From Labor to Capital

Artificial General Intelligence, General Equilibrium, and Asset Valuation

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The question

- Restrepo2025): with AGI every task can be done by compute; as compute grows, output becomes linear in compute, wages converge to the cost of the compute that replaces the worker, and the labor share goes to zero. "We won't be missed."
- This paper asks what happens to the *other side* of the ledger:
  - Who receives the income that leaves labor — compute owners, or the owners of what compute cannot reproduce?
  - What is that income *worth* as an asset?
  - How does the ownership of wealth evolve, and what do policies that tax or share it do?
- One change in production: compute is a reproducible, priced, depreciating capital good that needs energy and works alongside structures and land. Everything on the household side is new.

Preview of results

1. The labor-share asymptote is robust: it needs only within-task substitutability (Proposition 1).
2. The wage-level result is not: with gross complements ($\sigma < 1$) and cheap compute, wages go to zero in level; with a floor on the compute price, the wage equals the user cost of the replacement compute.
3. Income goes to the *scarcest* input: compute if it stays scarce, otherwise land / sites / structures.
4. Capital's share can rise while the wealth-to-income ratio falls: compute is a short-duration, cheapening asset.
5. A growth boom raises the real rate; with $\gamma > 1$ valuation ratios of long-duration claims *fall* during the boom.
6. Quantitatively (conditional scenarios, 2026–2100): labor share 0.283 in 2050 and 0.000 in 2100 in the baseline; real return peaks at 40.5% in 2060; wealth/GDP falls to 2.7 in 2042 before land takes over.

What is new relative to the source

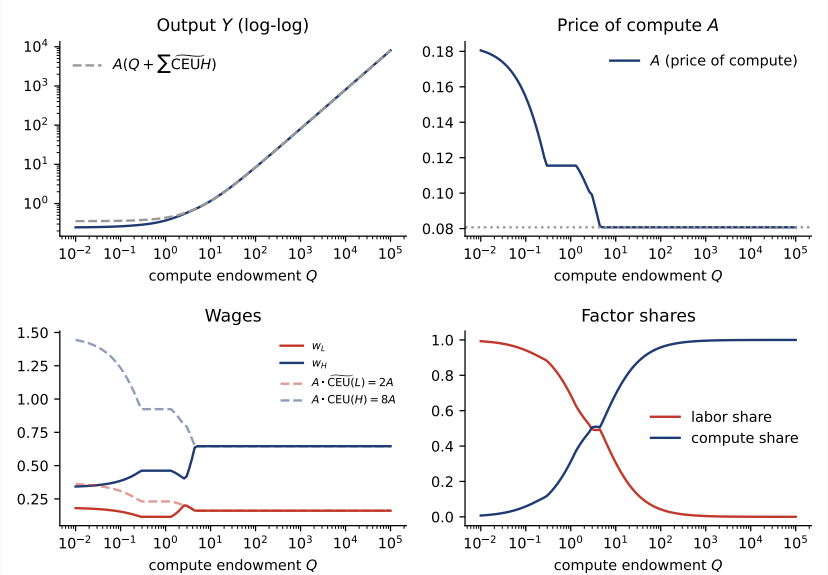
	Restrepo (2025)	This paper
Compute	exogenous endowment $Q_t \to \infty$	capital: price p_t^Q (falls to a floor), $\delta_Q = 0.25$, energy ε_t per unit, investment with adjustment costs
Other inputs	none (all "work")	structures, land, energy sites in a nested CES (σ_N, σ_T)
Households	none (wage bill only)	capitalists' Euler equation prices claims; heterogeneous households own them
Results	P1–P11, heuristic arguments	8 propositions with proofs; regime map; valuation; policy
Numbers	flops	calibrated 2026 base, 26 scenarios to 2300, checks and tests

Restrepo (2025) in one slide

$$X_t(\omega) = L_t(\omega) + \frac{Q_t(\omega)}{\alpha_t(\omega)}, \qquad Y_t = F(\{X_t(\omega)\}), \qquad \sum_{\omega} Q_t(\omega) \leq Q_t$$

- Premise 1 (AGI): every $\alpha_t(\omega)$ becomes finite. Premise 2: $Q_t \to \infty$.
- Bottleneck vs accessory work; all bottlenecks eventually automated (P1).
- $Y \to A[Q + \sum_s \widetilde{\mathrm{CEU}}(s) H_s]$, $\mathrm{CEU}(s) = \max_{\omega \in \Omega(s)} \alpha(\omega)$ (P2); growth = growth of compute (P3).
- $w_s \to A \cdot \widetilde{\mathrm{CEU}}(s)$ (P4); labor share $\to 0$ (P5); total wages higher than pre-AGI (P6, "unless a finite resource is also needed").
- No capital, no prices of compute, no households, no proofs (July 2025 draft).

