# Political commitment and loss-aversion

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# Summary *(1/2)*

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  - Investments
  - Reference point dynamics
  - Utility of workers
  - Tax determination
- Equilibria without loss-aversion
  - Markov strategies

# Summary *(2/2)*

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# Political commitment

- At least since the work of Kydland and Prescott, it is well known that the ability to commit is very important for political outcomes and welfare. Optimal sequence of taxes is typically time inconsistent, capital taxation example:
  - At $t$ fix future sequence of taxes, in particular $\tau_{t+s}$.
  - Planner accounts at $t$ the distortionary effects that has on investment between $t$ and $t+s$. Thus, optimally relatively low $\tau_{t+s}$.
  - At $t+s$ the tax is lump sum... it is optimal to set $\tau_{t+s}$ large... unlike what was optimal $s$ periods before.
- The (discretionary) Markov equilibrium predicts unrealistically high taxes. In general, a big policy failure whenever there is time inconsistency.
- **How do governments achieve (at least partial) commitment?**

# Traditional Commitment Technologies

- Classical explanations;
  - Delegation to a person with suitably chosen preferences.
  - Repeated interaction and non-Markovian strategies.
- The first begs the question and the second would typically involve complicated coordination between voters of different generations.
- Formally, the "threat" of a long punishment phase can sustain "good" equilibria with e.g., low taxation on sunk capital.
- But are these punishment phases credible threats, particularly in OLG settings? Renegotiation proofness takes away most (all?) of these non-Markovian equilibria.
- We argue **there is a need for other (complementary) explanations relying less on intergenerational voter coordination.**

# Our explanation: Entitlement

- Entitlement effects – people have a distaste for feeling **cheated**, not getting what they feel entitled to.
- Specifically, individuals form **reference levels for consumption**.
- Individuals are loss averse with respect to these reference levels (in the sense of Kahneman and Tversky) – losses relative to a reference point are valued strictly higher than gains, also if small.
- Loss-aversion can provide a commitment mechanism, complementing other ones. If a promise not to raise taxes is believed, *ex-post* it can become politically costly not to deliver. Such a commitment may have substantial positive welfare effects.

# Dynamic reference point formation *(1/2)*

- Dynamics of reference points is not much explored previously.
- Kahneman and Tversky (implicitly) used the past, *status quo*, as the reference point.
- But, reference points (entitlements) may be also partially forward-looking and determined by expectations about the future (see also Köszegi and Rabin, QJE'07).
- We allow for them to be either FORWARD or BACKWARD looking.

# Dynamic reference point formation *(2/2)*

- FORWARD LOOKING:

  - An important part of politics is to affect reference levels, telling people about what they should feel entitled to.

  - In our model, political candidates run only once and cannot make any *formally* binding commitments. But, they are allowed to make a “promise” about the future tax rate, although they will not be around to implement the latter.

  - If rationally believed, the “promise” can affect future reference levels and thereby be self-fulfilling. A seemingly empty promise with commitment value.

- BACKWARD LOOKING:

  - Based on last period’s experiences. To establish commitment for *tomorrow* has a cost *today* for the government.

# Plan of talk

- Loss aversion – a quick description.
- Present a very simple OLG-model with investment where taxes on capital returns are politically determined by self-interested voters under probabilistic voting.
- Future taxes distort investment, but there is a political incentive to tax sunk investments, providing transfers to poor or to valuable public goods.
- Without commitment, equilibrium involves 100% taxation and no investment.
- Loss-aversion change result completely.
- Same (partial commitment) result for backward and forward looking reference point formation.

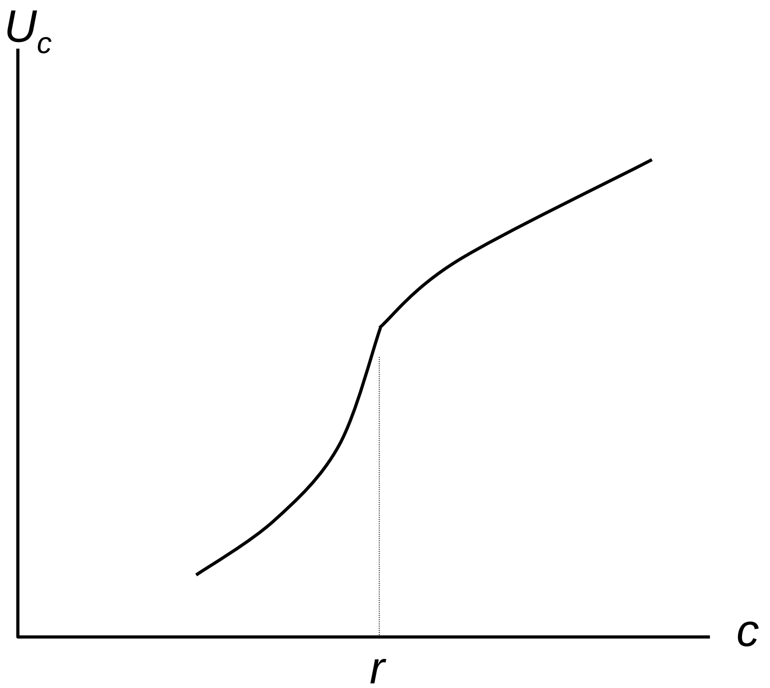
# Loss-aversion *(1/2)*

- Following Kahneman and Twersky we assume individuals have *loss-aversion*. Key features are that individuals:
  - care more about losses relative to a certain reference point than about gains,
    Formally, there is an $\varepsilon > 0$ such that
    $\frac{u(r;r,i)-(r-x;r,i)}{x} - \frac{u(r+x;r,i)-u(r)}{x} \geq \varepsilon \ \forall x > 0$.
  - are risk-loving in losses – a 50/50 chance of loosing $x$ or zero is better than a certain loss of $x/2$.

    $pu\,(r-x;r,i) + (1-p)\,u\,(r;r,i) > u\,(r-px;r,i)\,\forall x > 0, p \in (0,1)$

# Loss-aversion *(2/2)*

- This implies that utility has a kink at a possibly time-varying but pre-determined reference point, and that utility is concave (convex) above (below) the reference point.



# The model

- Set-up
- Preferences
- Reference consumption and reference taxes
- Investments
- Reference point dynamics
- Utility of workers
- Tax determination

## Set-up *(1/2)*

- Two types of rational and non-altruistic individuals, (poor) *workers* and *entrepreneurs*, living in a two period OLG-setup.

- The workers make no private choices, having a fixed wage normalized to zero, consuming in the second period of life.

- Young entrepreneurs in $t$

  + choose investments $i_t$
  + at a utility cost $\frac{i_t^2}{2}$,
  + returning $i_t\left(1-\tau_{t+1}\right)$ in second period of life when consumption takes place and the capital fully depreciates.
  + They observe $\tau_t$ before choosing $i_t$, but only affects them insofar
    - has information on $\tau_{t+1}$
    - affects their reference point for $t+1$

## Set-up *(2/2)*

- Old workers get a transfer $G_t$, financed by taxes on installed capital.
- Taxes, $\tau_t \in [0,1]$, are determined without commitment by **Probabilistic voting** with equal weight on all living individuals. – **Maximizing a Social Welfare Function with positive weight in all agents.**
- An **alternative interpretation** of the model is that there are only entrepreneurs and $G$ is a public good transfers with high marginal value.
- Key for the analysis is that there is **tension** between:

  + **ex post incentive to tax** and the

  + **ex ante cost of distorting investments**,

  ... a **time inconsistency** in taxation.

