



Going With the Flows

New Borrowing, Debt Service and the Transmission of Credit Booms

Mathias Drehmann (BIS), Mikael Juselius (BOF), and
Anton Korinek (University of Virginia)

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Introduction

- Key unanswered question in macro after GFC:
 - Why are credit booms are followed by endogenous reversals?
- We show that the transmission mechanism relies crucially on the **financial flows** between borrowers and lenders
 - Long-term debt and auto-correlated new borrowing generate highly predictable path of debt service
 - New borrowing and debt service explain majority of real effects from credit booms
- This implies endogenous and highly predictable boom-bust dynamics

Related literature

- Credit booms are followed by endogenous reversals and crises:
 - Schularick & Taylor (2012); Mian & Sufi (2014, 2018); Mian et al. (2013, 2017)
- Credit related slumps are remarkably deep and protracted:
 - Claessens et al. (2012); Jorda et al. (2013)
- Theoretical work on real effects of financial transfers:
 - Eggertsson & Krugman (2012); Farhi & Werning (2016); Korinek & Simsek (2016); Guerrieri & Lorenzoni (2017)

Contributions

- **We show:** *net borrowing* (new borrowing - debt service) follows a boom-bust pattern
 - Familiar analytical framework for debt compounding
 - Long term debt and auto-correlated new borrowing
- **We construct:** aggregate series for new borrowing and debt service for a panel of 17 countries, 1980-2015
- **We confirm:** lead-lag pattern from new borrowing to debt service
- **We document:** real effects of these variables
 - New borrowing: positive short-run; negative medium-run
 - Debt service: strong short-run negative effect
- **New approach:** tracing role of new borrowing and debt service in GDP impulse-response to credit supply and MP shocks
 - Account for large share of real effects

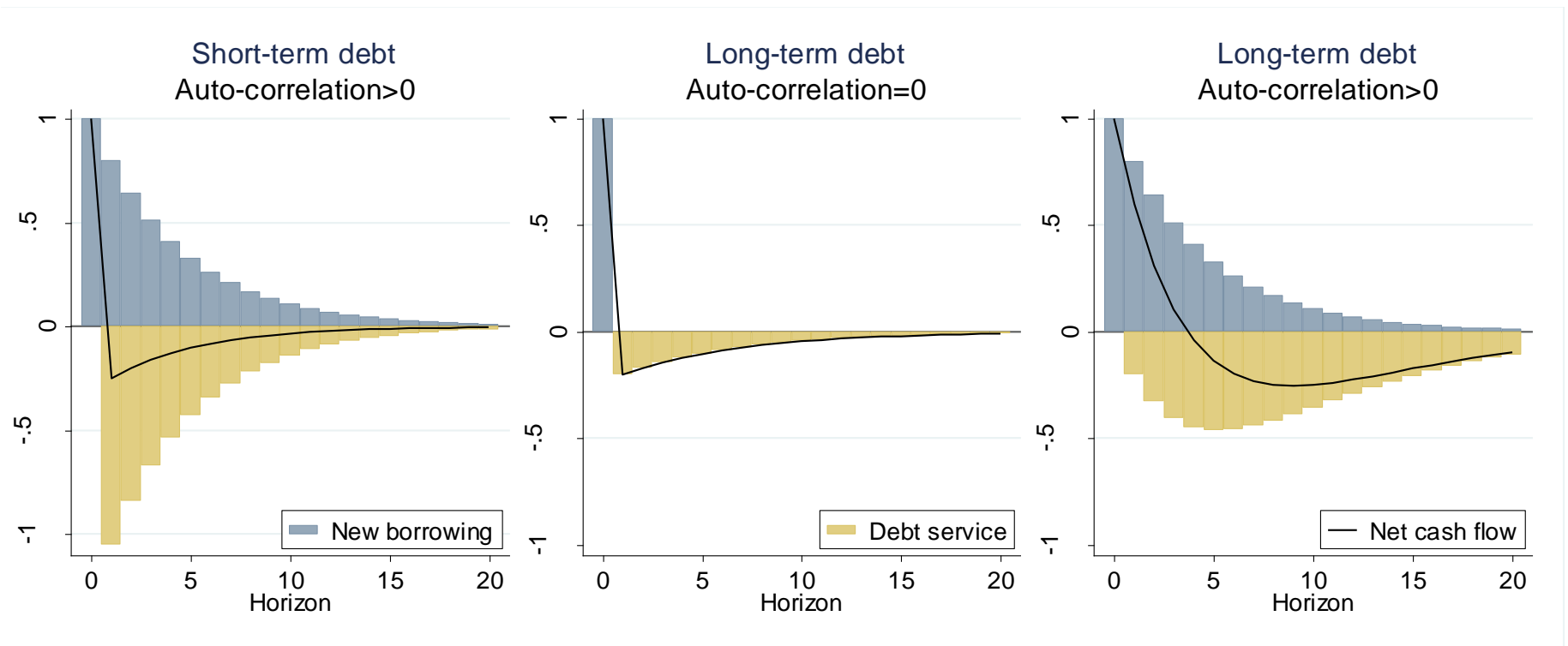
Debt compounding framework

- Borrowers take on long-term debt, B_t
- For simplicity: fixed interest and amortization rates r and δ
- Debt stock, D_t (with $D_0 = 0$) evolves as

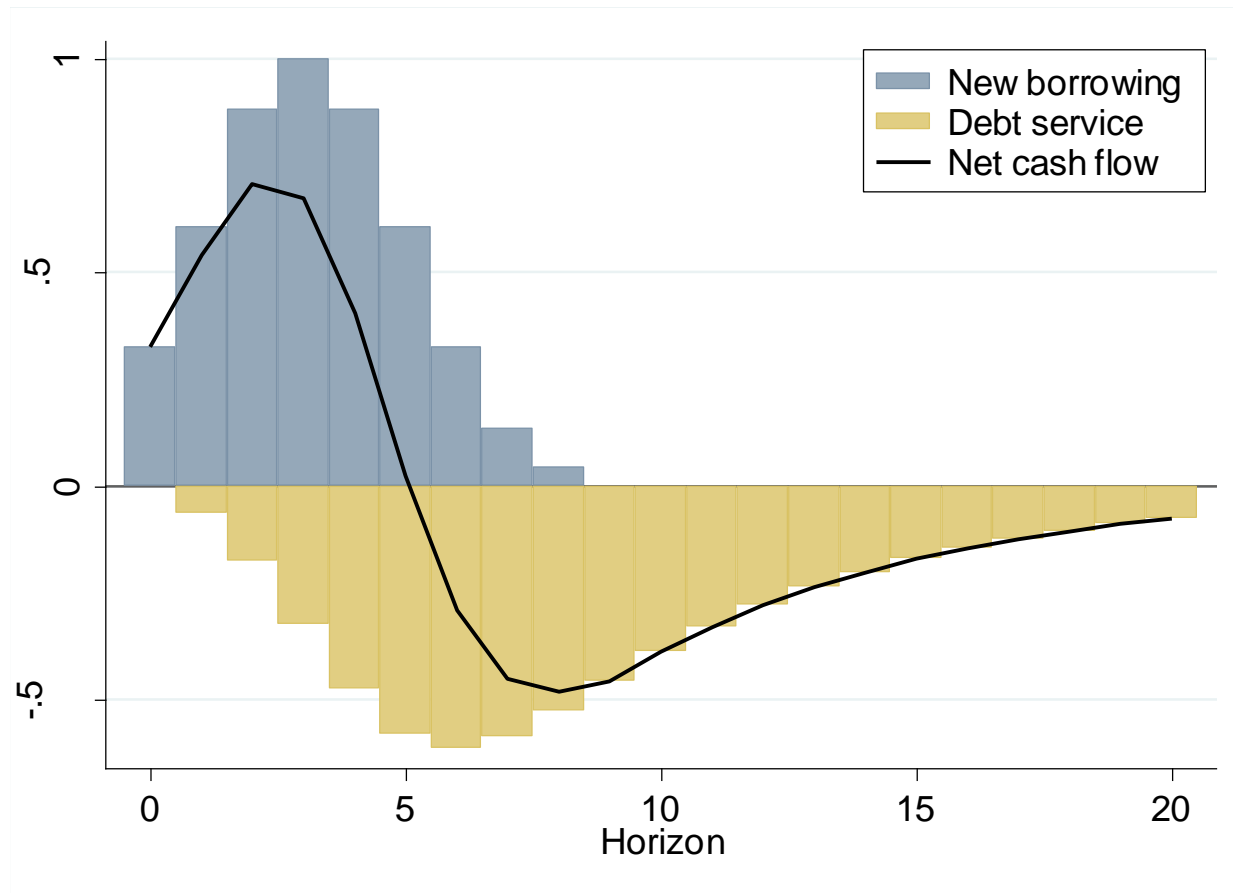
$$\begin{aligned} D_t &= (1 - \delta)D_{t-1} + B_{t-1} \\ &= \sum_{j=0}^{t-1} (1 - \delta)^{t-j-1} B_j \end{aligned}$$

