# Estimating the Elasticity of Intertemporal Substitution using Dividend Tax News

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The Elasticity of Intertemporal Substitution =  $EIS \equiv \frac{d \log(c_{t+1}/c_t)}{dr}$ 

- ► The elasticity of the growth rate of consumption to the real interest rate.
- ► Key parameter for optimal capital taxation, asset pricing, wealth hand-to-mouth, ...

### Example – optimal capital taxation



FIGURE 1. OPTIMAL TIME PATHS FOR CAPITAL (PANEL A) AND WEALTH TAXES (PANEL B)

*Note:* This figure shows the optimal time paths of capital  $k_t$  (panel A) and wealth taxes  $\mathcal{T}_t$  (panel B) for various values of the inverse IES  $\sigma$ .

Straub-Werning (2020)

## What do people think it is?

• Aggregate ( $\approx 0$ ):

Hansen-Singleton (1983), Hall (1988), Campbell-Mankiw (1989)

► Survey (0.3 - 2)

Zeldes (1989), Attanasio-Weber (1993, 1995), Vissing-Jørgensen (2002), Gruber (2013)

► Panel (0.02 - 4)

Best-Cloyne-Ilzetzki-Kleven (2020), Jakobsen-Jakobsen-Kleven-Zucman (2020), Ring (2024)

Havranek (2015): "[...] calibrations of the EIS routinely differ by an order of magnitude."

Novel approach to identify the EIS: news about future dividend taxes.

**March 2004:** dividend tax increase from 0% to 28%, effective from **January 2006**. Theory: an announced future dividend tax change operates like an Euler wedge. Event-study: estimate differential spending response based on exposure.

### What we do and find II



**Main result:** Spending  $\uparrow$  after news; spending  $\downarrow$  after implementation.

Theory: consistent with EIS > 1.

Structural model of workers and capitalists: EIS  $\approx$  1.6.

## **Related literature**

**EIS:** Hall (1988), Hansen and Singleton (1983), Campbell and Mankiw (1989), Mankiw and Zeldes (1991), Attanasio and Weber (1993), Blundell et al. (1994), Attanasio and Browning (1995), Beaudry and Van Wincoop (1996), Vissing-Jørgensen (2002), Vissing-Jørgensen and Attanasio (2003), Gruber (2013), Cashin and Unayama (2016), Calvet et al. (2021), Crump et al. (2022), ...

## **EIS using panel micro data:** Best et al. (2020), Jakobsen et al. (2020), Ring (2024). **Contributions:**

- 1. Large and salient reform; any optimization frictions that may bias the estimates are less relevant.
- 2. News about a dividend tax change is an almost ideal setting to identify the EIS relative to unity.

Real effects of dividend taxation: Harberger (1962), Hall and Jorgenson (1967), Feldstein (1970), Auerbach (1979), Bradford (1981), Poterba and Summers (1983), Cummins et al. (1994), Chetty and Saez (2005), Auerbach and Hassett (2007), House and Shapiro (2008), Chetty and Saez (2010), McGrattan (2012), Yagan (2015), Alstadsæter et al. (2017), Zwick and Mahon (2017), Stantcheva (2017), Barro and Furman (2018), Saez and Stantcheva (2018), Chodorow-Reich et al. (2024).

**Contribution:** A dividend tax can be distortionary when the reform is pre-announced and the EIS differs from unity, even when household consumption and firm investment decisions cannot be decoupled.

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#### Main innovation: use news about future dividends

Consider an agent solving the following problem:

$$\max_{\{c_t\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t \frac{c_t^{1-1/\psi}}{1-1/\psi} \quad \text{subject to} \quad k_{t+1} = k_t^{\alpha} + (1-\delta)k_t - (1+\tau_t)c_t,$$

where  $c_t = \text{cons.}$ ,  $k_t = \text{capital}$ ,  $\beta = \text{disc.}$  factor,  $\delta = \text{depr.}$  rate,  $\tau = \text{dividend}$  tax, and  $\psi = \text{EIS.}$ 

Solution:

$$c_t^{-1/\psi} = c_{t+1}^{-1/\psi} \beta \tilde{R}_{t+1}$$

with

$$\tilde{R}_{t+1} = \left(\frac{1+\tau_t}{1+\tau_{t+1}}\right) \left(\alpha k_{t+1}^{\alpha-1} + (1-\delta)\right).$$

#### Responses to an announced dividend tax increase



Figure: Example responses to a future dividend tax increase.

Labor income: adjusted but similar.

