl*} > \tau^{OPl*} > \tau^{OOh*} > \tau^{YP*} > \tau^{OPH*} \tag{A65}$$

## J. Proof of Proposition A2

**Proposition A2.** *If the number of young households is an infinitesimal amount smaller than that of old households, pessimists represent a fraction $\omega > 0.5$ of all voters, high-income households represent a fraction $\phi < 0.5$ of all voters, economic inequality is sufficiently low, and Assumption 4 (i) holds, the adaptation rates that maximize joint utility of each coalition are*

1.
$$\tau_t^{YP,OOh,OOl*} = A \cdot \left( \frac{\left[ \omega \underline{\theta} p_{t+1} + \left(\omega \underline{\theta} + (1-\omega)\bar{\theta}\right) \cdot \frac{\partial f\left(\mathbb{E}_{YP,OOh,OOl,t}\left(\bar{L}_{t+1}\right)\right)}{\partial \mathbb{E}_{YP,OOh,OOl,t}\left(\bar{L}_{t+1}\right)} \right]}{(1+\omega r)} \right)^2,$$

2.
$$\tau_t^{YP,OOh,OPl*} = A \cdot \left[\phi q + (1-\phi)\, w\right]^2 \cdot \left( \frac{\left[ \omega \underline{\theta} p_{t+1} + \left(\omega(2-\phi)\underline{\theta} + (1-\omega)\phi\bar{\theta}\right) \cdot \frac{\partial f\left(\mathbb{E}_{YP,OOh,OPl,t}\left(\bar{L}_{t+1}\right)\right)}{\partial \mathbb{E}_{YP,OOh,OPl,t}\left(\bar{L}_{t+1}\right)} \right]}{\omega \cdot (1+r) \cdot \left[\phi q + (1-\phi)\, w\right] + (1-\omega)\phi \cdot q + \omega(1-\phi) \cdot w} \right)^2,$$

3.
$$\tau_t^{YP,OPh,OPl*} = A \cdot \left( \frac{\underline{\theta} \left[ \frac{1}{2} p_{t+1} + \frac{\partial f\left(\mathbb{E}_{YP,OPh,OPl,t}\left(\bar{L}_{t+1}\right)\right)}{\partial \mathbb{E}_{YP,OPh,OPl,t}\left(\bar{L}_{t+1}\right)} \right]}{\left(1 + \frac{1}{2} r\right)} \right)^2.$$

*If economic inequality is sufficiently high and Assumption 4 (ii) holds,the adaptation rates that maximize joint utility of each coalition are*

1.
$$\tau_t^{YP,OOl,OPl*} = A \cdot \left[\phi q + (1-\phi)\, w\right]^2 \cdot \left( \frac{\left[ \omega \underline{\theta} p_{t+1} + \left(\omega(2-\phi)\underline{\theta} + (1-\omega)(1-\phi)\bar{\theta}\right) \cdot \frac{\partial f\left(\mathbb{E}_{YP,OOl,OPl,t}\left(\bar{L}_{t+1}\right)\right)}{\partial \mathbb{E}_{YP,OOl,OPl,t}\left(\bar{L}_{t+1}\right)} \right]}{\omega\,(1+r)\left[\phi q + (1-\phi)\, w\right] + (1-\phi)\, w} \right)^2,$$

2.
$$\tau_t^{YP,OOh,OPl*} = A \cdot \left[\phi q + (1-\phi)\, w\right]^2 \cdot \left( \frac{\left[ \omega \underline{\theta} p_{t+1} + \left(\omega(2-\phi)\underline{\theta} + (1-\omega)\phi\bar{\theta}\right) \cdot \frac{\partial f\left(\mathbb{E}_{YP,OOh,OPl,t}\left(\bar{L}_{t+1}\right)\right)}{\partial \mathbb{E}_{YP,OOh,OPl,t}\left(\bar{L}_{t+1}\right)} \right]}{\omega \cdot (1+r) \cdot \left[\phi q + (1-\phi)\, w\right] + (1-\omega)\phi \cdot q + \omega(1-\phi) \cdot w} \right)^2,$$

