Tax News and Intertemporal Substitution[†]

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Abstract

This paper proposes a novel approach to estimate the elasticity of intertemporal substitution (EIS) of firm owners using a quasi-natural experiment and new theoretical insights on spending responses to anticipated dividend tax changes. We study Norway's dividend tax reform, announced in 2004 and implemented in 2006, which raised the dividend tax rate by 28 percentage points. Using administrative data and a dynamic difference-in-differences framework, we find that exposed households increased spending after the announcement and reduced it following implementation. This pattern is consistent only with an EIS above 1. Using a structural model, we estimate owners' EIS to be 1.5.

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1 Introduction

Do firm owners shift consumption toward the present when future returns fall? If they do, the substitution effect dominates the income effect, implying an elasticity of intertemporal substitution (EIS) exceeding one. Whether the EIS is above or below one is consequential for a wide range of theoretical results. For example, Straub and Werning (2020) show that recovering the classic result that the optimal long-run capital tax is zero requires capital owners to have an EIS above one (Judd, 1985). Similarly, Barro (2009) and Gabaix (2012) show in disaster-risk models that asset prices decline in response to higher disaster risk only if the owner's EIS exceeds one.

There is a vast literature estimating the EIS, with most studies finding that it is below one (Havránek, 2015). However, there are two reasons why the EIS of firm owners could be higher than average. First, firm owners are wealthier, and wealthier households tend to consume more goods that are easier to substitute across time (Browning and Crossley, 2000; Guvenen, 2006). Second, in the presence of financial frictions, firm owners could have above-average EIS. For example, in models with upfront entry costs, agents more willing to substitute consumption over time (high EIS) would be more willing to start businesses (Wang et al., 2012).[1]

We identify the EIS of firm owners relative to unity using a novel approach applied to a unique quasi-natural experiment, the 2006 Norwegian dividend tax reform. In 2004, the Norwegian government announced that it would introduce a 28% dividend tax from January 2006. The spending response between announcement and implementation allows us to identify the EIS relative to unity. Consider a firm owner who saves within her own firm. If the tax change is immediate, it is equivalent to a consumption tax, creating no intertemporal distortions because it affects the price of consumption today and tomorrow equally. But when the reform is pre-announced, it introduces an *intertemporal wedge* between the price of consumption just before and immediately after the reform's implementation. This wedge induces the standard income and substitution effects on the agent's consumption decision. Following the general partial identification result of Flynn et al. (2023) adapted to our setting, we show that *if consumption of exposed agents increases in response to the news about the future dividend tax increase, their EIS must be above one*.

We identify the spending effects of the dividend tax announcement and its subsequent implementation using a dynamic difference-in-differences (DiD) approach. We compare the spending trajectories of a treatment group – defined as firm owners receiving dividend income before the reform – with a control group of firm owners with no dividend income.

[1] Similarly, individuals who accept more variation in their consumption (i.e., high EIS) are also more willing to invest in illiquid assets (Aguiar et al., 2025) such as firms.

This treatment exposure is plausibly exogenous to the reform, as it stems from pre-reform tax planning by owners of firms with different profitability. Under the pre-reform tax system, the effective marginal labor tax schedule created distinct incentives for owners of more profitable firms to shift income from wages to dividends. The treatment and control groups exhibit parallel spending trajectories before the reform.

We find that exposed households increased spending after the announcement and reduced spending after implementation. Relative to the control group, treated households increased their spending by around 7% in 2004, followed by a persistent decline. This observed spending response is only consistent with an EIS greater than one. The results are robust across several empirical specifications, including other concurrent tax changes, owner age, firm life-cycle effects, and stock market wealth effects.

To quantify the EIS, we construct a tractable structural model and calibrate it to match the estimated dynamic spending response. The model is a two-agent capitalist-worker production economy that includes dividend-tax news shocks, following the literature on news and macroeconomic fluctuations (Beaudry and Portier, 2004, 2006). The baseline model-implied EIS is 1.5 and differs from one at the 95% confidence level. This result is robust to several model extensions and sensitivity checks.

Related literature. Our paper contributes to the large body of work estimating the EIS, where no broad consensus has emerged (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, and more recently Gruber, 2013, Cashin and Unayama, 2016, Best et al., 2020, Calvet et al., 2021, Crump et al., 2022, Ring, 2024, among others).[2] Estimates of the EIS vary significantly by data type (aggregate time series, survey, or administrative), empirical method, and sample population, partly due to endogeneity issues and biases from using aggregate time-series variation in rates of return or model misspecification.[3] Our primary contribution is to use the news about a future dividend tax change to identify the EIS. This approach is novel to the literature and, under standard regularity conditions, sign-identifies the EIS relative to unity.

Our use of rich administrative datasets places our paper among a small group of recent empirical studies that estimate the EIS using micro data. Best et al. (2020) examine bunching around loan-to-value mortgage thresholds in the UK, combined with a dynamic

[2]Campbell, 2003, Hansen et al., 2007, Attanasio and Weber, 2010, Havránek et al., 2015, and Havránek, 2015 provide surveys and meta-studies detailing how estimates vary by method and publication bias.

[3]See Bansal et al., 2010, Bansal et al., 2011, Gruber, 2013, and Schmidt and Toda, 2015 on downward biases from time-series data and Yogo (2004) on weak instruments in EIS estimation.

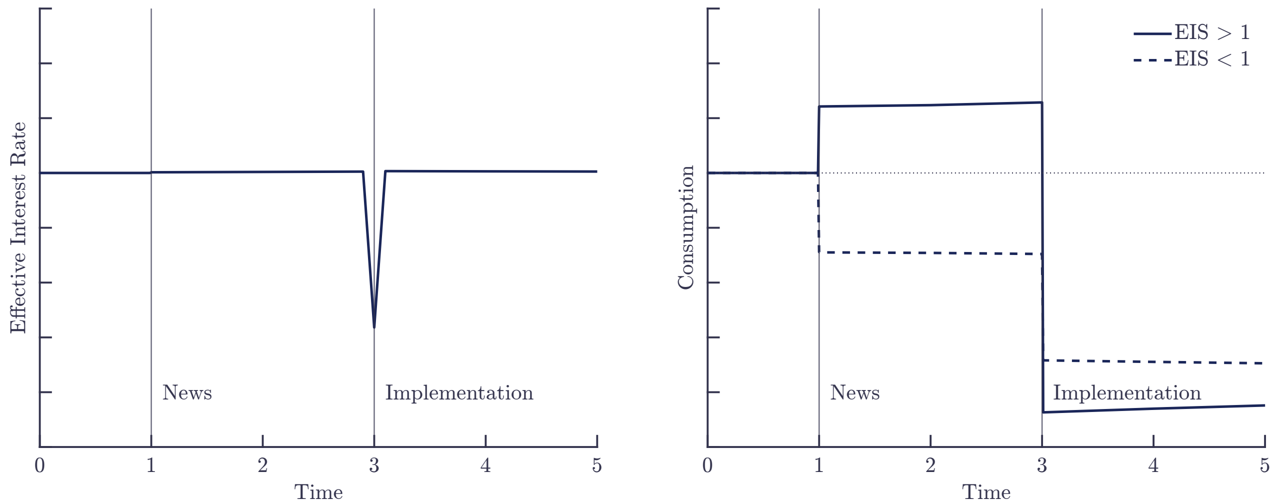
model of mortgage refinancing choice. Jakobsen et al. (2020) interpret their estimates of wealth responses to the 1989 Danish wealth tax reform in terms of structural parameters. Ring (2024) uses Norwegian administrative data, focusing on border discontinuities in the pricing of housing used to assess the wealth tax in Norway. Compared with this literature, our study has two advantages. First, we study a large and salient reform such that any optimization frictions that may bias the estimates are less relevant in our setting. Second, as we show in Section 2, the dividend tax reform we study mainly affected one specific future effective interest rate, an almost ideal setting to identify the EIS relative to unity.

We also contribute to a growing literature on the real effects of capital income taxation, particularly dividend income 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, 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). There are two broad views on the effects of dividend taxes on firm investment according to that literature – the "old" view (Harberger, 1962, Feldstein, 1970, and Poterba and Summers, 1983), which argues that corporate income taxes affect the cost of capital of firms, and a "new" view (Auerbach, 1979 and Bradford, 1981), which instead contends that dividend income taxes are neutral for firm investment decisions and only impact firm valuations. Our theoretical analysis aligns with the "new" view when dividend tax changes are unanticipated. However, we emphasize that when household consumption and firm investment decisions cannot be decoupled, a dividend tax can be distortionary, specifically when the reform is *pre-announced* and the EIS differs from unity. The point that dividend taxes influence behavior primarily when they are expected is also made by McGrattan (2012) in the context of the Great Depression.

2 How responses to dividend tax news identify the EIS

To illustrate how the spending response to news about future dividend taxes depends on the value of the elasticity of intertemporal substitution (EIS), consider an infinitely-lived firm owner who only has access to saving in firm capital:

$$\max_{\{c_t\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t \frac{c_t^{1-1/\psi}}{1-1/\psi}$$



(a) Effective interest rate, $\tilde{R}$.

(b) Consumption, c.

Figure 1: Example consumption and interest rate paths in response to a future dividend tax increase.

subject to

$$k_{t+1} = k_t^\alpha + (1 - \delta)k_t - (1 + \tau_t)c_t$$

where c_t is consumption, k_t is capital, β is the discount factor, δ is the depreciation rate of physical capital, $\alpha \in (0, 1]$ is the curvature parameter governing decreasing returns to capital, τ is the dividend tax, and $\psi > 0$ denotes the EIS.[4]

The solution to this problem has to satisfy the Euler equation

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

where $\tilde{R}_{t+1}$ is the effective interest rate:

$$\tilde{R}_{t+1} = \left(\frac{1 + \tau_t}{1 + \tau_{t+1}} \right) \left(\alpha k_{t+1}^{\alpha - 1} + (1 - \delta) \right) \tag{2}$$

When the dividend tax is constant, it does not affect the effective interest rate. In contrast, an expected change in the dividend tax rate does affect the effective interest rate, resulting in a transitory shift in the effective interest rate for firm owners.

To illustrate this, Figure 1 shows the effective interest rate and consumption responses to a reform that is announced in period 1 and increases the dividend tax from period 3. As per equation (2), there is a temporary drop in the effective interest rate when the new

[4]Note that this problem is equivalent to the canonical neoclassical growth model with a consumption tax and no labor inputs.

dividend tax is implemented. The owner responds to the announced dividend tax by increasing or decreasing consumption *at the time of the announcement*, and thus also by adjusting the level of capital.[5]

The *sign* of the consumption response between the news and implementation of the reform is determined by whether the EIS is greater or less than one. If consumption increases in response to the news about a future dividend tax increase, then the EIS is greater than one. Intuitively, the substitution effect induced by the lower future effective interest rate dominates the income effect. Conversely, if spending decreases before implementation, the EIS is less than one. This approach to signing the EIS relative to unity using news about future rates of return follows from Flynn et al. (2023) and holds more generally. Moreover, in addition to the sign of the EIS relative to unity, the value of the EIS will govern the size of the consumption response between the reform announcement and implementation dates.[6] We apply these two insights to the 2006 Norwegian dividend tax reform to determine both the sign of the EIS relative to unity for households exposed to the reform and its precise magnitude.

The model we present in this section is deliberately kept simple to convey the main intuition of partial identification. In Appendix A, we present several extensions to illustrate that the sign-comparative statics is valid also in richer frameworks that incorporate non-homothetic preferences, returns risk, labor income risk, durable goods, and multiple assets.

3 The dividend tax reform

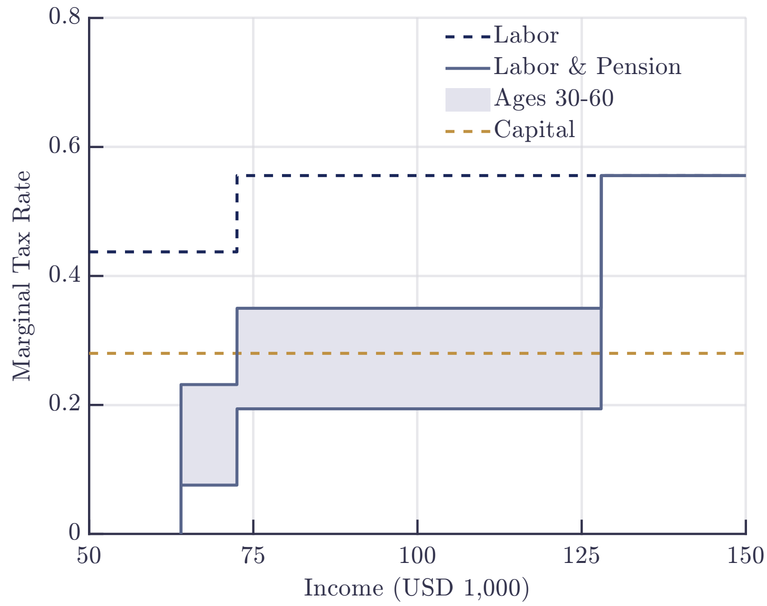
The tax system before 2006. Before 2006, the Norwegian tax system consisted of a progressive labor income tax combined with a flat capital income tax, as illustrated in Figure 2.[7] Wage earners faced a marginal tax rate that increased from around 42% to more than 60%. When including the marginal benefit of the compulsory pension contributions, the effective marginal tax rate for wage earners is substantially lower, with the exact magnitude depending on the individual's valuation of future pension benefits.[8] On the other hand, profits in the firm were taxed at 28% and dividends were tax-free, except for a temporary

[5]Unless the EIS equals unity, there is also an adjustment in the capital stock, which in turn affects the marginal product of capital and thus the effective interest rate in other periods. When the depreciation rate of capital is relatively low, as is the case in the numerical example in Figure 1, this effect is second-order compared to the direct impact of the dividend tax reform.

[6]With labor income, spending may increase in response to the dividend tax news even when the EIS is below one, because the news weakens the income effect. We address this explicitly when estimating the EIS using the structural model in Section 7.

[7]Appendix B.1 details how we compute the effective marginal tax rates.

[8]See Appendix B.1 for the assumptions used.



Notes: 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. Appendix B.1 explains how we construct marginal tax rates.

Figure 2: Effective marginal tax rates in 2000

11% dividend tax in 2001.[9]

The large difference in effective marginal tax rates between labor and capital income gave some small business owners a strong incentive to classify their own labor income as capital income. Specifically, Figure 2 shows that as income increased, the incentives for firm owners to pay themselves with dividends instead of wages strengthened. For example, for firm owners with income above 12 times the base amount in the Norwegian social security system, also known as "G" (around USD 10,500 in 2000), the effective marginal tax rate on capital income was significantly lower than on labor income, implying that firm owners would find it advantageous to shift income from labor to capital. In 1992, Norway introduced a set of tax rules ("delingsmodellen" in Norwegian) to prevent this, but they were widely circumvented. By 1998, among business owners working in their firms and earning above the threshold where capital income classification was advantageous, 96.5% had structured their business and tax arrangements to avoid the higher wage income tax rate (NOU 2003:9, 2003, p. 239).

