# Discounting Future Climate Change and the Equilibrium Real Interest Rate

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EGU 2020

Economics and Econometrics of Climate Change

May 7, 2020

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# Social discounting and eqbm. real interest rate ($r^*$)

- Social discount rate (SDR) essential for evaluating future damages from climate change
  - Emerging consensus that term structure is downward sloping
  - But considerable debate about its level
- What does macro-finance have to say about SDRs?
  - Equilibrium real interest rate $r_t^*$ plays central role
  - No-arbitrage arguments show that $r_t^*$ is fundamental anchor of term structure of SDRs
  - Changes over time – *substantial decline since 1990s*
  - Consequently lower SDRs and increased present value of climate change damages

# New results on SDRs and SCC

- Use descriptive approach to determine SDRs
  - Based on observed market rates
  - We use risk-free real Treasury yields $\rightarrow$ risk-free term structure
- Quantify downward shift in term structure of SDRs using time series models that allow for change in long-run mean $r_t^*$
- Lower SDRs substantially boost estimates of economic loss from climate change
  - Estimated social cost of carbon (SCC) at least doubles
- Descriptive approach vs. normative approach
  - Descriptive approach (e.g., Nordhaus) usually implies much higher SDRs than normative approach (e.g., Stern report)
  - Not the case anymore once we account for decline in $r_t^*$ — closely in line with results from normative approach

# An econometric definition of $r_t^*$

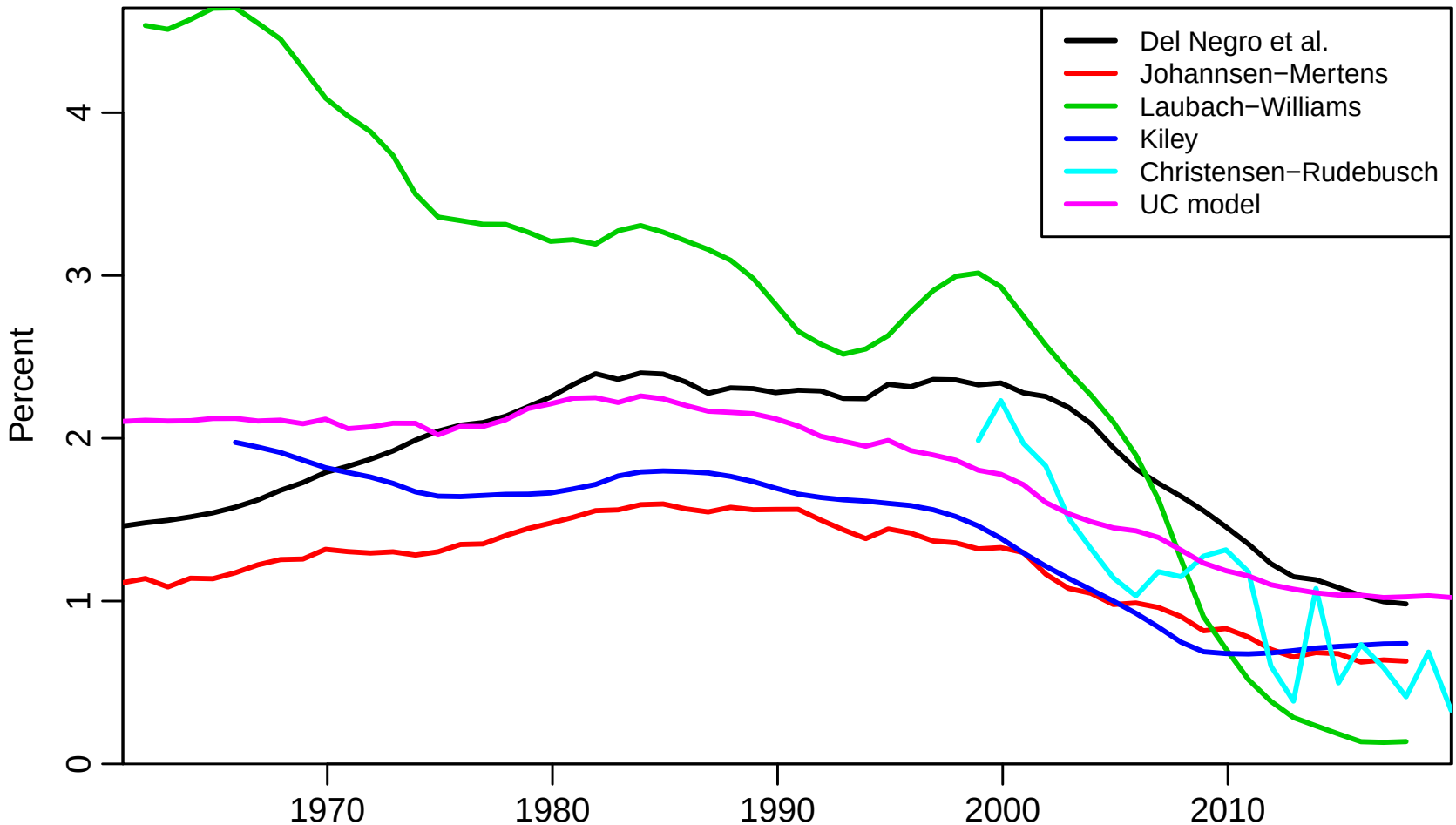
$$r_t^* = \lim_{h \to \infty} E_t r_{t+h} \tag{1}$$

