Population and Economic Growth
When Malthus Meets Romer

Anson Zhou

The University of Hong Kong

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Motivation: A Century-Old Disagreement

- Does a larger population raise or lower living standards?
  - → Malthus (1798): population strains resources ⇒ wages to subsistence
  - → Romer (1990): more people ⇒ more ideas ⇒ innovation dominates
- Never more consequential: 2bn → 8bn+ in a century, now fertility below replacement across the developed world
- Households disagree about which side is right — and altruistic parents' fertility choices depend on the world their children will inherit
- This paper: study the implications of the disagreement itself

This Paper

1. Model: OLG + Barro–Becker altruism + semi-endogenous growth + heterogeneous beliefs about scale effects (Romerians vs. Malthusians)
2. Theory: fertility ranking between types is state-dependent; wrong beliefs generate distinct pathologies:
   - → Malthusian world + Romerians ⇒ boom-bust cycles
   - → Romerian world + Malthusians ⇒ dormant stagnation trap
3. Evidence (GSS): Malthusian beliefs correlated with 0.3 fewer children
4. History: the role of beliefs in demographic transitions
5. Policy: announcements as unconventional family policy

Related Literature & This Paper's Contribution

- **Fertility & unified growth**: Barro–Becker (1989), Galor (2005, 2011), Hansen–Prescott (2002); captures transition from stagnation to growth
- **Scale effects**: Romer (1990), Kremer (1993), Jones (1995, 2022); the sign of θ is central to long-run projections
- **Heterogeneous beliefs**: Angeletos–La'O (2013), Coibion–Gorodnichenko (2015); climate disagreement (Bakkensen–Barrage 2022)
- **Cultural transmission**: Bisin–Verdier (2001, 2011), Doepke–Zilibotti (2017); how worldviews persist across generations

This paper: disagreement about the population scale effect in a unified growth model where the error itself can hide its own evidence

Roadmap

- Model
- Empirical evidence: beliefs and fertility
- Long-run dynamics
- Demographic history interpretation
- Policy: the value of announcements

Model: Environment

- Discrete-time OLG; continuum of atomistic households
- Time endowment 1; fertility n costs time $\psi(n)$, labor supply $1 - \psi(n)$
- Linear production: $Y_t = A_t L_t$, wage $= A_t$, so

$$c_{j,t} = A_t\big(1 - \psi(n_{j,t})\big)$$

- A_t = "effective" TFP (incorporates congestion/dilution)
- Population: $N_{t+1} = \bar{n}_t N_t, \quad \bar{n}_t = \phi_t n_{R,t} + (1 - \phi_t) n_{M,t}$

TFP Dynamics: The Population Gap

microfoundation

- Central state variable: population gap x_t = population relative to knowledge-consistent reference

$$\ln A_{t+1} = \ln A_t + g(x_t; \theta^*) + \eta_{t+1}, \qquad x_{t+1} = (1-\mu)x_t + \ln \bar{n}_t$$

- Leading case: $g(x;\theta) = \bar{g} + \theta x, \quad \theta_R > 0 > \theta_M$
- μ = catch-up rate of the knowledge stock (semi-endogenous, Jones 1995):
  - $\rightarrow$ one-time population increase $\Rightarrow$ temporary growth effect
  - $\rightarrow$ sustained growth $\bar{n} > 1 \Rightarrow$ permanent: $g_\infty = g(\ln \bar{n}/\mu; \theta^*)$
- Disagreement is about the sign of $\theta^* \in \{\theta_R, \theta_M\}$

Key Structural Property: The Uninformative Reference

- Rival models cross at $x = 0$: $g(0; \theta_R) = g(0; \theta_M) = \bar{g}$
  - $\rightarrow$ they must overlap somewhere, or disagreement could not survive
- Signal informativeness (KL divergence):

$$\mathcal{I}_t = \frac{(\theta_R - \theta_M)^2 \, x_t^2}{2\sigma_\eta^2} \qquad \Longrightarrow \qquad \mathcal{I}_t = 0 \text{ at } x_t = 0$$

