Productivity Growth Slowdown and MNE's Intangibles: where is productivity measured?

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Motivation

3 important phenomena in many advanced countries:

1. Aggregate productivity growth slowdown
2. Tax avoidance by multinational firms
3. Digitalization of the economy and the rise of intangible capital

Common denominator to these three issues: the measurement of value creation and of productivity both at the **micro** and **macro** level.

- Irish case in 2015 following MNEs' relocation of IPR: GDP annual growth in 2015 was revised from an expected 7.8% to 26%, exports were revised up by 50 billion euro and the net IIP was revised from expected –150 to –532 billion euro.

Evolution of ALP in France

Figure: ALP levels

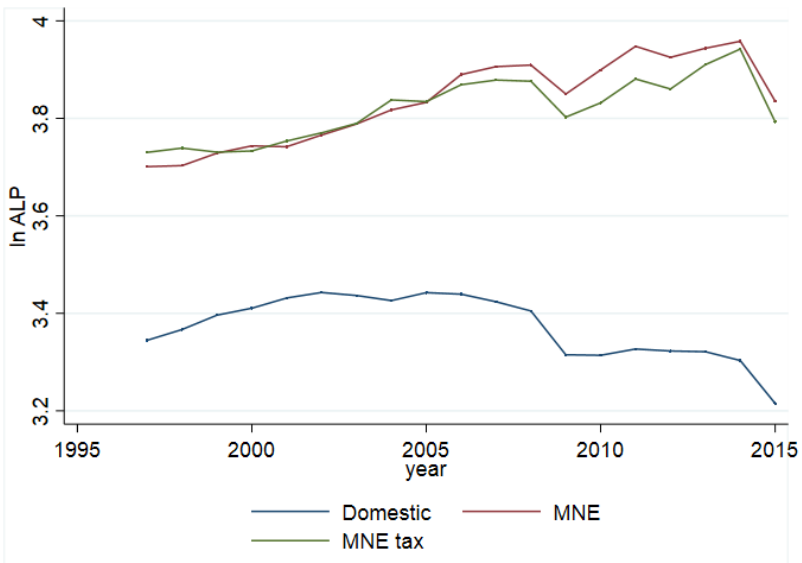
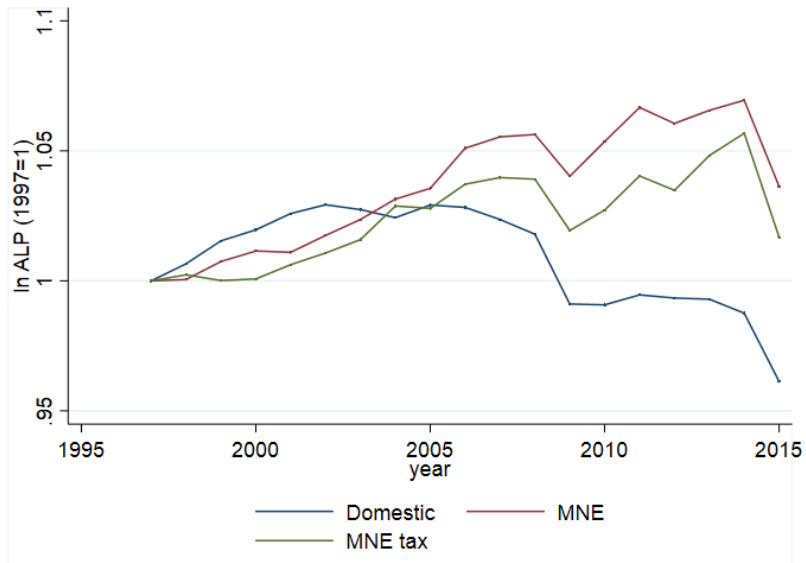


Figure: ALP growth



- Tax haven MNEs ALP growth appears to be systematically lower than that of MNEs and the gap widens around 2005.

TFP | Global race to the bottom

This Paper

Use universe of French firms 1997-2015 to examine the role of MNEs' presence in tax havens and use of intangible capital in shaping productivity at the micro and aggregate level.

- Does profit shifting contribute to the aggregate productivity slowdown in France 97-15? Is the effect concentrated among intangible intensive firms?

Mechanism: When firms shift their profits, thanks to location of their profits in low tax jurisdictions their productivity levels and growth are distorted $\rightarrow$ underestimated in the home country.

Theory

Preview of Findings

1. Tax havens presence of French firms is statistically significantly related to lower productivity at the micro-level (3.5%)[1]

2. This effect is magnified for firms relying more on intangible capital (4.1% high vs 2.7% low)

3. Strong dynamic effect (12% after 10 years)

4. Given these firms' weight in the economy, our results imply an annual loss of 9.5% in terms of the aggregate annual labor productivity growth.

[1] 1.5% for the level of TFP

Related literature

1. Productivity growth slowdown explanations (not mutually exclusive)
   - Demand secular stagnation: low investment (Summers (2014), Geerolf (2019)).
   - Supply secular stagnation: decline in the rhythm of technological progress (Gordon (2016)).
   - Mismeasurement: N.A. systems fail to measure intangible capital, product quality changes, creative destruction or activities enabled by the digitalization (Aghion et al. (2017), Haskel and Westlake (2016))

2. Tax avoidance is good suspect
   - visible at the macro-level (Zucman (2013))
   - driven by the happy few (Davies et al. (2018), Martin et al. (2020))
   - fueled by (but not limited to) firms relying intensively in intangible capital (OECD (2019), Laffitte et al. (2019))

Related literature (2/2)

- Closest related work is Guvenen et al. (2017) quantify contribution of US MNEs offshore profit shifting to the slowdown of aggregate productivity.[1]
  - MNEs' PS raises productivity growth annually by 0.09% for 1994-2004 and by 0.24% annually for 2004-2008.
  - R&D sectors: 0.53% increase for 2000-2008.

[1] *Using a formulary apportionment* technique.

Data sources

French yearly firm-level bilateral financial linkages and firm characteristics over 1997-2015.

FICUS-FARE : Firm-year balance-sheet data (employment, inputs, sales, wages, value added, etc).

LIFI : Firm-year-country foreign affiliates and foreign parents in each country.

DADS : Firm-year share of skilled labor.

IMF Tax havens : Country dummy for tax haven.

- Working dataset: keep firms with foreign parent or own an affiliate abroad at least twice over the period 1997-2015 $\rightarrow$ unbalanced panel of 37 995 MNEs firms Transitions

List of tax havens

Descriptive statistics (1/2)

Table: Firms' characteristics

	Domestic	MNE non tax haven	MNE Tax haven	Mean	Median
ln TFP	-0.03	0.11	0.09	-0.03	-0.02
Labor productivity	36.65	62.03	63.62	37.00	30.10
Employees	10	154	371	13	3
Sales	1 758	44 114	73 454	2 503	285
Intangible shares	0.24	0.21	0.23	0.24	0.07
Share of skilled workers	0.07	0.27	0.26	0.06	0.00
Export intensity	0.02	0.20	0.18	0.02	0.00
N firms	2 302 261	33 302	18 490	-	-
N obs	17 555 154	178 269	79 724	-	-

Note: Sales in thousand euro, Labor productivity (ALP) is real value added per hours worked. ln TFP is constructed based on an index number approach (Caves et al. 1982).
Source: Author's calculations based on FICUS-FARE, DADS and LIFI.

