

What Investment Data Implies about the AI Transition

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How much will AI contribute to economic growth?

- Existing answers span orders of magnitude
- [Acemoglu \(2024\)](#): TFP \uparrow ~ 0.7 pp over ten years
- [Amodei \(2024, 2026\)](#): “multiple trillions per year” of infrastructure, decades of progress in years

Approach: revealed preference from capex data.

1. **Facts.** Five firms; capex \$155B (2022) \rightarrow \$755B (2026 fcst)
2. **Model.** Two-sector economy, AI sector exposed to rare productivity booms
3. **Calibration.** 2024–2027 capex pins down boom size $\hat{\xi} \approx 0.99$
(one boom multiplies AI productivity by $e^{0.99} \approx 2.7$)
4. **Scenarios.** 2028–2029 window of elevated boom probability; aggregate valuations pin down post-window p_*
5. **Implications.** GDP, interest rates, equity premium

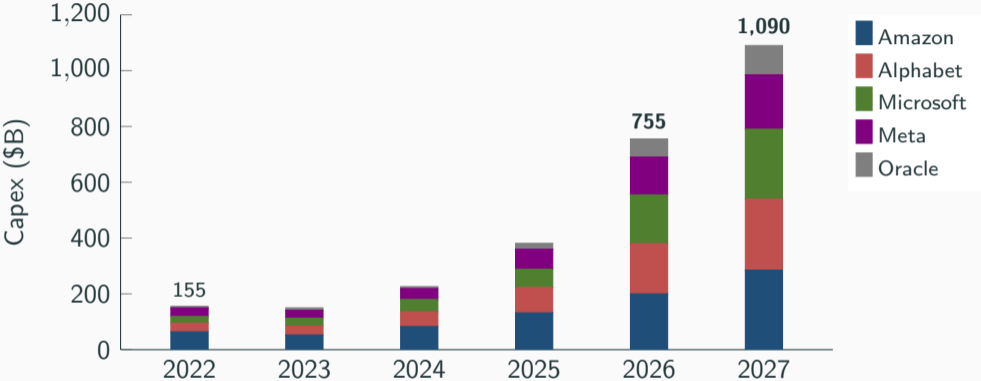
Investment facts

Five firms drive AI infrastructure capex

	2022	2023	2024	2025	2026 fcst	2027 est.
Amazon	64	53	83	132	200	285
Alphabet	31	32	53	91	180	255
Microsoft [†]	24	28	44	65	175	250
Meta	31	28	39	72	135	195
Oracle [†]	5	9	7	21	65	105
Total	155	150	226	381	755	1,090

Capital expenditure, \$ billions. *Sources:* 10-K cash-flow statements (2022–25); 8-K guidance (2026); bottom-up firm-by-firm anchors (2027).

The capex surge, visualized



Flat \$150B through 2023; tripled by 2026; nearly seven-fold by 2027.

Relative to the macroeconomy

	2022	2024	2025	2026 fcst	2027 est.
AI capex (\$B)	155	226	381	755	1,090
U.S. nominal GDP (\$T)	25.5	29.2	~30.5	~31.5	~32.4
U.S. gross priv. fixed inv. (\$T)	~4.7	~5.2	~5.4	~5.5	~5.7
Share of GDP (%)	0.6	0.8	1.2	2.4	3.4
Share of priv. fixed inv. (%)	3.3	4.3	7.1	13.7	19.2

2025 capex/GDP already exceeds the 1990s telecom peak (~1.5%).
AI capex accounted for ~1/5 of Q4 2025 real GDP growth (Pantheon).

