Ecological intuition versus Economic reason.

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Paper with O. Guéant, J.M Lasry.

Climate change, and the discount rate debate.

- Economic « reason » without doubts..
  - Nordhaus (DICE), a growth model with carbon as a factor.
  - Standard discount rates (5%) lead to « lenient policies ».
  - Behind : reference to market rates, explained by
    - Pure rate of time preferences 1-2%
    - Elasticity of marginal utility 1,5, growth rate of 2%.
- An attempt of reconciliation with « ecological intuition » : the Stern review.
  - Puts emphasis on uncertainty and probabilistic assesments.
  - Comprehensive assessments of the costs of damage.
  - Low discount rates : ….1,1% justified by
    - Pure rate of time preferences of 0,1%.
    - Log utiliy (Cobb-Douglas).
  - Criticisms.
- Directions for reassesments.
  - Uncertainty (Weitzmann)
  - Stress the specificities of environmental goods.

A two goods model.

- **The model :**
  - **2 goods :**
    - *aggregate consumption good : quantity*.
    - *« environnemental quality »*
- **The preferences parameters of generation t : σ', σ**
  - **Utility function :**
  - $v(x_t, y_t) = \{[x_t^{((\sigma - 1)/\sigma)} + y_t^{((\sigma - 1)/\sigma)}]^{(\sigma/(\sigma - 1))}\}$
  - $V(x_t, y_t) = [1/(1 - \sigma')][v(x_t, y_t)]^{(1 - \sigma')}$
  - Comment.
    - **y/x decreases of 1/100, the willingness to pay increases of (**$1/\sigma$) per 100
    - Iso-elastic cardinal utilty for generation t, constant relative risk aversion σ'

The four parameters world.

- **Elasticity of marginal utility or relative risk aversion σ', σ**
  - **σ>1, (<1) moderate, (radical environmentalist.**
  - σ' plays a role in the intensity of redistribution towards the poor..
  - 1,5, …. 3 ?
- **Intergenerational (social) welfare : δ**
  - $U= [1/(1- \sigma')]\Sigma_{t=0}^{infini}\{(\exp(- \delta t))[v(x_t ,y_t)]^{(1 - \sigma')}\}$
  - **Pure rate of time preferences.. utilitarian.** $\delta \rightarrow 0$, « ethical » viewpoint.
  - Positive (Koopmans).
  - > rate of survival of the planet ….
- **Economic possibilities : r.**
  - **A simplistic view of the growth possibilities : AK model.**
  - **or first take growth rates as given ..**

The concern for environment.

- The concern for environment σ
  - The world is radically different depending on whether σ is greater or smaller than one.
  - Opposes the « radical » environmentalist $\sigma<1$ and the « moderate » environmentalist $\sigma>1$.
  - Later, uncertainty bears on σ.
- A world with two goods…
  - Standard discount rate :relative price of the private good period t, vis-à-vis period 0
  - $(\exp(-\Sigma^T r^*(t))$
  - Ecological discount rate : relative price of the enviromental good $\exp(-\Sigma^T \beta^*(t))$.
  - « *Canonical » Ecological Cost benefit Analysis*
    - Generation 0 evaluates an invest (at 0), generating an improv of the environl quality for generation t, value measured with *the marginal willingness to pay of generation 0* : multiplied by the « ecological discount rate

