# Discussion of Comin and Mulani, “A Theory of Growth and Volatility”

Charles I. Jones

U.C. Berkeley and NBER

# Outline

1. Facts
2. Model
3. Comments

# Facts

1. Private R&D intensity rises 3-fold since 1950.
2. Productivity growth has no trend (boom, slowdown, recovery).
3. Aggregate volatility has fallen.
4. Firm-level volatility has risen.

Idea: Explain all of these facts in a single framework.

# Model

- Schumpeterian growth model with *two* kinds of innovations
  - $q$: Standard firm-specific innovations
  - $h$: “General innovations” (GI) – benefit all firms
    Innovator only captures own cost-reduction.

# Equilibrium: $\lambda_h$, $\lambda_q$, $v_\ell$, $v_f$

$$1 - \bar{s}_q = \bar{\lambda}(\delta_q^{1/N} v_\ell - v_f) \quad (1)$$

$$c'(\lambda_h/N) = (\delta_h - 1)v_\ell \quad (2)$$

$$v_f = 0 \quad (3)$$

$$rv_\ell = (1-\alpha)\theta - c(\lambda_h) + \lambda_h(\delta_h - 1)v_\ell - \lambda_q v_\ell \quad (4)$$

- (1) implies $v_\ell$ decreases in $\bar{s}_q$. (2) implies $\lambda_h$ increases in $v_\ell$.

  $\Longrightarrow \lambda_h$ decreases in $\bar{s}_q$.

- Also, $\lambda_q$ increases in $\bar{s}_q$ (not surprising).

# Growth

$$\gamma_{y_s} = \#q_s \cdot \ln \delta_q + \#h \cdot \ln \delta_h$$

$$\gamma_y = \frac{1}{N} \sum_{s=1}^{N} \gamma_{y_s} = \left( \frac{1}{N} \sum_{s=1}^{N} \#q_s \right) \cdot \ln \delta_q + \#h \cdot \ln \delta_h$$

- Poisson arrival

$$E\gamma_{y_s} = \lambda_q \ln \delta_q + \lambda_h \ln \delta_h$$

$$E\gamma_y = \lambda_q \ln \delta_q + \lambda_h \ln \delta_h$$

$$V\gamma_{y_s} = \lambda_q (\ln \delta_q)^2 + \lambda_h (\ln \delta_h)^2$$

$$V\gamma_y = \frac{1}{N} \cdot \lambda_q (\ln \delta_q)^2 + \lambda_h (\ln \delta_h)^2$$

- How do these change when $\bar{s}_q$ rises?

# Comments

# What about $\bar{s}_h$?

- Two facts about model:
  - Calibration: 90% of growth in 1960 due to GI.
  - Model features enormous spillovers of GI. ($N = 35$)
- Theory of institutional evolution: in a well-run society, evolution toward implementing optimal allocation.
- Strongly suggests that institutions should be evolving to increase $\lambda_h$; unclear what should be happening to $\lambda_q$.
  - But calibration features *declining* $\lambda_h$ and *rising* $\lambda_q$.
  - Is this toward or away from the optimal allocation?
- Perhaps in reality there is an $\bar{s}_h$ that has been rising?? Example: Broadening of patents to include software and algorithms.

  $\Longrightarrow$ This would sharply alter predictions.

# Evidence on $\lambda_h$?

- Main evidence is (nice) list of GIs
  - Of 25 listed, only 4 are from after 1960
- More recent GIs may not be sufficiently appreciated.
- Maybe list is incomplete. Recent examples:
  - Relational databases, spreadsheets
  - Inventory tracking programs
  - WalMart
- Very unclear how to count. Evidence surely inconclusive.

# Idea Production Functions

- Weird specification, something like:

$$\text{Probability of GI} = \bar{\lambda}_h \left(\frac{R}{Y}\right)^{\rho}$$

  where $R/Y$ is the *share* of sectoral output spent innovating.

- Problem: Suppose Hong Kong and the RestofWorld are separate closed economies, 1000-fold different in size.
  - Start with same initial conditions other than size.
  - Both generate same flow of GI, even though one has 1000 times more research.
- Alternatively, more sectors leads to more GI and growth (even if absolute amount of research is the same).

# Calibration

- A true RBC model – only (true) technology shocks!
- Table 3, using stdev instead of var; “explains” half of the decline

| Moment | Data | Model |
|---|---|---|
| E $\gamma_{y2000}$ | .020 | .017 |
| Stdev $\gamma_{y1950}$ | .020 | .016 |
| Stdev $\gamma_{y2000}$ | .012 | .012 |
| Increment | -.008 | -.004 |

- Model ignores all other sources of volatility, however, so matching volatility in 2000 is a weakness, not a strength.
- Other statistics? Sectoral, firm volatility, $\lambda_h$, $n_h$, $n_q$