# Probabilistic voting

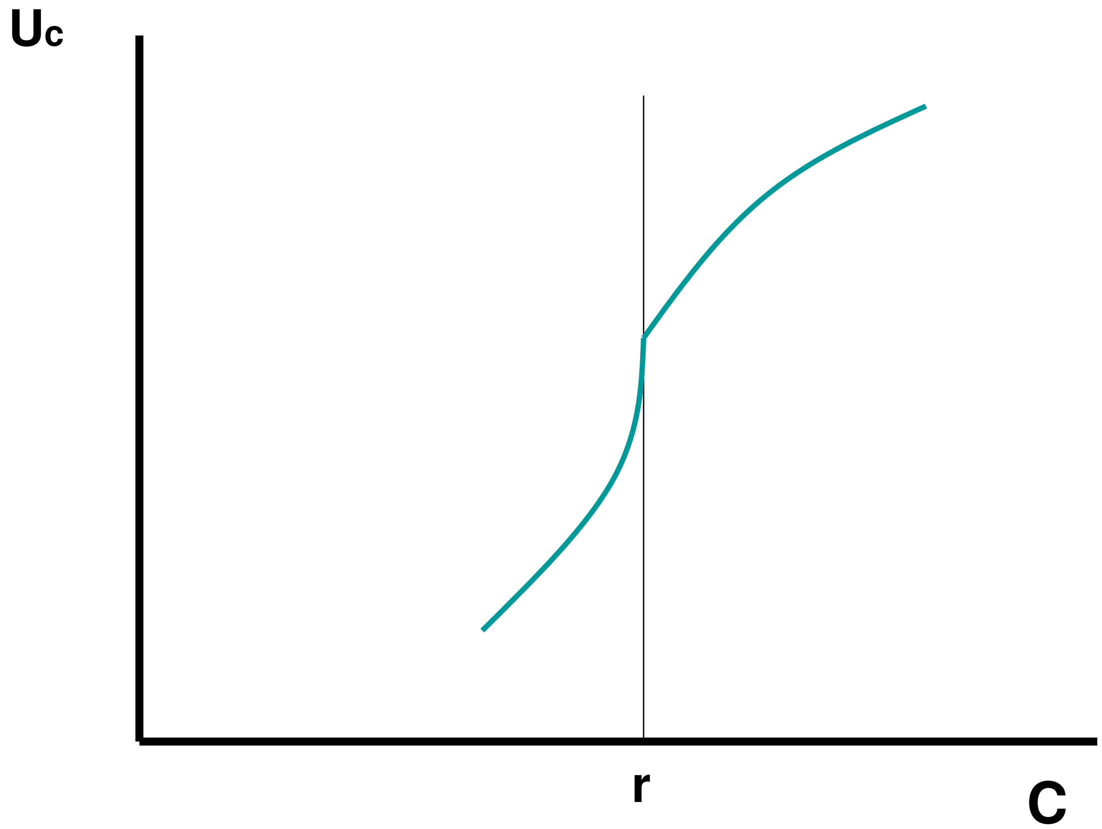
- Now standard way of smoothly aggregating preferences in a way that can be interpreted as the outcome of voting.
- Two candidates, a *red* and a *blue* where color is exogenous to candidates and called "ideology".
- Candidates choose policy platforms to run on, which gets implemented automatically if they win.
- Platform chosen to maximize probability of getting a majority of votes.
- Individuals have non-degenerate preferences over the implemented policy *and* on the ideology (color) of the candidate and vote sincerely.
- Unique Nash-equilibrium is as if policy was chosen to maximize (a weighted) sum of voter welfare, labeled the political objective function.

# Preferences *(1/7)*

- Given expectations of next period tax-rate $\tau_{t+1}$, an entrepreneur born in period $t$ solves

$$
\begin{aligned}
U_t &= \max_{c_{t+1}, i_t} -\frac{i_t^2}{2} + E_t \beta U_e \left(c_{t+1}, r_{t+1}, i_t\right) \\
s.t. c_{t+1} &= i_t \left(1 - \tau_{t+1}\right)
\end{aligned}
$$

$U_e$ is a loss-averse utility function, depending on $c_{t+1}, i_t$ and the reference point $r_{t+1}$.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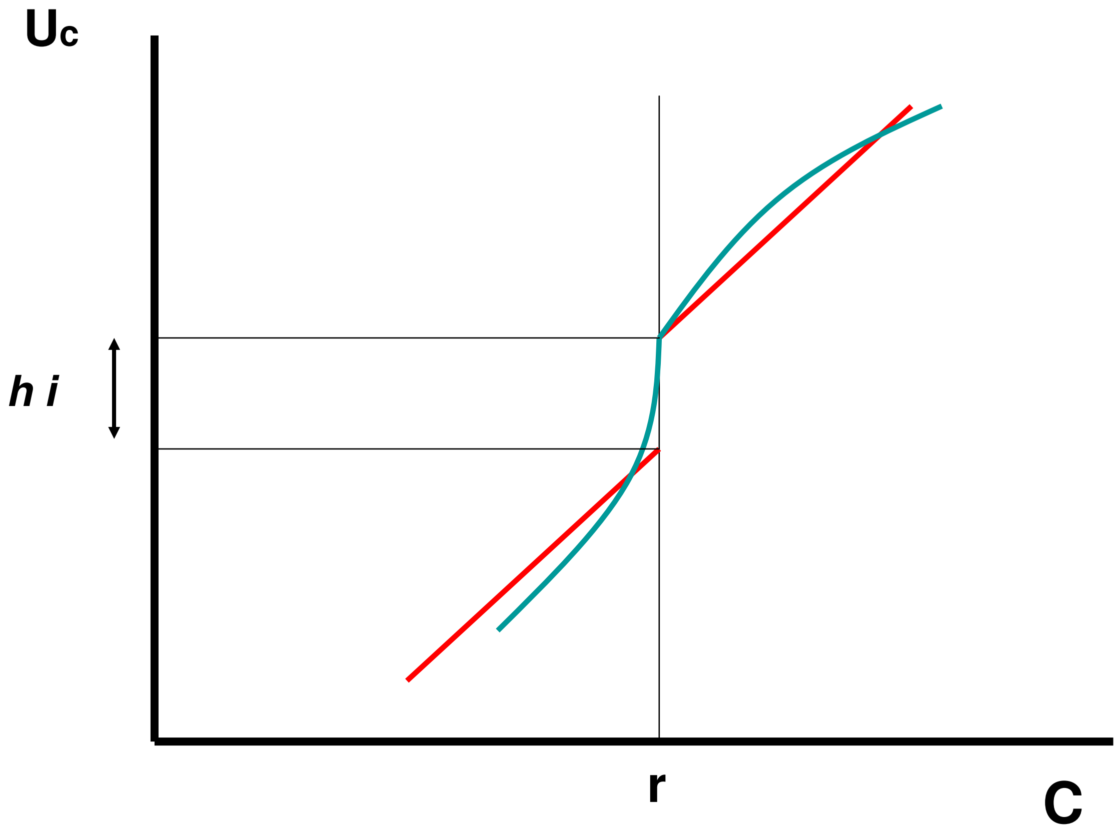
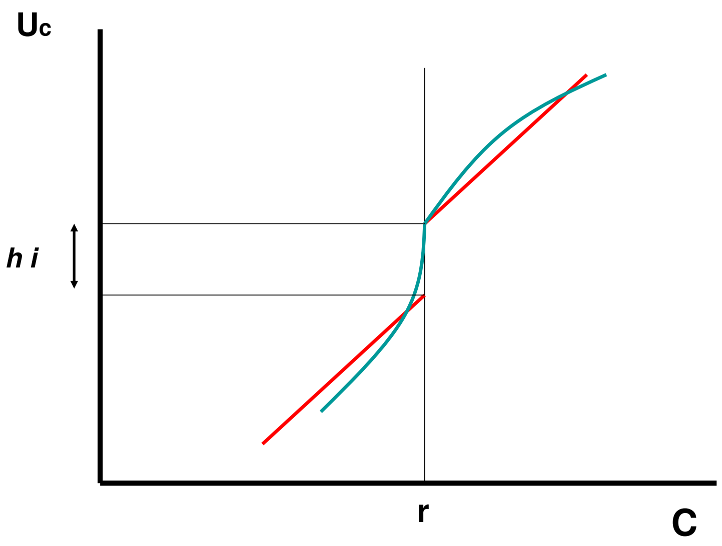
# Preferences *(3/7)*





