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Abstract

Based on French firm-level data over 15 years we evaluate the contribution of the microlevel profit-shifting –through tax haven foreign direct investments to the aggregate productivity slowdown measured in France. We show that firm measured productivity in France declines over the immediate years following the establishment in a tax haven, with an average estimated around 3.5% in labor apparent productivity. To isolate the contribution of multinationals' tax optimization to this decline of apparent productivity, we then exploit the 2006 Cadbury-Schweppes decision of the European Court of Justice limiting the extent to which member States can counter European MNEs' tax planning strategies. We find that multinational groups benefiting from that loosening of the legal constraints do exhibit lower apparent productivity in France following that ruling. Our results moreover suggest that this bias is bigger when firms rely more intensively on intangible capital. Finally, given these firms' weight in the economy, our results imply an annual loss of 9.7% in terms of the aggregate annual labor productivity growth.

JEL *classifications*: D33, F23, H26, H87, O47
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1 Introduction

In the midst of the Covid crisis in April 2020, Bruno Le Maire, the French ministry of Finance, announced that multinational firms with a presence in tax haven and without substantial economic activity in these jurisdictions would not benefit from the State's financial support. Echoing scholars views, this announcement was primarily made for fairness concerns.[1] Yet, conditioning public subsidies to economic transparency also finds an economic justification given the bias in the measurement of domestic economic activity introduced by tax-planning strategies in tax havens as this paper shows.

Productivity slowdown has been a major concern in many advanced countries over the past decade. Some economists argue that we have been facing a demand driven secular stagnation which is characterized by low investment ([Summers, 2014]). Others have, instead, argued that we face a supply-driven secular stagnation, explained by the maturity of the IT revolution and the secular decline in the rhythm of technological progress due to the declining productivity of research workers ([Gordon et al., 2016]). Yet, some others argue that it is mainly driven by mismeasurement issues according to which current national account systems fail to take a proper account of intangible capital, product quality changes, creative destruction or even new "self-service" activities enabled by the digitalization of the economy, all of which underestimate productivity growth ([Aghion et al., 2018], [Haskel and Westlake, 2018] and [Bean, 2016]). These explanations are not necessarily mutually exclusive and all may contribute to explaining the aggregate productivity decline.

In turn, aggregate productivity growth is closely related to productivity at the firm level. When firms become more efficient in transforming inputs into outputs, they contribute to overall efficiency gains. But how exactly do we measure productivity? And what role may international intra-group transfer of assets play in the measurement of firm productivity, and in the end, of GDP? Productivity measures are based, among others, on firm sales (both domestic sales and exports) and when a firm owns an affiliate in a foreign country, its sales abroad are not registered

[1] See, for instance, [Laffitte et al., 2020]

as part of the parent's sales. Neither are they accounted for in the parent's productivity, nor in the home country GDP. Although it makes sense to measure productivity in this way as long as the foreign affiliate produces abroad, it may not always be the case that production takes place abroad. Additionally, multinational entreprises (MNEs) are usually very big firms whose market shares are typically important enough to have an impact in the aggregate economy of a country. Thus, well measuring the activity of MNEs and understanding how tax havens distort national accounting is crucial when assessing countries' productivity.

To illustrate this, let us consider the hypothetical case of a French firm selling its products through a digital platform, for instance, providing services of big data analysis. The firm's research and development activities (R&D) required to develop its products are made in France, where it also pays its workers. When a customer in Germany buys the firm's services through the platform, the firm's sales are collected there where the firm has registered its property rights. In this case, it will be considered an export from France to Germany and it will contribute to the French GDP. However, if the firm, subject to a statutory corporate tax rate of 28%, decides to develop a global tax strategy by investing say in Ireland in order to move its intellectual property rights to a lower tax jurisdiction, its profits would instead be subject to a 12.5% tax rate. In this case, the transaction of these services would now be considered as an export from Ireland to Germany and the firm in France would see its sales – and productivity– go down. At the same time, its affiliate in Ireland would see its sales and productivity rise, even though the affiliate was not involved at any stage in the production process. Hence, the implication of the tax-motivated income shifting within multinational firms – or "base erosion and profit-shifting" (BEPS) is that activity in high-tax countries is underestimated while it is overestimated in low-tax jurisdictions.

Indeed, there is growing evidence showing that with the deeper international financial integration process that we have observed in the past decades, complex structures of MNEs aiming at reducing their tax bills, significantly distort official production statistics. Furthermore, there has been a deep transformation of the economy, with the digitalization of activities pushing firms to invest more in intangibles to the detriment of tangibles (e.g. Uber or Airbnb virtually don't own cars or buildings, respectively). This has resulted in a steady rise in the importance of intangible investment relative to tangible investment over the past 20 years, which, in major advanced countries, has overtaken tangible investment GDP share around the 2008 crisis.[2] Although techniques to reduce tax payments within MNEs have been around for long, decoupling capital location from production and value location (e.g. intellectual property rights) and transfer-pricing (i.e. absence of "arm's-length prices" for intangibles) has become much easier with the rapid rise of intangible capital. Thus, beyond the deep financial integration that we have observed over the past decades, in a context of international tax competition, the increasing intangible economy has provided new tools for MNEs to offshore their profits to low tax countries.[3]

Beyond measurement issues, which have long been a topic of academic debate and a concern for statistical offices, the social and political implications of the digitization of the economy and tax evasion by MNEs have increasingly attracted public attention and led to the BEPS framework.[4] This is a multi-year initiative of the OECD [Organization for Economic Cooperation and Development] and the G20, launched in 2012, to address the global fiscal challenges of economic digitization in order to prevent base erosion. Indeed, the growing discontent with globalization has crystallized in the aftermath of the Great Recession, and the perception that it has widened inequalities between elites - who benefit greatly from it - and the rest of society - who face increasing pressure from international competition - has intensified with recent scandals such as LuxLeaks and Panama Papers. In a context where globalization is increasingly perceived as an unfair process in which the equality of individuals and companies is trampled before taxation, public discontent towards tax optimization intensifies with every crisis episode. Interestingly, one of the first claims of the civil society with respect to the reforms of international taxation was the implementation of a public database shedding light country by country on the economic activity and corresponding taxes paid by MNEs. This demand - which laid the foundation of the Country-by-Country reporting (CbCR) eventually implemented by the OECD - was not directly motivated by potential biases in the official statistics but mainly to improve the transparency on the tax paid by MNEs. The opacity and the measurement issues associated with the offshore

[2] [Haskel and Westlake, 2018].

[3] For instance, the global average statutory corporate tax rate has fallen from 49 percent to 23 percent between 1985 and 2019 ([Clausing et al., 2020]).

[4] See, for example, the IMF's report on the challenges of measuring the digitalized economy: [International Monetary Fund, 2018].

world therefore appear to go hand in hand, raising the need for both political reforms and economic transparency.[5]

This paper relates to the latter. Its aim boils down to a study of the relationship between micro-level tax avoidance, firm productivity mismeasurement and domestic aggregate productivity slowdown for the case of France. Beyond the novelty of the French case, we propose a new methodology. To the best of our knowledge, this paper is the first to quantify macroeconomic mismeasurement linked to profit-shifting based on micro-econometric estimations and without relying on assumption on the production function. In order to correct activities of US MNEs [Guvenen et al., 2022] use apportionment formula while [Tørsløv et al., 2018] rely on the excess profitability of foreign affiliates compared to domestic firms to correct various indicators. Instead of resorting to a "normal" production function for MNEs, the adjustment technique used in this paper does not rely on proxies but on systematic deviations of firms' apparent productivity associated with the presence of MNEs in tax havens. Our identification strategy is validated by the use of the exogenous shock of the Court of Justice of the European Union (CJE) and has the virtue of relaxing assumptions on firms' production function. Finally, we make use of simple aggregation techniques, standard in the industrial organization literature, to construct a counterfactual aggregate productivity if MNEs had not been present in tax havens over the sample period.

More precisely, we evaluate the contribution of the micro-level tax optimization to the aggregate productivity slowdown using balance-sheet yearly data on the universe of French firms and their presence in foreign countries over 1997-2015. Next, we aim at linking the firm-level productivity effect of offshore profit-shifting to the aggregate decline in measured productivity growth in France over the sample period. We identify offshore profit-shifting from within-firm variation in presence in tax havens, exploiting the precise establishment of firms' new foreign presence in a tax or non-tax haven country. Additionally, given that productivity may be mean-reverting, our regressions include initial productivity interacted with firms' trends, following [Fons-Rosen et al., 2021]. Thus, we control for any productivity decline due to high initial productivity, since

[5] This point was first made by Richard Murphy and the Tax Justice Network in 2003.

this decline is not captured by the firm fixed effects or the sector-year effects.[6] Furthermore, we evaluate the dynamic effects by asking whether the productivity differential for firms with presence in tax havens evolves over time after the entry in tax haven and checking that the pre-trends do not exhibit specific patterns. Noting that firms self-select in tax havens, the entry in tax havens cannot be seen as purely exogenous and it could itself be linked to strategic decisions influencing firms' productivity. Even if our estimates are likely to be biased toward zero, providing, therefore, a lower bound of the true productivity mismeasurement, we reinforce the identification of the contribution of profit-shifting to the productivity measure by exploiting the 2006 Cadbury-Schweppes decision of the European Court of Justice.[7] This decision restricts the application of Controlled-Foreign Company by member States and therefore loosens legal constraints for European MNEs with a presence in a European tax haven before 2006, which we observe in our dataset.[8] Once we establish the link between profit-shifting and mismeasurement of productivity, we then explore two different channels: (i) the mediating role of intangible capital by splitting our sample between firms with high and low intensity in intangible capital and (ii) whether the mediating effect is opening an affiliate in a tax haven or having tax haven parent. Last but not least, we provide a macro-economic quantification of the productivity slowdown due to profit-shifting based on our micro-econometric estimates by relying on standard firm productivity aggregations, which allows us constructing an aggregate productivity counterfactual.

Our findings suggest that firm productivity in France experiences a decline over the immediate years following an establishment in a tax haven, with an average estimated drop around 3.5% in labor productivity depending on the list of tax haven used and 1% in total factor productivity. We argue that this productivity decline, following a presence in a tax haven, is most likely explained by MNEs' fiscal optimization, where domestic productivity is underestimated as profits

[6]This is important as not controlling for the tendency of high productivity firms to experience a productivity decline over time would result in a negative omitted variable bias, which could overstate the negative effect of offshore profit-shifting as high productivity firms have higher incentives to invest in tax havens.

[7]The reason why we argue that our estimates might be suffering from a bias toward zero is that the most likely source of endogeneity in our analysis is related to a reverse causality which generates an attenuation bias as the effect of productivity on the decision of establishing in a tax haven is positive and this effect is captured by the coefficient of interest, which is negative and significant. In the absence of a reverse causality, the coefficient should be more negative as it wouldn't capture the positive effect of the regressed variable on the regressor.

[8]The Controlled-Foreign Company (CFC) rules aimed at ensuring that offshore entities owed by a resident firm do not result in an absence of taxation from the point of view of the parent jurisdiction. The definition of ownership and of the economic activity covered by CFC rules vary across countries. The implementation of efficient CFC rules is at the core of the OECD BEPS programs (see in particular action 3 of the program).

are not recorded anymore in the home country. Additionally, we find that the mismeasurement has strong dynamic effects, as the decline becomes more important the longer the firm remains in a tax haven. For instance, we find that after 10 years of presence in a tax haven, ALP attains an average 11.7% drop with respect to the years before the tax haven presence, while the respective impact for TFP is around -4.8%. Finally, our findings are robust to the list of tax haven used and to a placebo test of the "tax haven presence treatment". We are confident that these estimates rightly capture the effect of profit-shifting since the difference-in-difference (DiD) strategy applied around the Cadbury-Schweppes decision gives rise to comparable effects: depending on the specification, the "treated" firms who benefited from the loosening of the applicability of CFC rules experienced a 1 to 2% decline of their productivity measured in France after 2006 other things kept equal. Turning to the aggregate quantification of our results imply that the share of the aggregate loss in the level of labor productivity in France that can be explained by micro-level fiscal optimization of MNEs is equivalent to 8% between 1997 and 2017. This is tantamount to 9.7% of the observed aggregate annual growth in labor productivity over the period.