Measuring productivity

- 2 measures of productivity used sake of robustness

1. *Apparent Labor Productivity* (ALP): is defined as the log-ratio of real value added on the average number of hours worked.

$$\ln ALP_{it} = \ln \left(\frac{V_{it}}{L_{it}} \right)$$

2. *Total Factor Productivity* (TFP): index number approach, which is a non-parametric estimation (Caves et al. (1982)).

TFP description

- ALP privileged: less data demanding and better suited for micro-macro effect

Empirical model 1: identification from pure within-firm variation over time

$$\begin{aligned} \textit{ln Prod}_{fst} =& \beta_1\, 1[\textit{MNE}_{ft}] + \beta_2\, 1[\textit{Tax haven}_{ft}] \\ &+ \beta_3\, 1[\textit{Tax haven}_{ft}] \times 1[\textit{Intansh}_f \geq p50\ \textit{Intansh}] \\ &+ \alpha\, Z_{ft}^{'} + \delta_f + \delta_{st} + \epsilon_{ft} \end{aligned} \tag{1}$$

In equation (1) and equation (2):

- $1[\textit{Tax haven}_{ft}] = \begin{cases} 1, & \text{if foreign presence in a tax haven in year } t \\ 0, & \text{otherwise} \end{cases}$
- $Z_{ft}^{'}$ = time-varying firm-level controls[1], δ_f and δ_{st} = firm and 2 dig. sector $\times$ year fixed effects

[1] Mean reversion control, share of skilled labor, num. of affiliates and export intensity.

Empirical model 1: Baseline results

	(1) ln ALP	(2) ln ALP	(3) ln ALP
$ln\ ALP_{f,1} \times firm\ trend_{ft}$	0.0082^a	-0.0246^a	-0.0246^a
	(0.0001)	(0.0004)	(0.0004)
$1[MNE_{ft}]$	0.0552^a	0.0057^b	0.0056^b
	(0.0020)	(0.0021)	(0.0021)
Share skilled$_{ft}$	0.7361^a	0.1514^a	0.1515^a
	(0.0051)	(0.0070)	(0.0070)
Num. Affiliates$_{ft}$	0.0040^a	0.0018^a	0.0018^a
	(0.0004)	(0.0004)	(0.0004)
$1[Tax\ haven_{ft}]$	-0.0453^a	-0.0357^a	-0.0269^a
	(0.0038)	(0.0039)	(0.0056)
$1[Tax\ haven_{ft}] \times 1[Intansh_f \geq p50\ Intansh]$			-0.0144^b
			(0.0071)
Observations	390695	389829	389829
Adjusted R^2	0.306	0.661	0.661
Firm FE	No	Yes	Yes
2-dig. sector X year FE	Yes	Yes	Yes

Standard errors in parentheses

All regressions include time-varying firm controls, robust standard errors in parentheses

^{c} $p < 0.10$, ^{b} $p < 0.05$, ^{a} $p < 0.001$

Interpretation

- Column (1): Firms who have a presence (parent or an affiliate) in a tax haven display a lower measured productivity in France than firms who are not in a tax haven (-4.4% for ALP and -1.1% for TFP)
- Column (2): Presence in a tax haven translates into lower apparent domestic productivity levels compared the period before the entry: (-3.5% for ALP and -1.2% with TFP)
- Column (3): the level of ALP is reduced by 4.1% when a firm becomes a tax haven MNE and belongs to the high intangibles intensive group, while it is on average reduced by 2.7% for a firm whose intangible intensity is below the sample median

Empirical model 2: estimating dynamic effects

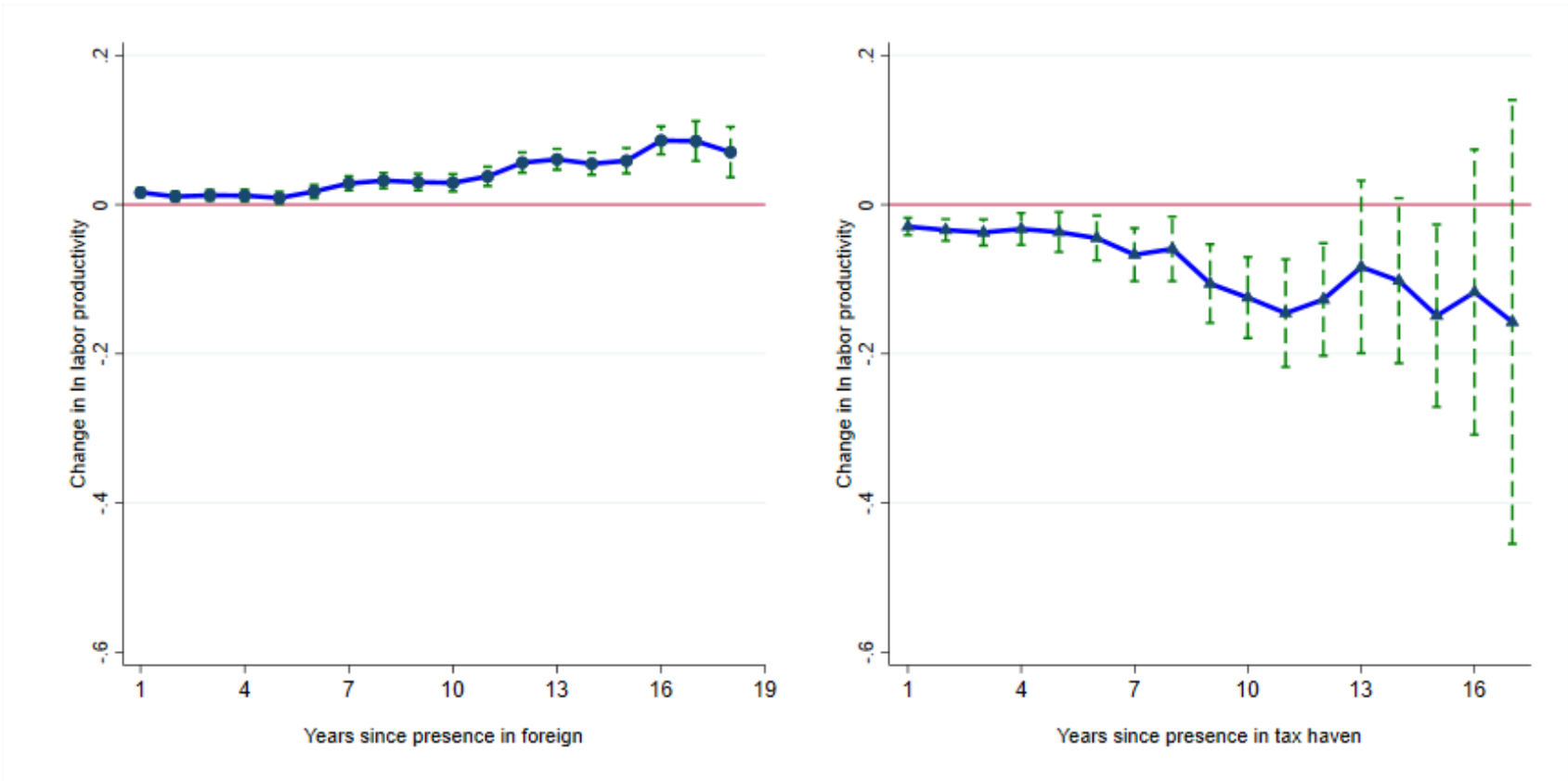
Allow the impact to vary with the number of years of the tax haven presence to explore the dynamic on firm productivity as follows,