[9]The government introduced a temporary dividend tax of 11% only in effect for the 2001 fiscal year (Innstilling til Odelstinget nr. 23, 2000-2001). In our sample period, the corporate income tax remained constant at 28% until it was reduced to 27% in 2014.

The 2006 tax reform. On January 11, 2002, the newly-elected government appointed an expert commission to suggest permanent changes in the tax system motivated by the large difference in marginal tax rates between labor and capital income and the widespread circumvention of the 1992 tax rules regarding income shifting (NOU 2003:9, 2003, p. 11). On February 6, 2003, the government-appointed commission published their findings (NOU 2003:9, 2003). Among the recommendations was the introduction of a 28% dividend tax, raising the effective capital tax rate on firm owners from 28% to 48.2%.[10] At the same time, the commission recommended reducing the top marginal tax rates on wage income to 54.3%. On March 26, 2004, the government officially announced a tax reform that mostly followed the commission's recommendations, introducing a dividend tax and reducing the marginal tax rate on wage income (Stortingsmelding nr. 29, 2003-2004). However, for administrative reasons, the introduction of the dividend tax was postponed to January 1, 2006. Henceforth, we will refer to the publication of the commission's report in February 2003 as the "news" date and January 2006 as the reform "implementation" date.

The reform – once it was officially implemented in 2006 – introduced a 28% personal tax on dividends and capital gains in excess of a threshold amount based on the riskless returns in any given year.[11] Under the previous tax regime, dividends were tax-exempt for any shareholder, while capital gains were almost always applied to a zero base and hence were tax-exempt as well. Firms paid no taxes on dividends and capital gains both before and after the reform.[12] The reform also decreased the top marginal tax on labor income from 64.7% to 54.3%.

4 Data

We use data from several Norwegian administrative registries from 2000 to 2014, combined using unique personal identification numbers. The main source is the income and balance sheet statements of all Norwegian households (Statistics Norway, 1993-2019d, "Data om inntekt, skatt, avgift og eiendom"). Because Norway levied wealth, inheritance, and income taxes at the time, the tax authorities collected detailed information on household

[10]The effective tax rate of firm owners is computed as $48.2\% = 28\% + (100\% - 28\%) \cdot 28\%$.

[11]The annual risk-free rate of return allowance for shareholders/partners is computed as the exemption rate multiplied by the sum of the cost price of the share/holding and any unused allowance from previous years. The unused allowance is then carried over to the next year with interest and can be deducted from future dividends and capital gains associated with the same share/holding. The exemption rate for shareholders and partners is the average interest rate on three-month Norwegian Treasury bills in the year for which the allowance is to be calculated. Therefore, the dividend payouts of firms with dividend yields lower than the average yield on 3-month Norwegian Treasury bills fall within the rate of return allowance exemption.

[12]During the transition period, stocks could be transferred to a holding company without triggering a capital gains tax.

balance sheets, familial inter vivos transfers, and income statements. Most variables in the income and wealth data are third-party reported by employers, financial intermediaries, or the tax authorities (e.g., assessed housing wealth and private business wealth).

We additionally rely on five data sources to supplement the tax registers. First, we use the housing transaction data when we impute spending (Statistics Norway, 1993-2019a, "Eiendomsregisteret"). Second, we use the stock ownership data to define private business owners (Statistics Norway, 2004-2019e, "Aksjonærregisteret"). Third, we use the income statements and balance sheets of firms to measure dividends and changes in paid-in capital (Statistics Norway, 2000-2019c, "Brønnøysundregisteret"). Fourth, we use information on family status to construct households, birth year, and home addresses (Statistics Norway, 1964-2019b, "Folkeregisteret"). Fifth, we use the employer-employee register for information on sector of employment (Statistics Norway, 2000-2014, "Aa-registeret"). All values are deflated to real 2011 U.S. dollars.

Imputed spending. The main variable of interest in our study is *imputed spending*, defined from the budget constraint as income not saved. Because the wealth tax is levied at the household level and imputed spending requires measuring saving, we compute imputed spending at the household level, then assign each adult in the household the average value as their individual-level observation.

We define the spending of a household that owns no private businesses (npbo) as

$$\begin{aligned} \text{spending}_{i,t}^{\text{npbo}} &= \text{disp. income}_{i,t} - \text{saving}_{i,t}, \\ &= \text{disp. income}_{i,t} - \text{saving}_{i,t}^{\text{deposits}} - \text{saving}_{i,t}^{\text{debt}} - \text{saving}_{i,t}^{\text{housing}} - \text{saving}_{i,t}^{\text{risky assets}} \end{aligned} \tag{3}$$

where $\text{saving}_{i,t}^{\text{deposits}}$ is the change in real deposits, $\text{saving}_{i,t}^{\text{debt}}$ is the (negative) change in real debt, and $\text{saving}_{i,t}^{\text{housing}}$ is the (real) net purchases in the housing market, and all of the above are directly observed. The main challenge for this group of households is to compute $\text{saving}_{i,t}^{\text{risky assets}}$, the sum of listed stocks and stock funds, which requires computing the difference in risky assets from one year to the next, net of capital gains. Appendix B.3 presents more details on how we compute saving for each asset class.

The main focus of this paper is the spending response of private business owners (owners of incorporated firms not listed on the public stock exchange) to the dividend tax reform. To impute spending of firm owners, we include income and saving in the private business as part of the owners' income and saving.

We define imputed spending of private business owners as

$$\begin{aligned}\text{spending}_{i,t} &= \text{spending}^{\text{npbo}}_{i,t} + \sum_f \left(\text{income}^f_{i,t} - \text{saving}^f_{i,t}\right) \\ &= \text{spending}^{\text{npbo}}_{i,t} + \sum_f \left(\text{dividends}^f_{i,t} + \Delta\text{ret. ear.}^f_{i,t} - \left(\Delta\text{ret. ear.}^f_{i,t} + \Delta\text{paid-in capital}^f_{i,t}\right)\right) \\ &= \text{spending}^{\text{npbo}}_{i,t} + \sum_f \left(\text{dividends}^f_{i,t} - \Delta\text{paid-in capital}^f_{i,t}\right)\end{aligned} \tag{4}$$

where spending^{npbo} is defined as spending when we ignore private businesses in equation (3). The key observation in equation (4) is that one only needs to keep track of the net flows between the firm and the owner to impute spending of firm owners. In the first line, imputed spending is defined as the sum of spending ignoring the private business and income minus saving in firm f going to owner i. Income in the firm is equal to the sum of dividends and the change in retained earnings. The "active" saving by the firm is defined as the change in retained earnings and the change in paid-in-capital (second line of eq. (4)).[13] Income minus saving in firm f for owner i is thus the dividends net of the change in paid-in capital – the net resource flow from firm to owner.

To apply equation (4), we need to observe how much of each firm an owner holds. We use the ownership register to compute ownership shares, including indirect ownership shares via other firms.[14] As the ownership registry only exists from 2004 we impute the ownership share of owner i in firm f before 2004 using ownership shares from 2004 if the firm existed in the firm registry and the owner had non-zero holdings of non-listed stocks in the tax accounts.[15] Figure B.2 in Appendix B.3 compares imputed spending in the administrative data with consumption in the national accounts. Reassuringly, imputed

[13]In our approach, saving in the firm is defined as the change in book value due to active transactions, which in turn equals the sum of the changes in retained earnings and paid-in-capital. Alternatively, one can define active saving in the firm as the change in book value net of capital gains. With this alternative definition, however, one would need to compute capital gains on the firm's assets, which is challenging because firm's asset classes include less information about what the firm owns and thus which prices to apply to each asset class (e.g., ships, rigs, aircraft).

[14]In the ownership registry, we observe all owners of private businesses, both firms and households. The ownership registry thus allows us to compute indirect ownership shares of all firms. We compute indirect ownership shares for households up to layer 10 when we compute ownership shares.

[15]Our sample is restricted to individuals owning at least 25% of each firm in their private business portfolio, and we observe that 86% of owners maintain the same ownership share after five years.

spending tracks consumption in the national accounts closely.[16]

Tax evasion. Our data relies on tax data, which is subject to measurement problems related to tax evasion. This raises two issues when interpreting our results. First, owners of private businesses may use these firms for private consumption. Consumption within the firm is illegal, but likely to be relatively prevalent (Leite, 2024). Systematic tax evasion by exposed firm owners may lead to level differences in imputed spending (if the bias is constant in logs within groups), which is not a problem. An issue arises if the dividend tax reform incentivizes firm owners to shift consumption to within-firm consumption to evade taxes to a larger extent, as suggested and documented in Alstadsæter et al. (2014). However, because this incentive primarily affects behavior after the tax is introduced, it would bias our result only *after* the reform is implemented. In the period between announcement and implementation, the relevant period for identifying the value of the EIS relative to unity, this is a less pertinent issue.

Second, households may evade taxes by hiding wealth abroad, which is also illegal. Because our data relies on administrative data collected by the tax authority, hidden wealth is always an issue, especially among wealthy households (Alstadsæter et al., 2019). A concern is that the latter observed pattern – heightened spending followed by a permanent decline – could be driven by owners hiding wealth before the reform. This would create a measured spending spike followed by a permanent decline if they later spend out of their hidden wealth. To alleviate this concern, we exclude outliers in the spending growth distribution below.

Sample restrictions. Our sample spans annual observations from 2000 to 2014. We impose several restrictions. First, we restrict the sample to individuals between 30 and 60 years old in 2000, capturing the prime working and wealth accumulation years. Second, we exclude households with disposable income below 2G (around USD 21,000) to avoid including those whose consumption patterns may be driven by financial constraints. Third, we limit the sample to households holding at least 25% of every firm in their private business portfolio.[17] Fourth, we retain households with stable imputed spending growth,

[16] Baker et al. (2021) compare imputed consumption with transaction data and show that measurement errors are minimal when controlling for individual portfolio holdings and fixed effects for individuals and time. A concern might be that some individuals frequently trade listed stocks, generating large intra-year realized capital gains or losses that we do not observe. However, the mean stock wealth in 2000 for our sample is only USD 2,215, and 65% of individuals change the number of shares in their stock portfolio by less than 20% after five years. To further mitigate concerns about individuals with very large asset holdings and transactions, we exclude those in the top 1% of the wealth distribution in 2000 from our sample.

[17] This restriction also rules out most individuals who own multiple firms (e.g., holding company structures) because they tend to also own ownership shares smaller than 25%.

excluding those with year-to-year log changes in spending in the top or bottom 1% of the distribution to address concerns that spending patterns may reflect tax evasion or asset price revaluations rather than underlying behavior. Fifth, we exclude households in the top 0.5% of capital income prior to the reform to ensure that extreme values do not disproportionately influence our results. After applying these restrictions, the final sample includes 16,855 individuals in 2000.

5 Econometric methodology

Our econometric specification to estimate the spending responses to the reform announcement is a standard dynamic difference-in-differences model:

$$\begin{aligned} c_{i,2000+h} - c_{i,2000} = \alpha &+ \sum_{k=1}^{H} \beta_k \left(D_{i,2000} \times \omega_{2000+k}\right) \\ &+ \sum_{k=1}^{H} \Gamma_k' \left(\mathbf{X}_{i,2000} \times \omega_{2000+k}\right) + \sum_{k=1}^{H} \gamma_k \omega_{2000+k} + \delta_i + \varepsilon_{i,h} \end{aligned} \tag{5}$$

for $h \in \{0, 1, 2, \ldots, 14\}$ and $H = 14$, where $c_{i,2000+h}$ denotes log imputed spending for individual i in year $2000 + h$, $D_{i,2000} \in \{0, 1\}$ is our treatment variable for individual i in year 2000, ω_t denotes a dummy variable for year t, and $\mathbf{X}_{i,2000}$ contains a set of controls for individual i in 2000, which are interacted with year dummies to allow for time-varying effects. The coefficients are normalized relative to the base year, $h = 0$. We include year fixed effects, represented by γ_k, to account for aggregate time-varying factors that uniformly affect all individuals, and we add individual fixed effects δ_i to absorb individual-specific, horizon-invariant components of cumulative spending growth. As we explain below, the baseline specification includes pre-reform controls for household non-financial income, industry fixed effects, municipality fixed effects, and separate controls for individual and firm age, all interacted with year dummies. Standard errors are clustered at the individual level to account for autocorrelation in $\varepsilon_{i,h}$ across observations for each individual.

Treatment definition. We define a household as treated if the mean share of its non-financial income in 2000 and 2002 attributable to dividends from its firm exceeds 30%.[18] We include the years 2000 and 2002 in our treatment definition because dividend payments tend to be lumpy and irregular such that one single payment does not necessarily indicate that the household relied on regular dividend income. Moreover, we exclude 2001 from

[18] We show in Figure 5c that the exact choice of this dividend threshold is not important.

	Control		Treated	
	Mean	S.D.	Mean	S.D.
Panel A: Household Characteristics				
Age	44.48	8.34	47.14	7.99
Number of individuals	12,659	.	4,196	.
Dividend share of net income (%)	.	.	32.39	27.17
Panel B: Household Spending, Income and Wealth				
Spending	47.46	44.60	67.96	75.16
Disposable income	40.26	19.51	70.16	45.97
Labor income	55.36	27.95	55.44	28.73
Dividend income[20]	.	.	29.58	35.86
Net wealth	228.19	404.95	648.76	706.46
Private business wealth	27.08	165.89	186.32	302.23
Panel C: Firm Income Statement, Balance Sheet and Characteristics				
Revenue	563.36	1,492.34	1,716.11	5,389.96
Wages	138.99	408.06	318.35	732.19
Cost of goods purchased	273.17	1,146.97	898.50	4,256.27
Total assets	262.09	2,687.55	780.06	5,950.42
Firm age	7.73	9.55	11.84	11.71
Employees	2.93	6.38	5.55	15.80
Value added per worker	46.95	166.57	116.79	424.81

Notes: We define *treated* as having the mean share of gross income (non-financial income + private-business dividends) from private-business dividends across 2000 and 2002 that exceeds 30%. The control group consists of private business owners with no dividend income in 2000 and 2002. Values in Panels B and C are in 1,000 dollars in 2011. Value added per worker is calculated as operating profit plus wages divided by the number of workers.

Table 1: Descriptive statistics in 2000.

the definition due to the temporary dividend tax. The control group is defined as private business owners who did not receive any dividend income in 2000 and 2002, including dividend income from listed stocks and mutual funds. Table 1 compares the treatment and control groups in 2000. The two groups are similar in labor income. However, treated owners are wealthier, have higher disposable income, and spend more due to substantial dividend earnings from their firms. Additionally, the firms owned by the treated group are larger across several dimensions, including total assets, revenue, number of employees, and value added.[19]

[19]The sectoral distribution of firms is similar between the two groups, as shown in Table B.1 in Appendix B.4.