Beyond 2027: industry projections

No firm has issued formal 2027 guidance, but filed disclosures anchor:

- Amazon \$285B ← OpenAI 2GW + Anthropic 5GW Trainium contracts
- Alphabet \$255B ← multi-GW TPU supply agreements (Q1'26 10-Q)
- Microsoft \$250B ← leases-not-yet-commenced: \$93B → \$155B → \$197B
- Meta \$195B; Oracle \$105B ← \$50B Feb'26 financing program

Two post-window scenarios in the model:

- **Moderate:** growth flattens at \$1.1T/yr (2028–29)
- **Transformative:** 50%/yr growth continues → \$1.6T (2028), \$2.5T (2029)

Musk (2026): “hundreds of GW within five years.” At \$12.5B/GW, transformative scenario \approx 196 GW/yr by 2029.

The puzzle these numbers create

At required return $\sim 15\%$, depreciation $\sim 25\%$,
\$2.5T of capex over 2024–2027 implies

either a **productivity boom**
or the largest misallocation of capital in history.

Revealed preference \Rightarrow what *managers believe* the boom is.

A two-sector model with rare booms

Setup: two sectors, rare productivity boom

Two sectors $j \in \{a, n\}$ (AI, non-AI), Cobb–Douglas:

$$Y_{jt} = z_{jt}^{1-\alpha} K_{jt}^\alpha, \quad K_{j,t+1} = (1 - \delta_j)K_{jt} + I_{jt}.$$

AI productivity subject to rare boom (probability p_t):

$$z_{a,t+1} = \begin{cases} z_{at} e^\xi & \text{w.p. } p_t \\ z_{at} & \text{w.p. } 1 - p_t \end{cases} \quad \xi > 0.$$

Non-AI unaffected. Timing: $K_{a,t+1}$ chosen at t , before $z_{a,t+1}$ realized.

Departs from Gourio (2012) / Gomes et al. (2018) disaster models: shock hits productivity only, not K . Predetermined capital \Rightarrow MPK jumps \Rightarrow investment surges.

Frictionless optimal investment

First-order condition w.r.t. $K_{a,t+1}$:

$$\mathbb{E}_t \left[\alpha \left(\frac{z_{a,t+1}}{K_{a,t+1}} \right)^{1-\alpha} \right] = r_a + \delta_a.$$

Define the **boom option value**:

$$\Omega(p) \equiv (1 - p) + p e^{(1-\alpha)\xi} \geq 1.$$

Optimal capital scales linearly with productivity, lifted by Ω :

$$K_{a,t+1}^* = z_{at} \left(\frac{\alpha \Omega(p_t)}{r_a + \delta_a} \right)^{1/(1-\alpha)}.$$

Non-AI satisfies same with $\Omega = 1$ (no boom exposure).

Revealed preference: ξ from investment data

Proposition (capital ratio after a boom)

Suppose a boom occurs at t and p shifts $p_{t-1} \rightarrow p_t$. Then

$$\frac{K_{a,t+1}^*}{K_{a,t}^*} = e^{\xi} \left(\frac{\Omega(p_t)}{\Omega(p_{t-1})} \right)^{1/(1-\alpha)}.$$

Key: the ratio is independent of r_a and $\alpha\Omega$ levels.

- $r_a + \delta_a$ cancels in the ratio
- \Rightarrow identify ξ from the capex jump alone
- \Rightarrow no stand on the required return

Calibration: $\hat{\xi}$ from 2024–2027 capex

Pre-boom AI capital: steady state, $I = \delta_a K$, so

$$K_{a,0} = I_{a,\text{pre}}/\delta_a = 155/0.25 = \$620\text{B.}$$

Cumulative 2024–2027 capex: $\bar{I} = 226 + 381 + 755 + 1090 = \$2,452\text{B.}$

Frictionless model: full adjustment in year 1, then replacement of depreciation:

$$\bar{I} = K_0(\delta_a + e^{\xi} + 3\delta_a e^{\xi} - 1)$$

Inverting,

$$e^{\hat{\xi}} = \frac{\bar{I}/K_0 + 1 - \delta_a}{1 + 3\delta_a} = \frac{2452/620 + 0.75}{1.75} \approx 2.69, \quad \hat{\xi} \approx 0.99.$$

Lower bound on the boom: assumes zero economic profits, $p_{\text{pre}} \approx 0$.

