Persistence and Nominal Intertia in a Gerneralized Taylor Economy.

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1 Introduction.

- Models of dynamic pricing: NNS

- Two approaches to nominal inertia: Calvo and Taylor.

- *Paradox*: Calvo seems to be much more persistent than Taylor.

- GTE: many sectors, different contract lengths.

- Synthesis of Calvo and Taylor.

- Comparison of Calvo and Taylor: similar persistence when calibrated properly. Difference arises because in Calvo firms uncertain about duration.

- Using US price-data (Bils-Klenow Data set) can get Impulse Response similar to empirical one.

2 The GTE

- Many sectors where the $i-$th sector has a contract length of i periods.

- The share of each sector is given by α_i with $\sum_{i=1}^{N} \alpha_i = 1$.

- Within each sector i, each firm is matched with a firm-specific union and there are i cohorts of equal size.

- Simple Taylor Economy: one sector. Simple Taylor 2 economy $\alpha_2 = 1$: two cohorts, move alternately; simple Taylor 4 $\alpha_4 = 1$.

- Can view as price or wage setting (we do wage setting) - factor mobility (Rochelle Edge).

2.1 The log-linearized Economy.

- Sectoral price level is given by the average wage set in the sector, and the wage is averaged of the i cohorts in sector i:

$$p_{it} = w_{it} = \frac{1}{i} \sum_{j=1}^{i} w_{ijt}$$

$$y_{it} = \theta(p_t - p_{it}) + y_t$$

$$p_t = \sum_{i=1}^{N} \alpha_i p_{it}$$

- Labour supply:

$$w_{it} - p_t = \eta_{LL} h_{it} + \eta_{cc} c_t \tag{1}$$

where $\eta_{cc} = \frac{-U_{cc}C}{U_c}$ (risk aversion), $\eta_{LL} = \frac{-V_{LL}H}{V_L}$ (inverse of the labour elasticity).

- $Y_t = C_t$, marginal cost in terms of sectoral and aggregate output

$$mc_{it} - p_t = \eta_{LL} y_{it} + \eta_{cc} y_t \tag{2}$$

- The growth of money μ is an $AR(1)$ process:.

$$\ln(\mu_t) = v.\ln(\mu_{t-1}) + \xi_t \tag{3}$$

We consider two values: $\nu = 0$ (not a good fit empirically); $\nu = 0.5$ (good fit, standard).

- Wage (Price) setting rule in sector i

$$x_{it} = \frac{1}{\sum_{s=0}^{i-1} \beta^s} \left[\sum_{s=0}^{i-1} \beta^s \left[p_{t+s} + \gamma y_{t+s} \right] \right] \tag{4}$$

where

$$\gamma = \frac{\eta_{LL} + \eta_{cc}}{1 + \theta \eta_{LL}} \tag{5}$$

2.2 Calibration.

- $\beta = 1$; $\eta_{cc} = \frac{-U_{cc}C}{U_c} = 1$; $\eta_{LL} = \frac{-V_{LL}H}{V_L}$ could be high (Pencavel 5).

- Chari et al CKM

$$\gamma^{CKM} = \eta_{LL} + \eta_{cc} = 1.2 > 1$$

- Ascari:

$$\gamma^{A} = \frac{\eta_{LL} + \eta_{cc}}{1 + \theta\eta_{LL}} = \frac{\gamma^{CKM}}{1 + \theta\eta_{LL}}$$

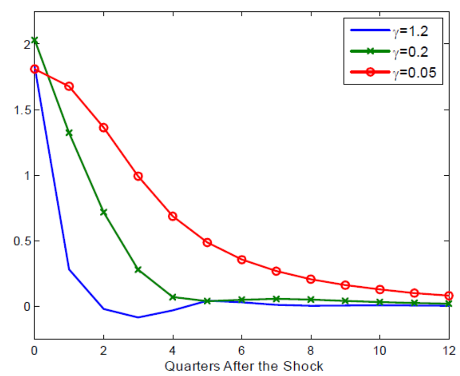
- Wage and Price setting: same γ if firm-specific labour market.

- Other γs : Mankiw and Reis (QJE 2004) "Sticky Information" $\gamma = 0.1$: Coenen et al (JME 2007) $\gamma = 0.023$.

- Emprical estimates (econometric): $\hat{\gamma} = 0.005$ (Fuhrer and Moore 1995): Taylor (1980) $\hat{\gamma} = 0.05$.

2.3 The Problem

- Simple Taylor 2: CKM, Ascari and Taylor. Money Random Walk and 1% shock to money growth.



- CKM: nothing. Ascari better, but still long way from "Taylor".

