Corporate Legacy Debt, Inflation, and the Efficacy of Monetary Policy

Charles A.E. Goodhart[1]   M. Udara Peiris[2]
Dimitrios P. Tsomocos[3]   Xuan Wang[4]

C.E.M.L.A., Mexico City
24 March 2023

[1]Financial Markets Group, London School of Economics and CEPR
[2]Oberlin College
[3]Saïd Business School and St Edmund Hall, University of Oxford
[4]Vrije Universiteit Amsterdam and Tinbergen Institute

Introduction

- **Non-financial** corporate debt level all time high globally (EA 115.1%, CHN: 160.7%, btw 2019 and 2020 alone, US rose by 12.5%)

- Meanwhile post-pandemic inflation surge propelled central banks to raise overnight rates, while labour market is tight

- Is raising short-term rates effective in controlling inflation when corporate debt level is high?

- We answer this question based on Fisher (1910)'s 'enterpriser-borrower' and 'creditor-labourer' economy.

Model's key feature

1 **Setup**: household portfolio heterogeneity corresponding to firm capital structure

   ▶ Owner household owns firms; firms owe corporate debt to lender-working household

   ▶ Lender-working household hold corporate debt and supply labour (top rich income groups hold predominately equity; middle income fixed-income securities and housing)

2 **Nominal friction**: transaction demand for money (liquidity-in-advance) à la Shapley and Shubik (1977); Lucas and Stokey (1986)
   $\rightarrow$ before receiving production proceeds, firms borrow money via credit to pay for labour, at the interest cost of $i(\neq 0)$
   $\rightarrow$ interest rate i affects MRS - non-neutrality of money

▶ Our innovation: presence of corporate debt affects transmission of i - its income effect offsets or even dominate the usual substitution effect

Related Literature

- Existing literature on corporate debt primarily on quantities, such as investment (see e.g., Farhi and Tirole, 2009; Bhamra et al., 2011; Occhino and Pescatori, 2014, 2015; Gomes et al., 2016; Greenwald, 2019; Darmouni et al., 2020; Lakdawala and Moreland, 2021; Ottonello and Winberry, 2020)

- Few focus on prices - how nominal corporate debt could affect the efficacy of monetary policy in controlling inflation (non-financial firms cannot monetise debt, nor do they create liquidity by extending credit). Our work serves to fill this gap in the literature

- Gomes et al. (2016) focus on inflation⇒ debt;
  we focus on the reverse: debt ⇒ inflation

- Empirical literature also focuses on real consequences of corporate debt on investment (e.g., Mian et al., 2017; Jordà et al., 2020); our theoretical result offers novel empirical prediction on inflation

Related Literature

- Our paper benefits from empirical papers household portfolio heterogeneity and firm capital structure (Gomes et al. (2020), Toda and Walsh (2020), Becker and Ivashina (2014), Haliassos and Bertaut, 1995; Parker, 2001; Vissing-Jorgensen, 2002; Campbell, 2006; Calvet and Sodini, 2014; Gârleanu and Panageas, 2015)

- Our paper uses the transaction demand for money, which connects with the cost channel of monetary policy literature (Kashyap et al., 1993, 1994; Gertler and Gilchrist, 1994; Christiano et al., 2005; Ravenna and Walsh, 2006...)

- Our paper offers a new heterogeneity to the existing macro literature on households heterogeneity (Kaplan et al., 2018; Auclert, 2019; Hagedorn and Mitman 2020, non-exhaustive), as our heterogeneity corresponds to firm's capital structure

- Our monetary framework is based on inside money in general equilibrium Grandmont and Younes, 1972, 1973; Shapley and Shubik, 1977, Dubey and Geanakoplos 1992, 2006, Tsomocos 2003, Bloise and Polemarchakis 2006...

Simplified Static Model

▶ The economy has *owner households* and *lender-working households*.

▶ Lender-working households hold safe corporate bonds for saving and supply labour.
  Lender-working households supply labour and do not actively participate in equity markets consistent with empirics in Benzoni et al., 2007

▶ Owner households own firms that issue corporate bonds for financing.

▶ Firms also subject to working capital financing requirement (inside money issued against credit to finance working capital).

Owner Households

$$U = c^o.$$

(simple utility function to derive closed form solutions; will be made standard later)

Their flow constraint is

$$Pc^o = \Pi + m.$$

where m is outside money (seigniorage transfer), modelled via central bank discount window and OMO in the dynamic model, and Π are profits. Consumption good is a consumption bundle of a variety of goods with CES θ between goods varieties.