Scenario design: a window of elevated p

Structural break in boom probability:

$$p_t = \begin{cases} p_{\text{pre}} \approx 0 & t < 2028 \\ p_{\text{max}} = 0.50 & t \in \{2028, 2029\} \\ p_* & t > 2029 \end{cases}$$

Two i.i.d. draws at $p_{\text{max}} = 0.50$:

Scenario	Add'l booms	Probability
Moderate	0	0.25
Transformative	1	0.50
Singularity	2	0.25

$p_{\text{max}} = 0.5$ is the maximum-entropy (Bernoulli max-variance) choice.

Identifying p_* from aggregate valuations

After the window, p reverts to a long-run value p_* . Discipline from the S&P 500:

- $P/D \approx 94 \Rightarrow D/P \approx 1.06\%$
- 30-yr TIPS yield 2.7% + ERP 5% $\Rightarrow r \approx 8\%$
- Gordon: $D/P = r - g \Rightarrow g \approx 7\%$

Match model-implied AI-sector growth to long-run dividend growth:

$$p_*(e^\xi - 1) = g = 0.07 \implies \boxed{p_* \approx 0.04}$$

At $p_* = 0.04$, $r_a = 0.15$: model-implied AI-sector P/E ≈ 14 .

Consistent with observed large-cap tech multiples.

Implied AI-sector value creation

Post-window steady state, $p_* = 0.04$. Capital's claim: $\alpha Y_a = \frac{r_a + \delta_a}{\Omega(p_*)} K_a^*$.

Scenario	K_a^* (\$B)	αY_a (\$B/yr)	Y_a (\$B/yr)	Y_a/Y
Pre-boom	620	240	720	3.1%
Moderate	1,763	680	2,040	8.0%
Transformative	4,745	1,830	5,490	19.0%
Singularity	12,769	4,930	14,790	38.7%

Even the **moderate** scenario implies AI sector $\approx 8\%$ of post-window output ($\alpha Y_a \approx \$680\text{B/yr} \approx 2.8\%$ of pre-boom GDP).

Alternative interpretation: overoptimism

The revealed-preference $\hat{\xi}$ is what **managers believe**. Three wedges to true productivity:

1. **Collective bubble.** Late-1990s fiber-optic precedent — firms invested in capacity not justified by subsequent demand.
2. **Wrong technological trajectory.** Scaling laws may break. Electrification vs. nuclear: history of GPTs offers both outcomes.
3. **Coordination failure.** Each firm rational given others' investment; aggregate over-investment.

Implied $\hat{\xi}$ is an *upper bound* on true productivity gain.

Asset-pricing and GDP implications are correspondingly an upper bound.

Other caveats: pointing both ways

1. Universe is incomplete.

↑ $\hat{\xi}$

Excludes xAI + neoclouds (CoreWeave, Crusoe, IREN, Lambda, Applied Digital, Hut 8).

Grand totals: \$843B (2026) vs. \$755B; \$1,223B (2027) vs. \$1,090B.

2022 baseline \approx unchanged $\Rightarrow \bar{I}/K_0$ rises \Rightarrow larger $\hat{\xi}$.

2. Timing: end-load the catch-up.

↑ $\hat{\xi}$

Current formula puts catch-up in 2024 \Rightarrow 3 yrs of depreciation eaten before measurement.

Data are back-loaded (\$226B \rightarrow \$1,090B); end-loading: $e^{\hat{\xi}} \approx 3.4\text{--}5.0$ ($\hat{\xi} \approx 1.2\text{--}1.6$).

3. Boom-size vs. boom-probability conflation.

↓ $\hat{\xi}$

Some 2024–27 capex (forward supply agreements, 2027 revenue contracts) reflects option value of *future* booms (p_{\max} window), not the realized 2024 boom. Re-attribution: total commitment unchanged.