- Debt service: $S_t = (r + \delta)D_t$
- Net borrowing: $N_t = B_t - S_t$

Lead-lag pattern of debt flows



More general credit boom



$\delta = 0.15; r = 0.05$

Measurement

- Accounting framework
 - New borrowing: change in debt stock + amortizations
 - Debt service: Interest payments + amortizations
- Data requirement:
 - Household debt stock, $D_{i,t}$ (available from BIS)
 - Interest payments by households (from national accounts)
 - Impute amortizations for broad loan categories (eg mortgages, consumer loans,..) based on maturity and lending rate data (national data sources)

Data

- Panel of 17 advanced economies from 1980-2015 (annual)
- Household
 - *New borrowing*, $b_{i,t} = B_{i,t}/Y_{i,t}$
 - *Debt service*, $s_{i,t} = S_{i,t}/Y_{i,t}$
- Outcome variable:
 - Real GDP growth, $\Delta y_{i,t}$

Controls

(i) Only GDP	(ii) Baseline	(iii) Additional controls
real GDP growth	real GDP growth	baseline controls
	real 3m money market rate	unemployment growth
	lending spread on mortgages	Δ real effective exchange rate
	growth in real residential property prices	Δ current account
		productivity growth
		1y ahead GDP forecast
		term spread
		corporate credit spread
		net worth
		Δ loan loss provisions
<i>Dummies</i>		
country fixed effects	country fixed effects	country fixed effects
	crisis dummy (1 if banking crisis starts)	crisis dummy (1 if banking crisis starts)
	global financial crisis (1 in 2009)	global financial crisis (1 in 2009)

Statistical methods

- We use local projections (Jorda (2003)):

$$z_{t+h|t} = \mu_{h+1} + A_{h+1}z_{t-1} + v_{t,t+h}$$

- The impulse response function of a shock, d , is then

$$IR(z_{t+h}, d) = \hat{A}_h d$$

- To keep track of the contribution of new borrowing and debt service in $IR(.)$ from $t+h-1$ to $t+h$ we use the approximation:

$$\begin{aligned}\hat{z}_{t+h|t} &= \hat{\mu}_{h+1} + \hat{A}_{h+1}z_{t-1} \\ &= \hat{\mu}_{h+1} + \hat{A}_1\hat{A}_h z_{t-1} + (\hat{A}_{h+1} - \hat{A}_1\hat{A}_h)z_{t-1} \\ &\approx \hat{\mu}_{h+1} + \hat{A}_1\hat{A}_h z_{t-1}\end{aligned}$$

- The impulse response function of a shock, d , is then

$$IR(z_{t+h}, d) = \hat{A}_h d_i \approx \hat{A}_1\hat{A}_{h-1}d = \hat{A}_1 IR(z_{t+h-1}, d)$$

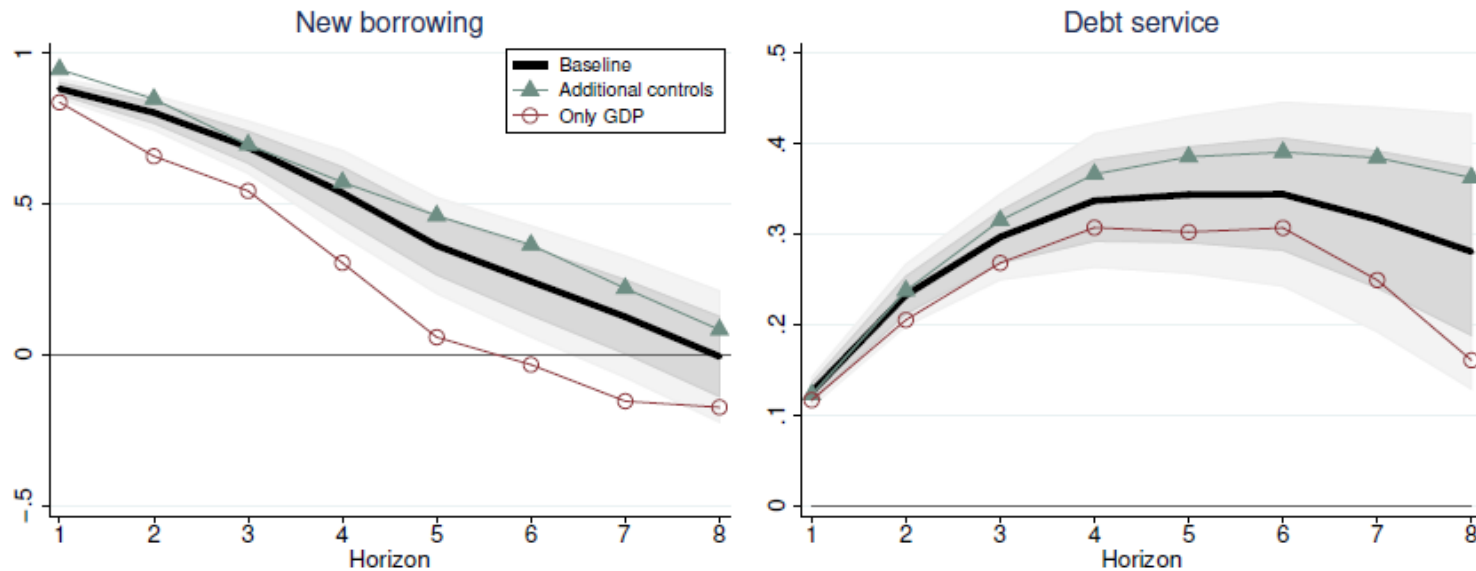
Reduced-form and structural shocks

- Reduced-form shocks, ε_t , and structural shocks, ξ_t , are related via $\varepsilon_t = B^{-1}\xi_t = D\xi_t$, where B is a structural matrix
- Let d_j be the j :th column of D corresponding to a particular structural shock, then

$$IR(z_{t+h}, d_j) = \hat{A}_h d_j = \hat{A}_h \left(\sum_{i=1}^n d_{ij} e_i \right) = \sum_{i=1}^n d_{ij} IR(z_{t+h}, e_i)$$

