# On the Welfare Costs from External Sovereign Borrowing


Mark Aguiar[1] Manuel Amador[2] Stelios Fourakis[3]

[1]Princeton University and NBER

[2]Minneapolis Fed, University of Minnesota and NBER

[3]University of Minnesota


February 19, 2020

# Starting point

- Sovereign debt
- Governments borrow, and sometimes default
- Growing quantitative literature

- Today: small tour of the literature using a particular lens

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- Households and politicians
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- Households and politicians
  - Disagree on how to discount future
  - Politicians more impatient than (average) household
- Borrowing and government debt
  - Fundamentally an inter-temporal decision
  - Distorted by political economy
- How to improve things?
  - Simple/transparent rules may work best

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  - Remove ALL gov't access to international debt markets

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  - Remove ALL gov't access to international debt markets
- Evaluate in recent quantitative sovereign debt models:
  - Compare outcomes with and without this rule

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  - Key political economy parameter

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Two questions when evaluating the rule

1. What is the level of disagreement that keep households indifferent wrt the rule?

2. How large are the (households') welfare gains?

# Results: A decomposition

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3. Default costs
   - Large disagreement: Rule valuable
   - Larger welfare effects: $\approx 1\%$ of consumption

# Warming up: A benchmark exercise

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- Deterministic small open economy with endowment $y$
- Government:
  - Manages external debt subject to **ad-hoc debt limit** $\overline{b}$
  - Discounts the future at rate $\rho_G$
- Households:
  - Enjoy same utility flows (CRRA, $\sigma$), discount at $\rho_H \leq \rho_G$
  - Consume from endowment net of government transfers
  - No inter-temporal decision, no labor supply decision

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- Only three parameters needed:
  - Elasticity of inter-temporal substitution, $1/\sigma$
  - International discount factor, $r$
  - Ad-hoc debt limit, $\overline{b}/y$

# Warming up: government's problem

- With access to borrowing.
  - Government chooses consumption for $b' < \overline{b}$:

$$u'(c) = \beta_G(1+r)u'(c')$$

    where $\beta_G = e^{-\rho_G}$, $b_0 = 0$ and budget constraint: $c = y - (1+r)b + b'$
  - At some point, $b' = \overline{b}$, and $c = y - r\overline{b}$

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    $c = y - (1 + r)b + b'$
  - At some point, $b' = \overline{b}$, and $c = y - r\overline{b}$
  - Enough to obtain the consumption process, $c_t^\star$.
- Without access to borrowing, $c_t = y$

# Warming up: HH welfare

- Households: same instantaneous utility function

  but discount factor: $\beta_H = e^{-\rho_H}$

- With access to borrowing:

$$W_0 = \sum_{t=0}^{\infty} {\beta_H}^t u(c_t^\star)$$

- Without access:

$$W^A = \frac{u(y)}{1 - \beta_H}$$

# Warming up: Welfare calculation

Welfare comparison in consumption units:

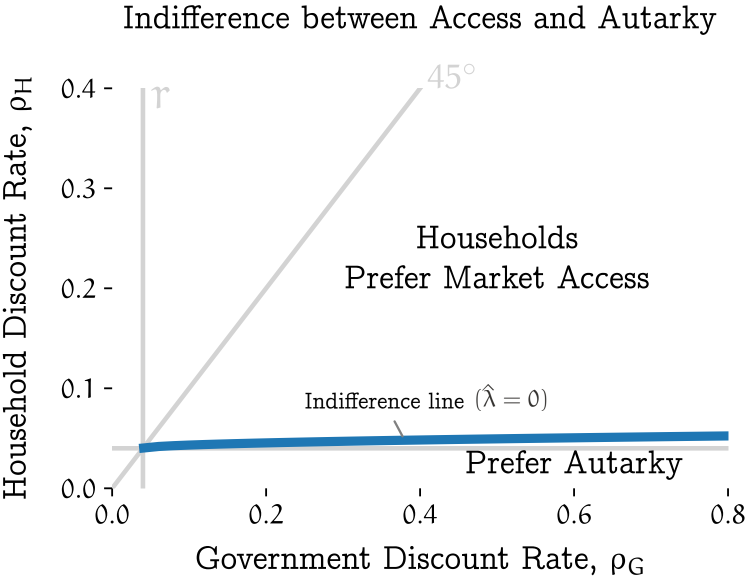
$$\hat{\lambda} = \left(\frac{W_0}{W_A}\right)^{\frac{1}{1-\sigma}} - 1$$

- $\hat{\lambda} = 0$: households are indifferent
- $\hat{\lambda} > 0$: households prefer access
- $\hat{\lambda} < 0$: households prefer no access

