Do Corporate Taxes affect Productivity and Investment at the Firm-level? Cross-country Evidence from European Micro Data

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Link between taxation and economic growth is key issue in public policy

Aggregate level studies:

- tax changes in a single country
- differences in tax rates/structures across countries

But:

- issues of business cycle influences and simultaneity
- limited understanding of channels through which taxation impacts on growth

This paper uses firm-level data to analyse the effect of corporate taxes on one of the main drivers of economic growth: TFP

Advantages:

- TFP measure free of aggregation biases
- heterogeneous effects across firms

Examples of heterogeneous effects:

- small vs. large firms: effectiveness of reduced rates/exemptions?
- "declining" vs. "rising" firms: reallocation effects?

Three main mechanisms through which corporate taxes may impact on TFP growth:

- investment in physical capital and embodied technological change
    - no immediate expensing of capital good purchases
    - corporate taxes reduce after-tax return to investment

- investment in productivity enhancing innovations
    - product, process, organisational, marketing innovations, ...
    - often intangible and therefore not deductible from corporate tax bill

- entrepreneurial risk taking
    - "asymmetric" corporate tax schedules: profits taxed at higher rate than losses are compensated
    - risky projects are effectively taxed at higher marginal rate

Corporate taxes may be interpreted as "success taxes" (Gentry & Hubbard, 2006):

- most corporate tax schedules are implicitly progressive: reduced rates/exemptions, loss offset provisions, ...
- may fall disproportionately on "successful" firms

"Success tax" interpretation motivates:

- our identification strategy
- our test of differential effect between "declining" vs. "rising" firms

Identification through differences-in-differences strategy:

- Rajan & Zingales (1998) identification assumption: Effect of financial openness on growth differs across sectors with different degrees of financial dependence
- Our identification assumption: Effect of corporate taxes differs across sectors with different degrees of profitability

Plausibility:

- characteristics inherent to the production conditions in a sector that determine average profitability
- not necessarily pure profits: sunk costs, investments in risky assets, ...

Results:

- corporate taxes have a negative and significant impact on TFP at the firm level: the effect on the annual TFP growth rate of a reduction of the corporate tax rate from 35% to 30% would be 0.4 percentage points higher for firms in the sector with median profitability than in the sector with the lowest level of profitability

- uniform effect across firms of different size and age classes, except for small-young firms

- negative effect disproportionately large for successful firms

- corporate taxes have a negative and significant impact on investment at the firm-level: part of the effect on TFP is driven by technological progress embodied in new vintages of physical capital

Balance sheet data from:

- Amadeus (Bureau van Dijk): European OECD countries 1996-2004

Focus on Western European OECD countries:

- CEEC structurally different from other OECD economies: transition economies

Further data restrictions:

- exclude obvious keypunch errors and outliers
- exclude utilities, holdings, public services, financial services
- exclude multinational firms: foreign owner/affiliate

Two types of TFP measures:

- production function approach
  - Cobb-Douglas production function $lnY_{it} = \alpha_{cs}lnL_{it} + \beta_{cs}lnK_{it} + \epsilon_{it}$
  - estimate by (i) OLS or (ii) LP (to correct for endogeneity of input choice)
  - retrieve residual

- superlative index approach
  - $TFP_{it} = ln(Y_{it}/\bar{Y}_s) - \sum_{z=1}^{Z} \sigma_i^z ln(x_{it}^z/\bar{x}_s^z)$
  - Y - value added, σ - factor share, x - input use

- no restriction on economies of scale and market structure of factor markets in production function approach vs. pooling of firms in the same sector across countries in the superlative index approach

Only a fraction of firms in Amadeus report information on all production function variables: our TFP sample is not representative of population distribution across countries, sectors, size

- obtain population weights for each country, sector, size strata from Eurostat Structural Business Statistics
- draw with replacement from our TFP sample until the weight in each strata corresponds to population weight
- $\rightarrow$ estimation sample representative of population distribution across countries, sectors, size

We choose a sample size of 100 000 firms in Amadeus:

- this results in 537 309 firm-year observations for Western European OECD countries

Other data:

- statutory corporate taxes: OECD Tax Database

- tax adjusted user cost of capital: OECD Productivity Database, IFS

- pre-determined measure of profitability to reduce simultaneity: 1997 US input-output tables from BEA

Our estimating equation is:

- $\Delta A_{icst} = \beta_0 \Delta \ln A_{Fcst} + \lambda \ln\left(\frac{A_{ics,t-1}}{A_{Fcs,t-1}}\right) + \beta_1 relprof_s * T_{c,t-1} + \gamma_s + \gamma_{ct} + \epsilon_{isct}$

  - A_{icst} - TFP of firm i in country c, sector s in year t
  - A_{Fcst} - leader TFP
  - $relprof_s * T_{ct}$ - relative profitability in sector s interacted with corporate tax in country c in year t

This specification captures two empirical regularities:

- persistence of firm-level TFP levels in the short run
- convergence of firm-level TFP levels in the long run

Remarks:

- this productivity catch-up specification is effectively an ECM (estimated on stationary data)

- $A_{ics,t-1}$ enters both the dependent variable and relative productivity: potential simultaneity

- *relprof$_s$* * T_{ct} implements diff-in-diff strategy: we expect β_1 to be negative

- standard errors are clustered by country and sector: error term correlated in an unrestricted way across firms and time within sectors in the same country

Dependent Variable: TFP growth	(1)	(2)	(3)	(4)
Basic Model				
Leader TFP Growth	0.173***	0.173***	0.173***	0.173***
	(0.019)	(0.019)	(0.019)	(0.019)
TFP Relative to Leader (t-1)	-0.190***	-0.190***	-0.190***	-0.190***
	(0.015)	(0.015)	(0.015)	(0.015)
Interactions between firm & sector characteristics & tax				
Profitability & tax	-0.307**			
	(0.128)			
Profitability & tax (Empl<30)		-0.238*		
		(0.128)		
Profitability & tax (Empl>=30)		-0.336**		
		(0.132)		
Profitability & tax (Age<6)			-0.218*	
			(0.130)	
Profitability & tax (Age>=6)			-0.335**	
			(0.131)	
Profitability & tax (Age<6&Empl<30)				-0.145
				(0.176)
Profitability & tax (Age<6&Empl>=30)				-0.275**
				(0.130)
Profitability & tax (Age>=6&Empl<30)				-0.285**
				(0.127)
Profitability & tax (Age>=6&Empl>=30)				-0.357***
				(0.134)
Fixed effects:				
Sector	yes	no	no	no
Sector-size	no	yes	no	no
Sector-age	no	no	yes	no
Sector-size-age	no	no	no	yes
Country-year	yes	yes	yes	yes
Observations	287 727	287 727	287 727	287 727
R^2	0.10	0.10	0.10	0.10

(i) In the estimated empirical model $\Delta lnTFP_{icst}$ denotes TFP growth in firm i, country c, sector s and year t, *(ii)* $\Delta lnTFP_{cst}$ denotes TFP growth in the technological leader firm, *(iii)* $(TFP_{ics,t-1}/TFP_{Fcs,t-1})$ denotes the inverse of distance to the leader, *(iv)* $Profit_{i,t}*TAX_{c,t}$ the interaction between profitability and the corporate tax, *(v)* γ_s and γ_{ct} sector and country-year fixed effects, respectively. The estimation sample contains 12 European OECD countries over the period 1998-2004. TFP is the residual of a Cobb-Douglas production function estimated at the country-sector level. Robust standard errors corrected for clustering at the country-sector level in parentheses. * denotes significant at 10%; ** at 5%; *** at 1%

Interpretation:

- negative and significant effect of corporate taxes: a reduction of the corporate tax rate from 35% to 30% would be 0.4 percentage points higher for firms in the sector with median profitability than in the sector with the lowest level of profitability

- effect is smaller for small firms and young firms: exemptions or lower profitability?

- insignificant effect for small-young firms but significant effect for small-old firms: exemptions are generally granted on size criteria $\rightarrow$ lower profitability

Dependent Variable: TFP growth	(1)	(2)	(3)
Basic model			
Leader TFP growth	0.493***	0.501***	0.204***
	(0.021)	(0.022)	(0.019)
TFP relative to leader (t-1)	-0.117***	-0.115***	-0.186***
	(0.010)	(0.010)	(0.015)
Rising	0.184***		
	(0.016)		
Interactions between firm & sector characteristics & tax			
Rising & profitability	0.117***		
	(0.027)		
Declining & profitability & tax	-0.027	-0.038	-0.126
	(0.090)	(0.088)	(0.113)
Rising & profitability & tax	-0.251***	-0.251***	-0.268**
	(0.091)	(0.090)	(0.120)
Fixed effects:			
Sector	yes	no	no
Sector-catchup	no	yes	yes
Country-year	yes	yes	yes
Observations	287 727	287 727	287 727
R^2	0.44	0.44	0.14
Definition of rising firm	Contemporaneous	Contemporaneous	Sample period