The rest of the paper is organized as follows. In Section 2 we briefly discuss the relevant literature related to our analysis; Section 3 describes our data sources and presents some stylized facts; Section 4 explains the econometric methodology, reports the empirical findings and tests their robustness; Section 5 inspects the underlying mechanisms; Section 6 discusses the aggregate implications of micro level offshore profit-shifting and Section 7 concludes.

2 Related Literature

This section briefly presents a non-exhaustive review of related work and compares the magnitude of our results with previous findings in the literature. First, this paper is related to the literature aiming at explaining the firm productivity developments and how internationalization affects firm performance. In line with the literature, our results suggest that MNEs are both more productive than domestic firms ([Helpman et al., 2004a] and that becoming an MNE is related to productivity increases

([Arnold and Javorcik, 2009], [Guadalupe et al., 2012], [Criscuolo and Martin, 2009] and [Fons-Rosen et al., 2021]). For comparability on the magnitudes with earlier work, the TFP effect of becoming an MNE in our sample is around 0.38% (and 0.57% for ALP). This number is clearly below that found by [Fons-Rosen et al., 2021], where the TFP effect of a new foreign acquisition of a domestic firm is on average 2%. Nonetheless, the effect remains well above other estimates in the literature on foreign acquisitions, where no effect is found upon inclusion of firm fixed effects. For instance [Arnold and Javorcik, 2009] find a 13% increase in productivity after 3 years of foreign acquisition in Indonesia and [Criscuolo and Martin, 2009] find a 4% productivity increase for firms in UK when acquired by American firms and 1% for the rest of acquisitions in the UK. While [Smarzynska Javorcik, 2004], [Liu, 2008], [Balsvik and Haller, 2010] and [Aitken and Harrison, 1999] find no effect. However, beyond the different time span and country idiosyncrasies, our estimates, by construction, capture situations reflecting all types of MNE status (new foreign affiliates in France, foreign acquisitions of domestic French firms, French domestic firms acquiring or opening a new affiliate in a foreign country) and not specifically the effect of foreign acquisitions.

Our paper is also linked to the literature evaluating the productivity slowdown in advanced economies. In particular, a strand of the literature focuses on measurement issues in the context of an increasingly digitalized and highly global integrated economy, which is the direction that we take in this paper. Robert Solow's famous productivity paradox in the 80's, that one "can see the computer age everywhere but in the productivity statistics" is still relevant today as the technological revolution has curiously been accompanied by a productivity growth slowdown in advanced economies. Productivity and real GDP measurement are closely related and some challenges arising from the digitization of the economy have been identified. For instance, underestimation of real output and, hence, productivity can be the result of overstated deflators for ICT products. In this sense, [Aghion et al., 2018] claim that not accounting for increases in quality -which has rapidly grown with the rise of ICT and globalization- for new products replacing old products results in an overstated inflation which understates growth. They find that in France the related mismeasurement represents 0.5 percentage point per year of output growth, which is about a third of the "true" productivity growth from 2004 to 2015. For comparison, we argue that the mismeasurement related to MNEs' offshore profit-shifting represents around 9.7% of the observed average productivity annual growth from 1997 to 2015 in France.

Furthermore, globalization has allowed MNEs' production to be fragmented across different countries which poses challenges to the definition of production location as it may become an ambiguous concept. Large networks of affiliates together with footloose capital make geographical boundaries an obsolete concept for providing a meaningful insight of production location. This is all the more an issue when relocation choices are motivated by tax reasons, as the reported location of production may often not describe where the production really takes place. The academic literature and statistical offices have extensively documented measurement issues that are related to tax evasion and affect official statistics, such as GDP (and thus, factor shares), and those relating to the external sector statistics such as the balance of payments (BOP) and the international investment position (IIP). For instance, a well known case is that of Ireland, whose GDP annual growth in 2015 was revised from an expected 7.8% to 26%, following some multinationals' relocation of intellectual property rights to Ireland (exports were revised up by 50 billion euro and the net IIP was revised from expected –150 to –532 billion euro). Artificially complex cross-border financial structures, where financial engineering is used to shift profits, to relocate profitable moveable assets or to sell digital services from a location without having a physical presence, inflate GDP and FDI figures in tax havens. In this sense, alternative concepts have been developed in Ireland, in order to assess the purely domestic portion of its economy by excluding factor income of foreign firms redomiciled in its territory and depreciation of relocated assets.

[Lane and Milesi-Ferretti, 2011] document the particularly large size of external balance sheets in small, offshore financial centers, while [Lane and Milesi-Ferretti, 2018] document how the increased complexity of the corporate structure of MNEs explains the continuous expansion of cross-border FDI positions after the 2008 financial crisis, essentially driven by positions vis-à-vis financial centers. This, they argue, makes it very difficult to disentangle ”genuine” financial integration and portfolio diversification from complex tax evasion schemes. In order to have a clearer understanding of globalization patterns, recent research by [Damgaard et al., 2019] seeks to identify which economies host what the IMF coined "phantom investments", which are corporate shells with no real activity in the host economy, and their counterparts. They find that phantom FDI may account for almost 40 percent of global FDI and that by allocating real investment to ultimate investors standard gravity variables explanatory power is significantly increased. In the same vein, [Delatte et al., 2022] evaluate FDI and portfolio securities around the world and find that 40% of global assets don't fit gravity estimates, are located in tax havens and are concentrated on only six jurisdictions. [Vicard, 2019] documents how the corporate tax rate correlates with excess returns to international assets, inflating therefore the investment income balance in the BOP. In the case of France, profit-shifting accounts for the average 2 pp differential between the return to French FDI assets and liabilities. This results in estimated missing profits in France equivalent to 1.6% of GDP in 2015. Moreover, a firm-level analysis conducted on French firms in 1999 uncovers systematic mispricing to related parties located in tax havens [Davies et al., 2018]. Interestingly, this study shows that this effect is concentrated among the biggest MNEs, supporting the idea that tax avoidance is a granular phenomenon. [Fisman and Wei, 2004] focus on Chinese data and argue that tax evasion helps explaining differences between reported bilateral imports and exports, where in addition to underreporting the value of imports, higher-taxed category imports are mislabeled to lower-taxed ones. [Tørsløv et al., 2018] document how MNEs are systematically more profitable in low-tax jurisdiction countries than in other places, and they are even much more profitable than domestic firms in low tax countries. Exploiting these tax generated anomalies, they estimate that around 40% of global profits in 2015 are shifted to tax havens and revise official statistics adjusted by profit-shifting. Their proposed database reports adjusted GDP, trade balance and capital shares, which are all underestimated in countries from where profits are shifted away and overestimated for low tax jurisdiction countries. For instance, in the case of the French trade balance in 2015, the trade deficit disappears with a surplus of 0.4% (equivalent to a 1.1 pp difference with the official statistics).

Our contribution is twofold. First, we bring new evidence on the micro-determinants of the aggregate productivity slowdown in France, which are due to firms' incentives for registering profits in locations different from where production takes place, namely corporate taxation and intangible assets. In this sense, the closest related work to our analysis is [Guvenen et al., 2022], who quantifies the contribution of US MNEs offshore profit-shifting to the slowdown of aggregate productivity by using a *formulary apportionment* technique.[9] Second, and by contrast to [Guvenen et al., 2022], we propose a methodology to correct MNEs' domestic production for profit-shifting that does not rely on apportionment method. Here, mismeasurement of productivity in the domestic economy is estimated based on systematic declines in productivity following the entry of a firm in a tax haven without resorting to apportionment factors that require information on the foreign activity of MNEs affiliates which is not always available and which can themselves be biased. On the one hand, wage bill is not an ideal proxy for value creation since it might capture labor market structure, may not correctly proxy the ownership of intangible assets and can be substituted by other forms of compensation (such as dividends). On the other hand, stocks of tangible capital depends on the local financial accounting conventions while intangible capital is also likely to be polluted by strategic location within MNEs given its high degree of footloosness and final sales are subject to manipulation (”sale-shifting”) and cannot truthfully serve as apportionment factors for MNEs real activity as suggested by the recent work of [Laffitte and Toubal, 2022].

3 Data and Stylized Facts

3.1 Sources and cleaning

Our main data sources for firms domiciliated in France come from the FICUS and FARE bases and are made available by the French national statistical institute (INSEE) and the public finances directorate (DGFiP). These bases are drawn from fiscal files and no firm size threshold determining the inclusion/exclusion is applied. Hence, there is full coverage of French firms given that every firm is subject to compulsory reporting with fiscal authorities.[10] The FICUS-FARE base contains balance sheet information on value added, employment, capital, depreciation, investment, the wage bill, materials, four-digit sector the firm belongs to, etc. that are important

[9] More specifically, they apportion the worldwide income of MNEs who are headquartered in the US to locations where they have operations, based on a combination of compensation of employees, net profit per employees stocks and stocks of intangible capital

[10] Excepting one person firms.

in estimating productivity and labor share. In addition, a unique firm identifier is associated to each firm (siren number) which is used to link it to other French databases (LIFI and DADS) which we use in order to get yearly information on the firms' bilateral international trade, the firms' bilateral presence in a foreign country (and in a tax haven), and on the detailed composition of the firms' workforce and wage bill in France.

The LIFI database is the "financial linkages base" (Liaisons Financières) which comes from the INSEE. More specifically, it provides information about the composition of economic groups through firm's ownership relations (foreign and domestic) of companies residing in Metropolitan France and French overseas departments. Although the base has a good coverage, it is not exhaustive in the sense that it is constructed by applying different thresholds. More specifically, it includes firms verifying at least one of the following conditions: having more than 500 employees, holding equity securities above 1.2 million euro, having a turnover of more than 60 million euro, being the parent of a group or being held by foreign capital in the previous year. The survey is complemented with additional administrative sources (DIANE) in order to ensure a better coverage of smaller groups. The relevant information that we can extract from this base is the position of the firm within the group (parent, subsidiary), the list of subsidiaries abroad as well as their nationalities, the nationality of the parent when a French firm is a subsidiary of a foreign company and the amount of direct participation of the main shareholders. We construct our main variable of interest, tax haven presence, in such a way that it reflects both the situation where a French residing firm has a parent or an affiliate in a tax haven, which we define according to the IMF list of offshore financial centers reported in the Appendix C.3. There is considerable overlap between jurisdictions that are major providers of offshore financial services and those offering profit-shifting opportunities, but they can differ. For this reason, we provide alternative lists of tax havens based on academic work such as the Dharmapala & Hines list ([Dharmapala and Hines, 2009]) or NGOs list of tax haven such as the one provided by Oxfam (see C.3). In order to reduce the sensitivity of our result to the definition of tax haven, we finally construct a "consensus" list that reports a country as a tax haven if this country is present in a least two of the three lists mentioned above.

Finally, the DADS database (Déclaration annuelle de données sociales) which is provided by the INSEE, is based on mandatory annual reports filled by all firms with employees; it contains annual hours paid in a firm, as well as the number of workers employed by different socio-professional occupation types. The relevant information that we extract from these data is the annual number of firm employees by socio-professional category, which we use to compute a firm-year share of skilled workers. The data cleaning required dropping observations that reported negative values of employment, value added and capital stocks. Table 1 reports the main descriptive statistics by firm type for around two million three hundred firms between 1997 and 2015, reflecting the universe of firms that are left after the data cleaning. Among these firms, we observe their transition from "no presence in a tax haven" to "presence in a tax haven" for 18 841 cases as indicated in Table 2, which displays the transition matrix for a Tax haven dummy that takes the value of 1 if there is presence in a tax haven for a certain firm in a given year. In other words, this means that these cases represent 0.12% of all our observations. We wish to emphasize this statistic as the main point that we want to make in this paper relates to the contribution of this tiny proportion of cases to the aggregate slowdown of productivity growth, as will be discussed in section 6.