$$\begin{aligned} ln\ Prod_{fst} = &\sum_{t=1}^{T} \lambda_t\ 1[MNE_{ft}] + \sum_{t=1}^{T} \theta_t\ 1[Tax\ haven_{ft}] \\ &+ \alpha\ Z_{ft}^{'} + \ \delta_f + \delta_{st} + \epsilon_{ft} \end{aligned} \tag{2}$$

- where $\sum_{t=1}^{T} 1[MNE_{ft}]$ is a set of dummy variables taking the value of 1 if the firm is a MNE in $t = 1$ and 0 otherwise.
- $\sum_{t=1}^{T} 1[Tax\ haven_{ft}]$ is a set of dummy variables indicating whether the firm is present in a tax haven in year=1, in year=2, in year=3 and so on.

Empirical model 2: point estimates

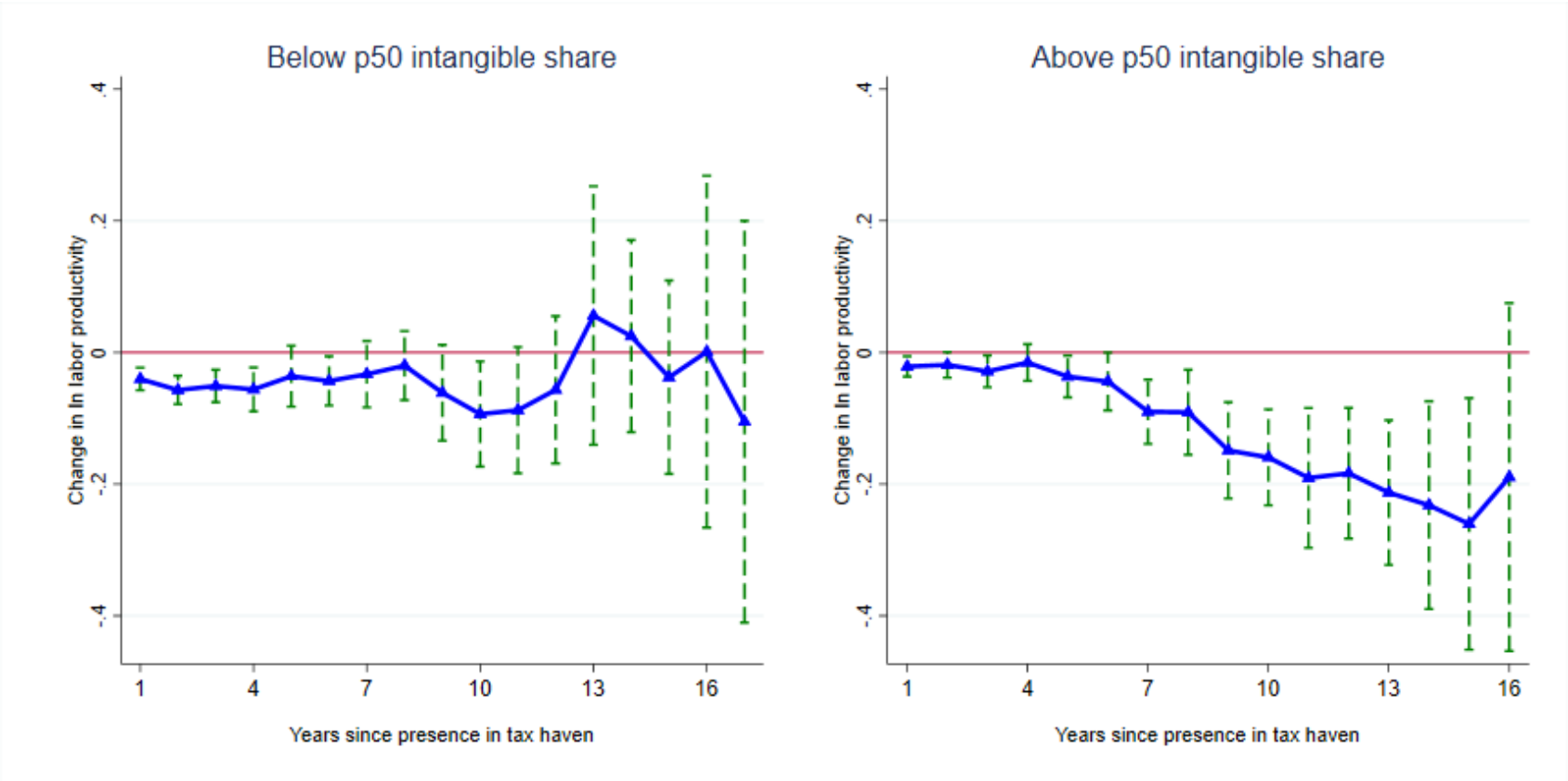
Figure: Foreign Presence and Labor Productivity Dynamics



Note: Plot of estimated coefficients of year dummies indicating MNE presence and MNE tax haven presence (solid blue line) and the corresponding CI (dashed green lines).

Empirical model 2: point estimates

Figure: Foreign Presence, Intangibles and Labor Productivity Dynamics



Note: Plot of estimated coefficients of year dummies indicating MNE presence and MNE tax haven presence (solid blue line) and the corresponding CI (dashed green lines).

TFP

Robustness: Placebo test

Re-estimate equation 1 and randomly setting the tax haven dummy.

