Leaning Against the Credit Cycle*

Paolo Gelain Kevin J. Lansing
Norges Bank FRBSF
Gisle J. Natvik
BI Norwegian Business School

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Motivation

- Recent monetary policy discussion: Emphasis on debt
  - Credit typically moves gradually and persistently over time
    - The "Credit cycle" (Aikman, Haldane and Nelson (2013), Drehman, Borio, Tsatsaronis (2012), etc.)
  - Debt matters for the risk and cost of crises (Schularik and Taylor (2010))
  - Svensson (2013): Interest rate hikes likely to raise debt-to-GDP ratio
    - Do not address a high debt-to-GDP ration with high interest rates

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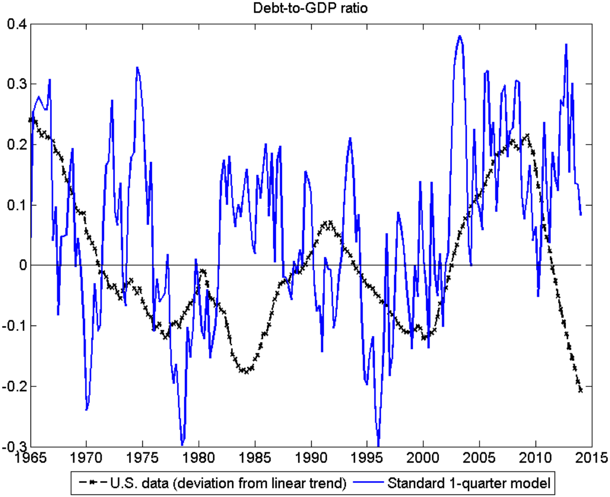
  - Debt matters for the risk and cost of crises (Schularik and Taylor (2010))
  - Svensson (2013): Interest rate hikes likely to raise debt-to-GDP ratio
    - Do not address a high debt-to-GDP ration with high interest rates
- Problem: Standard DSGE models used for monetary policy analysis do not account well for debt dynamics
  - Key assumption: One-quarter debt contract - all debt is fully amortized each period

Households debt dynamics

Standard model fails to capture the persistence in the data



Our paper

- Develop a simple New Keynesian DSGE model with reasonable debt dynamics
  - Collateral constraint (Iacoviello (2005))
  - Long term debt - only new loans constrained
- Study monetary policy in that environment
  - What is the likely effect of an interest rate hike on the aggregate debt burden?
  - What are the consequences of mechanically raising the interest rate in response to debt

Our paper

Result preview

- Develop a simple New Keynesian DSGE model with reasonable debt dynamics
  - Autocorrelation of debt closer to U.S. data
  - Cross-correlations and lead-lag relationships of debt with inflation, house prices, interest rate and GDP closer to U.S. data
- Study monetary policy in that environment
  - What is the likely effect of an interest rate hike on the aggregate debt burden?
    - Short-run increase, medium-run decline
  - What are the consequences of mechanically raising the interest rate in response to debt?
    - Indeterminacy
    - Debt more volatile
    - Responding to debt growth preferable to debt level

Related literature

- "Credit cycle": Drehman et al. (2012), Aikman et al. (2013), Strohsal et al. (2015), Iacoviello (2015)
- Policy rate and debt-to-GDP: Svensson (2013), Laséen and Strid (2013), Robstad (2014), Alpanda and Zubairy (2015)
- Multiperiod debt model: Rubio (2011), Kydland et al. (2012), Justiniano et al. (2013), Gelain et al. (2015), Garriga et al. (2013), Calza et al. (2013), Brzoza-Brzezina et al. (2014), Andrées et al. (2014), Chen et al. (2013)
- Debt and inflation: Mason and Jayadev (2014), Gomes et al. (2014)

Outline of the presentation

- Model
- Calibration
- Simulations
- Policy implications
- Conclusions

Simple NK model with housing and long term debt

- Two households types: Savers (patient) Borrowers (impatient)
    - Borrowers are subject to collateral constraint on new loans only
    - Reduced form law of motion for amortization rate as in Kydland, Rupert, and Sustek (2012)
- Firms owned by savers
- Fixed supply of houses
- Calvo-pricing
- Habits and price indexation