Finally, in order to better capture the change in productivity levels that is due to offshore profit-shifting, our regression sample restricts to firms which are MNEs at any point of time in our sample period (but we keep the universe of firms for descriptive statistics and aggregate stylized facts). For the same reason, we keep only those MNEs in tax havens for which we observe a new tax haven presence and drop those that were present in a tax haven at the beginning of our sample. On top of this, observations of firms which become again "non tax haven MNEs" after having been a tax haven MNE are dropped from the sample. This left us with an unbalanced panel of 37 995 MNEs firms throughout the years 1997-2015, out of which 11 004 firms are also present in a tax haven and whose transition into a tax haven MNE represents 2.78% of the regression sample, as indicated in Table 2.

Table 1: Main descriptive statistics by type of firm

	Domestic	MNE non tax haven	MNE Tax haven	Mean (arithmetic)	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.

Table 2: Transition Matrix (Markov)

	Dummy Tax haven (final)		
Dummy Tax haven (initial)	0	1	Total
0	15,416,060	18,841	15,343,901
	99.88	0.12	100.00
1	12,385	56,796	69,181
	17.90	82.10	100.00
Total	15,428,445	75,637	15,504,082
	99.51	0.49	100.00

Note: Transitions in frequencies and percentages.
Source: Author's calculations based on FICUS-FARE, DADS and LIFI.

3.2 Variable construction

3.2.1 Productivity measures

Productivity is a measure of market producers' ability to transform inputs into output. For the sake of robustness, two different productivity measures are calculated in this analysis: the simplest productivity measure -and our preferred one- is the standard apparent labor productivity (ALP) and the more complex one -which is more demanding in terms of data- the total factor productivity (TFP). While the two measures are strongly correlated, they do not exactly capture the same information. The former is defined as the log-ratio of real value added on the average number of hours worked and reflects output per hour worked while the latter, additionally adjusting for the contribution of capital and materials, provides a measure of technological change. Section A in the appendix provides more details for the construction of these two measures.These two productivity measures are used throughout the empirical analysis, where ALP is privileged given that it allows making use of a wider number of observations. Since TFP is very demanding in terms of data, a considerable number of observations are lost with respect to ALP. It should be kept in mind, however, that these two measures do not necessarily need to coincide in the results of the analyses. Even if they are highly correlated, they may differ, particularly for capital-intensive firms and sectors. As previously mentioned, TFP measures control for a broader set of inputs than ALP.[11]

3.3 Stylized facts

A first glance at the evolution of the average productivity by firm type, which we classify according to their year-specific status regarding their relation with a foreign tax haven, allows us to motivate our analysis and get an idea of how offshore profit-shifting relates to productivity. Figures 1 and 2 plot the simple average (or unweighted average) of productivity in the whole market economy by firm type, from 1997 to 2015, as measured by ALP in levels and evolution respectively. Similar figures for TFP are provided in the Appendix B.2. Firms are classified according to their presence abroad in year t, where firm i is classified as an MNE if she has a for-

[11] For the next section, all the descriptive statistics are given for ALP while all counterparts for TFP are provided in appendix.

eign presence (i.e. one or more affiliates or a parent abroad), to the extent that it doesn't involve any location in a tax haven. In case it does involve a tax haven, the firm will be categorized as a tax haven MNE in that specific year. The rest of firms, including exporters and importers not engaged in FDI (in and outward) in t are classified as domestic.[12]

The first message emerging from these figures is that, with no surprise, MNEs (regardless of whether they are related to a tax haven or not) display similar levels of productivity, which exceed by far those of domestic firms. What is more noteworthy, however, is that average levels of TFP of tax haven MNEs are systematically lower than TFP of MNEs. It is also the case for ALP levels starting from the mid-2000's, with almost identical average ALP levels before 2005 between tax haven and non tax haven MNEs. Additionally, the TFP gap between MNEs and tax haven MNEs is relatively small in 1997 and it starts to widen around 2005. Even if the productivity gap, for both ALP and TFP, seems to start to shrink by the end of the sample period, what its notable is that this productivity divergence coincides with a proliferation of tax haven MNEs in France -as will be explained below- and with a moment in which the country starts to become a relatively high-tax country.[13]

Figure 1: ALP level

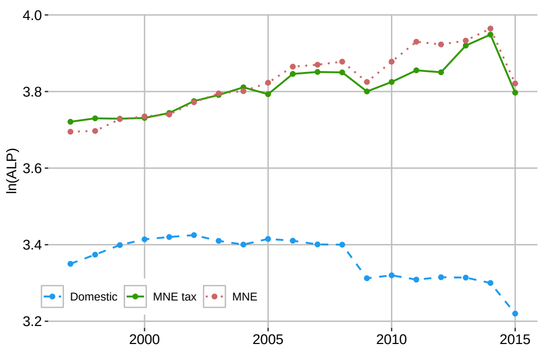
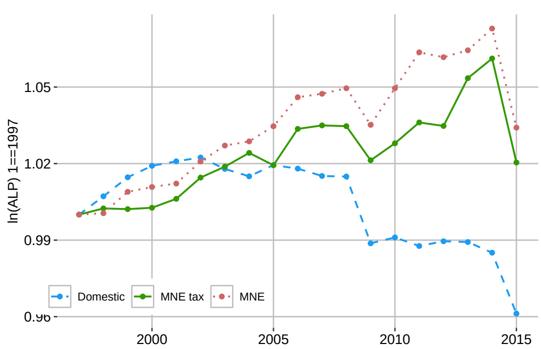


Figure 2: ALP evolution



[12]Note that in the econometric analysis, the classification is somewhat different: here MNEs that are in a tax haven are not included in the MNEs group, while in the regressions, an MNE in a tax haven will be attributed a tax haven dummy equal to one as well as an MNE dummy equal to one. This is because we have to control for the positive relation between MNE status and productivity, which would otherwise result in an omitted variable bias.

[13]See Figure 4 in the Appendix.

The relative productivity evolution of tax haven MNEs is best appreciated by normalizing it with respect to a given year (1997 in this case), as in Figures 2 (and 6 in the Appendix B.1 for TFP). A first conclusion from these figures is the significant productivity growth divergence between domestic firms and MNEs that came hand in hand with the financial crisis in 2008. This time, it is tax haven MNEs ALP growth that appears to be systematically lower than that of MNEs and the gap widens around 2005. On the other hand, TFP growth for tax haven MNEs closely follows that of MNEs before 2005, where it even appears to be slightly higher but this tendency reverts around 2009.

Indeed, in a context in which the deeper international financial integration over the past two decades has come hand in hand with a redefinition of domestic tax policies, increasingly aiming at supporting competitiveness, there has been a generalized tendency of tax cuts and tax incentives [Clausing et al., 2020]. In this global "race to the bottom" in terms of taxation and deregulation, France has become a high corporate tax country with respect to the rest of the world, despite a relatively stable tax rate. Figure 4 in the Appendix B.1, is taken from [Vicard, 2019] and shows that this tendency started around the mid-2000's and it accelerates around after the financial crisis in 2009. While it may be true that the statutory corporate tax rate can be very different from what companies effectively pay (usually much less in the case of tax havens), it serves the purpose of illustrating the generalized downward tax tendency around the world – which accelerated after the crisis, and how France stands in it.[14]

In this context, it comes as no surprise that tax haven MNEs proliferate in France in the end of the period. Table 10 in Appendix B.2 reports the distribution of our three dummies of interest: non-tax haven MNEs, tax haven MNEs and all MNEs, over time. It tells for instance, that among the entire set of firm-year MNE observations in our sample, around 4.6% are observed in 1997, 5.3% in 2008 and 6% in 2015. In the case of tax haven MNEs, we observe 2.3% in 1997,

[14]For instance, Luxembourg's statutory corporate tax rate between 2010 and 2020 has on average been 28%, which is one of the highest rates in the world (see KMPG global: https://home.kpmg/xx/en/home/services/tax/tax-tools-and-resources/tax-rates-online/corporate-tax-rates-table.html) while the country is on the top 10 of all of tax havens lists - with the exception, of course, of "governmental lists", which are highly political and from which members are excluded (e.g. the EU list of "non-cooperative tax jurisdictions" doesn't list Luxembourg).

while the presence of MNEs in tax havens is more than 4 times higher by the end of the period, with 9.5% of observations in 2015. Thus, while MNEs are almost proportionally distributed over the period, those having a presence in a tax haven are disproportionately distributed over the years, with a high prevalence at the end of the sample. Their presence increases over time and accelerates after 2008.[15] On top of this, the rapid rise of intangible investment, which in major European countries overtook tangible investment around the global financial crisis ([Haskel and Westlake, 2018]), adds to the equation as it facilitates tax avoidance.

As a matter of fact, the proliferation of tax haven MNEs is not a phenomenon specific to France, for instance, [Lane and Milesi-Ferretti, 2018] document that while global portfolio and other types of investment came to a halt in the aftermath of the financial crisis, FDI (the necessary condition for foreign presence), continued to expand. What is notable about this trend, is that it has primarily been driven by FDI in offshore financial centers, as a result, they argue, "of the growing complexity of the corporate structures of large multinationals".

The above stylized facts on the average evolution of productivity by firm type and the proliferation of tax haven MNEs in France are in line with the hypothesis that firms' presence in tax havens distorts domestic productivity. However, how much can this affect aggregate domestic productivity? We believe that it can be important given that these are usually very big firms. MNEs in general and tax haven MNEs in particular are responsible for a large share of aggregate outcomes as they are among biggest firms in terms of sales, production and employment as reported in table 1, where we can observe that they are on average responsible for 16% of employment over the period 1997-2015. Indeed a well established fact in the literature is that international markets are characterized by their granularity as firms engaged in internationalization are on average very large ([Bernard et al., 1995], [Mayer and Ottaviano, 2007]) and internationalization makes large firms even larger ([Pavcnik, 2002], [Bernard et al., 2003]). Going even further, a recent paper by [Martin et al., 2020] shows the very contribution of tax avoidance to sales concentration, implying that offshore profit-shifting allows firms to become

[15] One may be concerned by the fact that these statistics reflect -at least to some extent- the increased effort that the French administration has made in collecting information on MNEs and their financial linkages over time, however, this bias should equally affect coverage of MNEs and tax haven MNEs.

even larger.

Dynamic Olley-Pakes Productivity Decomposition. A first exercise with which we can get an approximated idea of the magnitude of tax haven MNEs' contribution to aggregate productivity, and how changes within these firms can affect aggregate changes, makes use of a productivity decomposition. More precisely, we can decompose the change in the aggregate productivity level over the period by including and excluding firms who are present in a tax haven at some point in the sample. In order to do so, we rely on the Dynamic Olley-Pakes Decomposition (DOPD), proposed by [Melitz and Polanec, 2015], a refined version of the static original decomposition [Olley and Pakes, 1996] (OP).

Basically, the OP decomposition allows assessing whether aggregate changes in productivity stem mostly from increases in technical efficiency (or generalized changes in firm productivity) or from allocative efficiency which implies a reallocation of market shares towards firms with high productivity, also referred to as allocative efficiency.[16] The DOPD additionally allows taking into account changes due to firm entries and exits from the market. In our particular case, the decomposition will allow us showing the mechanism through which the contribution of tax haven MNEs affects the most aggregate productivity changes.

Table 3: Dynamic Olley-Pakes Decomposition (ALP)

	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)	17.65	4.46	13.82	2.08	-2.71

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

[16] A detailed explanation of the DOPD methodology is provided in the Appendix B.2.

The main message of the decomposition is that while the exclusion of tax haven MNEs (those having either an affiliate or a parent in a tax haven) concerns only 18 490 firms (and 79 724 observations) out of 2 354 053 firms (and 17 813 147 observations), the impact on aggregate productivity variation, as measured by ALP, is 4 percentage points (pp) lower than when they are included (17.65 versus 21.51). On top of this, their contribution to the aggregate is essentially explained by the allocative efficiency term, which is almost 6 pp lower when excluded from the decomposition. This means that these firms are indeed among the most productive at the same time as they have large market shares. This should not come as a surprise in light of the literature and descriptive statistics reported above. The same qualitative message is found when analysing aggregate productivity by focusing on TFP (table 9 in Appendix B.2) with an even bigger effect.