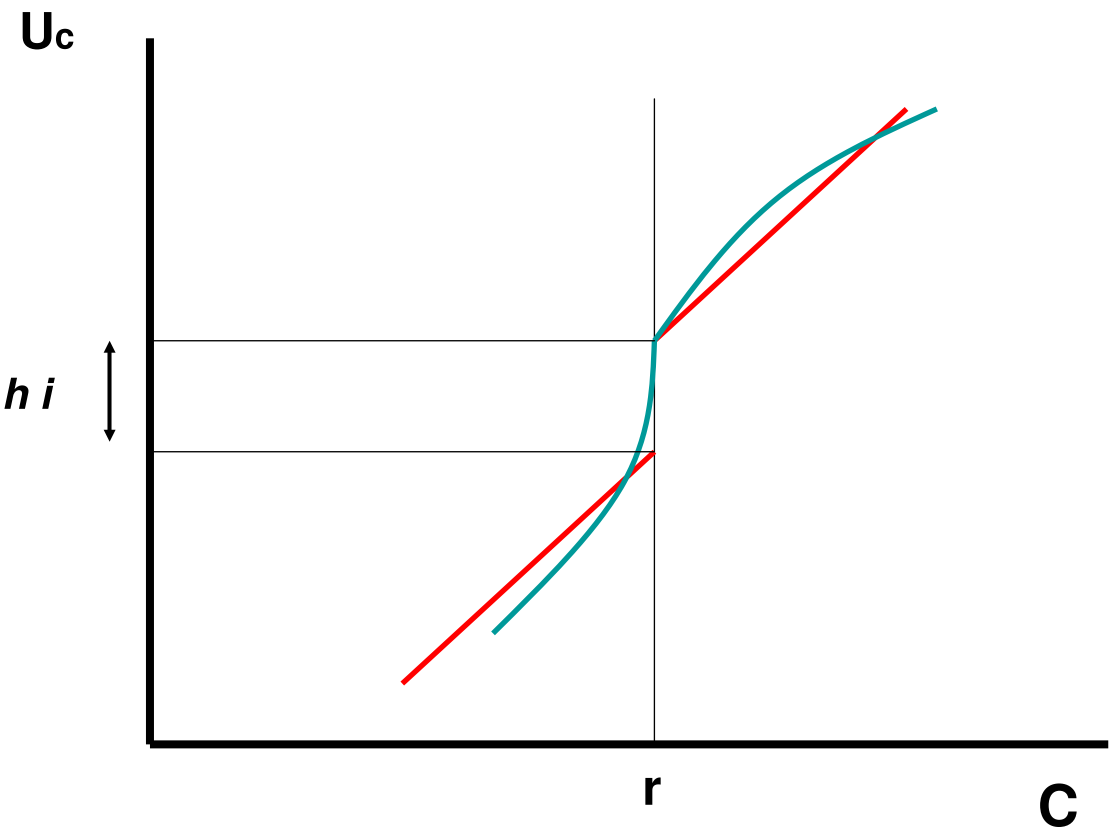

- **Discontinuity at $r$**;

  $U_e\left(c_{t+1}, r_{t+1}, i_t\right) = c_{t+1} - h \cdot I\left(c_{t+1} < r_{t+1}\right) i_t,$

- $h \geq 0$ parameterizes the degree of loss-aversion. Marginal utility, when existing, is unity.

- The loss associated with being "cheated" is proportional to pre-tax income. As investment and pre-tax return approach zero, loss associated with "too high" taxes goes to zero smoothly.

- We can smooth it a bit.



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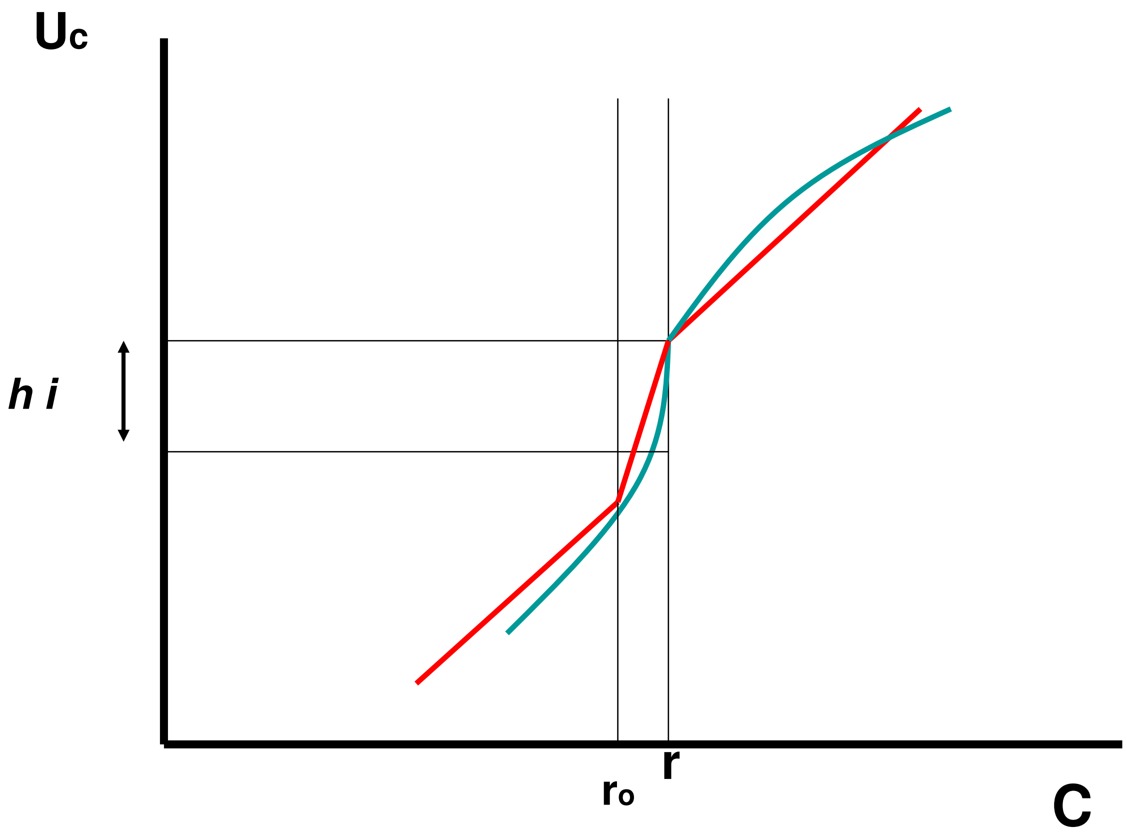


# Preferences *(7/7)*

- Workers derive utility from the transfer, $U_w(G_t)$, to be specified below.