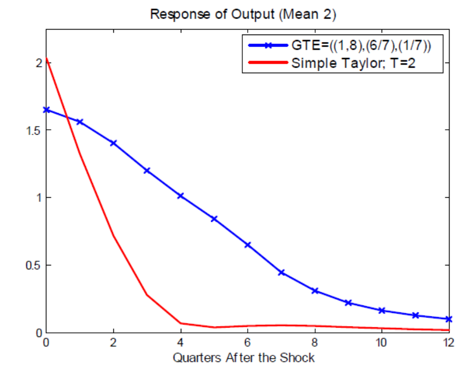
3 Persistence in a GTE.

- Simple two sector GTEs.

- Strategic complementarity: the presence of longer contracts slows down the shorter contracts. More nominal rigidity means more output persistence.

- Mean preserving spreads. $\bar{T} = 2 : \alpha_8 = 1/7; \alpha_1 = 6/7$. $\bar{T} = 3 : \alpha_2 =$

$5/6; \alpha_8 = 1/6$

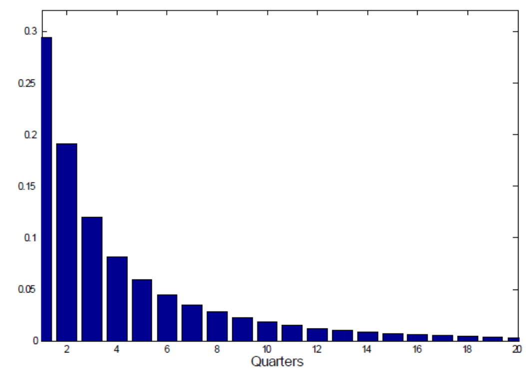


- Same average length of contracts: presence of "long" infects shorter contracts and leads to more output persistence.

4 Persistence in BK-GTE.

- The period 1995-7, 350 categories account for 69% of the CPI.

- Mean $\bar{T} = 4.4$



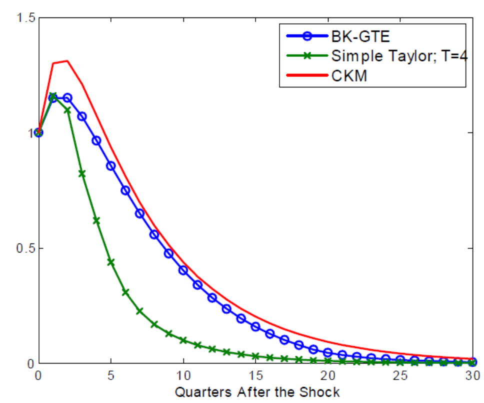
- US data: CKM: AR(2) process to quadtractically detrended log of real GDP:

$$y_t = 1.30 y_{t-1} - 0.38 y_{t-2} + \xi_t$$

This gives IR :Persistent: half life of output is 10Q.

- Money supply: $\nu = 0.5$ (CKM, CEE).

- BK-GTE: $\gamma = 0.2$. Comparison simple Taylor 4 and CKM estimate.



- $BK - GTE$ generates a hump-shaped persistent output response and the half life is about 10 quarters. Consistent with the data!

- CKM: "*contract multiplier*" the ratio of the half life of output to one-half length of average contract.

- Dotsey and King "*mean lag*" the ratio of

$$\left(\sum_{j=0}^{\infty} j * \kappa_j \right) / \sum_{j=0}^{\infty} \kappa_j$$

  where κ_j is the impluse response coefficient for output at lag j

	BK-GTE	**Taylor; T = 4**	**CKM IR**
Contract Multiplier	4.4	2.6	
Mean Lag	5.7	2.7	6.6

Table 1: Persistence Measures

5 Calvo and Taylor.

- With a reset probability the cross-sectional distribution is represented by the vector of proportions α_i^s of firms surviving at least i periods:

$$\alpha_i^s = \omega \left(1 - \omega\right)^{i-1} : i = 1..\infty \tag{6}$$

with mean $\bar{s} = \omega^{-1}$. In demographic terms, i is the *age* of the contract: α_i^s is the proportion of the population of age s; $\bar{s}$ is the average age of the population.

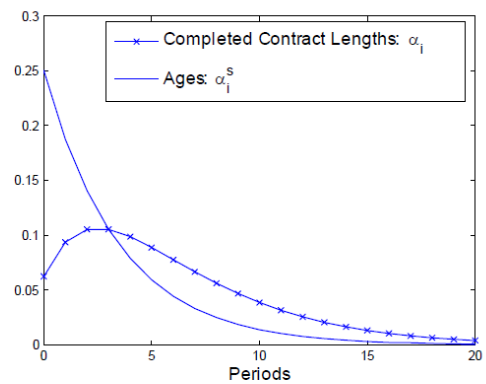
- The corresponding distribution of *completed* contract lengths is given by:

$$\alpha_i = \omega^2 i \left(1 - \omega\right)^{i-1} : i = 1..\infty \tag{7}$$

with mean $\bar{T} = \frac{2-\omega}{\omega}$. (Dixon and Kara *JMCB* 2006).