Households

Lender Households

$$\underbrace{U}_{c^l, L} = log(c^l) - L.$$

In the morning lender households obtain their labour income and carry the money till the evening
Their effective flow budget constraint is

$$Pc^l = wL^l + \psi D.$$

(The stock of corporate debt is D, and the legacy debt servicing cost is ψ, both endogenised in the dynamic setting.)

Firms

Technology is

$$y_j = Al_j.$$

- Maximise profits in owner's perspective by choosing b_j, l_j, y_j, facing consumer demand for its good variety while taking into accounts price impact

- The morning constraint is

$$wl_j = b_j, \tag{1}$$

(transaction demand for money; inside money issued *on demand* against an offsetting credit)

- The evening constraint is

$$\pi_j + \psi D + b_j(1 + i) = p_j y_j, \tag{2}$$

combining the morning and evening constraints:

$$\pi_j + (1 + i)wl_j + \psi D = p_j y_j.$$

Equilibrium

Equilibrium is defined as an allocation of resources and prices, given a positive monetary policy rate (i) and monetary endowment (m), and legacy debt (D) such that

(i) firms set prices while taking into account the price impact on demand,
(ii) agents maximise subject to their budget and liquidity constraints,
(iii) goods market, labour market, and **money market** clear, and expectations are rational.

Equilibrium

In equilibrium, real wage and labour supply elasticity are

$$\tilde{w} = \frac{A}{\sigma(1+i)}.$$

$$\epsilon_L = \frac{\frac{\partial L}{\partial \tilde{w}}}{\frac{L}{\tilde{w}}} = \frac{\psi D}{P\tilde{w}L} = \frac{\psi D}{b}$$

where $\sigma = \frac{\theta}{\theta-1}$.

Lemma 1

1. *Contractionary monetary policy reduces real wages.*
2. *Given the price level, the effective labour supply elasticity with respect to real wages is increasing on the ratio of corporate debt servicing cost to working capital*

- Consistent with empirics in Ziliak and Kniesner (1999) and Cesarini et al. (2017), whereas Christiano et al. (1997) has ϵ_L depending on preference parameter for leisure, to which their model empirical performance is sensitive

Substantiation and Income Effects

Aggregate Supply (AS) is

$$Y_s = A - \frac{\psi D}{P}\sigma(1+i). \tag{3}$$

1. Whenever $D = 0$, $Y_s = A$, inelastic; no supply-side effect of monetary policy (not generalisable)

2. If $D \neq 0$, AS becomes flatter as D increases; an increase in i makes labour supply scarce (generalisable)

3. Result 1 is due to linearity in utility function; with more general utility function for leisure/labour, even when $D = 0$, there is supply-side effect of i

4. Connecting with empirical evidence in Drechsler, Savov and Schnabl (2020, 2022) on endogenous supply side effects of monetary policy

Substitution and Income Effects

Proposition 1

In equilibrium, the response of aggregate demand to monetary contractions (increase in i) depends positively on legacy debt.

Aggregate demand (AD) is

$$Y_d = \frac{m}{P} + \int y_j dj + \left\{ \frac{\psi D}{P} i - \frac{Ai}{\sigma(1+i)} \right\}. \tag{4}$$

From (4) we can see two effects of monetary policy.

▶ Higher interest rates increase the financing cost of labour and less is demanded. The usual substitution effect.

▶ Corporate debt renders labour supply more elastic, so that increases in i cause the decrease in real wage expenditure to offset the increase in the financing costs.

▶ This leads to upward pressure on profits and hence, aggregate demand. The income effect through legacy debt.

(Ben-Ami and Geanakoplos (2019) model the income effect through debt affecting default/fragility)

Substitution and Income Effects

Intuition

The income effect affects both the aggregate demand and aggregate supply

- On AD, after i increases, the increase of financial costs of wage bills push down on AD (usual 'intertemporal' substitution effect). But with the high fixed cost of debt, firms feel the need to spread the fixed cost over a larger production scale and demand for labour decreases less and AD (income effect through debt on demand) decreases less, relative to the case without legacy debt

- On AS, after i increases, the negative marginal impact on lender-working households' wealth is less in the high debt scenario than low debt scenario, so labour more elastic when corporate debt level is high (this holds even when we consider fixed-coupon corporate bond)

Aggregate demand becomes

$$Y_d = \frac{m}{P} + \int y_j dj - i \frac{A}{\sigma(1+i)}. \qquad (5)$$

► Comparing (4) and (5), given a price level, raising interest rates only reduces aggregate demand in the representative agent case.