# Warming up: A benchmark exercise

$\sigma = 2$, $r = 0.04$, $\bar{b}/y = 0.25$ (annual rates)

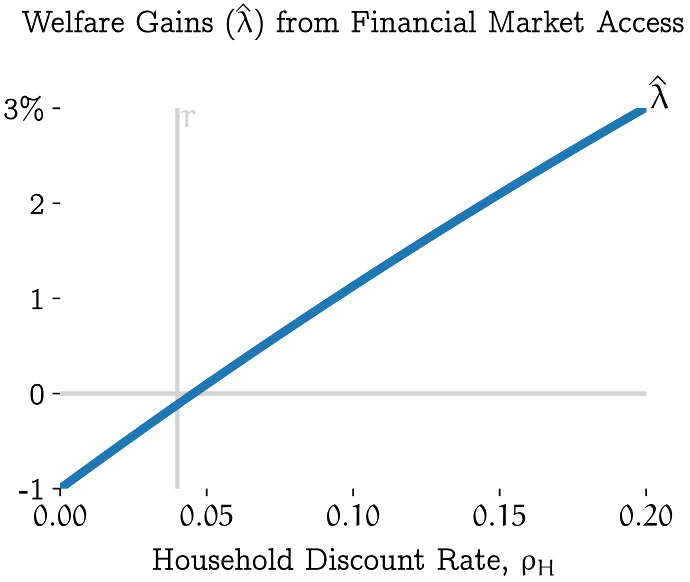
# Warming up: A benchmark exercise



# A benchmark exercise: Welfare magnitudes

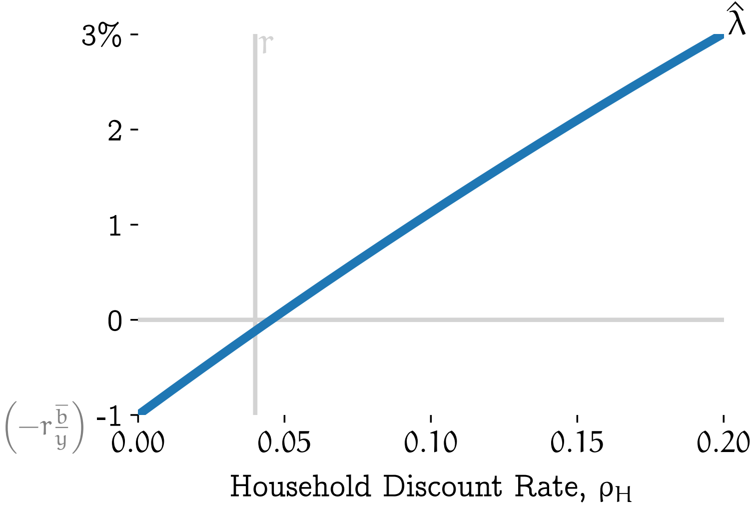
$$\sigma = 2,\ r = 0.04,\ \bar{b}/y = 0.25,\ \boxed{\rho_G = 0.20}$$

# A benchmark exercise: Welfare magnitudes



# A benchmark exercise: Welfare magnitudes

Welfare Gains ($\hat{\lambda}$) from Financial Market Access



# A benchmark exercise: Summary

- Just a bit of impatience enough for HH to prefer market access
- Welfare gains from access potentially large

Front-loading of expenditures: Not a strong case for banning external sovereign borrowing.

How robust is this?

# A benchmark exercise: Summary

- Simple benchmark misses many things:
  - No uncertainty
  - No default in equilibrium
  - No default costs
  - No relevant maturity choice

- Recent quantitative sovereign debt models have these
  - Still, some other ones missing ...

# The Eaton-Gersovitz model

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- Small open economy
- Stochastic endowment process $y(s)$
- Government borrows abroad using an uncontingent (but defaultable) bond

  It can default, output drops to $y^D(s)$
- Foreigners are risk-neutral, discount at $R$

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  It can default, output drops to $y^D(s)$
- Foreigners are risk-neutral, discount at $R$
- Government lacks commitment:
  - To repay its debts
  - To future deficits / debt accumulation

# The Eaton-Gersovitz model: Timing

- Government inherits debt, $b$, and state $s$ is realized
- Then, it decides to default or not
- If it does not, then issues new bonds at price $q$, consumes, and obtains a value $V(b, s)$
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This timing eliminates the possibility of failed auctions.

Simple but very rich model

# The Eaton-Gersovitz model: Budget constraint

How do we deal with maturity?

A bond is a promise to pay a geometrically decaying coupon.