- We will specify $U_w(.)$ and $U_e(.)$ so that the marginal utility of workers relative to that of entrepreneurs is high $\Rightarrow$ an *ex post* motive to tax sunk investments to finance transfers to workers.

- $h > 0$ implies utility is *loss-averse risk-neutral*. A mean-preserving spread does not affect expected marginal utility, but all key implications of loss aversion discussed above remain.

# Reference consumption and reference taxes

- It seems reasonable that reference consumption may depend on individual investments – if an individual invests more, she might feel entitled to more consumption.

- We assume simply

$$r_{t+1} = i_t \left(1 - \tau^r_{t+1}\right),$$

where $\tau^r_{t+1}$ is a period $t$ determined reference level for $\tau_{t+1}$

- Implies $c_{t+1} < r_{t+1} \Leftrightarrow \tau_{t+1} > \tau^r_{t+1}$

# Investments

- Entrepreneurs choose investments at $t$ to maximize utility,
  - given expectations about taxes at $t+1$
  - and given the reference level for taxes at $t+1$.
- FOC for investment is

$$i_t = \beta E_t \left[ 1 - \tau_{t+1} - h \cdot I\left(\tau_{t+1} > \tau^r_{t+1}\right) \right].$$

- Note that expectations of becoming "cheated" *reduces* the marginal value of investments.

# Reference point dynamics

- Forward looking (assumption **F**):
  - Like Köszegi and Rabin, we assume that reference points are rational expectations.
  - We require $\tau^r_{t+1}$ to be in the set of equilibrium tax rates for $t+1$.
  - We allow politicians to affect reference points by making "promises" about the future. But remember that the promise is empty – the politician does not remain in office nor runs again and he has no formal commitment power.
  - The promise can affect the future if it is believed, in which case it becomes the the reference point.
  - It is believed if it is done by the winning candidate and is in the set of equilibria for next period. If the promise is not an equilibrium, $\tau^r_{t+1}$ is some element of the set of equilibrium tax rates.
  - If the promise is not an equilibrium outcome, then it is not believed. In that case they believe taxes will be some (any) credible value.
- Backward looking (Assumption **B**):
  - Reference tax-levels are last period's tax: $\tau^r_{t+1} = \tau_t$

# Utility of workers

- It is "good" to give consumption to workers:

$$U_w(G) = (1+\gamma)G$$

with $\gamma > 0$

- $\gamma$ determines the short run benefit of taxation and redistribution, as workers have a large marginal utility.

- To simplify the presentation, we disregard loss-aversion for workers. If we assume instead:

$$U_w(G_t) = (1+\gamma)G_t - gI(G_t < G_t^r)$$

Assuming politicians also promise a level of transfer, reproduces the same result.

  - Intuition: there is no *ex post* political incentive to under-provide transfers.

# Tax determination

- We assume probabilistic voting with equal weight on all living individuals.
- Alternative interpretation: a benevolent planner/government that cares equally of all living individuals.
- Political objective function (alt. social welfare function)

$$W_t \equiv U_e(c_t, r_t, i_{t-1}) + U_w(G_t) - \frac{i_t^2}{2} + \beta U_e\left(c_{t+1}, r_{t+1}, i_t\right) + \beta U_w\left(G_{t+1}\right),$$

subject to the resource constraints

$$\begin{aligned} G_t &= \tau_t i_{t-1}, \\ G_{t+1} &= \tau_{t+1} i_t, \\ c_t &= i_{t-1}(1-\tau_t), \\ c_{t+1} &= i_t\left(1-\tau_{t+1}\right), \end{aligned}$$

and

$$i_t = max\left\{\beta E_t\left[1-\tau_{t+1} - h \cdot I\left(\tau_{t+1} > \tau_{t+1}^r\right)\right], 0\right\}$$

# Equilibria without loss-aversion

- To rule out trigger strategies and intergenerational voter coordination,
  - we focus on **Markov equilibria**,
  - derived by **backward induction**,
  - letting the **horizon go to infinity.**

- As comparison we characterize equilibria under commitment and under trigger strategies but without loss-aversion.
  - **Markov strategies**
  - **Commitment**
  - **Once and For All**
  - **"Reputation", Best Non-Markovian**

# Markov strategies

- Without Loss Aversion, under finite horizons, or **Markov strategies**, the only equilibrium is
  - $\tau_t = 1, i_t = 0 \forall t$.
  - **Intuition:**
    - Investments are sunk.
    - Since $\gamma > 0$, always better to tax away all income.

# Commitment

- Under commitment, the tax rate is
  - 1 today.
  - $\tau_c \equiv \frac{\gamma}{1+2\gamma}$ from tomorrow on.

- With "once and for all taxes", being fixed **today**, the optimal tax is:

$$\tau_f = 1 - \frac{\beta\,(1+\gamma)}{\beta\,(1+\gamma) + \gamma\,(1+\beta)} > \tau_c$$

- Using method of Abreu, Pierce and Staccetti (1988) we can characterize *best* non-Markovian equilibrium for infinite horizon.

$$\tau_t = \tau_b = \max\left\{\frac{2\gamma - \beta}{\beta + 2\gamma(1+\beta)}, \tau_c\right\} \forall t.$$

# Equilibrium Definitions:

- Optimizing private behavior, taking into account the rational expected public behavior.

- "Optimizing" public behavior, given rational private behavior.

- **Equilibrium Definition, Forward Looking:**

- **Equilibrium Definition, Backward Looking:**

# Equilibrium Definition, Forward Looking: *(1/2)*

A Markov equilibrium is a collection of functions $\langle \tau, \tau^p, i \rangle$, such that $\tau_t = \tau\left(i_{t-1}, \tau_t^r\right)$, $\tau_{t+1}^p = \tau\left(i_{t-1}, \tau_t^r\right)$ and $i_t = i\left(\tau_t, \tau_{t+1}^p\right)$ ,where $\tau : R^+ \otimes [0,1] \rightarrow [0,1]$ and i: $[0,1] \otimes [0,1] \rightarrow R^+$ satisfying simultaneously

**1.-** $\tau\left(i_{t-1}, \tau_t^r\right) = \arg\max_{\tau_t} W\left(\tau_t, \tau_{t+1}^p, i\left(\tau_t, \tau_{t+1}^p\right), \tau\left(i\left(\tau_t, \tau_{t+1}^p\right), \tau_{t+1}^r\right), \tau_{t+1}^r; i_{t-1}, \tau_t^r\right)$ s.t.