Business risk: affects risk-adjusted return but does not affect intertemporal trade-off. (Flynn, Schmidt, Toda, 2023)

Income risk: affects intertemporal trade-off; decreasing absolute prudence  $\rightarrow$  small effect. (Farhi, Olivi, Werning, 2022; Holm, 2023)

#### Durable goods: depends on the setting.

- 1. Perfectly competitive with no trading friction: no impact.
- 2. Partly irreversible / trading frictions: raises importance of permanent income loss.

#### More general preferences:

- 1. Epstein-Zin: no impact (Flynn, Schmidt, Toda, 2023).
- 2. Non-homothetic preferences (e.g., Straub, 2019): adjusted but similar.

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#### Timeline

Reform objective: Harmonize (marginal) labor and capital income tax rates.

2001: A temporary 11% dividend tax applicable only for that year.February 2003: Official commission recommends a 28% dividend tax rate.March 2004: Government announces a 28% dividend tax.January 2006: Implementation of the 28% dividend tax.

Feature 1: 28% tax on dividends in excess of riskless return allowance.Feature 2: top marginal tax on labor income falls from 64.7% to 54.3%.

Profit + dividend taxes increased from 28% to 48.2%.

### Effective marginal tax rates in 2000



<u>Notes:</u> The figure shows effective marginal tax rates for labor and capital income in 2000. "Labor" shows the statutory marginal tax rate on labor income, while "Capital" represents the corresponding rate on capital income. The "Labor & Pension" rate includes the implicit tax from compulsory pension contributions, which are exempt from the wealth tax. The shaded area illustrates that the marginal tax rate (from pensions) varies across individuals, particularly with age of the individual, because it relies on a net present value calculation.

## Was the reform expected?



Figure: Cumulative stock returns for high vs. low dividend stock portfolios.

Notes: This figure shows cumulative returns of two portfolios of below-median market-capitalization ("small-cap") firms with high- (above median) vs. low-dividend yields.

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- ► Household balance sheets and income statements from Norwegian tax registers
- ► Data on family status, demographics, education, employment status, etc.
- Employer-employee matched data
- Housing transaction data
- Business ownership data
- Firm income statements and balance sheets

► Deflated to real 2011 US dollars

Imputed Spending  $\equiv$  Disposable Income - "Active" Saving

Disposable income: labor income + transfers + business income + capital income + other income - taxes

"Active" saving: The change in net worth due to depositing and withdrawals.

Most households: deposit, debt, and housing transactions observed  $\rightarrow$  straightforward

**Issue 1:** Publicly-traded stocks  $\rightarrow$  use ownership data to impute capital gains

**Issue 2:** Business owners

### Imputing spending for business owners

How? Need to observe flow of funds between firm and owner.

$$spending_{i,t} = spending_{i,t}^{npbo} + \underbrace{\text{profits}_{i,t}}_{\text{income within the firm}} - \underbrace{(\Delta \text{ book value}_{i,t} - \text{ capital gains}_{i,t})}_{\text{retained earnings}_{i,t} + \Delta \text{paid-in capital}_{i,t}}$$
$$= spending_{i,t}^{npbo} + \underbrace{\text{profits}_{i,t}}_{\text{dividends}_{i,t} + \text{retained earnings}_{i,t}} - \underbrace{(\Delta \text{ book value}_{i,t} - \text{ capital gains}_{i,t})}_{\text{dividends}_{i,t} + \text{retained earnings}_{i,t}}$$

= spending<sup>npbo</sup><sub>*i*,*t*</sub> + dividends from the firm<sub>*i*,*t*</sub> -  $\Delta$ paid-in capital in firm<sub>*i*,*t*</sub>

## Imputing spending of business owners > Tax evasion

Challenge 1: Need to observe flows between firm and owner (dividends + paid-in capital).

Dividends paid by firm observed in firm accounts.

 $\Delta$  Paid-in-capital observed in firm accounts.

Combining this with ownership data  $\rightarrow$  relies on stable ownership to impute.

Challenge 2: Need to impute ownership before 2004.

Assumptions: ownership share is same as in 2004 if

- i. the owner owns 'non-listed stocks' in tax data
- ii. firm existed in firm accounts

 $\rightarrow$  relies on stable ownership.

 $\Rightarrow$  Restrict sample to owners with at least 25% ownership share in 2004 of one firm only (86% same 5 yrs later;  $\approx$  3% attrition rate)

## Imputed spending and consumption in the national accounts



- Annual data from 2000 to 2014.
- ▶ Between 30 and 60 years old in 2000.
- ► At least USD 21,000 (2 "G") in disposable income.
- ► At least 25% ownership in every firm they own.
- ► Exclude top/bottom 1% of log spending change distribution.
- ► Exclude top 1% of wealth distribution in 2000.