► This is because in the representative agent case, the distribution of income does not matter, the upward pressure on profits from lower wage expenditure is exactly offset by the increase in financing costs, and hence, the income effect is no longer present.

Proposition 2

Suppose corporate legacy debt is bounded: $\psi D \leq (\sigma - 1)(1 + \frac{1}{i})m$,

1. *when legacy debt is sufficiently low ($\psi D < \frac{b}{i}$),*
    1.1 *the standard Taylor principle applies,*
    1.2 *the higher debt is, the less effective is raising interest rates in lowering current inflation;*
2. *when legacy debt is sufficiently high ($\psi D > \frac{b}{i}$),*
    2.1 *the Taylor principle is inverted - raising interest rates increases current inflation,*
    2.2 *the higher debt, the worse inflation caused by raising interest rates.*

(Remark: in the dynamic model calibrated with the US data, the debt is below the threshold (the case of Proposition 2(1)- 1.1. 1.2))

Giffen-like property

Corollary 2

When the income effect through debt is sufficiently high, raising policy rate increases consumption demand (upward-sloping IS curve).

IS: given P, demand for output is $Y_d = \frac{m}{P} + \int y_j dj + \frac{\psi D}{P} i - \frac{Ai}{\sigma(1+i)}$

Giffen-like property

Suppose inside money supply is fixed, $b = \bar{M}_s$

$$\bar{M}_s = WL = \frac{PY}{\sigma(1+i)}$$

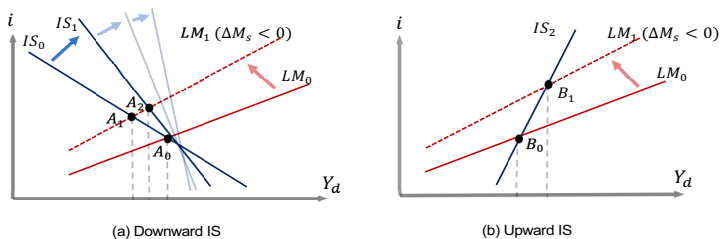$\rightarrow$ Upward sloping LM curve $i = \frac{P}{\sigma M_s}Y - 1$.

IS-LM

Figure 1: IS-LM

IS_0 is without corporate debt, IS_1 is introduced with corporate debt, and as debt increases, IS curve rotates close-wise, until it obtains a positive slope in IS_2. LM_0 is the money-market clearing, and with a reduction in inside money supply, LM_0 shifts to LM_1.

▶ Without corporate debt, monetary contraction moves A_0 to A_1, substitution effect dampening demand

▶ With corporate debt, A_1 moves to A_2, income effect offsets substitution effect a bit

▶ With sufficiently high debt, IS_1 becomes IS_2, monetary contraction moves B_0 to B_1, demand is boosted

Taking Stock

- The possibility of IS being upward sloping has long been recognised

- David Meiselman (1969) "My own judgment is that under a wide range of circumstances, the IS curve is best taken to have a positive slope"

- Silber (JF, 1971) argues that empirically an upward sloping IS curve is a real possibility and explores the determinants of the efficacy of monetary policy

- Consistent with Silber (1971), Burrows (JF, 1974) introduces an upward sloping IS curve to study the interaction between fiscal policy and monetary policy, and Cherneff (JF, 1976) introduces an upward sloping IS curve to an open economy with fixed exchange rates to study policy conflict and coordination

- These early works take an upward-sloping IS curve as a primitive, and none has shown how it endogenously occurs