- $\tau_{t+1}^r$ satisfying **F**.

**2.-** $\tau^p\left(i_{t-1}, \tau_t^r\right) = \arg\max_{\tau_{t+1}^p} W\left(\tau_t, \tau_{t+1}^p, i\left(\tau_t, \tau_{t+1}^p\right), \tau\left(i_t, \tau_{t+1}^r\right), \tau_{t+1}^r; i_{t-1}, \tau_t^r\right)$ s.t.

- $\tau_{t+1}^r$ satisfying **F**.

**3.-** $i\left(\tau_t, \tau_{t+1}^p\right) = \max\left\{0, \beta\left(1 - \tau_{t+1} - h \cdot I\left(\tau_{t+1} > \tau_{t+1}^r\right)\right)\right\}$, where

*(a).-* $\tau_{t+1} = \tau\left(i_t, \tau_{t+1}^r\right)$ and

*(b).-* $\tau_{t+1}^r$ satisfying **F**.

- 1 and 2 imply that the policy maker explicitly takes into account that the choice of $\tau_t$ and $\tau^p_{t+1}$ can affect next periods taxes, **since** $\tau_{t+1} = \tau\left(i\left(\tau_t, \tau^p_{t+1}\right), \tau^r_{t+1}\right)$

- The private choice (3) is taken for a given $\tau_{t+1}$ and 3(a) requires that this value satisfies rational expectations.

A Markov equilibrium is a collection of functions $\langle \tau, i \rangle$, such that $\tau_t = \tau\left(i_{t-1}, \tau_t^r\right)$, and $i_t = i\left(\tau_t, \tau_{t+1}^r\right)$,where $\tau : R^+ \otimes [0,1] \rightarrow [0,1]$ and i: $[0,1] \otimes [0,1] \rightarrow R^+$ satisfying simultaneously

**1.-** $\tau\left(i_{t-1}, \tau_t^r\right) = \arg\max_{\tau_t} W\left(\tau_t, \tau_{t+1}^r, i\left(\tau_t, \tau_{t+1}^r\right), \tau\left(i\left(\tau_t, \tau_{t+1}^r\right), \tau_{t+1}^r\right), \tau_{t+1}^r; i_{t-1}, \tau_t^r\right)$ s.t.

- $\tau_{t+1}^r = \tau_t$.

**2.-** $i\left(\tau_t, \tau_{t+1}^r\right) = \max\left\{0, \beta\left(1 - \tau_{t+1} - h \cdot I\left(\tau_{t+1} > \tau_{t+1}^r\right)\right)\right\}$, where

*(a).-* $\tau_{t+1} = \tau\left(i_t, \tau_{t+1}^r\right)$ and

*(b).-* $\tau_{t+1}^r = \tau_t$.

# Forward-looking loss-aversion

- We proceed by backward induction.
  - **Last Period ($T$)**
  - **Next to last period ($T-1$)**
  - **Previous to next to last ($T-2$)**
  - **Equilibrium characterization**
  - **Discussion**

## Last Period ($T$) *(1/5)*

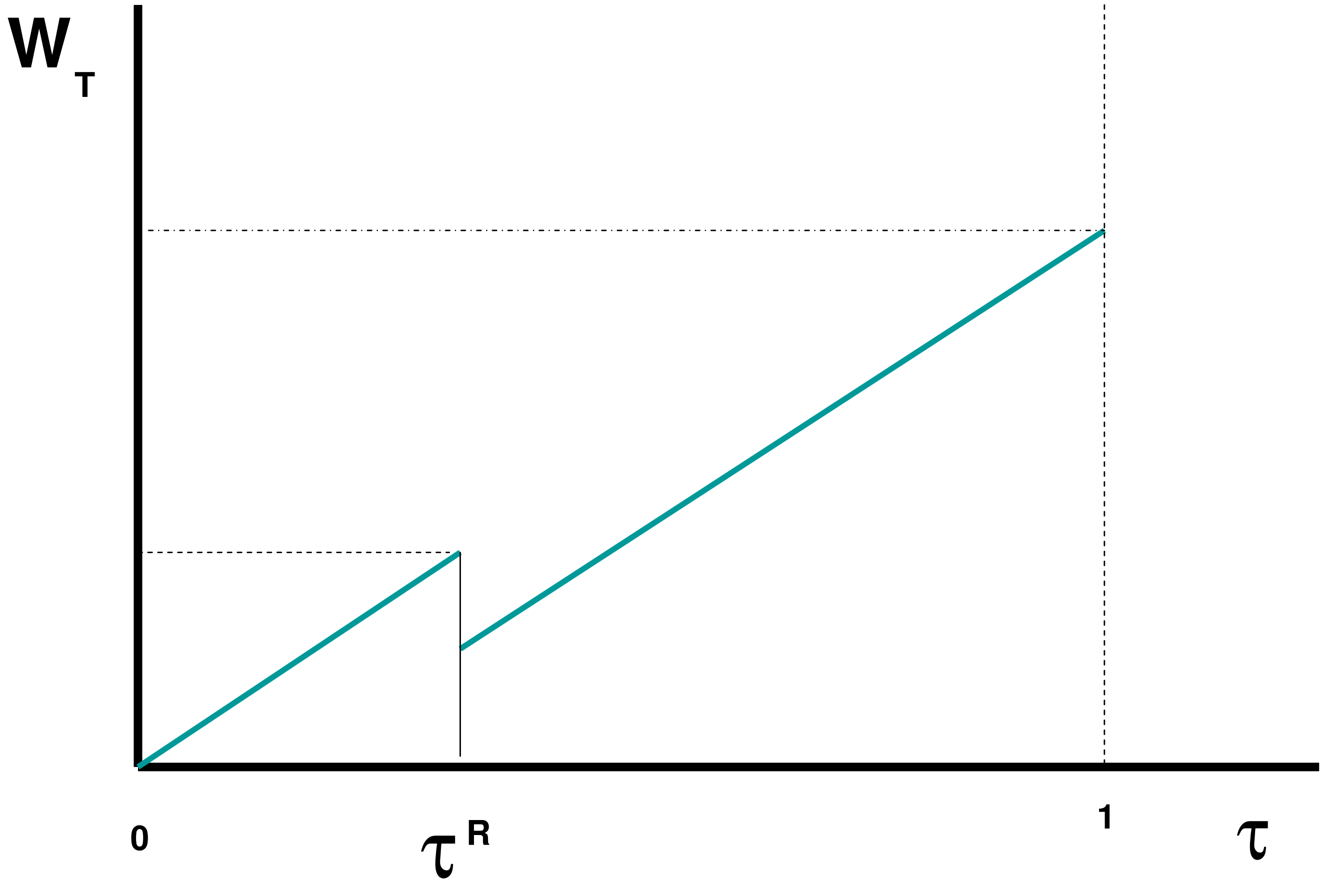
- In final period, the reference point is predetermined and the political objective is