Replication



The model: production

- Four bottleneck tasks, two skills, $X_i = L_i + Q_i/\alpha_{i,t}$, CES $\sigma_B = 0.5$.
- $V = \mathrm{CES}(K^N, X_B; \sigma_N)$, $Y = Z\,\mathrm{CES}(T, E^Y, V; \sigma_T)$: structures, land, energy are the physical complements.
- Compute: capacity K^Q bought at p_t^Q (falls at g_{pQ} to a floor), depreciates at $\delta_Q = 0.25$, needs ε_t energy per unit (falls to a floor). Idle if energy cost exceeds marginal value.
- Energy from energy capital and a fixed resource; housing from structures and residential land.
- Four Tobin's-q investment problems; perfect foresight; national accounting identity tested at every date.

The model: households and assets

- Two-class: capitalists (CRRA, $\gamma = 2$) own the fund that holds all claims; workers hand-to-mouth.
- Heterogeneous-agent layer: skills $\times$ discount types $\times$ productivity, borrowing constraint, one asset; GE by relaxation on the return path.
- Pricing: $V_t^k = q_t^k K_{t+1}^k$, land by backward recursion, aggregate wealth $W_t = \sum_k V_t^k + P_t^T T + P_t^{TH} T^H$.
- Exact Campbell–Shiller decomposition along deterministic paths: cash-flow vs discount-rate channels.

Proposition 1: the labor share result is robust

Once every bottleneck task is automated, $X_B = \mathcal{B}\,\widetilde{Q}$ with $\widetilde{Q} = Q + \sum_s \widetilde{\mathrm{CEU}}(s) H_s$ and $w_s = A\,\widetilde{\mathrm{CEU}}(s)$. For *any* constant-returns F increasing in X_B:

$$\frac{\sum_s w_s H_s}{Y} \leq \frac{\sum_s \widetilde{\mathrm{CEU}}(s) H_s}{Q + \sum_s \widetilde{\mathrm{CEU}}(s) H_s} \to 0.$$

Only within-task perfect substitutability matters. What the rest of production determines is the *level* of wages and *who* gets the income.

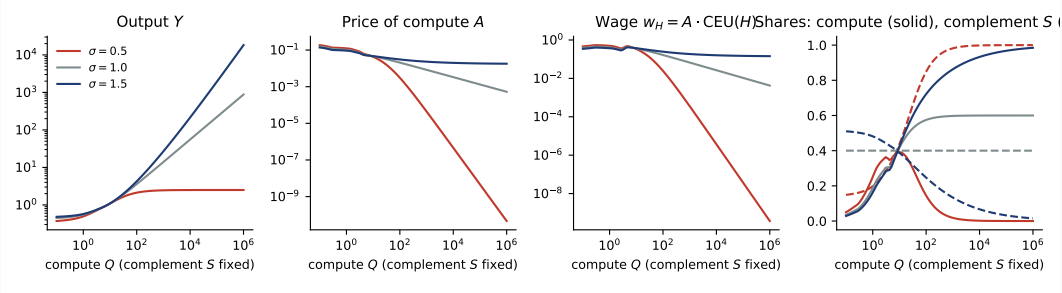
Proposition 2: scarce complement, S fixed

$Y = Z[\nu X_B^{\rho} + (1-\nu)S^{\rho}]^{1/\rho}$, $Q \to \infty$:

	$\sigma > 1$	$\sigma = 1$	$\sigma < 1$
Price of compute A	$\to Z\nu^{1/\rho}\mathcal{B} > 0$	$\to 0$	$\to 0$
Wages	positive	$\to 0$	$\to 0$
Compute share	$\to 1$	ν	$\to 0$
Output	linear in Q	$\propto Q^{\nu}$	bounded by S

Restrepo's Propositions 2–6 are the first column. In the other two, *total* wages go to zero: the "no-AGI zone" argument fails exactly where the source says it would.