	(1) ln ALP	(2) ln ALP	(3) ln ALP
$ln\ ALP_{f,1} \times firm\ trend_{ft}$	0.0082^a	-0.0246^a	-0.0246^a
	(0.0001)	(0.0004)	(0.0004)
$1[MNE_{ft}]$	0.0483^a	-0.0006	-0.0006
	(0.0019)	(0.0020)	(0.0020)
Share skilled$_{ft}$	0.7376^a	0.1516^a	0.1516^a
	(0.0051)	(0.0070)	(0.0070)
Num. Affiliates$_{ft}$	0.0039^a	0.0018^a	0.0018^a
	(0.0004)	(0.0004)	(0.0004)
$1[Tax\ haven\ placebo_{ft}]$	-0.0009	-0.0011	0.0025
	(0.0035)	(0.0026)	(0.0038)
$1[Tax\ haven\ Placebo_{ft}] \times 1[Intansh_f \geq p50\ Intansh]$			-0.0062
			(0.0052)
Observations	390695	389829	389829
Adjusted R^2	0.306	0.661	0.661
Firm FE	No	Yes	Yes
2-dig. sector X year FE	Yes	Yes	Yes

Standard errors in parentheses

All regressions include time-varying firm controls, robust standard errors in parentheses

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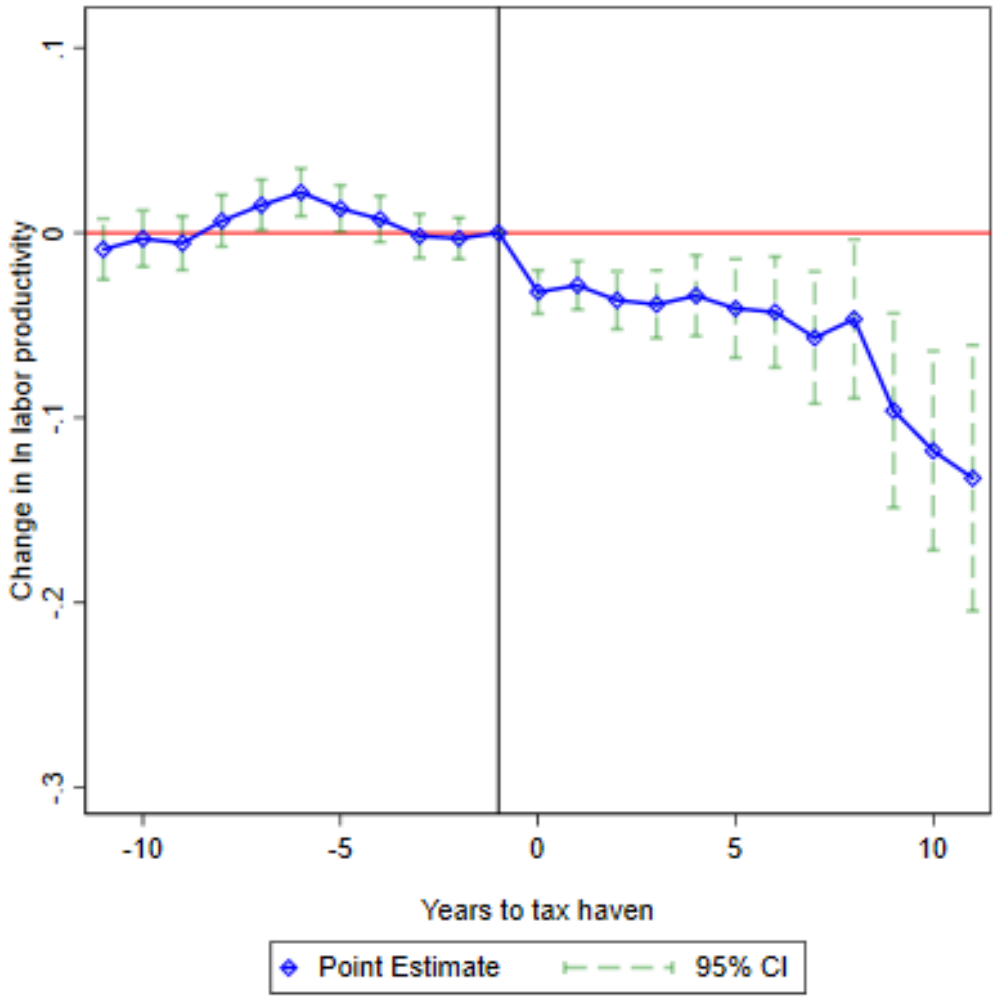
TFP

Robustness: Testing parallel pre-trends



Note: Plot of estimated coefficients of year dummies indicating the distance to the event of interest: entry into tax haven.

TFP

From micro to macro: quantifying the productivity growth lost in tax havens

DOPD

- Step 1: compute the observed change in aggregate productivity over the period.

$$\Delta Prod_{97-15} = \sum_{i \in NT,15} (\omega_{i,15}^{NT} Prod_{i,15}^{NT}) - \sum_{i \in NT,97} (\omega_{i,97}^{NT} Prod_{i,97}^{NT}) + \sum_{i \in TH,15} (\omega_{i,15}^{TH} Prod_{i,15}^{TH}) - \sum_{i \in TH,97} (\omega_{i,97}^{TH} Prod_{i,97}^{TH})$$

- Step 2: compute predicted change in aggregate productivity which should have occurred had not MNEs had a presence in tax havens

$$\widehat{\Delta Prod}_{97-15} = \sum_{i \in NT,15} (\omega_{i,15}^{NT} Prod_{i,15}^{NT}) - \sum_{i \in NT,97} (\omega_{i,97}^{NT} Prod_{i,97}^{NT}) + \sum_{i \in TH,15} \omega_{i,15}^{TH} \underbrace{Prod_{i,15}^{TH}}_{\text{observed}} \underbrace{[1 + |exp(\widehat{\beta}^{TH}) - 1|]}_{\text{predicted gain}} - \sum_{i \in TH,97} (\omega_{i,97}^{TH} Prod_{i,97}^{TH})$$

Aggregate effects

- Step 3: estimation of the loss of aggregate productivity that is due to the micro-level offshore profit shifting of MNEs

	$Prod_{97}$	$Prod_{15}$	$\Delta Prod_{97-15}$	$\widehat{Prod}_{15}$	$\Delta \widehat{Prod}_{97-15}$
$ALP = \frac{\sum_i VA_i}{\sum_i L_i}$	34.7	38.8	4.1	39.2	4.5

Source: Authors' calculations using LIFI and FICUS-FARE databases.

- We find an 8% difference (0.4 euros/hour) at the aggregate labor productivity *level*.
- Equivalent to a 0.06 pp gap between the predicted and the observed *annual growth* of labor productivity (-9,5%).

Results

- Using French firm-level data we examine role of international fiscal optimization and the rise of intangibles in the determination of productivity dynamics at the micro-level and macro-level.

  Hypothesis tested: shifting profits to low tax jurisdiction underestimates domestic productivity $\rightarrow$ effect particularly concentrated among intangible intensive firms.

