Online Appendices to "Does Corporate Tax Planning Affect Firm Productivity?"

The Online Appendices provide supplemental information to validate the theoretical and empirical constructs developed in the main body of study "Does Corporate Tax Planning Affect Firm Productivity?". All information available in the Online Appendices is briefly mentioned in the main body of the study. Below is the list of contents.

- Online Appendix A details the various total factor productivity estimation algorithms employed in the study.
- Online Appendix B provides detailed definitions on all variables used in the study.
- Online Appendix C provides robustness tests to the primary empirical framework in Section 4.2 of the paper.
- Online Appendix D reports robustness tests to the New Banking Relationships empirical framework in Section 4.4 of the paper.
- Online Appendix E presents robustness tests to the Check-the-Box identification strategy in Section 4.5 of the paper.

Online Appendix A – Total Factor Productivity Estimation Algorithms

A.1 – Olley and Pakes (1996) Estimation Algorithm (TFP_{it}^{OP})

We closely follow previous studies (e.g., Imrohoroğlu and Tüzel 2014, To et al. 2018, Bennett et al. 2020, Jacob 2021), and measure TFP as the residuals from a log-linear Cobb-Douglas production function, where firm value added is regressed on labor and capital. We use the semiparametric estimation algorithm proposed by Olley and Pakes (1996), and adjusted for estimation using Compustat data by Imrohoroğlu and Tüzel (2014). We collect firm financial data from Compustat, price index data from the Bureau of Economic Analysis (BEA), and national average wage data from the Social Security Administration (SSA).[1] We estimate TFP for publicly traded companies in the U.S. with positive total assets (at), net revenue ($sale$), number of employees (emp), capital expenditures ($capx$), depreciation and amortization (dp), accumulated depreciation, depletion, and amortization ($dpact$), and gross property, plant, and equipment ($ppegt$). We exclude firms operating in the Utilities (SIC: 4900 – 4999) and Financial Services (SIC: 6000 – 6999) sectors, and REITs (SIC: 6798). The estimation period spans from 1962 to 2018.

Value added (Y) is measured as sales minus materials, deflated by the price index for Gross Domestic Product (in 2012 constant dollars). Sales is measured as net revenue ($sale$). Materials is measured as total expenses ($sale - oibdp$) minus labor expenses. We use the product of the number of employees (emp) and the national average annual wage to proxy for labor expenses. Labor (L) is the number of employees (emp). Capital (K) is the gross property, plant, and equipment ($ppegt$) deflated by the price index for private fixed investments. Because firms invest in capital over time, we approximate the average age of capital in each year, and then apply the appropriate price index for private fixed investments (in 2012 constant dollars). That is, we assume that each firm makes lump-sum investments in capital stock in year $t - capital\ age_t$. We approximate $capital\ age_t$ as the three-year moving average of accumulated depreciation, depletion, and amortization ($dpact$) divided by current depreciation and amortization (dp). We lag capital by one year to capture the available capital stock at the beginning of the period (Olley and Pakes 1996, Imrohoroğlu and Tüzel 2014). Finally, investment (I) is capital expenses ($capx$) deflated by the price index for private fixed investments.

We estimate the Cobb-Douglas production function:

$$Y_{it} = A_{it} \times K_{it}^{\beta_K} \times L_{it}^{\beta_L} \tag{A.1}$$

[1] We obtain data on the price index for Gross Domestic Product from BEA NIPA Table 1.1.9 (line 1), and data on the price index for private fixed investments from BEA NIPA Table 5.3.4 (line 2). We collect data on the national average wage from the SSA national average wage indexing series.

where Y_{it} denotes value added for firm i in period t, K_{it} and L_{it} denote the capital and labor inputs for firm i in period t, respectively, and A_{it} denotes the Hicksian production efficiency of firm i in period t. The log-transformation of Eq. (A.1) results in the log-linear Cobb-Douglas production function:

$$y_{it} = \beta_0 + \beta_k \times k_{it} + \beta_l \times l_{it} + \omega_{it} + \epsilon_{it} \tag{A.2}$$

where lower-case letters denote the natural logarithms of value added (y_{it}), capital (k_{it}), and labor (l_{it}), β_0 denotes the mean production efficiency across firms and over time, ω_{it} denotes the observable deviation from β_0, and ϵ_{it} denotes the unobservable deviation from β_0.

Olley and Pakes (1996) argue that the estimation of production efficiency suffers from (i) *simultaneity bias* because ω_{it} is observable to the firm prior to taking input decisions, and (ii) *selection bias* because productivity depends on the ability of the firm to survive in the industry in the next period. To address simultaneity bias concerns, Olley and Pakes (1996) suggest using investment to proxy for productivity. Thus, they assume that labor stock is a variable input at time t, affected by current productivity ω_{it}, whereas capital stock is a fixed input at time t, affected by the conditional distribution of ω_{it} at time $t-1$. To address selection bias concerns, Olley and Pakes (1996) assume that, at the beginning of each period, the firm decides whether to continue operations or exit the market. The firm receives a sell-off value if it chooses to exit the market, or decides the level of input factors if it chooses to continue operations.

We derive firm investment from:

$$I_{it} = K_{it+1} - (1-\delta) \times K_{it}$$

where $I_{it} > 0$. In other words, investment decisions depend on capital and productivity with:

$$i_{it} = i(k_{it}, \omega_{it}) \tag{A.3}$$

The inversion of Eq. (A.3) yields:

$$\omega_{it} = h(i_{it}, k_{it})$$

where lower-case letters denote the natural logarithms of the variables, and $h(.)$ is strictly increasing in i_{it} (monotonicity condition).

We then define:

$$\phi_{it} = \beta_0 + \beta_k \times k_{it} + h(i_{it}, k_{it}) \tag{A.4}$$

We use Eqs. (A.2) and (A.4) to obtain:

$$y_{it} = \beta_l \times l_{it} + \phi_{it} + \epsilon_{it} \tag{A.5}$$

We use a second order polynomial expansion of capital and investment to approximate ϕ_{it}, and estimate Eq. (A.5) with industry (based on three-digit SIC industries) and year fixed effects. This estimation results in a consistent estimate for the coefficient on labor stock, $\hat{\beta}_l$, that accounts for the simultaneity bias. We then recover the coefficient on capital stock using firm information at period t:

$$\begin{aligned} E_t(y_{it+1} - \hat{\beta}_l \times l_{it+1}) &= \beta_0 + \beta_k \times k_{it+1} + E_t(\omega_{it+1} | \omega_{it}, survival) \\ &= \beta_0 + \beta_k \times k_{it+1} + g(\omega_{it}, \hat{\mathrm{P}}_{survival,t}) \end{aligned} \tag{A.6}$$

where $\hat{\mathrm{P}}_{survival,t}$ denotes the probability that the firm survives in the industry in the next period. We use a probit model with polynomial expression of capital and investment as covariates to estimate $\hat{\mathrm{P}}_{survival,t}$. We fit a non-linear least squares model in Eq. (A.6) to obtain $\hat{\beta}_k$:

$$y_{it+1} - \hat{\beta}_l \times l_{it+1} = \beta_k \times k_{it+1} + \rho \times \omega_{it} + \tau \times \hat{\mathrm{P}}_{survival,t} + \epsilon_{it+1} \tag{A.7}$$

where $\omega_{it} = \phi_{it} - \beta_0 - \beta_k \times k_{it}$. We then derive firm-level log TFP:

$$TFP_{it}^{OP} = y_{it} - \hat{\beta}_0 - \hat{\beta}_l \times l_{it} - \hat{\beta}_k \times k_{it}$$

We winsorize TFP_{it}^{OP} yearly at the 1% level to reduce the impact of outliers (Syverson 2011). However, we also consider two modifications of the Olley and Pakes (1996) estimation algorithm. In one approach, we estimate Eq. (A.5) with firm and year fixed effects. All other estimation parameters remain unchanged. We denote the firm-level log TFP derived from this estimation algorithm as TFP_{it}^{WLR}. In another approach, we consider the sum of knowledge capital and gross, property, plant, and equipment as our fixed input at time t, while all other estimation parameters do not change. We denote the firm-level log TFP derived from this modified production function as $Adjusted\ TFP_{it}^{OP}$.

A.2 – Levinsohn and Petrin (2003) Estimation Algorithm (TFP_{it}^{LP})

Olley and Pakes (1996) assume a strictly positive monotonic relationship between investment and productivity ($h(.)$ is strictly increasing in i_{it}). Therefore, Eqs. (A.4) and (A.6) can be estimated only for firms with positive investment, resulting in significant loss of efficiency. Levinsohn and Petrin (2003) suggest using intermediate inputs to proxy for productivity. The rationale is that firms typically consume materials and energy even if they do not invest. In essence, intermediate inputs are more likely to satisfy the monotonicity condition. In the Levinsohn and Petrin (2003) estimation algorithm, intermediate inputs depend on capital and productivity with:

$$m_{it} = m(k_{it}, \omega_{it}) \tag{A.8}$$

The inversion of Eq. (A.8) yields:

$$\omega_{it} = s(m_{it}, k_{it})$$

where $s(.)$ is strictly increasing in m_{it}. Using Eq. (A.8), we can rewrite Eq. (A.2):

$$y_{it} = \beta_0 + \beta_k \times k_{it} + \beta_l \times l_{it} + s(m_{it}, k_{it}) + \epsilon_{it} \tag{A.9}$$

In contrast to Olley and Pakes (1996), Levinsohn and Petrin (2003) do not control for the firm's survival probability, $\hat{\mathrm{P}}_{survival,t}$, in Eq. (A.6). All other estimation parameters are identical to those in Olley and Pakes (1996). We use materials, defined in Section A.1 of the Online Appendix A as total expenses ($sale - oibdp$) minus the product of the number of employees (emp) and the national average annual wage, to approximate intermediate inputs. We define the firm-level log TFP derived using the Levinsohn and Petrin (2003) estimation algorithm as TFP_{it}^{LP}. We winsorize TFP_{it}^{LP} yearly at the 1% level.

A.3 – Ackerberg et al. (2015) estimation algorithm (TFP_{it}^{ACF})

The Olley and Pakes (1996) and Levinsohn and Petrin (2003) TFP estimation algorithms assume that labor stock is a variable input. Stated differently, both estimators assume that firms can adjust labor inputs in a costless manner. However, Ackerberg et al. (2015) argue that, for Eq. (A.5) to estimate the coefficient on labor stock, $\hat{\beta}_l$, labor inputs must vary within firm over time. Ackerberg et al. (2015) propose an estimation algorithm that solves for the identification issue of the labor coefficient. The first stage removes the unobservable component of the production function, ϵ_{it}. We follow Olley and Pakes (1996) and use investment to invert out productivity. We then define:

$$\phi_{it} = \beta_0 + \beta_k \times k_{it} + \beta_l \times l_{it} + h(i_{it}, k_{it}) \tag{A.10}$$

We use Eqs. (A.2) and (A.10) to obtain:

$$y_{it} = \phi_{it} + \epsilon_{it} \tag{A.11}$$

Then, the second stage estimates all input coefficients:

$$y_{it+1} - \hat{\beta}_l \times l_{it+1} - \hat{\beta}_k \times k_{it+1} = \rho \times \omega_{it} + \epsilon_{it+1} \tag{A.12}$$

where $\omega_{it} = \phi_{it} - \beta_0 - \beta_l \times l_{it} - \beta_k \times k_{it}$. We define the firm-level log TFP derived using the Ackerberg et al. (2015) estimation algorithm as TFP_{it}^{ACF}. We winsorize TFP_{it}^{ACF} yearly at the 1% level.