Regime map (numerical illustration)



Propositions 3–5: compute as capital

- Floor on the compute price $\bar{p} > 0$, reproducible S: balanced AGI growth with

$$A = (r + \delta_Q)\bar{p}, \qquad w_s = (r + \delta_Q)\,\bar{p}\,\widetilde{\mathrm{CEU}}(s) > 0, \qquad s_Q \in (0, 1).$$

  The wage is the user cost of the compute that replaces you.

- $p^Q \to 0$: $\sigma > 1$ explosive; $\sigma \leq 1$: AK in S, $A \to 0$, $w \to 0$, value of compute $\to 0$.
- Energy bound $Q \leq \bar{E}/\bar{\varepsilon}$: labor share converges to a positive limit — Premise 2 fails.

Proposition 6: wealth-to-income

$$\frac{W}{Y} = \sum_k \frac{s_k(1+g)}{(1+r)(1+\pi_k) - (1-\delta_k)} + \frac{s_T(1+g_T)}{r - g_T}$$

- Reallocating income shares from land/structures to compute *lowers* W/Y: compute depreciates at 25% and its price falls.
- Price–earnings of compute at $r = 0.035,\ \delta_Q = 0.25,\ \pi_Q = 0.15$: about 2.3; structures 8; land $1/(r-g)$.
- "All income to compute" and "asset values explode" are different claims.

Proposition 7: the discount-rate channel

With $1 + r = \beta^{-1}(1 + g)^{\gamma}$, a claim growing at g has

$$\frac{P}{D} = \frac{1 + g}{\beta^{-1}(1 + g)^{\gamma} - (1 + g)}, \qquad \frac{\partial \log(P/D)}{\partial \log(1 + g)} \text{ has the sign of } 1 - \gamma.$$

An AI growth boom raises the real rate; with $\gamma > 1$ price–rent and price–earnings ratios of long-duration claims fall even as cash flows and prices rise.

Proposition 8: wages and taxes in the limit

$$w_s = \widetilde{\mathrm{CEU}}(s)\Big[\frac{(r+\delta_Q)\bar{p}}{1-\tau_Q} + \varepsilon P_E\Big]$$

A compute tax raises wages one-for-one with the tax-inclusive user cost, at the cost of output; a land tax changes nothing but the land price.

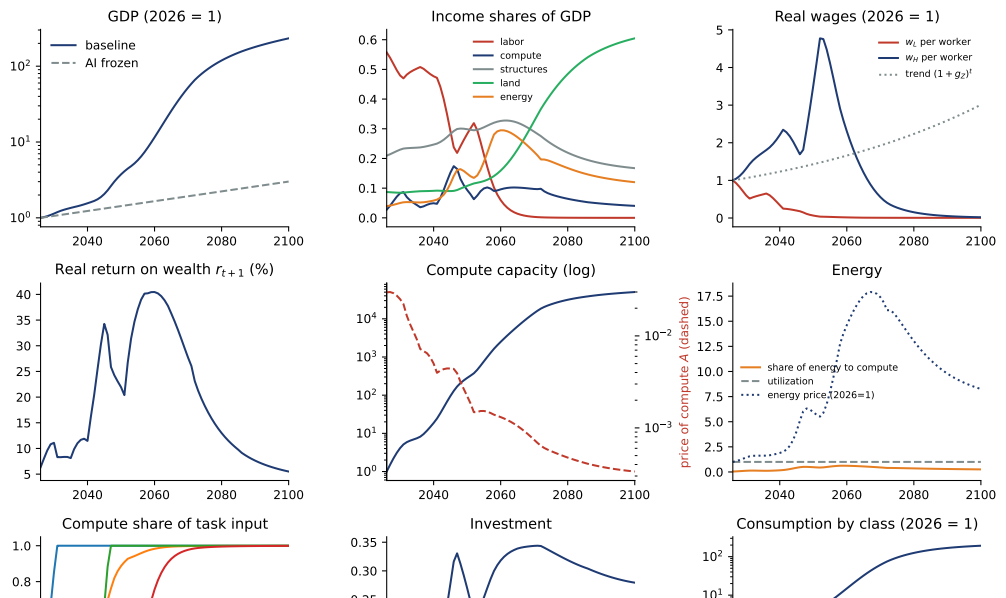
Calibration (2026, US)

