The Aggregate Implications of Innovative Investment

by A. Atkeson and A. Burstein

Discussion by erm, July 2017

Question

- If policy changed to induce more innovation,
- What happens to
  - Output
  - Productivity
  - Welfare?

Contribution of AB

- Develop model nesting many others

- Use discipline of national accounts

Why Important?

- Welfare gains are potentially huge
- But, results very sensitive to
  - Model choice
  - Parameter estimates

My Discussion

- AB's main result doesn't rely on cross-section data
- Aggregate implications of innovative investment:
  - Can estimate medium-run growth
  - Can't yet estimate long-run growth or welfare

RBC-friendly Version

- Firm output:

$$y_t = K_{It}^{\rho}(k_{Tt}^{\alpha} k_{It}^{\gamma} l_t^{1-\alpha-\gamma})$$

- Capital accumulation

$$\begin{aligned} k_{Tt+1} &= (1-\delta_T)k_{Tt} + x_{Tt} \\ k_{It+1} &= (1-\delta_I)k_{It} + \underbrace{A_{rt} K_{It}^{\phi-1} x_{It}}_{y_{rt}} \end{aligned}$$

AB's Impact Elasticity

- Given α, γ, define:

$$\log Z_t = \log Y_t - \alpha \log K_{Tt} - (1-\alpha-\gamma) \log L_t$$

- Then growth rates are:

$$g_{Zt} = (\rho+\gamma) g_{K_{It}}$$
$$g_{K_{It}} = \log(1-\delta_I + Y_{rt}/K_{It})$$

- And AB's elasticity is:

$$\epsilon_{zr} = \frac{g_{Zt} - \bar{g}_Z}{\log Y_{rt} - \log \bar{Y}_r} \approx (\rho+\gamma) \left(\frac{\exp\, \bar{g}_{K_I} - 1 + \delta_I}{\exp\, \bar{g}_{K_I}} \right)$$

AB's Impact Elasticity

$$\epsilon_{zr} \approx (\rho + \gamma) \left(\frac{\exp \bar{g}_{K_I} - 1 + \delta_I}{\exp \bar{g}_{K_I}} \right)$$

$\rho + \gamma = 1/3$ (based on variety models)

$\bar{g}_Z = .0123$ (based on BEA/BLS data)

$\bar{g}_{K_I} = .0369$ (from definition)

δ_I?

0.0, $\epsilon_{zr} = .012$

.15, $\epsilon_{zr} = .06$

1.0, $\epsilon_{zr} = 1/3$

AB's Impact Elasticity

$$\epsilon_{zr} \approx (\rho + \gamma)\left(\frac{\exp \bar{g}_{K_I} - 1 + \delta_I}{\exp \bar{g}_{K_I}}\right)$$

$$\begin{aligned}
\rho + \gamma &= 1/3 \text{ (based on variety models)} \\
\bar{g}_Z &= .0123 \text{ (based on BEA/BLS data)} \\
\bar{g}_{K_I} &= .0369 \text{ (from definition)} \\
\delta_I&? \text{ Not known}
\end{aligned}$$

$\Rightarrow$ use investment/value ratio (X_I/V_I) instead

AB's Impact Elasticity

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δ_I? Not known

$\Rightarrow$ use investment/value ratio ($X_I/V_I = .08$)

X_I: NIPA+imputation for entrants

V_I: dividends/(interest rate − growth rate)

AB's Impact Elasticity

$$\epsilon_{zr} \approx (\rho+\gamma)\left(\frac{\exp\,\bar{g}_{K_I} - 1 + \delta_I}{\exp\,\bar{g}_{K_I}}\right) \approx (\rho+\gamma)\frac{X_I}{V_I}$$

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AB's Impact Elasticity

$$\epsilon_{zr} \approx (\rho+\gamma)\left(\frac{\exp\,\bar{g}_{K_I} - 1 + \delta_I}{\exp\,\bar{g}_{K_I}}\right) \approx (\rho+\gamma)\frac{X_I}{V_I} = .027$$