Online Appendix B – Expanded Variables Definitions

Dependent variables:

TFP^{OP}_{it+1}	Residuals from a log-linear Cobb-Douglas production function calculated following Olley and Pakes (1996). *Sources:* Online Appendix A.
Adjusted TFP^{OP}_{it+1}	Residuals from a log-linear Cobb-Douglas production function calculated following Olley and Pakes (1996), which broaden the capital stock input factor to also incorporate knowledge capital. *Sources:* Online Appendix A and Peters and Taylor (2017).
TFP^{WLR}_{it+1}	Residuals from a log-linear Cobb-Douglas production function calculated following Olley and Pakes (1996) with firm and year fixed effects. *Source:* Online Appendix A.
TFP^{LP}_{it+1}	Residuals from a log-linear Cobb-Douglas production function calculated following Levinsohn and Petrin (2003). *Sources:* Online Appendix A.
TFP^{ACF}_{it+1}	Residuals from a log-linear Cobb-Douglas production function calculated following Ackerberg et al. (2015). *Sources:* Online Appendix A.
$\Delta Capital_{it+1}$	Capital growth rate. We define $\Delta Capital_{it+1}$ as $\log_e(ppent_{it+1}) - \log_e(ppent_{it})$.
$\Delta Labor_{it+1}$	Labor growth rate. We define $\Delta Labor_{it+1}$ as $\log_e(emp_{it+1}) - \log_e(emp_{it})$.
$DTFP^{OP}_{i,(t,t+2)}$	Long-run total factor productivity gains. We define $DTFP^{OP}_{i,(t,t+2)}$ as $\frac{\frac{TFP^{OP}_{it}+TFP^{OP}_{it+1}+TFP^{OP}_{it+2}}{3}-TFP^{OP}_{it-1}}{at_{it-1}}$. *Sources:* Almeida et al. (2024) and Online Appendix A.
$DOPM_{i,(t,t+2)}$	Long-run operating margin. We define OPM_{it} as $\frac{Sales_{it}-Materials_{it}-Labor\ Expenses_{it}}{Sales_{it}}$. We then estimate $DOPM_{i,(t,t+2)}$ as $\frac{\frac{OPM_{it}+OPM_{it+1}+OPM_{it+2}}{3}-OPM_{it-1}}{at_{it-1}}$. *Sources:* Almeida et al. (2024) and Online Appendix A.
$Sales/Emp_{it+1}$	Labor productivity. We define $Sales/Emp_{it+1}$ as $\log_e(\frac{sale_{it+1}}{emp_{it}})$.

Test variables:

$CETR_{it}$	Cash effective tax rate. We define $CETR_{it}$ as $(-1) \times \frac{txpd_{it}}{pi_{it}-spi_{it}}$. We require $txpd_{it} \geq 0$ and $(pi_{it} - spi_{it}) > 0$. We truncate $CETR_{it}$ between minus one and zero.
$TA.CETR_{it}$	Industry-size-adjusted cash effective tax rate. We benchmark $CETR_{it}$ against the $\overline{CETR}_{lkt}$ of peers of similar size (based on Fama-French 48 industry classifications).
$3YCETR_{it}$	Long-run cash effective tax rate. We define $3YCETR_{it}$ as $(-1) \times \frac{\sum_{t=-2}^{0} txpd_{it}}{\sum_{t=-2}^{0}(pi_{it}-spi_{it})}$. We require $\sum_{t=-2}^{0}(txpd_{it}) \geq 0$ and $\sum_{t=-2}^{0}(pi_{it} - spi_{it}) > 0$. We truncate $3YCETR_{it}$ between minus one and zero.
$5YCETR_{it}$	Long-run cash effective tax rate. We define $5YCETR_{it}$ as $(-1) \times \frac{\sum_{t=-4}^{0} txpd_{it}}{\sum_{t=-4}^{0}(pi_{it}-spi_{it})}$. We require $\sum_{t=-4}^{0}(txpd_{it}) \geq 0$ and $\sum_{t=-4}^{0}(pi_{it} - spi_{it}) > 0$. We truncate $5YCETR_{it}$ between minus one and zero.
$Delta/MVA_{it}$	Market cash tax non-conformity. We define $Delta/MVA_{it}$ as $(-1) \times \frac{[txpd_{it}-(txr_{it}-txr_{it-1})]-[0.35\times(pi_{it}-spi_{it})]}{at_{it}+prcc\_f_{it}\times csho_{it}-seq_{it}}$. We replace $prcc\_f_{it} \times csho_{it}$ with $mkvalt_{it}$ whenever $prcc\_f_{it}$ is missing. *Source:* Henry and Sansing (2018).
$Tax\ Effectiveness_{it}$	Firm-level effective tax planning ($tax\_effectiveness_{it}$). *Source:* Schwab et al. (2022).

$Shelter_{it}$	Tax shelter activities indicator. We define $Shelter_{it}$ as an indicator taking the value of one for firms that belong to the top quintile of the predicted probability of tax sheltering activities ($PPTS_{it}$), and zero otherwise. We estimate $PPTS_{it}$ as $-4.3+6.63\times\frac{pi_{it}-[\frac{txfed_{it}+txfo_{it}}{0.35}-(tlcf_{it}-tlcf_{it-1})]}{at_{it-1}}-1.72\times\frac{dltt_{it}}{at_{it}}+0.66\times\log_e(at_{it})+2.26\times\frac{pi_{it}}{at_{it}}+1.62\times\frac{pifo_{it}}{at_{it-1}}+1.56\times\frac{xrd_{it}}{at_{it-1}}$. We winsorize all components of $PPTS_{it}$ yearly at the 1% level. *Source:* Wilson (2009).

DD variables:

$\mathbb{1}^{\mathbb{NBR}}(ib=T)$	New banking relationship treated firm-banks indicator. We define $\mathbb{1}^{\mathbb{NBR}}(ib=T)$ as an indicator taking the value of one for firms that established a new loan contract with a lead bank identified as a tax planning intermediary, and zero otherwise. We identify tax planning intermediary banks as follows. We start by estimating $\overline{3YCETR}_{ibt}$ defined as the average long-run cash effective tax rate of the bank's other clients in year t. Next, we measure the annual median of $\overline{3YCETR}_{ibt}$. We then consider those banks with a $\overline{3YCETR}_{ibt}$ value above the yearly median of the distribution in at least three of the five years prior to the initiation of the new loan contract as facilitating clients' tax planning. *Source:* Gallemore et al. (2019).
$\mathbb{1}^{\mathbb{NBR}}(t\geqslant 0)$	Post-NBR indicator. We define $\mathbb{1}^{\mathbb{NBR}}(t\geqslant 0)$ as an indicator taking the value of one for years following the initiation of a new banking relationship, and zero otherwise.
$\mathbb{1}^{\mathbb{CTB}}(i=T)$	Check-the-Box treated firms indicator. We define $\mathbb{1}^{\mathbb{CTB}}(i=T)$ as an indicator taking the value of one for multinational firms, and zero for domestic firms. We identify multinational firms based on non-zero pre-tax foreign income ($pifo$) before and after 1997. We identify domestic firms based on zero pre-tax foreign income ($pifo$) before and after 1997. *Sources:* Balakrishnan et al. (2019).
$\mathbb{1}^{\mathbb{CTB}}(t\geqslant 1997)$	Post-CTB indicator. We define $\mathbb{1}^{\mathbb{CTB}}(t\geqslant 1997)$ as an indicator taking the value of one for fiscal years after 1996, and zero otherwise.

Control variables:

$Firm\,Size_{it}$	Firm scale. We define $Firm\,Size_{it}$ as $\log_e(value\,added_{it})$. *Source:* Online Appendix A.
$Foreign\,Income_{it}$	Foreign income ratio. We define $Foreign\,Income_{it}$ as $\frac{pifo_{it}}{at_{it-1}}$. We set missing values of $pifo_{it}$ to zero.
$Marginal\,Q_{it}$	Tobin's marginal q. We define $Marginal\,Q_{it}$ as $\frac{prcc\_f_{it}\times csho_{it}+at_{it}-ceq_{it}-txdb_{it}}{at_{it}}$.
$Profitability_{it}$	Return-on-net-operating-assets ratio. We define $Profitability_{it}$ as $\frac{oibdp_{it}}{ceq_{it-1}+pstk_{it-1}+dltt_{it-1}+dlc_{it-1}+mibt_{it-1}}$. We set missing values of $pstk_{it-1}$ and $mitb_{it-1}$ to zero.
$Capital\,Investments_{it}$	Capital investments ratio. We define $Capital\,Investments_{it}$ as $\frac{capx_{it}}{at_{it-1}}$.
$R\&D\,Investments_{it}$	R&D investments ratio. We define $R\&D\,Investments_{it}$ as $\frac{xrd_{it}}{at_{it-1}}$. We set missing values of xrd_{it} to zero.
$Cash\,Flows_{it}$	Cash flows ratio. We define $Cash\,Flows_{it}$ as $\frac{ib_{it}+dp_{it}-dv_{it}-capx_{it}}{at_{it-1}}$. We set missing values of dp_{it} and dv_{it} to zero.
$Book\,Leverage_{it}$	Total leverage. We define $Book\,Leverage_{it}$ as $\frac{dltt_{it}+dlc_{it}}{at_{it}}$.
$WW\,Score_{it}$	Whited and Wu's (2006) financial constraints score. We define $WW\,Score_{it}$ as $(-1)\times[-0.091\times\frac{ib_{it}+dp_{it}}{at_{it}}-0.062\times\mathbb{1}(dvc_{it}\|dv_{it}>0)+0.021\times\frac{dltt_{it}}{at_{it}}-0.044\times\log_e(at_{it})+0.102\times\frac{\overline{sale}_{kt}-\overline{sale}_{kt-1}}{\overline{sale}_{kt-1}}-0.035\times\frac{sale_{it}-sale_{it-1}}{sale_{it-1}}]$. We winsorize all components of $WW\,Index_{it}$ yearly at the 5% level.
NOL_{it}	Net operating loss carryforward indicator. We define NOL_{it} as an indicator taking the value of one for firms that report positive tax loss carrryforwards ($tlcf_{it-1}>0$), and zero otherwise. *Source:* Dyreng et al. (2017).
$DNOL_{it}$	Changes in tax loss carryforwards. We define $DNOL_{it}$ as $\frac{tlcf_{it}-tlcf_{it-1}}{at_{it-1}}$. We set missing values of $tlcf_{it}$ and $tlcf_{it-1}$ to zero.
$\%\,NED_{it}$	Percentage of independent members in the board of directors in year t. *Source:* BoardEx.

$Duality_{it}$	Indicator taking the value of one if the CEO is also the chairperson of the board of directors in year t, and zero otherwise. *Source:* BoardEx.
$Quasi\,Instit._{it}$	Percentage of shares held by quasi-indexed institutional investors (io_qix_{it}). *Source:* Ghaly et al. (2020).
$Anti-Takeover_{it}$	Firm-level hostile takeover index $[(-1) \times hostile\_index_{it}]$. *Source:* Cain et al. (2017).
$PT\ Risk_{it}$	Firm-level political tax risk ($PRiskT\_tax_{it}$). *Source:* Hassan et al. (2019).
$P.\,SIM_{it}$	Firm-level product similarity ($tnic3tsimm_{it}$). *Source:* Hoberg and Phillips (2016).
$Man.\ Ability_{it}$	Firm-level managerial ability index (ma_score_{it}). *Source:* Demerjian et al. (2012).
MTR_{it}	Firm-level post-financing marginal tax rate (bcg_mtrint_{it}). *Source:* Blouin et al. (2010).
$BONUS_{kt}$	PV increase in tax shields generated from each $1 of new equipment due to Bonus Depreciation incentives. *Source:* Ohrn (2018).
$DPAD_{klt}$	Percentage point drop in the corporate tax rate due to Domestic Production Activities Deduction incentives. *Source:* Ohrn (2018).
ETI_{kt}	Percentage point drop in the corporate tax rate due to Extraterritorial Income Exclusion incentives. *Source:* Ohrn (2018).
$Markup_{it}$	Firm-level markup derived from a production function approach ($lmu1_{it}$). *Source:* De Loecker et al. (2020).

Additional variables:

P/K_{it}	Physical-to-knowledge-capital ratio. We define P/K_{it} as $\log_e[\frac{0.5\times(ppent_{it}+ppent_{it-1})}{k\_int\_know_{it}}]$. *Source:* Peters and Taylor (2017).
$KC\,Growth_{it}$	Knowledge capital growth ratio. We define $KC\,Growth_{it}$ as $log_e[\frac{xrd_{it}-xrd_{it-1}}{0.5\times(intan_{it}+intan_{it-1})}]$.