$\delta$ is the rate of decay:

$$c = y(s) - b + q \times \underbrace{(b' - \delta b)}_{\text{issuances}}$$

# The Eaton-Gersovitz model: Markov Equilibria

$$V(b, s) = \max_{b'} \left\{ u(c) + \beta_G \sum_{s'|s} \pi(s'|s) \max\{V(b', s'), \underline{V}(s')\} \right\}$$

subject to:

$$c = y(s) - b + q(b', s)(b' - \delta b)$$

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$$\underline{V}(s) = u(y^D(s)) + \beta_G \sum_{s'|s} \pi(s'|s) \left(\theta V(0,s') + (1-\theta)\underline{V}(s')\right)$$

$\theta$: re-entry probability

# The Eaton-Gersovitz model: Markov Equilibria

Bond price:

$$q(b,s) = \underbrace{\frac{1}{R}\sum_{s'|s}\pi(s'|s)\mathbb{1}_{\{V(b,s')\geq \underline{V}(s')\}}}_{\text{prob of no default}}\left(1 + \underbrace{\delta q(\mathcal{B}(b,s'),s')}_{\text{bond price tomorrow}}\right)$$

where $\mathcal{B}$ is the debt policy function

# The Eaton-Gersovitz model: The Rule

Autarky welfare (starting from zero debt) for the government:

$$V^A(s) = u(y(s)) + \beta_G \sum_{s'|s} \pi(s'|s) V^A(s')$$

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Autarky welfare (starting from zero debt) for the government:

$$V^A(s) = u(y(s)) + \beta_G \sum_{s'|s} \pi(s'|s) V^A(s')$$

In any Markov equilibrium, and for any maturity $\delta$,

$$V(0, s) \geq V^A(s)$$

for all $s \in S$.

A government will not shut itself out.

# The Eaton-Gersovitz model: Household's welfare

Value with Market Access ($\mathcal{D}$: equilibrium default policy)

$$W(b,s) = u\Big(y(s) - b + q(\mathcal{B}(b,s),s)(\mathcal{B}(b,s) - \delta b)\Big) + \\ \beta_H \sum_{s'|s} \pi(s'|s)\left[(1-\mathcal{D}(b,s'))W(\mathcal{B}(b,s),s') + \mathcal{D}(b,s')\underline{W}(s')\right]$$

$$\underline{W}(s) = u(y^D(s)) + \beta_H \sum_{s'|s} \pi(s'|s)\left(\theta W(0,s') + (1-\theta)\underline{W}(s')\right)$$

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$$\underline{\mathcal{W}}(s) = u(y^D(s)) + \beta_H \sum_{s'|s} \pi(s'|s) \left(\theta \mathcal{W}(0, s') + (1 - \theta)\underline{\mathcal{W}}(s')\right)$$

Value without Market Access:

$$\mathcal{W}^A(s) = u(y(s)) + \beta_H \sum_{s'|s} \pi(s'|s)\mathcal{W}^A(s').$$

# Goal

Welfare gains in terms of consumption

$$(1+\lambda) = \left[ \frac{\sum \pi^{\infty}(s_0) W(0, s_0)}{W^A} \right]^{\frac{1}{1-\sigma}}$$

# Decomposing the consumption process

$C(h_t)$: eqm consumption given shocks and exclusion history $h_t$.
$h_0$ starting history with no debt. $d_t$ default indicator.

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Consumption without default costs:

$$c^{ND}(h_t) \equiv (1 - d_t)C(h_t) + d_t y(s_t)$$

Expected consumption without default costs:

$$\bar{c}^{ND}(t) \equiv \sum_{h_0} \pi^\infty(s_0) \sum_{h_t} \pi(h_t|h_0) c^{ND}(h_t)$$

Expected autarkic consumption:

$$\bar{c}_A(t) \equiv \sum_{s_0} \pi^\infty(s_0) \sum_{h_t} \pi(h_t|h_0) y(s_t) = y^\infty$$

# Welfare measures

Equilibrium household welfare:

$$W(0) \equiv \sum_{s_0} \pi^{\infty}(s_0) \sum_{t=0}^{\infty} \sum_{h_t} \pi(h_t|h_0) {\beta_H}^t u(C(h_t))$$

Equilibrium household welfare without default costs:

$$W^{ND}(0) \equiv \sum_{s_0} \pi^{\infty}(s_0) \sum_{t=0}^{\infty} \sum_{h_t} \pi(h_t|h_0) {\beta_H}^t u(c^{ND}(h_t))$$

Equilibrium household welfare without default cost and uncertainty:

$$\overline{W}^{ND}(0) \equiv \sum_{t=0}^{\infty} {\beta_H}^t u(\bar{c}^{ND}(t))$$