- Findings suggest presence in tax haven countries is negatively related to productivity (both for TFP and ALP)

  - Stronger intangible intensive firms
  - Strong dynamic effects
  - Robust to placebo test
  - Can't reject common pre-trend assumption
  - Important at aggregate level

Future work

- Exploit OFATS database in order to check the robustness w.r.t. tax haven dummy
- Investigate GE effects of profit shifting with the model

Appendix starts here

Appendix: Tax havens list

Table: List of tax havens

ANDORRA	DOMINICA	LIECHTENSTEIN	NIUE
ANGUILLA	GIBRALTAR	LUXEMBOURG	PANAMA
ANTIGUA AND BARBUDA	GRENADA	MACAU	NETHERLANDS
DUTCH ANTILLES	GUAM	MALAYSIA	PHILIPPINES
ARUBA	GUERNSEY	MALTA	SAINT LUCIA
BAHRAIN	HONG KONG	MAN (ISLAND)	WESTERN SAMOA
BARBADOS	IRELAND, or EIRE	NORTHERN MARIANA (ISLANDS)	SEYCHELLES
BELIZE	ISRAEL	MARSHALL ISLANDS	SINGAPORE
BERMUDA	JAPAN	MAURITIUS	SWITZERLAND
CAIMANS (ISLANDS)	JERSEY	MICRONESIA (FEDERATED STATES OF)	THAILAND
CYPRUS	JORDAN	MONACO	TURKS AND CAICOS (ISLANDS)
COOK (ISLANDS)	LEBANON	MONTSERRAT	URUGUAY
COSTA RICA	LIBERIA	NAURU	VANUATU
DJIBOUTI			

Source: Offshore Financial Centers (IMF, 2000). `www.imf.org/external/np/mae/oshore/2000/eng/back.htm`

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Descriptive statistics (2/2)

Table: Presence in tax haven (Markov matrix)

	Dummy Tax haven (final)		
Dummy Tax haven (initial)	0	1	Total
0	338,965	9,700	348,665
	97.22	2.78	100.00
1	0	17,297	17,297
	0.00	100.00	100.00
Total	338,965	26,997	365,962
	92.62	7.38	100.00

Note: Transitions in frequencies and percentages.

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Appendix: TFP definition

TFP is an index computed as:[2]

$$\begin{aligned}\ln \text{TFP}_{it} = \ & \ln Y_{it} - \overline{\ln Y_t} + \sum_{\tau=2}^{t} \left(\overline{\ln Y_\tau} - \overline{\ln Y_{\tau-1}}\right) \\ & - \sum_{n=1}^{N} \frac{1}{2} \left(S_{nit} + \overline{S_{nt}}\right) \left(\ln X_{nit} - \overline{\ln X_{nt}}\right) \\ & - \sum_{\tau=2}^{t} \sum_{n=1}^{N} \frac{1}{2} \left(\overline{S_{n\tau}} + \overline{S_{n\tau-1}}\right) \left(\overline{\ln X_{n\tau}} - \overline{\ln X_{n\tau}}\right)\end{aligned}$$

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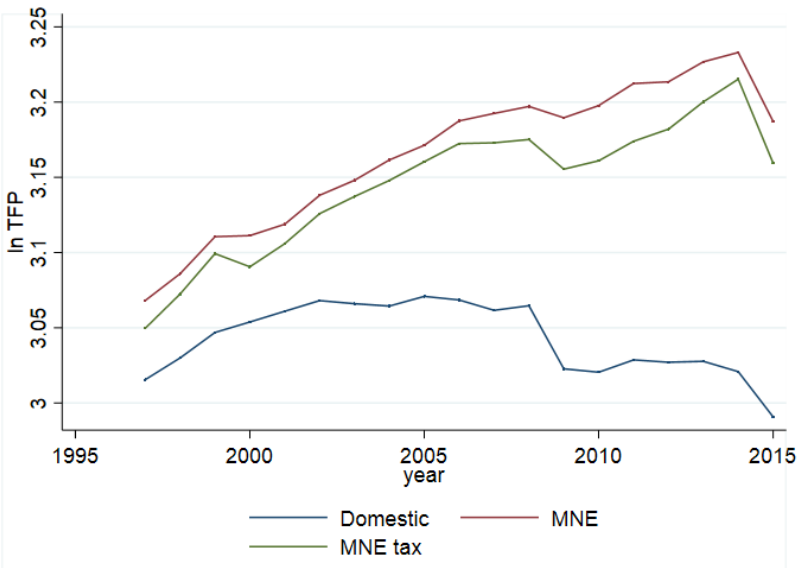
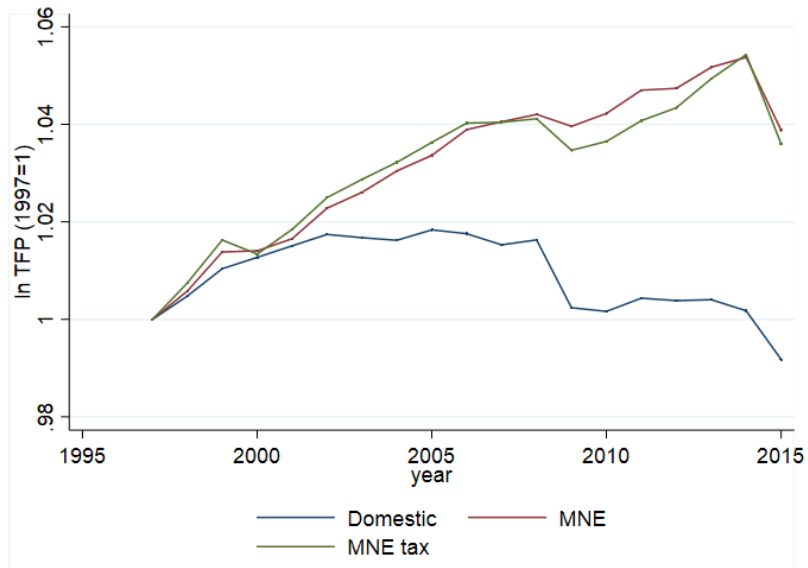
[2] As in Good et al. (1997)

Appendix: TFP trends





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Appendix: International tax competition

- Clausing et al. (2020): Global average statutory corporate tax rate 1985-2019: ↓ from 49% to 23%
- Vicard (2019): France has become a high tax country w.r.t. RoW despite relatively stable statutory corporate tax rate

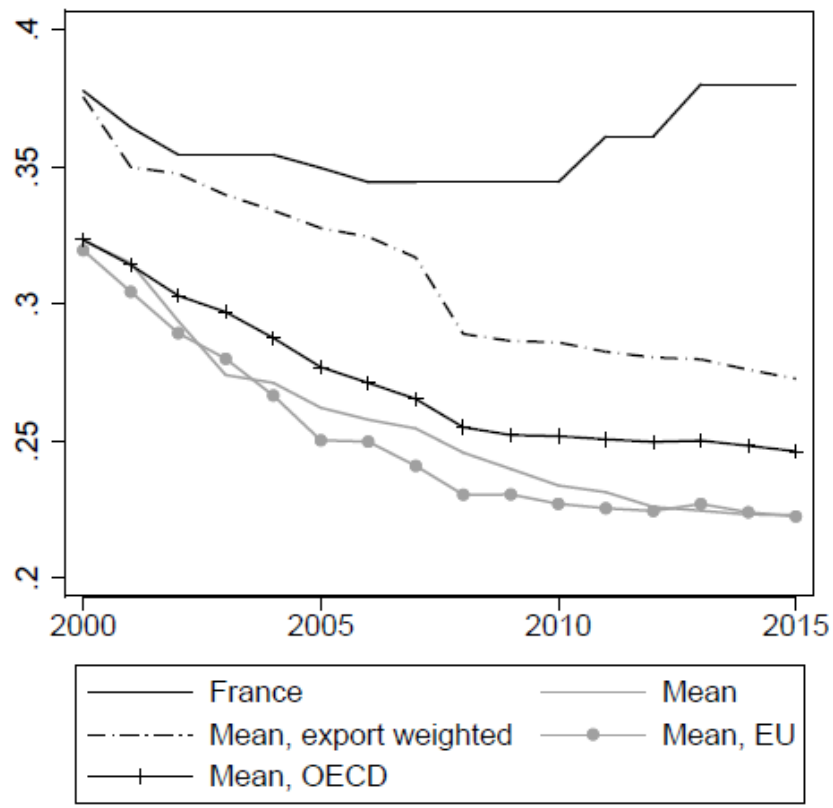

Figure: Vicard (2019)

