Missing Growth from Creative Destruction

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[1]DISCLAIMER: Opinions and conclusions herein are those of the authors and do not necessarily represent the views of the Federal Reserve System. All results have been reviewed to ensure that no confidential information from the U.S. Census Bureau or U.S. Bureau of Labor Statistics have been disclosed.

Creative Destruction (CD)

Does CD show up in measured growth?

- CD = new producers replacing incumbent producers by having *lower* quality-adjusted price
- But standard measurement infers this change in quality-adjusted price from *non*-CD goods

Relation to Boskin Commission

Focus of Boskin Commission:

Quality bias from incumbent own-product improvements (and brand new varieties)

Focus of BLS quality adjustments:

Quality bias from incumbent own-product improvements

Our focus:

Quality bias from creative destruction

Numerical Example

- 80% of items: 4% inflation (no innovation)
- 10% of items: -6% inflation (innovation w/o CD)
- 10% of items: -6% inflation (CD)
- True inflation $= 2\%$, True growth $= 2\%$
- Imputation for CD $= \frac{8}{9} \cdot 4\% + \frac{1}{9} \cdot (-6\%) = 2.9\%$
- Measured growth $= 1.1\%$, Missing Growth $= 0.9\%$

Our Questions

1. How much is U.S. growth understated, on average, because of imputation for creative destruction?

2. Has "missing growth" increased a lot in recent years?

Our Answers

1. How much is U.S. growth understated, on average, because of imputation for creative destruction?

   $\sim$ **0.5 ppt per year** between 1983–2013

2. Has "missing growth" increased a lot in recent years?

   No

Imputation in the CPI, 1988–2004

Klenow & Kryvtsov (2008)

- 3.9% monthly exit rates of products
- 48% of the product substitutions "noncomparable"
- So 22.5% average annual "true" exit
- Noncomparable item substitutions:
  - 31% direct quality adjustments (mostly same producer products)
  - 69% linking or class-mean imputation
- CD substitutions was treated with imputation 90% of the time

Imputation in the PPI

2.3% monthly exit rate (Nakamura & Steisson 2008)

Missing prices

If no price report from a participating company has been received in a particular month, the change in the price of the associated item will, in general, be estimated by averaging the price changes for the other items within the same cell (i.e., for the same kind of products) for which price reports have been received.

– BLS Handbook of Methods (2015, ch. 14, p. 10)

True growth

Aggregate and product-level output

$$Y = \left[\int_0^N \left[q(j)\, y(j) \right]^{1-1/\sigma} dj \right]^{\frac{\sigma}{\sigma-1}}$$

$$y(j) = l(j)$$

True growth

$$\frac{Y_{t+1}}{Y_t} = \left[1 + \underbrace{\lambda_d \left(\gamma_d^{\sigma-1} - 1 \right)}_{\text{CD}} + \underbrace{(1-\lambda_d)\lambda_i \left(\gamma_i^{\sigma-1} - 1 \right)}_{\text{OI}} + \underbrace{\lambda_n \gamma_n^{\sigma-1}}_{\text{NV}} \right]^{\frac{1}{\sigma-1}}$$

True vs. Measured Growth

True growth

$$\frac{Y_{t+1}}{Y_t} = \left[1 + \overbrace{\lambda_d\left(\gamma_d^{\sigma-1}-1\right)}^{\text{impute}} + \underbrace{(1-\lambda_d)\lambda_i\left(\gamma_i^{\sigma-1}-1\right)}_{\text{OI}} + \overbrace{\underbrace{\lambda_n\gamma_n^{\sigma-1}}_{\text{NV}}}^{\text{miss}}\right]^{\frac{1}{\sigma-1}}$$

Measured growth

$$\frac{\widehat{Y_{t+1}}}{Y_t} = \left[1 + \lambda_i\left(\gamma_i^{\sigma-1}-1\right)\right]^{\frac{1}{\sigma-1}}$$

Relative prices $\Leftrightarrow$ market shares

CES $\Rightarrow$ market share isoelastic with respect to price

$$\text{Missing Growth} = \frac{\frac{Y_{t+1}}{Y_t}}{\widehat{\frac{Y_{t+1}}{Y_t}}} = \frac{\frac{P^S_{t+1}}{P_{t+1}}}{\frac{P^S_t}{P_t}} = \left(\frac{S_{I_t,t+1}}{S_{I_t,t}}\right)^{\frac{1}{1-\sigma}}$$