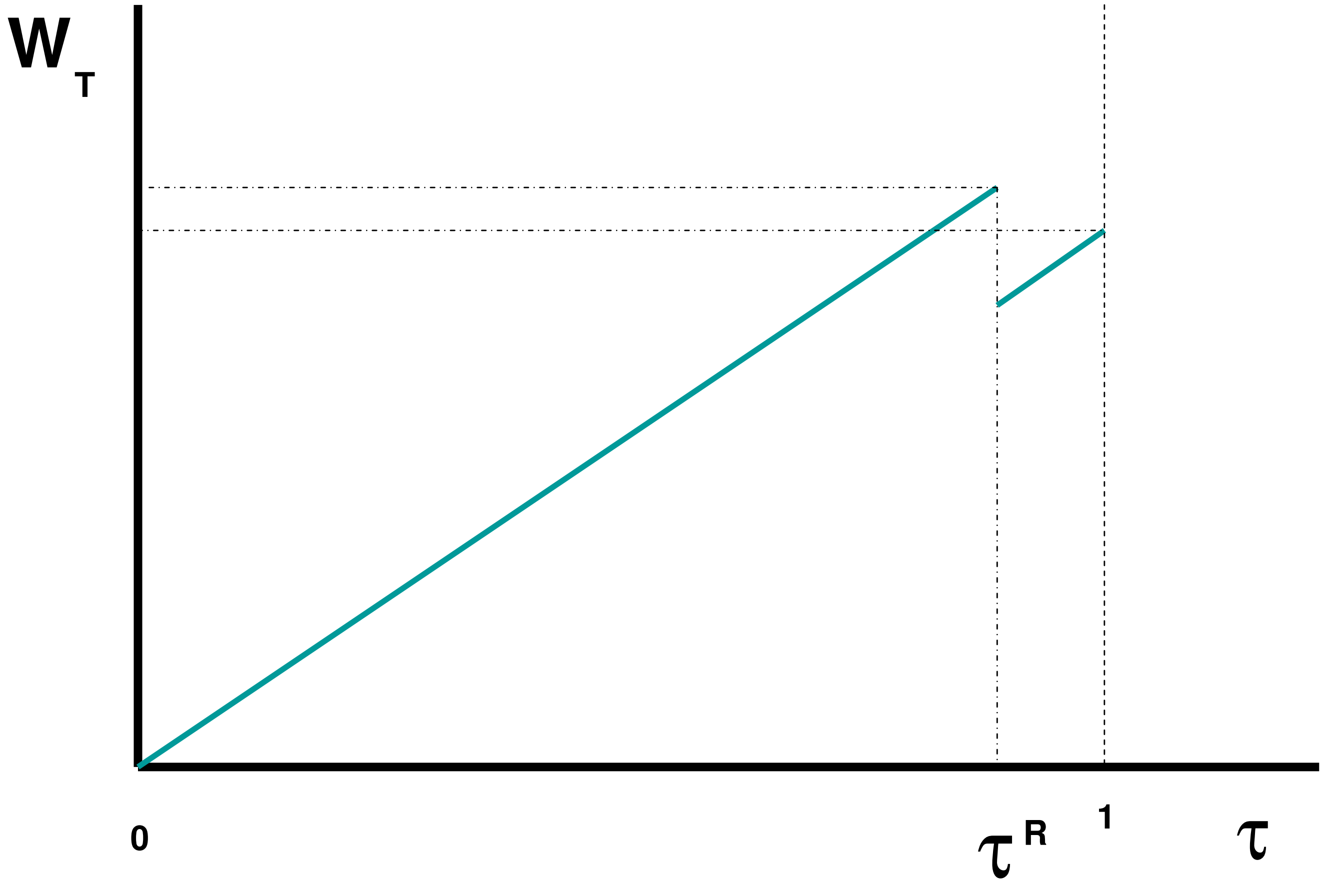
$$\begin{aligned} W_T &= c_T - h \cdot I\left(\tau_T > \tau_T^r\right) i_{T-1} + i_{T-1}\tau_T\left(1+\gamma\right) \\ &= i_{T-1}\left(1 + \gamma\tau_T - h\left(\tau_T > \tau_T^r\right)\right). \end{aligned}$$

- If $\tau_T^r$ is low, you choose $\tau_T = 1$

- If it is large, you choose $\tau_T^r$.

# Last Period ($T$) *(2/5)*

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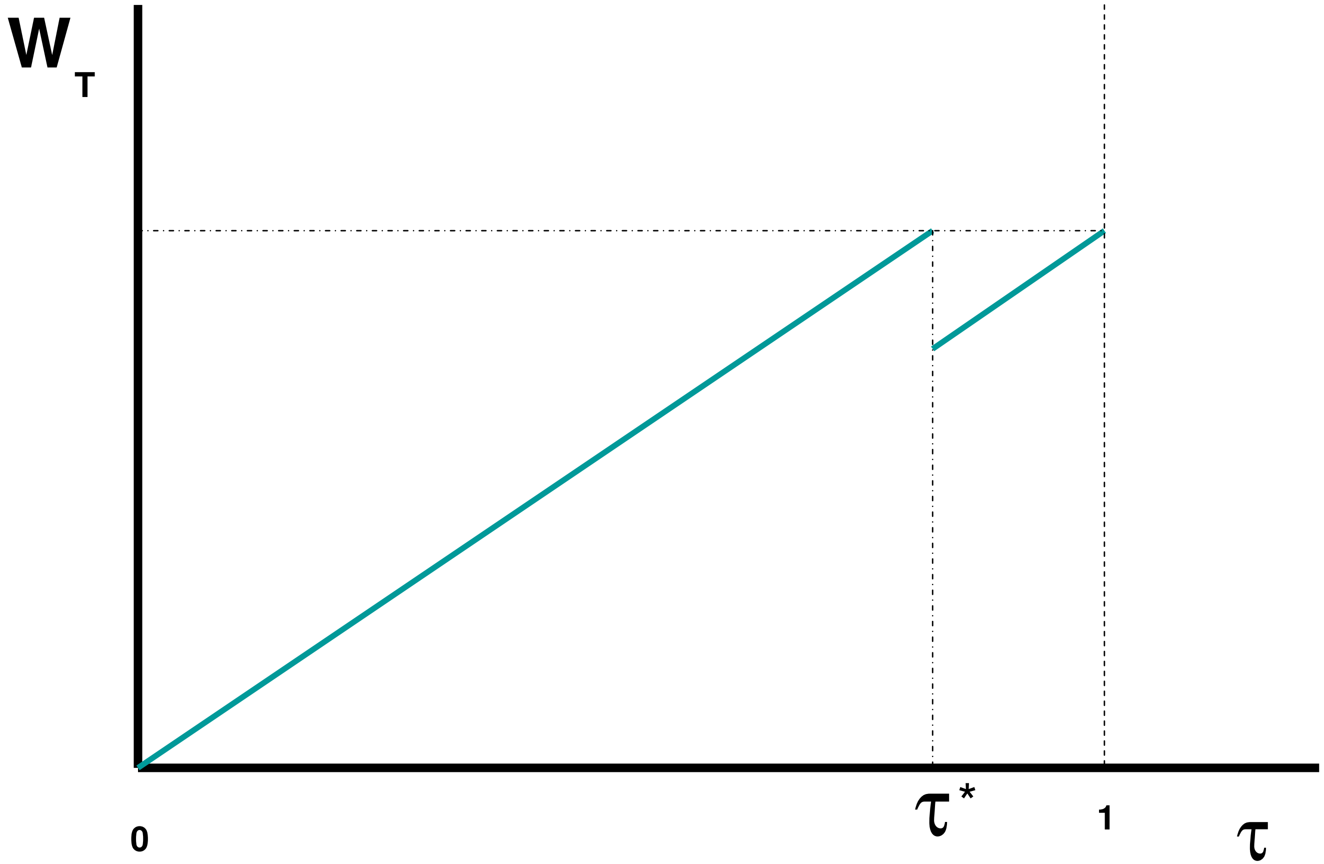
# Last Period ($T$) (4/5)