- We provide a micro-foundation for it by modelling money and credit in a general equilibrium and demonstrate that how an upward sloping IS and a downward sloping IS curve can both endogenously arise, depending on the extent of the income effect through corporate legacy debt
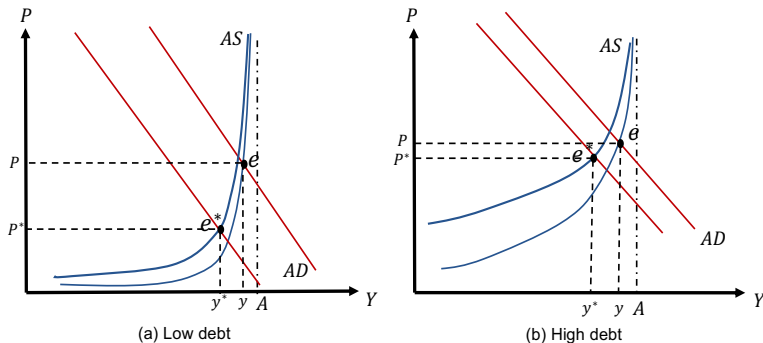
To clear the output market

Figure 2: AS-AD diagram: a rise in policy rate

The left diagram (a) illustrates a low debt scenario. The right diagram (b) illustrates a high debt scenario. Equilibrium e is the equilibrium before the rise in the policy rate, and equilibrium e* is the equilibrium after the rise in the policy rate. The vertical line at A is the output when there is no debt in the economy.

Markup

We also uncover a novel interaction between corporate debt and firm markups. Below is the trend of rising markups and corporate debt in the US.

Figure 3: Aggregate markup and corporate debt in the US
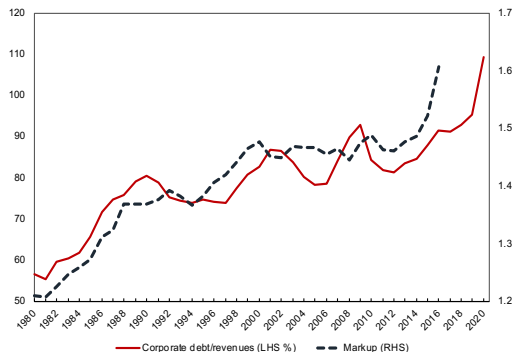
Source: The markup data is from De Loecker et al. (2019). Data on non-financial corporate debt and revenues of non-financial businesses are from Board of Governors of the Federal Reserve System (US) and U.S. Bureau of Economic Analysis, retrieved from FRED, Federal Reserve Bank of St. Louis.

Corollary 3

A markup shock increases price level, and it only has indirect effect on monetary transmission to inflation: an increase in markup makes Taylor principle inversion more likely.

We show $\partial P / \partial \sigma > 0$, and $\partial \epsilon_{Pi} / \partial \sigma = 0$, and whenever $1 < \frac{\psi D}{b} < (1 + i)(\sigma - 1)$, the Taylor principle is inverted.

Suppose $\psi = \Psi(1 + i)$

So far, we have assumed legacy debt servicing cost ψ to be exogenous to short-term rate i changes, but via the yield curve, i will likely influence ψ. Let ψ be a function of the gross short-term policy rate $1 + i$, i.e., $\psi = \Psi(1 + i)$. If $\epsilon_{\psi i} > 0$, the condition of Taylor principle inversion is relaxed, i.e., $iD(\psi + \frac{\partial \psi}{\partial(1+i)}(1 + i)) > b$.

Proposition 3

When $\epsilon_{\psi i} > -1$, the presence of debt makes monetary contraction less effective in controlling inflation.
When $\epsilon_{\psi i} < -1$, the presence of debt makes monetary contraction more effective in controlling inflation.

Remark: when is $\epsilon_{\psi i} < -1$ likely? A large presence of fixed-coupon debt and a steepening of the yield curve,
but in fact, firms debt maturity is getting shorter (e.g., Harford et al. 2014, Graham et al. 2015...), and recent monetary contractions are associated with yield curve flattening or even inversion.

Dynamic Model

▶ We now extend our static model to a dynamic model with sticky prices (via Calvo pricing), capital accumulation, and an endogenous monetary policy rule (Taylor rule).

▶ Intermediate goods firms have the wholesale units and selling units. Wholesale units are price-takers and can access short-term financing from the money market to produce wholesale goods. Selling units purchase wholesale goods to produce differentiated good varieties, and they are static price-setters with market power.

▶ We assume a steady-state level of legacy debt which intermediate goods sectors choose to roll over at prevailing interest rates.

▶ We also replace the monetary endowment of households with central bank open market operations in the bond market.