Autarkic household welfare without uncertainty

$$\overline{W}^{A}(0) \equiv \frac{u(y^{\infty})}{1 - \beta_H}$$

# An Exact Decomposition

Welfare gains in terms of consumption

$$(1+\lambda) = \left[\frac{W_0}{W^A}\right]^{\frac{1}{1-\sigma}}$$

$$= \underbrace{\left[\frac{W_0}{W^{ND}(0)}\right]^{\frac{1}{1-\sigma}}}_{1+\lambda_D} \times \underbrace{\left[\frac{W^{ND}(0)}{\overline{W}^{ND}(0)} \times \frac{\overline{W}^A}{W^A}\right]^{\frac{1}{1-\sigma}}}_{1+\lambda_V} \times \underbrace{\left[\frac{\overline{W}^{ND}}{\overline{W}^A}\right]^{\frac{1}{1-\sigma}}}_{1+\lambda_T}$$

$$= (1+\lambda_D) \times (1+\lambda_V) \times (1+\lambda_T)$$

$\lambda_D$: role of *default costs*.

$\lambda_V$: role of the *variability* of consumption.

$\lambda_T$: welfare effects generated by the *tilting* of consumption.

# The Eaton-Gersovitz model: Parameters

- In all exercises
  - Period is a quarter, utility parameter: $\sigma = 2$
  - Same output process (targeted to Argentina)[1]

- Other parameters vary across calibrations:
  - Real interest rate, $r$
  - Maturity of the bonds, $\delta$
  - Discount rate of the government, $\rho_G$
  - Re-entry probability after default, $\theta$
  - Output losses after default, $\{y^D\}$

[1] Includes endowment specification of Chatterjee-Eyigungor (2012) to guarantee existence of pure strategy equilibria.

# Aguiar-Gopinath (2006) "transitory" calibration

One period bonds, $y^D = 0.98y$,

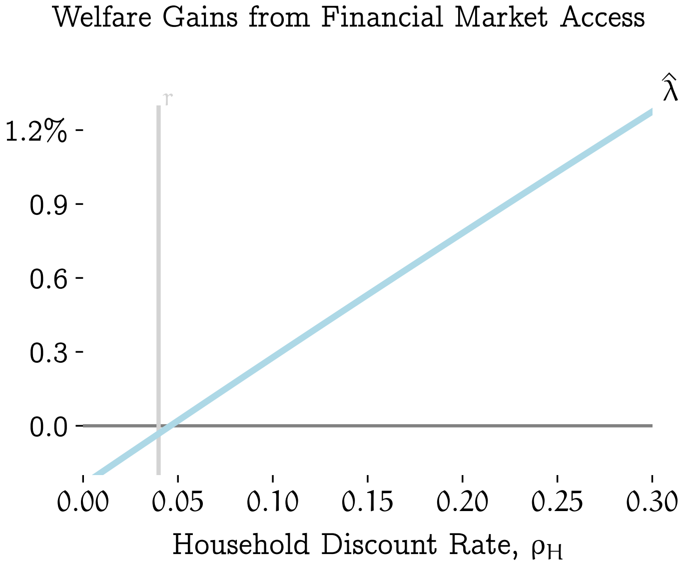
$\boxed{\rho_G = 0.89 \text{ (annual)}}$,

Quarterly: $\theta = 0.1$, $r = 0.01$

$\widehat{\lambda}$: result using benchmark model without uncertainty/default.

$\lambda, \lambda_{T,D,V}$: actual results from model.

# Aguiar-Gopinath (2006) “transitory” calibration



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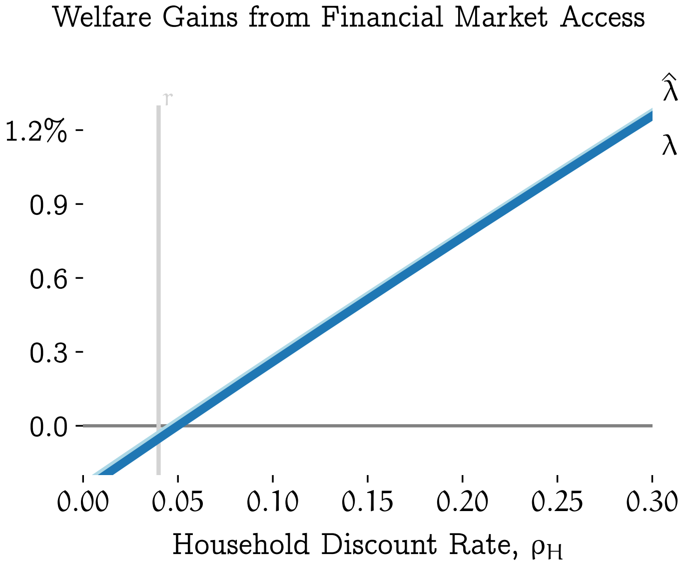