This simple exercise shows two important facts about tax haven MNEs. First, that these firms' big market shares translate into big contributions to the changes in the aggregate. Second, that there is a strong selection effect given that firms in tax havens are among most productive firms. These two facts taken together mean that in order to assess the negative contribution of MNEs' offshore profit-shifting to the evolution of aggregate productivity one has to control for selection bias as it is evident that presence in a tax haven is not a randomly assigned variable. Instead, it is the high productive firms who have the incentives and means to offshore profits to low tax countries, which generates a positive selection bias. Therefore, we have to rely on productivity regressions allowing to solve or at least to attenuate the bias, in order to assess the degree of the underestimation of domestic productivity due to MNEs' tax avoidance.

4 Empirical Analysis

4.1 Tax Havens Presence and Productivity

As explained earlier, ALP is less demanding in terms of firm information with respect to TFP, allowing to keep more observations in the analysis. Which is why we privilege an ALP-based analysis over a TFP-based analysis. Nonetheless, for the sake of robustness, we will provide results of each strategy using both productivity measures. This explains why sample size is not the same from one measure to another. Even if both measures are highly correlated, TFP measures control for a broader set of inputs than ALP and hence, results may differ across both measures.

Within a two-way fixed effects framework we begin by estimating the *average effect over the sample period* of tax haven presence on the level of productivity. Next we turn to the analysis of the *dynamic effects before and after* the tax haven entry. This step is important to show how the profit-shifting related mismeasurement evolves over time (post-period estimates) but also to limit the risk of endogeneity related to a non-random choice of entering a tax haven which would translate into non-parallel pre-trends in the cases where a firm would decide to enter a tax haven following a change in productivity (pre-period). The robustness of our results is validated in several ways. First, we inspect the potential econometric issues with the two-way fixed effect set-up adopted in the first place by computing the share of negative weights associated to our average treatment effects obtained in the baseline regressions to ensure that the identification procedure is not polluted by a spurious comparison with always-treated entities. Second, we test whether our results are robust to alternative tax haven lists, where three additional lists are used. Third, we carry a placebo test by assigning the tax haven dummy in a random manner. Last but not least, we use the Cadbury-Schwepps decision of the ECJ (2006) as an exogenous event providing European tax havens with a fiscal comparative advantage enhancing risks of profit-shifting from French entities of a group toward entities located in European low-tax jurisdiction.[17]

Empirical strategy. The first effect of interest is the average relative change in productivity levels (measured in France) of a given firm when she is present in a tax haven, with respect to the average productivity level that she displayed the years before establishing in a tax haven. Thus, in our preferred specification identification will be purely over time, on those firms who change their status (from no presence to presence in a tax haven) over the period of observations. More specifically, we estimate the following two-way fixed effects model for firm f, belonging to sector

[17] See [De Chaisemartin and d'Haultfoeuille, 2020] for details on the problems related to negative weights in two-way fixed effects with heterogeneous treatments and how to solve them.

s at time t,

$$\begin{aligned} ln\,Prod_{fst} =& \beta_1\, \mathbb{1}[MNE_{ft}] \; + \beta_2\, \mathbb{1}[Tax\; haven_{ft}] \\ & + \gamma\, ln\, Prod_{f,1} \; \times \; firm\, trend_{ft} \; + \alpha\, Z'_{ft} \\ & + \; \delta_f + \delta_{st} + \epsilon_{ft} \end{aligned} \tag{1}$$

where $Prod_{fst}$ is alternatively measured by ALP_{fst} and TFP_{fst}. $\mathbb{1}[MNE_{ft}]$ is a dummy variable for MNE status and it is equal to 1 when firm f has a foreign presence (different from a tax haven) in year t and 0 otherwise. In the same fashion, $\mathbb{1}[Tax\; haven_{ft}]$ is an indicator of whether firm f is present in a tax haven (either with a parent or an affiliate company) in year t and 0 otherwise. $ln\,Prod_{f,1} \times firm\,trend_{ft}$ is the initial productivity level of the firm multiplied by the number of years since the firm is observed in the sample. This allows controlling for an eventual mean-reverting process of productivity.[18] Indeed, failure to control for the tendency of high productivity firms to experience a productivity decline over time could bias our results by overstating the negative effect of offshore profit-shifting given that high-productivity firms self-select into tax havens. Z'_{ft} is time-varying firm-level vector of controls (the share of skilled labor, the number of affiliates abroad and export intensity). δ_f and δ_{st} are firm and 2-digit sector $\times$ year fixed effects. The former allow controlling for observable firm heterogeneity to the extent that it doesn't vary over time, while the latter account for aggregate shocks and trends that are common to all firms as well as those that are specific to each 2-digit sector, such as targeted regulations or demand and technology shocks that are sector specific. Finally, ϵ_{ft} is the robust standard error term. Given that our data cover the universe of MNEs and that our "treatment" variable of interest (i.e. presence in a tax haven) as well as the dependent variable (productivity) are firm and time specific, we report robust standard errors and not clustered ones.[19]

We expect the coefficient of the tax haven dummy, β_2, to be negative and significant, according to the theoretical predictions. The results from this baseline specification are displayed in column (2) in Table 4 for ALP (and in Table 11 in appendix C.1 for TFP). A variant of this regression is reported in column (1), where firm fixed effects are dropped. Given that our preferred specifi-

[18]See [Fons-Rosen et al., 2021] for more details.
[19]See [Abadie et al., 2017] for a recent contribution on when and how standard errors should be clustered.

cation includes firm fixed effects, the coefficient of interest captures the differential effect within a given firm, of starting to be present in a tax haven in a given year with respect to the previous years, when she was not a tax haven MNE. In this sense, in the first column, which presents the results of a pooled estimation where no firm effects are included, β_2 is interpreted as the differential effect of being a tax haven MNE with respect to the rest of firms. In this case, there is no reason to expect a negative and significant coefficient given that tax haven MNEs are among the most productive firms in the sample and that these firms also happen to self-select in tax havens (in levels). Last but not least, columns (3) report the baseline regression with saturated fixed effects and including an additional firm-level time-varying control, where we aim to capture any possible changes in real activity in France by including the size of the firm as proxied by log of the number of employees. Indeed, a recent contribution by [Lopez-Forero, 2021] shows that French MNEs downsize employment in France by 8.6% following an entrance in tax havens, suggesting that the use of secrecy jurisdictions allows firms to circumvent severance payments related to mass lay-offs.

Baseline results. As expected, the baseline estimation results of equation 1 display a negative β_2 which is statistically significant at the highest levels for both productivity measures. The tax haven dummy is always negatively and significantly associated with productivity Table 4 for ALP and in Table 11 in appendix C.1 for TFP. In line with the model predictions and with existing literature, our results suggest that a firm's mere presence in a tax haven translates into lower domestic productivity levels. The tax haven effect is around -3.5% as deducted from our preferred specification displayed in column (2) in Table 4.[20] Given that this estimation includes firm fixed effects, we identify the effect of tax haven presence and other covariates by using the variation in firm-level attributes within firm (from one year to another). Thus, our results imply that on average, becoming an MNE who is present in a tax haven (either through an affiliate or a parent) translates into a 3.5% reduction in its level of labor productivity measured in France, with respect to the years before this decision. As mentioned earlier, these estimates are additionally purged from time-varying heterogeneity between sectors, and hence, robust to all shocks

[20]Recall that the percentage effect of a dummy in a log-linearized dependent variable is given by: $100[exp(\beta)-1]$, where β is the estimated coefficient of the dummy variable. For instance, for the coefficient of $1[Tax\ haven]$ in column (2) in Table 4: [exp(0.0341)-1] $\times$ 100 is equal to -3.5%.

Table 4: Baseline

	(1) ln labor productivity	(2) ln labor productivity	(3) ln labor productivity
$\mathbb{1}[\text{Tax haven}_{f,t}] = 1$	-0.0417^a	-0.0341^a	-0.0342^a
	(0.0036)	(0.0037)	(0.0036)
$\mathbb{1}[\text{MNE}_{f,t}] = 1$	0.0539^a	0.0095^a	0.0284^a
	(0.0019)	(0.0020)	(0.0019)
Share skilled$_{f,t}$	0.7089^a	0.1447^a	0.0637^a
	(0.0049)	(0.0066)	(0.0062)
Num. affiliates$_{f,t}$	0.0038^a	0.0020^a	0.0022^a
	(0.0005)	(0.0005)	(0.0006)
Export intensity$_{f,t}$	0.0049	0.0015	0.0017
	(0.0038)	(0.0009)	(0.0011)
$lnALP_{f,1} \times$ firm trend$_{ft}$	0.0080^a	-0.0244^a	-0.0226^a
	(0.0001)	(0.0003)	(0.0003)
ln Employees$_{f,t}$			-0.2539^a
			(0.0023)
Observations	387302	386387	386387
R^2	0.312	0.700	0.730
Adjusted R^2	0.310	0.667	0.701
Firm FE	No	Yes	Yes
2-dig. sector x year FE	Yes	Yes	Yes

Robust *s.e.* in parentheses; ^{c} $p < 0.10$, ^{b} $p < 0.05$, ^{a} $p < 0.01$.

that are sector and year specific. Finally, as presented in table 11 in appendix C.1, our results are robust when the effect is tested on TFP instead of labor productivity. Note however, that the coefficient associated with the presence in tax haven is smaller in magnitude for TFP (1%).

In column (1), we report estimates of a less stringent version of equation 1 where firm heterogeneity is not accounted for and only pair year-2-digit sector effects are included. In this case we identify the covariates and the tax haven effect using the variation in characteristics across firms within sector and year. We find again a negative impact of the tax have presence on firm productivity and the effect is significant at the highest confidence levels as well. This suggests that firms who have either a parent or an affiliate in a tax haven display, on average, a labor productivity that is 3.5% lower than for firms who are not in a tax haven (and 1.1% lower in terms of TFP, as displayed in the appendix).

The estimated coefficients of the rest of the covariates display the expected signs and are highly significant at conventional levels. In line with the literature, our results suggest that MNEs are both more productive than domestic firms ([Helpman et al., 2004a] and that becoming an MNE is related to productivity increases ([Arnold and Javorcik, 2009], [Guadalupe et al., 2012], [Criscuolo and Martin, 2009] and [Fons-Rosen et al., 2021]). In terms of magnitudes, we find an effect of becoming an MNE in our sample is around 0.5% for ALP, which lies within the magnitudes found in earlier literature, as discussed in section 2. In the same way, firms with a higher share of skilled workforce and increases in this share within the firm translate into higher productivity level, with stronger effects for ALP than for TFP -which adjusts for capital variation, probably reflecting that skilled workers complement with capital.[21] Interestingly, the coefficient of initial productivity is positive for pooled regression in column (1) when we exploit the between-firm variation and is negative in (2) for the firm fixed effects regression. This shows that firms who initially have high productivity levels are and remain among the most productive ones. Nonetheless, the existence of a reversion to the mean tendency in firm productivity makes them experience a productivity decline over time. This can only be captured in the firm fixed effects regressions, where one identifies variation purely over time within the firm. This result is in line with [Fons-Rosen et al., 2021] who emphasize the importance of controlling for the productivity mean reversion. Last but not least, when comparing column (2) with column (3), it can be noted that the inclusion the log of the number of employees, which aims at capturing

[21] See for instance [Acemoglu and Restrepo, 2018] for a recent contribution to the literature on skilled-biased technological change.

changes in real activity does not alter the size and the significance of the tax haven dummy. This is important as it allows us to be confident about the fact that our estimates capture a profit-shifting related mismeasurement in productivity and not a decline in real activity.