(i) In the estimated empirical model $\Delta lnTFP_{icst}$ denotes TFP growth in firm i, country c, sector s and year t, *(ii)* $\Delta lnTFP_{Fcst}$ denotes TFP growth in the technological leader firm, *(iii)* ($TFP_{ics,t-1}/TFP_{Fcs,t-1}$) denotes the inverse of distance to the leader, *(iv)* $Profit_s *TAX_{c,t}$ the interaction between profitability and the corporate tax, *(v)* γ_s and γ_{ct} sector and country-year fixed effects, respectively. The estimation sample contains 12 European OECD countries over the period 1998-2004. TFP is the residual of a Cobb-Douglas production function estimated at the country-sector level. I is an indicator variable that takes a value of 1 if the firm is in the process of catching up with the technological frontier and a value of 0 otherwise. Robust standard errors corrected for clustering at the country-sector level in parentheses. * denotes significant at 10%; ** at 5%; *** at 1%

Investment measures:

- first difference of net capital stocks plus depreciation

- following the literature: restrict to strictly positive investment

- additionally: restrict to investment-to-capital ratios < 1 to avoid that results are driven by extreme outliers (results robust to alternative choices of truncation threshold)

The following estimating equation can be derived from a Euler
equation (Becker & Sivadasan, 2007):

- $(\frac{I}{K})_{icst} = \beta_1(\frac{I}{K})_{ics,t-1} + \beta_2(\frac{I}{K})^2_{ics,t-1} + \beta_3(\frac{CF}{K})_{ics,t-1} +$
  $+ \beta_4 UC_{cs,t-1} + \gamma_s + \gamma_{ct} + \epsilon_{icst}$

There are two potential explanations for a negative β_4:

- driven by components of user cost that are unrelated to taxes (real
  cost of debt/equity, economic depreciation, capital gains/losses)
- driven by tax adjustment (statutory corporate tax adjusted for
  depreciation allowance)

But:

- we can use assumption that effect of other components of user cost
  are unlikely to be systematically related to relative profitability for
  identification

Dependent Variable: Investment-to-capital ratio	(1)	(2)	(3)
Basic model			
Investment-to-capital ratio (t-1)	0.532***	0.531***	0.534***
	(0.026)	(0.026)	(0.026)
Investment-to-capital ratio squared (t-1)	-0.415***	-0.414***	-0.418***
	(0.025)	(0.025)	(0.025)
Output-to-capital ratio (t-1)	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)
Cashflow-to-capital ratio (t-1)	0.048***	0.048***	0.047***
	(0.003)	(0.003)	(0.003)
Tax adjusted user cost (t-1)	-0.829**	0.147	
	(0.410)	(0.689)	
Interactions between firm & sector characteristics & tax			
Profitability & tax adjusted user cost		-0.723**	
		(0.351)	
Tax adjusted user cost (Age<6&Empl<30)			-0.339
			(0.497)
Tax adjusted user cost (Age<6&Empl>=30)			-0.401
			(0.476)
Tax adjusted user cost (Age>=6&Empl<30)			-0.832*
			(0.437)
Tax adjusted user cost (Age>=6&Empl>=30)			-1.039**
			(0.430)
Long-run tax adjusted user cost elasticity	-0,69		
Observations	211 599	211 599	211 599
Fixed effects:			
Sector	yes	yes	yes
Size-age	no	no	yes
Country-year	yes	yes	yes
R^2	0.12	0.12	0.12

(i) In the estimated empirical model $(I/K)_{icst}$ denotes the investment-to-capital ratio, (ii) $(I/K)_{ics,t-1}$ its lag, (iii) $(I/K)^2_{ics,t-1}$ its squared lag, (iv) $(Y/K)_{ics,t-1}$ the lag of the output-to-capital ratio, (v) $(CF/K)_{ics,t-1}$ the lag of the cashflow-to-capital ratio, (vi) $UCtax_{cs,t-1}$ the lag of the tax adjusted user cost and (vii) γ_s and γ_{ct} sector and country-year fixed effects, respectively. The estimation sample contains 12 European OECD countries over the period 1998-2004 and only observations with investment ratios beween 0 and 1. Robust standard errors corrected for clustering at the country-sector level in parentheses. * denotes significant at 10%; ** at 5%; *** at 1%