3.
$$\tau_t^{YP,OOh,OPh*} = A \cdot \left[\phi q + (1-\phi)\, w\right]^2 \cdot \left( \frac{\left[ \omega \underline{\theta} p_{t+1} + \left(\omega(1+\phi)\underline{\theta} + (1-\omega)\phi\bar{\theta}\right) \cdot \frac{\partial f\left(\mathbb{E}_{YP,OOl,OPl,t}\left(\bar{L}_{t+1}\right)\right)}{\partial \mathbb{E}_{YP,OOl,OPl,t}\left(\bar{L}_{t+1}\right)} \right]}{\omega\,(1+r)\left[\phi q + (1-\phi)\, w\right] + \phi q} \right)^2.$$

*Alternatively, if the condition in Assumption 4 ((i) respectively (ii)) is not satisfied, the adaptation rate that maximizes the joint utility of the prevailing coalition is given by the expression for $\tau_t^{YP,OOh,OPl*}$.*

We assume that coalitions choose a adaptation rate that maximizes their joint utility function. Then, the adaptation rates preferred by each coalition are derived using similar steps as in Proof of Proposition 3.

## K. Proof of Proposition A3

**Proposition A3.** *If the number of young households is an infinitesimal amount smaller than that of old households, pessimists represent a fraction $\omega > 0.5$ of all voters, high-income households represent a fraction $\phi < 0.5$ of all voters, economic inequality is low, Assumption 4 (i) holds, and*

$$\frac{1}{(1+\omega r)^2}\cdot\left(p_{t+1}+\left(1+\frac{(1-\omega)}{\omega}\cdot\frac{\bar{\theta}}{\underline{\theta}}\right)\cdot\frac{\partial f\left(\mathbb{E}_{YP,OOh,OOl,t}\left(\bar{L}_{t+1}\right)\right)}{\partial\,\mathbb{E}_{YP,OOh,OOl,t}\left(\bar{L}_{t+1}\right)}\right)^2 \tag{A66}$$
$$-\left(\frac{[\phi q+(1-\phi)\,w]}{(1+\omega r)\,\phi\cdot q+(2+r)\omega\,(1-\phi)\cdot w}\right)^2$$
$$\cdot\left(p_{t+1}+\left((2-\phi)+\phi\cdot\frac{(1-\omega)}{\omega}\cdot\frac{\bar{\theta}}{\underline{\theta}}\right)\cdot\frac{\partial f\left(\mathbb{E}_{YP,OOh,OPl,t}\left(\bar{L}_{t+1}\right)\right)}{\partial\,\mathbb{E}_{YP,OOh,OPl,t}\left(\bar{L}_{t+1}\right)}\right)^2$$
$$<\frac{\Delta v\left(L_{YP,t}\right)+\Delta f\left(E_{P,t}\left(\bar{L}_{t+1}\right)\right)}{(1+r)}\cdot\frac{\bar{L}_t}{(\omega\underline{\theta}\mu\gamma_{t+1})^2}$$

*the political economy equilibrium is characterized by a coalition of young pessimists and old optimists. The adaptation rate proposed by this coalition equals*

$$\tau_t^{YP,OOh,OOl*}=A\cdot\left(\frac{\left[\omega\underline{\theta}p_{t+1}+\left(\omega\underline{\theta}+(1-\omega)\bar{\theta}\right)\cdot\frac{\partial f\left(\mathbb{E}_{YP,OOh,OOl,t}\left(\bar{L}_{t+1}\right)\right)}{\partial\,\mathbb{E}_{YP,OOh,OOl,t}\left(\bar{L}_{t+1}\right)}\right]}{(1+\omega r)}\right)^2. \tag{A67}$$