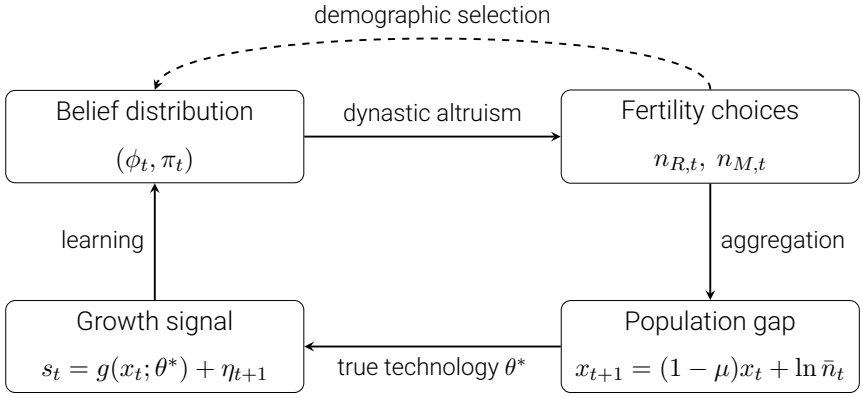
- When $x_t = 0$, observed data cannot help distinguish between worldviews

Households, Beliefs, and Transmission

- Two types: share ϕ_t Romerians ($\theta_R > 0$), $1 - \phi_t$ Malthusians ($\theta_M < 0$)
- Each acts on its worldview as if certain
- Social credence π_t: culturally shared posterior, updated by Bayes from growth outcomes $s_t = g(x_t; \theta^*) + \eta_{t+1}$
- Belief distribution evolves via two channels:

$$\phi_{t+1} = \underbrace{\lambda\, \phi_t^{birth}}_{\text{cultural transmission}} + \underbrace{(1-\lambda)\, \pi_{t+1}}_{\text{learning-based recruitment}}$$

The Belief–Fertility–Growth Feedback Loop



- Near $x = 0$: both feedback channels into beliefs shut down together

Preferences: Barro–Becker Dynasties

why these preferences

- Dynastic utility:

$$U_{it} = \frac{c_{it}^{1-\sigma}}{1-\sigma} + \beta\, n_{it}^{1-\varepsilon}\, \mathbb{E}_{it}\big[V_{i,t+1}\big], \qquad \sigma, \varepsilon \in (0,1)$$

- Time cost $\psi_\sigma(n)$ constructed so marginal cost of a child is exactly linear: $(1-\psi_\sigma)^{-\sigma}\psi'_\sigma = \gamma n$
- Consequence: TFP level cancels from the fertility FOC
  - → level channel ("income supports children") shut down by construction
  - → beliefs matter only via growth forecasts — where the disagreement lives

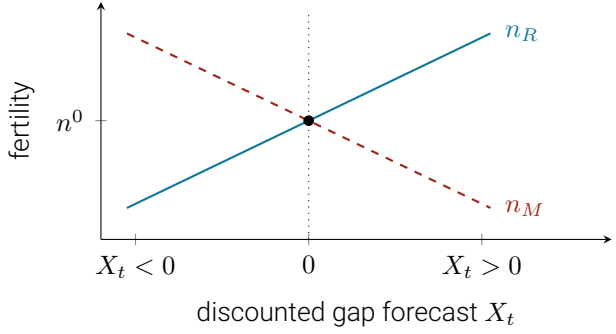
Optimal Fertility Choice

- FOC (TFP cancelled): $\gamma n_j^{1+\varepsilon} = \beta(1-\varepsilon)\,\mathbb{E}_j[V_j']/A^{1-\sigma}$
- Lemma: at the dormant point $(x, \bar{n}^e) = (0, 1)$, the FOC is belief-free: both types choose the same n^0
- Intuition: beliefs act only on forecasts of the gap
  - → gap is zero and expected to stay zero ⇒ both types forecast the same future
  - → disagreement exists but has nothing to act on
- Everything a worldview operates on is the discounted gap forecast:

$$X_t \equiv \mathbb{E}_t\left[\sum_{k\geq 0}\delta^k x_{t+k}\right] = \frac{x_t + \frac{\delta}{1-\delta}\ln\bar{n}^e}{1-(1-\mu)\delta}$$