TFP robustness checks:

- instrumental variables: first lag of relative profitability

- TFP measure: Levinsohn-Petrin

- TFP measure: superlative index

	(1)	(2)	(3)
Dependent Variable: TFP growth	IV	LP	Index
Basic Model			
Leader TFP Growth	0.145***	0.133***	0.084***
	(0.021)	(0.019)	(0.006)
TFP Relative to Leader (t-1)	-0.098***	-0.158***	-0.144***
	(0.012)	(0.012)	(0.007)
Interactions between firm & sector characteristics & tax			
Profitability & tax	-0.383***	-0.198*	-0.314***
	(0.139)	(0.119)	(0.085)
Fixed effects:			
Sector	yes	yes	yes
Country-year	yes	yes	yes
Observations	214 075	278 984	285 931
R^2	0.05	0.09	0.07

(i) In the estimated empirical model $\Delta lnTFP_{icst}$ denotes TFP growth in firm i, country c, sector s and year t, (ii) $\Delta lnTFP_{Fcst}$ denotes TFP growth in the technological leader firm, (iii) $(TFP_{ics,t-1}/TFP_{Fcs,t-1})$ denotes the inverse of distance to the leader, (iv) $Profit_s *TAX_{c,t}$ the interaction between profitability and the corporate tax, (v) γ_s and γ_{ct} sector and country-year fixed effects, respectively. The estimation sample contains 12 European OECD countries over the period 1998-2004. LP denotes TFP estimated using the Levinsohn & Petrin (2003) method, Index the superlative productivity index and OLS TFP estimated using OLS. Robust standard errors corrected for clustering at the country-sector level in parentheses. * denotes significant at 10%; ** at 5%; *** at 1%

Investment robustness checks:

- accelerator effects: output growth instead of output ratio

- truncation of dependent variable: choose threshold of 1.5

	(1)	(2)
Dependent Variable: Investment-to-capital ratio	<1	<1.5
Basic model		
Investment-to-capital ratio (t-1)	0.475***	0.474***
	(0.018)	(0.022)
Investment-to-capital ratio squared (t-1)	-0.380***	-0.290***
	(0.023)	(0.016)
Output growth rate (t)	0.137***	
	(0.008)	
Output-to-capital ratio (t-1)		0.000***
		(0.000)
Cashflow-to-capital ratio (t-1)	0.052***	0.060***
	(0.003)	(0.003)
Tax adjusted user cost (t-1)	-1.463**	-1.521***
	(0.641)	(0.510)
Long-run tax adjusted user cost elasticity	-1.21	-1.27
Observations	128,228	232,448
Fixed effects:		
Sector	yes	yes
Country-year	yes	yes
R^2	0.13	0.12
Sample	Amadeus	Amadeus

(i) In the estimated empirical model (I/K)$_{ icst}$ denotes the investment-to-capital ratio, (ii) (I/K)$_{ ics,t-1}$ its lag, (iii) (I/K)$^2_{ ics,t-1}$ its squared lag, (iv) (Y/K)$_{ ics,t-1}$ the lag of the output-to-capital ratio, (v) (CF/K)$_{ ics,t-1}$ the lag of the cashflow-to-capital ratio, (vi) UCtax$_{ cst,t-1}$ the lag of the tax adjusted user cost and (vii) γ$_s$ and γ$_{ct}$ sector and country-year fixed effects, respectively. The estimation sample contains 12 European OECD countries for the Amadeus sample and 15 OECD countries for the joint Amadeus-Worldscope sample over the period 1998-2004. It is restricted to observations with investment ratios beween 0 and 1 in columns (1) and (3) and to investment ratios between 0 and 1.5 in column (2). Robust standard errors corrected for clustering at the country-sector level in parentheses. * denotes significant at 10%; ** at 5%; *** at 1%

Conclusions:

- corporate taxes have a negative and significant effect on TFP at the firm-level; economically the effect appears to be substantial

- all types of firms are affected except young-small

- firms that are in the process of catching up with the technological frontier are more negatively affected than the remaining firms

- part of the effect may be driven by a reduction in investment in physical capital which embodies technological progress