- Where d_{ij} is the i :th element of d_j , and e_i is a unit-vector with 1 as its i :th element
- $IR(z_{t+h}, e_i)$ is the impulse-response from a reduced-form shock!
- Interpretation is the issue, not endogeneity/exogeneity
 - Reduced-form shocks are linear combinations of structural shocks via $\varepsilon_t = B^{-1}\xi_t$, and therefore exogenous as well

Lead-lag between borrowing and debt service in data

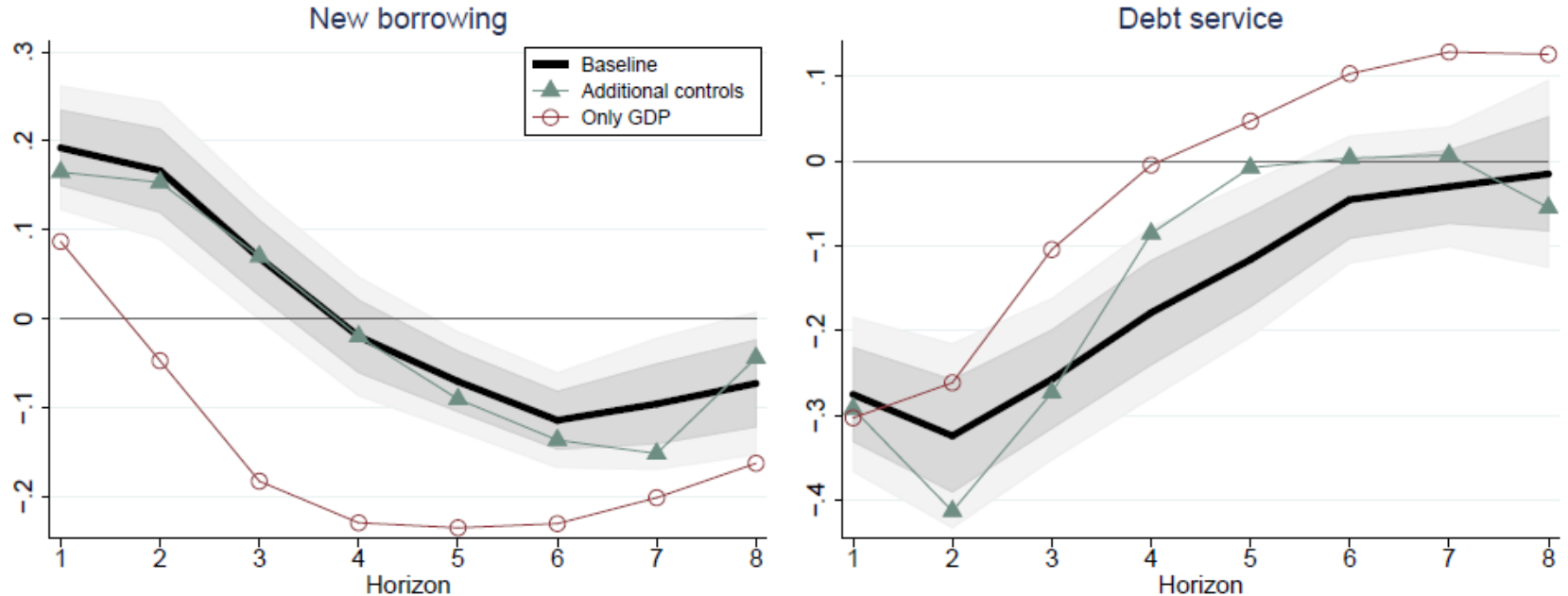


- Local projections:

- $b_{i,t+h} = \mu_{b,i}^h + \beta_{bb}^h b_{i,t} + \beta_{bs}^h s_{i,t} + controls + \epsilon_{b,i,t+h}^h$

- $s_{i,t+h} = \mu_{s,i}^h + \beta_{sb}^h b_{i,t} + \beta_{ss}^h s_{i,t} + controls + \epsilon_{s,i,t+h}^h$

Response of output growth to credit supply shock

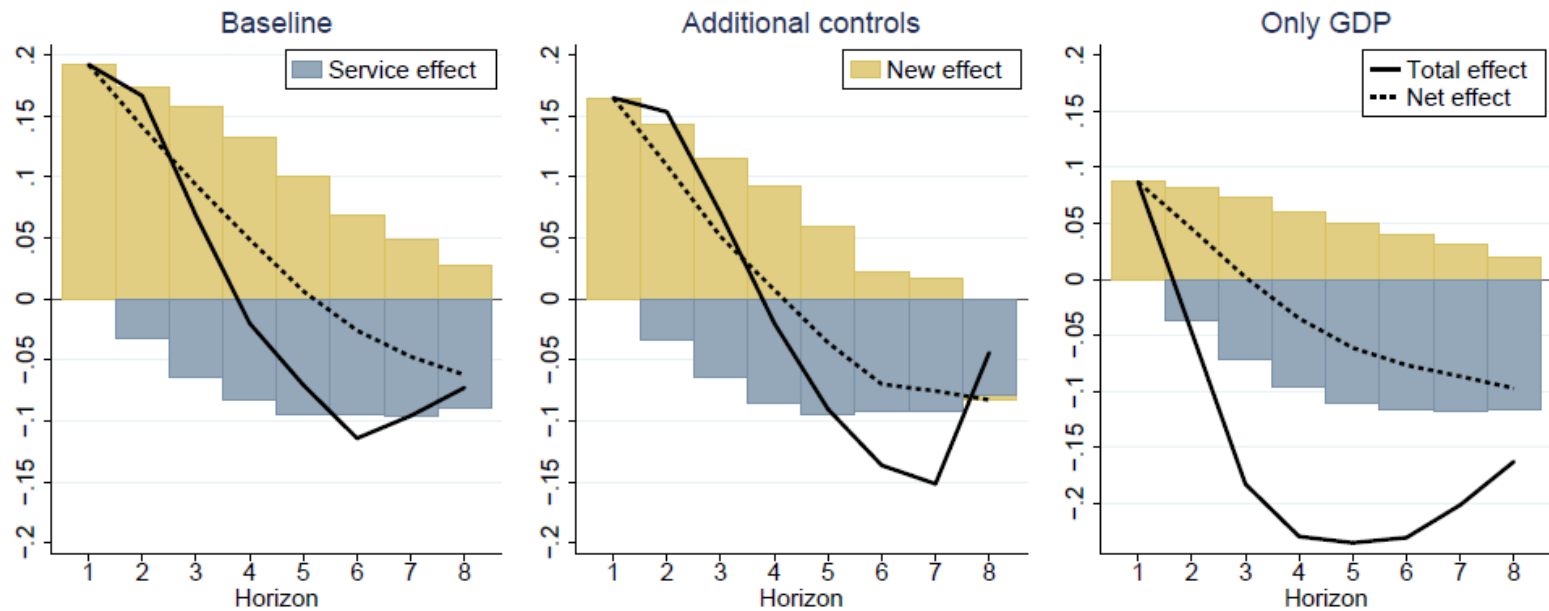


- Local projection:

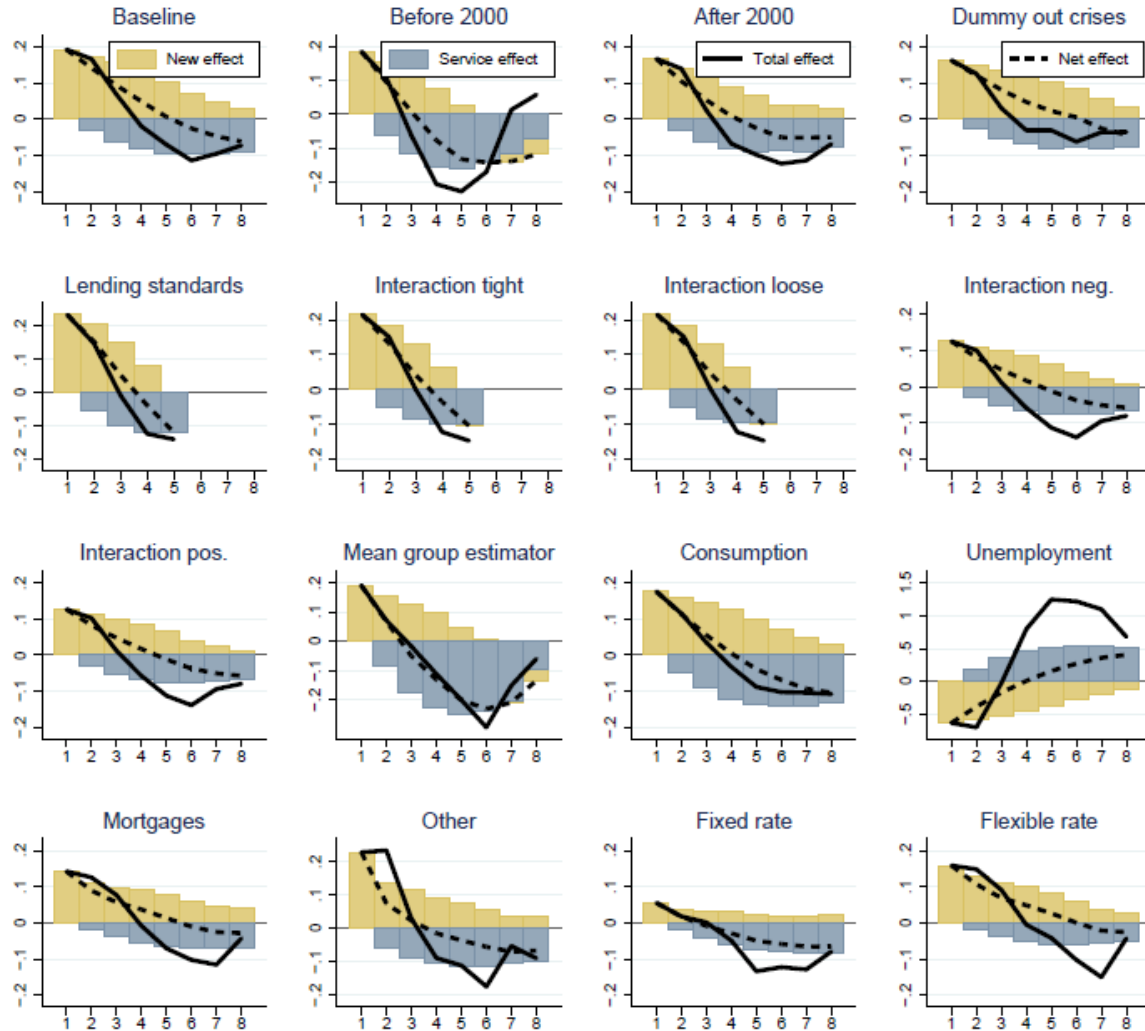
$$- \Delta y_{i,t+h} = \mu_{y,i}^h + \beta_{yb}^h b_{i,t} + \beta_{ys}^h s_{i,t} + controls + \epsilon_{y,i,t+h}^h$$

- New borrowing: positive short- but negative medium-run effects
- Debt service strong negative short-run effect

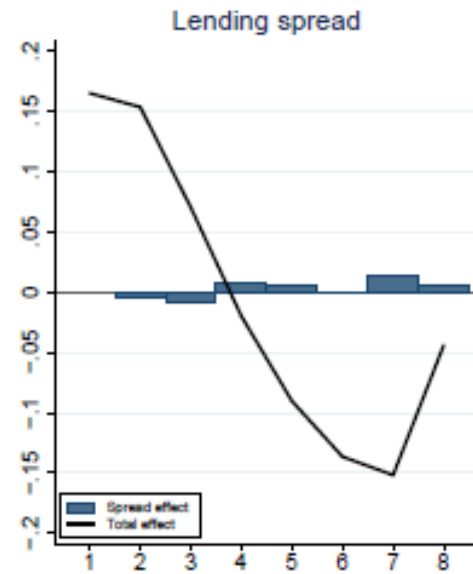
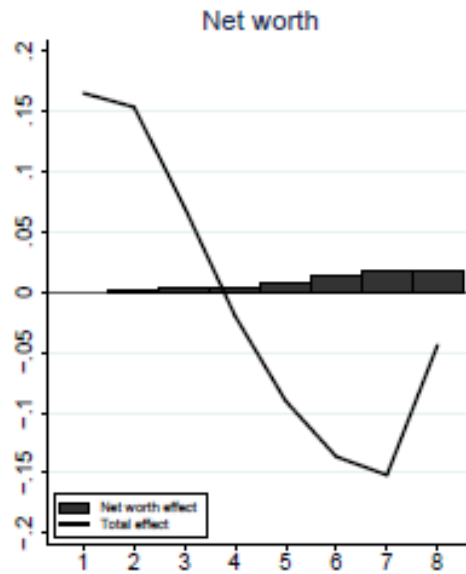
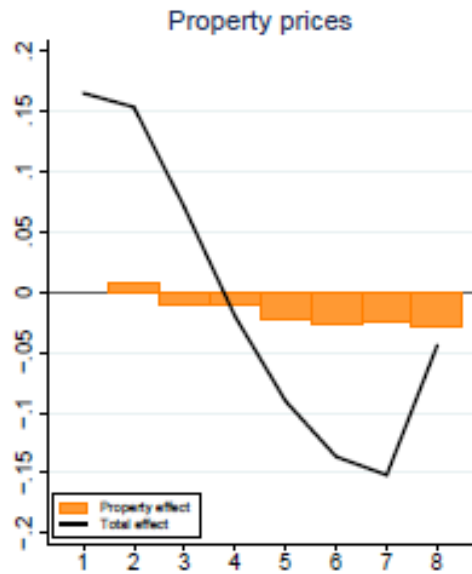
Increased debt service largely accounts for lower output growth