Negative weights. In a recent paper [De Chaisemartin and d'Haultfoeuille, 2020] show how two-way fixed effects models can result in unreliable estimates of average treatment effects in the presence of heterogeneous effects across groups and time periods. In particular, they show that such models estimate weighted sums of the average treatment effects (ATE) in each group and period, where weights can be negative. The consequence is that linear regression coefficients can appear to be negative while all the ATEs are positive. If this was the case in our set-up, the negative coefficient of our tax haven variable could be the result of a high proportion of negative weights instead of the mismeasurement hypothesis that we test. We thus, compute the share of negative weights associated to our baselines specifications in order to test whether treatment effect heterogeneity is a serious concern for our estimation results. We find that the share of negative weights is lower than 6% for the ALP regressions and 7% for the TFP estimations, we therefore conclude that negative wights are not a concern for our results.

Dynamic effects. Is the *conditional independence assumption* (CIA) verified for our "treatment effect"? If it is the case that, conditional on the control variables, the tax haven dummy is independent from productivity changes, we can give a causal interpretation to our regression estimates of β_2. This requires, however, that the common variables that affect treatment assignment and treatment-specific outcomes be observable. Is it the case? First, it should be emphasized that our estimation approach provides a very stringent test. The set of fixed effects included is exhaustive in that only explanatory variables that simultaneously vary by firm and year can be estimated and where all time variation that is sector specific is purged out. This significantly alleviates concerns regarding omitted variables and alternative explanations. Interestingly, when imposing a firm fixed effect, the magnitude of the tax haven dummy remains relatively stable. By contrast, the dummy variable indicating whether a firm is a multinational one is divided by 5 between column (1) and column (2) in Table 4. This change of magnitude is likely to be driven by the self-selection of the most productive firms to multinational production. Indeed when compared *ceteris paribus* to other firms, the MNE status is associated with a higher level of productivity but this effect is largely decreased when the comparison is done within-firm, suggesting that this self-selection process explains a significant part of the positive coefficient found in column (1). The fact that this pattern is not observed for the tax haven dummy is reassuring for us as it suggests that the entry in tax haven does not necessarily follow a self-selection based on firms' idiosyncratic productivity à la [Helpman et al., 2004b].

Nonetheless, we cannot completely rule out the fact that higher productivity can facilitate the entry of firms in tax havens through unobserved channels: all time-varying determinants of firm productivity - which are not included in our regressions, will be *positively* correlated with our treatment variable, $\mathbb{1}[Tax\ haven]$. This, in turn, will mean that the CIA won't be verified as $\mathbb{E}(\epsilon_{ft}|x_{ft}) \neq 0$ and we won't be able to claim a causal effect. Thus, to the extent that there exist time-varying unobservable determinants of firm productivity, there will be a positive correlation between $\mathbb{1}[Tax\ haven]$ and the error term, in which case the coefficient of the treatment, $\hat{\beta}_2$, will be biased. However, given that $\hat{\beta}_2$ is negative and highly significant and that $cov(\epsilon, \mathbb{1}[Tax\ haven]) > 0$, we believe that the $\hat{\beta}_2$ presented here are likely to be suffering from a bias toward zero.[22] This implies that the mismeasurement of the domestic productivity provided by our estimates should be interpreted as a lower bound of the real mismeasurement of firm productivity.

Note however that assessing the existence of a conditional common trend allows testing whether the dependence between our treatment assignment and the treatment-specific outcome has been removed or at least strongly reduced by conditioning on observable variables. In the case where the choice of entering a tax haven was part of a more general strategy of the firm to re-organize the production and also associated with productivity gains, this would likely pollute the pre-trend with ex-ante changes in the firm's productivity dynamic.[23] To do so, we rely on an event-study design, where we are interested in the impact of the $Event_f$, which is the switch from not being

[22] This is because the most productive firms go to tax havens, as we saw in the descriptive statistics in Table 1.
[23] Recent evidences show that changes in top management are an important drivers explaining firms' entry in tax havens and could also be associated with productivity changes. See [Souillard, 2022]

present in a tax haven to being present in a tax haven, as follows,

$$
\begin{aligned}
ln\, Prod_{fst} = &\sum_{j=2}^{J} \sigma_j\, \mathbb{1}[Lag\, j]_{ft} + \sum_{k=1}^{K} \eta_t\, \mathbb{1}[Lead\, k]_{ft} \\
&+ \rho\, MNE_{ft} + \gamma\, ln\, Prod_{f,1} \times firm\, trend_{ft} \\
&+ \alpha\, Z^{'}_{ft} + \delta_f + \delta_{st} + \epsilon_{ft}
\end{aligned}
\tag{2}
$$

where the set of dummy variables $Lag\, j$ and $Lead\, k$ denote the distance to the $Event_f$ of interest, which is the first entry into a tax haven, and are defined as follows,

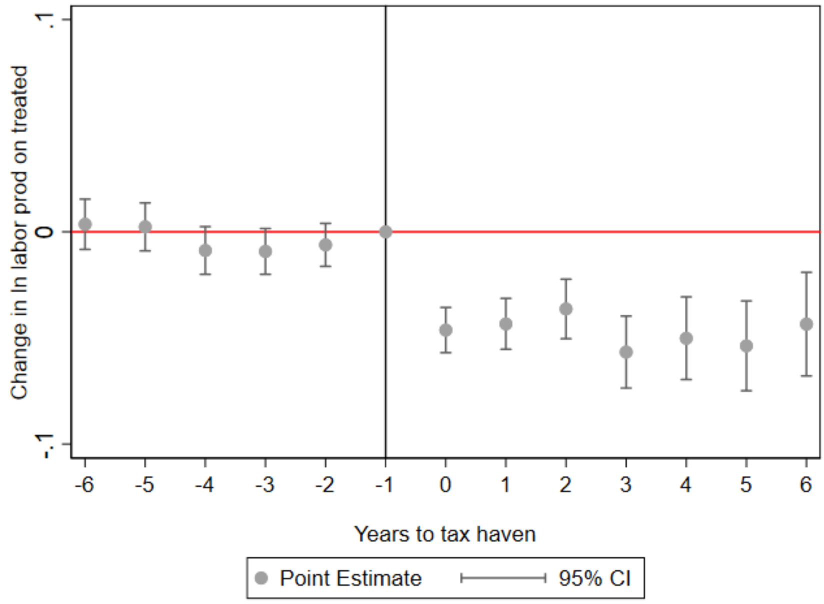
$$
\begin{aligned}
(Lag\ J)_{ft} &= \mathbb{1}[\, t \leq Event_f - J] \\
(Lag\ j)_{ft} &= \mathbb{1}[\, t = Event_f - j]\ for\ j \in \{1, ..., J-1\} \\
(Lead\ k)_{ft} &= \mathbb{1}[\, t = Event_f + k]\ for\ k \in \{1, ..., K-1\} \\
(Lead\ K)_{ft} &= \mathbb{1}[\, t \geq Event_f + K]
\end{aligned}
$$

The final lags and leads accumulate lags and leads beyond periods J and K, in our case we set them equal to 7 years. As indicated in equation 2, the reference period with respect to which we compare the effect of tax haven entry is $j = 1$, which is the year before the event. As before, we include a set of time-varying observables in $Z^{'}$, we control for the fact of becoming an MNE, for any mean-reversion of productivity, firm size, export intensity, the number of affiliates, the share of skilled workers and, importantly, for unobservable firm time-invariant heterogeneity and shocks varying at the level of the sector. If the conditional common trend assumption is verified, then the coefficients on the lags should not be significantly different from zero, in which case we could be confident about an effect caused by the tax haven entry. The results of the event study design are plotted in Figure 3. The corresponding regression table is presented in appendix C.4.

We observe a clear downward negative trend after the tax haven entry, as we did in the previous specifications. The absence of any clear pre-treatment trend makes us confident about the fact that our treatment captures the productivity effect of entering a tax haven and not any other confounding effects. Interestingly, this parallel pre-trend is slightly less verified when not accounting for possible negative real effects related to tax haven entry. Figure 11 in the appendix displays results for the same model as in equation 2 but excluding the log of employees, with pre-event estimates being strictly equal to zero only up to 4 lags and -5 and -6 estimates being positive and significant and with slightly lower post-event coefficients in terms magnitude.

The post-event coefficients suggest long-lasting effects: the bias remains significant 6 years after the entry of a firm in a tax haven suggesting that this feature of their corporate organisation is more structural and more prone to artificial transfers of capital to low-tax jurisdictions. These results are confirmed by the specification of a dummy impact function where only dummies are added for post-period only. Figure 8 in Appendix B.1 plots the coefficients for the first 10 years for the tax haven dummy and the MNE status, confirming the downward trend observed in figure 3. A longer stay in tax haven is indeed associated with a more pronounced bias, an effect that is exacerbated when the sample is restricted to firms with higher intangible share than the median of their sector.

Figure 3: Event study (ALP)



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

Definition of tax haven. The IMF list adopted in this paper presents several advantages such as its comprehensiveness and the objectivity related to its institutional nature. However, this is a list of offshore financial centers that relates directly to the rules and the importance of the offshore financial instruments. While there is an important overlap between the legal rules facilitating offshore finance and corporate profit-shifting, these financial instruments are not the ones used by MNEs for tax planning strategies. For this reason, as is common in the literature, we also test the Dharmapala and Hines (DH) list ([Dharmapala and Hines, 2009], see the list in Appendix C.3) of 41 jurisdictions capturing the coexistence of a low tax rate and legal features prone to tax avoidance.[24] The main difference between these two lists is the presence of Japan and Netherlands in the IMF list. We complement this exercise by the multi-crietria list provided by Oxfam (35 countries). In addition, we construct a list assigning a country as tax haven if it appears on a least two of these three lists (see Appendix C.3).

[24]This list is itself based upon the Hines and Rice [Hines and Rice, 1994] augmented OECD criteria

Finally, an extremely simple but equivalently helpful supplementary check consists in artificially re-defining the ”treatment” variable of interest in such a way that it is not related to the original treatment. Therefore, we re-estimate equations 1 and replace the tax haven dummy by the placebo dummy, where we randomly assign a tax haven presence across different firms-observations in a proportion that is equivalent to the original number of firms-observations. The interest of doing this is that in case the estimated coefficients on the placebo treatment were similar or pointed in the same direction as our benchmark regressions, it would mean that our tax haven dummy fails to capture our effect of interest: the mismeasurement of the domestic productivity.

Results in table 5 shows that the productivity mismeasurement is robust to alternative tax haven lists in columns (2)-(4), with all tax haven coefficients being significant at the highest levels of acceptance and comprised between 2.8% and 4.4% - to be compared to the 3.5% from the baseline model in column (1). The effect is slightly more pronounced for ”restrictive” lists of tax havens (DH-list and consensus list) which are exempt of big tax haven. Indeed the consensus list excludes Japan (only included in the IMF list) and Canada (only included in the Oxfam list) and the DH-list even excludes the Netherlands. This suggests that the effect captured by the tax haven dummy is not polluted by productive transfer of capital toward big tax havens where low taxation is not the only investment determinant. In addition, the results of the placebo test displayed in column (5) appear to be positive and unsignificant which is reassuring for the robustness of the results.