Net of (1) and (2): substantive conclusion gets **larger**, not smaller.

GDP growth

How a boom translates to output

A boom at $t + 1$: productivity jumps, capital is predetermined \Rightarrow two-stage response.

Impact period ($t + 1$): only the productivity factor moves

$$Y_{a,t+1} = e^{(1-\alpha)\xi} z_{at}^{1-\alpha} (K_{a,t+1}^*)^\alpha.$$

At $\alpha = 1/3$, $\xi = 0.99$: $e^{(1-\alpha)\xi} \approx 1.93$ (+93%).

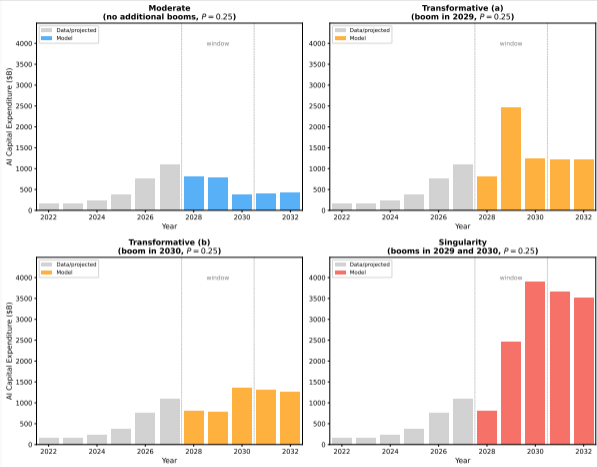
Adjustment period ($t + 2$): capital catches up, $K_{a,t+2}^* = e^\xi K_{a,t+1}^*$

$$Y_{a,t+2} = e^\xi z_{at}^{1-\alpha} (K_{a,t+1}^*)^\alpha.$$

Full factor $e^\xi \approx 2.69$ realized; capital contributes the remaining $e^{\alpha\xi} \approx 1.39$.

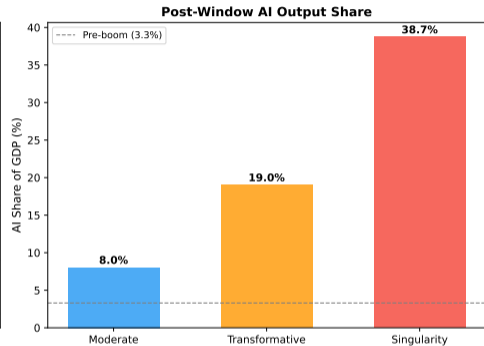
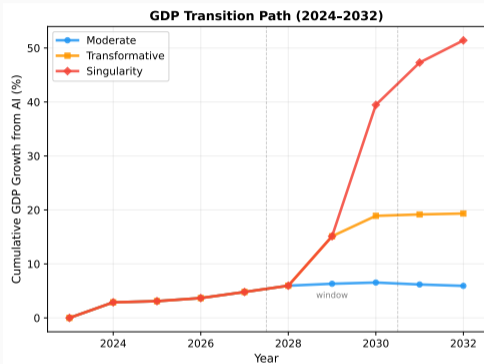
α governs the split between immediate and deferred output response.

Investment paths by scenario



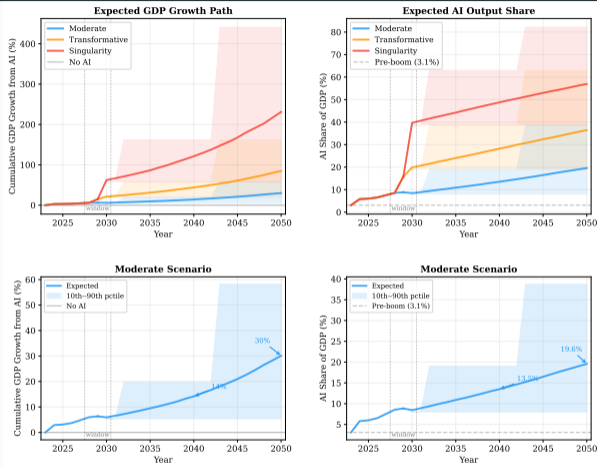
Gray = data/projected. Colored = model ($\theta_a = 3$). 2028 identical across scenarios.