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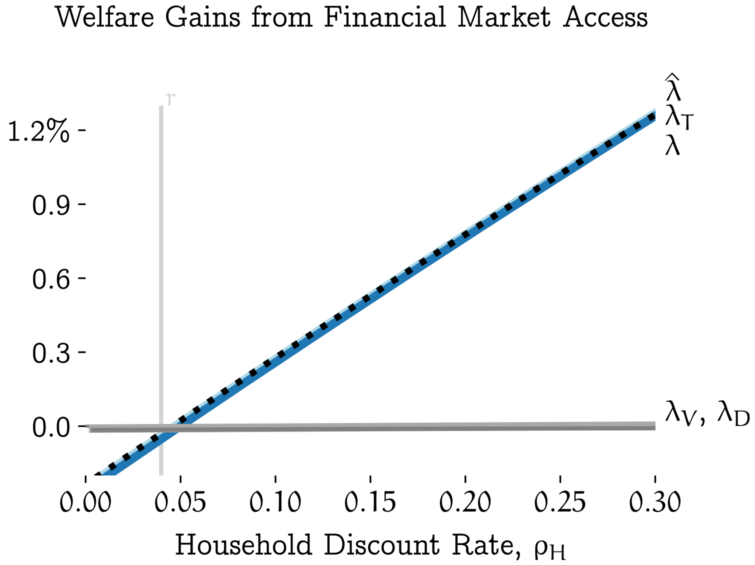


# Aguiar-Gopinath (2006) calibration: Summary

- Benchmark exercise right on top of AG calibration
  - Uncertainty does not add much
- Default probability is small
- Debt to output ratio is small

# Arellano (2008) calibration: Non-linear costs

- Improves model fit by introducing non-linear costs of default

  $y^D(s) = \min\{y(s), \lambda \mathbb{E} y\}$
- Default is *less* costly in low endowment states
- Default probability comparable to the data

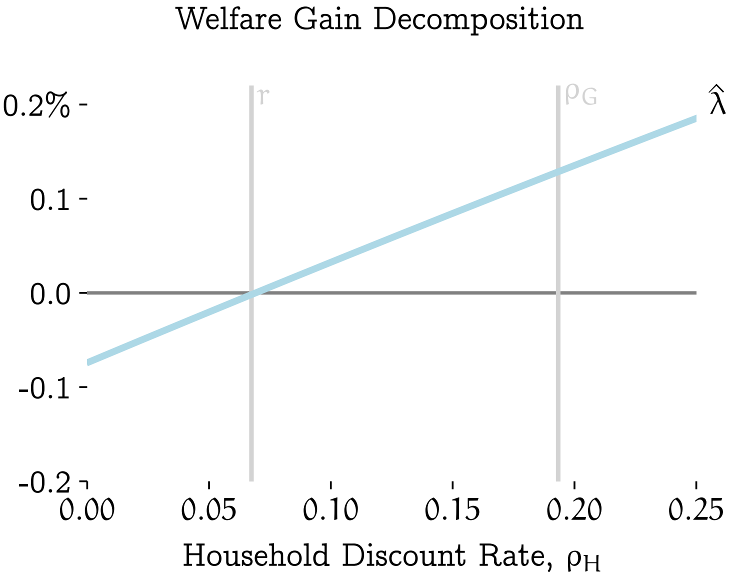
# Arellano (2008) calibration: Non-linear costs

One period bonds, $\rho_G = 0.19$ (annual),

$$\boxed{y_t^D = \min\{y_t, 0.97\mathbb{E}y\}}$$

Quarterly rates: $\theta = 0.28$, $r = 0.017$

# Arellano (2008) calibration: Non-linear costs



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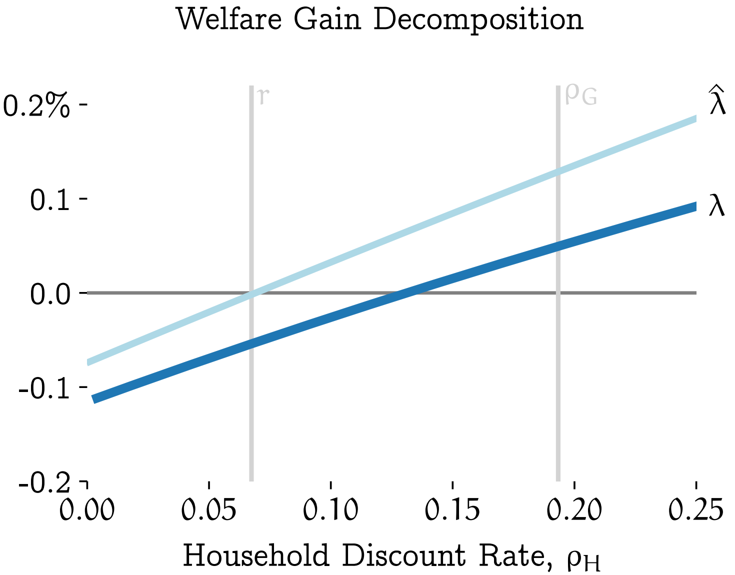