Anchors term structure of real discount rates

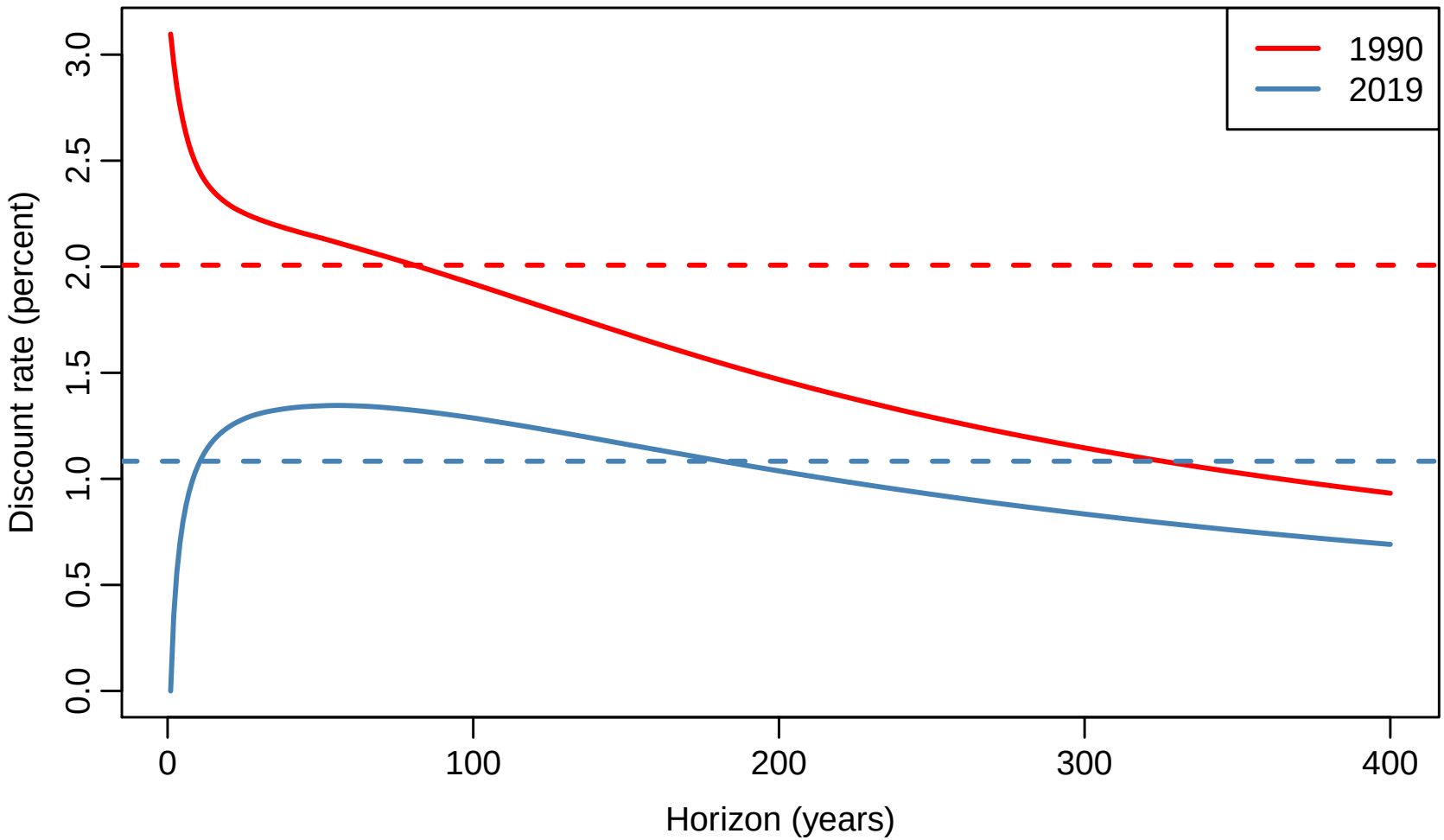
$$y_t^{(n)} = r_t^* + \frac{1}{n} \sum_{j=0}^{n-1} E_t \tilde{r}_{t+j} + c_n \tag{2}$$

$\tilde{r}_t = r_t - r_t^*$ is cyclical component of the real interest rate, $c_n$ is negative convexity that causes discount rates to decline with horizon

# Macro-finance estimates show secular decline in $r_t^*$



# Term structure of SDRs has shifted down



# Related literature

- Huge literature on intergenerational social discounting, reviewed in Arrow et al. (1996, 2014), Gollier (2013), Gollier and Hammitt (2014)
- Newell and Pizer (2003) used time series models of real interest rate to estimate term structure of SDRs
  - Subsequent work using similar approach: Groom et al. (2007), Gollier et al. (2008), Hepburn et al. (2009), Freeman et al. (2015)
  - Models do not allow for long-run trend in real interest rates (time variation in $r_t^*$). Either stationary or random walk.