What is productive investment? Insights from firm–level data for the United Kingdom

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Motivation

- At aggregate level, UK data suggests a strong positive correlation between corporate debt and investment, whereas the correlation between debt and productivity is more tenuous.
- At firm level, there is strong evidence in the literature suggesting that high corporate debt leads to lower investment, especially in times of crisis, with negative subsequent effects on productivity. (see e.g. Duval et al. (2020), Gopinath et al. (2017), Kalemli-Ozcan et al. (2018), Buera and Karmakar (2019)).
- Typically leverage is assumed to be "good" in the boom phase, as it allows firms to invest in their productive capacity. Debt then becomes "bad" in a downturn owing to debt overhang reasons.
- Potentially important monetary policy and financial stability implications.

Research questions

1. What are the characteristics of different types of investment, debt and total factor productivity (TFP) in UK firm–level data?

2. Using both a stylised structural model, and empirical firm–level data for the UK, can we distinguish between "good" and "bad" leverage in terms of higher debt being associated with investment that is productive (i.e., a positive effect on TFP) vs investment that is not productive (i.e., a zero/negative effect on TFP)?

Structural model

- First, we build a stylised model to illustrate the effects of different types of uses of funds and debt on TFP. Model is based on Levine and Warusawitharana (2020) and Warusawitharana (2015) with a standard firm–level Cobb-Douglas production function.
- The novelty of our approach comes from the way financing stocks and flows are embedded in the model as control and state variables, rather than as residuals of the cash–flows, as in previous approaches.
- In the model state equations, we distinguish between accumulation of tangible and intangible capital. Both can be financed from either own cash–flows or (costly) external financing. TFP is assumed to be a random process, which can be accumulated with decreasing returns to scale by investing in intangible capital.
- We solve the firm's value function with numerical perturbation methods. The cash–flow entering the value function is standard, with quadratic capital adjustment costs, plus a penalty function defining the cost of excessive investment.

Model propositions

Model propositions:

1. An increase in intangibles (synonymous with productivity–enhancing investment) stock, through intangible investment flow, leads to higher productivity (measured as the level of TFP in the next period).
2. An increase in external debt stock, through external financing flow, leads to higher productivity.
3. An increase in the share of external financing used for intangible investment leads to higher productivity.
4. An increase in tangibles stock, through tangible investment flow, has an ambiguous effect on productivity.

which imply: i) different types of investment can have different effects on TFP, ii) debt can have a positive effect on TFP, if it is used for productive investment, iii) if external financing is restricted to a fixed amount, using the debt to become more intangibles intensive has a positive effect on TFP.

Empirical analysis - Data

- Worldscope financial account data on UK listed firms.
- Annual data 1990-2018.
- Exclude finance and oil sectors (ISIC 2-digit sectors 2, 19, 64–66).
- 26,881 firm–year observations.
- Data winzorised at 1st/99th quantiles.

Data - main variables

Table 1: *Key variables of interest*

Variable	Definition	Worldscope code
log_tfp	Ackerberg-Caves-Frazer (2015) measure of TFP (log level)	n/a
intan_stock	intan_stock	n/a
intan_stock2	intan_stock excluding goodwill	n/a
intan_stock_yy	y/y change of intan_stock	n/a
intan_stock2_yy	y/y change of intan_stock2	n/a
debt_ratio	total debt divided by total assets (corrected for industry medians)	totdebt/totass
capex_ratio	capital expenditure divided by total assets	capex/totass
oth_ratio	measure of other uses of funds ((equity buybacks+dividends)/total assets)	(ebuyback+div)/totass
age	years since incorporation	age
size	real total assets (log level, deflated by aggregate GDP deflator)	totass
profit_ratio	profits (EBITDA) divided by total assets	ebitda/totass
cash_ratio	cash and short-term investment divided by total assets	csti/totass
iex_ratio	interest expense divided by total debt	intex/totdebt

Empirical methodology

Our panel regression specification is the following:

$$z_{it} = \alpha + \beta_1 D_{it} + \beta_2 R_{it} + \beta_3 D_{it} R_{it} + c_i + f_t + X_{it} + e_{it} \quad (1)$$

where z_{it} is (log)level of TFP for firm i at time t, D_{it} is debt_ratio and R_{it} is investment variable dummy (=1 for the highest quartile), X_{it} are firm–level controls (profits, age, size) c_i and f_t are firm and year FE, respectively, and e_{it} is i.i.d. error. Investment variable $R \in (capex, intans, oth)$.

- Estimation with system–GMM to mitigate endogeneity issues, with interest–to–debt ratio as an additional instrument.
- Interested in effect of investment variable (β_2), debt ratio (β_1), the interaction effect (β_3) and the joint significance of debt ($\beta_1 + \beta_3$).
- Also estimate a version with lagged RHS variables to investigate lagged effects and to mitigate endogeneity without using system-GMM:

$$z_{it} = \alpha + \beta_1 D_{i,t-1} + \beta_2 R_{i,t-1} + \beta_3 D_{i,t-1} R_{i,t-1} + c_i + f_t + X_{i,t-1} + e_{it} \quad (2)$$

Economic effects

Table 2: *Size of effects on TFP*

What is the effect on level of TFP of...

...firm being in the highest quartile of...		
...variable:	*effect :*	
	t-1 (OLS)	t (GMM)
intan_stock2_d	8.2% ***	11.1% ***
intan_stock2_yy_d	2.5% ***	4.0% **
capex_ratio_d	-3.0% ***	-5.0% **
oth_ratio_d	0.3%	-2.0%

...a 10pp increase in debt ratio and firm being in the highest quartile of...		
...variable:	*effect :*	
	t-1 (OLS)	t (GMM)
intan_stock2_d	1.0% **	0.6%
intan_stock2_yy_d	0.9% *	0.6%
capex_ratio_d	0.2%	-1.3%
oth_ratio_d	0.7% **	-0.8%

Conclusions

- We study the effects of different types of investment and levels of debt on productivity, using firm-level data on UK listed firms.
- We find intangibles investments to be a good proxy for "productive" investment, as they have a positive effect on TFP.
- We find no consistent evidence of positive TFP effects for other uses of funds, like tangible capital expenditure and dividends/equity buybacks.
- We find no consistent evidence that higher levels of debt result in lower levels of TFP. There is tentative evidence that this effect may be positive, when high debt levels are associated with high intangibles investments.

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