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Empirical model: Baseline results (TFP)

	(1) ln TFP	(2) ln TFP	(3) ln TFP
$ln\ TFP_{f,1} \times firm\ trend_{ft}$	0.0333^a	-0.0361 ^{a}	-0.0361^a
	(0.0005)	(0.0009)	(0.0009)
$1[MNE_{ft}]$	0.0081^a	0.0038^a	0.0037^a
	(0.0009)	(0.0010)	(0.0010)
Share skilled$_{ft}$	0.2720^a	0.0584^a	0.0584^a
	(0.0031)	(0.0039)	(0.0039)
Num. Affiliates$_{ft}$	0.0006^a	0.0004^b	0.0004^b
	(0.0001)	(0.0002)	(0.0002)
$1[Tax\ haven_{ft}]$	-0.0113^a	-0.0118^a	-0.0062^b
	(0.0017)	(0.0018)	(0.0027)
$1[Tax\ haven_{ft}] \times 1[Intansh_f \geq p50\ Intansh]$			-0.0092^b
			(0.0034)
Observations	366094	365352	365352
Adjusted R^2	0.299	0.655	0.655
Firm FE	No	Yes	Yes
2-dig. sector X year FE	Yes	Yes	Yes

Standard errors in parentheses

All regressions include time-varying firm controls, robust standard errors in parentheses

^{c} $p < 0.10$, ^{b} $p < 0.05$, ^{a} $p < 0.001$

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Measuring intangibles

- Intangible capital is hard to measure in absolute terms
- We use a relative measure of intensity in intangible.

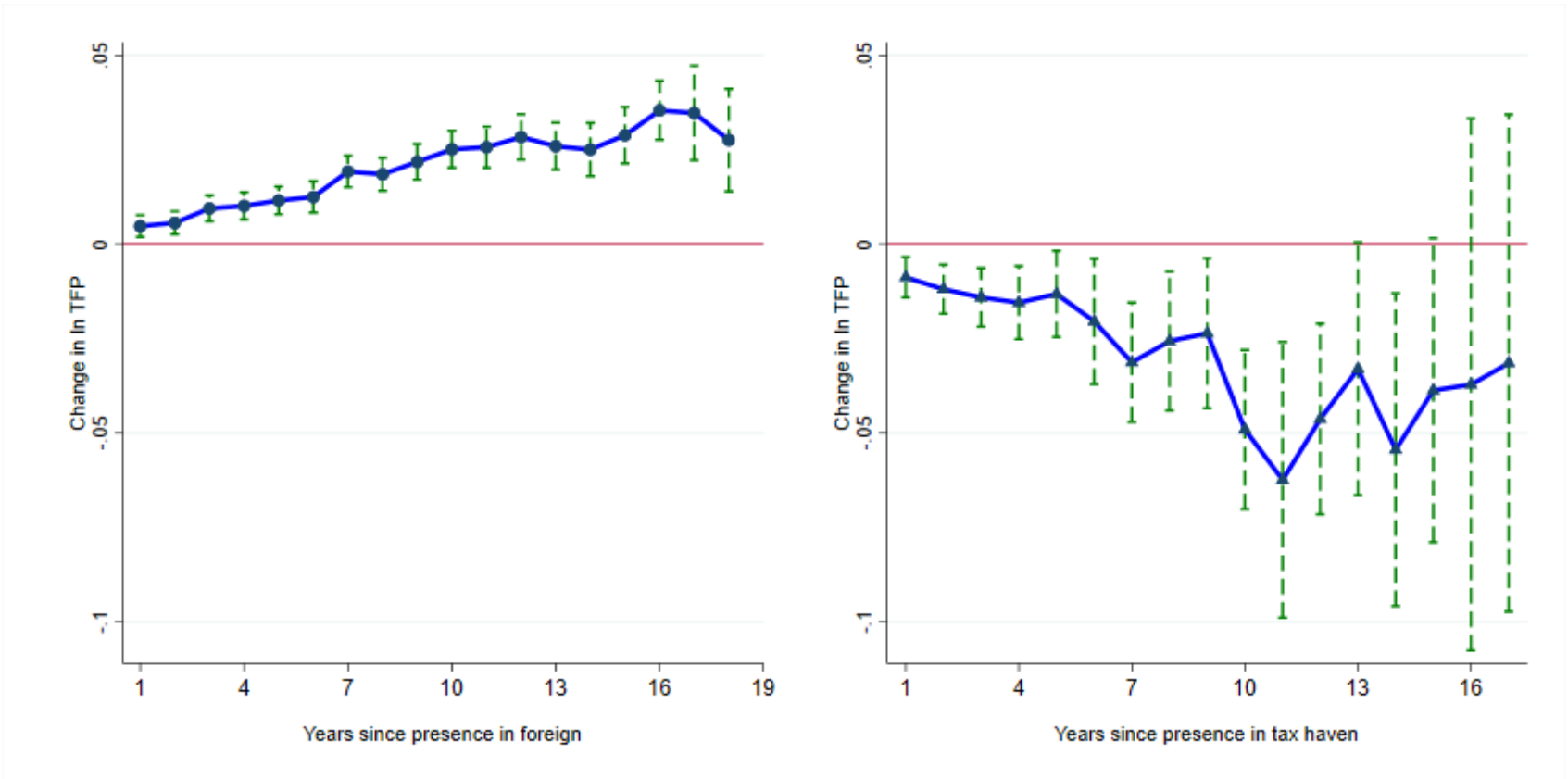
Intanshf $\geq$ *p*50 *Intansh* indicates that the average share of intangible assets (over total assets) of firm f over the whole period is above the median intangible share of assets in the sample. Where,

$$Intansh_f = \frac{1}{T} \sum_{t=1}^{T} \frac{Intangibles_{ft}}{Intangibles_{ft} + Tangibles_{ft}}$$

and where *p*50 *Intansh* is the median value observation (not average) of intangibles share observed over the whole sample period.