*If economic inequality is high, Assumption 4 (ii) holds and*

$$\left(\frac{\left[p_{t+1}+\left((2-\phi)+\frac{(1-\omega)}{\omega}(1-\phi)\frac{\bar{\theta}}{\underline{\theta}}\right)\cdot\frac{\partial f\left(\mathbb{E}_{YP,OOl,OPl,t}\left(\bar{L}_{t+1}\right)\right)}{\partial\,\mathbb{E}_{YP,OOl,OPl,t}\left(\bar{L}_{t+1}\right)}\right]}{\omega\,(1+r)\,[\phi q+(1-\phi)\,w]+(1-\phi)\,w}\right)^2 \tag{A68}$$
$$-\left(\frac{\left[p_{t+1}+\left((2-\phi)+\frac{(1-\omega)}{\omega}\phi\frac{\bar{\theta}}{\underline{\theta}}\right)\cdot\frac{\partial f\left(\mathbb{E}_{YP,OOh,OPl,t}\left(\bar{L}_{t+1}\right)\right)}{\partial\,\mathbb{E}_{YP,OOh,OPl,t}\left(\bar{L}_{t+1}\right)}\right]}{(1+\omega r)\,\phi\cdot q+(2+r)\omega\,(1-\phi)\cdot w}\right)^2$$
$$<\frac{\Delta v\left(L_{YP,t}\right)+\Delta f\left(E_{P,t}\left(\bar{L}_{t+1}\right)\right)}{(1+r)\cdot[\phi q+(1-\phi)\,w]}\cdot\frac{\bar{L}_t}{(\omega\underline{\theta}\mu\gamma_{t+1})^2}$$

*the political economy equilibrium is characterized by a coalition of young pessimists and the low-income old. The adaptation rate proposed by this coalition equals*

$$\tau_t^{YP,OOl,OPl*}=A\cdot[\phi q+(1-\phi)\,w]^2\cdot\left(\frac{\left[\omega\underline{\theta}p_{t+1}+\left(\omega(2-\phi)\underline{\theta}+(1-\omega)(1-\phi)\bar{\theta}\right)\cdot\frac{\partial f\left(\mathbb{E}_{YP,OOl,OPl,t}\left(\bar{L}_{t+1}\right)\right)}{\partial\,\mathbb{E}_{YP,OOl,OPl,t}\left(\bar{L}_{t+1}\right)}\right]}{\omega\,(1+r)\,[\phi q+(1-\phi)\,w]+(1-\phi)\,w}\right)^2. \tag{A69}$$

*Alternatively, if the implicit condition on the dispersion of beliefs is not satisfied (in either case), the political economy equilibrium is characterized by a coalition of young pessimists, high-income, old optimists and low-income, old pessimists. Then, the adaptation rate proposed equals*

$$\tau_t^{YP,OOh,OPl*}=A\cdot[\phi q+(1-\phi)\,w]^2\cdot\left(\frac{\left[\omega\underline{\theta}p_{t+1}+\left(\omega(2-\phi)\underline{\theta}+(1-\omega)\phi\bar{\theta}\right)\cdot\frac{\partial f\left(\mathbb{E}_{YP,OOh,OPl,t}\left(\bar{L}_{t+1}\right)\right)}{\partial\,\mathbb{E}_{YP,OOh,OPl,t}\left(\bar{L}_{t+1}\right)}\right]}{(1+\omega r)\,\phi\cdot q+(2+r)\omega\,(1-\phi)\cdot w}\right)^2. \tag{A70}$$

**Low Economic Inequality** Young pessimists prefer a coalition with high-income, old optimists and low-income, old optimists rather than high-income, old optimists and low-income, old pessimists if

$$\mathbb{E}_t\left(U_{YP}\left(\tau^{YP,OOh,OOl*}\right)\right) > \mathbb{E}_t\left(U_{YP}\left(\tau^{YP,OOh,OPl*}\right)\right) \tag{A71}$$

Using similar steps as in Proof of Proposition 5, the relevant condition is given by