- Labor share 0.568 (PWT), residential structures 1.17 GDP, $\delta_N = 0.089$, $\delta_H = 0.023$ (BEA via FRED); compute capital 6.2% of GDP (IPE investment capitalized); data centers 4.4% of electricity (LBNL).
- $r^* = 3.5\%$, $g_Z = 1.5\%$, $\gamma = 2$; $\sigma_B = 0.5$, $\sigma_N = 0.7$, $\sigma_T = 0.6$ (literature).
- Scenario inputs: $g_\alpha = 0.10$, $g_{pQ} = 0.15$ (Epoch: 0.34), floor 10^{-2}, $g_\varepsilon = 0.10$.
- Implied: $\alpha_{1,0} = 14.9$ (compute does 22% of the routine task in 2026).
- 162 retrieved targets with URLs and hashes; nothing typed from memory.

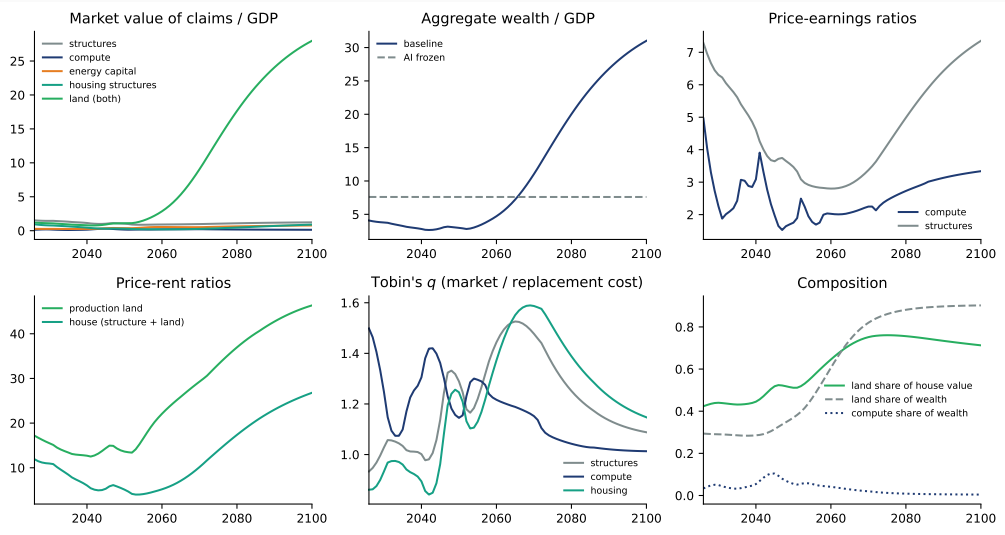
Sequence of automation in the baseline

- Routine task automated from 2029, cognitive tasks from 2043 and 2045, expert task from 2057 — equilibrium dates ($A_t \alpha_{i,t} < w_{s,t}$), not feasibility dates.
- Lower skill: compute-binding transition (wage falls in steps, no jump): 0.60 (2030), 0.34 (2040), 0.06 (2050) of its 2026 level.
- Higher skill: technology-binding transition — premium of the last-automated skill, 3.51× in 2050, then collapse (0.02 in 2100).
- Labor share 0.480 (2030), 0.283 (2050), 0.001 (2075).
- GDP ×3.7 by 2050, ×233.0 by 2100; growth peaks at 16.3% in 2062; then back to trend — land binds.