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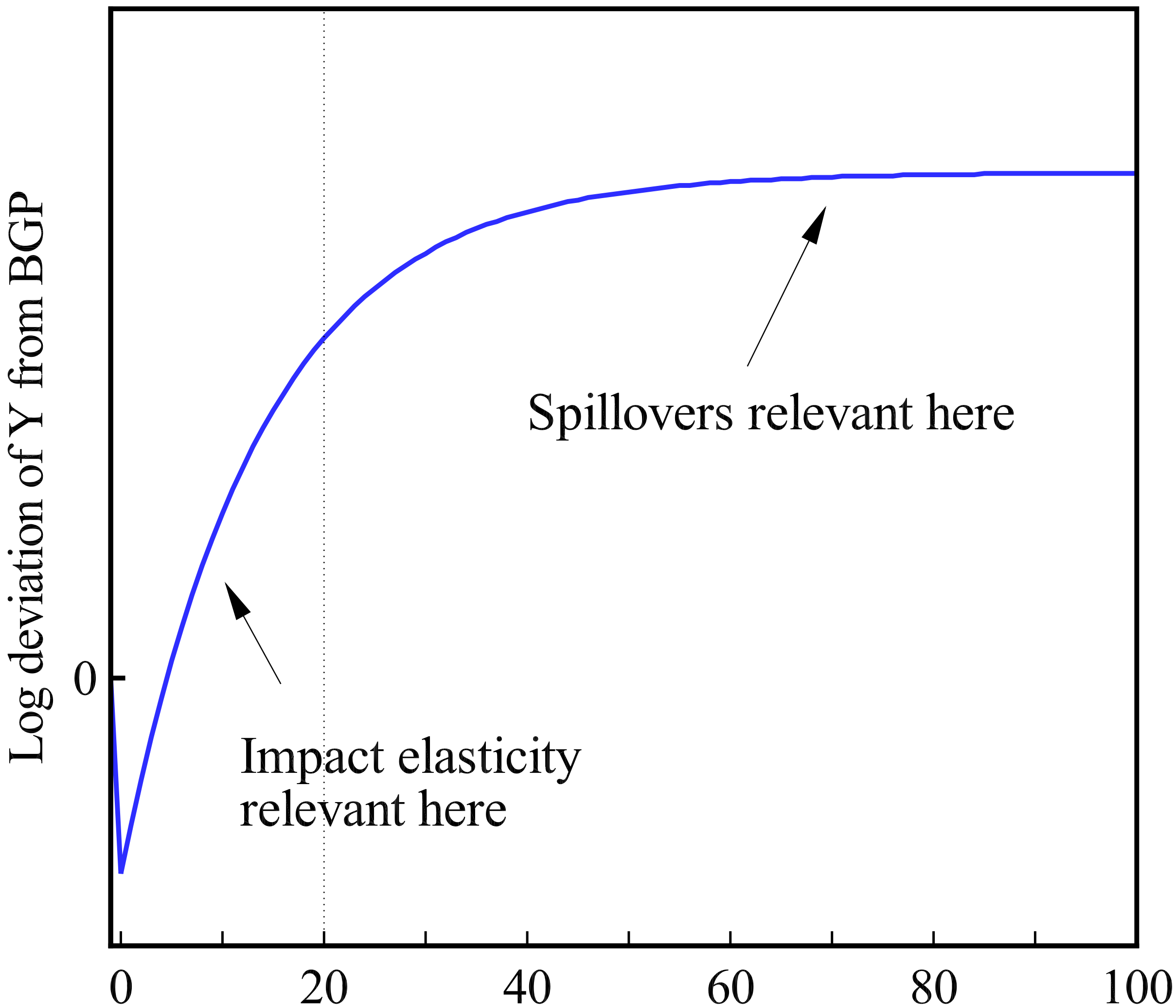
Main Result

- $\epsilon_{zr} = 2.7\%$
  - Used no information from LBD or GHK
  - Relied on only one dubious parameter (ρ)