Result 1: State-Dependent Fertility Ranking

$$n_{R,t} - n_{M,t} \;=\; K\,(1-\sigma)\,(\theta_R - \theta_M)\,\bar{w}^0\,X_t \;+\; O(2)$$

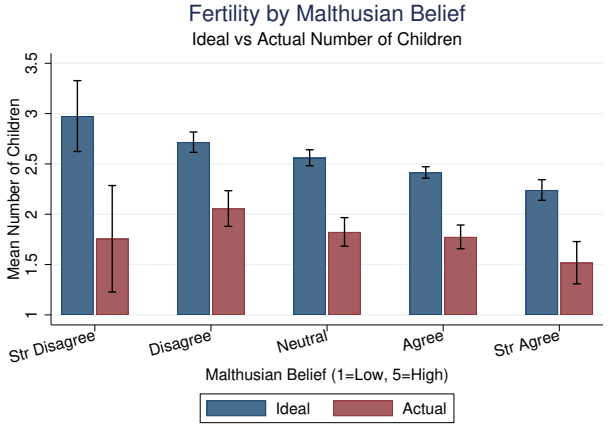


- $X_t > 0$ (growing world): Romerians out-reproduce; $X_t < 0$: ranking flips
- At $X_t = 0$: heterogeneity behaviorally dormant

Correlational Between Belief and Fertility

proxy regressions

- GSS 2000 & 2010 ($N = 1{,}822$): agree/disagree "Earth cannot continue to support population growth" – 55% Malthusian
- Malthusians desire 0.27 fewer children (ideal) and have 0.29 fewer (actual)
- Gradient robust to age, education, sex, year, completed fertility



Malthusian Ideas Move High-Stakes Behavior

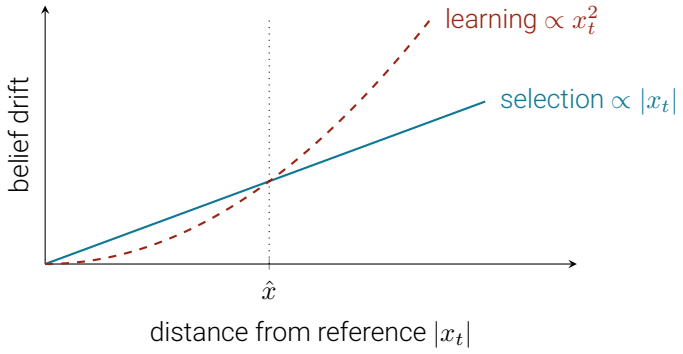
- Robertson: British Indian officials trained at Haileybury, where Malthus himself taught political economy
- Malthus's abrupt death $\Rightarrow$ replaced by Richard Jones (a critic) $\Rightarrow$ quasi-exogenous variation in doctrine across cohorts
- Officials taught by Malthus provided systematically less famine relief, decades later
- Three features: exogenous assignment, costly behavior (not cheap talk), decades-long durability
- Complements GSS: clean identification of the belief channel, though in bureaucratic relief rather than fertility

Strategic Structure

regions multiplicity

- Households atomistic, but optimal fertility depends on forecast of aggregate fertility (via the future gap)
- Finding 1: Romerian fertility is a strategic complement while Malthusian a substitute
- Finding 2: multiplicity requires $\tilde{\theta}_R \gtrsim 10.4$ at baseline $\Rightarrow$ nothing downstream depends much on selection

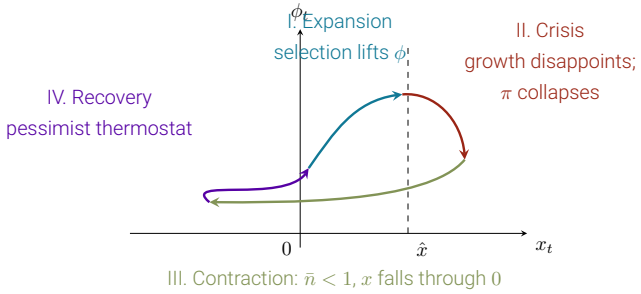
Two Engines of Belief Change



- Selection favors trajectory-optimists — vanishes linearly
- Learning favors the truth — vanishes quadratically
- Near reference: selection dominates; far away: learning dominates; at $x = 0$: both exactly zero