Baseline transition



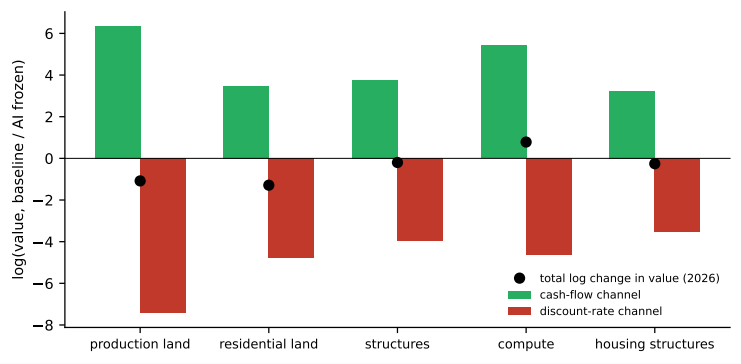
Baseline: valuation



Baseline in numbers

	2026	2030	2040	2050	2075	2100
GDP (2026 = 1)	1.00	1.14	1.56	3.74	85.77	232.96
GDP growth (%)	2.2	4.5	3.5	9.7	7.8	2.3
Labor share	0.557	0.480	0.477	0.283	0.001	0.000
Compute income share	0.027	0.083	0.049	0.094	0.079	0.040
Structures share	0.210	0.230	0.247	0.299	0.250	0.167
Land share (both)	0.087	0.085	0.091	0.108	0.417	0.605
Energy share	0.039	0.050	0.058	0.149	0.190	0.120
Wage L per worker (2026 = 1)	1.000	0.600	0.342	0.065	0.005	0.005
Wage H per worker (2026 = 1)	1.000	1.314	2.206	3.515	0.275	0.020
Real return r (%)	6.3	11.1	11.5	21.9	18.3	5.5
Compute capacity (2026 = 1)	1.0	4.1	18.7	283.0	23,934	50,330
Value of compute / GDP	0.136	0.187	0.152	0.164	0.193	0.135
Wealth / GDP	4.08	3.78	2.81	2.97	15.63	31.01
Land price–rent ratio	17.2	15.5	12.7	13.6	33.1	46.3
House price–rent ratio	11.9	11.0	6.0	5.1	13.9	26.8
P/E compute	5.0	2.3	3.1	1.8	2.4	3.3
P/E structures	7.3	6.3	4.6	3.5	4.1	7.4
Tobin's q compute	1.50	1.25	1.31	1.14	1.07	1.01
Share of energy used by compute	0.044	0.121	0.166	0.474	0.390	0.256
Investment / GDP	0.153	0.219	0.170	0.270	0.334	0.279
Workers' consumption / GDP	0.467	0.402	0.400	0.237	0.001	0.000
Tasks using compute (of 4)	1	1	2	3	4	4

Cash-flow vs discount-rate channels (2026 values, baseline vs AI frozen)



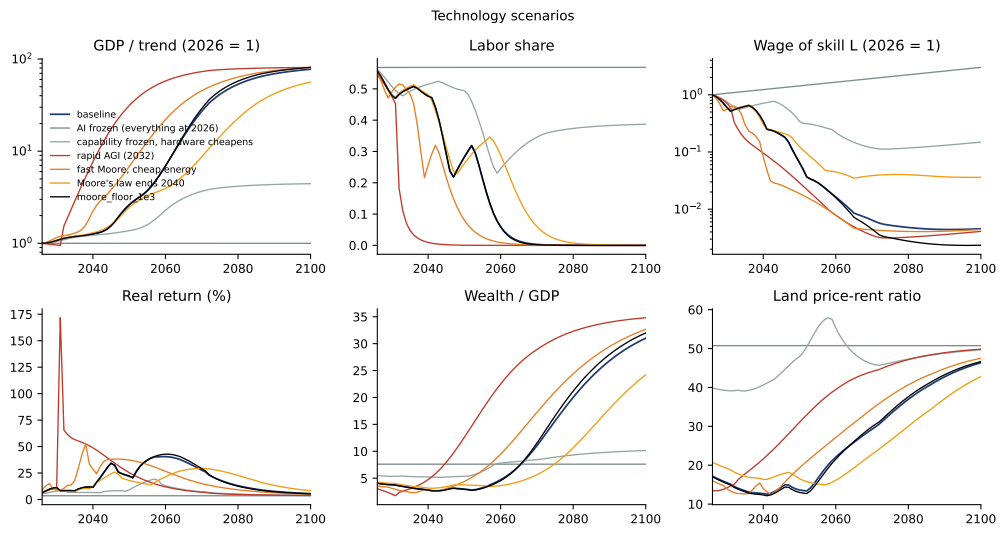
The balance sheet in words

- 2026–2042: capital's share rises, wealth/GDP *falls* from 4.1 to 2.7 — high real rate, long-duration claims discounted (land P/R from 17 to 12.5), compute capitalized at P/E ≈ 2.
- Compute never exceeds one fifth of GDP in value; its share of wealth peaks near 10% around 2045.
- After 2050: land captures 0.605 of income, wealth/GDP rises to 31.0 by 2100, land is 90% of wealth.
- Piketty-like end state by a non-Piketty route: scarcity of what compute cannot make, not $r > g$ on reproducible capital.
- Cash-flow and discount-rate channels of the same order, opposite signs (next slide).