Notes: Subscripts i, b, t, k, and l are the firm, bank, year, industry, and size bin indices, respectively. Unless otherwise stated, all continuous variables are winsorized yearly at the 1% and 99% levels.

Online Appendix C – Sensitivity Analyses of Main Regression Results

In this appendix, we report the results from robustness tests on the relation between productivity and tax planning. Fig. C.1 presents binned scatter plots of productivity vs. corporate tax planning. The majority of binned data lie within one standard deviation of the within fixed effects mean $ETR_{it} \in \{CETR_{it}, TA.CETR_{it}\}$. Thus, outliers do not affect the estimates reported in Table 2 of the paper, and the empirical evidence represents the average firm-year. In Table C.1, we split the sample into the three decades that comprise the sample period (i.e., 1993 – 1999, 2000 – 2009, and 2010 – 2017). We reject the null that $CETR_{it}$ (or $TA.CETR_{it}$) does not have a positive association with TFP^{OP}_{it+1} for all time periods. In Table C.2, we investigate the link between tax planning and productivity separately for domestic firms (DEs), multinational firms without tax-haven operations (MNEs), and multinational firms with tax-haven operations (TMNEs). Again, we reject the null that ETR_{it} does not have a positive association with TFP^{OP}_{it+1} at conventional levels for all firm types. Despite the global tax race-to-the-bottom during our sample period (e.g., Kim et al. 2021), Dyreng et al. (2017) evidence that DEs and MNEs face similar declining ETR patterns over time. Finding that the link between TFP and ETR is evident in DEs highlights that the increasing disparity between the U.S. corporate tax rate and foreign corporate tax rates over the sample period does not explain substantial variation in our setting. Overall, Fig. C.1, Table C.1, and Table C.2 suggest that sample composition does not impact our empirical evidence.

Furthermore, growing firms experience lower profitability (Fairfield et al. 2003) but higher productivity (To et al. 2018, Darrough et al. 2019) in subsequent periods. We posit that our empirical framework might capture a mechanical positive association between productivity and tax planning due to poor prior profitability. In fact, Christensen et al. (2022) recently documented that poor profitability associates with low ETRs owing to the accumulation of net operating losses (NOLs). We address this concern by estimating Eq. (1) of the paper for a (sub)sample of firms with accumulated surplus ($re_{it} > 0$). The empirical evidence is reported in Table C.3. Across columns, the point estimate is always significant at the 1% level with an economic magnitude quantitatively in line with what we document throughout the study.

In addition, the empirical framework could capture tax system variations rather than firm-specific attempts to reduce the tax liability. For instance, Kaymak and Schott (2019) document that loss offset provisions stimulate loss-making firms' investment, Ohrn (2018) evidences that investment rose following the introduction of the Domestic Production Activities Deduction (DPAD; tax rate cuts on manufacturing income) and bonus depreciation (tax base-narrowing incentive) in the early 2000s, while Jacob (2021) finds that dividend tax cuts around 2006 increased productivity in Swedish firms with limited internal capital markets. In Table C.4, we attempt to examine tax planning activities while presumably maintaining the primary tax system components (i.e., tax rate and base) constant across firms. For this analysis, we focus on DEs because these firms cannot benefit from cross-country disparities in statutory tax rates and tax base definitions. More specifically, we examine DEs with accumulated surplus (i.e., firms that do not benefit from NOLs; Panel A), DEs in low qualified production activities income industry-size bins (i.e, firms that do not benefit from DPAD; Panel B), DEs in industries that invest in short-lived assets (i.e., firms that do not benefit from bonus depreciation incentives; Panel C), and non-dividend paying DEs (i.e., firms that do not benefit from dividend tax rate cuts; Panel D). The β_1 estimate on ETR_{it} measures remains significant at least at the 5% level across columns in all panels. Thus, Table C.4 indicates that our empirical framework identifies firm-specific tax planning variation rather than economy-wide tax policy variation.

Furthermore, unobservable trends with heterogeneous effects across firms might confound the relation between TFP^{OP}_{it+1} and ETR_{it}. We address this concern in three ways. First, we incorporate controls for an extensive number of potentially confounding firm characteristics in Eq. (1) of the paper. The factors we consider are (a) the percentage of independent members in the board of directors, $\%NED_{it}$, (b) an indicator taking the value of one if the CEO of the firm is also the chairperson of the board, and zero otherwise, $Duality_{it}$, (c) the percentage of shares held by quasi-indexed institutional investors, $Quasi\ Instit._{it}$ (Ghaly et al. 2020), (d) the anti-takeover index, $Anti-Takeover_{it}$ (Cain et al. 2017), (e) firm-specific political tax uncertainty, $PT\ Risk_{it}$ (Hassan et al. 2019), (f) product similarity, $P.\ SIM_{it}$ (Hoberg and Phillips 2016), (g) managerial ability, $M.\ Abil_{it}$ (Demerjian et al. 2012), (h) the post-financing marginal tax rate, MTR_{it} (Blouin et al. 2010), (i) the present value increase in tax shields from new capital investments due to bonus depreciation tax incentives, $BONUS_{kt}$ (Ohrn 2018), (j) the percentage point drop in the corporate tax rate due to DPAD tax incentives, $DPAD_{klt}$ (Ohrn 2018), (k) the percentage point drop in the corporate tax rate due to Extraterritorial Income Exclusion (ETI) tax incentives, ETI_{kt} (Ohrn 2018), and (l) firm-level markup, $Markup_{it}$ (De Loecker et al. 2020).

We justify the selection of these covariates as follows. Strong corporate governance structures could allow firms to efficiently manage available resources or to efficiently exploit investment opportunities. For instance, Khurana et al. (2018) provide evidence that stronger corporate governance mitigates investment inefficiencies in tax avoiding firms, and Bennett et al. (2020) document that better corporate governance policies increase the stock price informativeness effect on firm productivity. Furthermore, heightened uncertainty could drive our findings. In fact, aggregate uncertainty accounts for significant variation in the cross-sectional structure of both firm-level production input factors (e.g., Baker et al. 2016) and tax planning (e.g., Li et al. 2022). Meanwhile, due to intense market competition, which is associated with increased tax planning (Cai and Liu 2009), firms must utilize all available resources to survive and increase market share (Syverson 2004). Additionally, firm growth prospects depend on high-quality managerial skills (Bloom and Van Reenen 2007), and a skilled manager shapes tax planning outcomes (Koester et al. 2017). Likewise, tax planning requires the firm to incur substantial setup costs (e.g., tax experts, organizational structure changes). An alternative explanation to our findings relates to *clientele* formation. Depending on current and future profitability expectations, firms could belong in high-MTR and low-MTR tax clienteles. Firms in the former group expect sustained profitability levels and have an incentive to incur the setup costs, while firms in the latter group refrain from engaging in tax planning strategies. Moreover, U.S. firms could utilize various tax incentives that not only stimulated investment, but also reduced cash ETRs (Ohrn 2018) during our sample period. For instance, ETI provision allowed firms to deduct 15% of export income from taxable income during 2000 – 2004, the Bonus Depreciation provision allowed firms to accelerate the tax depreciation of new physical capital during 2001 – 2017, and DPAD provision allowed firms to deduct up to 9% of domestic manufacturing income from taxable income during 2005 – 2017. Finally, when firms charge prices significantly above the marginal cost of production (i.e., markup ratios are above 1), the observed contribution of input factors to value-added is lower than their actual contribution (De Loecker et al. 2020), leading to an overestimation of production efficiency.

We display results for each individual factor in Columns (1) – (12) of Table C.5. Tax planning is measured by $CETR_{it}$ in Panel A, and by $TA.CETR_{it}$ in Panel B. Each column shows that controlling for the abovementioned factors does not impact the statistical and economic significance of the β_1 coefficient on $CETR_{it}$ (or $TA.CETR_{it}$). We also consider a comprehensive specification in which we incorporate all the factors simultaneously (reported in Column (13) of both panels). Despite the significant drop in firm-years (-86.32%), the β_1 estimate remains significantly positive at least at the 5% level, and its economic magnitude increases by 30.61% ($= \frac{0.064-0.049}{0.049}$) relative to the estimate in Table 2 Column (5).

Second, we augment Eq. (1) of the paper with trends on observable firm characteristics. The characteristics we consider are: managerial ability ($Man.\ Ability_{it}$), earnings returns ($Profitability_{it}$), growth opportunities ($Marginal\ Q_{it}$), and available corporate tax planning opportunities ($CETR_{it}$). We split sample firm-years into deciles based on the observable firm characteristic, and then interact the decile bins with year fixed effects. This ensures that the β_1 estimate is identified through variation across firms that face similar industry, managerial ability, profitability, growth, and tax planning trends. The results from this test are reported in Table C.6. Across columns, the magnitude of the point estimates is identical to that reported in Table 2 Column (5) for $CETR_{it}$, and Column (10) for $TA.CETR_{it}$.

Third, we investigate the stability of β_1 to unobservable confounding factors in Table C.7. To that extent, we perform the Oster (2019) test assuming that (i) $Adj.\ R^2_{max} = 1.25 \times Adj.\ R^2$, and that (ii) vector X_{it} is not orthogonal to the vector of unobservable confounding factors. The Oster (2019) δ is equal to 2.101 (2.096) when $CETR_{it}$ ($TA.CETR_{it}$) is the main test variable. The δ estimate implies that selection on unobservable confounding factors should be 2.101 (2.096) as large as selection on observable factors to eliminate the effect of $CETR_{it}$ ($TA.CETR_{it}$) on TFP^{OP}_{it+1}. The δ estimate is well above the critical value of 1 identified by Oster (2019), thus confirming that β_1 is not sensitive to unobservable confounding factors. If we relax assumption (ii), — i.e., assume that several factors in vector X_{it} are fully observable (e.g., $Marginal\, Q_{it}$, $Book\, Leverage_{it}$, or $Firm\, Size_{it}$) — the Oster (2019) δ increases to 2.775 (3.667). Based on the results in Tables C.5, C.6, and C.7 we conclude that potentially correlated omitted variables do not seem to drive our empirical evidence.

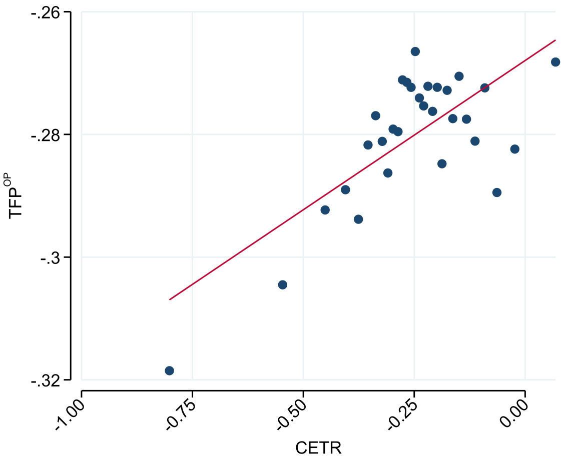
Moreover, we follow the literature (Dyreng et al. 2008, Blouin 2014, Henry and Sansing 2018, Balakrishnan et al. 2019, Schwab et al. 2022), and investigate alternative tax planning measures. Henry and Sansing (2018) argue that truncating sample observations to profitable firm-years biases the empirical findings. So, we first model TFP^{OP}_{it+1} on Henry and Sansing's (2018) delta ($Delta/MVA_{it}$), for a broad sample of profitable and unprofitable firm-years, and our sample of profitable firm-years ($pi - spi > 0$). We then examine tax effectiveness ($Tax\ Effectiveness_{it}$) in the spirit of Schwab et al. (2022), again, for the broader sample and our sample of profitable firm-years. We then consider the mismatching between the numerator and denominator of ETR (Blouin 2014), and model TFP^{OP}_{it+1} on long-run cash ETRs, $3YCETR_{it}$ / $5YCETR_{it}$ (Dyreng et al. 2008). Finally, we examine tax shelter activities, $Shelter_{it}$ (Wilson 2009).