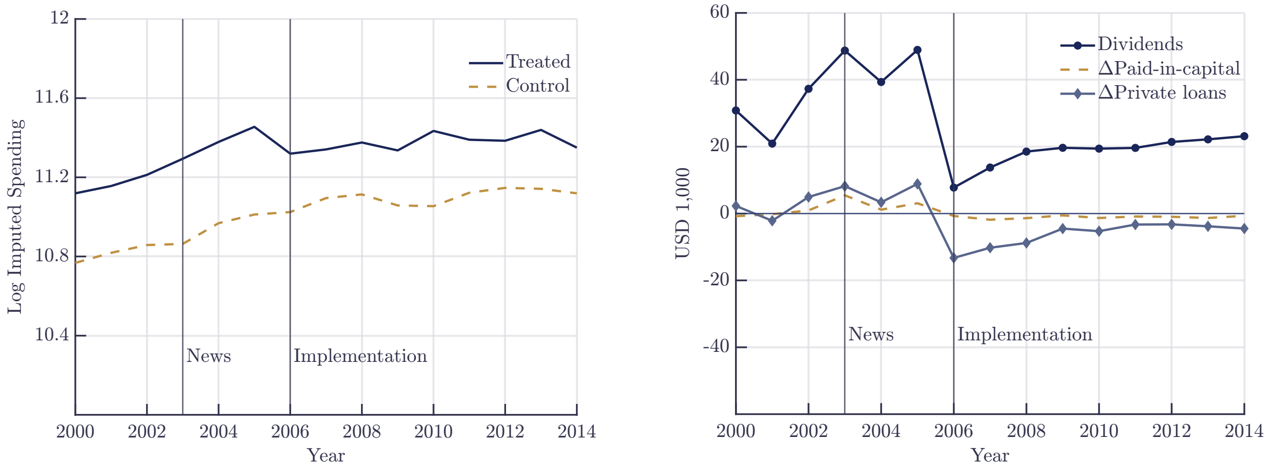
[20]The treatment group's average listed-equity holdings are less than USD 4,700. Consequently, dividend income from public assets is negligible, with virtually all dividends arising from their private businesses.

Identification. Identification relies on two key assumptions. First, the reform announcement in 2003 was unexpected, such that households did not adjust their behavior in anticipation of the news about future dividend taxes. As shown in Figure B.1 in Appendix B.2, stock returns between 2000 and 2003 exhibit no patterns that would plausibly point to anticipatory effects of the reform's announcement date. Second, we assume that treatment exogeneity or equivalently the parallel trends assumption holds – the control group represents a relevant counterfactual for the treated group's spending *growth* absent the reform.

Conceptually, unconstrained forward-looking agents have similar spending *growth rates*, which implies parallel log-spending trajectories, if they have similar preferences and face similar interest rates.[21] We argue that treatment exogeneity holds in our setting, as it stems from the pre-reform tax planning of firm-owners with different permanent incomes generated by the firms they own. As shown in Figure 2, firm-owners' incentives to pay themselves in dividends rather than wage increased in income due to the effective marginal tax schedule they faced. Owners of firms generating higher income (i.e., larger or more productive firms) would have a stronger incentive to pay themselves in dividends before the reform, and thus, be exposed to the reform. On the other hand, owners of firms generating lower income (i.e., smaller or less productive firms) would have weaker incentives to shift income from wages to dividends. Table 1 corroborates the systematic heterogeneity in firm size and productivity between the treatment and control groups. Crucially, Figure 3a shows the mean log spending in the treated and control groups over our sample period. The two groups exhibit similar spending growth in the period before the reform announcement, giving credence to the parallel trends assumption and treatment exogeneity.

Threats to identification. We address specific potential confounders, relating to systematic variation in interest rates or subjective time preferences across the treatment and control groups. Firm owners in the treatment and control groups may face different interest rates due to systematic differences in firm life-cycles. For example, younger firms generate less income and may, in addition, retain more earnings to finance growth, thus delivering higher cash-flows and dividends in the future. Older firms, on the other hand, are more likely to have reached optimal scale and distribute back a steady stream of dividends. If households in the treatment group are disproportionately the owners of older firms, this could bias our estimation of the spending responses. Another concern is that the dividend

[21] From the consumption Euler equation, $u'(c_t) = \beta(1+r)u'(c_{t+1})$, the consumption growth rates for two individuals are the same if β, $(1+r)$, and the elasticities of inter-temporal substitution are the same.



(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.

Notes: Panel (a) displays the average log imputed spending in the treatment and control groups. Panel (b) shows the average dividends from private businesses to the owner, changes in paid-in capital, and changes in private loans for the treated group.

Figure 3: The evolution of spending, dividends, and changes in paid-in-capital and private loans.

share of income may vary systematically with the age of owners themselves, which could correlate with differences in spending growth across households due to, e.g., differences in income prospects or portfolio compositions (Fagereng et al., 2017). Consequently, if the exposed households are, on average, older, and older households follow different spending trajectories compared to the younger households, then this could bias our results. To address the concerns with the life cycles of firms and owners, we include eight age bins for both individuals and firms in our empirical specification.

Additionally, there may be confounding effects from three concurrent reforms. First, the concurrent labor income tax reform reduced the top marginal tax rates on wage income during the same period as the dividend tax reform (as detailed in Section 3). This raises the concern that households in the treatment and control groups may have been differentially affected by changes in wage taxation. We include controls for non-financial income, categorized into four bins based on differential changes in marginal tax rates, following Thoresen et al. (2010, Figure 1) to address this concern.[22] Second, the abolition of the five geographically differentiated payroll tax zones between 2004 and 2006 affected the total tax on wage income (Ku et al., 2020). Households in the treatment and control groups may also differ in their exposure to sectors of the economy and to labor market shocks. To account

[22]Specifically, we use three cutoffs for the 2000 non-financial income, corresponding to the 2006 marginal tax thresholds in NOK: 394,000, 750,000, and 936,800.

for potential differences arising from both sectoral exposure and the payroll tax reform, we control for the household's primary employment sector, defined by 2-digit NACE industry codes, and include municipality fixed effects. Third, the 2006 tax reform also included a change in the inheritance tax from a stepped-up to a carry-over basis. Msall and Næss (2025) show that this reform led to more capital gains realization, especially among older individuals. In our sample of relatively young individuals (ages 30-60), this reform has limited impact. Moreover, our specification includes controls for age interacted with year, which alleviates the concern that this reform may confound our results.

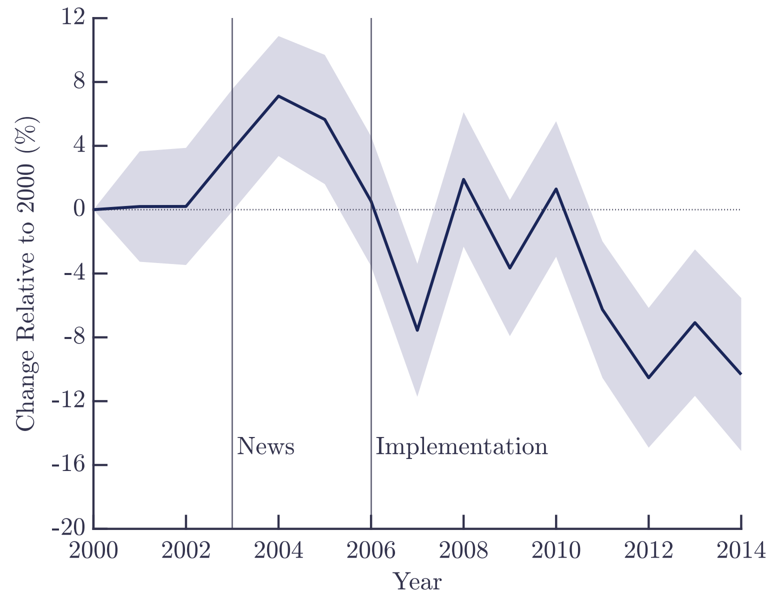
Stock-price growth during 2004–2006 is another concern, since dividend income is correlated with stock holdings. If treated households are disproportionately stock-rich, this could bias our estimates. We therefore conduct a robustness exercise that additionally controls for the stock share of household financial wealth as well as gross household wealth.

A separate concern is that changes in *imputed* spending between the treatment and control groups may be driven mechanically by changes in dividend income. Specifically, owners of firms had incentives to extract dividends from the firm prior to the reform, and if we fail to measure saving well, this may erroneously raise imputed spending. Figure 3b shows the dividends together with the changes in private loans and paid-in capital for the treated group. The treated group consistently paid themselves dividends before 2003, continued to do so after the news in 2003, and reduced dividend payments significantly after the dividend tax was introduced in 2006.[23] Hence, the increase in spending of treated households between 2003 and 2006 was not due to a mechanical increase in dividend payments.

6 Empirical results

Figure 4 shows the spending response of treated households relative to the control group. Following the announcement and before implementation of the reform, treated households increased spending by about 7% relative to the control group. After implementation in 2006, their relative spending declined. The anticipatory increase in spending following the announcement of the reform is only consistent with an elasticity of intertemporal substitution greater than one. Furthermore, the subsequent decline in spending after the reform's implementation aligns with a reduction in the permanent income of treated households.

[23] In addition, they accumulated private loans to the firm and paid-in capital before 2006 and spent the years after 2006 on repaying these private loans and extracting paid-in capital – the two common ways of avoiding the dividend tax.



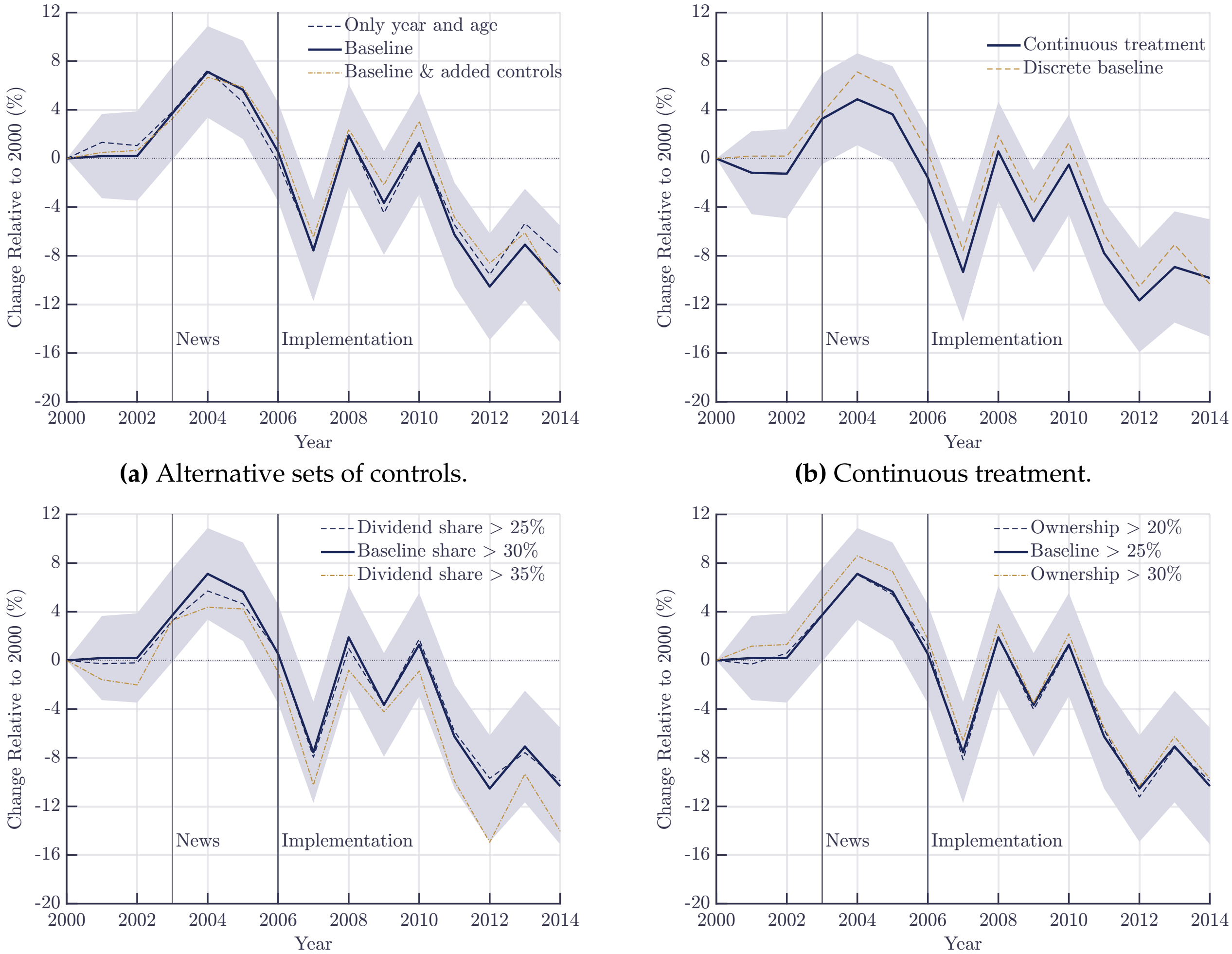
Notes: The figure displays the estimated coefficients of equation (5) with 95% confidence bands computed using standard errors clustered at the individual level.

Figure 4: The spending response to the dividend tax reform.

Robustness. Figure 5 presents a number of robustness exercises. First, Figure 5a shows results from two alternative specifications: a simpler model with only year and age fixed effects, and a model that additionally includes eight bins each for the stock share of financial wealth and gross wealth. The results change only marginally.

Second, in our baseline specification, households are defined as treated if their dividend share of income exceeds 30%. As an alternative, we use the dividend share of income as a continuous measure of treatment exposure, capturing variation in exposure intensity across households. This specification exploits the full distribution of pre-reform dividend shares, including households with zero dividend income, and therefore allows us to assess whether the spending response scales with exposure rather than with a particular treatment threshold. Following Callaway et al. (2024), under strong parallel trends across exposure levels, comparisons with the zero-exposure group identify dose-specific average treatment effects. We estimate the following continuous specification:

$$\begin{aligned} c_{i,2000+h} - c_{i,2000} = \alpha &+ \sum_{k=1}^{H} \beta_k \Big(\text{exposure}_{i,2000} \times \omega_{2000+k}\Big) \\ &+ \sum_{k=1}^{H} \Gamma_k' \Big(\mathbf{X}_{i,2000} \times \omega_{2000+k}\Big) + \sum_{k=1}^{H} \gamma_k \omega_{2000+k} + \delta_i + \varepsilon_{i,h} \end{aligned} \tag{6}$$



(a) Alternative sets of controls.