The Cadbury-Schwepps (2006) shock. In order to further ensure that tax-related motives are driving the mismeasurement bias, it is useful to exploit the heterogeneity among tax havens. More precisely, we make use of the fact that countries can limit the extent to which MNEs benefit from low tax rates in tax havens by imposing Controlled-Foreign-Company (CFC) rules. In the case of CFC rules imposed by France, when a company establishes in a tax haven and it is directly or indirectly owned by a French firm, the share of income attributed to the French controlled company can be taxed. Profits of the controlled company are consolidated within the tax base of

Table 5: Alternative lists

	(1)	(2)	(3)	(4)	(5)
	ln labor productivity	ln labor productivity	ln labor productivity	ln labor productivity	ln labor productivity
$\mathbb{1}$[Tax haven$_{f,t}$] =1	-0.0341^a				
	(0.0037)				
$1[MNE_{f,t}] = 1$	0.0095^a	0.0087^a	0.0093^a	0.0092^a	0.0035^c
	(0.0020)	(0.0020)	(0.0019)	(0.0020)	(0.0019)
$Share\ skilled_{f,t}$	0.1447^a	0.1448^a	0.1445^a	0.1447^a	0.1449^a
	(0.0066)	(0.0066)	(0.0066)	(0.0066)	(0.0066)
Num. affiliates$_{f,t}$	0.0020^a	0.0020^a	0.0020^a	0.0020^a	0.0020^a
	(0.0005)	(0.0005)	(0.0006)	(0.0005)	(0.0005)
Export intensity$_{f,t}$	0.0015	0.0015	0.0015	0.0015	0.0015
	(0.0009)	(0.0009)	(0.0009)	(0.0009)	(0.0009)
$lnALP_{f,1}$ × firm trend$_{ft}$	-0.0244^a	-0.0244^a	-0.0245^a	-0.0244^a	-0.0244^a
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
$\mathbb{1}$[Tax haven$_{f,t}$] (Oxfam list) =1		-0.0285^a			
		(0.0037)			
$\mathbb{1}$[Tax haven$_{f,t}$] (Dharmapala, Hines 2009)=1			-0.0444^a		
			(0.0044)		
$\mathbb{1}$[Tax haven$_{f,t}$ (consensus)] =1				-0.0341^a	
				(0.0038)	
$\mathbb{1}$[Tax haven placebo$_{f,t}$]					0.0026
					(0.0024)
Observations	386387	386387	386387	386387	386387
R^2	0.700	0.700	0.700	0.700	0.700
Adjusted R^2	0.667	0.667	0.667	0.667	0.667
Firm FE	Yes	Yes	Yes	Yes	Yes
2-dig. sector x year FE	Yes	Yes	Yes	Yes	Yes

Robust *s.e.* in parentheses; ^{c} $p < 0.10$, ^{b} $p < 0.05$, ^{a} $p < 0.01$.

the parent company while losses cannot be deducted from the tax base. This ensures a minimum taxation of the economic activity of the affiliate and reduces the incentive for the MNE to locate affiliates in low-tax jurisdictions for tax purposes. However, in 2006, the Court of Justice of the European Union (ECJ) made an important decision through the Cadbury-Schwepps case and decided that CFC-rules were not compatible with the freedom of capital within the European Union. This decision therefore made European tax havens (Ireland, Netherlands, Luxembourg, Malta and Cyprus) comparatively more profitable for French MNEs as this decision limits tax authorities' ability to tax back European affiliates.

We exploit this decision as a shock affecting the tax-planning strategies of European MNEs. Other empirical studies have investigated the impact of this decision: [Schenkelberg, 2020] shows that pre-tax earnings of subsidiaries located in European low-tax jurisdictions increased by 10% after this judgment.[Overesch et al., 2018] provide evidence of decrease of effective tax rate for Europeans MNEs (since the ECJ ruling applies in all member States) after 2005. In our case, the question we ask is whether the profit-shifting-related mismeasurement of productivity is more severe for Europeans MNEs based in France (and therefore present in our administrative database) with affiliates located in European tax havens after 2006 compared to other MNEs in our database. Thus, this difference-in-difference exercise exploits the difference of measured productivity from 2006 onwards between firms with investments in European tax havens before the ruling (”treated group”) and other MNEs (”control group”). Because firms can endogenously decide to open-up affiliates in European tax havens following this decision, we add a specification where the control group is restricted to MNEs without presence in European tax havens throughout the whole period. The sample is similar to the one used in the previous regression but firms with a presence in tax havens in 1997 (first year of the sample) are kept since the identification no longer relies on the tax haven entry, explaining therefore the higher number of observations compared to previous regressions. Moreover, since the aim of this exercise is to isolate tax-related strategies' effect on productivity mismeasurement, we add the log of the number of employees to the set of firm level controls to ensure that the results reflect value added shifted to tax havens and not the real changes in value added. We thus estimate the following model,

$$\begin{aligned} ln\, Prod_{fst} = & \beta_1 \, \mathbb{1}[MNE_{ft}] \; + \; \beta_2 \, \mathbb{1}[Treated_f] \; \times \mathbb{1}[Post2005] \\ & + \; \gamma \, ln\, Prod_{f,1} \; \times \; firm\, trend_{ft} \; + \alpha \, Z^{'}_{ft} \\ & + \; \delta_f + \delta_{st} + \epsilon_{ft} \end{aligned} \tag{3}$$

where $\mathbb{1}[Treated\, haven_f]$ takes value 1 if the ruling is binding for the firm when decided by the ECJU and $\mathbb{1}[Post2005]$ takes value 1 if the ruling applies, that is, from 2006 onwards.

Table 6: The Cadbury-Schwepps shock

	(1) ln labor productivity	(2) ln labor productivity	(3) ln labor productivity
CJE-treated=1 × $post-2005$ =1	-0.0183^{b}	-0.0189^{b}	-0.0163^{b}
	(0.0068)	(0.0064)	(0.0062)
$lnALP_{f,1}$ × firm trend$_{ft}$		-0.0220^{a}	-0.0224^{a}
		(0.0005)	(0.0005)
$\mathbb{1}[MNE_{f,t}] = 1$		0.0301^{a}	0.0260^{a}
		(0.0023)	(0.0021)
Share skilled$_{f,t}$		0.0678^{a}	0.0724^{a}
		(0.0084)	(0.0078)
Num. affiliates$_{f,t}$		0.0002	0.0003
		(0.0002)	(0.0002)
Export intensity$_{f,t}$		0.132^{a}	0.127^{a}
		(0.0091)	(0.0097)
ln(employees$_{f,t}$)		-0.248^{a}	-0.250^{a}
		(0.0036)	(0.0033)
Control group	All MNEs excl. post-2005 EU TH	All MNEs excl. post-2005 EU TH	All MNEs
Regressors	No	Yes	Yes
R2	0.69	0.74	0.74
Observations	402,330	388,607	474,618
Firm-FE	Yes	Yes	Yes
2-dig. sector x year FE	Yes	Yes	Yes

Robust *s.e.* in parentheses; ^{c} $p < 0.10$, ^{b} $p < 0.05$, ^{a} $p < 0.01$.

As expected, estimation results in table 6 show a negative and significant -at the 10 per cent level - treatment effect on firm-level apparent labor productivity, which translates into a drop by 1.8% in productivity after the ECJ ruling for firms with ex-ante investments in European tax havens. This result holds without any firm-level control (column 1) and is robust to the inclusion of the set of controls introduced in previous exercises (column 2). Given that our set of controls includes the log of employees, we conclude that the effect captured by our treatment variable is driven by shifts of value added towards tax havens and not by real changes in value added. On top of this, this exercise restricts the control group to firms without presence in European tax havens during the whole period (”All MNEs excluding post-2005 EU TH”) in order to reduce the risk of pollution of the control group by endogenous decision of firms to invest in European tax haven following the ECJ ruling. However, we can allow for a less restrictive control group by including also MNEs in European tax havens after 2006 as in column (3). Estimation results, while slightly lower, are not significantly altered when allowing for firms that decide to establish in European tax havens after 2006 to enter the control group. A possible explanation for a slightly lower magnitude in the treatment effect is that this coefficient additionally captures the ability of MNEs to establish in a tax haven, which, as we have extensively argued in previous exercises, should result in a downward bias as only the most productive firms have incentives to shift their profits to tax havens.

Finally, it is worth noting that the treatment effect coefficient from this DiD is more or less divided by two compared to the baseline results. Note however that for the sake of providing a causal interpretation, here we focus on one side of the story only: profit-shifting through European tax havens starting from 2006. Thus, there is no reason to expect an equivalent effect in terms of magnitude as in our benchmark results, where we have a broader definition of tax havens allowing for wider profit-shifting possibilities and where the timing of of the mismeasurement in productivity is also longer as it starts from 1998.

5 Underlying mechanisms

Before turning to the macro-economic quantification of this measurement bias, we explore the channels through which firms can shift part of their profits abroad. We can broadly distinguish four different ways in which profit-shifting can lead to mismeasurement of the productivity in the home economy.

The first channel through which firms can reduce their profits in high-tax countries is through mispriced intra-firm transactions (transfer pricing) of good or services. Such strategies ultimately artificially reduce the value creation recorded in the domestic economy without corresponding changes in the factors of productions, leading to a reduction of the apparent productivity (labor or TFP). On top of this, a strategic localization of footloose and profitable assets (intangible capital) in low-tax jurisdiction leads to a direct reduction of the tax bill due by the firm on their returns. This optimization of asset localization within the multinational firms also induce a loss of the productivity from the perspective of the high-tax country. Recent evidences (see [Laffitte and Toubal, 2022]) show that MNEs can directly set-up contracts in order to record part of their sales in tax havens. Sales shifting no longer affects the link between economic activity and productivity in the intensive margin but artificially conceals part of the production in high-tax countries with a corresponding loss in terms of productivity.

Finally, an interesting assessment a distinction between the presence of a group in a tax haven through a simple related legal unit that can serve for transfer-pricing or debt shifting purposes and the switch of the parent company from the domestic country to tax haven (usually through the incorporation of the initial headquarter to a broader group lead by an offshore entity). This strategy, also known as "inversion", might have bigger effects on the total tax bill of an enterprise since it provides the whole group with more business-friendly legislation (bilateral investment treaties signed by the tax haven, corpus of international commitments, etc.) and it facilitates earnings stripping plannings.[25]

Empirical strategy. Within the same framework, we therefore explore the tax planning strategies driving the productivity mismeasurement in France. We first test whether our benchmark findings are exacerbated for firms that rely intensively on intangible capital. To do so, we begin by re-estimating equation 1, which we augment with an interaction term between the "treatment" (presence in a tax haven) and an indicator variable of whether the firm belongs to the high or low intangible intensive firms group. Accordingly, we estimate the following equation on the whole sample,

$$\begin{aligned} ln\ Prod_{fst} =& \beta_1\, \mathbb{1}[MNE_{ft}] + \beta_2\, \mathbb{1}[Tax\ haven_{ft}] \\ &+ \beta_3\, \mathbb{1}[Tax\ haven_{ft}] \times \mathbb{1}[Intansh_{ft} \geq p50\ Intansh] \\ &+ \gamma\ ln\ Prod_{f,1} \times firm\ trend_{ft} + \alpha\, Z^{'}_{ft} \\ &+ \delta_f + \delta_{st} + \epsilon_{ft} \end{aligned} \tag{4}$$

[25]The location of corporate debt is an important vehicle for tax optimization: the subsidiary pays interest payments on loans granted by the parent company located in a tax haven and deducts it from its tax bill by reducing its earnings.

where $\mathbb{1}[Intansh_{ft} \geq p50\, Intansh_{st}]$ is a dummy variable indicating whether the firm belongs to the high or low intangibles intensity group within its sector, where the latter is defined with respect to the annual median value of intangible share of the sector in which the firm is operating.[26] As with β_2, we expect the coefficient of this interaction, β_3, to be negative and significant if it is the case that intangible assets facilitate offshore profit-shifting. The results from this first strategy are displayed in column (2) in Table 7 (to be compared with the benchmark results from equation(1), displayed again in this section for the sake of comparability in column 1).

Next, in a second exercise we explore the difference between a presence in tax haven through a simple legal entity and the presence in tax haven through a parent company by replacing the Tax Haven Entry dummy by two dummy variables of tax haven entry through the presence of the parent company and an entry through an affiliate. Estimation results from this exercise are displayed in column (3) in Table 7.

Results. Estimation results in Table 7 confirm our priors. First, the mechanism that we test with the help of the interaction term between our variable of interest, tax haven entry, and intangibles intensity in column (2) suggests that, on average, when a firm belonging to the bottom 50 percent of intangible intensity within its sector enters a tax haven, she experiences a 3% drop on its productivity level (to be compared to -3.5%, the baseline result displayed in column 1). This effect remains significant at the highest levels of acceptance. The opposite is true for firms whose average share of intangibles is above the median share of their sector, with a measurement bias which is exacerbated, although estimated with less precision (at the 10 percent level). In this case, our results suggest an average productivity level decline by more than 4% when these firms become tax haven MNEs.[27] Thus, strategic localisation of intangible capital (patent, trade-

[26]More specifically, $Intansh_{ft} \geq p50\, Intansh_{st}$ indicates that the share of intangible assets (over total assets) of firm f at time t is above the median intangible share of assets of its sector s at time t. Where,

$$Intansh_{ft} = \frac{Intangibles_{ft}}{Intangibles_{ft} + Tangibles_{ft}}$$

and where $p50\, Intansh_{st}$ is the median value observation (not average) of intangibles share observed in sector s at time t.