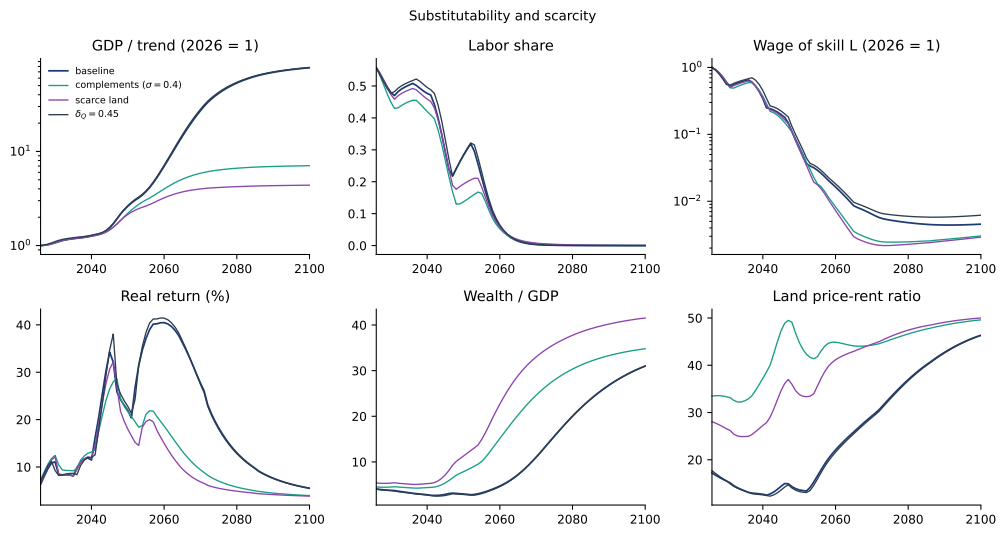
Scenario catalogue (2050 / 2100)

	2050								2100							
Scenario	Labor share	w_L (2026=1)	GDP (2026=1)	r (%)	W/GDP	Land P/R	V^Q/GDP	C_W/GDP	Labor share	w_L (2026=1)	GDP (2026=1)	r (%)	W/GDP	Land P/R	V^Q/GDP	C_W/GDP
Baseline	0.283	0.065	3.7	21.9	3.0	13.6	0.164	0.237	0.000	0.005	233.0	5.5	31.0	46.3	0.135	0.000
AI frozen (everything at 2026)	0.569	1.431	1.4	3.5	7.6	50.8	0.063	0.475	0.569	3.013	3.0	3.5	7.6	50.8	0.063	0.475
Capability frozen, hardware cheapens	0.494	0.343	2.0	9.1	5.3	47.9	0.168	0.414	0.387	0.149	13.4	3.9	10.1	49.7	0.458	0.324
Rapid AGI (all tasks in 2032)	0.001	0.029	44.7	28.3	12.6	31.0	0.095	0.001	0.000	0.004	243.9	3.8	34.8	49.8	0.132	0.000
Slow capability ($g_{\Omega 0} = 0.05$)	0.274	0.213	2.4	29.0	3.4	17.7	0.297	0.229	0.002	0.007	134.1	9.9	18.5	36.3	0.312	0.002
Fast capability ($g_{\Omega 0} = 0.20$)	0.066	0.029	7.5	54.2	3.8	20.8	0.169	0.056	0.000	0.004	246.3	4.0	34.1	49.1	0.132	0.000
Terminal compute requirements $\times 5$	0.274	0.071	3.6	21.6	3.1	14.5	0.182	0.229	0.000	0.022	203.5	5.0	29.4	46.6	0.221	0.000
Fast Moore ($g_{\mu Q} = 0.34$), cheap energy	0.080	0.019	9.7	37.2	4.4	19.3	0.377	0.068	0.000	0.004	244.3	5.0	32.6	47.5	0.136	0.000
Moore's law ends 2040 (floor 0.12)	0.262	0.124	3.5	18.0	3.8	16.5	0.443	0.219	0.000	0.036	169.3	8.2	24.2	42.8	0.430	0.000
Compute price floor 10^{-3}	0.282	0.065	3.7	22.1	2.9	13.0	0.164	0.236	0.000	0.002	244.1	5.3	32.0	46.6	0.021	0.000
Strong complements ($\sigma_M = \sigma_T = 0.4$)	0.137	0.063	3.2	21.7	7.9	44.9	0.121	0.115	0.000	0.003	21.2	4.0	34.8	49.6	0.033	0.000
Scarce land (share 8%, $\sigma_T = 0.4$)	0.193	0.060	3.1	18.0	11.3	33.8	0.149	0.163	0.000	0.003	13.2	3.8	41.5	50.0	0.078	0.000
Severe chip depreciation ($\delta_Q = 0.45$)	0.284	0.077	3.8	22.8	2.9	13.3	0.150	0.238	0.000	0.006	234.8	5.5	31.0	46.3	0.110	0.000
Expert task never automated	0.323	0.057	4.4	14.8	6.3	39.5	0.171	0.271	0.308	0.003	23.3	5.5	10.6	44.0	0.486	0.258
$\gamma = 1$	0.351	0.044	5.0	16.6	13.3	136.0	0.241	0.294	0.000	0.004	245.2	4.2	34.7	50.7	0.139	0.000
$\gamma = 4$	0.217	0.088	2.6	39.2	1.8	4.1	0.150	0.182	0.000	0.006	201.6	11.1	18.8	29.9	0.120	0.000