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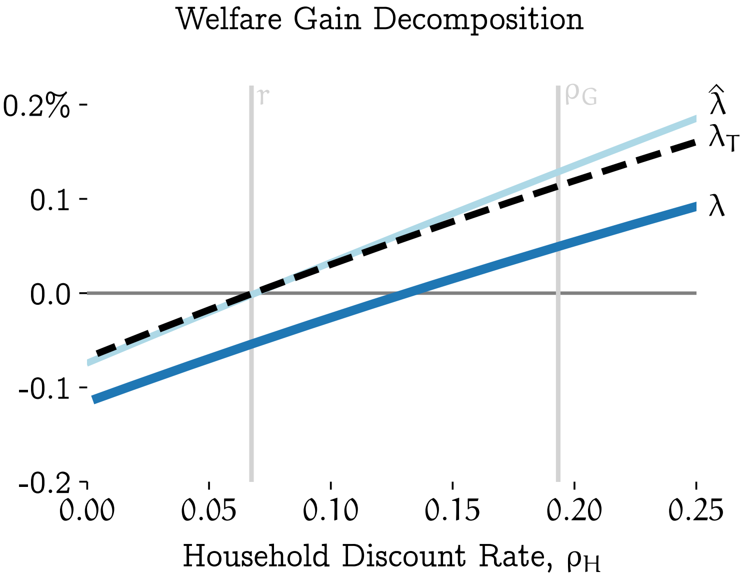

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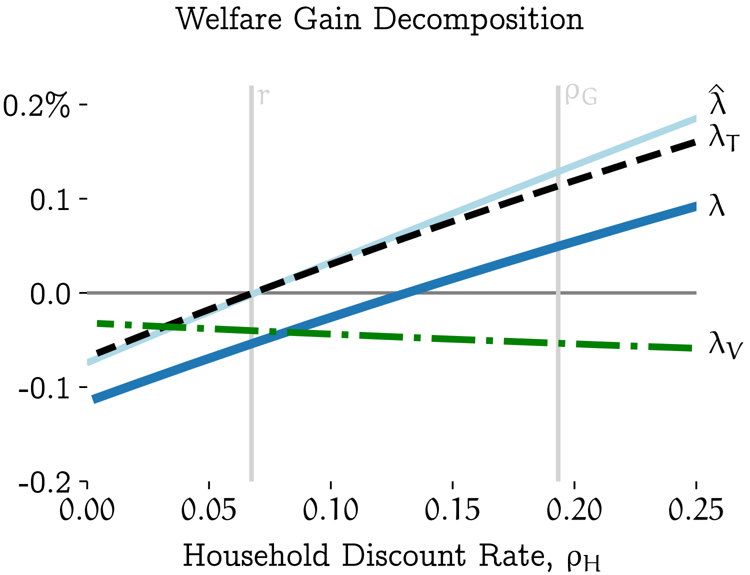

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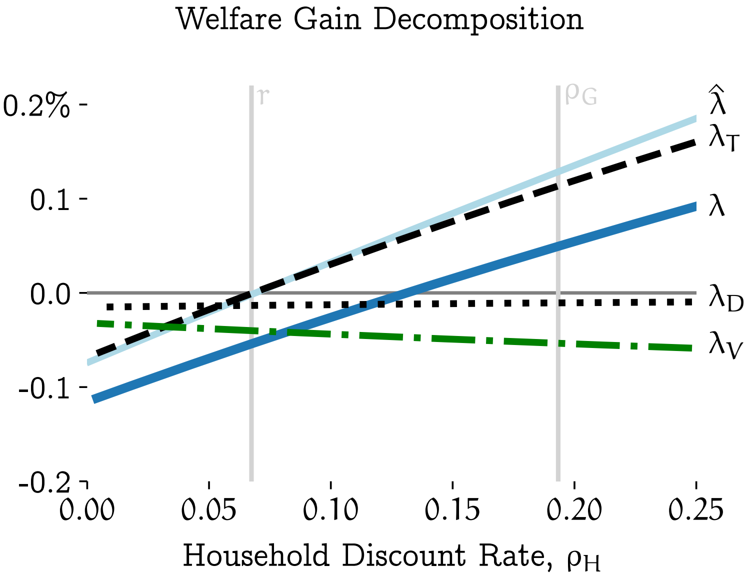