Dynamic Properties

We obtain the *Phillips curve*
(where ϕ prob of not adjusting prices, η is inflation)

$$(1 \hat{+} \eta) = \frac{(1-\phi)(1-\phi\beta)}{\phi}\hat{p}_W + \beta(1 \hat{+} \eta'). \tag{6}$$

where the marginal cost is given by

$$\hat{p}_W = -\frac{(1 \hat{+} \eta) + \bar{q}\hat{q}}{1-\bar{q}} - \frac{(1 \hat{+} i)}{((1 \bar{+} i) - 1)} \left\{ 1 - \frac{(1 \bar{+} i)(1-\alpha)\bar{d}(1-\bar{q})}{2(\bar{w}\bar{l} + \bar{d}(1-\bar{q}))} \right\}$$
$$- \hat{A} - \alpha\hat{k} - \frac{(1-\alpha)\bar{d}\left\{\bar{q}\hat{d}' - \hat{d}\right\}}{2(\bar{w}\bar{l} + \bar{d}(1-\bar{q}))}.$$

As the steady state level of legacy debt increases, the absolute value
of the coefficient of interest rates on the path of inflation declines, i.e.
changes in interest rates have smaller negative effect on inflation.

Dynamic Properties

We obtain the *dynamic* **IS curve**:

$$\hat{q} + (1 \hat{+} i) - \hat{p}_W - \hat{y}(1 - \frac{2}{1-\alpha}) - 2\frac{\hat{A} + \alpha\hat{k}}{1-\alpha}$$
$$= (1 \hat{+} i)' - \hat{p}'_W - \hat{y}'(1 - \frac{2}{1-\alpha}) - 2\frac{\hat{A}' + \alpha\hat{k}'}{1-\alpha} - (1 \hat{+} \eta)'. \tag{7}$$

The level and dynamics of corporate debt affects aggregate demand through the real marginal cost $\hat{p}_W$.

Output gap would reflect two distortions: 1) nominal rigidities; 2) heterogeneity affecting wealth distribution, and hence, AD and AS.

Quantitative Example

We take the standard calibrated parameters from the recent literature

Table 1: Calibration

Parameter	A	α	β	i	σ	κ	ϕ	ϕ_d	ρ_y	ρ_η	ρ_i
Value	100	0.33	0.99	0.01	1.25	0.1	0.7	0.001	0.2	1.5	0.5

- population share of owners 10% (see Toda and Walsh, 2020 and Campbell, 2006).

- Taylor rule response to inflation 1.5 and smoothing parameter 0.5 (Gomes, Jermann and Schmid 2016)
  Taylor rule output coefficient 0.2 (Christiano, Trabandt and Walentin 2010).

- benchmark corporate debt-to-GDP ratio at ss 75 %
  high debt case corporate debt-to-GDP ratio at ss 100% (conservative take). (debt ratios based on US non-financial corporate debt to quarterly revenue from 2001 to date)

Monetary Shocks

- As the debt level increases, the more pro-cyclical owner households' consumption appears, and the more acyclical lender households' consumption expenditure becomes.

- This result connects with the literature on the high sensitivity of consumption growth of wealthy stockholders to the stock market and aggregate fluctuations (Malloy et al. (2009) , Parker and Vissing-Jorgensen (2009), Mankiw and Zeldes, 1991; Parker, 2001).

Table 2: Cyclical properties: correlations with output

	c^o	c^l	b	l	d
y (BMK lev)	0.73	0.38	0.96	0.93	-0.76
y (High lev)	0.88	0.20	0.99	0.97	-0.86

BMK lev refers to the benchmark leverage of 75% (annual), or $\bar{b}/\bar{y} = 3$. High lev refers to the high debt leverage of 100% (annual), or $\bar{b}/\bar{y} = 4$.