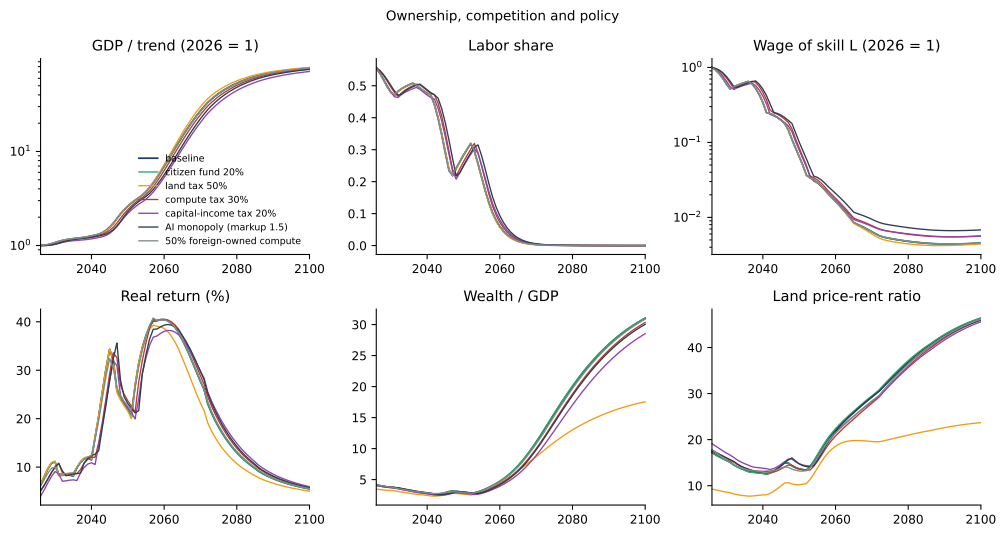
Technology scenarios



Substitutability and scarcity



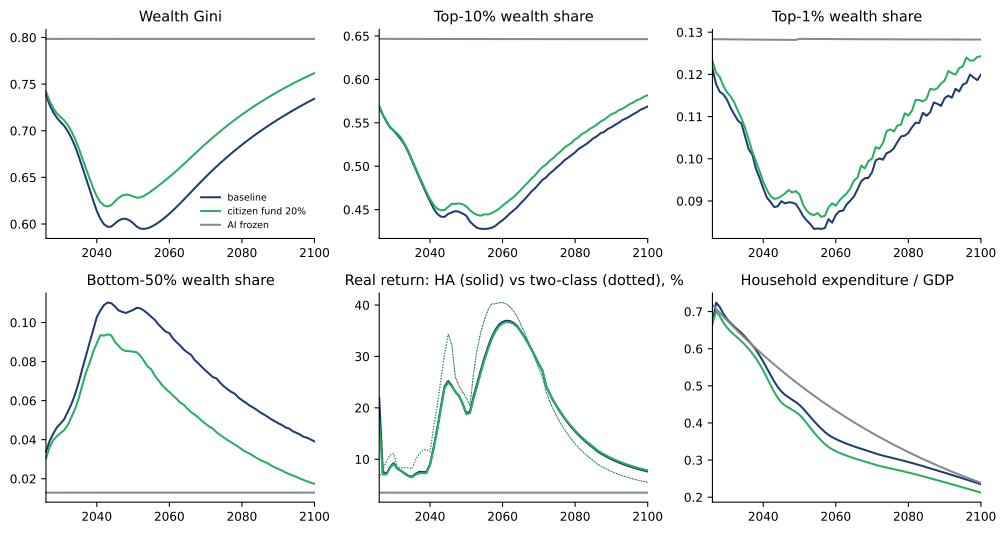
Ownership, competition and policy



Policy and welfare

Scenario	GDP 2050	GDP 2100	w_L 2050	C_W/GDP 2050	C_W/GDP 2100	CEV workers 2026–65
Baseline	3.74	233.0	0.065	0.237	0.0000	
Citizen fund (20% of equity)	3.73	233.0	0.065	0.270	0.0569	
Land tax 50%	3.75	235.8	0.064	0.283	0.2554	
Compute tax 30%	3.45	228.4	0.084	0.251	0.0126	
Capital-income tax 20%	3.13	213.5	0.079	0.334	0.1676	
AI monopoly (markup 1.5)	3.27	224.6	0.101	0.210	0.0000	
50% foreign-owned compute	3.75	232.6	0.065	0.238	0.0000	

Heterogeneous households



Numerical discipline

- Static block: concave program + Newton polish of the KKT equalities; KKT violation $< 10^{-6}$; income identity to 10^{-8}; a deliberately broken accounting fails the test.
- Dynamics: 6 unknowns per year (4 log stocks, log expenditure, r), banded Jacobian by colored finite differences, direct solve on 275 years from a partial-equilibrium guess; residuals $< 10^{-9}$; 50 extra years change the first 225 by $< 10^{-7}$.
- Base point re-calibrated for each scenario's anticipated price path (otherwise a jump at 2026 makes the system singular).
- Households: EGM, 300-point grid, non-stochastic simulation; GE by damped quasi-Newton on the return path with the household Jacobian.
- Everything reproducible with `make all`; every number in the text is a generated macro.

What would falsify the model in the next decade

- Wages of exposed occupations fall *after* the compute-equivalent cost crosses the wage, not when the technology becomes feasible.