Final sample: 16,966 individuals in 2000.

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## **Econometric methodology**

$$c_{i,2000+h} - c_{i,2000} = \alpha + \sum_{h=\underline{h}}^{H} \beta_h \left( D_{i,2000} \times \omega_{2000+h} \right) + \sum_{h=\underline{h}}^{H} \Gamma'_h (\mathbf{X}_{i,2000} \times \omega_{2000+h}) + \sum_{h=\underline{h}}^{H} \gamma_h \times \omega_{2000+h} + \delta_i + \varepsilon_{i,h}$$
(1)

- c: log imputed spending
- D: treatment variable
- $\omega :$  horizon-fixed effect

 $X_{i,2000}$ : Non-financial income, NACE employment, age, municipality.

 $\gamma_h$ : time-fixed effects.

Standard errors clustered at the individual level.

Treated: relied on dividend income prior to the reform

Mean share of dividend as a share of gross income exceeds 30% in 2000 and 2002.

Control group: firm owners who did not rely on dividend income prior to the reform. No dividend income in 2000 and 2002.

## **Descriptive statistics**

	Control		Treated	
	Mean	S.D.	Mean	S.D.
Panel A: Household Characteristics				
Age	44.42	8.33	47.02	7.93
Number of individuals	13,046		3,920	
Dividend share of net income (%)			46.97	13.99
Panel B: Household Spending, Income and We	alth			
Spending	47.60	44.78	70.30	78.28
Disposable income	43.45	15.75	114.06	107.21
Labor income	56.02	27.88	58.81	24.90
Dividend income from private businesses			75.25	107.60
Net Wealth	216.18	366.80	591.64	548.05
Private Business Wealth	28.99	171.33	198.07	322.55
Panel C: Firm Income Statement, Balance Sheet and Characteristics				
Revenue	579.17	1,472.85	1,512.12	3,299.63
Wages	144.11	402.57	296.99	598.67
Cost of goods purchased	280.90	1139.15	813.09	2519.59
Total assets	210.61	1,161.04	676.10	4,050.04
Firm age Employees	7.73	9.45 6.28	12.01 4.97	11.39 8.41
Value added per worker	48.43	162.56	101.55	168.22

Notes: Values in Panel B and C are in 1,000 dollars in 2011.

1. The reform announcement in 2003 was unexpected. (Stock market graph in the beginning)

**2. Treatment exogeneity** / **parallel trends:** the control group represents a relevant counterfactual for the treated group's spending growth absent the reform.

Theoretically: yes, if on Euler with similar preferences and interest rates.

Variation stems from pre-reform tax planning for owners with different permanent income.



(a) Log spending in the treatment and control group.



(b) Average dividends, and changes in paid-in-capital and private loans in the treatment group.



- ► Owner age control for age.
- ► Firm age control for firm age.
- ► Two concurrent reforms:
  - 1. Labor income tax control for tax bracket
  - 2. Geographically determined payroll tax in 2004-2006 control for NACE code of employment and municipality-fixed effects.
- ► Exposure to stock market movements control for stock share of financial wealth.

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Notes: The figure displays the estimated coefficients of equation (1) with 95% confidence bands computed using standard errors clustered at the individual level.

#### Partial identification: EIS > 1



#### Robustness



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Two-agent real business cycle framework: capitalists and workers.

Households:

Capitalist + workers—limited asset market participation.

Heterogeneous tax avoidance opportunities.

Firms: Pay dividends to capitalists subject to tax.

Policy: News shocks about future dividend and labor income taxes.

$$\begin{split} \max_{\{C_{k,t}, S_{t+1}\}} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \frac{C_{k,t}^{1-1/\psi} - 1}{1 - 1/\psi} \\ \text{s.t.} \quad S_{t+1} P_t + C_{k,t} \leq (1 - \tau_{k,t}) N_k + S_t (D_t + P_t) + T_{k,t} \end{split}$$

*C* consumption, *S* firm, *P* price of firm, *D* dividends, *T* transfers, *N* labor supply (inelastic). Only access to saving in firm.