(b) Continuous treatment.

(c) Alternative dividend thresholds.

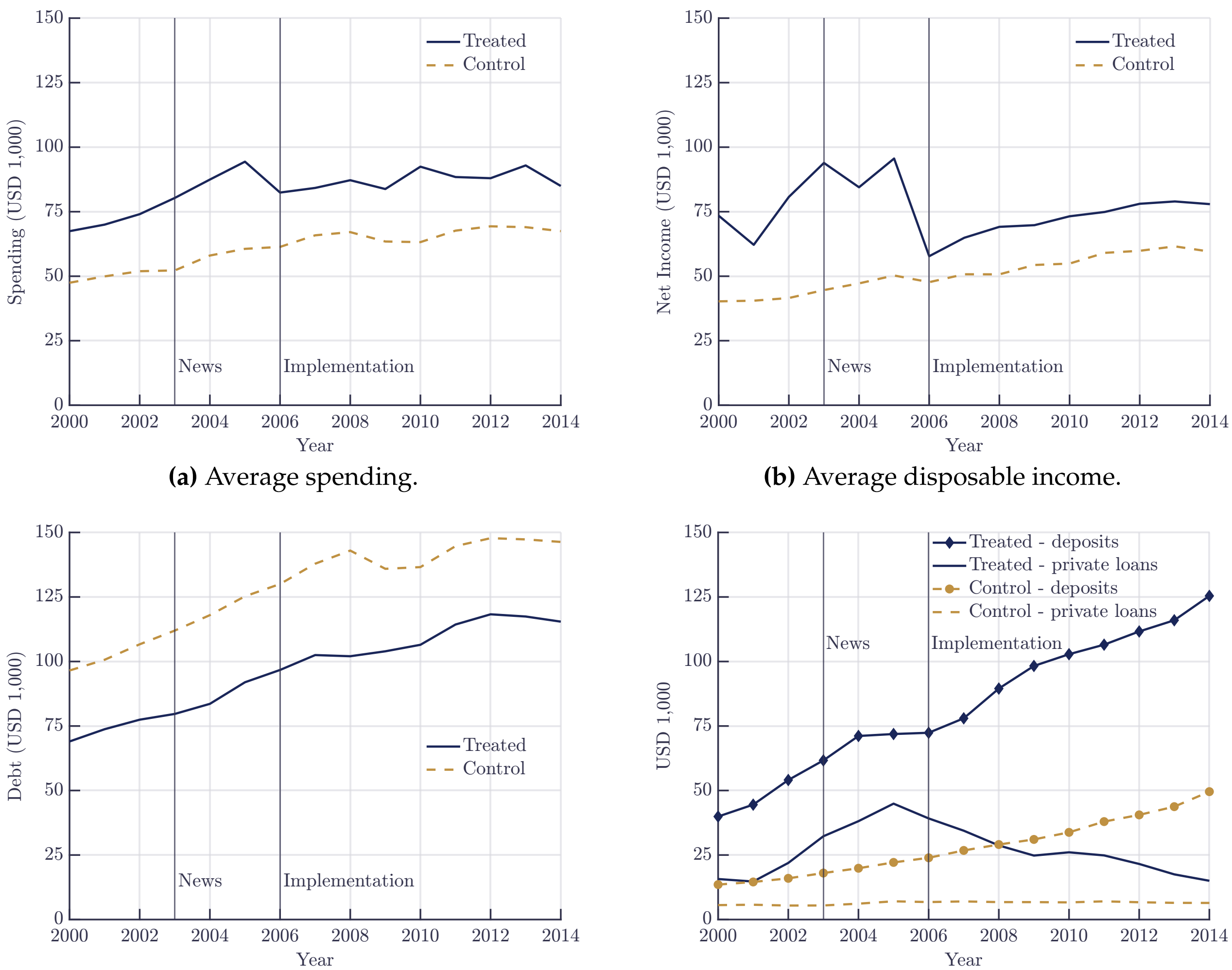
(d) Alternative ownership thresholds.

Notes: The figures display the estimated coefficients of equation (5) and (6) with 95% confidence bands computed using standard errors clustered at the individual level.

Figure 5: Robustness of the empirical results.

where exposure$_{i,2000}$ denotes the average dividend share of household income for household i in 2000 and 2002. We rescale the coefficients from the continuous-exposure specification so that they represent the effect of a 50 percentage point increase in exposure and are comparable in scale to the discrete baseline results. Figure 5b presents the coefficients from equation (6) alongside the baseline results from the specification with a dividend threshold. The continuous-exposure specification yields the same qualitative pattern as the baseline specification: a positive response following the announcement and a negative response after the reform's implementation.

Third, Figure 5c displays results when varying the treatment threshold for the average dividend share of income to 25% and 35%, respectively, illustrating that the results do not change materially. Fourth, in our sample restrictions we require owners to hold ownership shares above 25% in all private businesses they own. In Figure 5d, we display robustness to this restriction by either relaxing it (20%) or tightening it (30%). The results remain unchanged.



(a) Average spending. **(b)** Average disposable income. **(c)** Average debt. **(d)** Average deposits and private loans.

Notes: Panel (a) displays the average imputed spending in the treatment and control groups. Panel (b) shows the average disposable income in the treatment and control groups. Panel (c) shows the average debt in the treatment and control groups. Panel (d) shows the average deposits and private loans in the treatment and control groups.

Figure 6: The evolution of spending, disposable income, debt, deposits and private loans in the treatment and control groups.

Figure 6 displays the evolution of decomposed imputed spending of the control and treatment groups, and reveals that important drivers of the imputed spending increase in 2004 and 2005 in the treatment group are both an increase in debt and somewhat higher disposable income. Both of these were partly offset by a rise in savings, mostly in deposits and private loans.

Taking stock Overall, we find that news about a future dividend tax increase induced a positive spending response among households who relied on dividend income before the news. Following the reform's implementation, this group experienced a persistent decline in spending. The observed front-loading of spending in anticipation of lower future post-tax income is consistent with an elasticity of intertemporal substitution (EIS) greater than one when interpreted through the lens of the simple model in Section 2. The following section shows that this conclusion also holds in a richer structural model.

7 Structural approach

The reduced-form estimates show that the exposed households increased spending before implementation and reduced spending after the dividend tax took effect. The simple model in Section 2 shows how the response to the news shock signs the EIS relative to unity. In this section, we quantify the EIS using a structural model that incorporates the intertemporal wedge from the simple framework, while adding only the minimal features needed to match the empirical difference-in-differences response in Section 6.

7.1 Model

The economy consists of two groups of households. A fraction $1 - \lambda$ of households are *capitalists*, representing the firm owners in our sample who are exposed to the reform. The remaining fraction λ are *workers*, representing the control group of firm owners who receive only labor income from the firm. Both groups share the same preferences and supply labor inelastically. Capitalists can save only by holding firms' shares, whereas workers can save only through a risk-free bond. In addition, capitalists are subject to a dividend tax with imperfect pass-through. They also have access to transitory tax-avoidance opportunities that allow them to defer the incidence of the dividend tax.

Capitalists. Capitalists are denoted by k and $C_{k,t}$ is their consumption in period t. Dynamically, capitalists maximize the discounted utility flow from consumption subject to a sequence of constraints:

$$\max_{\{C_{k,t+j},S_{k,t+1+j}\}_{j=0}^{\infty}} \mathbb{E}_t \sum_{j=0}^{\infty} \beta^j \frac{C_{k,t+j}^{1-1/\psi} - 1}{1-1/\psi} \quad \text{s.t.} \quad S_{k,t+1}P_t + C_{k,t} \leq (1-\tau_{k,t})N_k + S_{k,t}(D_t + P_t) \tag{7}$$

where $\beta \in (0,1)$ is the subjective discount factor, N_k is labor supply, $S_{k,t}$ are claims on firms, P_t is the market value of those claims, D_t are dividends paid by firms to capitalists, and $\tau_{k,t}$ is the proportional labor income tax.

Utility maximization subject to the sequence of period budget constraints implies the following Euler equation for firm shares:

$$1 = \mathbb{E}_t \left[\beta \left(\frac{C_{k,t+1}}{C_{k,t}} \right)^{-1/\psi} \frac{D_{t+1} + P_{t+1}}{P_t} \right] \tag{8}$$

where the parameter of interest is ψ, the EIS. [24]

Tax avoidance opportunities. Following the literature on income taxation, we assume that capitalists have access to tax avoidance opportunities (Piketty and Saez, 2013; Piketty et al., 2014). These opportunities are available upon arrival of the news but disappear every period with an exogenous (i.i.d.) probability $1-\theta$. As a result, following a tax news shock, the share of capitalists still avoiding the new dividend tax declines geometrically over time. Over time, the economy converges to the steady state under the new tax regime where all capitalists face the new tax.[25] This assumption serves two purposes. First, it describes a relevant feature of the 2006 dividend tax reform in which owners could postpone the incidence of the dividend tax increase by extracting dividends tax-free before the reform was implemented. Second, it smooths the model-implied spending response to the tax news shock, in line with the data.

Workers. Workers save in risk-free one-period bonds B_t (in zero net supply) that pay an exogenous gross return R^B each period, pinned down by the rate of time preferences. The

[24] Because we assume that there is no risk in the model, our results would not change with recursive utility (Kreps and Porteus, 1978; Epstein and Zin, 1989, 1991; Weil, 1990). Moreover, in Appendix A.2 we discuss how the presence of risk affects the identification of the EIS.

[25] Tax avoidance is modeled as an exogenous delay in dividend-tax incidence. Hence, it affects the equilibrium transition path through the timing of effective tax incidence, but does not add a separate tax-avoidance choice or first-order condition. The parameter θ governs how transition paths are aggregated across capitalists whose avoidance opportunities expire over time. Our modeling choice builds on the literature on deviations from full information and rational expectations (FIRE) by assuming an i.i.d. disappearance of tax avoidance opportunities (Mankiw and Reis, 2002; Reis, 2006a,b; Auclert et al., 2020; Carroll et al., 2020).

maximization problem is:

$$\max \mathbb{E}_t \sum_{j=0}^{\infty} \beta^j \frac{C_{w,t+j}^{1-1/\psi} - 1}{1 - 1/\psi} \quad \text{s.t.} \quad C_{w,t} + \frac{B_{t+1}}{R^B} = N_w + B_t \tag{9}$$

where the solution has to satisfy the Euler equation:[26]

$$1 = R^B \mathbb{E}_t \left[\beta \left(\frac{C_{w,t+1}}{C_{w,t}} \right)^{-1/\psi} \right] \tag{10}$$

Firms. There is a continuum of perfectly competitive firms of mass one that produce the final good. The production technology is:

$$F(K_t, N) = K_t^{\alpha} N^{1-\alpha} \tag{11}$$

where K_t is capital and N is labor supply (assumed to be constant). Capital evolves according to $K_{t+1} = I_t + (1-\delta)K_t$ where I_t is investment and δ is the depreciation rate such that K_t is pre-determined. Dividends received by capitalists are denoted by D_t. The tax-inclusive resource cost to the firm of delivering these dividends is $\varphi_t(D_t) = D_t(1+\tau_{d,t})^{\kappa}$. The implied dividend-tax wedge is

$$\varphi_t(D_t) - D_t = D_t \left[(1+\tau_{d,t})^{\kappa} - 1 \right] \tag{12}$$

where $\kappa \in [0, 1]$ is a parameter that governs how much a change in the tax rate affects the relevant tax rate for capitalists. When $\kappa < 1$, the dividend tax change less than fully passes through to the effective return capitalists face because they have access to alternative (lower-return) saving vehicles.[27]

Firms take the production function and the law of motion of capital as given and decide the dividend payout D_t and investment I_t. The optimization problem of firms can be written recursively as

$$V(K_t) = \max_{\{D_t, K_{t+1}\}} \left[D_t + \mathbb{E}_t \beta \left(\frac{C_{k,t+1}}{C_{k,t}} \right)^{-1/\psi} V(K_{t+1}) \right] \text{s.t. } \varphi_t(D_t) + K_{t+1} \leq (1-\delta)K_t + F(K_t, N) - N \tag{13}$$

[26]We explicitly assume workers pay no labor tax to keep the model tractable because it does not affect our results when we also assume a constant wage.

[27]Appendix A.4 provides the microfoundation of this reduced-form parameter: in a model where capitalists have access to other assets with returns strictly below the return on capital in the firm, the effective interest rate given the tax news has a lower bound equal to the return on these alternative assets.

where $V(K_t)$ is the market value of the firm and the stochastic discount factor is used to price the firm. The first-order condition with respect to K_{t+1} is

$$\mathbb{E}_t \beta \left(\frac{C_{k,t+1}}{C_{k,t}} \right)^{-1/\psi} \left(\frac{1 + \tau_{d,t}}{1 + \tau_{d,t+1}} \right)^{\kappa} \left[F_k(K_{t+1}, N) + (1 - \delta) \right] = 1 \tag{14}$$

Government. We assume that the government collects tax income and finances government spending:

$$G_t = D_t \left[(1 + \tau_{d,t})^{\kappa} - 1 \right] + \tau_{k,t}(1 - \lambda) N_k \tag{15}$$

Aggregation and market clearing. Since only capitalists own firms, the holdings of each asset holder are pinned down solely by the share of capitalists in the economy: $S_t = S_{t+1} = \frac{1}{1-\lambda}$. Labor market clearing in our environment is trivial and equates the weighted average of endowments to the production function input N: $N = \lambda N_w + (1 - \lambda) N_k$. Similarly, aggregate consumption is determined by: $C_t = \lambda C_{w,t} + (1 - \lambda) C_{k,t}$. The resource constraint is $Y_t = C_t + I_t + G_t$, which is also the goods market clearing condition.

Tax processes. The government has at its disposal two policy instruments: the tax on dividends τ_d and the tax on capitalists' labor endowment τ_k. These instruments are assumed to follow the following exogenous stochastic processes:

$$\begin{aligned} \tau_{d,t} &= \tau_{d,t-1} + \sigma_d \varepsilon_{d,t-j} \\ \tau_{k,t} &= \tau_{k,t-1} + \sigma_k \varepsilon_{k,t-j} \end{aligned} \tag{16}$$

where $\varepsilon_{d,t-j}$ and $\varepsilon_{k,t-j}$ are drawn from $\mathcal{N}(0, 1)$.[28] The stochastic processes capture the news component of the dividend tax reform. The shock that affects taxes in period t was announced j periods before the tax was implemented, with $j = 2$ to mimic the 2006 dividend tax reform.

Definition 1. *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) 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) the bond price R^B, such that: all policies solve the respective agents' optimization problems and all markets clear at any given time t.*

[28]The shock processes are assumed to be unit root. In practice, we compute impulse responses to very persistent shocks, with autocorrelation of all shock processes set to 0.9999.