Borrowers problem

Borrowers maximize

$$\max_{c_{b,t},\, h_{b,t}, L_{b,t},\, b_{b,t},\, \delta_t} \; E_0 \sum_{t=0}^{\infty} \beta_b^t U_t(c_{b,t}\, h_{b,t}, L_{b,t}),$$

subject to the following constraints

$$c_{b,t} + q_t h_{b,t} + \frac{r_{t-1} + \delta_{t-1}}{\pi_t} b_{b,t-1} = w_{b,t} L_{b,t} + q_t h_{b,t-1} + l_{b,t},$$

$$b_{b,t} = (1 - \delta_{t-1})\, b_{b,t-1} + l_{b,t}, \qquad l_{b,t} = \text{New loans}$$

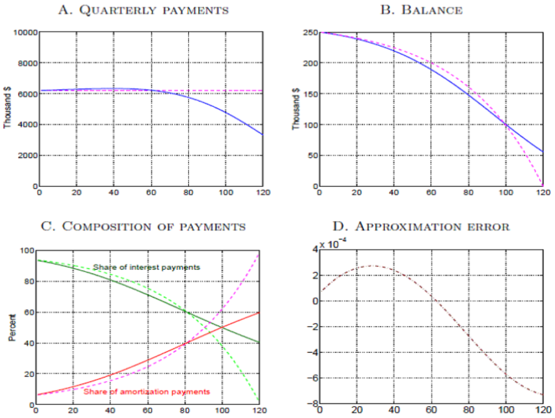
$$\delta_t = \left(1 - \frac{l_{b,t}}{b_{b,t}}\right) \delta_{t-1}^{\alpha} + \frac{l_{b,t}}{b_{b,t}} (1 - \alpha)^{\kappa}$$

$\alpha \in [0, 1)$ and $\kappa > 0$ are parameters.

Payment schedule: Model vs. 30-year mortgage

From Kydland, Rupert, and Sustek (2012), NBER Working Paper 18432.

Solid line: Model. Dashed line: 30-year mortgage schedule.



Borrowers problem (continued)

Borrowers maximize

$$\max_{c_{b,t},\, h_{b,t}, L_{b,t},\, b_{b,t},\, \delta_t} \quad E_0 \sum_{t=0}^{\infty} \beta_b^t U_t(c_{b,t}\, h_{b,t},\, L_{b,t}),$$

subject to the following constraints

$$c_{b,t} \; + \; q_t h_{b,t} \; + \; \frac{r_{t-1} + \delta_{t-1}}{\pi_t} b_{b,t-1} \; = \; w_{b,t} L_{b,t} + \; q_t h_{b,t-1} + l_{b,t}, \qquad (1)$$

$$b_{b,t} \; = \; (1 - \delta_{t-1})\, b_{b,t-1} \; + \; l_{b,t}, \qquad l_{b,t} \; = \; \text{New loans} \qquad (2)$$

$$\delta_t = \left(1 - \frac{l_{b,t}}{b_{b,t}}\right) \delta_{t-1}^{\alpha} + \frac{l_{b,t}}{b_{b,t}} (1-\alpha)^{\kappa} \qquad (3)$$

NB! 1 and 2 imply:

$$c_{b,t} \; + \; q_t\, (h_{b,t} - h_{b,t-1}) = \; w_{b,t} L_{b,t} + b_{b,t} - \frac{R_{t-1}}{\pi_t} b_{b,t-1}, \qquad R_t = 1 + r_t$$

Borrowers problem (continued)

Collateral constraint

Why does δ_t matter?

$$l_t \leq m \underbrace{\left[\frac{E_t\left[q_{t+1}\pi_{t+1}\right]h_{b,t}}{R_t} - b_{b,t}\right]}_{\text{Next period home equity.}}$$

which combined with equation 2 in the previous slide (i.e. debt law of motion) gives

$$b_{b,t} = \frac{m}{1+m}\frac{E_t\left[q_{t+1}\pi_{t+1}\right]h_{b,t}}{R_t} + \frac{1-\delta_{t-1}}{1+m}\frac{b_{b,t-1}}{\pi_t}$$

- Debt $b_{b,t}$ becomes persistent
- Relation between debt $b_{b,t}$ and expected inflation $E_t\left[\pi_{t+1}\right]$ changes with respect to the 1-quarter model