The results are reported in Table C.8. In Columns (1) and (2), coefficient β_1 is positive and significant at the 1% level (0.703 and 0.909, respectively). The estimates indicate that a one standard deviation increase in the within fixed effects $Delta/MVA_{it}$ is associated with a 0.91% – 1.05% increase in TFP^{OP}_{it+1}, 3.75% – 3.82% of the variable's within fixed effects standard deviation. The positively significant point estimates in Columns (3) and (4) (0.067 and 0.048, respectively) further indicate that a standard deviation increase in tax planning effectiveness is associated with a 4.23% – 4.60% TFP^{OP}_{it+1} increase (in s.d. units). The coefficients on our long-run cash ETRs in Columns (5) and (6) are economically and statistically consistent with those for $CETR_{it}$. Lastly, Column (7) reports the β_1 coefficient on the tax shelter activities indicator, $Shelter_{it}$. $Shelter_{it}$ has a positively significant coefficient (0.019, $p_{\beta_1} \approx 0.00$), suggesting that firms in the uppermost quintile of the tax shelter prediction score have, on average, a 1.9% higher subsequent year TFP. The evidence from these alternative tax planning proxies strengthens our inference that activities intended to reduce corporate tax payments improve productivity.

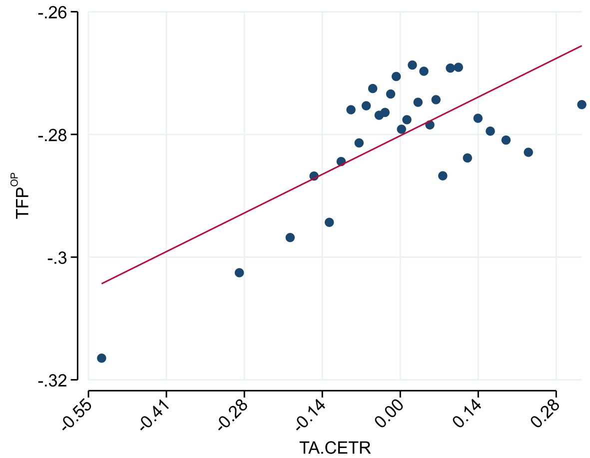
Last but not least, we investigate the sensitivity of the results to alternative proxies for firm efficiency. First, we investigate an Olley and Pakes (1996) estimation algorithm with firm and year fixed effects, TFP^{WLR}_{it+1}, to account for within-firm time-invariant heterogeneity and aggregate yearly trends. Second, we scrutinize a TFP measure in which we incorporate knowledge capital as a (fixed) production input factor following Imrohoroğlu and Tüzel (2014), $Adjusted\ TFP^{OP}_{it+1}$. We do so because our estimation algorithm might result in upward-biased TFP estimates for firms in industries that rely more on intangible assets as opposed to physical capital. Third, we consider TFP measures derived from other estimation algorithms, TFP^{LP}_{it+1} by Levinsohn and Petrin (2003), and TFP^{ACF}_{it+1} by Ackerberg et al. (2015). Finally, we replace TFP with other proxies for firm efficiency. In particular, we investigate increases in average future productivity relative to historical productivity levels, $DTFP^{OP}_{i,(t,t+2)}$ (Almeida et al. 2024), increases in average future operating margin relative to historical operating margin, $DOPM_{i,(t,t+2)}$ (Almeida et al. 2024), and labor productivity, $Sales/Emp_{it+1}$ (Darrough et al. 2019). Panels A and B of Table C.9 report the results for $CETR_{it}$ and $TA.CETR_{it}$, respectively. Across columns in both panels, the β_1 point estimate remains strongly significant and economically meaningful. The evidence from these alternative firm efficiency proxies complements our main findings in Table 2 (in Section 4.2) of the paper that tax planning is positively associated with productivity.

Fig. C.1. Tax planning and productivity.

(A) Cash ETR



(B) Industry-size-adjusted cash ETR



Notes: This figure presents binned scatter plots of firm productivity, TFP^{OP}_{it+1}, vs. corporate tax planning, $ETR_{it} \in \{CETR_{it}, TA.CETR_{it}\}$. To construct the binned scatter plots, we first residualize TFP^{OP}_{it+1} and ETR_{it} against the vector of control variables, X_{it}, and firm and industry-year fixed effects. We then split residualized ETR_{it} into 30 equally-sized bins, and plot the average residualized TFP^{OP}_{it+1} in each bin against the average residualized ETR_{it} in each bin. In Panel A, $CETR_{it}$ is the x-axis variable. In Panel B, $TA.CETR_{it}$ is the x-axis variable. The fitted lines represent conditional expectation functions corresponding to β_1 estimates from Columns (5) and (10) of Table 2, respectively. Variable definitions are available in Online Appendix B.

Table C.1. Tax planning and productivity across decades.

	(1)	(2)	(3)	(4)	(5)	(6)
		TFP^{OP}_{it+1}			TFP^{OP}_{it+1}	
Sample period	1990's	2000's	2010's	1990's	2000's	2010's
$CETR_{it}$	0.068***	0.052***	0.050***			
	[0.015]	[0.013]	[0.019]			
$TA.CETR_{it}$				0.063***	0.054***	0.053***
				[0.015]	[0.013]	[0.019]
Firms	3,597	3,039	2,049	3,597	3,039	2,049
Firm – Years	15,776	17,563	11,125	15,776	17,563	11,125
Adj. R^2	0.679	0.731	0.811	0.679	0.731	0.811
Clusters (firms)	3,597	3,039	2,049	3,597	3,039	2,049
Controls	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y
Ind-Yr FE	Y	Y	Y	Y	Y	Y
Dependent variable s.d.	0.200	0.205	0.178	0.200	0.205	0.178
Test variable s.d.	0.151	0.161	0.138	0.149	0.158	0.134

Notes: This table presents panel regressions of productivity (TFP^{OP}_{it+1}) on tax planning and control variables, separately for each decade in our sample period. In Columns (1) – (3), tax planning is measured by $CETR_{it}$. In Columns (4) – (6), tax planning is measured by $TA.CETR_{it}$. The sample consists of Compustat firms with available data to estimate Eq. (1), and the sample period spans from 1993 to 2017. The covariates vector, X_{it}, is included in all columns, but the coefficients vector, Γ, is not displayed for brevity. All columns include firm and industry-year fixed effects. Robust standard errors clustered at the firm level are reported in brackets. The standard deviations of the dependent and test variables are estimated using within fixed effects variation in the respective variables. Variable definitions are available in Online Appendix B. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table C.2. Tax planning and productivity across firm types.

	(1)	(2)	(3)	(4)	(5)	(6)
		TFP^{OP}_{it+1}			TFP^{OP}_{it+1}	
Firm type	DEs	MNEs	TMNEs	DEs	MNEs	TMNEs
$CETR_{it}$	0.057***	0.086***	0.042**			
	[0.017]	[0.030]	[0.018]			
$TA.CETR_{it}$				0.060***	0.087***	0.038**
				[0.017]	[0.031]	[0.018]
Firms	2,509	1,174	1,668	2,509	1,174	1,668
Firm – Years	13,353	5,542	11,976	13,353	5,542	11,976
Adj. R^2	0.670	0.673	0.712	0.670	0.673	0.712
Clusters (firms)	2,509	1,174	1,668	2,509	1,174	1,668
Controls	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y
Ind-Yr FE	Y	Y	Y	Y	Y	Y
Dependent variable s.d.	0.215	0.179	0.200	0.215	0.179	0.200
Test variable s.d.	0.153	0.134	0.147	0.150	0.132	0.146

Notes: This table presents panel regressions of productivity (TFP^{OP}_{it+1}) on tax planning and control variables, separately for domestic firms (DEs), multinational firms without tax-haven operations (MNEs), and multinational firms with tax-haven operations (TMNEs). In Columns (1) – (3), tax planning is measured by $CETR_{it}$. In Columns (4) – (6), tax planning is measured by $TA.CETR_{it}$. The sample consists of Compustat firms with available data to estimate Eq. (1), and the sample period spans from 1993 to 2017. The covariates vector, X_{it}, is included in all columns, but the coefficients vector, Γ, is not displayed for brevity. All columns include firm and industry-year fixed effects. Robust standard errors clustered at the firm level are reported in brackets. The standard deviations of the dependent and test variables are estimated using within fixed effects variation in the respective variables. Variable definitions are available in Online Appendix B. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table C.3. Controlling for benign tax positions.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	TFP^{OP}_{it+1}					TFP^{OP}_{it+1}				
$CETR_{it}$	0.232***	0.095***	0.103***	0.049***	0.054***					
	[0.019]	[0.015]	[0.015]	[0.010]	[0.010]					
$TA.CETR_{it}$						0.212***	0.076***	0.075***	0.050***	0.051***
						[0.019]	[0.015]	[0.015]	[0.010]	[0.011]
Firms	4,918	4,918	4,918	4,126	4,115	4,918	4,918	4,918	4,126	4,115
Firm – Years	36,193	36,193	36,193	35,401	35,265	36,193	36,193	36,193	35,401	35,265
Adj. R^2	0.012	0.320	0.323	0.697	0.711	0.009	0.319	0.322	0.697	0.711
Clusters (firms)	4,918	4,918	4,918	4,126	4,115	4,918	4,918	4,918	4,126	4,115
Controls		Y	Y	Y	Y		Y	Y	Y	Y
Yr FE			Y	Y				Y	Y	
Ind FE			Y					Y		
Firm FE				Y	Y				Y	Y
Ind-Yr FE					Y					Y
Dependent variable s.d.	0.421	0.421	0.420	0.235	0.217	0.421	0.421	0.420	0.235	0.217
Test variable s.d.	0.199	0.199	0.197	0.165	0.155	0.188	0.188	0.188	0.160	0.151

Notes: This table presents panel regressions of productivity (TFP^{OP}_{it+1}) on tax planning and control variables for a (sub)sample of firms with retained earnings surplus (i.e., $re_{it} > 0$; following Christensen et al. (2022)). In Columns (1) – (5), tax planning is measured by $CETR_{it}$. In Columns (6) – (10), tax planning is measured by $TA.CETR_{it}$. The sample consists of Compustat firms with available data to estimate Eq. (1), and the sample period spans from 1993 to 2017. Fixed effects choice varies across specifications. Robust standard errors clustered at the firm level are reported in brackets. The standard deviations of the dependent and test variables are estimated using within fixed effects variation in the respective variables. Variable definitions are available in Online Appendix B. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table C.4. Tax planning and productivity: isolating tax planning efforts from tax system changes.