Malthusian World: Boom-Bust Cycles

cycle mechanics



- Selection and learning oppose above the reference $\Rightarrow$ tug-of-war
- Busts reinforced by selection; recoveries engineered by pessimists (they raise fertility when $x < 0$)

Romerian World: The Dormant Trap

details

- At $x = 0$, both views agree on growth $\Rightarrow$ zero info $\Rightarrow$ identical fertility $\Rightarrow$ wrong beliefs can survive forever
- Fertility slightly above replacement $\Rightarrow$ composition slowly shift toward Romerians $\Rightarrow$ trap breaks permanently
- Fertility slightly below replacement $\Rightarrow$ deeper pessimism $\Rightarrow$ signals get quieter $\Rightarrow$ deepening spiral
- Key asymmetry: optimism eventually exposes itself; pessimism hides the evidence that would correct it

Pre-Industrial Era: Informative Depopulation

evidence

- Pre-1800: Malthusian world, $x \approx 0$, Malthusian beliefs dominant $\phi \approx 0$
- The Black Death (1347–51): largest pre-modern demographic shock
  - $\rightarrow$ deep excursion into $x < 0 \Rightarrow$ signal informativeness $\mathcal{I}_t$ high
  - $\rightarrow$ above-trend wage growth observed (Clark, 2007) $\Rightarrow$ strong evidence for θ_M $\Rightarrow \pi_t$ collapsed toward Malthusian
- Recovery: Malthusians are high-fertility at $x < 0$ (thermostat) $\Rightarrow$ repopulated, undoing wage gains
- **Self-sealing property**: every state visited produced either
  - $\rightarrow$ silence at the reference ($x \approx 0$), or
  - $\rightarrow$ confirmation of pessimism (away from zero)
- On the eve of transition, four centuries of evidence pointed the wrong way about the world that was coming

The Escape: Industrial Revolution

trap mechanics

- Puzzle: why the long delay between usable knowledge and takeoff?
- Model: at $x \approx 0$, a Romerian world looks exactly like a Malthusian one
- Two escape channels, both present in the historical literature:
  1. **Compositional selection**: if $n^0 > 1$, small $x^* > 0 \Rightarrow$ selection slowly favors Romerians $\Rightarrow \phi$ drifts up until the trap destabilizes (Galor–Moav logic)
  2. **Cultural shift** (Mokyr 2016): Industrial Enlightenment = exogenous surge of optimism about progress, not from macro data but from ideas
- Once escaped, self-cementing: sustained growth keeps data informative, truth locks in

The Modern Fertility Decline: Three Readings

- Fertility below replacement across the developed world
- Three configurations of (θ^*, ϕ_t, x_t):
  1. Trap entry: truth $\theta_R > 0$, but pessimism spreads (overpopulation alarm, climate) $\Rightarrow \bar{n} \to 1$, entering the deepening spiral from above
  2. Correct learning: ideas harder to find (Bloom et al. 2020) $\Rightarrow$ observed weak growth at high x is informative $\Rightarrow$ low fertility is efficient
  3. Orthogonal forces: quantity–quality tradeoff dominates; beliefs epiphenomenal (though GSS gradient survives controls)
- Identification: do beliefs track narratives (R1) or productivity news (R2)?
- Opposite policy implications: pessimism to be fought vs. accommodated

Unconventional Family Policy

welfare

- Planner observes noisy $\hat{\theta}$, announces z with credibility τ_A
- Operates on beliefs, not the price of children $\Rightarrow$ closest analogue: Delphic forward guidance
- Three channels:
  1. Information provision (shifts π, recruits next generation)
  2. Equilibrium selection (multiplicity regions)
  3. Expectation coordination at the reference: raising expected $\bar{n}$ raises $X_t \Rightarrow$ reactivates the dormant differential and both engines
- Decentralized fertility too low in a Romerian world: scale externality + head-counting wedge (planner counts heads, dynasties weight $n^{1-\varepsilon}$)

What to Say, and the Planner's Dilemma

formal results

- Optimal announcement depends on the welfare criterion:

$$\mu_a^{dyn} = \hat{\theta} \;<\; \mu_a^{avg} \;<\; \mu_a^{tot} = \hat{\theta} + \chi^{tot}$$

  → dynastic planner: truthful (unanimity)

  → utilitarian planners: optimism shade in Romerian worlds, closing fertility wedges with the only instrument available

The Planner's Dilemma

Public information is most valuable in the trap — but the trap starves the planner of evidence.