Main Result

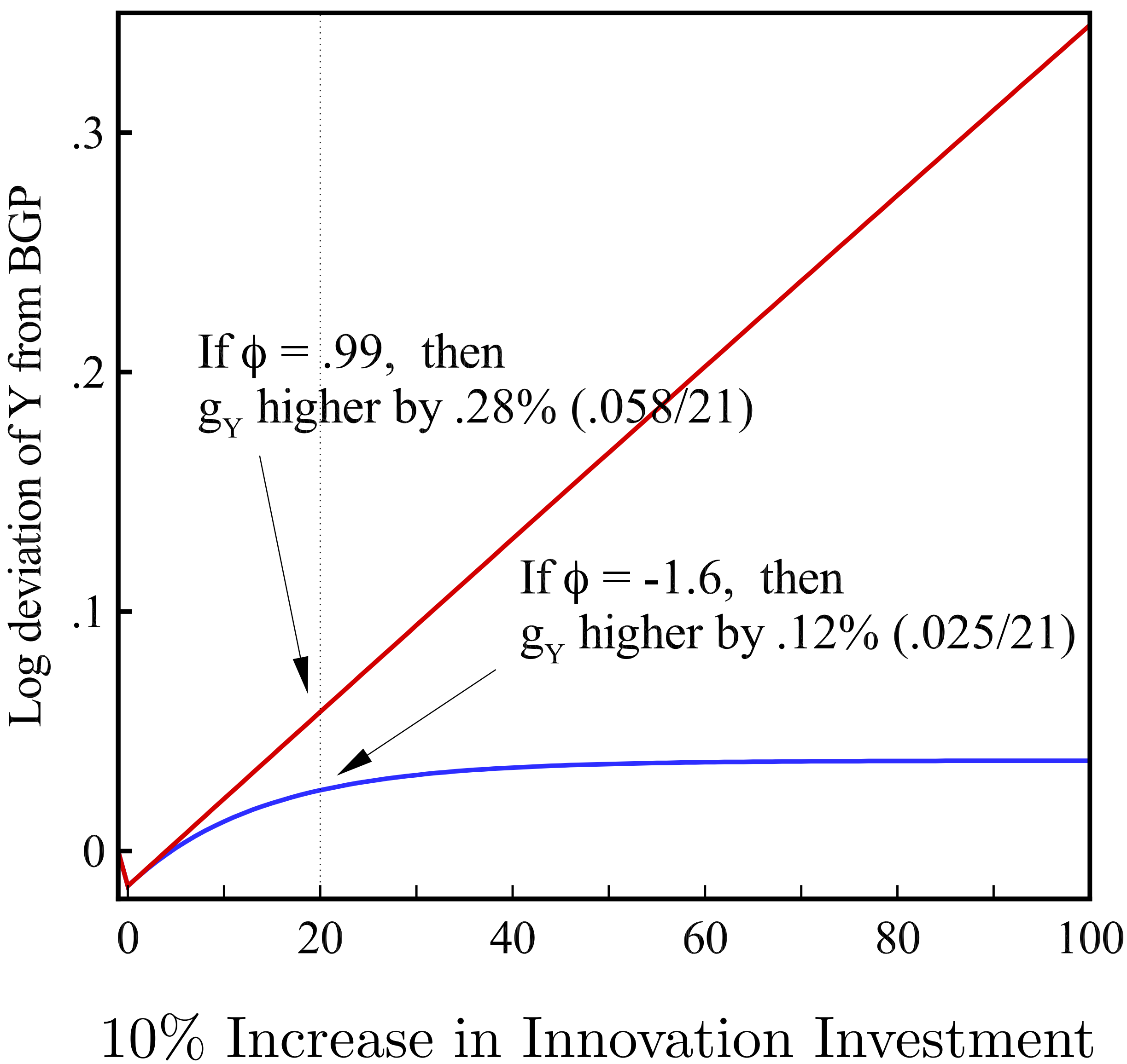
- $\epsilon_{zr} = 2.7\%$
  - Used no information from LBD or GHK
  - Relied on only one dubious parameter (ρ)
- What does this imply for future growth and welfare?