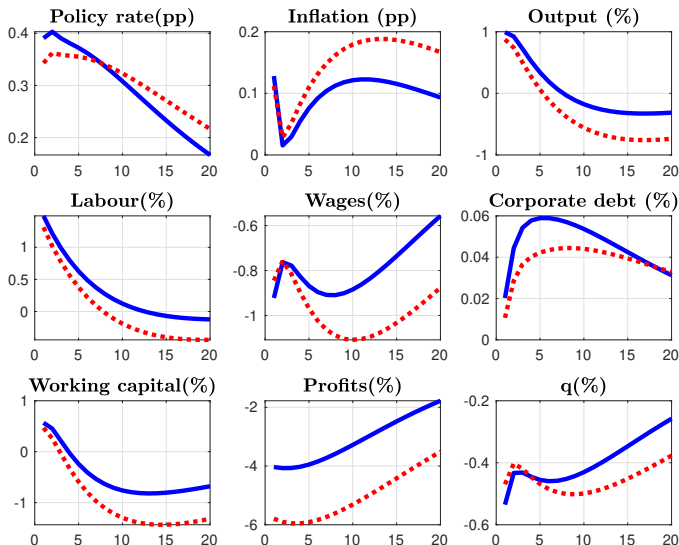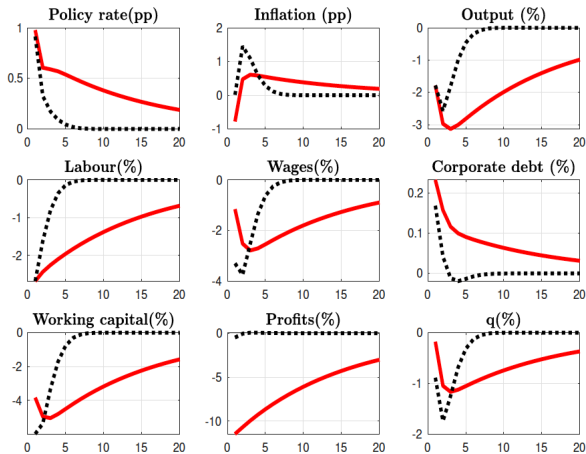# Positive Demand Shock

Inflation and Output Stabilisation

Figure 5: Monetary contractions with or without output stabilisation

Red solid line is benchmark Taylor rule with output coefficient 0.2, and dashed black line is output stabilisation Taylor rule with output coefficient 0.9. Y-axis is % change.

Robustness Check

▶ Monetary contractions lead to a reduction in both real wages and corporate bond price.

▶ One might be concerned that lenders' wealth takes a more significant hit in the high debt case than the low debt case, particularly if lenders are holding fixed coupon bonds ($\epsilon_\psi < 0$). Would the the effective labour elasticity still turn out higher in the high debt case?

▶ We added a two-period fixed coupon bond whose steady-state quantity is set four times as much as that of the floating rate bond. This is to generate a noticeable decrease in lender working households' non-labour income wealth after monetary contractions.

▶ All results go through. For example...
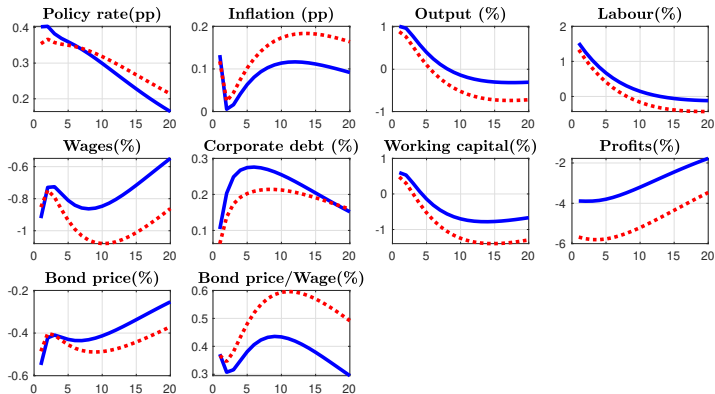
Blue line is 75% leverage and red line is 100% leverage. y-axis is % change and x-axis is the number of periods. Other than inflation and policy rate, all variables are in real terms.

Robustness Check

Intuition

- After monetary contractions, both real wages and bond price go down.
- But bond price-to-wage ratio increases, and increases more in the high debt scenario.
- Though both short rate and long rate go up after monetary contraction
  - the long rate increases to a less degree
  - the term structure becomes flatter (twist of the yield curve, no parallel shift of the term structure)
  (implies that condition $\epsilon_{\psi i} \leq -1$ in Proposition 3 is not reached)
- Thus, the negative impact on wealth in high-debt scenario is less severe, and effective labour supply elasticity is still higher in the high debt scenario than low debt.

Conclusions

- General equilibrium model to study the effect of corporate indebtedness on the monetary transmission mechanism to inflation.
- Emphasise endogenous supply side effects of monetary policy
- High corporate debt levels render contractionary monetary policy less effective in controlling inflation, and labour appears scarce in equilibrium
- When the level of corporate debt is sufficiently high, a Giffen-like property is revealed, and contractionary monetary policy even increases inflation
- With corporate debt present, the rise in firms markup makes controlling inflation more challenging
- The key assumptions are household heterogeneity corresponding to firm capital structure and the transaction demand for money. Generality: could also replace labour/leisure with capital/durable assets.