Conclusion

- Disagreement about the sign of population scale effects generates:
  - → state-dependent fertility rankings (validated in GSS)
  - → boom-bust cycles in Malthusian worlds
  - → an absorbing dormant trap in Romerian worlds
- Pessimism delays take-off as optimism self-undermines while pessimism self-protects
- Unconventional family policy, but subject to the planner's dilemma
- Next: causal identification, gradient reversal in depopulating contexts, quantitative implementation

Ecological vs. Economic Malthusianism

back

- GSS question is in environment modules: captures ecological concern (resource depletion, climate)
- For the fertility margin, distinction is second-order: A_t is broad TFP, and both idioms point to $\theta < 0$, a poorer future for descendants
- For historical claims the distinction is substantive; the survey only validates the belief-to-fertility arrow

Regression Evidence (Details)

back

	Ideal Fertility	Actual Fertility
Malthusian (binary)	-0.268^{***}	-0.292^{***}
	(0.041)	(0.066)
Malthusian (1–5 scale)	-0.153^{***}	-0.146^{***}
	(0.021)	(0.033)
Controls + Year FE	Yes	Yes
Observations	1,822	1,822

Completed fertility, heterogeneity by education, and further robustness are available in the paper.

Gradient Holds Within Education Groups

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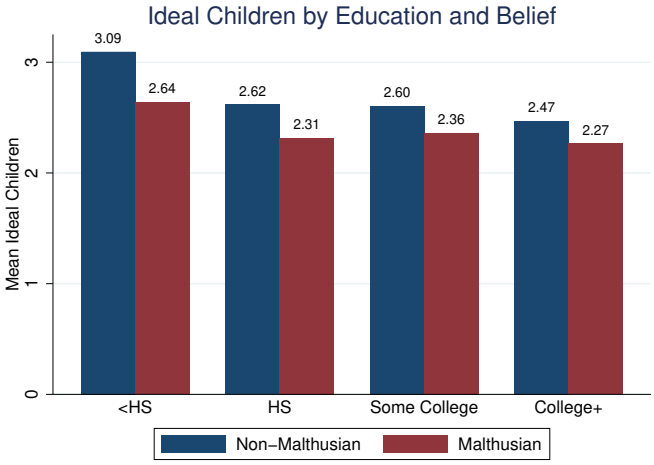

Completed Fertility

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	Full Sample	Completed	Not Yet Completed
Malthusian	-0.292^{***}	-0.257^{**}	-0.288^{***}
	(0.066)	(0.109)	(0.079)
Observations	1,822	848	974

- Completed = women 45+, men 50+; all controls included
- Estimate stable: not driven by incomplete childbearing among the young

Heterogeneity by Education

back

	Ideal		Actual	
	HS or Less	College+	HS or Less	College+
Malthusian	-0.318^{***}	-0.235^{***}	-0.209^{*}	-0.392^{***}
	(0.069)	(0.049)	(0.115)	(0.081)

- Preferences: gradient across the whole education distribution
- Behavior: stronger among the educated — perhaps fewer constraints on hitting fertility targets

Why Each Preference Ingredient Is Load-Bearing

back

- Time cost + CRRA: TFP level cancels; income-supports-children channel off by construction
- $\sigma < 1$: required for positive dynastic value of children; mirror $\sigma > 1$ (with $\varepsilon > 1$) flips sign — rejected by data
- $\varepsilon \in (0, 1)$: well-posed fertility problem; becomes the head-counting wedge in the welfare analysis
- Boundedness: $\beta \kappa_\sigma n_{\max}^{1-\varepsilon} < 1$ ensures finite value; baseline $\beta^\dagger \approx 0.22$ from $n^0 = 1$