Parameter	Value	Description
λ	0.990	Share of workers
β	0.980	Discount factor
δ	0.075	Depreciation rate
α	0.330	Capital share
N	0.300	Labor endowment
σ_d	0.280	St. dev., capitalist dividend tax news
σ_k	0.104	St. dev., capitalist labor tax news

Table 2: Externally set model parameters.

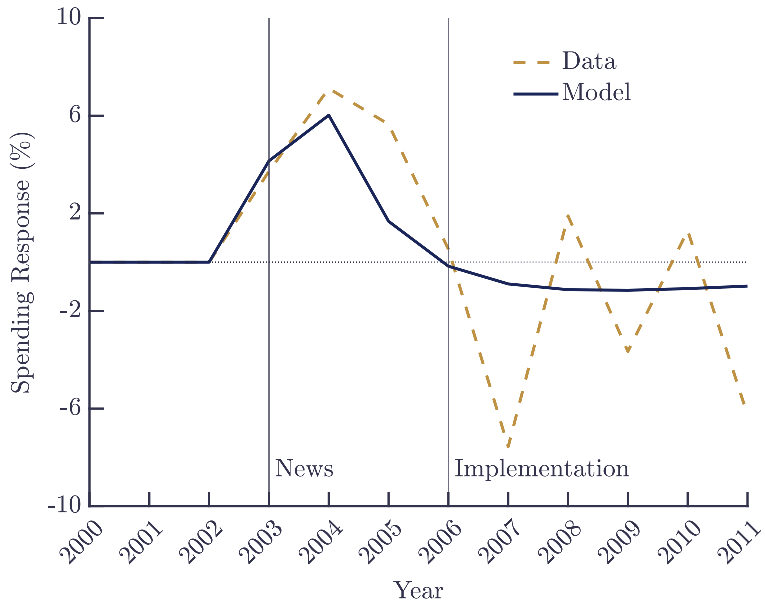
7.2 Estimation

We estimate the model using the method of simulated moments. First, we externally calibrate a set of parameters. Next, we simulate a dividend tax increase from 0% to 28%, announced two years in advance. Because the capitalists in our model represent the treated owners while the workers represent the control group, the differential consumption response of capitalists and workers in response to the announced reform maps directly to our empirical difference-in-differences estimates. We estimate the model's remaining parameters, including the EIS, by minimizing the distance between the experiment in the model and the empirical difference-in-differences results.[29]

External parameters. Table 2 lists the externally calibrated parameters. The frequency of our calibration is annual. The subjective discount factor and depreciation rates are set to $\beta = 0.98$ and $\delta = 0.075$, respectively. The fraction of capitalists $1 - \lambda$ is set to 0.01, which corresponds to the share of business owners in the data. The capital share α is set to 0.33 and labor endowments $N = N_k = N_w$ are set to 0.3. We calibrate the standard deviations of the dividend and labor tax shocks to represent the institutional details of the Norwegian tax reform with $\sigma_d = 0.28$ and $\sigma_k = 0.104$. These two shocks map to the Norwegian 2003-2006 experience of a simultaneous increase in the dividend tax rate and reduction of the marginal labor income tax rate for the highest income bracket.

Estimation results. Figure 7 shows the model-generated consumption response of capitalists relative to workers. The implied EIS (ψ) is 1.48, a value significantly greater than unity. The model-implied spending response closely follows the data: the spending differential increases after the announcement and then gradually declines after implementation. The corresponding values of κ and θ are 0.02 and 0.45, respectively. This suggests that

[29] Appendix C.1 provides details on our numerical procedure.



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. Differential spending in data is defined accordingly in Section 5.

Figure 7: Matched model responses to the dividend tax news shock.

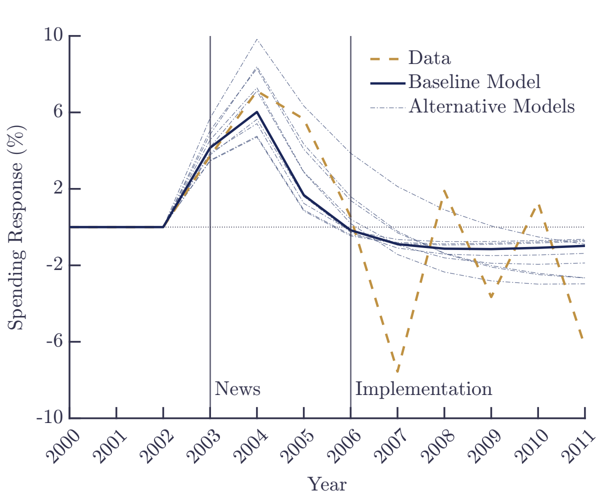
through the lens of the structural model, there exist alternative financial assets that capitalists can save in (a low κ) and that they engage in substantial transitory tax avoidance (a high θ).[30] The latter points to high levels of private-business intertemporal tax shifting.

7.3 Robustness

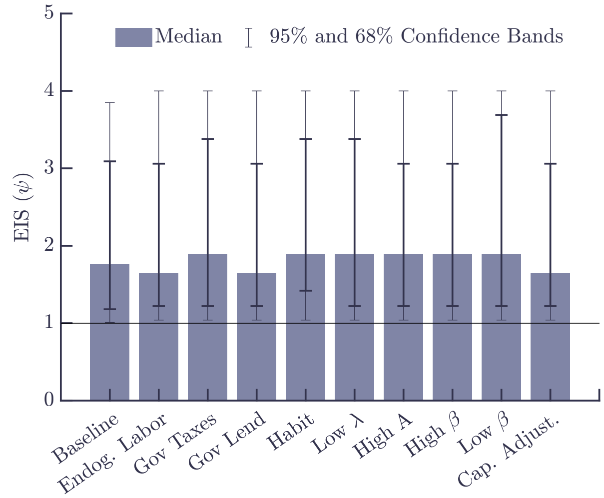
To explicitly account for coefficient uncertainty in the estimated spending response, we conduct a bootstrapping exercise in which we compute the EIS using 10,000 independent draws from the empirically estimated spending response coefficients. Results are summarized in Panel (b) of Figure 8. For the baseline model, the median EIS is 1.76 and the 95% confidence interval is [1.05, 3.70]. Thus, the estimated EIS is robustly above unity.

To account for possible model mis-specification, we consider several extensions of the baseline framework and run additional sensitivity checks. We repeat the same bootstrapping procedure for every extension. First, we allow the wage rate, W_t, to be determined

[30] Another possible explanation for the low value of κ is in the nature of the tax reform itself. The main purpose of the reform was to prevent opportunistic reclassification of labor income as capital income by business owners, thus closing a loophole in the tax code. Since the tax reform consisted of both a dividend tax increase and a labor income tax decrease, in addition to the intended goal, it may have induced some opportunistic reclassification of income in the other direction, from capital income to labor income, reducing the “bite” of the reform on capital income.



(a) Consumption response in alternative models.



(b) EIS estimates in alternative models.

Notes: Panel (a) plots relative spending responses to the Norwegian tax reform in the baseline and the alternative models, as described in the text. Panel (b) reports median EIS values as well as 68% and 95% bootstrapped confidence intervals implied by each alternative model. Model versions, from left to right, correspond to: the baseline, endogenous wages and labor supply, fiscal rule with lump-sum taxes instead of government spending, fiscal rule with government bond lending instead of spending, habit formation instead of heterogeneous tax incidence, high share of capitalists, high aggregate productivity, high discount factor, low discount factor, and capital adjustment costs.

Figure 8: Model robustness.

competitively, rather than being set exogenously to unity as in the baseline. Labor supply is also endogenized via non-separability between consumption and leisure in the spirit of Greenwood et al. (1988).[31] Second, we consider two alternative fiscal rules for the redistribution of surpluses along the transition path following dividend tax news shocks: lump-sum redistribution and lending abroad via one-period bonds. Third, as an alternative way of generating smooth transition dynamics following the tax news shock, we introduce internal habit formation into the consumption problem of the capitalists in the spirit of Christiano et al. (2005). Fourth, we consider an alternative parameterization of the share of workers, λ. Fifth, aggregate productivity, which is normalized to unity in the baseline, is set to a higher value. Sixth and seventh, we run two variants to allow for the possibility that capitalists are either more patient *or* less patient than workers in our model, we set the β of capitalists first to a larger and then to a smaller number, while keeping the β of workers unchanged. Finally, we extend the baseline model by incorporating capital

[31] An important literature has related the EIS to intertemporal labor supply elasticities in various dynamic settings (Chetty, 2006). To first order, one can show that the labor elasticity can be derived by assigning values to the marginal propensity to earn out of non-labor income, the EIS, and the consumption-to-labor-income ratio. In the case of capitalists, if the MPE out of non-labor income is around -0.2 and the consumption-to-labor-income ratio is roughly 1, then an EIS of 1.5 implies a labor elasticity of 0.4. This value aligns with the microeconomic estimates, which range from 0.26 to 0.54 (Chetty et al., 2011).

adjustment costs, as described in Hayashi (1982), and allow the price of capital, Q_t, to deviate from unity. Appendix C.2 provides further details and derivations for every model robustness test. Figure 8 reports all the results in two stages. First, in Panel (a) we plot relative spending responses implied by all the alternative models that we have described above. Every pattern is qualitatively indistinguishable from the baseline case and tracks the data well. Second, in Panel (b) we report the median values of ψ implied by each model with the 68% and 95% bootstrapped confidence bands. The EIS is consistently above unity in all of our robustness exercises.

Additional results. We present and discuss several supplementary results in the Appendix. First, Appendix C.3 provides a decomposition of the total response to a dividend tax news shock into partial and general equilibrium effects. Second, Appendix C.4 presents all model impulse responses, including those of aggregate variables. Third, in Appendix C.4, we consider three alternative parameterization approaches: we set the EIS to a counterfactually low value of 0.1 to illustrate how the model-implied consumption response looks in this case, set $\theta = 0$ to highlight the importance of tax avoidance opportunities for generating the empirically-consistent shape of the spending response, and set $\kappa = 1$ to emphasize that low reform pass-through is very important for matching impulse responses quantitatively. Fourth and finally, Appendix C.4 presents impulse responses for a surprise tax shock, as opposed to a tax news shock. In all of these sensitivity checks, our main results do not change and key assumptions are validated.

8 Conclusion

This paper has proposed a novel approach to identify the elasticity of intertemporal substitution. We estimate firm owners' spending responses to *news* about a future dividend tax reform using detailed administrative data and a unique quasi-natural experiment – the Norwegian dividend tax reform of 2006. We find that exposed owners increased spending between the announcement and implementation of the reform. This behavior is consistent only with an EIS above one. Using a structural model, we estimate the EIS to be around 1.5.

Beyond estimating the EIS of firm owners, our paper identifies a spending response to news about a future change in the after-tax return to saving inside the firm. This response is of independent interest in macroeconomics because it captures how firm owners reallocate expenditure when policy changes the timing of returns. We therefore provide a direct empirical target for models of taxation, firm saving, and household spending under anticipated shocks.

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Online Appendix for “Tax News and Intertemporal Substitution”

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Contents

A Theoretical appendix

This section presents several extensions of the simple framework in Section 2: non-homothetic preferences, risk, durable goods, and portfolio choice. The main takeaway is that the sign comparative statics result in Section 2 also holds in more general frameworks.

A.1 Comparative statics with non-homothetic preferences

The sign comparative statics hold for more general preferences (e.g., Epstein-Zin), as shown by Flynn et al. (2023). They also hold for particular non-homothetic preferences used in the macro literature. Here, we demonstrate that the comparative static result holds for non-homothetic preferences, as in Straub (2019). The main adjustment is that, in an environment with non-homothetic preferences, the EIS depends not on a single parameter but on a combination of parameters and the level of spending, and may therefore vary with changes in that level.

We illustrate the robustness of the sign comparative statics for the value of the elasticity of intertemporal substitution relative to unity derived in Flynn et al. (2023) for a simple two-period setting with non-homothetic preferences as in Straub (2019).

Suppose that the agent's period t utility function is given by $u_t(c_t) = \frac{c_t^{1-\sigma_t}}{1-\sigma_t}$ ($\ln(c_t)$ if $\sigma_t = 1$). The agent allocates initial wealth a over period $t = 0$ consumption and period $t = 1$ savings a_1. The period $t = 1$ gross return is R, so that period $t = 1$ consumption is $C_1 = RA_1$.

We follow Flynn et al. (2023) and define the aggregator function between period $t = 0$ consumption c and the period $t = 1$ continuation value v as $f(c, v) = u_0(c) + u_1(v)$. Notice that f and $v = c_1$ define a strongly regular environment according to definition 1 in Flynn et al. (2023), as the aggregator f is strictly increasing and twice continuously differentiable with a non-negative cross-partial derivative, and the continuation value v is also strictly increasing and twice continuously differentiable by the properties of a CRRA utility function. Furthermore, the period $t = 1$ consumption c_1 is interior to the budget set given that the CRRA period utility satisfies Inada conditions. Consequently, Theorem 1 in Flynn et al. (2023) applies to our environment. Specifically, we have the following sign comparative static:

$$\operatorname{sgn}\left(\frac{\partial c}{\partial \log R}\right) = \operatorname{sgn}\left(1 - \varepsilon\psi\right),$$

where ψ is the elasticity of intertemporal substitution and ε is the Relative Elasticity of the Marginal Value of Wealth (REMV), an object that measures the impact of wealth effects on the response of consumption.

Following Flynn et al. (2023), we define the elasticity of intertemporal substitution (EIS) as

$$\psi = -\frac{\frac{\partial \log\left(\frac{c}{v}\right)}{\partial \log R}}{\frac{\partial \log\left(\frac{f_c}{f_v}\right)}{\partial \log R}}.$$

Similarly, noting that period $t = 1$ wealth and period $t = 1$ consumption coincide, we define the Relative Elasticity of the Marginal Value of Wealth (REMV) as

$$\varepsilon = \frac{\frac{\partial \log v_a}{\partial \log R}}{\frac{\partial \log v}{\partial \log R}}.$$

For the continuation value defined as $v = c_1$, the value of the REMV is

$$\varepsilon = \frac{\frac{\partial \log v_a}{\partial \log R}}{\frac{\partial \log v}{\partial \log R}} = 1,$$

and we have that

$$\operatorname{sgn}\left(\frac{\partial c}{\partial \log R}\right) = \operatorname{sgn}\left(1 - \psi\right).$$

Hence, the sign of the consumption response to the change in log returns is the same as the sign of the EIS relative to unity. Note, however, that in this case, the EIS is not a single parameter as would be the case with time-invariant preferences but instead depends on the values of both σ_0 and σ_1. Specifically, we can re-write the EIS as

$$\psi = -\frac{\partial \log c/\partial \log R - \partial \log v/\partial \log R}{-\sigma_0 \partial \log c/\partial \log R + \sigma_1 \partial \log v/\partial \log R} = \frac{1}{\sigma_0}\frac{\partial \log c/\partial \log R - \partial \log v/\partial \log R}{\partial \log c/\partial \log R - \frac{\sigma_1}{\sigma_0}\partial \log v/\partial \log R}.$$

Hence, with time-varying values of σ, the EIS is a function of the current level of consumption, the level of returns R, and the CRRA parameters for the period utility functions.