[27]As explained in footnote 20, the percentage effect of a dummy in a log-linearized dependent variable is given by: $100[exp(\beta) - 1]$, where β is the estimated coefficient of the dummy variable. Here, non-interacted coefficient in column (2 in Table 7 leads to an effect of: [exp(0.0299)-1] × 100 is equal to -3% while the total effect is given by [exp(0.0299+0.0113)-1] × 100=4.2%

Table 7: Mechanisms

	(1)	(2)	(3)
	ln labor productivity	ln labor productivity	ln labor productivity
$\mathbb{1}[MNE_{f,t}] = 1$	0.0095^a	0.0096^a	0.0096^a
	(0.0020)	(0.0019)	(0.0020)
Share skilled$_{f,t}$	0.1447^a	0.1469^a	0.1447^a
	(0.0066)	(0.0067)	(0.0066)
Num. affiliates$_{f,t}$	0.0020^a	0.0021^a	0.0019^a
	(0.0005)	(0.0005)	(0.0005)
Export intensity$_{f,t}$	0.0015	0.0014	0.0015
	(0.0009)	(0.0008)	(0.0009)
$lnALP_{f,1}$ × firm trend$_{ft}$	-0.0244^a	-0.0244^a	-0.0244^a
	(0.0003)	(0.0003)	(0.0003)
$\mathbb{1}$[Tax haven$_{f,t}$] =1	-0.0341^a	-0.0299^a	
	(0.0037)	(0.0050)	
$\mathbb{1}$[Tax haven$_{f,t}$] =1 × $\mathbb{1}$[Above p50 intangible share$_{f,t}$]		-0.0113^c	
		(0.0063)	
$\mathbb{1}$[Above p50 intangible share$_{f,t}$]		-0.0256^c	
		(0.0024)	
$\mathbb{1}$[Tax haven HQ$_{f,t}$] =1			-0.0367^a
			(0.0039)
$\mathbb{1}$[Tax haven af.$_{f,t}$]			-0.0145
			(0.0115)
Observations	386387	386387	386387
R^2	0.700	0.700	0.700
Adjusted R^2	0.667	0.667	0.667
Firm-FE	Yes	Yes	Yes
2-dig. sector x year FE	Yes	Yes	Yes

Robust *s.e.* in parentheses; ^{c} $p < 0.10$, ^{b} $p < 0.05$, ^{a} $p < 0.01$.

marks, etc.) appears to be a key channel explaining the productivity mismeasurement related to offshore profit-shifting.

Second, when we disentangle the tax haven entry effect on productivity between an entry via headquarters versus an entry via an owned entity, our results, displayed in column (3) in Table 7, show a coefficient for the headquarters tax haven dummy which is almost equivalent to the tax haven dummy in the benchmark model (3.7% to be compared to 3.4%) in terms of magnitude and significance; while the tax haven affiliate dummy doesn't appear to be significant at any level of acceptance and displays a much lower magnitude (1.4%). This suggests that the productivity decline related to profit-shifting that we estimate throughout the paper is driven by French firms owned by a legal entity located in a tax haven and rather than by firms owing an affiliate in a tax haven. This result is both surprising and informative about the underlying channel through which profit-shifting operates. Relocating decision centers, a process often referred to as "inversion" strategies, is a way of determining which set of tax rules will prevail regarding transfers of dividend and interests between the affiliate and the headquarter.[28]

6 From Micro to Macro: Aggregate Productivity

The previous sections have presented firm evidences that are in line with our theoretical framework and the literature on how international tax optimization by MNEs can contribute to productivity mismeasurement in high-tax countries and how intangible assets facilitate the optimization strategy given their "footloose" properties and the relative absence of market prices for firm-specific intangibles. Given that MNEs and particularly those with a presence in tax havens are on average very big firms who are responsible for a significant share of total sales, employment and value added, one should expect changes happening within these firms to affect aggregate changes as well.[29] In this sense, we aim at assessing the share of the aggregate variation of productivity that can be explained by micro-level fiscal optimization of MNEs. We do so with the help of our regression results, the tax haven MNEs' weights on total employment and the change in the proportion of firms who have become tax haven MNEs over the sample period.

Predicted aggregate productivity levels. We begin by computing the observed change in aggregate productivity, next we compute the predicted change in aggregate productivity which should have occurred had not MNEs had a presence in tax havens. Finally we compute the difference between these two aggregates, which gives us an approximation of the loss of aggregate productivity that is due to the micro-level offshore profit-shifting of MNEs. Aggregate produc-

[28] The incentives to do inversions are particularly high under worldwide taxation regimes but also exist under territorial tax regimes via the application of CFC rules and non-resident withholding tax rules, for instance.

[29] See descriptive statistics in Table 1 for more details.

tivity ($Prod_t$) in a given year t can be expressed as the weighted sum of individual productivities, as follows,

$$Prod_t = \sum_i \omega_{i,t} \cdot Prod_{i,t} = \frac{\sum_i VA_{i,t}}{\sum_i L_{i,t}}$$

where $Prod_{it}$ can either be ALP or TFP, both in logs or levels and where ω_{it} is the size weight of the firm which can be value added, sales or inputs. In the case where $Prod_{it}$ is measured as value added per hour (in levels) and the weights are employment shares (in terms of hours), $Prod_t$ measures aggregate value added per hour. This is because in this case the weighted average of ALP is exactly equal to the aggregate measure of ALP, defined as the sum of firms' value added over the sum of firms' total number of hours worked. This particular choice has thus the advantage that the aggregate productivity measure that results from the firm-level measure can have a direct data counterpart.[30] Additionally, one can express aggregate productivity in terms of the contribution of firms following their status as domestic or non-tax haven MNEs (NT) on the one hand and, and tax haven MNEs (TH) on the other hand,

$$Prod_t = \sum_{i \in NT,t} (\omega_{i,t}^{NT} Prod_{it}^{NT}) + \sum_{i \in TH,t} (\omega_{i,t}^{TH} Prod_{it}^{TH})$$

where the aggregate change in productivity levels between 1997 and 2015 is given by the difference of each groups' contribution to the weighted average productivity levels in 1997 and in 2015, as

[30] More specifically, if aggregate labor productivity is given in levels and labor is the chosen weight, such that $\omega_{i,t} = \frac{L_{i,t}}{\sum_i L_{i,t}}$, one has that the weighted average exactly corresponds to the aggregate ALP:

$$ALP_t = \frac{\sum_i VA_{i,t}}{\sum_i L_{i,t}} = \frac{\sum_i VA_{i,t} \cdot \frac{L_{i,t}}{L_{i,t}}}{\sum_i L_{i,t}} = \sum_i \left(\frac{VA_{i,t}}{L_{i,t}} \cdot \frac{L_{i,t}}{\sum_i L_{i,t}} \right) = \sum_i \omega_{i,t} \cdot Prod_{i,t}$$

For different ways of aggregating productivity see [Van Biesebroeck, 2008]. Such exact aggregation using total factor productivity appears to be more cumbersome.

follows,

$$\Delta Prod_{97-15} = Prod_{15} - Prod_{97} = \sum_{i,15}(\omega_{i,15} Prod_{i,15}) - \sum_{i,97}(\omega_{i,97} Prod_{i,97})$$
$$= \sum_{i \in NT,15}(\omega^{NT}_{i,15} Prod^{NT}_{i,15}) - \sum_{i \in NT,97}(\omega^{NT}_{i,97} Prod^{NT}_{i,97}) \quad (5)$$
$$+ \sum_{i \in TH,15}(\omega^{TH}_{i,15} Prod^{TH}_{i,15}) - \sum_{i \in TH,97}(\omega^{TH}_{i,97} Prod^{TH}_{i,97})$$

Our econometric results imply that if every MNE that established a new presence in a tax haven between 1997 and 2015 had decided not to, its predicted ALP level in 2015 would have been on average 3.5% higher. Thus, the predicted aggregate productivity change in levels is given by the following expression,

$$\Delta \widehat{Prod}_{97-15} = \sum_{i \in NT,15}(\omega^{NT}_{i,15} Prod^{NT}_{i,15}) - \sum_{i \in NT,97}(\omega^{NT}_{i,97} Prod^{NT}_{i,97})$$
$$+ \sum_{i \in TH,15} \omega^{TH}_{i,15} \underbrace{Prod^{TH}_{i,15}}_{\text{observed}} \underbrace{[1 + |exp(\widehat{\beta}^{TH}) - 1|]}_{\text{predicted gain}} - \sum_{i \in TH,97}(\omega^{TH}_{i,97} Prod^{TH}_{i,97}) \quad (6)$$

where $\widehat{\beta}_{TH}$ is the estimated coefficient from equation (1) and the expression "predicted gain" is the only thing that changes with respect to equation 5. This term represents the additional productivity that we would have observed had THMNEs not been present in a tax haven. Table 8 displays the observed aggregate labor productivity in 1997 and in 2015, the difference between these two aggregates, the predicted aggregate labor productivity in 2015 if THMNEs had not been present in tax havens and the predicted change with respect to 1997. Given the choices made to calculate the aggregate, ALP represents aggregate value added per hour (in our sample), which are tantamount to 34.7 euros per hour in 1997 and 38.8 in 2015.[31] Thus, we observe an increase of 4.1 euros per hour in aggregate labor productivity levels between 1997 and 2015.

[31]It is worth noting that our sample is composed of firms in the market economy who have at least one employee, it excludes therefore public administrations and self-employed. Additionally we drop some specific sectors and firms after the data cleaning. This means that aggregate value added per hour does not necessarily coincide with official statistics.

Our econometric estimates imply that the predicted aggregate labor productivity level in 2015, $\widehat{Prod}_{15}$, would have been 39.2 euros per hour had we not observed firms in tax havens and everything else had remained equal. In which case, the predicted difference with respect to 1997 is 4.5 euros per hour. Thus, we find an 8% difference at the aggregate labor productivity level throughout the whole sample period, due to presence of MNEs in tax havens.[32] This suggests that the "lost productivity", which we claim to be "mismeasured" productivity, has an important macro effect. To see this more clearly, it is useful calculating the respective growth rates of productivity.

Table 8: Observed and Predicted Aggregate Labor productivity

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

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

Predicted aggregate annual productivity growth. In order to calculate the predicted loss in the annual aggregate growth rate of labor productivity we begin by calculating the observed *annual* growth rate of aggregate labor productivity, APG_{97-15}, as follows,

$$APG_{97-15} = \left[\left(\frac{Prod_{2015}}{Prod_{1997}} \right)^{1/18} - 1 \right] = 0.62\%$$

which we compare to the predicted annual aggregate productivity growth rate,

$$\widehat{APG}_{97-15} = \left[\left(\frac{\widehat{Prod}_{2015}}{Prod_{1997}} \right)^{1/18} - 1 \right] = 0.68\%$$

We find thus a difference of 0.06 percentage point between the predicted and the observed annual

[32]This number reflects the predicted difference in aggregate productivity changes as a percentage: (4.47-4.14)/4.14=0.080.

aggregate labor productivity growth (0.62-0.68), which is equivalent to 9.7% loss in the annual growth rate of labor productivity at the aggregate level (expressed in terms of the observed annual labor productivity growth).[33]

7 Conclusions

This paper adds to the literature that examines GDP and productivity mismeasurement issues related to intangible investment and offshore profit-shifting by MNEs. Indeed, the significant slowdown in aggregate productivity over the past two decades has become a major concern in advanced economies. We argue, as [Guvenen et al., 2022] do for the case of the US, that official French productivity statistics are significantly distorted by MNEs' profit-shifting behavior. We propose a new methodology to measure this magnitude of this bias at the firm-level based on systematic deviation of domestic apparent productivity following the entry of a firm in tax haven. This method implies less assumption regarding the production function of MNEs and is robust to a series of robustness checks.