Equilibrium Regions

back

Region	Condition	$\rho(\phi)$	Equilibrium
Malthusian-dominated	$\phi < \phi^*$	< 0	Unique
Contraction	$\phi^* \leq \phi \leq \phi^{**}$	$[0, 1)$	Unique
Static multiplicity	$\phi > \phi^{**}$, $d_R > 1$	> 1	Multiple; RD selection

- $\rho(\phi) = \phi d_R + (1 - \phi) d_M$; pessimists' substitutability enlarges uniqueness regions
- Multiplicity requires $\tilde{\theta}_R \gtrsim 10.4$ at baseline $\Rightarrow$ empty
- Kremer-style calibrations ($\mu \to 0$): global-games perturbation selects risk-dominant cutoff ϕ^{rd}

Expectational Multiplicity at the Reference

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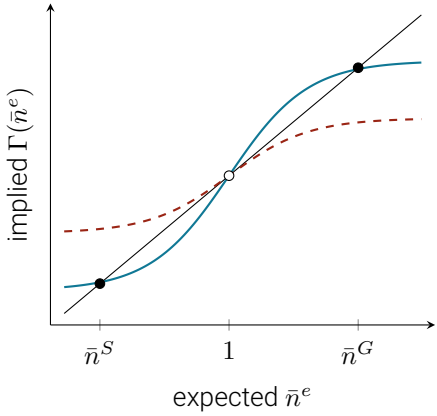

- $\hat{b}(\phi) < 1$ (dashed): reference determinate; $\hat{b}(\phi) > 1$ (solid): stagnation $\bar{n}^S$ and growth $\bar{n}^G$ flank an unstable reference
- Threshold ordering: trap ($\bar{\theta}_\phi \approx 1.1$) < expectational ($\approx 7.7$) < static ($\approx 10.4$) $\Rightarrow$ dynamic margin is key

Dormant Trap: Formal Statement

back

- Exact dormant point: $x_0 = 0 \Rightarrow x_t = 0, \mathcal{I}_t = 0, \pi_t = \pi_0, n_R = n_M = 1$; wrong beliefs never corrected
- Near-dormant: $|x_t| \leq \rho^t |x_0|$, $\sum_t \mathcal{I}_t$ finite, $\pi_t \to \pi_\infty$ with prob. $\geq 1 - C|x_0|/\varsigma$
- Generic $\nu \neq 0$: quasi-steady gap $x^* = \nu/(\mu - \bar{b})$;

$$\mathbb{E}[T^{esc}] = \Omega(|\nu|^{-1}) \text{ if } \nu > 0, \qquad \Omega(\nu^{-2}) \text{ if } \nu < 0$$

- Both escape engines (selection & learning) vanish with $|x_t|$; stagnation switches them off

Trap Regimes Diagram

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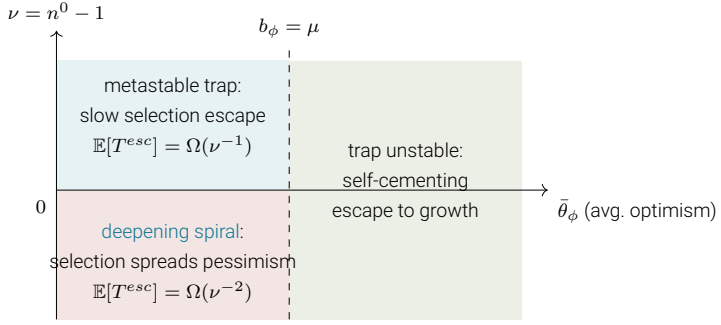

Conditional Convergence in Romerian Worlds

back

- On event $\{\liminf_t \bar{n}_t \geq 1 + \epsilon\}$: $\liminf x_t > 0$, infinite total information; $\pi_t \to 1$, $\phi_t \to 1$, $g_t \to$ Romerian BGP
- Complement event has positive probability (probability one from deep inside the trap)
- Truth emerges only along paths that generate evidence

Cycle Mechanics and Comparative Statics

back

- Maps onto Beaudry–Galizia–Portier (2020) conditions: strategic complementarities, accumulation variable that depresses further investment (x_t under θ_M), sluggish adjustment (μ)
- Learning strength determines cycle character:
  - $\rightarrow$ weak learning: long expansions
  - $\rightarrow$ strong learning: quick correction, Malthusian quasi-steady state
  - $\rightarrow$ intermediate: pronounced recurrent cycles