A.2 Model with risk

We now consider the model in Section 2 where capital earns a constant rate R_t and where we include labor income and returns risk. The problem is:

$$\max_{\{c_t\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t \frac{c_t^{1-1/\psi}}{1-1/\psi}$$

subject to

$$\begin{aligned} \frac{b_{t+1}}{1+\tau_t} &= \frac{b_t R_t}{1+\tau_t} + y_t - c_t, \\ &R_t \text{ follows a Markov process,} \\ &y_t \text{ follows a Markov process,} \end{aligned}$$

where c_t is consumption, b_t is a real bond, R_t is the return on the bond, y_t is income, β is the discount factor, τ is the dividend tax, and $\psi > 0$ denotes the EIS. The solution to this problem has to satisfy the Euler equation

$$c_t^{-1/\psi} = \beta \left(\frac{1+\tau_t}{1+\tau_{t+1}} \right) \mathbb{E}_t \left\{ c_{t+1}^{-1/\psi} R_{t+1} \right\}. \tag{A.1}$$

Labor income. The first complication is that compared with the model in Section 2, this model has income from sources other than capital. When the model includes other income sources, it is not the EIS relative to unity that governs the sign of the consumption response between announcement and implementation. Instead, it is the EIS relative to a value lower than unity because the income effect is weaker in a model with labor income. Intuitively, the income effect is about changing the value of the present value budget constraint. In a model where the capitalist only has capital income, this can be computed as the change in the net present value of the consumption plan, similar to a wealth effect today. When there is also labor income, the income effect is about how the net present value of the plan of consumption net of labor income is affected.

Risk. The second complication is that the model now includes risk from two sources: labor and capital. The first observation is that the dividend tax term is multiplicative in the Euler equation. Hence, if we compute the first-order approximation around the expected level of labor income and return, the dividend tax affects the owner similarly to a situation with no risk.

Nevertheless, there will be higher-order effects of risk that affect how the owner responds to dividend tax changes. These higher-order effects are determined by how the response to the dividend tax affects the choice between consuming today and tomorrow. Consider an increase in the future dividend tax and assume the owner responds by increasing consumption in the period before the introduction of the dividend tax. This increase in consumption affects the strength of the precautionary saving motive. How much a change in consumption affects the strength of the precautionary saving motive is governed by the curvature of the precautionary saving motive, which is in turn driven by the fourth derivative of the utility function (temperance). This effect weakens with wealth under the reasonable assumption of power utility (or decreasing absolute prudence more generally). We would thus expect risk to play an insignificant role in our empirical setup.

A.3 Model with durable goods

Consider an infinitely-lived firm owner who only has access to saving in a real bond but who consumes both durable and non-durable goods:

$$\max_{\{c_{d,t},c_{n,t}\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t \frac{\left(c_{n,t}^{\alpha} c_{d,t}^{1-\alpha}\right)^{1-1/\psi}}{1-1/\psi}$$

subject to

$$\begin{aligned} b_{t+1} &= b_t(1+r) - (1+\tau_t)(c_{n,t} + p_{d,t} I_t), \\ c_{d,t+1} &= (1-\delta_d)c_{d,t} + I_t, \end{aligned}$$

where c_n is non-durable consumption, c_d is durable consumption, b_t is a real bond, β is the discount factor, δ_d is the depreciation rate on durable goods, p_d is the price of durable goods, r is the real interest rate, τ is the dividend tax, and $\psi > 0$ denotes the EIS.

Define wealth as the sum of bonds and durable goods: $a_t \equiv b_t + p_{d,t}(1+\tau_t)c_{d,t}$. The budget constraint is then

$$a_{t+1} = (1+r)a_t - (1+\tau_t)(c_{n,t} + \overbrace{p_{d,t}\left(r + \delta_d - \frac{p_{d,t+1}(1+\tau_{t+1}) - p_{d,t}(1+\tau_t)}{p_{d,t}(1+\tau_t)}\right)}^{\hat{p}_{d,t}} c_{d,t}),$$

where the relevant price of durable goods is the user cost $\hat{p}_{d,t}$. Suppose the relative price of durables $\hat{p}_{d,t}$ is priced competitively such that it is always constant. In this case, the dividend tax only moves the price of aggregate consumption, not the relative price of non-durable and durable goods. The comparative static with durables is therefore the same as in the model with only non-durable consumption in Section 2.

A.4 Model with portfolio choice

This appendix presents a model of a firm owner who can save in capital and a riskless bond. The firm owner solves

$$\max \sum_{t=0}^{\infty} \beta^t \frac{c_t^{1-1/\psi}}{1-1/\psi}$$

subject to

$$b_{t+1} = (1+r)b_t + y_t + d_t - c_t - e_{t+1}, \tag{A.2}$$
$$k_{t+1} = k_t^{\alpha} + (1-\delta)k_t - (1+\tau_t)d_t + e_{t+1}, \tag{A.3}$$
$$b_{t+1} \geq 0, \quad k_{t+1} \geq 0, \quad e_t \geq 0, \quad d_t \geq 0, \tag{A.4}$$

where b is a bond with constant real return r, k is capital in the firm, y is non-financial income, c is consumption, d is dividends from the firm, and e is resources allocated from the owner to the firm (an equity injection). We assume that $\beta(1+r) < 1$, such that the owner holds no bonds in the steady state.

The first-order conditions of this problem can be summarized by two Euler equations,

$$u'(c_t) \geq \beta(1+r)u'(c_{t+1}), \tag{A.5}$$
$$u'(c_t) = \beta X_{t,t+1} R_{t+1} u'(c_{t+1}), \tag{A.6}$$

where $R_{t+1} = \alpha k_{t+1}^{\alpha-1} + (1-\delta)$ is the return on physical capital and X_t is a tax wedge given by

$$X_{t,t+1} = \begin{cases} \frac{1+\tau_t}{1+\tau_{t+1}} & \text{if } d_t > 0 \text{ and } d_{t+1} > 0 \\ 1 & \text{if } d_t = 0 \text{ and } d_{t+1} = 0 \\ 1+\tau_t & \text{if } d_t > 0 \text{ and } d_{t+1} = 0 \\ \frac{1}{1+\tau_{t+1}} & \text{if } d_t = 0 \text{ and } d_{t+1} > 0 \end{cases}$$

and depends on whether the firm owner chooses to pay dividends or insert equity. This model nests the quantitative model in Section 7 (with $\kappa = 1$ and $\theta = 0$) in the paper if $b_{t+1} = 0$ and $d_t > 0 \ \forall\ t$.

Consider an initial situation in which the firm is of the optimal size, $k^* = \left(\frac{\alpha}{1/\beta-(1-\delta)}\right)^{\frac{1}{1-\alpha}}$, the dividend tax τ is zero, and the firm pays dividends. Suppose the firm owner learns there will be a permanent increase in τ from period $T+1$ onward.

Suppose first that the firm owner has no access to the bond. The owner will then respond as in the illustrative model in Section 2. If the EIS exceeds 1, the owner will increase consumption today and reduce capital. After implementation, the firm owner will gradually accumulate capital to its unchanged steady-state value while consumption is permanently reduced.

The response is different if the owner also has access to a bond. Since $\beta(1+r) < 1$, the owner will still respond by increasing consumption if the EIS > 1. But the response will be quantitatively smaller because the owner can temporarily save in the bond. Specifically, the bond Euler equation (A.5) will hold with equality at T. Therefore, unlike the model without access to saving in bonds, in this case, the effective interest rate that enters the owner's Euler equation is $1+r \geq X_{T,T+1}R_{T+1}$. The solution is thus to take out capital from the firm in period T ($d_T > 0$) such that $R_{T+1} = (1+r)$, consume c_T and save the remainder in bonds $b_T > 0$. This is achieved by choosing capital $k_t = \left(\frac{\alpha}{\left(\frac{1+\tau_{t+1}}{1+\tau_t}\right)(1+r)-(1-\delta)}\right)^{\frac{1}{1-\alpha}}$. After the reform is implemented, the owner will sell all bonds ($b_{T+1} = 0$) and put these resources back into the firm ($d_{T+1} = 0$ and $e_{T+1} > 0$) . Since $1+r < 1/\beta$, just like in the case in Section 2, with EIS>1, the owner spends more than income at T, so capital after the equity injection at $T+1$ is below its steady-state level. Consequently, $R_t > 1/\beta$ for $t > T+1$, and the owner will accumulate capital going forward ($d_t = 0$).

The key observation is that the presence of the bond implies a limit to how much the effective interest rate $\tilde{R}_{t+1}$ that the owner faces may fall. The interest rate on the bond is the floor for the effective interest rate because if the effective interest rate on capital falls below this level, the owner would prefer to move all capital into bonds. This observation allows us to reinterpret the parameter κ in our structural model in Section 7. Specifically, in that model, we have the dividend Euler equation

$$u'(c_t) = \beta\left(\frac{1+\tau_t}{1+\tau_{t+1}}\right)^{\kappa} R_{t+1}u'(c_{t+1}).$$

Therefore, a value of $\kappa < 1$ captures, in a reduced form way, the possibility to save in other assets, such as bonds or bank deposits, such that $\left(\frac{1+\tau_t}{1+\tau_{t+1}}\right)^{\kappa} R_{t+1}$ equals the gross return on those assets. The presence of other assets thus imposes a floor on the effective interest rate, parametrized by κ in the specific model in Section 7. Specifically, the estimated κ is, through this interpretation, only relevant for the specific empirical setting analyzed in this paper and does not represent a general pass-through parameter.

B Empirical appendix

B.1 Effective marginal tax rates

This appendix explains how we compute the effective marginal tax rates on labor and capital income in Figure 2 for 2000, based on The Ministry of Finance (2000, Table 2.1).

Capital income taxes. The only capital income tax that the owner faces is the flat corporate income tax of 28%.

Labor taxes. For wage income, the base of the system is a flat tax rate of 28% (same as capital income taxes) and a flat tax of 7.8% national insurance contribution (trygdeavgift). In addition, we include an employer's tax (arbeidsgiveravgift) of 14.1%. The "top tax" (toppskatt) then adds progressivity in the marginal tax rates, adding tax of 13.5% on each NOK above 329,000, which increases to 19.5% for each NOK above 762,700. We compute the marginal tax rates as

$$\text{marginal tax rate}_{\text{labor}} = \frac{0.28 + 0.078 + 0.141 + \text{top tax rate}}{1 + 0.141}. \tag{B.1}$$

Additionally, we include the benefit from public pension contributions. The public pension system in 2000 is based on a point system where an individual on the margin earns the following pension points:

$$\text{marginal pension point (MPP)} = \begin{cases} 1 & \text{if income } \in (\text{NOK}49,090,\ \text{NOK}294,540] \\ \frac{1}{3} & \text{if income } \in (\text{NOK}294,540,\ \text{NOK}589,080] \\ 0 & \text{if income } \geq \ \text{NOK}589,080 \end{cases}$$

The pension payment at retirement is defined as the average of the 20 years with the highest pension points accumulated for an individual. Next, the payout depends on how many years an individual has worked, up to 40 years. We assume the individual will work for 40 years and that this one year is one of that person's 20 best years. The marginal effect of a pension point on the annual payment from the social security pension system is then

$$\text{marginal annual pension payout per pension point}(MAPP) = \frac{0.45}{20} = 0.0225. \tag{B.2}$$

Four additional complications play a role. First, pension payments are received in the future, and we therefore need to compute the net present value of pension accumulations.

Second, the pension accumulation is in real units, adjusted annually almost one-for-one with the nominal wage growth. Third, pension payouts are received each year the individual survives and therefore depends on the health and mortality risk of the individual. Fourth, the Norwegian tax system includes a wealth tax but the social security pension wealth is not part of the wealth tax base. Hence, accumulating social security pensions represents an additional advantage for individuals who pay the wealth tax at the margin, compared with saving in private (and taxable) wealth. The net present value of annual pension payment for an individual with age a, retirement age R, expected lifetime T, who faces the real interest rate r, the expected real wage growth rate in the social security system g, and the wealth tax wt is

$$\text{NPV}_{\text{annual pension payment}} = e^{-(r-g-wt)(R-age)} \sum_{t=0}^{T} e^{-(r-g-wt)t}. \tag{B.3}$$

The marginal pension tax is then

$$\text{marginal pension tax} = -\text{MPP} \cdot \text{MAPP} \cdot \text{NPV} \tag{B.4}$$

We use a retirement age R of 67, an expected lifetime after retirement T of 20, a real interest rate r of 0.0172, a real wage growth g of 0.025, and a wealth tax wt of 0.011 in the computation. In Figure 2, the shaded area represents variation by age between 30 and 60 years (our sample restriction).

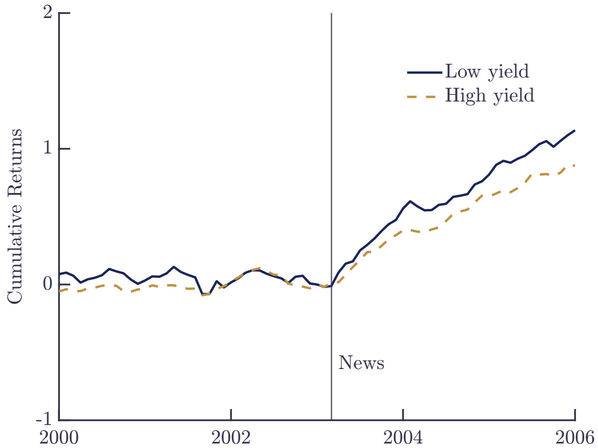
B.2 Stock market analysis details

To examine the stock-market response to the 2003 reform news, we compute cumulative returns for high- and low-dividend portfolios around the announcement. This section first describes the data used, and next presents the results.