- $\tau^*$ is the value of reference point that makes the gov't indifferent between "cheating" and put $\tau_T = 1$ and keep the taxes equal to the reference point.
  - $\tau^* = 1 - \frac{h}{\gamma}$
  - Independent from $\beta$, depends only on:
    - the cost of disappointing per unit of investment (h)
    - and the benefits ($\gamma$)
- Worthwhile to "cheat" people only if $\tau_T^r$ is sufficiently low.
  - Independently of period $T-1$ investments.

$$\tau_T = \arg \max_{\tau_T \in [0,1]} W_T = \begin{cases} \tau_T^r & \text{if } \tau_T^r \geq 1 - \frac{h}{\gamma} \\ 1 & \text{else,} \end{cases}$$

loss of "cheating" larger than gain

gain of "cheating" larger than loss

# Next to last period ($T-1$) *(1/2)*

- The reference point at $T$ is determined by the promises made at $T-1$.

  Promises at or above $\tau^*$ would have been believed, forming the reference point:

$$\tau_T^r = \begin{cases} \tau_T^p & \text{if } \tau_T^p \geq \tau^* \quad \text{If the promise can be believed} \\ \bar{\tau} & \text{else.} \quad \text{If the promise can } \textbf{not} \text{ be believed} \end{cases}$$

  where $\bar{\tau} \in [\tau^*, 1]$ is the (out of equilibrium) belief if $\tau_T^p < \tau^*$

- Given period $T$ tax decisions, investments in $T-1$ are

$$i_{T-1} = \begin{cases} \beta\left(1 - \tau_T^p\right) & \text{if } \tau_T^p \geq \tau^* \quad \text{the promise is believed} \\ \beta(1-\bar{\tau}) & \text{else.} \quad \text{the promise is } \textbf{not} \text{ believed} \end{cases}$$

  - Notice! They do not depend on the taxes placed at $T-1$, only on the promises made at $T-1$ on the taxes at $T$.

- In period $T-1$ political competition maximizes voter welfare.
  - The problem of choosing $\tau_{T-1}$ is identical to that at $T$,
    - The investment is not affected by it!

$$\tau_{T-1} = \begin{cases} \tau^r_{T-1} & \text{if } \tau^r_{T-1} \geq \tau^*, \\ 1 & \text{else.} \end{cases}$$

  - The "promise" at $T-1$ on $T$ that maximizes voter welfare is

$$\tau^p_T = \max\{\tau_c, \tau^*\}$$

+ Nothing below $\tau^*$ is believed

+ Going below the commitment tax rate is suboptimal.

# Previous to next to last $(T-2)$

The problem is perfectly identical to the one at $T-1$.

- The reference point for $T-1$ depends on if the promise made at $T-2$ is believed...
  - On whether it is larger than $\tau*$
  - because $\tau_{T-1}$ depends only on this.
- The investment level depends only on the promise for $T-1$, not on $\tau_{T-2}$
- The political decision on $\tau_{T-2}$ does not affect the investment.
  - Thus, it depends only on whether $\tau_{T-2}$ is larger than the reference for $T-2$ (a state variable).
- The political decision on the promise is the max of
  - $\tau*$ (nothing lower is believed) or
  - $\tau_c$ (it is the global max, and you want it **if it is believable**)

# Equilibrium characterization

- There is a unique equilibrium in the finite horizon case.
- This equilibrium is also a Markov equilibrium in the infinite horizon
- and features

$$\begin{aligned}
\tau_t &= \tau\left(\tau_t^p\right) = \begin{cases} \tau_t^p & \text{if} \tau_t^p \geq \tau^* \\ 1 & \text{else.} \end{cases} \\
\tau_{t+1}^p &= \tau^p\left(\tau_t^p\right) = \max\left\{\tau_c, \tau^*\right\} \\
i_t &= i\left(\tau_{t+1}^p\right) = \begin{cases} \beta\left(1 - \tau_{t+1}^p\right) & \text{if } \tau_{t+1}^p \geq \tau^* \\ \beta\left(1 - \bar{\tau}\right) & \text{else.} \end{cases}
\end{aligned}$$

for $\tau^* \equiv 1 - \frac{h}{\gamma}$ and any $\bar{\tau} \in [\tau^*, 1]$

- **Thus**, given any starting $\left[i_0, \tau_1^p\right]$, then $\forall t > 1$ the tax is

$$\tau_t = \max\left\{\tau_c, \tau^*\right\}$$

# Discussion

- Equilibrium
  - Renegotiation proof.
  - Does not rely on strategies with long memory.
  - Independent of $\beta$, because it hinges on the gain today.
  - Tomorrow's things are determined by the promises.
  - Promises need to be credible.
- Equilibrium provides with the equivalent of partial commitment.
- With worker loss-aversion, the equilibrium is identical.

# Backward-looking loss-aversion

- The reference point for taxation is the tax level the previous period.

$$\tau^r_{t+1} = \tau_t.$$

- **Commitment is now costly!**
  - To restrain future taxes, current tax needs to be restrained.
  - "Promises" don't work, actions are necessary.
- Natural benchmark: tax chosen if fixed forever, $\tau_f > \tau_c$.
- If $\tau^* < \tau_f$ loss-aversion is so large enough that $\tau_f$ can be achieved.
  - This is boring, so we assume $\tau_f < \tau^*$
- **It is not obvious how to achieve commitment:Procrastination**
- **Finite horizon**
- **Finite horizon equilibrium: discussion**
- **Infinite horizon**

# Procrastination

- The equilibrium policy can NOT be to fix the best (low) tax level.
- Imagine it were...
    - You know today that the government tomorrow would set the low tax.
    - So, **today** it would be optimal to put large taxes.
    - The benefits of low taxes tomorrow are there anyway.
- If you know that tomorrow the gov't will be "good", the gov't today wants to be "bad".
- ... but you "like" $\tau_f$, so if you know that tomorrow's government is going to be "bad", incentives for you to be "good" and **discipline future governments.**
- ... Oscillating policies or mixed strategies.

# Finite horizon *(1/5)*

- **Final period $T$.** Political objective:

$$W_T = i_{T-1}\left(1 + \gamma\tau_T - h\left(\tau_T > \tau_{T-1}\right)\right)$$

(as before, but $\tau_T^r = \tau_{T-1}$), implying taxes:

$$\tau_T = \begin{cases} \tau_{T-1} & \text{if } \tau_{T-1} \geq \tau^* \\ 1 & \text{else,} \end{cases}$$

The loss of deviating is too large.
The loss of deviating is smaller than the gain.