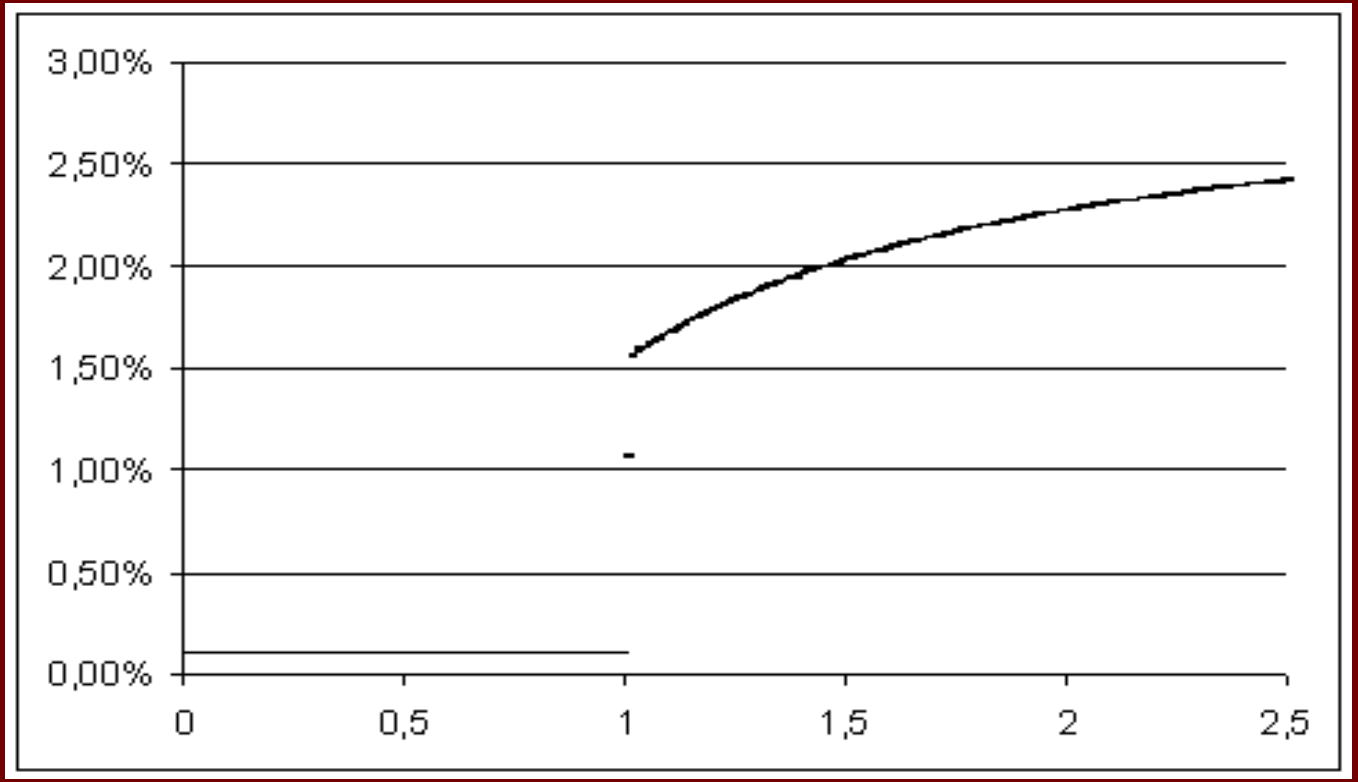
Ecological discount rate from the reform viewpoint.

- ***The reform viewpoint :***
  - *Fixed enviromental quality*
  - *Given trajectory of growth rates g*
  - *The long run .*
- *A basic insight : the relative price effect.*
  - $B = r - (g/\sigma)$
- ***Proposition A : the « moderate » environmentalist.***
  - Standard discount rate : $\text{Min}\,(g\sigma') + \delta$
  - Ecological long run discount rate : $\lim \rho(T) = \underline{\mathbf{g\,[\sigma' - (1/\sigma)]}} + \delta$
  - $\text{Min}\{g\}[\text{Min}\{\underline{\sigma}'\} - 1/\{\text{Min}\,\underline{\sigma}\}$: (1) (1,4 - 0.9) = 0,5 pour cent !
- ***Proposition B : the « radical » environmentalist.***
  - Standard discount rate : $(g/\sigma) + \delta$
  - ecological long run discount rate : $\lim \rho(T) = \delta$

The optimum in the 4-parameters world.

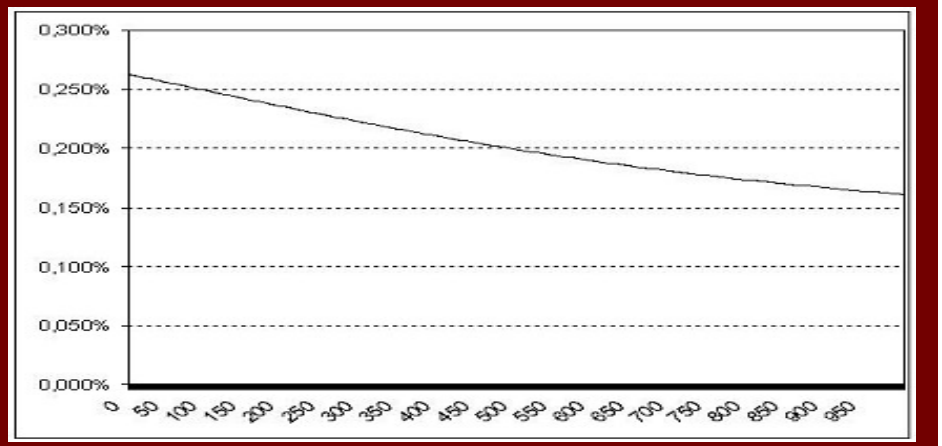
- Constraints.
  - Fixed environmetal quality.
  - Fixed interest rate (standard discount rate).
- Results : optimal asymptotic growth with moderate environmental concerns.
  - Asymptotic growth rate : $g^*=(r-\delta)/\sigma'$
  - Ecological discount rate : $B^*=[1-1/(\sigma'\sigma)]r+ 1/(\sigma'\sigma)]\ \delta$.
- Optimal growth with radical environmental concerns :
  - Asymptotic growth rate : $g^*= \sigma(r-\delta)$
  - Ecological discount rate : $B^*=\delta$.
- Discontinuity and continuity :
  - At each t, the optimal trajectory, as well as the ecological discount rate, is a continuous function of σ