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Accumulated Surplus DEs				TFP^{OP}_{it+1}		
$CETR_{it}$	0.089***	0.050***	0.069***			
	[0.018]	[0.017]	[0.020]			
$TA.CETR_{it}$				0.095***	0.054***	0.072***
				[0.019]	[0.018]	[0.020]
Firms	1,894	1,894	1,806	1,894	1,894	1,806
Firm – Years	10,397	10,397	9,664	10,397	10,397	9,664
Adj. R^2	0.658	0.703	0.703	0.658	0.703	0.703
Clusters (firms)	1,894	1,894	1,806	1,894	1,894	1,806
Dependent variable s.d.	0.220	0.220	0.192	0.220	0.220	0.192
Test variable s.d.	0.168	0.168	0.147	0.162	0.162	0.144
Panel B: 0% DPAD DEs				TFP^{OP}_{it+1}		
$CETR_{it}$	0.072***	0.040**	0.046**			
	[0.019]	[0.018]	[0.020]			
$TA.CETR_{it}$				0.075***	0.042**	0.042**
				[0.020]	[0.018]	[0.020]
Firms	1,334	1,334	1,277	1,334	1,334	1,277
Firm – Years	7,139	7,139	6,748	7,139	7,139	6,748
Adj. R^2	0.667	0.701	0.699	0.667	0.701	0.699
Clusters (firms)	1,334	1,334	1,277	1,334	1,334	1,277
Dependent variable s.d.	0.217	0.217	0.193	0.217	0.217	0.193
Test variable s.d.	0.165	0.165	0.147	0.161	0.161	0.145
Panel C: 0% BONUS DEs				TFP^{OP}_{it+1}		
$CETR_{it}$	0.099***	0.065***	0.073***			
	[0.025]	[0.023]	[0.027]			
$TA.CETR_{it}$				0.102***	0.067***	0.075***
				[0.026]	[0.024]	[0.027]
Firms	1,138	1,138	1,094	1,138	1,138	1,094
Firm – Years	5,851	5,851	5,527	5,851	5,851	5,527
Adj. R^2	0.587	0.636	0.635	0.587	0.636	0.635
Clusters (firms)	1,138	1,138	1,094	1,138	1,138	1,094
Dependent variable s.d.	0.253	0.253	0.233	0.253	0.253	0.233
Test variable s.d.	0.175	0.175	0.162	0.171	0.171	0.160
Panel D: Non-dividend paying DEs				TFP^{OP}_{it+1}		
$CETR_{it}$	0.082***	0.043**	0.064***			
	[0.020]	[0.019]	[0.022]			
$TA.CETR_{it}$				0.088***	0.045**	0.069***
				[0.020]	[0.019]	[0.022]
Firms	2,017	2,017	1,894	2,017	2,017	1,894
Firm – Years	9,380	9,380	8,595	9,380	9,380	8,595
Adj. R^2	0.618	0.659	0.639	0.618	0.659	0.640
Clusters (firms)	2,017	2,017	1,894	2,017	2,017	1,894
Dependent variable s.d.	0.252	0.252	0.227	0.252	0.252	0.227
Test variable s.d.	0.177	0.177	0.156	0.170	0.170	0.152
Controls		Y	Y		Y	Y
Firm FE	Y	Y	Y	Y	Y	Y
Yr FE	Y	Y		Y	Y	
Ind-Yr FE			Y			Y

Notes: This table presents panel regressions of productivity (TFP^{OP}_{it+1}) on tax planning and control variables, separately for DEs that do not benefit from tax loss carryforwards (Panel A), DEs that do not benefit from DPAD (Panel B), DEs that do not benefit from bonus depreciation (Panel C), and DEs that do not benefit from dividend tax cuts (Panel D). In Columns (1) – (3), tax planning is measured by $CETR_{it}$. In Columns (4) – (6), tax planning is measured by $TA.CETR_{it}$. The sample consists of Compustat firms with available data to estimate Eq. (1), and the sample period spans from 1993 to 2017. Fixed effects choice varies across specifications. Robust standard errors clustered at the firm level are reported in brackets. The standard deviations of the dependent and test variables are estimated using within fixed effects variation in the respective variables. Variable definitions are available in Online Appendix B. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table C.5. Tax planning and productivity: additional covariates.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
							TFP^{OP}_{it+1}						
Additional control	$\% NED_{it}$	$Duality_{it}$	$Quasi\ Instit._{it}$	$Anti-Takeover_{it}$	$PT\ Risk_{it}$	$P.SIM_{it}$	$Man.\ Ability_{it}$	MTR_{it}	$BONUS_{kt}$	$DPAD_{klt}$	ETI_{kt}	$Markup_{it}$	All controls
Panel A:													
$CETR_{it}$	0.060***	0.060***	0.041***	0.048***	0.057***	0.051***	0.049***	0.050***	0.051***	0.053***	0.050***	0.051***	0.064**
	[0.014]	[0.014]	[0.013]	[0.009]	[0.015]	[0.010]	[0.009]	[0.009]	[0.009]	[0.010]	[0.009]	[0.009]	[0.027]
Adj. R^2	0.748	0.747	0.698	0.673	0.747	0.695	0.680	0.677	0.672	0.668	0.671	0.678	0.758
Test variable s.d.	0.153	0.153	0.155	0.166	0.149	0.163	0.166	0.165	0.166	0.166	0.166	0.166	0.137
Panel B:													
$TA.CETR_{it}$	0.059***	0.059***	0.039***	0.045***	0.058***	0.052***	0.046***	0.047***	0.049***	0.051***	0.047***	0.049***	0.058**
	[0.013]	[0.013]	[0.014]	[0.010]	[0.015]	[0.010]	[0.009]	[0.009]	[0.010]	[0.010]	[0.010]	[0.010]	[0.027]
Adj. R^2	0.748	0.747	0.698	0.673	0.747	0.695	0.680	0.677	0.672	0.668	0.671	0.678	0.757
Test variable s.d.	0.150	0.150	0.152	0.162	0.146	0.160	0.162	0.162	0.162	0.162	0.162	0.162	0.136
Firms	2,525	2,529	2,676	4,914	2,391	4,353	5,331	5,070	5,110	4,953	5,063	5,014	1,065
Firm – Years	22,216	22,235	22,486	39,741	19,096	36,443	45,123	42,495	41,102	38,405	40,601	40,820	6,351
Clusters (firms)	2,525	2,529	2,676	4,914	2,391	4,353	5,331	5,070	5,110	4,953	5,063	5,014	1,065
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Ind-Yr FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Dependent variable s.d.	0.210	0.210	0.226	0.237	0.205	0.231	0.238	0.236	0.238	0.236	0.238	0.235	0.188

Notes: This table presents panel regressions of productivity (TFP^{OP}_{it+1}) on tax planning, controls, plus other potentially confounding factors. In Panel A, tax planning is measured by $CETR_{it}$. In Panel B, tax planning is measured by $TA.CETR_{it}$. The sample consists of Compustat firms with available data to estimate Eq. (1), and the sample period spans from 1993 to 2017. The covariates vector, X_{it}, is included in all columns, but the coefficients vector, Γ, is not displayed for brevity. All columns include firm and industry-year fixed effects. Robust standard errors clustered at the firm level are reported in brackets. The standard deviations of the dependent and test variables are estimated using within fixed effects variation in the respective variables. Variable definitions are available in Online Appendix B. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table C.6. Tax planning and productivity: additional fixed effects.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
				TFP^{OP}_{it+1}				
$CETR_{it}$	0.050***	0.051***	0.051***	0.052***				
	[0.009]	[0.009]	[0.009]	[0.009]				
$TA.CETR_{it}$					0.047***	0.047***	0.048***	0.048***
					[0.009]	[0.009]	[0.009]	[0.009]
Firms	5,332	5,332	5,332	5,332	5,332	5,332	5,332	5,332
Firm – Years	45,156	45,156	45,156	45,156	45,156	45,156	45,156	45,156
Adj. R^2	0.680	0.680	0.682	0.682	0.680	0.680	0.682	0.682
Clusters (firms)	5,332	5,332	5,332	5,332	5,332	5,332	5,332	5,332
Controls	Y	Y	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y	Y	Y
Ind-Yr FE	Y	Y	Y	Y	Y	Y	Y	Y
Man. Ability-Yr FE	Y	Y	Y	Y	Y	Y	Y	Y
Profitability-Yr FE		Y	Y	Y		Y	Y	Y
Marginal Q-Yr FE			Y	Y			Y	Y
CETR-Yr FE				Y				Y
Dependent variable s.d.	0.237	0.236	0.235	0.234	0.237	0.236	0.235	0.234
Test variable s.d.	0.165	0.165	0.164	0.164	0.162	0.161	0.161	0.160

Notes: This table presents panel regressions of productivity (TFP^{OP}_{it+1}) on tax planning, control variables, and various fixed effects. In Columns (1) – (4), tax planning is measured by $CETR_{it}$. In Columns (5) – (8), tax planning is measured by $TA.CETR_{it}$. Columns (1) and (5) incorporate firm, industry-year, and $Man.\ Ability_{it}$ deciles-year fixed effects (Man. Ability-Yr FE). Columns (2) and (6) further incorporate $Profitability_{it}$ deciles-year fixed effects (Profitability-Yr FE). Columns (3) and (7) further incorporate $Marginal\ Q_{it}$ deciles-year fixed effects (Marginal Q-Yr FE). Columns (4) and (8) further incorporate $CETR_{it}$ deciles-year fixed effects (CETR-Yr FE). The sample consists of Compustat firms with available data to estimate Eq. (1), and the sample period spans from 1993 to 2017. The covariates vector, X_{it}, is included in all columns, but the coefficients vector, Γ, is not displayed for brevity. Robust standard errors clustered at the firm level are reported in brackets. The standard deviations of the dependent and test variables are estimated using within fixed effects variation in the respective variables. Variable definitions are available in Online Appendix B. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table C.7. Tax planning and productivity: Oster (2019) test.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable	TFP^{OP}_{it+1}	TFP^{OP}_{it+1}	TFP^{OP}_{it+1}	TFP^{OP}_{it+1}	TFP^{OP}_{it+1}	TFP^{OP}_{it+1}	TFP^{OP}_{it+1}	TFP^{OP}_{it+1}
Test variable	$CETR_{it}$				$TA.CETR_{it}$			
Bias-adjusted β_1	0.028	0.042	0.048	0.036	0.026	0.038	0.044	0.038
Delta	2.101	4.357	8.022	2.777	2.096	4.015	7.322	3.669
Controls	Y	Y	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y	Y	Y
Ind-Yr FE	Y	Y	Y	Y	Y	Y	Y	Y
Observable: $Marginal\ Q_{it}$		Y	Y	Y		Y	Y	Y
Observable: $Book\ Leverage_{it}$			Y	Y			Y	Y
Observable: $Firm\ Size_{it}$				Y				Y

Notes: This table presents bias-corrected β_1 coefficients from estimations of Eq. (1) using the Oster (2019) estimation methodology. In Columns (1) – (4), tax planning is measured by $CETR_{it}$. In Columns (5) – (8), tax planning is measured by $TA.CETR_{it}$. In Columns (2) – (4) and Columns (6) – (8), we assume that certain firm characteristics are fully observed. Those characteristics are growth opportunities ($Marginal\ Q_{it}$), leverage ($Book\ Leverage_{it}$), and firm size ($Firm\ Size_{it}$). The sample consists of Compustat firms with available data to estimate Eq. (1), and the sample period spans from 1993 to 2017. The covariates vector, X_{it}, is included in all columns, but the coefficients vector, Γ, is not displayed for brevity. All columns include firm and industry-year fixed effects. Variable definitions are available in Online Appendix B. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table C.8. Alternative test variables.

	(1)	(2)	(3)	(4) TFP^{OP}_{it+1}	(5)	(6)	(7)
Sample	Full	Profit	Full	Profit	Profit	Profit	Profit
$Delta/MVA_{it}$	0.703***	0.909***					
	[0.132]	[0.165]					
$Tax\ Effectiveness_{it}$			0.067***	0.048***			
			[0.014]	[0.011]			
$3YCETR_{it}$					0.050***		
					[0.012]		
$5YCETR_{it}$						0.056***	
						[0.016]	
$Shelter_{it}$							0.019***
							[0.006]
Firms	6,139	5,346	3,533	2,824	4,739	3,902	5,568
Firm – Years	56,363	45,349	31,761	24,139	41,125	35,003	47,854
Adj. R^2	0.669	0.680	0.727	0.753	0.692	0.712	0.674
Clusters (firms)	6,139	5,346	3,533	2,824	4,739	3,902	5,568
Controls	Y	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y	Y
Ind-Yr FE	Y	Y	Y	Y	Y	Y	Y
Dependent variable s.d.	0.281	0.238	0.252	0.212	0.241	0.232	0.243
Test variable s.d.	0.015	0.010	0.173	0.187	0.141	0.126	0.247