Robustness

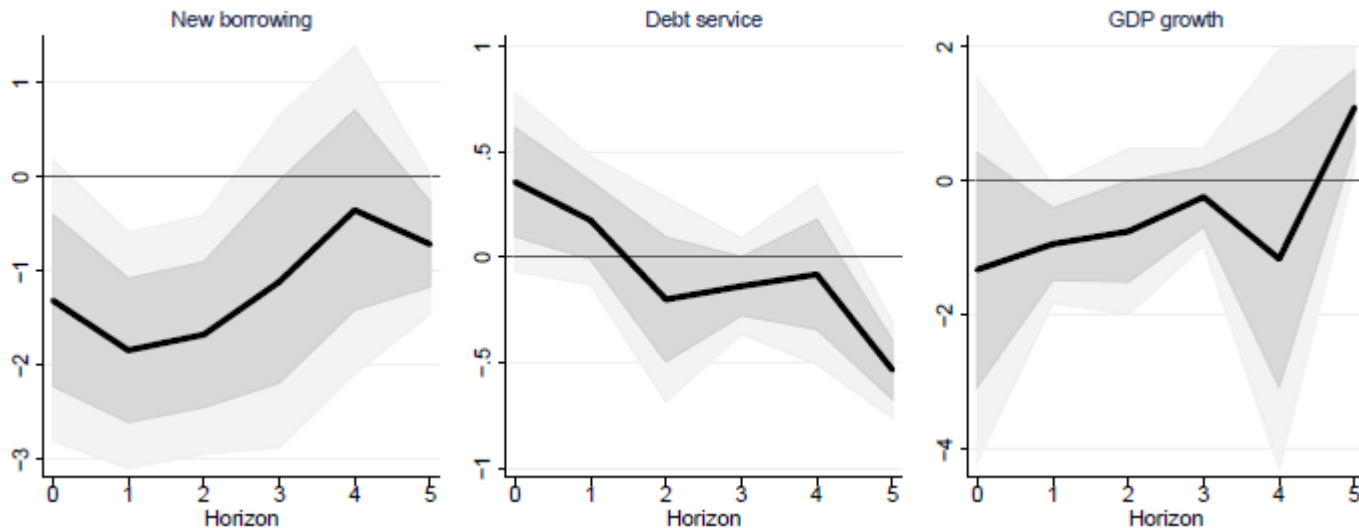


Other effects

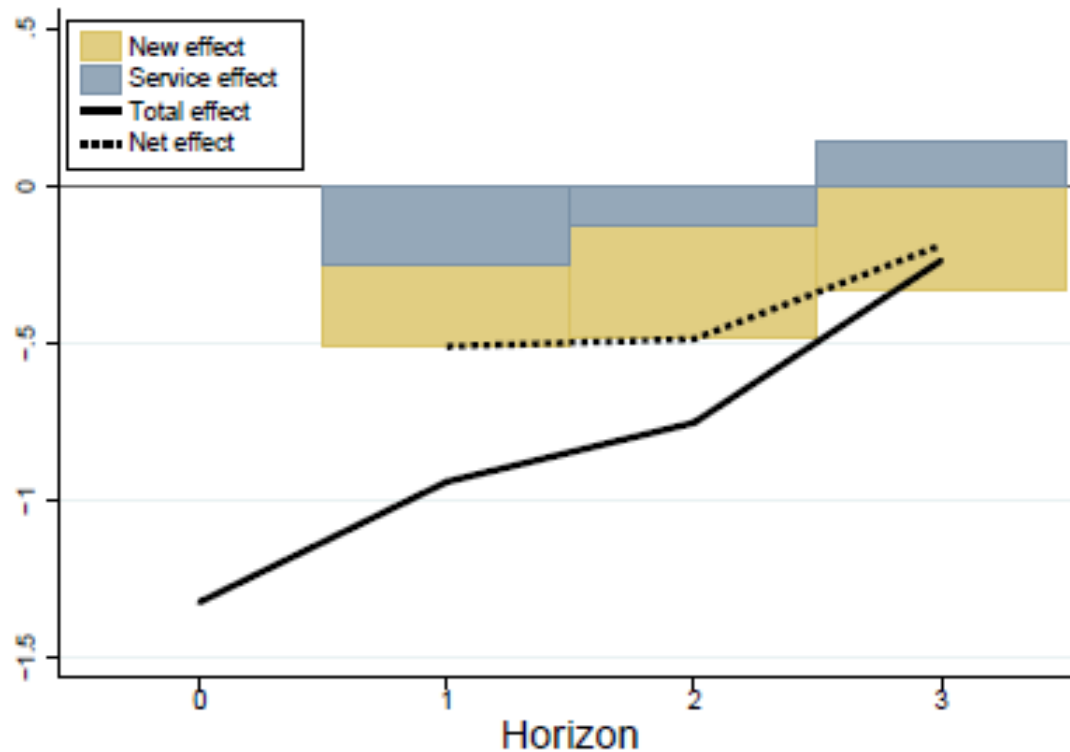


Effect of MP shocks

- LP-IV estimator with high-frequency MP shocks as instrument
 - Term-structure shocks from Swanson (2015) and Ferrari et al. (2017)



Contribution from new borrowing and debt service

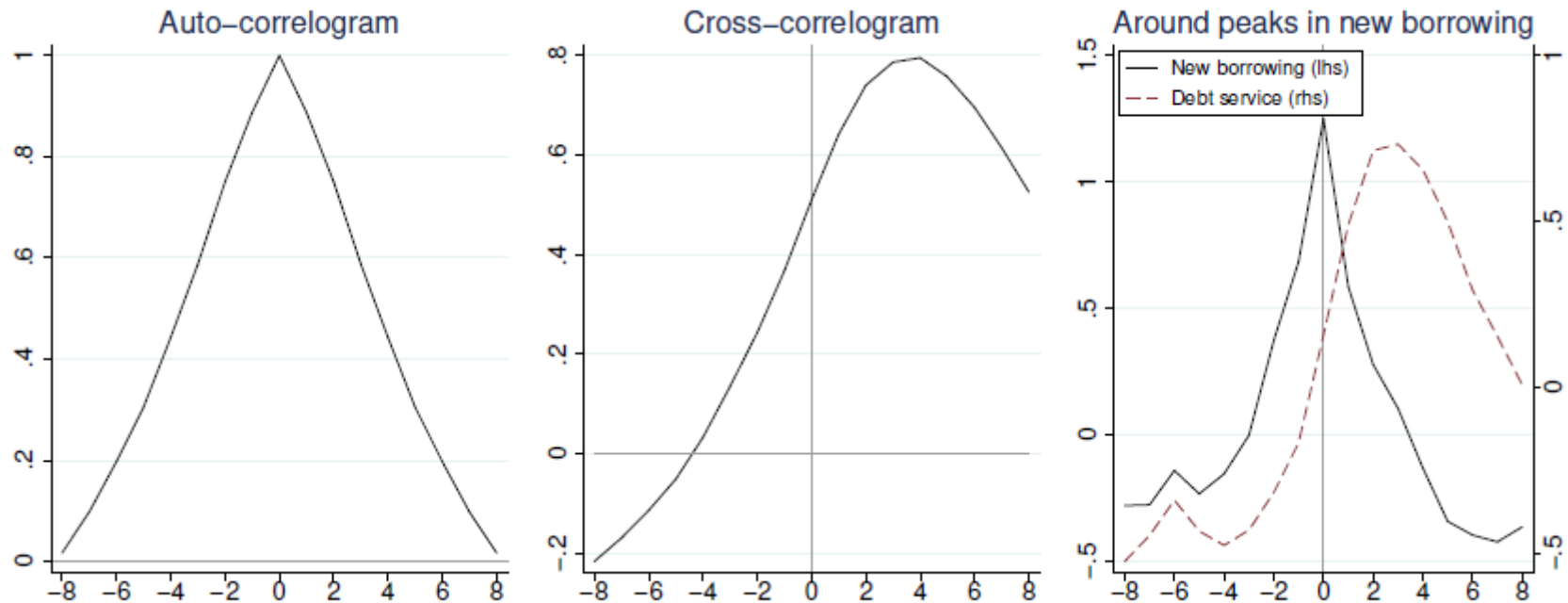


Conclusion

- Flows between borrowers and lenders largely account for predictable reversals
 - New borrowing has positive effect on GDP
 - Debt service has negative effect on GDP
 - Debt service peaks 5 years after a credit supply shock and remains high after new borrowing has returned to normal
- Reversals crucial for theorists and policymakers:
 - Delayed debt service effects -> long-lasting effects of policy
 - To correctly respond to credit-related output dynamics, we have to take borrower lender transfers into account
 - Open issue: why do transfers matter for real outcomes?