Model parameter values

- Steady state targets
  - Share of liquidity constrained, relative hours worked and relative labor incomes in Justiniano, Primiceri and Tambalotti (2013) (n,$\nu_{l,l}$,$\nu_{l,b}$,ϖ)
  - Ratio of housing wealth to yearly consumption in Iaccoviello and Neri (2010) (ν_h)
  - Approximate 30-year annuity loan contract, as in Kydland, Rupert, Sustek (2013) (κ,α)

Parameters Value							
β_l	0.99	φ	1	ε	6	m	0.0446
β_b	0.97	ϵ	0.5	θ	0.75	ρ_z	0.9
ν_h	0.0839	n	0.61	ι	0.5	ρ_{cp}	0.9
$\nu_{l,l}$	0.1055	ϖ	0.5	κ	1.0487	ϕ_π	1.5
$\nu_{l,b}$	0.2218	ξ	0.33	α	0.0059	ϕ_y	0.75

Moments comparison: U.S. data vs. baseline model

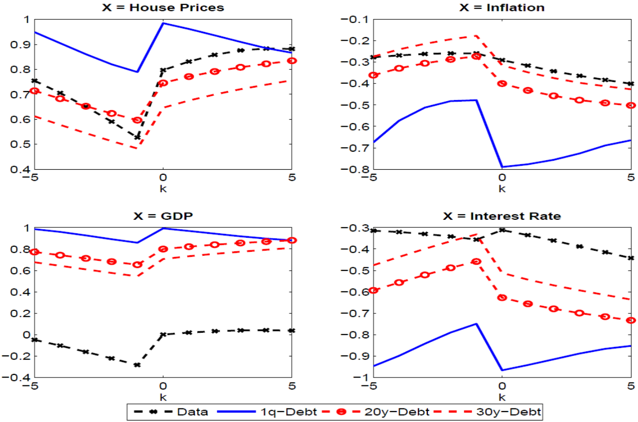
Baseline model fits debt-to-GDP autocorrelation better than the 1-quarter model

Moment	Data	30-year model	20-year model	1-quarter model
B/Y autocorrelation 1	0.9940	0.9979	0.9975	0.9544
B/Y autocorrelation 2	0.9818	0.9929	0.9913	0.9231
B/Y autocorrelation 3	0.9642	0.9855	0.9820	0.8970

Simulations are done with tfp shock only and data are linearly detrended.

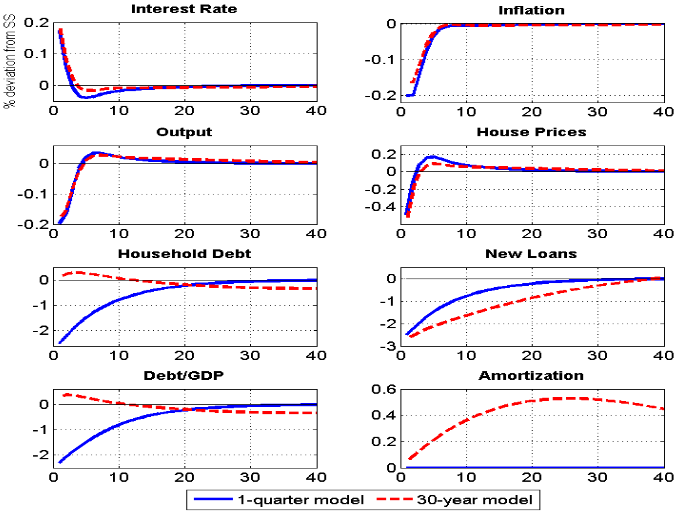
Moments comparison: U.S. data vs. baseline model

Baseline model fits cross-correlations better than the 1-quarter model



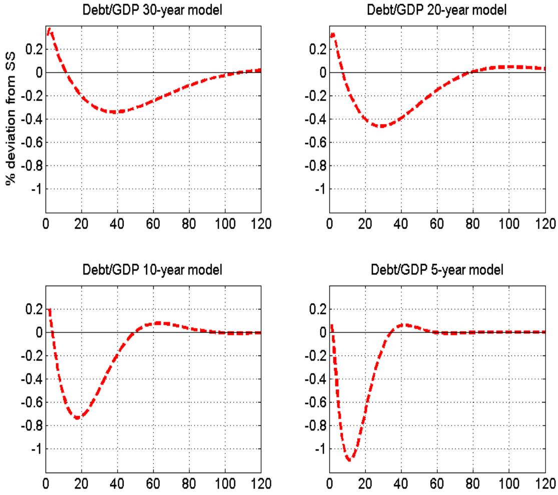
Correlation between variable X at time t and household debt and time $t+k$.