Notes: This table presents panel regressions of productivity (TFP^{OP}_{it+1}) on tax planning and control variables. In Columns (1) and (2), tax planning is measured by $Delta/MVA_{it}$. In Columns (3) and (4), tax planning is measured by $Tax\ Effectiveness_{it}$. In Column (5), tax planning is measured by $3YCETR_{it}$. In Column (6), tax planning is measured by $5YCETR_{it}$. In Column (7), tax planning is measured by $Shelter_{it}$. The sample consists of Compustat firms with available data to estimate Eq. (1), and the sample period spans from 1993 to 2017. The covariates vector, X_{it}, is included in all columns, but the coefficients vector, Γ, is not displayed for brevity. All columns include firm and industry-year fixed effects. Robust standard errors clustered at the firm level are reported in brackets. The standard deviations of the dependent and test variables are estimated using within fixed effects variation in the respective variables. Variable definitions are available in Online Appendix B. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table C.9. Alternative dependent variables.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A:	TFP_{it+1}^{WLR}	$Adjusted\ TFP_{it+1}^{OP}$	TFP_{it+1}^{LP}	TFP_{it+1}^{ACF}	$DTFP_{i,(t,t+2)}^{OP}$	$DOPM_{i,(t,t+2)}$	$Sales/Emp_{it+1}$
$CETR_{it}$	0.066***	0.046***	0.051***	0.049***	0.005***	0.023***	0.019**
	[0.008]	[0.010]	[0.010]	[0.010]	[0.000]	[0.002]	[0.010]
Adj. R^2	0.795	0.704	0.737	0.740	0.134	0.118	0.913
Test variable s.d.	0.162	0.162	0.162	0.162	0.162	0.162	0.162
Panel B:	TFP_{it+1}^{WLR}	$Adjusted\ TFP_{it+1}^{OP}$	TFP_{it+1}^{LP}	TFP_{it+1}^{ACF}	$DTFP_{i,(t,t+2)}^{OP}$	$DOPM_{i,(t,t+2)}$	$Sales/Emp_{it+1}$
$TA.CETR_{it}$	0.063***	0.044***	0.048***	0.047***	0.005***	0.021***	0.019*
	[0.008]	[0.010]	[0.010]	[0.010]	[0.000]	[0.002]	[0.010]
Adj. R^2	0.795	0.704	0.737	0.740	0.131	0.116	0.913
Test variable s.d.	0.159	0.158	0.159	0.159	0.159	0.159	0.159
Firms	4,405	4,228	4,405	4,405	4,405	4,405	4,405
Firm – Years	37,696	34,998	37,696	37,696	37,696	37,696	37,696
Clusters (firms)	4,405	4,228	4,405	4,405	4,405	4,405	4,405
Controls	Y	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y	Y
Ind-Yr FE	Y	Y	Y	Y	Y	Y	Y
Dependent variable s.d.	0.193	0.222	0.233	0.227	0.008	0.037	0.225

Notes: This table presents panel regressions of productivity on tax planning and control variables. In Panel A, tax planning is measured by $CETR_{it}$. In Panel B, tax planning is measured by $TA.CETR_{it}$. In Column (1), productivity is measured by TFP_{it+1}^{WLR}. In Column (2), productivity is measured by $Adjusted\ TFP_{it+1}^{OP}$. In Column (3), productivity is measured by TFP_{it+1}^{LP}. In Column (4), productivity is measured by TFP_{it+1}^{ACF}. In Column (5), productivity is measured by $DTFP_{i,(t,t+2)}^{OP}$. In Column (6), productivity is measured by $DOPM_{i,(t,t+2)}$. In Column (7), productivity is measured by $Sales/Emp_{it+1}$. The sample consists of Compustat firms with available data to estimate Eq. (1), and the sample period spans from 1993 to 2017. The covariates vector, X_{it}, is included in all columns, but the coefficients vector, Γ, is not displayed for brevity. All columns include firm and industry-year fixed effects. Robust standard errors clustered at the firm level are reported in brackets. The standard deviations of the dependent and test variables are estimated using within fixed effects variation in the respective variables. Variable definitions are available in Online Appendix B. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Online Appendix D – Sensitivity Analyses of New Banking Relationships

In this appendix, we provide sensitivity analyses for our first Difference-in-Differences (DD) empirical framework pertaining to the new banking relationships (NBR) setting. We start by presenting regression results from the association between NBR and production input factors. The findings in Table 3 of the paper indicate that capital and labor are, on average, complements for our sample firm-years. We predict and empirically evidence that the complementarity assumption is satisfied in our NBR framework. The results are reported in Table D.1. The DD estimator is positive and significant across columns in both panels, and implies a 0.9% – 2.0% increase in capital, and a 1.0% – 1.7% increase in labor for treated firm-banks in the post-NBR period.

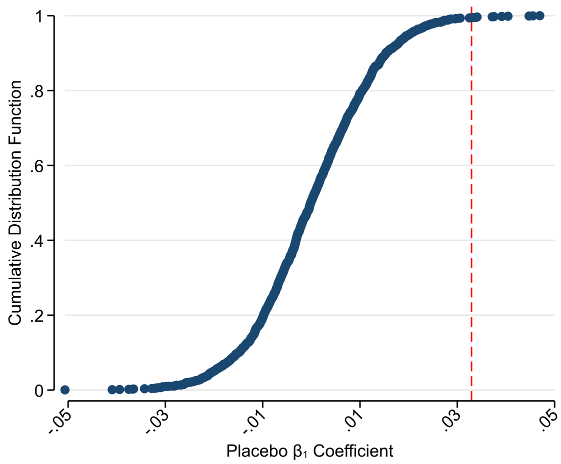
In Table D.2, we report output from estimations of Eq. (3), where we replace the dependent variable with either $TFP^{LP}_{ib,(t-2,t)}$ or $TFP^{ACF}_{ib,(t-2,t)}$. The β_1 point estimate is positively significant at the 1% level, irrespective of the dependent variable choice. The DD estimates imply that treated firm-bank pairs see a 2.4% – 4.6% productivity increase relative to control firm-bank pairs in the post-NBR period. In sum, the evidence indicates that the DD estimates are not sensitive to the TFP estimation algorithm choice. Furthermore, the DD estimates in Table D.3 indicate that observable linear trends based on firm characteristics (i.e., managerial ability, profitability, growth, and tax planning) do not seem to explain significant variation in productivity between treated and control observations around the initiation of new banking contracts.

The block permutations depicted in Fig. D.1 further provide an extensive series of placebo treatment tests on other productivity measures. For $TFP^{LP}_{ib,(t-2,t)}$, 11 out of 2,000 placebo β_1 estimates are higher that the one reported in Table D.2 Panel A Column (2), implying a nonparametric *p-value* of 0.006 ($=\frac{11}{2,000}$). Similarly, 8 out of 2,000 placebo treatment effects are higher than 0.031 (Table D.2 Panel B Column (2)) when $TFP^{ACF}_{ib,(t-2,t)}$ is the dependent variable (nonparametric *p-value* $= 0.004$). We conclude that the sensitivity tests reported in the abovementioned figure and tables mitigate concerns that functional form misspecification affects our DD framework based on the initiation of loan contracts with banks acting as tax planning intermediaries.

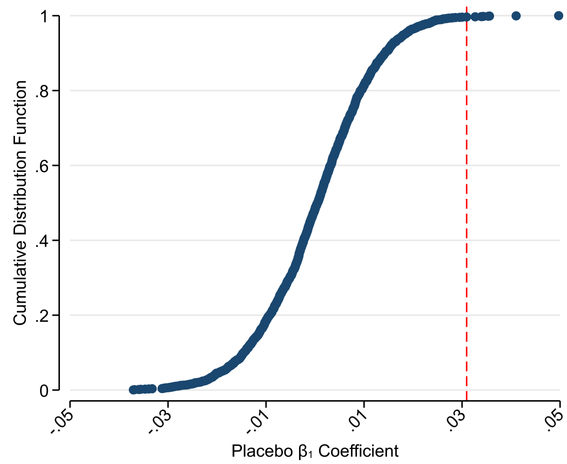
Last but not least, we follow Gallemore et al. (2019) and look at whether NBRs associate with firms' tax planning strategies. In Table D.4 we report empirical results from estimations of a DD framework where $3YCETR_{ibt}$ is the dependent variable. The DD estimator indicates that firms pairing with tax planning intermediary banks reduce the long-run cash ETR by 0.9 – 1.2 percentage points relative to control firm-banks during the post-NBR period. The DD estimator is also close in range with that documented by Gallemore et al. (2019, 0.7% - 1.1%), and indicates a $3YCETR_{ibt}$ increase of 11.11% – 12.24% in standard deviation units. Overall, banks acting as tax planning intermediaries most likely offer services that reduce clients' tax liabilities.

Fig. D.1. Placebo DD estimates of the new banking relationship initiation on firm productivity.

(A) Placebo estimates on $TFP^{LP}_{ib,(t-2,t)}$



(B) Placebo estimates on $TFP^{ACF}_{ib,(t-2,t)}$



Notes: This figure plots the empirical cumulative distribution function of 2,000 placebo DD estimators. To create the plots, we implement block permutation tests based on the procedure described in Fig. 1. In Panel A, productivity is measured by $TFP^{LP}_{ib,(t-2,t)}$. In Panel B, productivity is measured by $TFP^{ACF}_{ib,(t-2,t)}$. The vertical lines show the DD estimates reported in Table D.2 Column (2) of Panels A and B, respectively. Variable definitions are available in Online Appendix B.

Table D.1. New banking relationship: substitution vs. complementarity of production input factors.

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A:	$\Delta Capital_{ib,(t-2,t)}$					
$\mathbb{1}^{\mathbb{NBR}}(ib=T) \times \mathbb{1}^{\mathbb{NBR}}(t \geqslant 0)$	0.020***	0.013***	0.009**	0.020***	0.013**	0.009*
	[0.006]	[0.005]	[0.005]	[0.007]	[0.005]	[0.005]
Adj. R^2	0.492	0.678	0.735	0.492	0.678	0.735
Dependent variable s.d.	0.145	0.145	0.125	0.145	0.145	0.125
Panel B:	$\Delta Labor_{ib,(t-2,t)}$					
$\mathbb{1}^{\mathbb{NBR}}(ib=T) \times \mathbb{1}^{\mathbb{NBR}}(t \geqslant 0)$	0.017***	0.012***	0.010***	0.017***	0.012***	0.010***
	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.003]
Adj. R^2	0.496	0.613	0.694	0.496	0.613	0.694
Dependent variable s.d.	0.110	0.110	0.094	0.110	0.110	0.094
Firm – Banks	6,078	6,078	6,048	6,078	6,078	6,048
Firm – Bank – Years	38,925	38,925	38,591	38,925	38,925	38,591
Clusters (firm-banks / industries)	6,078	6,078	6,048	187	187	181
Controls		Y	Y		Y	Y
Year FE	Y	Y		Y	Y	
Event-Year FE	Y	Y	Y	Y	Y	Y
Firm-Bank FE	Y	Y	Y	Y	Y	Y
Ind-Year FE			Y			Y

Notes: This table shows the association between new banking relationships and production input factors. In Panel A, capital input factor is measured by $\Delta Capital_{ib,(t-2,t)}$. In Panel B, labor input factor is measured by $\Delta Labor_{ib,(t-2,t)}$. A firm-bank is defined as a treated (control) firm-bank if it established a new contract with a bank identified as a tax (nontax) planning intermediary. $\mathbb{1}^{\mathbb{NBR}}(ib=T)$ is the treatment indicator. The DD estimation window spans from five years before to five years after the initiation of the banking relationship. $\mathbb{1}^{\mathbb{NBR}}(t \geqslant 0)$ is the post-NBR indicator. $\mathbb{1}^{\mathbb{NBR}}(ib=T) \times \mathbb{1}^{\mathbb{NBR}}(t \geqslant 0)$ is the DD estimator. The covariates vector, $X_{ib,(t-2,t)}$, is included in Columns (2) – (3) and Columns (5) – (6), but the coefficients vector, Γ, is not displayed for brevity. All columns include fixed effects, but fixed effects choice varies across specifications. Robust standard errors clustered at the firm-bank or industry level are reported in brackets. The standard deviation of the dependent variable is estimated using within fixed effects variation in the variable. Variable definitions are available in Online Appendix B. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table D.2. New banking relationship: alternative dependent variables.