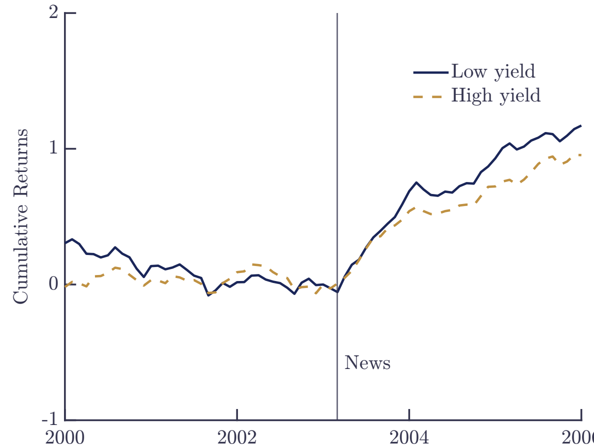
Data construction. We derive cumulative returns for a sample of Norwegian firms as follows. First, we use monthly data on all publicly traded stocks on the Norwegian stock exchange. The data is comparable to CRSP for the USA in that it accounts for stock splits and other similar events. We also have data on dividend payouts, including the monthly payment date; see Ødegaard (2013) for details. Second, to focus on a sample more comparable to the closely held businesses we study in the micro analysis, we drop the top decile of firms by market capitalization. We also exclude monthly stock-return observations below the 1st percentile and above the 99th percentile over the plotted window. Third, we compute the dividend yield for each publicly traded stock (based on the ISIN number) using annual dividends data up to the reform news. The dividend yield is defined as dividends over the price as of December 2002, i.e., prior to the reform news shock. We double-sort all stocks into portfolios based on the dividend yield (above and below the median) and either market capitalization or market beta. Fourth, we compute equal-weighted portfolio-specific cumulative returns over the period January 2000 to January 2006, normalized to zero in January 2003.

Results. Figure B.1 displays the cumulative returns of portfolios of high and low yield stocks, in a sample of low beta or low market capitalization stocks. We construct the market beta for each stock using monthly returns data until and including December 2002. For each stock, we run an OLS regression of excess returns on the excess return of the Norwegian stock market index. When computing betas, we remove regressions with less than 24 observations (two years). Figure B.1a shows the results which indicate a growing premium for low-yield stocks following the reform announcement. We then perform a two-way sorting based on size (market capitalization) and dividend yield. Figure B.1b reports the results, which were also shown in the main text. Excess returns for low-yielding stocks are small or insignificant in the case of high-beta and high-size stocks.

Overall, our findings suggest that the market priced in a premium on low-yield stocks following the announcement of the Norwegian dividend tax reform. The premium was driven by low-beta and low-size firms, which are more likely to represent the closely held businesses that we analyze with the administrative data. The normalized series move closely together before 2003 and begin to diverge after the reform news, consistent with



(a) Low beta.



(b) Low market capitalization.

Notes: This figure shows cumulative returns for high vs. low dividend stock portfolios among firms with low beta (a) and low market capitalization (b). Returns are plotted from January 2000 to January 2006 and normalized to zero in January 2003. Monthly stock-return observations below the 1st percentile and above the 99th percentile are excluded.

Figure B.1: Cumulative stock returns for high vs. low dividend stock portfolios.

the interpretation that the news was capitalized into stock prices after the announcement. The response of market prices to the news shock was gradual, which is consistent with portfolio adjustment frictions by investors (Gabaix and Koijen, 2021).

B.3 Household spending imputation from income and asset data

The first challenge when imputing spending is to define income and saving consistent with the budget constraint. We define income as *disposable income*, the sum of labor income, transfers, business income, capital income, and other income (e.g., inheritances and lottery prizes), net of taxes. We define *saving* as the change in net wealth due to either depositing or withdrawing resources from asset classes. Income, as defined above, is directly observed in the tax accounts. The main challenge in imputing spending is to compute the relevant measure of saving.[1]

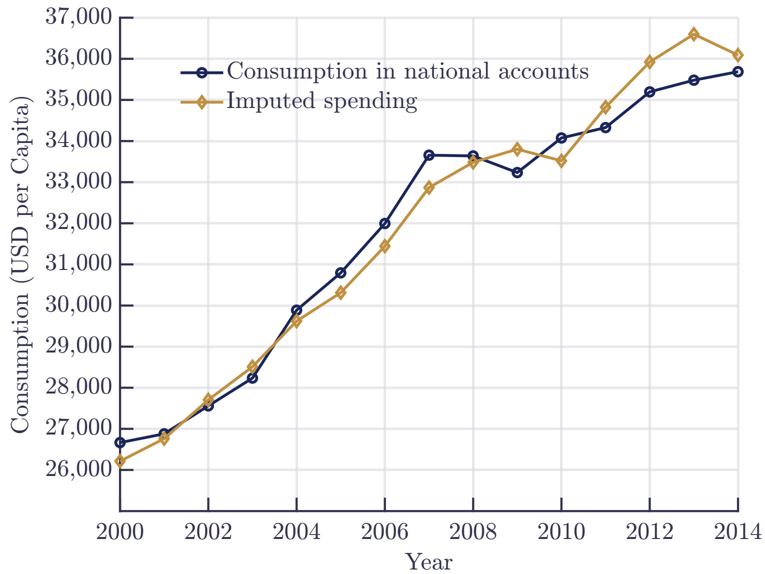
The relevant measure of saving using the budget constraint described above is the sum of active depositing or withdrawing of resources into and from all asset classes. The main challenge is that the tax authorities only report total valuations within broad asset classes at the end of the year, and changes in these values could be due to either saving or capital gains. We compute saving within each asset class differently depending on data availability. For nominal assets, such as debt and deposits, saving during the year is directly observed as the change between end-of-year and beginning-of-year values.

For housing, we observe housing transactions in the transaction registry, allowing us to observe the relevant saving measure. Hence, saving in housing is the sum of all housing bought minus all housing sold. Specifically, we do not need to know the estimated valuation of the house from year to year.

For stocks, we compute capital gains on household stocks using the stock ownership register after 2005. This register allows us to observe a household's ownership of specific stocks at the end of each year. We combine this ownership information with price changes in individual stocks to compute capital gains.[2] Before 2005, we only observe total wealth in stocks and impute capital gains for households using capital gains rates from the financial accounts. This approach ensures that capital gains are correct on average but will imply that capital gains for any specific household may be wrong. For stock funds, we use the capital gains rate from the financial accounts to impute capital gains for all years in our sample.

[1] An alternative and consistent way of imputing spending is to include capital gains as part of income and define saving as the change in net wealth. In that case, saving would be directly observed and the challenge would be to compute income. In either case, one must compute a measure of *unrealized* capital gains, which is unobserved in the tax data.

[2] Because we only observe ownership at the beginning and end of the year, we need to impose when the stock was traded to compute capital gains. We assume stocks are traded uniformly during the year. For example, if an individual owned 100 shares of Equinor at the beginning and 50 shares at the end of the year, we assume the individual sells Equinor shares gradually throughout the year.



Notes: The figure presents real imputed spending alongside real aggregate consumption data from the national accounts, following the approach of Holm et al. (2021).

Figure B.2: Comparison of imputed spending and consumption data from the national accounts.

Imputed spending ignoring private businesses, spending^{npbo}, is computed as

$$\text{spending}_{i,t}^{\text{npbo}} = \underbrace{\text{disp. income}_{i,t} - \text{saving}_{i,t}^{\text{nominal assets}} - \text{saving}_{i,t}^{\text{housing}}}_{\text{observed}} \underbrace{-\text{saving}_{i,t}^{\text{stocks/stock funds}}}_{\text{unobserved}},$$

where the main source of measurement errors comes from the unobserved component, saving in stocks and stock funds.

Figure B.2 compares imputed spending in the administrative data with consumption in the national accounts. The imputed spending measure closely tracks consumption in the national accounts.

B.4 Additional empirical results

Industry	Control (%)	Treated (%)
Agriculture, forestry and fishing	0.99	0.38
Mining and quarrying	1.48	0.38
Manufacturing	9.72	8.90
Electricity, gas, etc	0.47	0.42
Water supply; sewerage, etc	1.14	0.49
Wholesale and retail trade	11.78	12.27
Transportation	28.43	27.91
Accommodation	4.62	2.23
Information and communication	5.63	4.51
Financial and insurance activities	0.21	0.23
Professional, scientific and technical activities	26.06	33.06
Administrative and support service activities	1.23	0.45
Education	2.30	3.86
Human health and social work activities	0.24	0.34
Arts, entertainment and recreation	4.93	3.52
Unknown	0.76	1.06
Total	100.00	100.00

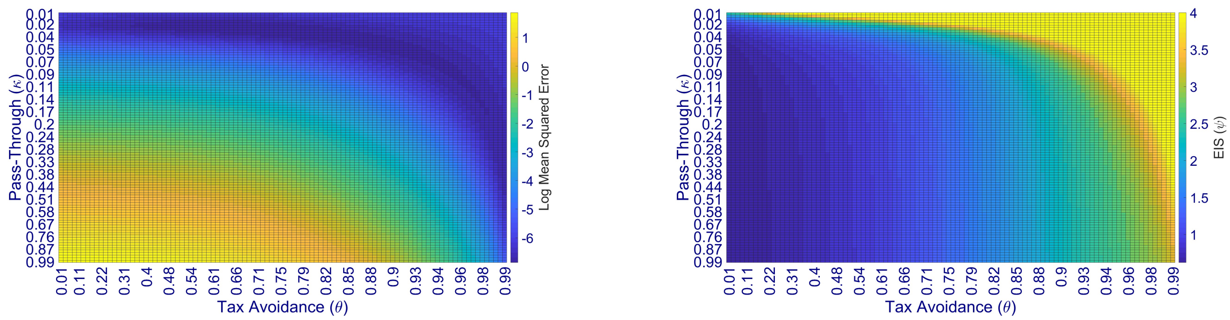
Table B.1: Distribution of firms across sector categories by treatment status in 2000 (%).

C Structural model appendix

C.1 Numerical details for the structural model

Our impulse response matching approach consists of several steps. First, we take the empirically documented differential response of the treated (capitalists) vs. the control (workers) group. For the baseline case, we use the estimates from Figure 4. We calibrate a sub-set of model parameters externally, as reported in Table 2. We then construct a coarse two-dimensional grid for the pass-through parameter κ and the EIS, ψ. The grid for κ is agnostic, ranging from 0.01 to 0.99. The grid for ψ is $[0.1, 4]$, with the lower bound corresponding to the value conjectured by Hall (1988) and the upper bounds being slightly above what is estimated using cross-household differences in after-tax real interest rates (Gruber, 2013). To improve accuracy, all grids are non-linearly spaced, allowing for more points in the region of the parametric space that is most likely to generate low matching errors.

Next, we solve the model for each $\{\kappa, \psi\}$ pair, i.e., for every point on the two-dimensional grid. The grid comprises 100 nodes in each direction. We thus solve the model 10,000 times under different parameter configurations. In every case, we compute and store impulse-response functions to a combination of two news shocks: a positive one-standard deviation news shock to ε_d and a one-standard deviation negative news shock to ε_k. In particular, we are interested in the model-implied estimates of the consumption response of capitalists less the consumption response of workers following the news shocks. This allows us to construct a response matrix under no tax avoidance. Finally, we construct the cum-avoidance response matrix. To this end, we first build a grid for the tax avoidance parameter θ, ranging from 0.01 to 0.99 using 100 non-linearly spaced nodes. For each value of θ on this grid, we compute and store a new response path. This completes the first step of our approach.



(a) Matching Errors

(b) Implied EIS Values

Notes: 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.

Figure C.1: Impulse response matching results.

In the second step of our procedure, we locate the point on the grid that minimizes the distance between the empirical and the model-implied spending differentials. In other words, we identify the values of parameters that "match" the empirical impulse responses as closely as feasible. Our candidate model-based sequences are stored in a $10 \times 100 \times 100 \times 100$ array, corresponding to the three-dimensional grid $\{\kappa, \psi, \theta\}$ with ten years.

The targets for the moment matching procedure are as follows. For ψ, which governs the extent of front-loading of spending, we target the differential spending response between capitalists and workers in 2004, which corresponds to the year of the formal announcement of the reform. We then compute the mean squared differences between the moments in the model and data and identify the value of the EIS, $\bar{\psi}$, that delivers the smallest matching error. For κ, which governs the long-run pass-through of the reform, we target the average differential spending response over 2007-2011, the years that correspond to the post-implementation period. We obtain the error-minimizing value of $\bar{\kappa}$ in a similar fashion. Finally, conditional on $\bar{\psi}$ and $\bar{\kappa}$, for θ, which controls the smoothness of the response path, we target the full spending sequence over 2003-2011 and obtain $\bar{\theta}$.[3]

Figure C.1 plots the outcome of this impulse response matching exercise. In Panel (a), we present a heatmap with θ and κ on the x-axis and y-axis, respectively. Each colored square on the map represents a (log) mean-square error between model and data for the corresponding combination of parameters. Panel (b) presents the corresponding estimates of the EIS. From Panel (a) we see that the matching error declines as tax avoidance

[3]Our results do not change if the search for $\{\bar{\kappa}, \bar{\psi}, \bar{\theta}\}$ is done simultaneously rather than sequentially.

intensity rises and pass-through falls, i.e., the northeastern region is where the best-fitting combinations of parameters are. In fact, there is a clearly visible dark-blue patch that showcases the global minimum area. From Panel (b), we observe that this area corresponds to the values of the EIS that are generally in the [1.2, 2.3] interval with the baseline value of 1.48 being the estimate that produces the lowest moment matching error according to our approach.

C.2 Model robustness and sensitivity tests

In this section we detail extensions of the baseline structural model. The first exercise tests the sensitivity of the results to the specification of the labor market. We allow for an endogenous wage rate W_t, which was set to unity in the baseline. The competitive wage rate is determined via the marginal product of labor in every period: $W_t = (1-\alpha)K_t^{\alpha}N_t^{-\alpha}$. We also endogenize the labor supply of capitalists and workers with non-separability between consumption and leisure in the spirit of Greenwood et al. (1988). The first-order condition with respect to labor supply for agent type x is: $(1-\tau_x)W_t = \phi N_{x,t}^{\chi}$, where τ_x is a proportional labor tax only in the case of capitalists.