Monetary policy shock



Debt response to monetary policy shock

Debt-to-GDP increases significantly only if the loan duration is long enough

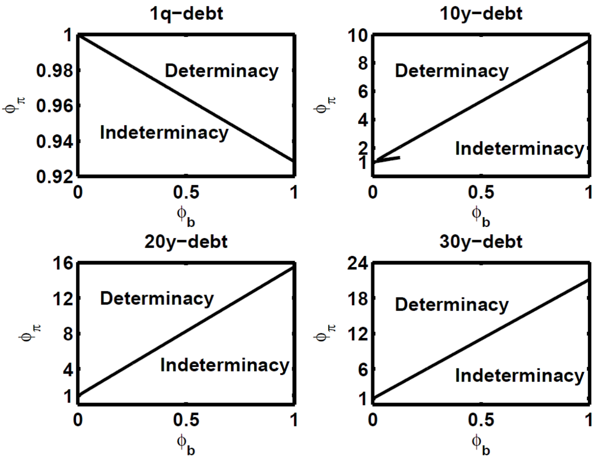


Policy Implications

- Svensson 2013: Higher policy rate increases the debt burden - therefore it is wrong to use monetary policy to stabilize debt.
- But: Even if a higher policy rate increases the stock of real debt, the policy implication is unclear
- The question: What are the consequences of letting the interest rate systematically respond to debt?
- Simple policy rule

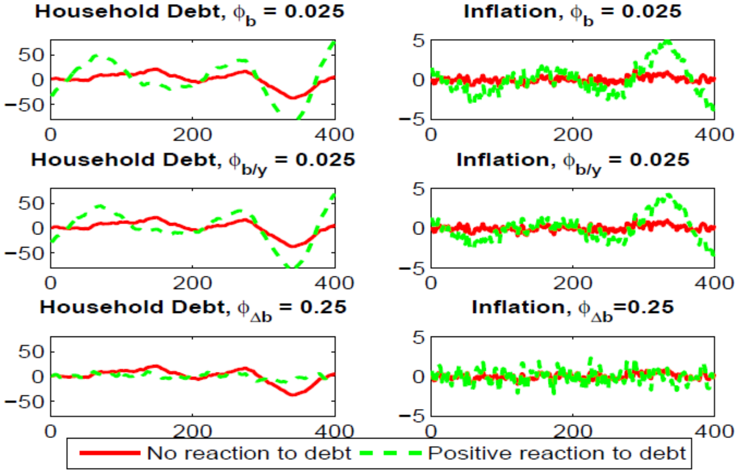
$$R_t = (1 + r)\, \pi_t^{\phi_\pi} \left(\frac{b_{b,t}}{\bar{b}_b} \right)^{\phi_b}$$

Determinacy analysis - reacting to the real debt level



$$b_{b,t} = \frac{m}{1+m}\frac{E_t\left[q_{t+1}\pi_{t+1}\right]h_{b,t}}{R_t} + \frac{1-\delta_{t-1}}{1+m}\frac{b_{b,t-1}}{\pi_t}$$

Reacting to Debt Level vs Debt Growth, 30-year model



Conclusions

- A tractable model with realistically gradual amortization process captures persistent nature of debt dynamics à la "credit cycle"
  - Other macro variables unaffected by debt dynamics unless monetary policy emphasizes debt
- Monetary policy implications
  - Policy tightening likely to raise households' debt burden in the short run (à la Svensson)
    - but also likely to reduce the debt burden in the medium run
  - Mechanically increasing the interest rate in response to debt (or debt-to-GDP) level causes equilibrium indeterminacy
    - Opposite under 1-quarter model
    - Destabilizes debt itself
    - Better to respond to debt growth