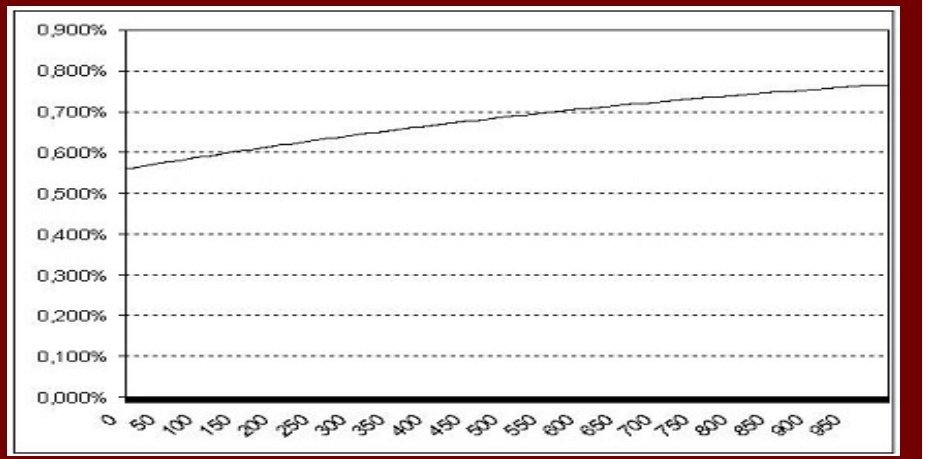
Long run ecological discount rate as a function of sigma.



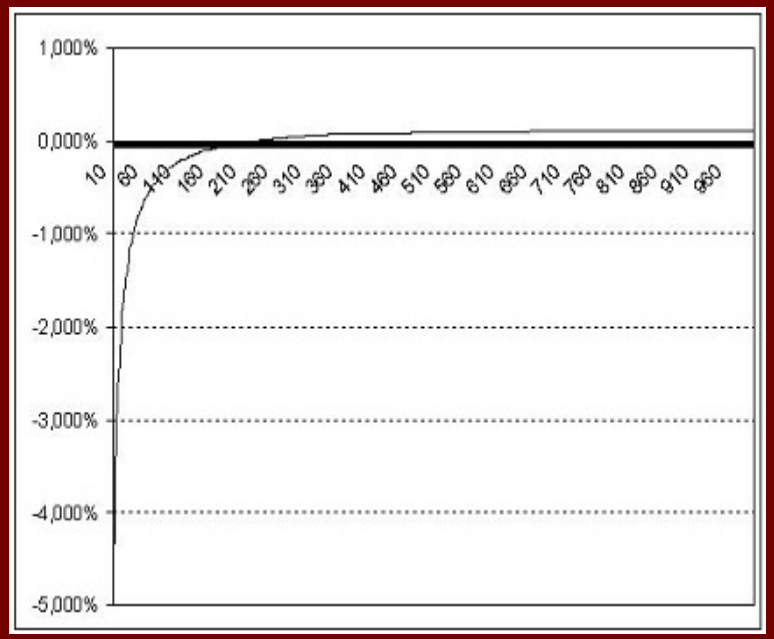
The dynamics of « ecological discount rates ».