$S_{I_t,t}$ = market share in t of all goods sold in both t and $t+1$

$S_{I_t,t+1}$ = market share in $t+1$ of all goods sold in t & $t+1$

Shrinking share of non-CD goods $\Rightarrow$ missing growth

Going from model to data

If existing plants carry out OI but not CD or NV:

$$\text{Missing Growth} = \frac{\frac{Y_{t+1}}{Y_t}}{\widehat{\frac{Y_{t+1}}{Y_t}}} = \frac{\frac{P^S_{t+1}}{P_{t+1}}}{\frac{P^S_t}{P_t}} = \left(\frac{S_{I_t,t+1}}{S_{I_t,t}}\right)^{\frac{1}{1-\sigma}}$$

$S_{I_t,t}$ = market share in t of all <u>establishments</u> operating in both t and $t+1$

$S_{I_t,t+1}$ = market share in $t+1$ of all <u>establishments</u> operating in both t and $t+1$

U.S. Census Data

- Longitudinal Business Database (LBD)
- all nonfarm private sector plants
- employment, wage bill, firm, industry
- results for 1983–2013

Some details

Use employment share as plant-level revenue is not available

In Census of Mfg, bigger MG with rev. than emp.

"entrants" = plants who are 5 years old

$\sigma = 4$ from Redding and Weinstein (2016), Hottman, Redding and Weinstein (2016)

Missing Growth Implied by Survivor Market Shares

% points per year

1983–2013	**0.64**
1983–1995	0.66
1996–2005	0.55
2006–2013	0.74

Measured vs. True Growth

% points per year

	Measured	"True"
1983–2013	1.87	2.51
1983–1995	1.80	2.46
1996–2005	2.68	3.23
2006–2013	0.98	1.72

Robustness checks

	Lower $\sigma = 3$	Baseline $\sigma = 4$	Higher $\sigma = 5$
1983–2013	**0.96**	**0.64**	**0.48**

	Employment	Payroll
1983–2013	**0.64**	**0.69**

Missing Growth: 1 Sector vs. Weighted Sectors

	1-sector	2-digit	3-digit	4-digit	5-digit
1983–2013	**0.64**	**0.64**	**0.66**	**0.74**	**0.77**

Similar average bias with disaggregated industry

No surge in missing growth

Contribution to Missing Growth

1.	Retail Trade	17.6%
2.	Restaurants & Hotels	17.4%
3.	Health Care	16.0%
4.	Admin support services	12.2%
5.	Professional services	8.1%
	⋮	
15.	Manufacturing	1.1%

Missing Growth vs. Declining Dynamism

	Plants	Firms	Net Entry	Gross Entry
1983–1995	0.66	0.33	0.54	0.70
1996–2005	0.55	0.17	0.40	0.06
2006–2013	0.74	0.09	0.06	-0.49

Net entry assumes equal-sized firms

Gross entry assumes equal-sized firms and a fixed exit rate

Indirect inference on firms

Key advantage:

- Need not assume CD and NV come from new plants
- Bernard, Redding and Schott (2010) find that manufacturing plants do add SIC's

We extend Garcia-Macia, Hsieh and Klenow (2016):

- GHK assume measured growth = true growth; we assume CD and NV are not measured
- Fit the same employment dynamics in LBD firms to infer arrival rates and step sizes

Missing growth from indirect inference

% points per year

1976–1986	all	0.52
	from CD	0.41
2003–2013	all	0.42
	from CD	0.33

Conclusions

Missing growth from CD and new varieties:

- $\sim 0.5\%$ per year, mostly from CD

About one-fourth of true growth is missed

No surge in missing growth since 2005

What should the BLS do?

Ideally:

- Collect data on market shares of incoming and outgoing products and estimate their substitutability

A practical alternative:

- Impute based only on those surviving products with innovations (not all surviving products)
- Might subtract $\sim 1\%$ per year from inflation

Why do we care?

1. Relating growth to policy

2. Gauging the proportional decline in growth / whether ideas are getting harder to find (Gordon, Jones)

3. Assessing how many people are better off than their parents (Chetty et al.'s Fading American Dream)

4. Setting the Fed's inflation target

5. Indexing Social Security and tax brackets