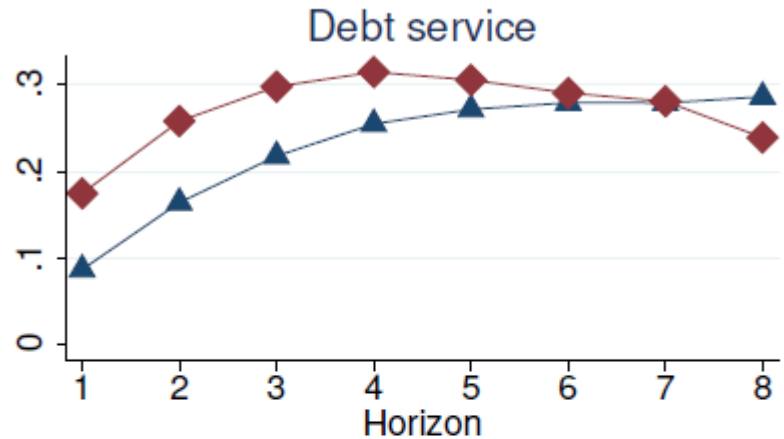
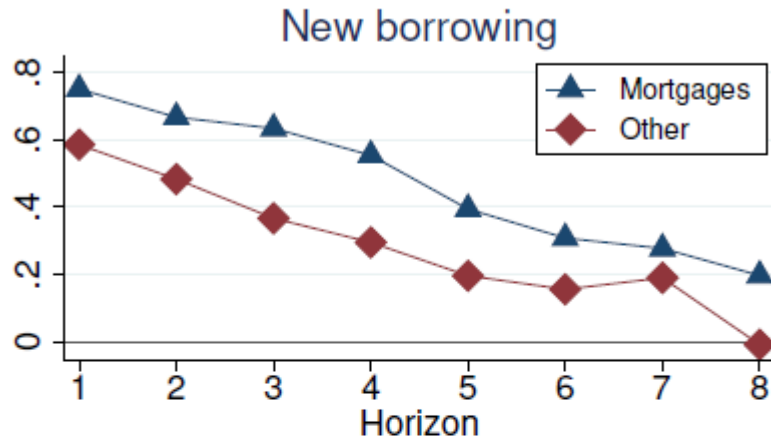
Annex

New borrowing and debt service

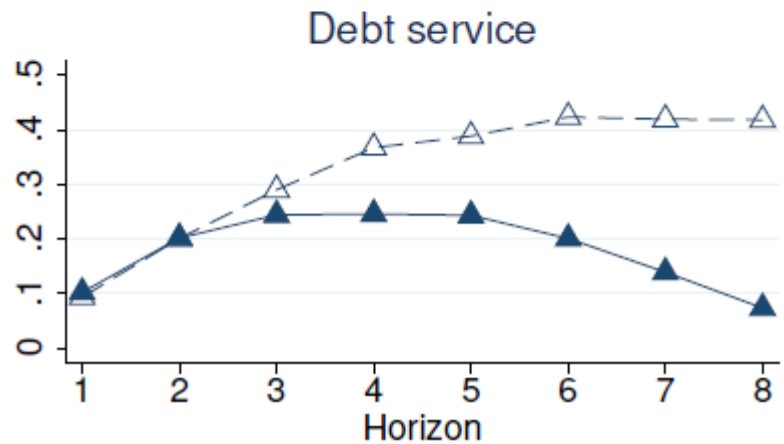
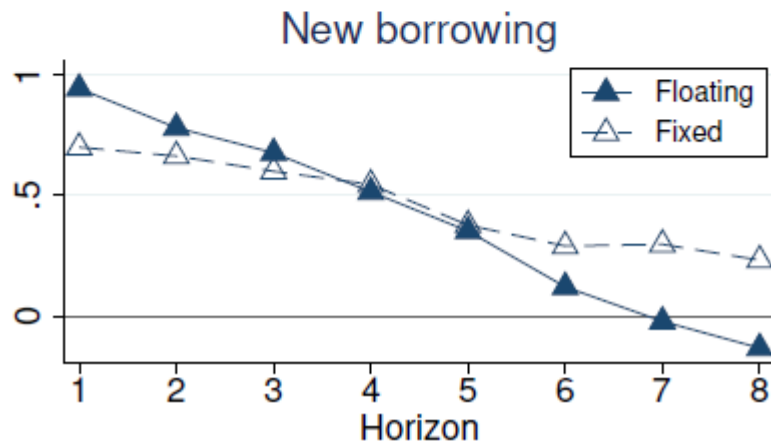


- Lag between peak in new borrowing and peak in debt service on about 3 – 4 years on average in the panel