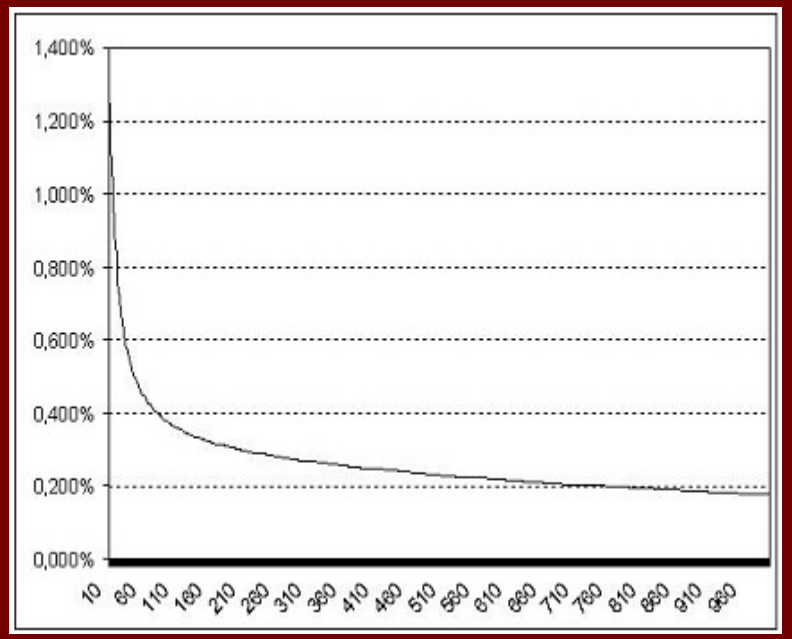
- The dynamic of optimal growth rates ($\sigma'\sigma>1$)
  - **σ <1,** g*(t) is increasing.
  - **σ >1,** g*(t) is decreasing.
- The dynamics of ecological discount rates
  - **σ <1,**
    - B*(t) is decreasing
    - and converges to δ.
  - **σ >1,**
    - B*(t) is increasing
    - and conv to : **r-(r- δ)/ $\sigma'\sigma$**
- **σ'=1,5,**
  - **σ=**
  - **0,8,**
  - **1,2,**
- **δ=0,1, r=2%**





Ecological return : the wealth effect.





Valuing an irreversible damage to the environment.

- The question :
  - Consider an irreversible damage to the environment
  - Generation 0 is willing to pay x to avoid the damage for itself.
  - How much should it be willing to pay, considering other generations ?
  - The answer is mx, m>1.
- An Answer : A Bound on m, with a broad validity range ?
  - *Consider* $a=[1-1/(\sigma'\sigma)]r+1/(\sigma'\sigma)]\,\delta$
  - *m>1/a, irrespective of* σ.
- Examples :
  - $\sigma'=1,5$, $\delta=0,1\%$, $r=2\%$, $\sigma=0,8$,
    - m>300
  - $\sigma'=1,5$, $\delta=1\%$, $r=3\%$
    - **$\sigma=1,2$, bound 52,94, actual m : 61, 49.**
    - **$\sigma=0,8$, bound 75, actual m : 86, 68.**
  - $\sigma'=1,5$, $\delta=0,1\%$, $r=3\%$,
    - **$\sigma=0,8$, m=200,**
    - **$\sigma=1,2$, m=75.**

Introducing uncertainty on σ

- Modelling :
  - The elasticity of substitution σ **is uncertain.**
  - **the uncertainty on** σ remains steady untill period τ
  - It will be fully revealed at time τ.
- Question 1 : what about the long run « ecological discount rate » ?
  - The long run ecological discount rate is δ. (WPP)
- Question 2 :
  - Revelation of the uncertainty comes together with an « ecological » accident,
  - the present generation would be willing to pay x for avoiding this accident to itself under the assumption that the moderate environmentalist hypothesis has probability (1-p)
  - How much should it be prepared to pay to avoid the « accident » that will concern all generations following τ

Strong precautionary principle.

- Question 2 :
  - Revelation of the uncertainty comes together with an « ecological » accident,
  - the present generation would be willing to pay
  - How much should it be prepared to pay to avoid the « accident » that will concern all generations following τ
- WPP : ecological discount rate tends to delta
- Answer 2 : SPP
  - $a=[1-1/(\sigma'\sigma)]r+ 1/(\sigma'\sigma)] \delta$
  - $m > \exp(-a(h)\tau)f(p, \tau)$
  - $f>((1-p)/a(h)+p/a(l))$ and concave.
  - $\text{Lim}(\tau) [f(p, \tau.)=a(l)$
- Back of the enveloppe computation.

m as a function of the probability of accident