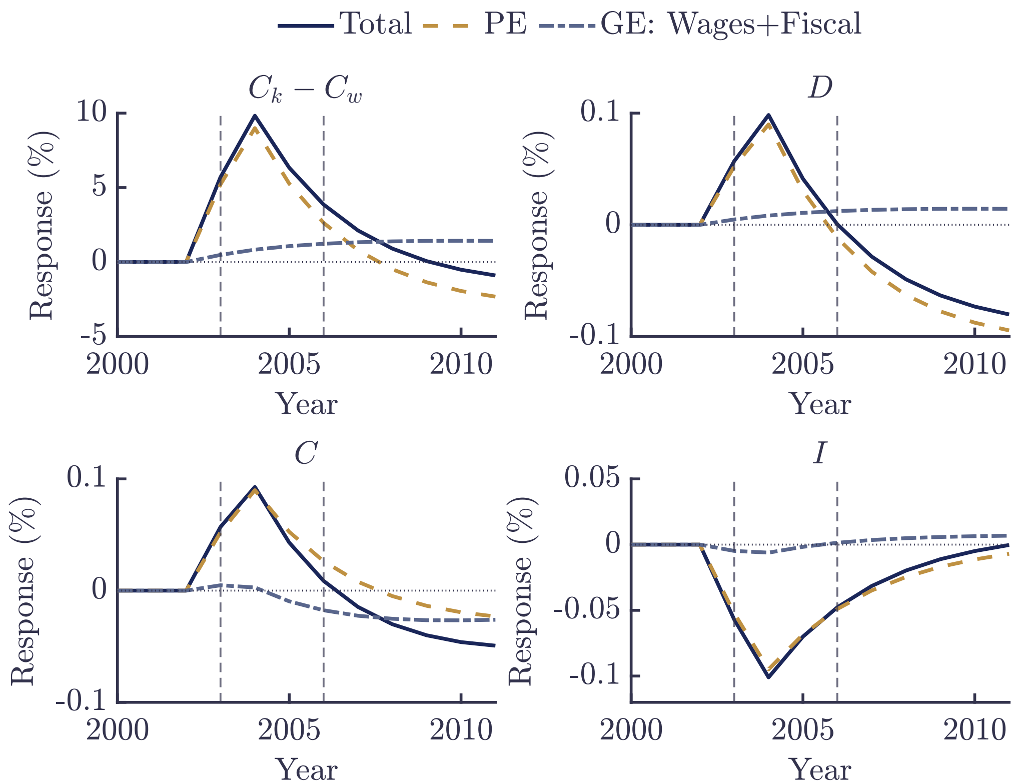
The next two exercises concern government fiscal rules. The baseline model assumes that any fiscal surplus along the transition path following dividend tax news shocks is used to finance government spending. We now test two alternative fiscal plans. First, we assume that the government rebates back the surplus to the households lump sum. The government budget constraint is, in this case, $T_{k,t} = \frac{\varphi_t(D_t)-D_t}{1-\lambda} + \tau_{k,t}N_k$. And the resource constraint becomes $Y_t = C_t + I_t$. Second, we allow the government to lend abroad via one-period bonds at the risk-free rate R^F. The government budget constraint becomes: $\frac{1}{R_t^F}B_{t+1} + \varphi_t(D_t) - D_t + \tau_{k,t}(1-\lambda)N_{k,t} = B_t$. In equilibrium, the risk-free rate is pinned down by the stochastic discount factor: $R_t^F = \frac{1}{\mathbf{E}_t m_{t,t+1}}$.

An alternative way of generating smooth transition dynamics following tax news shocks is by introducing habits in consumption. We now allow for internal habit formation in the consumption problem of the capitalists in the spirit of Christiano et al. (2005). Tax avoidance opportunities are shut down (θ=0). The stochastic discount factor becomes: $\Lambda_{t,t+1} = \beta\left(\frac{C_{k,t+1}-\zeta C_{k,t}}{C_{k,t}-\zeta C_{k,t-1}}\right)^{-1/\psi_k}$. As with θ in the baseline model, we target the full spending sequence over 2003-2011 and obtain $\bar{\zeta}$.

Next, we test sensitivity of model results to the values of externally calibrated parameters. First, the *share* of capitalists $1-\lambda$ directly controls the mass of agents affected by the reform. In the baseline, we calibrate λ to the data. However, our baseline λ could be argued to be high; although it is Norway-consistent, the external validity of our findings could be questioned if λ is generally lower in other countries. We therefore lower our λ to 0.95. Second, Hicks-neutral total factor productivity, A_t, is increased to 1.01 from the benchmark value of unity. Third, to allow for the possibility that capitalists are either more patient *or* less patient than workers, we set the β of capitalists first to 1.03 and then to 0.93 while keeping the β of workers unchanged.

Finally, in our baseline model the price of capital, Q_t, is always equal to unity. We now extend the model with capital adjustment costs. We follow Hayashi (1982) and assume that the capital accumulation equation can be written as $K_{t+1} = I_t - \frac{\phi}{2}\left(\frac{I_t}{K_t} - \delta\right)^2 K_t + (1-\delta)K_t$. Preferences and technology specifications otherwise do not change. Solution to this extended problem now includes an additional equation: $Q_t = \left[1 - \phi\left(\frac{I_t}{K_t} - \delta\right)\right]^{-1}$ The price of capital is increasing in the ratio of $\frac{I_t}{K_t}$. The first-order-condition of the firms problem with respect to K_{t+1}, in recursive notation, takes on the following form now: $Q = \mathbb{E}\,\beta\left(\frac{C_k'}{C_k}\right)^{-1/\psi}\left(\frac{1+\tau_d}{1+\tau_d'}\right)^{\kappa}\left[F_k(A,K',N') + Q'\left(1 - \delta + \phi\left(\frac{I'}{K'} - \delta\right)\frac{I'}{K'} - \frac{\phi}{2}\left(\frac{I'}{K'} - \delta\right)^2\right)\right]$. With $\phi > 0$ we can generate time-variation in the price of capital, Q_t, in response to the dividend tax reform. Whenever $\phi = 0$, we are back to the benchmark model. In our calibration, we set $\phi = 1$.

C.3 Direct and indirect effects decomposition



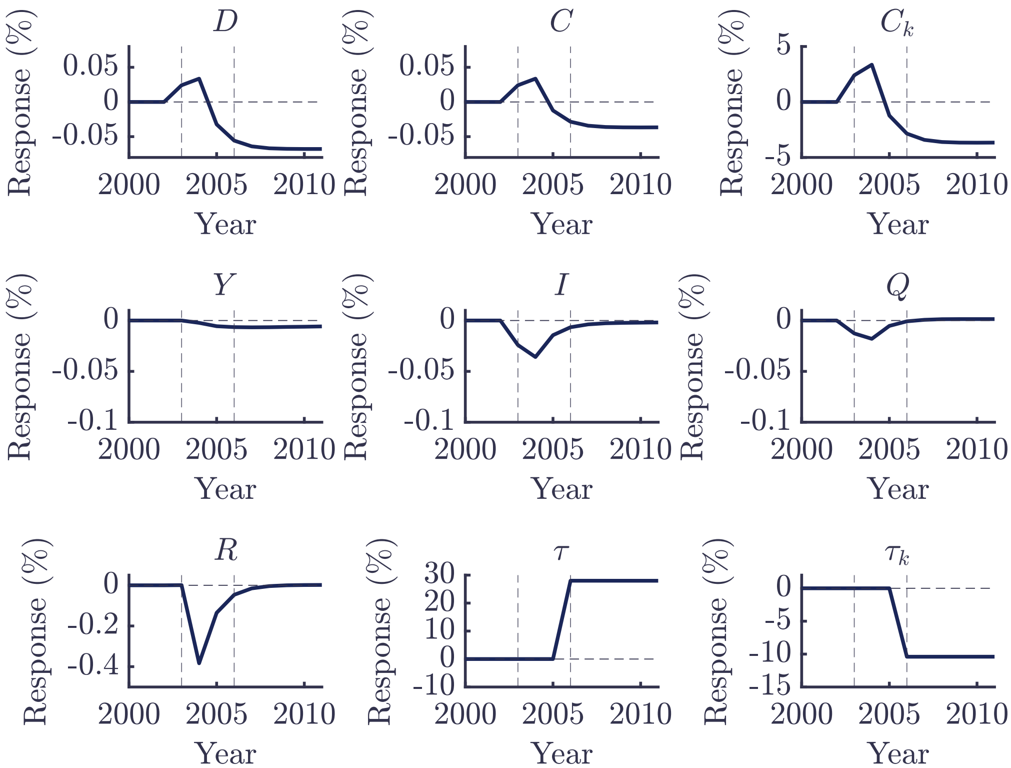
Notes: Decomposition of impulse response functions from the structural model into direct (partial equilibrium or PE) and indirect (general equilibrium or GE) effects.

Figure C.2: Decomposition into direct (PE) and indirect (GE) effects.

To better understand the mechanism that underlies our structural model, in this appendix we produce and report the decomposition of impulse response functions into partial and general equilibrium components. Our approach follows closely the methodology in Kaplan et al. (2018) and Auclert (2019). To this end, we will be considering a version of the model with endogenous GHH labor supply and the fiscal rule characterized by lump-sum rebates of fiscal surpluses to the capitalists. The total response to the dividend tax news shock is comprised of two effects. First, the direct effects (or partial equilibrium) channel captures the reaction to the change in the interest rate, R_t, while keeping wages W_t and government spending G_t fixed at their steady-state values. Second, the indirect effects channel captures the feedback onto the economy from general-equilibrium changes in W_t and G_t.

Figure C.2 reports the decompositions for the differential response of spending of capitalists less spending of workers ($C_k - C_w$), aggregate dividends, aggregate consumption, and investment. For the differential spending response as well as the other aggregate variables, total responses are driven primarily by the direct effects. In other words, general equilibrium forces are rather mild. This lends further credence to our identification strategy and the close alignment of the model with the empirical estimates, the latter being inherently partial-equilibrium.

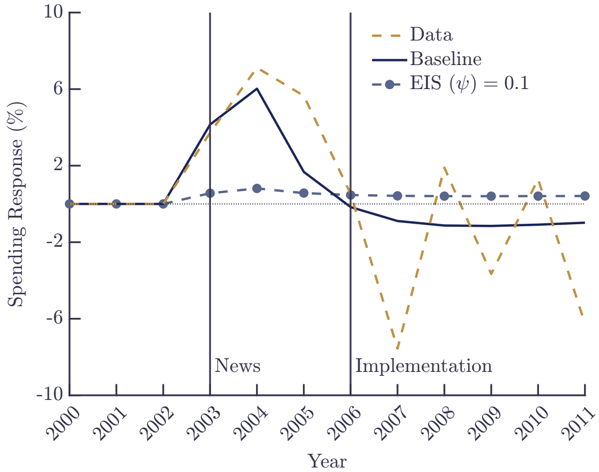
C.4 Additional model results



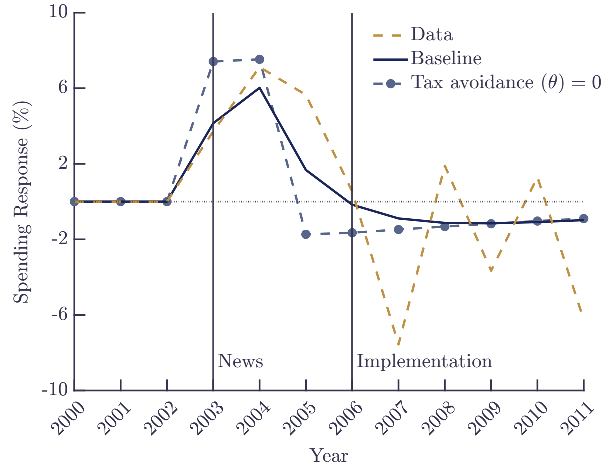
Notes: All impulse response functions from the structural model extended with capital adjustment costs.

Figure C.3: Impulse responses of all variables.

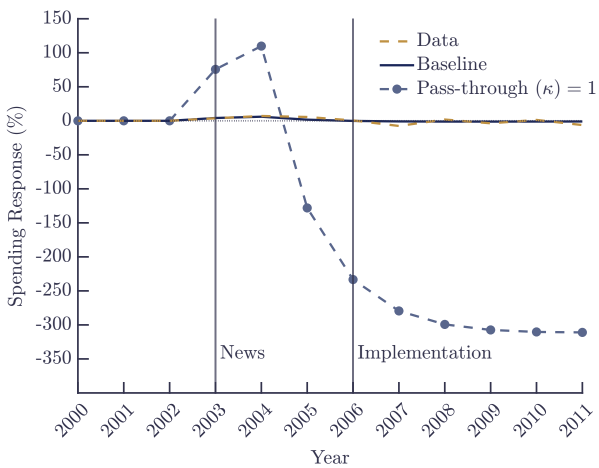
In this section, we present several additional model results that complement the main text. First, we report all impulse response functions from the baseline model with capital adjustment costs included. Figure C.3 shows the responses to the dividend tax reform of aggregate dividends, aggregate consumption, consumption of capitalists, aggregate output, investment, the price of capital, the interest rate, the tax rate on dividends, and the tax rate on capitalists' labor income. Notice that while the response of capitalists' spending is relatively large, recall that their share in the economy is small and thus the macroeconomic impacts on consumption, investment, and output are less stark. The front-loading of dividends and spending starts immediately as the news of the reform hits in 2003, similar to the baseline results in Figure 7. The macroeconomy then begins to adjust downward as the interest rate that firm owners face falls. Demand for investment goes down, putting downward pressure on the price of capital, leading to a macroeconomic contraction.



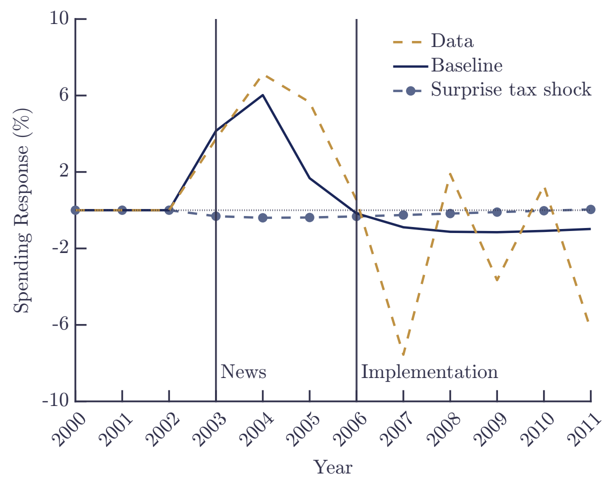
(a) Setting the EIS (ψ) to 0.1.



(b) Setting tax avoidance (θ) to 0.



(c) Setting pass-through (κ) to 1.



(d) The impact of surprise tax shocks.

Notes: Panels (a), (b), and (c) plot relative spending responses implied by alternative parametrizations in which we set $\psi = 0.1$, $\theta = 0$, and $\kappa = 1$, respectively. Panel (d) reports relative spending responses after a surprise tax shock, rather than a news shock.

Figure C.4: Additional model results.

Second, we test whether picking a wrong model with high matching errors produces empirically inconsistent results. Panel (a) of Figure C.4 shows the result when we counterfactually set the EIS (ψ) to 0.1, a very different value from what our calibration suggests but a value that is often referenced in the macro literature. The spending response in this case corresponds to a mean squared error that is at least an order of magnitude above the minimum and such a low EIS fails to match the front-loading of spending before implementation.

Third, panel (b) of Figure C.4 presents relative spending responses from a model with θ equal to 0, corresponding to no tax avoidance in the short run. This shows that the tax avoidance friction does not impact our results qualitatively but is crucial to quantitatively match the relatively smooth response to the tax news shock.

Fourth, panel (c) of Figure C.4 shows relative spending responses from a case with full pass-through, i.e. $\kappa = 1$. The magnitudes of the responses are now much larger, suggesting that low reform pass-through is very important for matching the relative spending response patterns quantitatively. Finally, panel (d) presents impulse responses for a surprise tax shock, rather than a news shock. A surprise shock completely fails to reproduce the increase in spending during the 2003-2006 period.

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