GDP transition path (2024–2032)



Moderate \approx 5% cumulative; Transformative \approx 20%; Singularity \approx 58%.

Simulated paths to 2050 ($p_* = 0.04$)



10,000 sims; bands = 10th-90th pctile. Modal: no further booms (44% of paths).

GDP implications: summary

	AI share (%)	Cum. GDP growth (%)	Transition avg. (%/yr)	Post-window I_a (\$B/yr)
Pre-boom	3.1	—	—	155
Moderate	8.0	5.4	0.8	441
Transformative	19.0	19.7	2.8	1,186
Singularity	38.7	58.2	8.3	3,192

Long-run expected growth (post-window):

$$g = p_*(e^\xi - 1) = 0.04 \times 1.69 \approx 6.8\%/yr$$

Concentrated in rare discrete jumps, not smooth compounding.

Asset-pricing implications

From open economy to general equilibrium

So far: r_a exogenous (open economy with elastically supplied capital).

Now: representative agent, Epstein–Zin with $\psi = 1$, risk aversion γ .

Stochastic discount factor (Miller, Parolin, Wachter 2025):

$$M_{t+1} = \beta \mathbb{E}_t \left[\left(\frac{C_{t+1}}{C_t} \right)^{1-\gamma} \right]^{-1} \left(\frac{C_{t+1}}{C_t} \right)^{-\gamma} .$$

Aggregate consumption growth:

$$\Delta C_{t+1} = \mu + \sigma \varepsilon_{t+1} + \underbrace{x_{d,t+1}}_{\text{disasters}} + \underbrace{x_{b,t+1}}_{\text{AI booms}} .$$

Disasters (Barro 2006 / Wachter 2013): $p_d = 0.036$, $\xi_d = -0.15$.

Booms enter the aggregate via the AI sector's output share.

Mapping the sectoral boom to consumption

The boom is sector-specific. Mapping to aggregate ξ_b requires:

- AI's output share s_a (consumption boom scales with AI's importance)
- Wedge between output and consumption from investment dynamics

Two bounding calibrations:

Panel A (lower bound)	Panel B (upper bound)
$\xi_b = s_a \cdot (1 - \alpha) \xi$	$\xi_b = (1 - \alpha) \xi$
AI sector frozen at post-window size	AI sector absorbs everything ($s_a \rightarrow 1$)
<i>Moderate:</i> $\xi_b = 0.053$	
<i>Transformative:</i> $\xi_b = 0.126$	
<i>Singularity:</i> $\xi_b = 0.256$	All scenarios: $\xi_b = 0.660$

Risk-free rate and equity premium

Let $\Phi_d(u) = (1 - p_d) + p_d e^{u\xi_d}$, $\Phi_b(u) = (1 - p_b) + p_b e^{u\xi_b}$.

Risk-free rate:

$$r_f = \rho + \mu + \frac{1-2\gamma}{2}\sigma^2 + \log \frac{\Phi_d(1-\gamma)}{\Phi_d(-\gamma)} + \log \frac{\Phi_b(1-\gamma)}{\Phi_b(-\gamma)}.$$

Equity risk premium (on the consumption claim):