- Margins fall in labor-intensive exposed activities (compute is competitively supplied); they rise only where a scarce complement is owned.
- Price–earnings ratios of compute-heavy capital are low and track $(1 + r)(1 + \pi_Q) - (1 - \delta_Q)$.
- Rising relative electricity prices and data-center energy shares in compute-intensive regions.

Limitations

- Perfect foresight: no risk premia; a stochastic AGI-arrival extension is sketched, not solved in full.
- The level of wages after 2060 depends on the product of the compute-price floor and terminal compute per worker — a scenario input.
- No endogenous innovation, no new-task creation beyond the reinstatement scenario, no nonhomothetic preferences.
- Heterogeneous-agent block has no return heterogeneity (top-1% share under-predicted).
- Not forecasts: conditional scenarios with every input documented.

Conclusion

- Restrepo's labor-share result survives everything; his wage-level and "income to compute" results survive only if compute stays scarce.
- When it does not, the income that labor loses goes to the owners of the scarcest complement, and wages fall to the rental price of the replacement compute.
- Asset values follow duration, not income shares: compute is capitalized at the duration of chips; land at $1/(r-g)$; a growth boom raises r and compresses valuation ratios first.
- Policy: a land tax redistributes without distortion; a compute tax raises wages at the cost of output; a citizen fund keeps workers' consumption share bounded below.

References

Restrepo, Pascual, "We Won't Be Missed: Work and Growth in the Era of AGI," July 2025. NBER conference paper f227505, Yale University, July 4, 2025.