Empirical model 2: point estimates

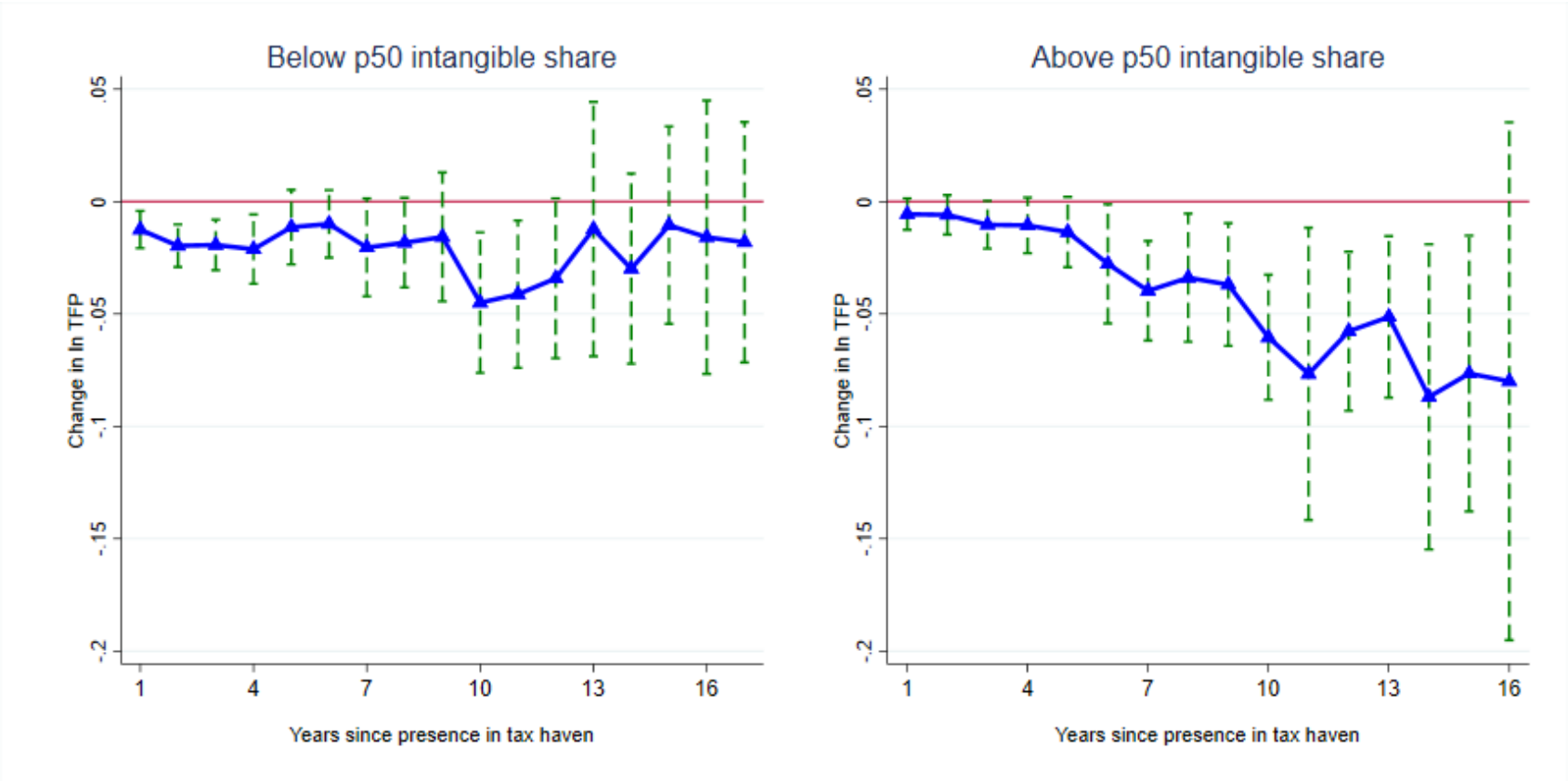
Figure: Foreign Presence and TFP Dynamics



Note: Plot of estimated coefficients of year dummies indicating MNE presence and MNE tax haven presence (solid blue line) and the corresponding CI (dashed green lines).

Empirical model 2: point estimates

Figure: Foreign Presence, Intangibles and TFP Dynamics



Note: Plot of estimated coefficients of year dummies indicating MNE presence and MNE tax haven presence (solid blue line) and the corresponding CI (dashed green lines).

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Robustness: Placebo test TFP

Re-estimate equation 1 and randomly setting the tax haven dummy.

	(1) ln TFP	(2) ln TFP	(3) ln TFP
$ln\ TFP_{f,1} \times firm\ trend_{ft}$	0.0333^{a}	-0.0361^{a}	-0.0361^{a}
	(0.0005)	(0.0009)	(0.0009)
$1[MNE_{ft}]$	0.0064^{a}	0.0017^{c}	0.0017^{c}
	(0.0009)	(0.0009)	(0.0009)
Share skilled$_{ft}$	0.2723^{a}	0.0584^{a}	0.0584^{a}
	(0.0031)	(0.0039)	(0.0039)
Num. Affiliates$_{ft}$	0.0006^{a}	0.0004^{b}	0.0004^{b}
	(0.0001)	(0.0002)	(0.0002)
$1[Tax\ haven\ Placebo_{ft}]$	0.0019	-0.0006	0.0011
	(0.0016)	(0.0012)	(0.0017)
$1[Tax\ haven\ Placebo_{ft}] \times 1[Intansh_{f} \geq p50\ Intansh]$			-0.0030
			(0.0023)
Observations	366094	365352	365352
Adjusted R^2	0.299	0.655	0.655
Firm FE	No	Yes	Yes
2-dig. sector X year FE	Yes	Yes	Yes

Standard errors in parentheses

All regressions include time-varying firm controls, robust standard errors in parentheses