Assume  $\theta$  share of wealth remains "avoided" from one year to the next.

$$\max_{\{C_{w,t},B_{w,t+1}\}} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \frac{C_{w,t}^{1-1/\psi} - 1}{1 - 1/\psi} \quad \text{s.t.} \quad C_{w,t} + \frac{B_{w,t+1}}{R_t^B} = N_w + B_{w,t}$$

*C* consumption, *B* real bond, *R* return on bond, *N* labor supply (inelastic). Only access to saving in bonds.

$$V(K_t) = \max_{\{D_t, K_{t+1}\}} [D_t + \mathbb{E}\Lambda_{t, t+1}V(K_{t+1})]$$
  
s.t.  $\varphi(D_t) + K_{t+1} \le (1 - \delta)K_t + AK_t^{\alpha}N_t^{1-\alpha} - N$ 

V(K) value,  $\Lambda$  stochastic discount factor, K capital, D dividends, N labor,  $\delta$  depreciation rate. The first-order condition with respect to  $K_{t+1}$  is:

$$\mathbb{E} \Lambda_{t,t+1} \underbrace{\left(\frac{\varphi_D(D_t)}{\varphi_D(D_{t+1})}\right) \left[1 - \delta + F_k(K_{t+1}, N_{t+1})\right]}_{\text{Net Return on Investment } R_t} = 1.$$

Key component:  $\varphi(D) = D(1 + \tau)^{\kappa}$ .

 $\tau$  dividend tax,  $\kappa$  = reduced-form parameter capturing the existence of other assets

$$T_{k,t} = \tau_{d,t} D_t + \tau_{k,t} N_k$$

T transfers, D dividends, N labor,  $\tau$  tax rates.

Transfers adjust when dividend tax is increased.

A rational expectations general equilibrium, given tax policy innovation shocks  $\{\varepsilon_{d,t}, \varepsilon_{k,t}\}$  and the tax policy processes, is defined as a set of policies for

- (i) policies for capitalists:  $C_k$  and  $S_k$ ;
- (ii) policies for workers:  $C_w$  and  $B_w$ ;
- (iii) policies for firms: *K* and *D*;
- (iv) firm market value V(K);
- (v) aggregate prices  $\Lambda$  and  $R^b$ ;

such that all policies solve the respective agents' optimization problems,  $\Lambda_{t,t+1} = \beta \frac{U_c(c_{k,t+1})}{U_c(c_{k,t})}$ , and all markets clear at any given time *t*.

Unexpected permanent change to the dividend and labor tax two years from now:

$$\log \tau_{d,t} = \log \tau_{d,t-1} + \sigma_d \varepsilon_{d,t-2},$$
$$\log \tau_{k,t} = \log \tau_{k,t-1} + \sigma_k \varepsilon_{k,t-2}$$

Parameter	Value	Description
$\lambda$	0.990	Share of workers
$\beta$	0.980	Discount factor
$\delta$	0.075	Depreciation rate
$\alpha$	0.330	Capital share
N	0.300	Labor endowment
$\sigma_d$	0.280	St. dev., capitalist dividend tax news
$\sigma_l$	0.104	St. dev., capitalist labor tax news

 $\psi$  (EIS),  $\kappa$  (access to other assets), and  $\theta$  (tax avoidance) are estimated from IRF matching.

#### 



Notes: This figure shows the differential response of spending in the model (straight line) and the data (dashed line) in response to the tax reform. Differential spending in the model is defined as consumption by capitalists less consumption by workers.

$$\bar{\psi} = 1.59, \, \bar{\kappa} = 0.02, \, \text{and} \, \bar{\theta} = 0.56.$$

## Impulse response matching



(a) Matching Errors

#### (b) Implied EIS Values

<u>Notes:</u> Panel (a) represents a heatmap of IRF matching errors produced by the calibration procedure over the three-dimensional grid  $\{\psi, \kappa, \theta\}$  with tax avoidance intensity and reform pass-through on the horizontal and vertical axes, respectively. Colder colors correspond to lower mean squared errors. Panel (b) presents the corresponding EIS estimates. Warmer colors correspond to higher EIS values.

### **Model robustness**



Notes: Panel (a) plots relative spending responses to the Norwegian tax reform in the baseline and the alternative models. Panel (b) reports median EIS values as well as 68% and 95% bootstrapped confidence intervals implied by each alternative model.

#### EIS and tax avoidance



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Use news about future dividend tax rate to identify the EIS.

Spending  $\uparrow$  after announcement, spending  $\downarrow$  after implementation.

Consistent with EIS > 1 (partial identification).

Structural model: EIS  $\approx$  1.6.

#### **Relevance:**

**1.** The EIS of a specific sub-group of the population

Predominately among the top 5% of wealth distribution

EIS may increase with wealth (Browning and Crossley, 2000; Guvenen, 2006)

Disproportionately relevant in some settings (capital formation, asset pricing, innovation, ...)

**2.** Our estimated spending response is one column of the Jacobian of consumption with respect to the interest rates, a key calibration target in dynamic macro models.

## Appendix

#### Issue 1: Consumption within the firm (Leite, 2023).

Issue 2: Hidden wealth (Alstadsæter-Johannesen-Zucman, 2019).

#### Responses of other variables > Back