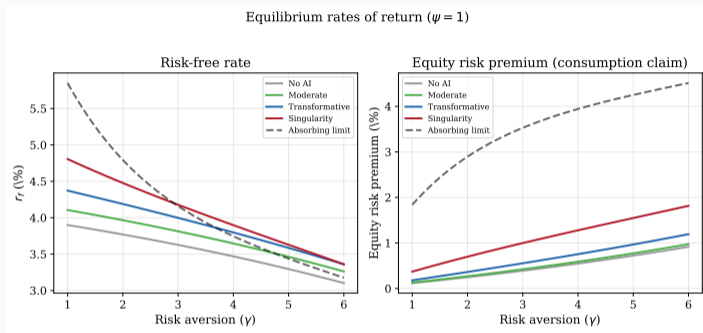
$$\log \mathbb{E}[R_W] - r_f = \gamma\sigma^2 + \log \frac{\Phi_d(1)\Phi_d(-\gamma)}{\Phi_d(1-\gamma)} + \log \frac{\Phi_b(1)\Phi_b(-\gamma)}{\Phi_b(1-\gamma)}.$$

For small p_b (and p_d):

$$\log \mathbb{E}[R_W] - r_f \approx \gamma\sigma^2 + p_b(e^{\xi_b} - 1)(1 - e^{-\gamma\xi_b}) + \text{disaster term}.$$

Both disasters and booms raise the equity premium.

Quantitative results



Left: risk-free rate (%). Right: equity risk premium (%).

Gray = pre-AI; colored = post-window scenarios (Panel A); dashed black = absorbing limit (Panel B).

At $\gamma = 3$: r_f up ~ 50 bp; ERP up ~ 60 bp (Panel A, Sing.) to 315 bp (Panel B).

Historical context and conclusion

Historical growth episodes in perspective

Episode	Period	Years	Multiplier	log(mult.)
<i>Industrial revolutions</i>				
British Ind. Rev. (1st)	1760–1840	80	1.7	0.53
U.S. Railroad era	1850–1910	60	2.8	1.01
2nd Ind. Rev. (U.S.)	1870–1920	50	2.4	0.88
<i>East Asian growth miracles</i>				
Japan postwar, Korea, Taiwan, Singapore, China	1945–2020	25–30	8–13	2.1–2.6
<i>Technology booms</i>				
U.S. IT boom	1995–2005	10	1.5	0.41
<i>AI window booms (calibrated $\xi = 0.99$)</i>				
AI moderate (1 boom)	2024–29	5	2.7	0.99
AI transformative (2 booms)	2024–29	5	7.2	1.98
AI singularity (3 booms)	2024–29	5	19.5	2.97
<i>AI sector long-run (post-window expected, $p_* = 0.04$)</i>				
AI sector, 30-year horizon	2030–60	30	7.2	1.97
AI sector, 50-year horizon	2030–80	50	26.8	3.29

What investment data adds

Existing literature:

- **Task-based** (Acemoglu 2024, Babina et al. 2024): TFP gains $\sim 0.7\text{--}1$ pp/decade
- **Wage & labor share** (Korinek-Suh 2024, Trammell-Korinek 2025, Restrepo 2025)
- **Sectoral complementarity bounds** (Korinek-Maris 2025)

This paper: use **capex commitments** as a revealed-preference moment for the productivity boom.

- Investment ramps to \$1T+ *require* a productivity boom much larger than task-based estimates
- The boom is **in investment data, but not yet in productivity data**
- “Not yet” — consistent with Cobb-Douglas: $(1 - \alpha)\xi$ at impact, full ξ after capital adjusts

Conclusion

Headline numbers (revealed preference from \$2.5T 2024–27 capex):

Boom size $\hat{\xi}$	≈ 0.99	($e^{\hat{\xi}} \approx 2.7$)
Long-run expected AI-sector growth	$\approx 6.8\%/yr$	
Cumulative GDP gain by 2030 (Mod–Sing)	5–58 pp	
AI share of post-window output	8–39%	
r_f change (GE, $\gamma = 3$)	+50 bp	
ERP change (GE, $\gamma = 3$, Panel B)	+315 bp	

The boom is in investment data, but not yet in productivity data.

If it fails to materialize, this is the largest capital misallocation in history.

Those who are certain of that outcome may be making a mistake analogous to 2007.