Thank you!

Acharya, V. V., Crosignani, M., Eisert, T., and Steffen, S. (2021). Zombie lending: Theoretical, international, and historical perspectives. CEPR Discussion Paper No. DP16685.

Becker, B. and Ivashina, V. (2014). Cyclicality of credit supply: Firm level evidence. *Journal of Monetary Economics*, 62:76–93.

Benzoni, L., Collin-Dufresne, P., and Goldstein, R. S. (2007). Portfolio choice over the life-cycle when the stock and labor markets are cointegrated. *The Journal of Finance*, 62(5):2123–2167.

Bhamra, H. S., Fisher, A. J., and Kuehn, L.-A. (2011). Monetary policy and corporate default. *Journal of Monetary Economics*, 58(5):480–494.

Caballero, R. J., Hoshi, T., and Kashyap, A. K. (2008). Zombie lending and depressed restructuring in japan. *American Economic Review*, 98(5):1943–77.

Calvet, L. E. and Sodini, P. (2014). Twin picks: Disentangling the determinants of risk-taking in household portfolios. *The Journal of Finance*, 69(2):867–906.

Campbell, J. Y. (2006). Household finance. *The Journal of Finance*, 61(4):1553–1604.

Christiano, L. J., Eichenbaum, M., and Evans, C. L. (2005). Nominal rigidities and the dynamic effects of a shock to monetary policy.

Appendix

Advanced Economies					
	US	EA	SWE	CAN	UK	JPN
Dec-07	70	93.3	125.2	81.7	82.1	99.5
Dec-18	75.2	106.2	158.8	114.3	76.1	99
Dec-20	84.6	115.1	175.3	132.4	80	115.6
Emerging Economies					
	CHN	KOR	HK	CHL	BRA	TUR
Dec-07	94.3	84.8	124	65.2	29.7	29.6
Dec-18	149.1	95.6	219.5	100.2	46.3	68.1
Dec-20	160.7	111.1	246.8	115.9	54	72.1

Source: BIS. Numbers express non-financial corporate debt as % of GDP.

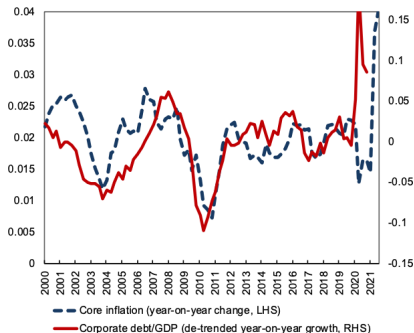# Corporate Debt and Inflation

(a) Markup and non-financial corporate debt-to-GDP
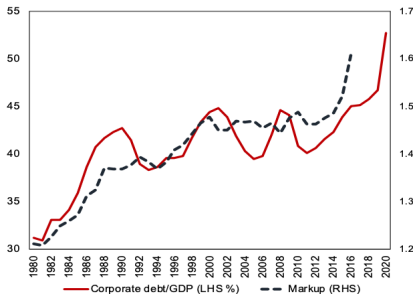
Source: The markup data is from De Loecker et al. (2020). Data on corporate debt and GDP are from Board of Governors of the Federal Reserve System (US) and U.S. Bureau of Economic Analysis, retrieved from FRED, Federal Reserve Bank of St. Louis.

(b) Core inflation and de-trended corporate debt/GDP

Source: Board of Governors of the Federal Reserve System (US) and U.S. Bureau of Economic Analysis, retrieved from FRED, Federal Reserve Bank of St. Louis, and authors' calculation.

No bankruptcy

- ▶ We have assumed no firm expected to go into bankruptcy for reasons below
    1. Policies were expansionary for a long time: high liquid savings and tight labour market.
    2. Post-pandemic, high-debt zombie firms staying afloat with imminent firm defaults at record lows (see e.g., Acharya et al., 2021; Caballero et al., 2008).
    3. With bankruptcy possibilities, the basic problem of contractionary monetary policy with high corporate debt is that a small increase in rates may not restore inflation back to target, while a larger increase might bring large bankruptcies as to bring about a recession.

- ▶ To study the quantitative importance and show the mechanism of the static model holds in a dynamic general equilibrium, we now embed the key ingredients in a canonical New Keynesian framework.