# Arellano (2008) calibration: Summary

- Disagreement
  - HH with less than 10% annual discount prefer no access
- By borrowing more in good times than bad
  - Government introduces more variability to the expenditure allocation
  - Opposite of consumption smoothing intuition
- Households dislike this – but magnitudes remain small
- What about default costs?
  - Default probability is higher, but equilibrium default costs are small

# Long-duration bond models

- These first models have problems:
  - Debt/output ratios were too small
  - Spreads were not volatile enough

# Long-duration bond models

- These first models have problems:
  - Debt/output ratios were too small
  - Spreads were not volatile enough
- Hatchondo and Martinez (09) and Chatterjee and Eyigungor ('12) introduced long term bonds
  - Government borrows in bonds with maturity longer than one period
  - Also allowed for a more flexible specification of default costs
  - Significantly more complex to solve .. but much better fit

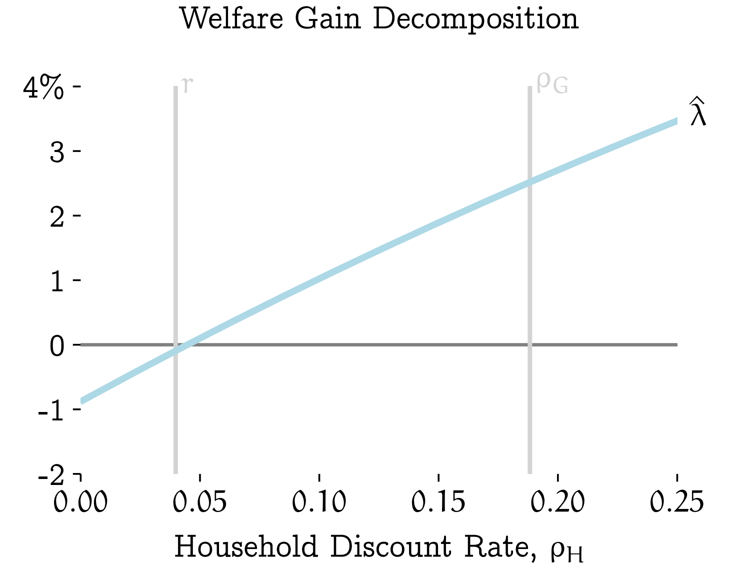
# Chatterjee and Eyigungor ('12): Long bonds

Long duration bonds, $\rho_G = 0.19$ (annual)

Flexible default costs

Quarterly rates: $\theta = 0.0385$, $r = 0.01$

# Chatterjee and Eyigungor ('12): Long bonds



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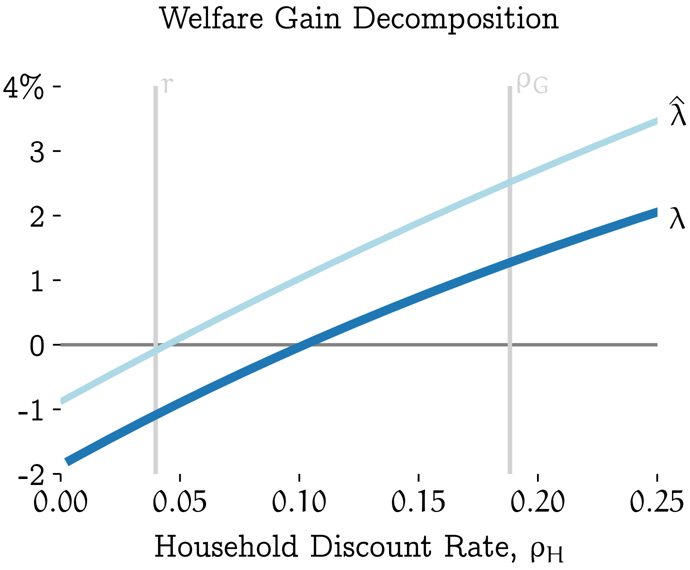