...exactly as in the forward-looking case, except that $\tau_T^p$ is replaced by $\tau_{T-1}$

- Knowing this, in **period $T-1$** individuals choose investment:

$$i_{T-1} = \begin{cases} \beta\left(1 - \tau_{T-1}\right) & \text{if } \tau_{T-1} \geq \tau^* \\ 0 & \text{else,} \end{cases}$$

they know that $\tau_T = \tau_{T-1}$.
They know that $\tau_T = 1$.
Tomorrow's temptation will be too large!

- In $T-1$, a reduction in $\tau_{T-1}$ **increases** $i_{T-1}$ in the range $\tau_{T-1} \in (\tau^*, 1]$ – **limited costly commitment**.

# Finite horizon *(2/5)*

- We can then show that;

$$\tau_{T-1}\left(\tau_{T-2}\right) = \tau^{*} \quad \forall \quad \tau_{T-2}, \quad i_{T-2}$$

- The tax is independent from the state variable ($\tau^{r}_{T-1} = \tau_{T-2}$)!!!

# Finite horizon *(3/5)*

- $\tau_f < \tau^*$, so W is decreasing $\forall \tau \in [\tau^*, 1]$.
  - Increase in taxes reduces investment.
  - So, taxes $\tau_{T-1}$ not larger than $\tau^*$: $\tau_{T-1} \leq \tau^*$
- If $\tau_{T-1} < \tau^*$, investment $i_{T-1}$ will be zero, since agents then rationally expect $\tau_T = 1$.
  - $i_{T-1}\left(\tau_{T-1}\right)$ is discontinuous at $\tau^*$!!!!!!
- If $\tau_{T-2}$ was large ($\tau^* < \tau_{T-2}$), then certainly $\tau_{T-1} = \tau^*$,
  - There is no loss aversion in reducing taxes to $\tau^*$
  - and the investment would fall dramatically if you reduce it further.
- If $\tau_f \leq \tau_{T-2} < \tau^*$.
  - $h$ (the utility loss due to an increase in taxes) is not large enough to prevent an increase to $\tau^*$.
  - By increasing the taxes you incur in a loss,
  - But you also increase investment (it would be zero if $\tau_{T-1} < \tau^*$.
  - the same if $\tau_f \leq \tau_{T-2} < \tau^*$
  - So it can not be that $\tau_{T-1} < \tau^*$.

# Finite horizon *(4/5)*

- We now know that $\tau_{T-1}$ is set independently of $\tau_{T-2}$, i.e.,
  - $\tau_{T-1}$ **is politically forward-looking only**.

- Since $\tau_{T-1}$ is set independently of $\tau_{T-2}$, political decisions on $\tau_{T-2}$ can be taken without considerations about the future.

- The optimal choice of $\tau_{T-2}$ is therefore identical to that of period $T$.

$$\tau_{T-2} = T_{T-2}(\tau_{T-3}) = \begin{cases} \tau_{T-3} \text{ if } \tau_{T-3} \geq \tau^*, \\ 1 \text{ else,} \end{cases}$$

$\tau_{T-2}$ **is politically backward-looking** .

- Continuing backward, we establish:

The only finite horizon equilibrium features

$$\tau_{T-s} = \begin{cases} \tau_e\left(\tau_{T-s-1}\right) & = \begin{cases} 1 & \text{if } \tau_{T-s-1} < \tau^* \\ \tau_{T-s-1} & \text{if } \tau_{S-s-1} \geq \tau^* \end{cases} \text{ and } s \text{ is even.} \\ \\ \tau_o\left(\tau_{T-s-1}\right) & = \tau^* \text{ if } s \text{ is odd.} \end{cases}$$

# Finite horizon equilibrium: discussion

- The equilibrium involves oscillation between forward-looking strategic behavior (the odd strategy) and complete "myopic" behavior, constrained by the previous tax rate. These oscillations are key to the equilibrium existence.

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  - T-1, forward-looking

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  - T-1, forward-looking
  - T-2, myopic

–

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- If voters and political candidates expect future voters to behave strategically, limiting next periods taxes in order to constrain later taxes, there is no need to be strategic already in the current period. Instead, it is better to **procastinate**, behaving myopically.

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- If voters and political candidates expect future voters to behave strategically, limiting next periods taxes in order to constrain later taxes, there is no need to be strategic already in the current period. Instead, it is better to **procastinate**, behaving myopically.
- Conversely, an expectation that future voters will behave myopically, creates an incentive to act strategically in the current period, despite its short run costs.
- Although tax policies must oscillate in equilibrium, the actual tax-rate does not. It is constant at $1 - \frac{h}{\gamma} \equiv \tau^*$ after the first period.

# Infinite horizon *(1/2)*

- First, the finite horizon equilibrium does not converge to a Markov equilibrium as the horizon is extended backwards to infinity.

- The logic – that expectation of future myopia gives incentives for strategic behavior and *vice versa* – suggests the existence of a Markov equilibrium in mixed strategies.

- The conjecture is correct.

# Infinite horizon *(2/2)*

- A Markov equilibrium exists with the following characteristics:

$$\tau_t = \tau(\tau_{t-1}) = \begin{cases} \tau_e(\tau_{t-1}) & \text{with probability} \quad 1 - p(\tau_{t-1}) \\ \tau_o(\tau_{t-1}) & \text{with probability} \quad p(\tau_{t-1}) \end{cases},$$

$$i(\tau_t) = \begin{cases} 0 & \text{if} \quad \tau_t < \tau^* \\ \beta(1 - \tau_t + p(\tau_{t-1})(\tau_t - \tau^*)) & \text{if} \quad \tau_t \geq \tau^* \end{cases}$$

with $i'(\tau_t) < 0 \; \forall \tau_t > \tau^*$.

- Starting from any $\tau_0 \in [0,1]$ and $i_0 = i(\tau_0)$, the equilibrium tax-rate converges with probability 1 to $\tau^*$.

$$p(\tau_t^r) = \begin{cases} 1 \text{ for } \tau_t^r = 1, \\ \frac{p_1 + \frac{1}{2}\sqrt{\left((2p_1)^2 - 4p_2(2(p_1+\gamma h) - p_2)\right)}}{p_2} \text{for } 1 > \tau_t^r > \tau^* \\ < \gamma \text{ for } \tau < \tau^* \end{cases},$$

$$\begin{aligned} p_1 &= \gamma(\gamma(1+\beta)(1-\tau) - \beta\tau(1+\gamma) - h) \text{ and} \\ p_2 &= \beta(\gamma(1-\tau) - h)(1+2\gamma). \end{aligned}$$

- Starting from any $\tau_0 \in [0,1]$ and $i_0 = i(\tau_0)$, the equilibrium tax-rate converges with probability 1 to $\tau^*$.

# Conclusion

- We have constructed a tractable voting model where, due to *standard* loss-aversion it is politically costly to "cheat" people. This provides a (limited) commitment device that does not rely on complicated trigger-strategies and intergenerational voter coordination.

- The equilibrium is different from that of trigger strategies.

- In the model, political cost of cheating and real consequences of seemingly empty political promises are given explicit foundations.

- When reference points are sluggish and backward looking, interesting dynamics may occur, where current "responsible" and forward-looking policies require the possibility of future political myopia.

- Both backward and forward looking reference point dynamics provide with the same steady state.

# Political commitment and loss-aversion

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