$$\begin{aligned}
&\frac{1}{(1+\omega r)^2}\cdot\left(p_{t+1}+\left(1+\frac{(1-\omega)}{\omega}\cdot\frac{\bar{\theta}}{\underline{\theta}}\right)\cdot\frac{\partial f\left(\mathbb{E}_{YP,OOh,OOl,t}\left(\bar{L}_{t+1}\right)\right)}{\partial\,\mathbb{E}_{YP,OOh,OOl,t}\left(\bar{L}_{t+1}\right)}\right)^2 \\
&-\left(\frac{[\phi q+(1-\phi)\,w]}{(1+\omega r)\,\phi\cdot q+(2+r)\omega\,(1-\phi)\cdot w}\right)^2 \\
&\cdot\left(p_{t+1}+\left((2-\phi)+\phi\cdot\frac{(1-\omega)}{\omega}\cdot\frac{\bar{\theta}}{\underline{\theta}}\right)\cdot\frac{\partial f\left(\mathbb{E}_{YP,OOh,OPl,t}\left(\bar{L}_{t+1}\right)\right)}{\partial\,\mathbb{E}_{YP,OOh,OPl,t}\left(\bar{L}_{t+1}\right)}\right)^2 \\
&<\frac{\Delta v\left(L_{YP,t}\right)+\Delta f\left(E_{P,t}\left(\bar{L}_{t+1}\right)\right)}{(1+r)}\cdot\frac{\bar{L}_t}{(\omega\underline{\theta}\mu\gamma_{t+1})^2}
\end{aligned} \tag{A72}$$

which implicitly defines an upper bound on the degree of dispersion in beliefs for which young pessimists prefer to form a coalition with high-income, old optimists and low-income, old optimists. a coalition of young pessimists, high-income, old optimists and low-income, old pessimists prevails.

**High Economic Inequality** Young pessimists prefer to prefer a coalition with low-income, old optimists and low-income, old pessimists rather than high-income, old optimists and low-income, old pessimists if

$$\mathbb{E}_t\left(U_{YP}\left(\tau^{YP,OOl,OPl*}\right)\right) > \mathbb{E}_t\left(U_{YP}\left(\tau^{YP,OOh,OPl*}\right)\right) \tag{A73}$$

Using similar steps as in Proof of Proposition 5, the relevant condition is given by

$$\begin{aligned}
&\left(\frac{\left[p_{t+1}+\left((2-\phi)+\frac{(1-\omega)}{\omega}(1-\phi)\frac{\bar{\theta}}{\underline{\theta}}\right)\cdot\frac{\partial f\left(\mathbb{E}_{YP,OOl,OPl,t}\left(\bar{L}_{t+1}\right)\right)}{\partial\,\mathbb{E}_{YP,OOl,OPl,t}\left(\bar{L}_{t+1}\right)}\right]}{\omega\,(1+r)\,[\phi q+(1-\phi)\,w]+(1-\phi)\,w}\right)^2 \\
&-\left(\frac{\left[p_{t+1}+\left((2-\phi)+\frac{(1-\omega)}{\omega}\phi\frac{\bar{\theta}}{\underline{\theta}}\right)\cdot\frac{\partial f\left(\mathbb{E}_{YP,OOh,OPl,t}\left(\bar{L}_{t+1}\right)\right)}{\partial\,\mathbb{E}_{YP,OOh,OPl,t}\left(\bar{L}_{t+1}\right)}\right]}{\omega\cdot(1+r)\cdot[\phi q+(1-\phi)\,w]+(1-\omega)\phi\cdot q+\omega(1-\phi)\cdot w}\right)^2 \\
&<\frac{\Delta v\left(L_{YP,t}\right)+\Delta f\left(E_{P,t}\left(\bar{L}_{t+1}\right)\right)}{(1+r)\cdot[\phi q+(1-\phi)\,w]^2}\cdot\frac{\bar{L}_t}{(\omega\underline{\theta}\mu\gamma_{t+1})^2}
\end{aligned} \tag{A74}$$

which implicitly defines an upper bound on the degree of dispersion in beliefs for which young pessimists prefer to form a coalition with low-income, old optimists and low-income, old pessimists. If this condition is not satisfied, we have that

$$\mathbb{E}_t\left(U_{YP}\left(\tau^{YP,OOl,OPl*}\right)\right) < \mathbb{E}_t\left(U_{YP}\left(\tau^{YP,OOh,OPl*}\right)\right) \tag{A75}$$

and a coalition of young pessimists, high-income, old optimists, and low-income, old pessimists prevails.