Future Growth

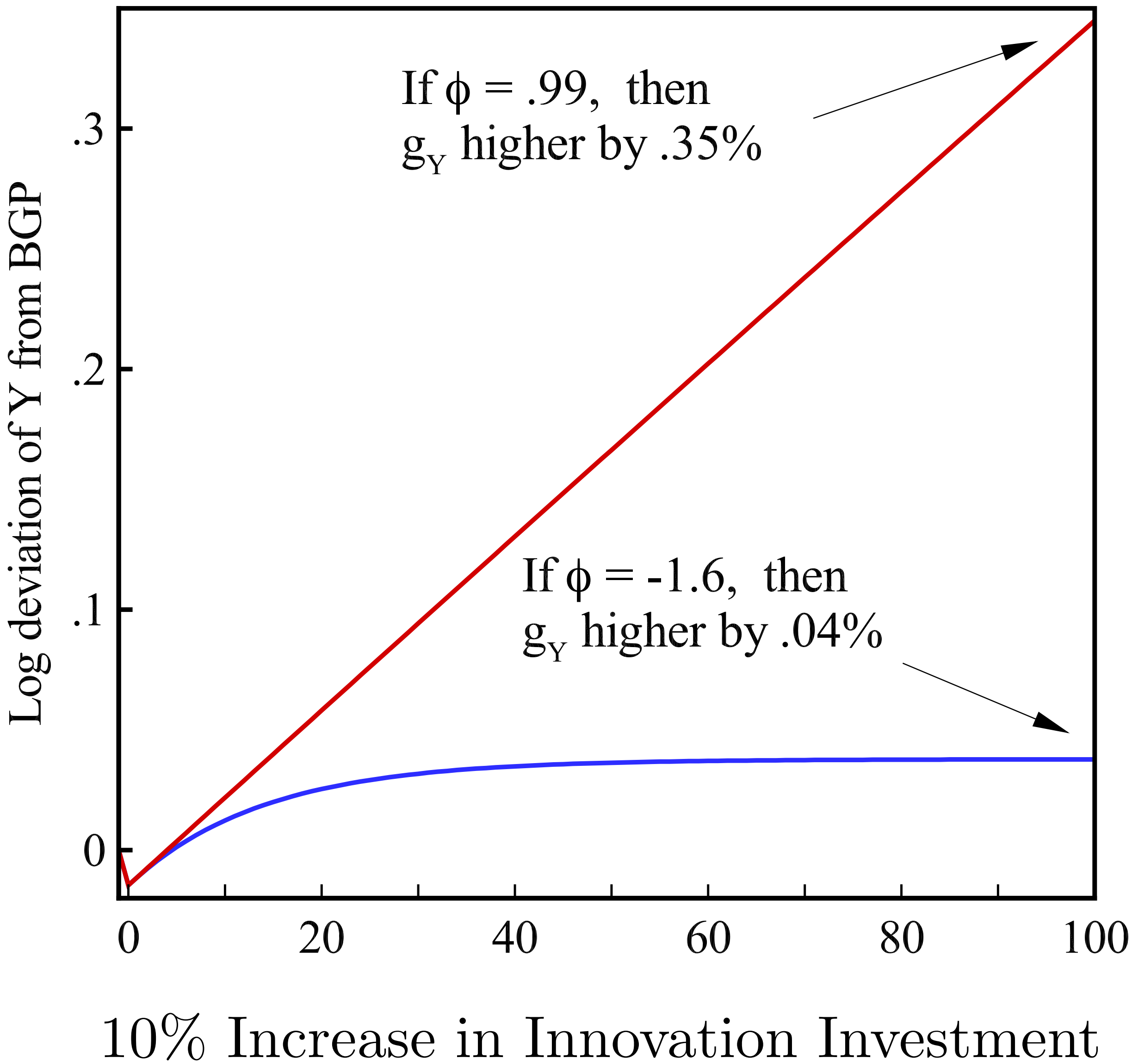


10% Increase in Innovation Investment

100 Years Later



100 Years Later



But...

- To rationalize both
  - Observed growth in Y, L *and*
  - Large negative spillovers
- Requires high growth in A_r

Mapping from Spillovers to g_{A_r}

- Recall

$$y_t = K_{It}^{\rho}(k_{Tt}^{\alpha} k_{It}^{\gamma} l_t^{1-\alpha-\gamma})$$

$$y_{rt} = A_{rt} K_{It}^{\phi-1} x_{It}$$

- Growth in output (with $\phi = 1$):

$$\underbrace{\bar{g}_Y}_{.025} = \underbrace{\frac{\rho+\gamma}{(1-\alpha)(2-\phi)-(\rho+\gamma)}}_{.762} \underbrace{g_{A_r}}_{.033}$$

$$+ \underbrace{\frac{(1-\phi)(1-\alpha-\gamma)}{(1-\alpha)(2-\phi)-(\rho+\gamma)}}_{0} \underbrace{g_L}_{.008}$$

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- Growth in output (with $\phi = -1.6$):

$$\underbrace{\bar{g}_Y}_{.025} = \underbrace{\frac{\rho+\gamma}{(1-\alpha)(2-\phi)-(\rho+\gamma)}}_{.137} \underbrace{g_{A_r}}_{.144}$$
$$+ \underbrace{\frac{(1-\phi)(1-\alpha-\gamma)}{(1-\alpha)(2-\phi)-(\rho+\gamma)}}_{.672} \underbrace{g_L}_{.008}$$

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Choice of ϕ also matters for welfare...

Welfare estimates

- Depend importantly on
  - Spillovers
  - Appropriation

... which are both hard to estimate

Appropriation

- Proportion κ stolen

$$k_{It+1} = (1 - \delta_I)k_{It} + (1 + \kappa)q_{rt}x_{It} - \kappa q_{rt}k_{It}\frac{X_{It}}{K_{It}}$$

- New impact elasticity: $\epsilon^*_{zr} = \epsilon_{zr}/(1 + \kappa)$
- How to interpret κ?
  - Weak IP protection?
  - Quid pro quo policy?
- How to measure κ?

Implications for Welfare

- No appropriation:

$$1\% \text{ rise in } X_I/Y$$

$$\Rightarrow \; 2.3 \text{ to } 15\% \text{ rise in welfare depending on } \phi$$

- With appropriation:

$$1\% \text{ rise in } X_I/Y$$

$$\Rightarrow \; \text{possibly negative welfare!}$$

- Optimal policy may involve barriers to new firms, products

Bottom Line

- Need estimates for some key parameters
- AB on right track
  - Match theory to NIPA
  - Should look at cross-country evidence
- Don't see that they need LBD or GHK