Discussion of the paper

Optimal Trend Inflation
by
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Praise

- Very nice paper!...a must read
- Important classic question: Optimal Inflation Rate
- Standard NK model ⇒ Optimal Trend (SS) Inflation rate = 0
- Contrast with usual CB target (roughly 2%)
- Way out:
  - Non-linearities (e.g., ZLB or DNW)
  - Heterogeneity...this paper
Heterogeneous firms with different (firm-level?) productivity trends

Optimal inflation rate should respond to the difference in productivity

1. The optimal trend inflation reflects firms’ productivity ratio
2. The optimal inflation rate is positive
3. Empirical application on US data: time varying (declining) optimal inflation rate: 1977: 1.5%, 2015: 1%
Contribution and Main results

- Very elegant solution, closed form...
- ... that's class
Outline

- Intuition
- The Cost of Trend Inflation
- How general
  - Firms dynamics => Empirical Application
  - Wages
  - Heterogeneity/Network
The Cost of Trend Inflation

- Rationale for zero inflation: Homogeneous firms should set the same price.

- In a standard model productivity of price-adjusting firms is equal to that of non-adjusting firms => price adjusting firms need to charge the same price as non-adjusting firms.

- Inflation creates price dispersion, because it distorts the FOC of price-resetting firms => inefficient allocation => optimal trend inflation rate = 0.

- See hndk chapter by Schmitt- Grohe & Uribe.
The Cost of Trend inflation

\[ N_t = \int_0^1 N_{i,t} \, di \]
\[ = \int_0^1 \frac{Y_{i,t}}{A_t} \, di = \frac{Y_t}{A_t} \int_0^1 \left( \frac{P_{i,t}}{P_t} \right)^{-\varepsilon} \, di. \]

\[ Y_t = \frac{A_t}{s_t} N_t. \]

↑ trend inflation, ↑ Calvo parameter, ↑ the elasticity of demand => ↑ Price dispersion s, ↓ aggregate productivity

↑ trend inflation =>
↑ Average markup, \( \mu \),
The Cost of Trend Inflation

Figure 7. The Cost of Price Dispersion

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- Firms have different productivity, because they could be hit by a random shock that puts them on a different productivity trajectory => Interpretation:
  - Exit/entry
  - Introduction of new products
  - Quality improvements

- 3 productivity trend
  - Common productivity trend (irrelevant)
  - Experience growth trend => $g$
  - Cohort growth trend (new firms productivity trend) => $q$

- Firms are allowed to change price only if they meet the Calvo fairy or the productivity goblin
This Paper
This Paper: Intuition

- Firm prices should reflect their productivity

- Effect of the experience trend => new firms are less productive than experienced firms => new firms should have higher prices => call for positive inflation

- Effect of the cohort trend => new firms are more productive than old firms => new firms should have lower prices => call for negative inflation

- Optimal steady state inflation = ratio experience-to-cohort trend $g/q$ (limit when the productivity distribution converges to the stationary distribution)
This paper Main Results

Cost of Trend Inflation

\[ Y_t = \frac{A_t Q_t}{\Delta_t} \left( K_t^{1-\frac{1}{\phi}} L_t^{\frac{1}{\phi}} - F_t \right) \]

\[ \Delta_t = \int_0^1 \left( \frac{Q_t}{G_{jt}Q_{t-sjt}} \right) \left( \frac{P_{jt}}{P_t} \right)^{-\theta} \, dj \]

\[ y_t = \left( \frac{\Delta^e_t}{\Delta_t} \right) \left( k_t^{1-\frac{1}{\phi}} L_t^{\frac{1}{\phi}} - f \right) \]

\[ \Delta^e_t \equiv \left( \int_0^1 \left( \frac{Q_t}{G_{jt}Q_{t-sjt}} \right)^{1-\theta} \, dj \right)^{\frac{1}{1-\theta}} \]

\[ \Delta_t = \Delta^e_t \]

\[ \Pi^*_t = \Xi^*_{t-1,t} \left( \frac{1 - \delta (\Delta^e_t)^{\theta-1}}{1 - \delta} \right)^{\frac{1}{\theta-1}} \]

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This paper Main Results
Cost of Trend inflation

1. Firms hit by a $\delta$-shock choose the same optimal relative price as in the flexible price economy
2. Firms hit by a Calvo shock optimally choose not to adjust their price, which avoids the emergence of price dispersion between otherwise identical firms
3. Initial prices reflect initial productivities, ensures that all relative prices are identical to those in the flexible-price equilibrium
4. Under the assumed output subsidy, it then follows that household allocations are also identical to the flexible-price equilibrium, which is efficient
Main Point: How Novel

- Optimal Inflation should reflect relative trend in productivities
  - Wolman (2011): 2 sectors, 2 productivity trends, prices adjust less frequently in the sector with an increasing relative price => deflation => less price adjustment on services means that goods prices must fall at a greater rate than services prices rise, implying deflation overall

- also relative stickiness (Aoki, 2001; Benigno, 2004)

- But here is even more surprising...achieve optimal allocation!
Where’s the magic? A limited instrument like the aggregate inflation rate can cure the productivity differentials…

The neat aggregation and the main result rest on some assumptions

A sale subsidy to correct for market power => would the economy otherwise anyway be able to replicate the flexible price equilibrium?