## A2. Additional Simulations: Extended Model

### *A. Gradually Increasing Inequality*

| Time | 2010 | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | 2080 | 2090 | 2100 |
|---|---|---|---|---|---|---|---|---|---|---|
| Inequality multiplier | 1.000 | 1.005 | 1.020 | 1.050 | 1.110 | 1.200 | 1.340 | 1.450 | 1.505 | 1.527 |
| $q$ | 0.127 | 0.127 | 0.127 | 0.127 | 0.127 | 0.127 | 0.127 | 0.117 | 0.117 | 0.117 |
| $w$ | 0.127 | 0.126 | 0.123 | 0.119 | 0.111 | 0.100 | 0.086 | 0.071 | 0.068 | 0.066 |
| $q/w$ | 1 | 1.006 | 1.025 | 1.063 | 1.141 | 1.263 | 1.464 | 1.634 | 1.722 | 1.759 |

TABLE 2: **The values of the income parameters in the extended model simulations**.

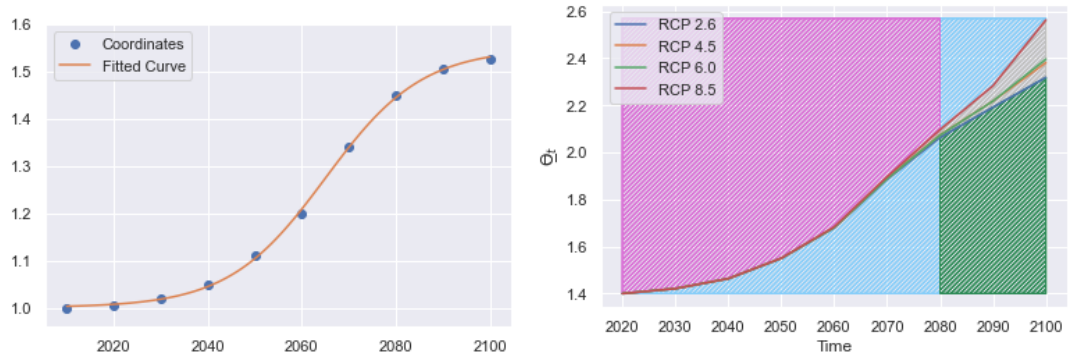



FIGURE 9: **The evolution of the inequality multiplier in the extended model and the fitted S-curve (left) and the corresponding evolution of Assumption 4 in the extended model under the different RCP trajectories (right).**.

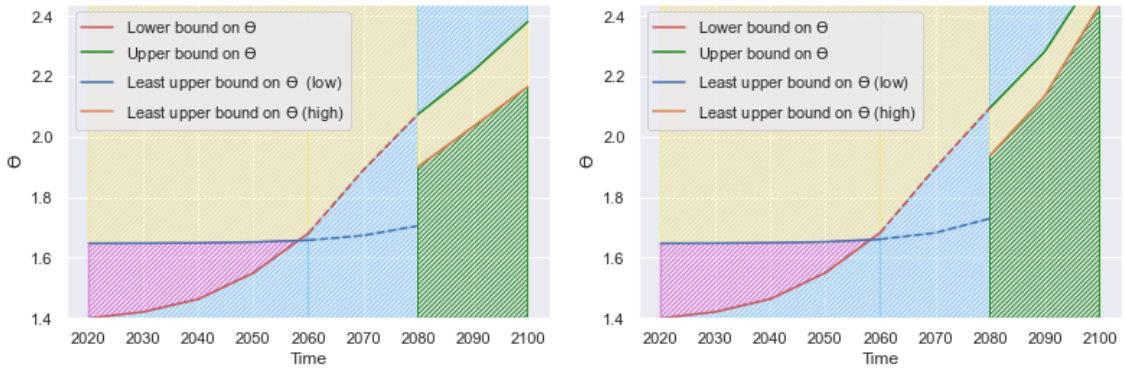



FIGURE 10: **Evolution of the political equilibrium**

KEY: JOINT EVOLUTION OF THE BOUNDS ON THE DISPERSION IN BELIEFS. THE PANELS SHOW THE EVOLUTION OF THE BOUNDS OVER TIME AND UNDER THE DIFFERENT RCP TRAJECTORIES. THE LEFT PANEL SHOWS THE EVOLUTION OF THE BOUNDS UNDER RCP 4.5, WHILE THE RIGHT PANEL SHOWS THE EVOLUTION OF THE BOUNDS UNDER RCP 8.5.