Microfoundation and the Kremer Channels

back

- Jones idea production: $\ln(A_{t+1}/A_t) = \nu + \lambda \ln N_t - \omega \ln A_t + \eta_{t+1}$; define x_t to get $\mu = \omega\theta$
- Limit $\mu \to 0$ reproduces Kremer–Romer strong-scale-effects; trap reverts to slow learning
- Absorbing trap is a genuine semi-endogenous phenomenon
- θ encodes growth channel net of congestion; level channel neutralized by preferences

Welfare Criteria and Decomposition

back

- Three criteria: dynastic, total utilitarian, average utilitarian
- First best vs. decentralized (Romerian world): $n^{FB} > n^{CB}$ from two wedges
  - $\rightarrow$ scale externality: no household internalizes children's effect on future gap
  - $\rightarrow$ head-counting: planner weights descendants linearly; dynasties weight by $n^{1-\varepsilon}$
- Welfare gap decomposition: Δ_0 (head-count), Δ_1 (externality), Δ_2 (mean bias), Δ_3 (dispersion)
- $\Delta_3 = O(X^2)$: disagreement costless exactly where it is incorrigible
- Announcements move Δ_2 and Δ_3 only

Optimal Announcements: Formal Results

back

- Dynastic: truthful, maximally informative — each type expects vindication; shading is zero-sum
- Total utilitarian: $\chi^{tot} = \frac{\Omega PG}{c+\Omega P^2} > 0$ whenever the fertility wedge is positive; shade hump-shaped in pass-through P, peak at $P = \sqrt{c/\Omega}$
- Ordering (Romerian world): $\mu_a^{dyn} = \hat{\theta} < \mu_a^{avg} < \mu_a^{tot}$
- In the trap: $\mathcal{V}^{trap} = pP^{esc}\Delta W^{esc} - (1-p)P^{mis}\Delta W^{mis} - P^{deepen}\Delta W^{deepen}$
  - → downside is $O(x_0^2)$; modest precision threshold
  - → at high precision, planner's own noise binds — formal content of the dilemma

Distinguishing the Historical Interpretations

back

- Genuine regime change: centuries of flat real wages (Clark); structural breaks in Unified Growth Theory
- Informational escape: Kremer (1993) shows rising population over millennia; trap reading says scale effect always present, invisible at $x \approx 0$
- Trap reading predictions: pessimism favored in below-reference episodes; takeoff preceded by mortality-driven net reproduction rise, not productivity acceleration

Escape Mechanics: Why n^0 Matters So Much

back

- Dormant-point fertility $n^0 = 1 + \nu$ determines direction of drift
- $\nu > 0$: gap $x^* > 0$, selection slowly favors Romerians; once $b_\phi > \mu$, escape is self-cementing
- $\nu < 0$: gap $x^* < 0$, selection favors Malthusians; false belief spreads, signals get quieter; $\mathbb{E}[T^{esc}] = \Omega(\nu^{-2})$
- Escape trigger is demographic (n^0, mortality), not a productivity acceleration

Robustness: What Would Break the Results

back

- No common crossing: learning always active; trap vanishes
- No separation: capped informativeness; crisis and self-cementing escape weaken
- $\sigma > 1$: all rankings reverse, gradient flips — rejected by data
- $\mu \to 0$: trap reverts to slow learning; absorbing character is semi-endogenous
- Vanishing noise at $x = 0$: trap dissolves if $\sigma_\eta^2(x)$ shrinks as fast as the gap
- Multiple crossings: several dormant points; local results survive

Key Thresholds at Baseline

back

Threshold	Condition	Baseline value
Trap destabilization	$b_\phi > \mu$	$\bar{\theta}_\phi \gtrsim 1.1$
Expectational indeterminacy	$\hat{b}(\phi) > 1$	$\bar{\theta}_\phi \gtrsim 7.7$
Static multiplicity	$d_R > 1$	$\tilde{\theta}_R \gtrsim 10.4$

- Ordering implies the relevant coordination margin near the reference is the dynamic one (trap destabilization)
- Expectational and static thresholds linked by $1/(1-\delta^0) \approx 1.34$