Initial prices reflect relative productivities => not very important

Fixed Trend Productivities and Trend inflation
There is really one only trend \((g/q)\) => \(q\) gives a level shift, but within each cohort productivity trend is the same \((g)\) => same optimal inflation rate (vs Wolman)
How general: firm dynamics

- Firms dynamics in reality is very different from the one assumed
- It is true the unconditionally average productivity of start-ups is lower than incumbent \((g>q)\)....
- ...but that’s simply because among the entrants there is a bunch of very unproductive firms
- only about a half of all startups survive for more than five years and most of those that continue to operate are small and do not create jobs or innovate
- (e.g. Hurst and Pugsley, 2011; Haltiwanger et al., 2013; Haltiwanger et al., 2016)
firm dynamics

- ...as well as very productive one => “Gazelles” (young firms with average employment growth above 20 percent p.a. for at least three years) or rare “unicorns”

- young businesses = engines of aggregate employment and productivity growth in the U.S. (Foster et al., 2008; Haltiwanger et al., 2013) and other countries (Ayagari et al., 2011)
firm dynamics: old firms

- There is a lot of heterogeneity also among old firms
- Most of these firms grow very little or do not grow at all
- Many of these are small
- Haltiwanger et al. (2013) => once controlling for firm age, the negative relationship between firm size and growth disappears
- Also among old ones, productivity growth driven again by very few firms
firm dynamics and cyclicality

- There are also large macroeconomic consequences and relation to business cycle

- About 40% of business cycle fluctuations in aggregate employment can be traced back to changes in the number of startups, despite new firms accounting for only about 3 percent of the workforce (Pugsley and Sahin, 2015; Sedláček, 2015, Sedláček and Sterk, 2017)

- Transitory changes in the number and composition of startups can have long-lasting aggregate effects (Gourio et al., 2014; Sedláček, 2015; Siemer, 2016; Clementi and Palazzo, 2016; Sedláček and Sterk, 2017)
firm dynamics and cyclicality

- During business cycle entry and exit rates varies
  - ...while here are supposed fixed
  - ...and equal (two $\delta$'s?)
  - $\delta$ may vary with the cycle

- Aggregate shocks have effects on productivity and hence price dispersion
Productivity and innovation

- Productivity growth is very heterogeneous.
- It varies across sectors in the economy =>
  Lower productivity growth in services.
- Entry/exit also varies across sectors =>
  Lower firm turnover in retails.
Empirical Application

➢ After all this evidence how much shall we trust this relationship

\[ \Pi^*_t = \Xi^*_{t-1,t} \frac{a_t g_t}{A_t Q_t} \frac{A_{t-1} Q_{t-1}}{\Delta^e_{t-1}} \frac{\Delta^e_t}{\Delta^c_t} \]

\[ \Pi^*_t = \Xi^*_{t-1,t} \left( \frac{L^c_t}{L_t} \right)^{\frac{1}{\theta-1}} \]
1) Cyclicality
2) Firm Dynamism: drop in startup rate and reallocation for incumbent (Decker et al., 2017)
Empirics

- Similarly there is no way this model is going to replicate any evidence regarding the behavior and dispersion of micro data on price changes....

- ...sorry Klaus cheap point

- Idiosyncratic shocks might help?
# Wages

*(Amano et al., 2009; Ascari, Sims, Phaneuf, 2018)*

## Table 3: Welfare Costs of Trend Inflation

<table>
<thead>
<tr>
<th>( \pi^* )</th>
<th>1.0000</th>
<th>1.0200</th>
<th>1.0352</th>
<th>1.0400</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(a) Steady State</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.0000</td>
<td>0</td>
<td>n/a</td>
<td>n/a</td>
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<tr>
<td>1.0200</td>
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<tr>
<td>1.0352</td>
<td>0.0449</td>
<td>0.0263</td>
<td>0</td>
<td></td>
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<tr>
<td>1.0400</td>
<td>0.0557</td>
<td><strong>0.0373</strong></td>
<td>0.0113</td>
<td></td>
</tr>
<tr>
<td><strong>(b) Means</strong></td>
<td></td>
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</tr>
<tr>
<td>1.0000</td>
<td>0</td>
<td>n/a</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>1.0200</td>
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<td>1.0352</td>
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</table>
Wages
(Amano et al., 2009; Ascari, Sims, Phaneuf, 2018)

<table>
<thead>
<tr>
<th>Alternative Specification</th>
<th>$\pi^*$: 1.02 → 1.04</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Steady State</td>
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<tr>
<td>(i) Flexible wages</td>
<td>0.0093</td>
</tr>
<tr>
<td>(ii) No trend growth</td>
<td>0.0210</td>
</tr>
<tr>
<td>(iii) All growth from neutral productivity</td>
<td>0.0375</td>
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<tr>
<td>(iv) All growth from IST</td>
<td>0.0371</td>
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<tr>
<td>(v) Flexible wages, no growth</td>
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<tr>
<td>(vi) Flexible prices</td>
<td>0.0332</td>
</tr>
<tr>
<td>(vii) No RP</td>
<td>0.0316</td>
</tr>
</tbody>
</table>

1) Wage rigidity do matter, price rigidity not much
2) Especially if there is productivity growth
3) Roundabout production also matters
Roundabout/Network => Misallocation

- Misallocation literature is also about productivity differentials
- Network effects are also important
- Large and growing literature...could help nailing down the empirics more convincingly?