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A:			$TFP^{LP}_{ib,(t-2,t)}$			
$\mathbb{1}^{\mathbb{NBR}}(ib=T) \times \mathbb{1}^{\mathbb{NBR}}(t \geqslant 0)$	0.046***	0.033***	0.026***	0.046***	0.033***	0.026***
	[0.008]	[0.006]	[0.005]	[0.008]	[0.006]	[0.006]
Adj. R^2	0.833	0.915	0.933	0.833	0.915	0.933
Dependent variable s.d.	0.168	0.168	0.139	0.168	0.168	0.139
Panel B:			$TFP^{ACF}_{ib,(t-2,t)}$			
$\mathbb{1}^{\mathbb{NBR}}(ib=T) \times \mathbb{1}^{\mathbb{NBR}}(t \geqslant 0)$	0.043***	0.031***	0.024***	0.043***	0.031***	0.024***
	[0.007]	[0.005]	[0.005]	[0.008]	[0.006]	[0.006]
Adj. R^2	0.835	0.918	0.935	0.835	0.918	0.935
Dependent variable s.d.	0.162	0.162	0.133	0.162	0.162	0.133
Firm – Banks	6,078	6,078	6,048	6,078	6,078	6,048
Firm – Bank – Years	38,925	38,925	38,591	38,925	38,925	38,591
Clusters (firm-banks / industries)	6,078	6,078	6,048	187	187	181
Controls		Y	Y		Y	Y
Year FE	Y	Y		Y	Y	
Event-Year FE	Y	Y	Y	Y	Y	Y
Firm-Bank FE	Y	Y	Y	Y	Y	Y
Ind-Year FE			Y			Y

Notes: This table shows the association between new banking relationships and productivity. In Panel A, productivity is measured by $TFP^{LP}_{ib,(t-2,t)}$. In Panel B, productivity is measured by $TFP^{ACF}_{ib,(t-2,t)}$. A firm-bank is defined as a treated (control) firm-bank if it established a new contract with a bank identified as a tax (nontax) planning intermediary. $\mathbb{1}^{\mathbb{NBR}}(ib=T)$ is the treatment indicator. The DD estimation window spans from five years before to five years after the initiation of the banking relationship. $\mathbb{1}^{\mathbb{NBR}}(t \geqslant 0)$ is the post-NBR indicator. $\mathbb{1}^{\mathbb{NBR}}(ib=T) \times \mathbb{1}^{\mathbb{NBR}}(t \geqslant 0)$ is the DD estimator. The covariates vector, $X_{ib,(t-2,t)}$, is included in Columns (2) – (3) and Columns (5) – (6), but the coefficients vector, Γ, is not displayed for brevity. All columns include fixed effects, but fixed effects choice varies across specifications. Robust standard errors clustered at the firm-bank or industry level are reported in brackets. The standard deviation of the dependent variable is estimated using within fixed effects variation in the variable. Variable definitions are available in Online Appendix B. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table D.3. New banking relationship: additional fixed effects.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$TFP^{OP}_{ib,(t-2,t)}$							
$\mathbb{1}^{\mathbb{NBR}}(ib=T)\times\mathbb{1}^{\mathbb{NBR}}(t\geqslant 0)$	0.018***	0.017***	0.017***	0.017***	0.018***	0.017***	0.017***	0.017***
	[0.005]	[0.005]	[0.005]	[0.005]	[0.006]	[0.005]	[0.005]	[0.005]
Firm – Banks	5,484	5,484	5,484	5,484	5,484	5,484	5,484	5,484
Firm – Bank – Years	36,540	36,540	36,540	36,540	36,540	36,540	36,540	36,540
Adj. R^2	0.925	0.926	0.926	0.927	0.925	0.926	0.926	0.927
Clusters (firm-banks/industries)	5,484	5,484	5,484	5,484	177	177	177	177
Controls	Y	Y	Y	Y	Y	Y	Y	Y
Firm-Bank FE	Y	Y	Y	Y	Y	Y	Y	Y
Event-Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Ind-Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Man. Ability-Yr FE	Y	Y	Y	Y	Y	Y	Y	Y
Profitability-Yr FE		Y	Y	Y		Y	Y	Y
Marginal Q-Yr FE			Y	Y			Y	Y
CETR-Yr FE				Y				Y
Dependent variable s.d.	0.127	0.126	0.125	0.123	0.127	0.126	0.125	0.123

Notes: This table shows the association between new banking relationships and productivity ($TFP^{OP}_{ib,(t-2,t)}$). A firm-bank is defined as a treated (control) firm-bank if it established a new contract with a bank identified as a tax (nontax) planning intermediary. $\mathbb{1}^{\mathbb{NBR}}(ib=T)$ is the treatment indicator. The DD estimation window spans from five years before to five years after the initiation of the banking relationship. $\mathbb{1}^{\mathbb{NBR}}(t\geqslant 0)$ is the post-NBR indicator. $\mathbb{1}^{\mathbb{NBR}}(ib=T)\times\mathbb{1}^{\mathbb{NBR}}(t\geqslant 0)$ is the DD estimator. The covariates vector, $X_{ib,(t-2,t)}$, is included in all columns, but the coefficients vector, Γ, is not displayed for brevity. All columns include fixed effects, but fixed effects choice varies across specifications. Columns (1) and (5) incorporate firm-bank, event-year, industry-year, and $Man.\ Ability_{it}$ deciles-year fixed effects (Man. Ability-Yr FE). Columns (2) and (6) further incorporate $Profitability_{it}$ deciles-year fixed effects (Profitability-Yr FE). Columns (3) and (7) further incorporate $Marginal\ Q_{it}$ deciles-year fixed effects (Marginal Q-Yr FE). Columns (4) and (8) further incorporate $CETR_{it}$ deciles-year fixed effects (CETR-Yr FE). Robust standard errors clustered at the firm-bank or industry level are reported in brackets. The standard deviation of the dependent variable is estimated using within fixed effects variation in the variable. Variable definitions are available in Online Appendix B. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table D.4. New banking relationship: tax planning responses.

	(1)	(2)	(3)	(4)	(5)	(6)
			$3YCETR_{ibt}$			
$\mathbb{1}^{\mathbb{NBR}}(ib=T)\times\mathbb{1}^{\mathbb{NBR}}(t\geqslant 0)$	0.012**	0.011**	0.009*	0.012**	0.011**	0.009*
	[0.005]	[0.005]	[0.005]	[0.005]	[0.005]	[0.005]
Firm – Banks	4,969	4,969	4,896	4,969	4,969	4,896
Firm – Bank – Years	23,365	23,365	22,865	23,365	23,365	22,865
Adj. R^2	0.496	0.505	0.605	0.496	0.505	0.605
Clusters (firm-banks / industries)	4,969	4,969	4,896	182	182	171
Controls		Y	Y		Y	Y
Year FE	Y	Y		Y	Y	
Event-Year FE	Y	Y	Y	Y	Y	Y
Firm-Bank FE	Y	Y	Y	Y	Y	Y
Ind-Year FE			Y			Y
Dependent variable s.d.	0.098	0.098	0.081	0.098	0.098	0.081

Notes: This table shows the association between new banking relationships and tax planning ($3YCETR_{ibt}$). A firm-bank is defined as a treated (control) firm-bank if it established a new contract with a bank identified as a tax (nontax) planning intermediary. $\mathbb{1}^{\mathbb{NBR}}(ib=T)$ is the treatment indicator. The DD estimation window spans from five years before to five years after the initiation of the banking relationship. $\mathbb{1}^{\mathbb{NBR}}(t\geqslant 0)$ is the post-NBR indicator. $\mathbb{1}^{\mathbb{NBR}}(ib=T)\times\mathbb{1}^{\mathbb{NBR}}(t\geqslant 0)$ is the DD estimator. The covariates vector is taken from Table 2 of Dyreng et al. (2022) and averaged over a three-year period to match the measurement period of $3YCETR_{ibt}$. The covariates vector is included in Columns (2) – (3) and Columns (5) – (6), but the coefficients vector, Γ, is not displayed for brevity. All columns include fixed effects, but fixed effects choice varies across specifications. Robust standard errors clustered at the firm-bank or industry level are reported in brackets. The standard deviation of the dependent variable is estimated using within fixed effects variation in the variable. Variable definitions are available in Online Appendix B. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Online Appendix E – Sensitivity Analyses of Check-the-Box

In this appendix, we discuss additional analyses that assess the sensitivity of the Check-the-Box (CTB) identification strategy to specification parameters. First, we inspect the complementarity between the two production function inputs, capital and labor. In Panel A (B) of Table E.1, we examine the relative physical capital (labor) responses of treated and control firms to CTB. The DD estimator is strongly and positively significant for both production factors. Hence, the evidence indicates that treated firms responded to the introduction of CTB by increasing both capital and labor, reinforcing the conclusion derived from the evidence in Table 3 of the paper that production process factors complement each other.

Second, in Table E.2, we report results from estimations of Eq. (5) where the dependent variable is either TFP_{it}^{LP} or TFP_{it}^{ACF}. The DD estimator is positive, significant at conventional levels, and economically meaningful. The point estimates indicate that the productivity of treated firms, based on TFP_{it}^{LP} (TFP_{it}^{ACF}), increased in the post-CTB period by 3.2% – 4.0% (2.5% – 3.3%) relative to the productivity of control firms. The increase represents 16.75% – 22.47% (13.74% – 19.53%) of the within fixed effects standard deviation of TFP_{it}^{LP} (TFP_{it}^{ACF}).

Third, we incorporate managerial ability, profitability, growth, and tax planning trends in our identification framework, Eq. (5). The results are reported in Table E.3. In Column (4) of the table, where we simultaneously incorporate the four trends, the DD estimate is 0.039 (significant at the 1% level), representing a 39.29% ($=\frac{0.039-0.028}{0.028}$) increase in the regulations' magnitude compared to the DD estimate in Column (3) of Table 5. Hence, differential trends with respect to firm characteristics appear to bias the β_1 estimate in our DD framework downwards.

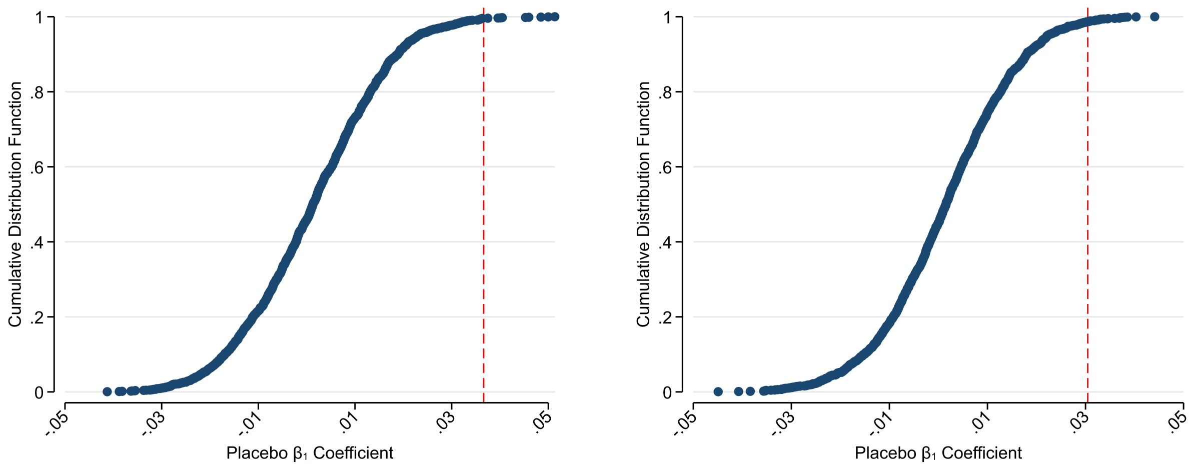
In Fig. E.1, we implement block permutation tests on Eq. (5), where TFP_{it}^{OP} is replaced with TFP_{it}^{LP} or TFP_{it}^{ACF}. For TFP_{it}^{LP}, only 9 out of 2,000 placebo treatment effects are higher than 0.037, the DD coefficient in Table E.2 Panel A Column (2). This finding suggests a 0.005 ($=\frac{9}{2{,}000}$) nonparametric *p-value* on TFP_{it}^{LP}. Similarly, 1,972 out of 2,000 placebo treatment effects are lower than 0.030, the DD point estimate in Table E.2 Panel B Column (2), implying a nonparametric *p-value* of 0.014 ($=\frac{28}{2{,}000}$) on TFP_{it}^{ACF}. Overall, the evidence from block permutation tests on productivity measures derived from alternative estimation algorithms (i) is consistent with the evidence in Fig. 2 Panel B, (ii) corroborates the notion in Table E.3 that unobservable trends probably do not drive our findings, and (iii) provides a number of placebo tests on the effect of CTB on alternative productivity measures.