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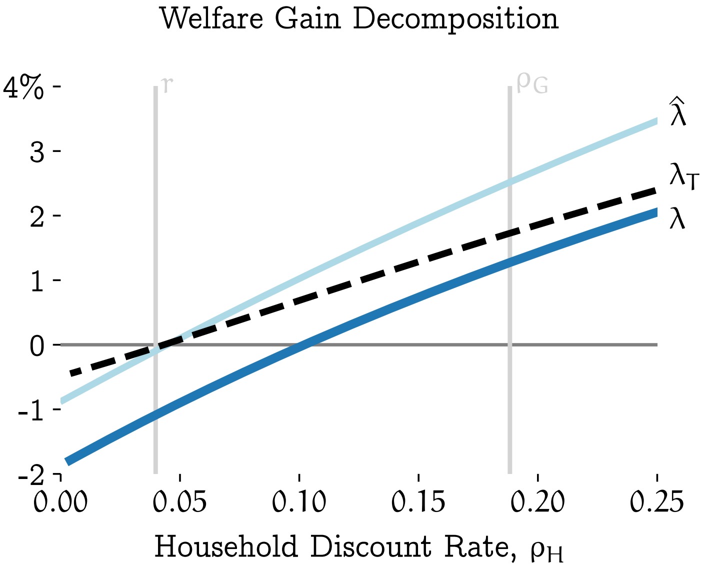

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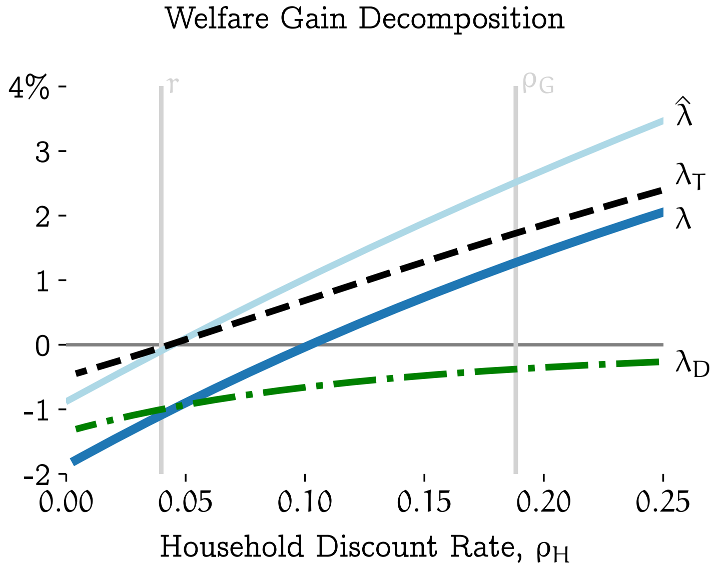

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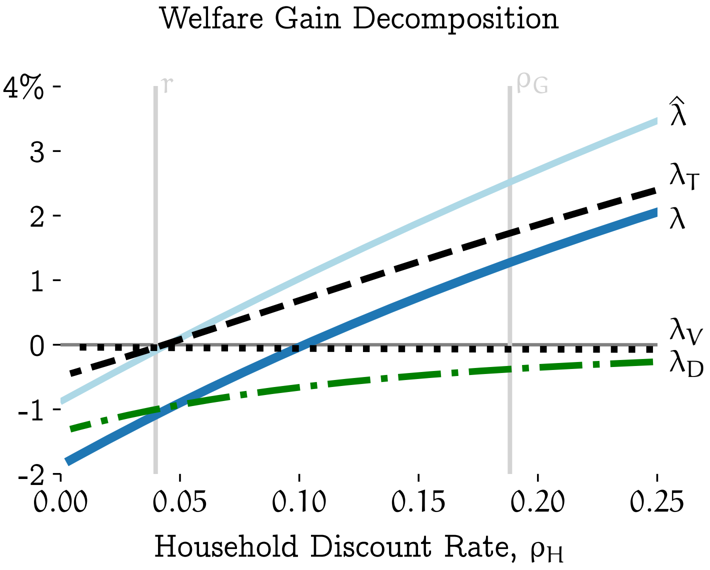

# Chatterjee and Eyigungor (2012): Summary

- Disagreement remains
  - HH with less than 10% annual discount prefer no access

- Welfare magnitudes much larger ($\approx 1\%$)
  - Much larger debt to output ratio
  - Default is happening in equilibrium and it is costly

# Conclusions

- When the government is impatient and can borrow, it generates three type of costs to more patient households:
  - It distorts allocation towards the present
  - It introduces extra variability in expenditures
  - It exposes the country to costly defaults
- The latter significantly strengthens the case against access to external sovereign debt markets.

# Conclusions

Default costs are key for welfare .. but we don't know enough

We are missing other things ..

- HH (private) external borrowing and investment
- Self-fulfilling debt runs / failed auctions / sudden stops
- Distortions in the composition of government expenditures
- Non-expected utility

.. leave this for future work.