^{c} $p < 0.10$, ^{b} $p < 0.05$, ^{a} $p < 0.001$

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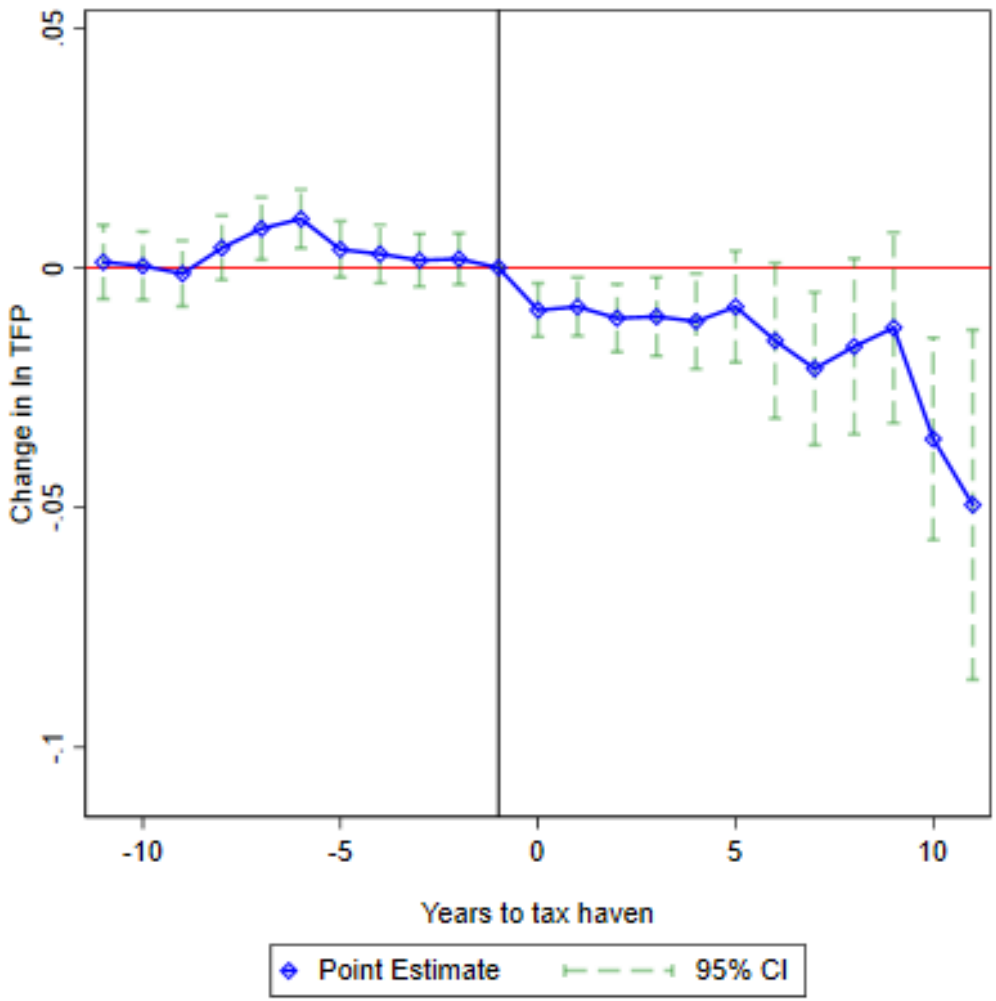
Robustness: Testing parallel pre-trends



Note: Plot of estimated coefficients of year dummies indicating the distance to the event of interest: entry into tax haven.

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Contribution to the variations of aggregate ALP

- What is the magnitude of tax haven MNEs' contribution to aggregate productivity ? $\rightarrow$ Dynamic Olley-Pakes Decomposition [1]

Aggregate change in productivity, Φ, of individual firms ϕ_i between year 1 and year 2 is decomposed into four terms accounting for the contribution of survivors (S), exitors (X) and entrants (E), as follows:

$$\Delta\Phi = \underbrace{\Delta\phi_S}_{Within-firm} + \underbrace{\Delta\,\mathrm{cov}_S}_{Between-firm} + \underbrace{S_{E2}\left(\Phi_{E2} - \Phi_{S2}\right)}_{Exitors} + \underbrace{S_{X1}\left(\Phi_{S1} - \Phi_{X1}\right)}_{Entrants}$$

- within-firm: average change of surviving firms in the two periods
- between-firm: change in the allocation of market shares among survivors
- contribution of entrants: only observed in t=2 and whose ϕ of reference is that of survivors in t=2
- contributions of exitors: only observed in t=1 and whose ϕ is compared to that of the survivors in t=1.

[1] Melitz and Polanec, (2015) propose a refined version of the static original decomposition of Olley and Pakes (1996)

Aggregate effects

ALP Dynamic Olley-Pakes Decomposition with/without MNE in tax havens

	Δ Aggregate ALP	Within-firm term	Between-firm term	Exitors	Entrants
All firms 1997-2015	21.51	4.71	19.42	3.90	-6.52
Excl. tax havens 1997-2015	17.10	4.41	13.12	2.98	-3.40

Source: Authors' calculations using LIFI and FICUS-FARE databases.

Excl. MNE's having either an affiliate or a parent in a tax haven concerns only 18 490 firms (79 724 observations) out of 2 354 053 firms (and 17 813 147 observations).

Strong selection: Firms in tax havens among most productive → Calls for econometrics. Back

Agrgegate effects

TFP Dynamic Olley-Pakes Decomposition with/without MNE in tax havens

	Δ Aggregate TFP	Within-firm term	Between-firm term	Exitors	Entrants
All firms 1997-2015	15.96	4.95	19.07	-3.37	-4.69
Excl. tax havens 1997-2015	7.95	4.78	6.36	-0.26	-2.93

Source: Authors' calculations using LIFI and FICUS-FARE data bases.

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Theoretical framework

Apparent Labor Productivity (ALP) in the domestic economy is defined as value added per worker. Value added of firm d in this model is equal to turnover, $p(d)x(d)$ since we abstract from materials.
Let κ be share of revenues recorded offshore by tax haven MNEs

$$ALP = \frac{1}{L}\left(\int_{\varphi^{dom}}^{\varphi^{mne}} p(d)x(d)dG(\varphi) + \int_{\varphi^{mne}}^{\infty}(1-\kappa)p(d)x(d)dG(\varphi)\right)$$

$$= \frac{1}{L}\left(\underbrace{\int_{\varphi^{dom}}^{\infty} p(d)x(d)dG(\varphi)}_{\text{true production}} - \underbrace{\int_{\varphi^{mne}}^{\infty} \kappa p(d)x(d)dG(\varphi)}_{\text{mismeasured production}}\right)$$

Strategic profit shifting

- MNEs earn post-tax profit $\pi^{th}(d)$:

$$\pi^{th} = (1-t)\left[(1-\kappa)p(d)x(d) - \frac{w}{\varphi(d)}x(d) - \frac{1}{2}\frac{w}{\eta(d)}\kappa^2)\right] + (1-t_{th})\left[\kappa(p(d)x(d))\right] - f^{mne}$$

From the firm point of view, the optimal amount to be shifted in tax haven writes:

$$\kappa^* = \eta(d)\frac{p(d)x(d)}{w}\left(\frac{t-t_{th}}{1-t}\right) \tag{3}$$

The amount of revenue shifted in the tax haven:

- increases with the tax differential
- increases with the size of revenue itself
- increases with the intensity in intangible capital

- Firms select into domestic or MNE according to their idiosyncratic productivity φ

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Caves, D. W., L. R. Christensen, and W. E. Diewert (1982). The economic theory of index numbers and the measurement of input, output, and productivity. *Econometrica: Journal of the Econometric Society*, 1393–1414.

Clausing, K. A., E. Saez, and G. Zucman (2020). Ending corporate tax avoidance and tax competition: A plan to collect the tax deficit of multinationals. *Unpublished Working Paper*.

Guvenen, F., R. Mataloni, D. Rassier, and K. Ruhl (2017, April). Offshore Profit Shifting and Domestic Productivity Measurement. Technical Report w23324, National Bureau of Economic Research, Cambridge, MA.

Vicard, V. (2019). The exorbitant privilege of high tax countries. *CEPII Working Paper 2019- 06 , March 2019*.