## B. *Escalating Inequality*

| Time | 2010 | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | 2080 | 2090 | 2100 |
|---|---|---|---|---|---|---|---|---|---|---|
| Inequality multiplier | 1.000 | 1.000 | 1.002 | 1.045 | 1.115 | 1.230 | 1.400 | 1.600 | 1.850 | 2.150 |
| $q$ | 0.127 | 0.127 | 0.127 | 0.127 | 0.127 | 0.127 | 0.127 | 0.117 | 0.117 | 0.117 |
| $w$ | 0.127 | 0.127 | 0.126 | 0.120 | 0.110 | 0.097 | 0.081 | 0.062 | 0.050 | 0.039 |
| $q/w$ | 1.000 | 1.000 | 1.002 | 1.057 | 1.148 | 1.305 | 1.556 | 1.882 | 2.349 | 3.018 |

TABLE 3: **The values of the income parameters for the simulations of the extended model, when inequality rises at an increasing rate**.

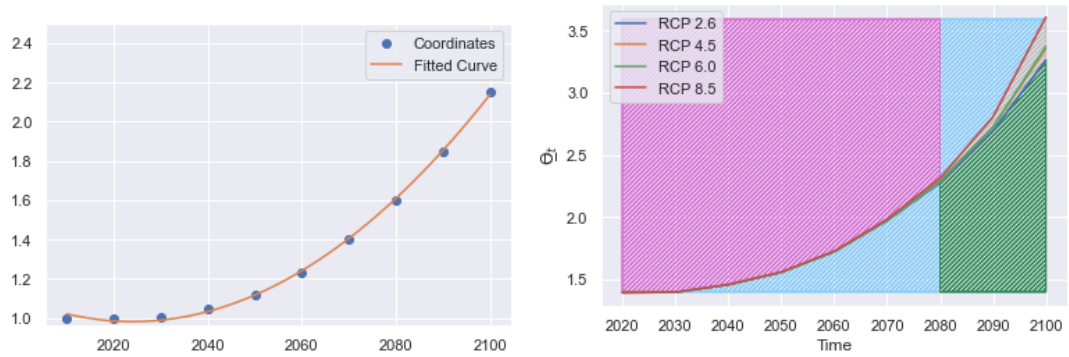



FIGURE 11: **The evolution of the inequality multiplier in the extended model and the fitted S-curve (left) and the evolution of Assumption 4 in the extended model under the different RCP trajectories, when inequality rises at an increasing rate (right)..**

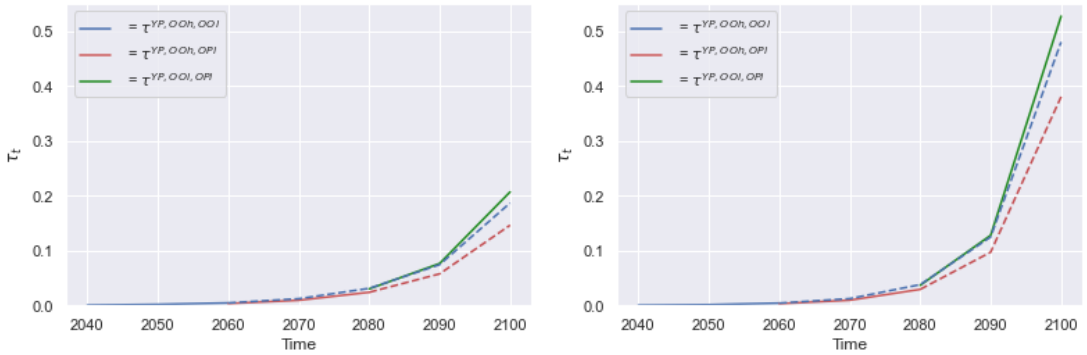



FIGURE 12: **Tipping of the adaptation rate**

KEY: THE TIME PATH FOR THE ADAPTATION RATE WHEN THE POLITICAL EQUILIBRIUM TIPS AROUND 2050, AND 2080, UNDER RCP 4.5 (LEFT PANEL) AND RCP 8.5 (RIGHT PANEL), WHEN INEQUALITY RISES AT AN INCREASING RATE.