Finally, we examine the tax planning responses of treated vs. control firms to the introduction of CTB. We report evidence from estimations of a DD framework where $CETR_{it}$ is the dependent variable in Table E.4. Based on the reported DD estimators, treated firms reduce the cash ETR by 1.7 – 2.2 percentage points relative to control firms during the post-1997 period. The magnitudes indicate a $CETR_{it}$ increase of 10.69% – 15.49% in standard deviation units, and are consistent with magnitudes reported in Dyreng et al. (2022).[2] Hence, we conclude that sampled multinationals are more likely to increase tax planning compared to domestic firms in response to CTB regulations.

[2] In untabulated analyses, we also find that the global tax race-to-the-bottom during the late 1990s does not impact treated firms' productivity and tax planning responses to CTB.

Fig. E.1. Placebo effect of Check-the-Box on firm productivity.

(A) Placebo effects on TFP_{it}^{LP} **(B)** Placebo effects on TFP_{it}^{ACF}



Notes: This figure plots the empirical cumulative distribution function of 2,000 placebo DD estimators. To create the plots, we implement block permutation tests based on the procedure described in Fig. 2. In Panel A, productivity is measured by TFP_{it}^{LP}. In Panel B, productivity is measured by TFP_{it}^{ACF}. The vertical lines show the DD estimates reported in Table E.2 Column (2) of Panels A and B, respectively. Variable definitions are available in Online Appendix B.

Table E.1. Check-the-Box: substitution vs. complementarity of production input factors.

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A:	$\Delta Capital_{it}$					
$\mathbb{1}^{\mathbb{CTB}}(i=T) \times \mathbb{1}^{\mathbb{CTB}}(t \geqslant 1997)$	0.035***	0.022***	0.033***	0.035***	0.022***	0.033***
	[0.010]	[0.008]	[0.009]	[0.009]	[0.008]	[0.009]
Adj. R^2	0.209	0.471	0.485	0.209	0.471	0.485
Dependent variable s.d.	0.258	0.258	0.245	0.258	0.258	0.245
Panel B:	$\Delta Labor_{it}$					
$\mathbb{1}^{\mathbb{CTB}}(i=T) \times \mathbb{1}^{\mathbb{CTB}}(t \geqslant 1997)$	0.026***	0.025***	0.021***	0.026***	0.025***	0.021**
	[0.007]	[0.007]	[0.008]	[0.008]	[0.008]	[0.010]
Adj. R^2	0.195	0.319	0.338	0.195	0.319	0.338
Dependent variable s.d.	0.202	0.202	0.191	0.202	0.202	0.191
Firms	4,215	4,215	4,212	4,215	4,215	4,212
Firm – Years	22,242	22,242	22,217	22,242	22,242	22,217
Clusters (firms/industries)	4,215	4,215	4,212	185	185	184
Controls		Y	Y		Y	Y
Yr FE	Y	Y		Y	Y	
Firm FE	Y	Y	Y	Y	Y	Y
Ind-Yr FE			Y			Y

Notes: This table shows the effect of Check-the-Box on production input factors. In Panel A, capital input factor is measured by $\Delta Capital_{it}$. In Panel B, labor input factor is measured by $\Delta Labor_{it}$. A firm is defined as a treated (control) firm if it reports non-zero (zero) pre-tax foreign income before and after 1997. $\mathbb{1}^{\mathbb{CTB}}(i=T)$ is the treatment indicator. The DD estimation window spans from five years before to five years after the introduction of the regulations. $\mathbb{1}^{\mathbb{CTB}}(t \geqslant 1997)$ is the post-CTB indicator. $\mathbb{1}^{\mathbb{CTB}}(i=T) \times \mathbb{1}^{\mathbb{CTB}}(t \geqslant 1997)$ is the DD estimator. The covariates vector, X_{it}, is included in Columns (2) – (3) and Columns (5) – (6), but the coefficients vector, Γ, is not displayed for brevity. All columns include fixed effects, but fixed effects choice varies across specifications. Robust standard errors clustered at the firm or industry level are reported in brackets. The standard deviations of the dependent variables are estimated using within fixed effects variation in the respective variables. Variable definitions are available in Online Appendix B. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table E.2. Check-the-Box: alternative dependent variables.

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A:	TFP_{it}^{LP}					
$\mathbb{1}^{\mathbb{CTB}}(i=T) \times \mathbb{1}^{\mathbb{CTB}}(t \geqslant 1997)$	0.032***	0.037***	0.040***	0.032**	0.037***	0.040***
	[0.011]	[0.008]	[0.010]	[0.013]	[0.010]	[0.010]
Adj. R^2	0.763	0.874	0.878	0.763	0.874	0.878
Dependent variable s.d.	0.191	0.191	0.178	0.191	0.191	0.178
Panel B:	TFP_{it}^{ACF}					
$\mathbb{1}^{\mathbb{CTB}}(i=T) \times \mathbb{1}^{\mathbb{CTB}}(t \geqslant 1997)$	0.025**	0.030***	0.033***	0.025*	0.030***	0.033***
	[0.010]	[0.008]	[0.009]	[0.013]	[0.009]	[0.010]
Adj. R^2	0.753	0.870	0.874	0.753	0.870	0.874
Dependent variable s.d.	0.182	0.182	0.169	0.182	0.182	0.169
Firms	4,215	4,215	4,212	4,215	4,215	4,212
Firm – Years	22,242	22,242	22,217	22,242	22,242	22,217
Clusters (firms/industries)	4,215	4,215	4,212	185	185	184
Controls		Y	Y		Y	Y
Yr FE	Y	Y		Y	Y	
Firm FE	Y	Y	Y	Y	Y	Y
Ind-Yr FE			Y			Y

Notes: This table shows the effect of Check-the-Box on productivity. In Panel A, productivity is measured by TFP_{it}^{LP}. In Panel B, productivity is measured by TFP_{it}^{ACF}. A firm is defined as a treated (control) firm if it reports non-zero (zero) pre-tax foreign income before and after 1997. $\mathbb{1}^{\mathbb{CTB}}(i=T)$ is the treatment indicator. The DD estimation window spans from five years before to five years after the introduction of the regulations. $\mathbb{1}^{\mathbb{CTB}}(t \geqslant 1997)$ is the post-CTB indicator. $\mathbb{1}^{\mathbb{CTB}}(i=T) \times \mathbb{1}^{\mathbb{CTB}}(t \geqslant 1997)$ is the DD estimator. The covariates vector, X_{it}, is included in Columns (2) – (3) and Columns (5) – (6), but the coefficients vector, Γ, is not displayed for brevity. All columns include fixed effects, but fixed effects choice varies across specifications. Robust standard errors clustered at the firm or industry level are reported in brackets. The standard deviations of the dependent variables are estimated using within fixed effects variation in the respective variables. Variable definitions are available in Online Appendix B. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table E.3. Check-the-Box: additional fixed effects.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	TFP_{it}^{OP}							
$\mathbb{1}^{\mathbb{CTB}}(i=T) \times \mathbb{1}^{\mathbb{CTB}}(t \geqslant 1997)$	0.028***	0.034***	0.037***	0.039***	0.028***	0.034***	0.037***	0.039***
	[0.008]	[0.008]	[0.008]	[0.008]	[0.010]	[0.010]	[0.010]	[0.010]
Firms	3,407	3,407	3,407	3,407	3,407	3,407	3,407	3,407
Firm – Years	19,701	19,701	19,701	19,701	19,701	19,701	19,701	19,701
Adj. R^2	0.862	0.863	0.864	0.864	0.862	0.863	0.864	0.864
Clusters (firms/industries)	3,407	3,407	3,407	3,407	179	179	179	179
Controls	Y	Y	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y	Y	Y
Ind-Yr FE	Y	Y	Y	Y	Y	Y	Y	Y
Man. Ability-Yr FE	Y	Y	Y	Y	Y	Y	Y	Y
Profitability-Yr FE		Y	Y	Y		Y	Y	Y
Marginal Q-Yr FE			Y	Y			Y	Y
CETR-Yr FE				Y				Y
Dependent variable s.d.	0.158	0.156	0.156	0.155	0.158	0.156	0.156	0.155

Notes: This table shows the effect of Check-the-Box on productivity (TFP_{it}^{OP}). A firm is defined as a treated (control) firm if it reports non-zero (zero) pre-tax foreign income before and after 1997. $\mathbb{1}^{\mathbb{CTB}}(i=T)$ is the treatment indicator. The DD estimation window spans from five years before to five years after the introduction of the regulations. $\mathbb{1}^{\mathbb{CTB}}(t \geqslant 1997)$ is the post-CTB indicator. $\mathbb{1}^{\mathbb{CTB}}(i=T) \times \mathbb{1}^{\mathbb{CTB}}(t \geqslant 1997)$ is the DD estimator. The covariates vector, X_{it}, is included in all columns, but the coefficients vector, Γ, is not displayed for brevity. All columns include fixed effects, but fixed effects choice varies across specifications. Columns (1) and (5) incorporate firm, industry-year, and $Man.\ Ability_{it}$ deciles-year fixed effects (Man. Ability-Yr FE). Columns (2) and (6) further incorporate $Profitability_{it}$ deciles-year fixed effects (Profitability-Yr FE). Columns (3) and (7) further incorporate $Marginal\,Q_{it}$ deciles-year fixed effects (Marginal Q-Yr FE). Columns (4) and (8) further incorporate $CETR_{it}$ deciles-year fixed effects (CETR-Yr FE). Robust standard errors clustered at the firm or industry level are reported in brackets. The standard deviation of the dependent variable is estimated using within fixed effects variation in the variable. Variable definitions are available in Online Appendix B. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

Table E.4. Check-the-Box: tax planning responses.

	(1)	(2)	(3)	(4)	(5)	(6)
			$CETR_{it}$			
$\mathbb{1}^{\mathbb{CTB}}(i=T)\times\mathbb{1}^{\mathbb{CTB}}(t\geqslant 1997)$	0.021***	0.017**	0.022***	0.021***	0.017**	0.022***
	[0.007]	[0.007]	[0.008]	[0.007]	[0.007]	[0.008]
Firms	3,892	3,892	3,888	3,892	3,892	3,888
Firm – Years	17,808	17,808	17,735	17,808	17,808	17,735
Adj. R^2	0.289	0.309	0.309	0.289	0.309	0.309
Clusters (firms/industries)	3,892	3,892	3,888	185	185	184
Controls		Y	Y		Y	Y
Yr FE	Y	Y		Y	Y	
Firm FE	Y	Y	Y	Y	Y	Y
Ind-Yr FE			Y			Y
Dependent variable s.d.	0.149	0.149	0.141	0.149	0.149	0.141

Notes: This table shows the effect of Check-the-Box on tax planning ($CETR_{it}$). A firm is defined as a treated (control) firm if it reports non-zero (zero) pre-tax foreign income before and after 1997. $\mathbb{1}^{\mathbb{CTB}}(i=T)$ is the treatment indicator. The DD estimation window spans from five years before to five years after the introduction of the regulations. $\mathbb{1}^{\mathbb{CTB}}(t\geqslant 1997)$ is the post-CTB indicator. $\mathbb{1}^{\mathbb{CTB}}(i=T)\times\mathbb{1}^{\mathbb{CTB}}(t\geqslant 1997)$ is the DD estimator. The covariates vector is taken from Table 2 of Dyreng et al. (2022). The covariates vector is included in Columns (2) – (3) and Columns (5) – (6), but the coefficients vector, $\mathit{\Gamma}$, is not displayed for brevity. All columns include fixed effects, but fixed effects choice varies across specifications. Robust standard errors clustered at the firm or industry level are reported in brackets. The standard deviation of the dependent variable is estimated using within fixed effects variation in the variable. Variable definitions are available in Online Appendix B. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

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