- Average across firms is given by (7).

- Distribution for $\omega = 0.25$: $\bar{T} = 7, \bar{s} = 4$.



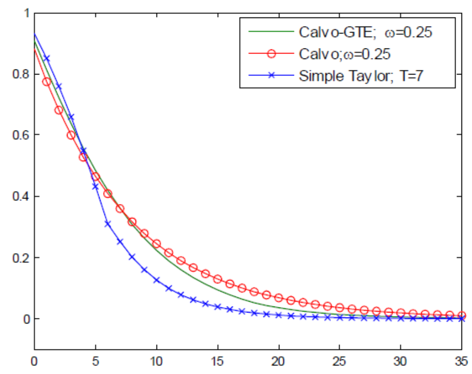
- Puzzle: why is Calvo more persistent than Taylor.
  - The models have calibrated the wrong thing: reset probability $\omega = 0.5$ compared with Simple Taylor 2.

  - There is a distribution of contract lengths: longer contracts make the economy more sluggish in nominal terms.

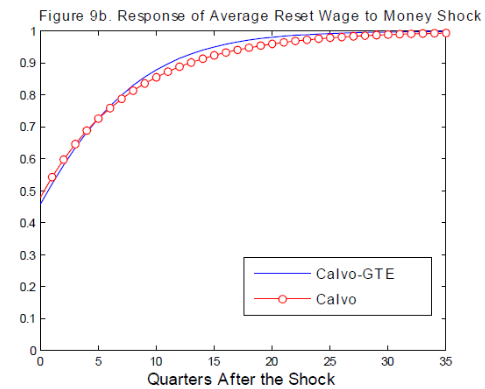
- Calvo: when the firm sets wage/price, does not know how long it will last (imperfect information). Only finds out after it sets the wage/price.

- Calvo more forward looking: Taylor, ignore what happens when contract finishes (start a new one).

- Calvo-GTE: same distribution as Calvo, but firms know how long contract lasts:



- Quite similar IRFs, but output is a bit larger earlier on (until 6Q) for Calvo-GTE. This is because wages and prices initially respond more in Calvo case (more forward looking).



- Multiple Calvo economy (Bils-Klenow).

5.1 Carvalho: multiple calvo.

- Carlos Carvalho (2006), there are many sectors each with a calvo process (heterogeneity).

- Derives NKPC with hetrogeneity: sectoral $\omega_i's$.

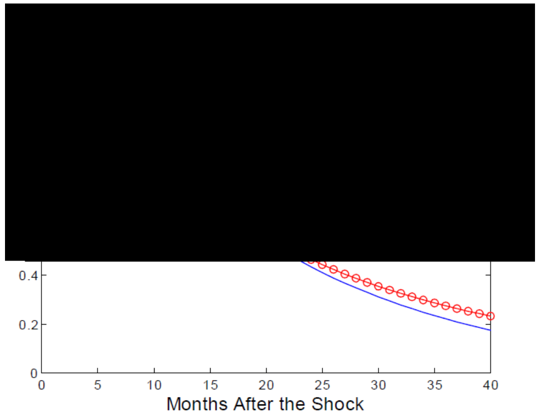
- Derive NKPC for each sector:

$$\begin{aligned} \pi_{it} &= E_t \pi_{it-1} + \gamma_i y_{it} \\ \gamma_i &= \left[\frac{\omega_i \left(\left(1 - \left(1 - \omega_i \right) \beta \right) \right)}{1 - \omega_i} \right] \gamma \end{aligned}$$

- Aggregate inflation:

$$
\begin{aligned}
\pi_t &= \sum_{i=1}^{n} \alpha_i \pi_{it} \\
&= \sum_{i=1}^{n} \alpha_i E_t \pi_{it+1} + \sum_{i=1}^{n} \alpha_i \gamma_{it} y_{it} \\
&= E_t E_t \pi_{t+1} + \bar{\gamma}.y_t + \sum_{i=1}^{n} \alpha_i (\gamma_{it} - \bar{\gamma}) y_{it}
\end{aligned}
$$

- BK multiple calvo vs BK GTE:



6 Conclusions.

- A small proportion of long-term contracts can generate a significant increase in persistence.

- If we use the Bils-Klenow Data set on prices, can get a realistic IR which fits in with the data despite an average contract length of only 4.4Q. Similar to CKM.

- Solution to Calvo Paradox: correct calibration and distribution.

- If you want to use a simple Taylor economy to represent a complex economy, then choose an average length in excess of actual average ($T = 8$).