Mortgages versus other debt

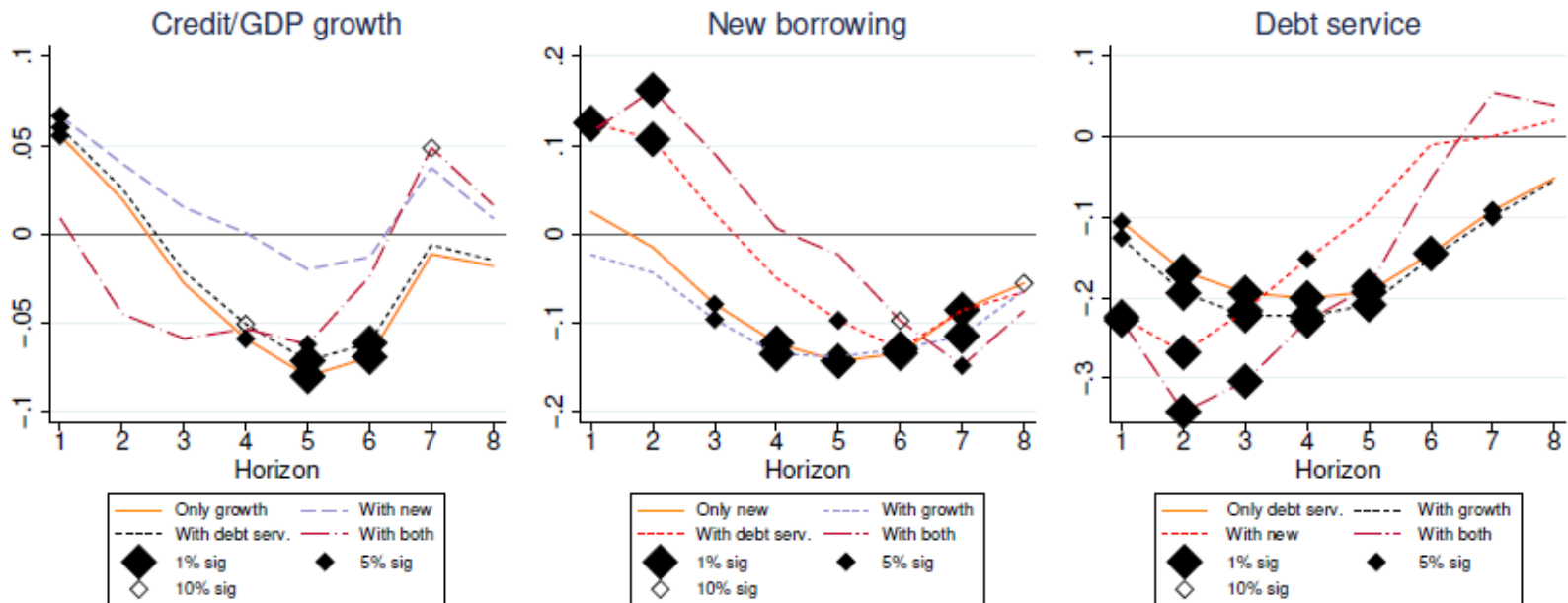


Fixed versus flexible rate mortgages

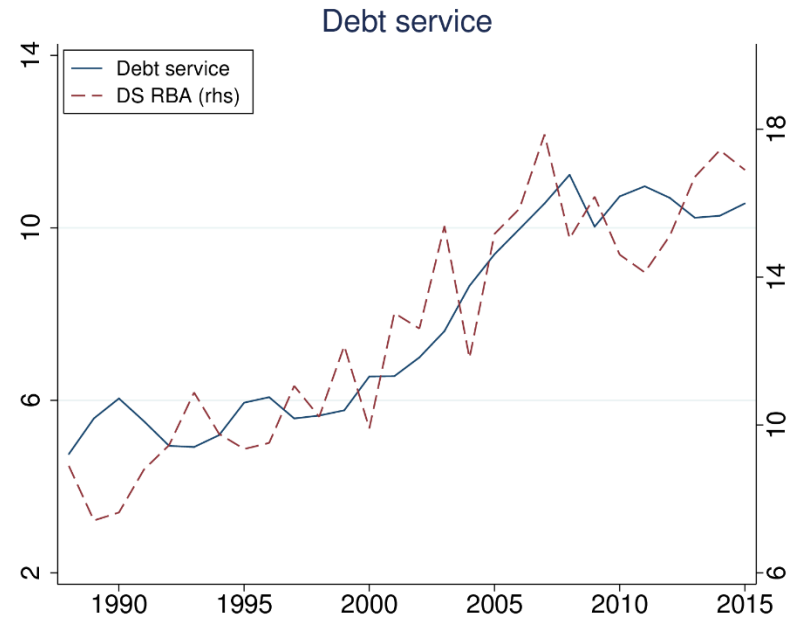
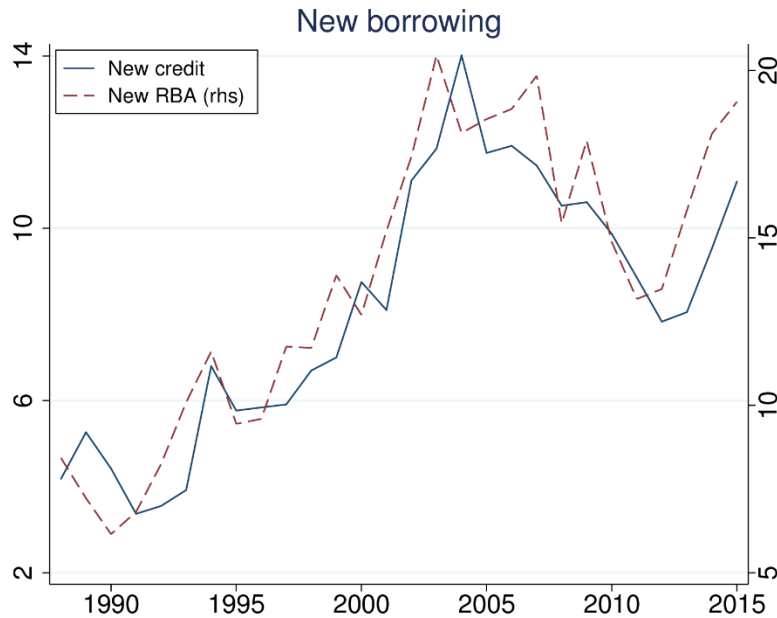


Comparison with credit to GDP growth

- Response of GDP growth from unit impulse to:

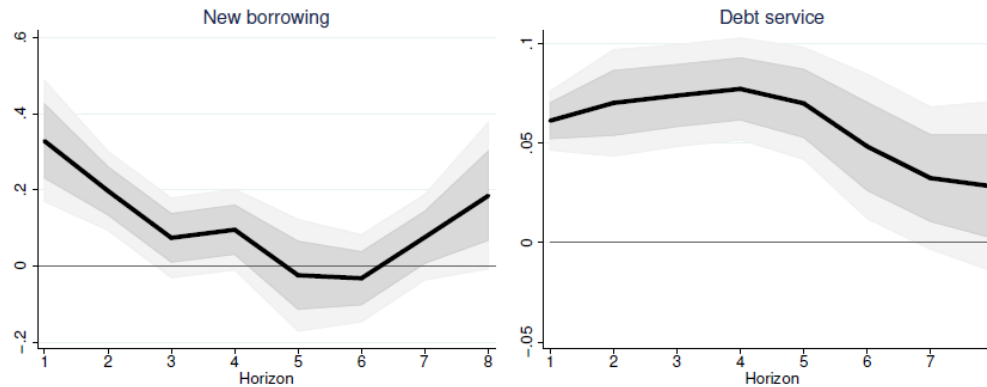


Alternative debt service measure for Australia

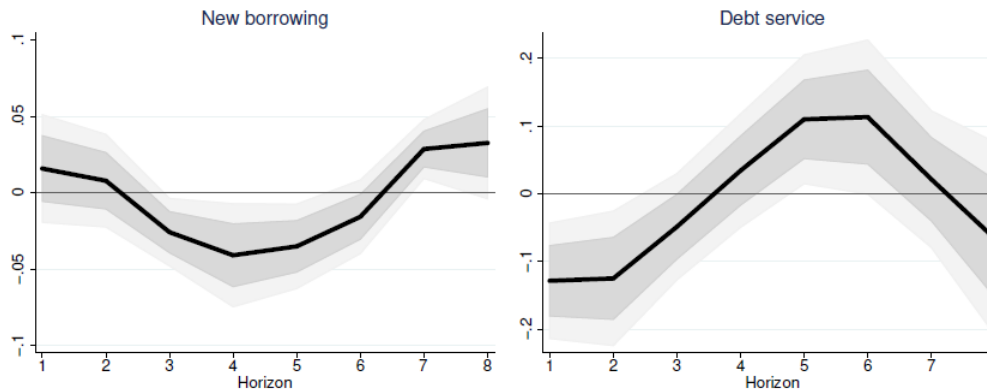


Corporate sector

- Impulse to new borrowing on:



- Response on GDP growth from impulse to:



Tables

Local projections on new borrowing from a unit impulse to new borrowing								
	$t + 1$	$t + 2$	$t + 3$	$t + 4$	$t + 5$	$t + 6$	$t + 7$	$t + 8$
Only GDP	0.947***	0.849***	0.697***	0.573***	0.462***	0.365***	0.221**	0.083
Base	0.883***	0.804***	0.689***	0.537***	0.363***	0.244**	0.127	-0.005
Additional	0.838***	0.659***	0.544***	0.305**	0.059	-0.032	-0.153	-0.174
Base res.	0.859***	0.703***	0.608***	0.415***	0.229**	0.112	-0.038	-0.296*
Time FE	0.846***	0.772***	0.652***	0.574***	0.478***	0.452***	0.338***	0.224*
Before 2000	0.776***	0.638***	0.397***	0.126	-0.020	-0.085	-0.198**	-0.244**
After 2000	0.814***	0.687***	0.540***	0.406***	0.198*	0.176**	0.086	0.057
Mean group	0.767***	0.617***	0.467***	0.213**	0.008	-0.074	0.019	-0.300**
Mortgages	0.770***	0.687***	0.647***	0.561***	0.394***	0.291**	0.247	0.157
Other loans	0.614***	0.511***	0.391***	0.310**	0.208	0.151	0.175	-0.022
Fixed rate	0.701***	0.665***	0.601***	0.547**	0.378	0.291	0.298	0.232
Flex rate	0.945***	0.782***	0.678***	0.516**	0.353*	0.121	-0.023	-0.133

Tables

Local projections on debt service from a unit impulse to new borrowing								
	$t + 1$	$t + 2$	$t + 3$	$t + 4$	$t + 5$	$t + 6$	$t + 7$	$t + 8$
Only GDP	0.123***	0.238***	0.315***	0.366***	0.386***	0.391***	0.385***	0.363***
Base	0.126***	0.233***	0.297***	0.337***	0.344***	0.344***	0.316***	0.281***
Additional	0.117***	0.205***	0.268***	0.307***	0.303***	0.307***	0.249***	0.161
Base res.	0.111***	0.197***	0.255***	0.291***	0.297***	0.303***	0.258***	0.190**
Time FE	0.131***	0.227***	0.283***	0.325***	0.338***	0.365***	0.356***	0.331***
Before 2000	0.173***	0.317***	0.403***	0.419***	0.378***	0.298***	0.184**	0.085
After 2000	0.110***	0.200***	0.246***	0.281***	0.280***	0.284***	0.232***	0.206***
Mean group	0.105***	0.210***	0.273***	0.290***	0.245***	0.206***	0.093*	0.002
Mortgages	0.089***	0.168***	0.222***	0.261***	0.272***	0.279***	0.279***	0.286***
Other loans	0.177***	0.266***	0.308***	0.325***	0.315***	0.295***	0.239***	0.228**
Fixed rate	0.093***	0.201***	0.290***	0.367***	0.389***	0.423***	0.420***	0.418**
Flex rate	0.102***	0.202***	0.244***	0.246**	0.243**	0.201*	0.139	0.073

Tables

Local projections of real GDP growth from a unit impulse to new borrowing								
	$t + 1$	$t + 2$	$t + 3$	$t + 4$	$t + 5$	$t + 6$	$t + 7$	$t + 8$
Only GDP	0.087**	-0.047	-0.183***	-0.230***	-0.235***	-0.231***	-0.201***	-0.163***
Base	0.126***	0.107**	0.024	-0.050	-0.097**	-0.130***	-0.086*	-0.065
Additional	0.129***	0.118**	0.067	0.067	-0.005	-0.099*	-0.195**	-0.207**
Base res.	0.151***	0.121**	0.050	-0.002	-0.060	-0.128**	-0.162***	-0.141***
time FE	0.061*	0.048	-0.011	-0.071	-0.071*	-0.056	-0.018	-0.001
before 2000	0.136*	0.059	-0.093	-0.225***	-0.215***	-0.119***	0.070	0.070
after 2000	0.124**	0.101	0.012	-0.054	-0.102**	-0.152**	-0.142*	-0.090
Mean group	0.205***	0.065*	-0.027	-0.104	-0.155***	-0.362***	0.090	-0.034
Mortgages	0.106***	0.076**	0.043	-0.012	-0.070*	-0.100**	-0.108	-0.058
Other loans	0.167	0.197	0.005	-0.114	-0.134	-0.180**	-0.040	-0.082
Fixed rate	0.044	-0.006	-0.006	-0.006	-0.045	-0.139**	-0.137*	-0.142*
Flex rate	0.122**	0.088	0.033	0.033	-0.014	-0.039	-0.086	-0.117

Tables

Local projections of real GDP growth from a unit impulse to debt service								
	$t + 1$	$t + 2$	$t + 3$	$t + 4$	$t + 5$	$t + 6$	$t + 7$	$t + 8$
Only GDP	-0.303***	-0.261***	-0.104	-0.005	0.047	0.103*	0.128*	0.125
Base	-0.224***	-0.268***	-0.216***	-0.152**	-0.094	-0.009	0.001	0.021
Additional	-0.223***	-0.338***	-0.240*	-0.109	0.017	0.116	0.087	0.012
Base res.	-0.309***	-0.340***	-0.274**	-0.215*	-0.123	-0.013	0.102**	0.097
time FE	-0.126***	-0.163***	-0.129**	-0.060	-0.043	-0.017	-0.031	-0.043
before 2000	-0.357***	-0.417**	-0.303**	-0.051	0.119	0.108	0.061	0.015
after 2000	-0.227**	-0.256**	-0.195	-0.116	-0.037	0.063	0.071	0.021
Mean group	-0.725***	-0.814***	-0.739***	-0.423***	-0.240	-0.034	0.192	-0.249
Mortgages	-0.187***	-0.195**	-0.179**	-0.133	-0.095	-0.036	0.058	0.062
Other loans	-0.291***	-0.412***	-0.277***	-0.168*	-0.091	0.035	-0.069	-0.013
Fixed rate	-0.155**	-0.157	-0.177	-0.156	-0.063	-0.099	-0.074	0.005
Flex rate	-0.217**	-0.208*	-0.150	-0.118	-0.148	-0.059	0.098	0.050

Tables

Local projections of financial crisis probability								
Impulse to new borrowing								
	$t + 1$	$t + 2$	$t + 3$	$t + 4$	$t + 5$	$t + 6$	$t + 7$	$t + 8$
No controls	0.198	0.484***	0.860***	0.624***	0.419**	0.223*	0.160	0.193***
Only GDP	0.136	0.431***	0.825***	0.585***	0.421**	0.227*	0.124	0.207***
Base	0.528**	0.781**	0.966***	0.721***	0.484**	0.296*	0.182	0.127
Additional	1.203*	0.811**	0.999***	1.209***	0.706***	0.896**	0.364***	0.147
Base res.	0.931*	0.540	0.695*	0.934**	1.624***	0.554	0.251	0.037
OLS	0.006	0.005	0.017***	0.014***	0.016**	0.010*	0.005	0.003
Impulse to debt service								
	$t + 1$	$t + 2$	$t + 3$	$t + 4$	$t + 5$	$t + 6$	$t + 7$	$t + 8$
No controls	2.212***	1.452***	0.494	0.045	-0.076	-0.005	-0.063	-0.237
Only GDP	2.709***	2.044**	0.814***	0.239	-0.083	-0.019	0.024	-0.191
Base	4.265***	3.037***	2.022***	0.487	-0.011	-0.100	-0.123	-0.152
Additional	4.265***	3.353**	2.672***	0.425	-0.517	-0.885**	-0.479**	-0.696***
Base res.	4.675***	3.075**	1.710***	0.977**	-1.356*	-0.434	-0.181	-0.526
OLS	0.023***	0.022**	0.007	0.008	-0.002	-0.002	-0.002	-0.003