Relying on data of the universe of French firms over 1997-2015 and their bilateral investment abroad, we test whether shifting profits to low tax jurisdiction underestimates domestic productivity and whether the effect is particularly concentrated among intangible intensive firms. For robustness concerns we consider firm productivity by means of two different measures, apparent labor productivity (ALP) and total factor productivity (TFP). Our estimates imply that firm productivity experiences a statistically significant slowdown over the immediate years following an establishment in a tax haven, presumably because part of the profits are not anymore recorded in the home country. More precisely, we show that firm productivity in France experiences a decline with respect to the years before the tax haven presence, with an average estimated drop by 3.5% in labor productivity and 1.3% in total factor productivity. In addition, we find that there are strong dynamic effects, where the longer the presence in a tax haven the more important the decrease in productivity. On top of this, we explore the channel through which firms shift value added offshore: the effect we find is especially strong in firms that are intensive in intangible

[33] This number reflects the annual labor productivity growth that is lost in terms of the observed annual labor productivity growth: (0.0068-0.0062)/0.0062=0.097.

capital, arguably because this type of assets is more easily transferred across countries. Our results also suggest that this bias is more severe when firms establish their parent company in a tax haven.

Given these firms' strong weight in aggregate value added and employment, their productivity evolution has a significant impact at the aggregate level. Our results imply that if tax haven MNEs had not established a new presence in tax havens between 1997 and 2015, aggregate labor productivity annual growth would have been 0.06 percentage point higher, which is tantamount to 9.7% of the observed aggregate labor productivity annually. Besides, our findings are robust to a placebo tax haven presence treatment or to the definition of tax haven adopted. Finally, exploiting exogenous legal changes from the European Court of Justice, this paper is able to isolate the central role of tax optimization in this measurement bias.

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Appendix A Main variables and data description

A.1 ALP construction

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

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

where V_{it} denotes the value added of the firm i in year t, deflated by sectoral price indexes published by INSEE (French System of National Accounts). L_{it} is the average number of hours worked at the firm level, defined as the product of firm employees and 2-digit sector average yearly hours worked per employee. Sector averages are also taken from INSEE. The advantage of using value added instead of gross output or total revenues in this measure is that it controls for the usage of intermediate inputs. For instance, for firms in the retail sector whose activity is based on reselling goods, gross output-based ALP will appear to be very high. As value added is measured as the difference between output (or sales) and intermediate inputs (e.g., resold goods), value added-based ALP allows controlling for differences in intermediate input intensity across firms. Nonetheless, value added-based ALP does not control for differences in capital intensity between firms, and neither for differences in other inputs that are not accounted for in the value added. Total factor productivity (TFP) measures allow this problem to be alleviated, as they control for a broader set of inputs, particularly capital.

A.2 TFP construction

We rely on firm-level data for nominal output and inputs variables and on industry level data for price indexes, average worked hours and depreciation rates.

Output

Gross output is deflated using sectoral price indexes published by INSEE (French System of National Accounts).

Labor

Labor input is calculated by multiplying the number of effective workers at the level of the firm (i.e. number of employees plus number of outsourced workers minus workers taken from other firms) by the average worked hours at the sector level. We rely on sector data given that there is no data on hours worked in the FICUS-FARE census. The annual series for worked hours are available at the 2-digit industry level and provided by the INSEE.

Capital input

Capital stocks are computed using investment and tangible assets (in book values) following the traditional perpetual inventory method (PIM), as follows,

$$K_t = (1 - \delta_{t-1})\, K_{t-1} + I_t \tag{7}$$

where δ_t is the depreciation rate and I_t is real investment (deflated nominal investment). Both investment price indexes and depreciation rates are available at the 2-digit industrial classification from INSEE data series.

Intermediate inputs

Intermediate inputs are defined as purchases of materials and merchandise, transport and traveling, and miscellaneous expenses. These are deflated using sectoral price indexes for intermediate inputs published by INSEE (French System of National Accounts).

Input cost shares

We begin by computing the total cost of production of firm i, belonging to industry I at time t, as follows,

$$CT_{it} = w_{it}L_{it} + c_{It}K_{it} + m_{It}M_{it} \tag{8}$$

where w, c and m denote the wage rate, the user cost of capital and price index for intermediate inputs, respectively. Labor, capital and intermediate inputs cost shares are then respectively given by,

$$s_{Lit} = \frac{w_{it} L_{it}}{CT_{it}} \; ; \; s_{Kit} = \frac{c_{It} K_{it}}{CT_{it}} \; ; \; s_{Mit} = \frac{m_{It} M_{it}}{CT_{it}} \tag{9}$$

Labor cost share is computed by using the variable "labor compensation" in the FICUS and FARE census as a proxy for the theoretical variable $w_{it} L_{it}$. It includes total wages plus income tax withholding. The intermediate inputs cost share is computed by relying on variables on intermediate goods consumption in the FICUS-FARE census and the price index for intermediate inputs in industry I provided by INSEE.

The "user cost of capital" is the rental price of capital and is computed following [Hall, 1988], which in the presence of a proportional tax on business income and of a fiscal depreciation formula (we abstract from any tax credit allowance), is given by,

$$c_{It} = (r_t + \delta_{It} - \pi_t^e) \left(\frac{1 - \tau_t z_I}{1 - \tau_t} \right) p_{IKt} \tag{10}$$

where τ_t is the business income tax in period t and Z_I represents the present value of the depreciation deduction on one nominal unit investment in industry I. Finally, the depreciation is calculated as follows,

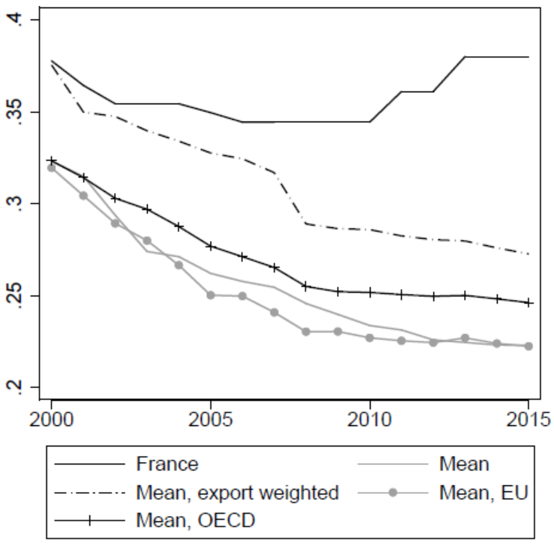
$$z_I = \sum_{t=1}^{n} \frac{(1 - \bar{\delta}_I)^{t-1} \delta}{(1 + \bar{r})^{t-1}}$$

where $\bar{\delta}_I$ is a mean of the industrial depreciation rates and $\bar{r}$ is a mean of the nominal interest rate over the period.

Appendix B Additional descriptive statistics

B.1 Descriptive statistics

Figure 4: Statutory Corporate tax rate France and partners



Source: [Vicard, 2019]

Figure 5: TFP levels

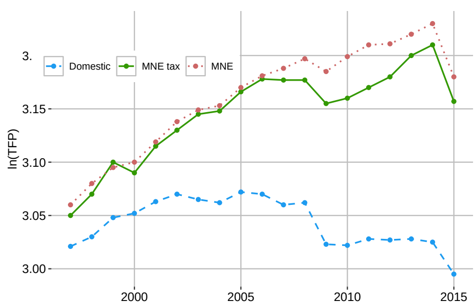
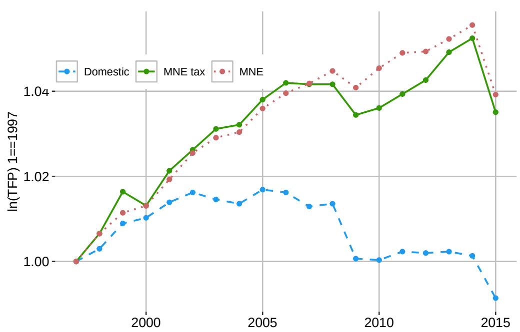


Figure 6: TFP evolution



B.2 Productivity decomposition

Dynamic Olley-Pakes Decomposition (DOPD). Aggregate evolutions are the result of changes at the micro level, where a pertinent question to ask is whether there are compositional effects. In particular, one would like to know if the changes in the aggregate productivity in France stem mostly from generalized changes in firm productivity (i.e., the average firm increases its productivity at constant market shares), from reallocation of market shares towards firms with high productivity (at constant levels of productivity) or from firm entering and exiting the market. In order to assess this question we follow [Melitz and Polanec, 2015] decomposition for productivity, which we apply to aggregate productivity changes.

The decomposition à la Melitz-Polanec, is just a refined measure of the Olley-Pakes (OP) decomposition, where dynamics are taken into account.[34] The advantage of this decomposition is that it reduces the biases due to the fact of not accounting for entries and exits (relative to the basic OP 1996), and those due the fact of using the same reference productivity level for the contribution of survivors, entrants and exitors – i.e., the decompositions based on [Baily et al., 1992]. The authors show that the consequence of these biases is an underestimation of the contribution of an improved allocative efficiency (between firm component). More precisely, we decompose aggregate productivity as follows,

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

Where the change of aggregate productivity Φ of individual firms ϕ_i in a given sector between year 1 and year 2 (in sub-indices) is decomposed into four terms accounting for the contribution of survivors (subindex S), exitors (X) and entrants (E). The first term is the within-firm

[34] As a reference, the basic OP decomposition ([Olley and Pakes, 1996]) for a given point in time,

$$\Phi = \underbrace{\left[\frac{1}{N}\sum_{i}^{N}\phi_i\right]}_{\text{Technical efficiency}} + \underbrace{\sum_{i}^{N}\left(s_i - \bar{s}\right)\left(\phi_i - \bar{\phi}\right)}_{\text{Allocative efficiency}}$$

Where aggregate productivity Φ is decomposed into a within-firm component (first term) and a between-firm component (second term), which is the covariance between the market share of the firm, s_i, and its productivity ϕ_i.

contribution and is the average productivity change of surviving firms in the two periods (S in sub-indices); the second term is measured as the between-firm contribution and is the change in the allocation of market shares among survivors, it is measured as the covariance between firm market shares and productivity; the third term is the contribution of entrants (E which by definition are only observed in period 2 and where the productivity reference is that of surviving firms in period 2); and a fourth term which captures the contributions of exitors (X which are only observed in period 1 and whose productivity is compared to that of the surviving firms in period 1).

Table 9: Dynamic Olley-Pakes Decomposition (TFP)

	Δ Aggregate TFP	Within-firm term	Between-firm term	Exitors	Entrants
All firms 1997-2015	16.36	4.95	19.07	-3.22	-4.43
Excl. tax havens 1997-2015	9.04	4.82	6.70	-0.17	-2.30

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

Table 10: Evolution of MNE and tax haven MNE

	No tax haven	Tax haven	Total
1997	4.6	2.3	4.5
1998	4.5	2.4	4.5
1999	4.6	4.0	4.6
2000	4.8	4.1	4.8
2001	4.7	4.3	4.7
2002	4.9	4.4	4.9
2003	5.0	4.5	4.9
2004	5.0	4.3	5.0
2005	4.9	4.6	4.9
2006	5.2	4.7	5.2
2007	5.3	5.0	5.3
2008	5.4	5.2	5.4
2009	5.9	5.7	5.9
2010	6.0	6.5	6.0
2011	5.9	6.4	6.0
2012	5.8	7.3	5.9
2013	5.9	7.7	5.9
2014	5.9	7.2	6.0
2015	6.0	9.5	6.0
Total	100.0	100.0	100.0

Source: Author's calculations based on LIFI-FICUS-FARE.

Appendix C Empirical results

C.1 Baseline results on TFP

Table 11: Baseline

	(1)	(2)	(3)
	ln TFP	ln TFP	ln TFP
$\mathbb{1}[\text{Tax haven}_{f,t}]$ =1	-0.0111^a	-0.0094^a	-0.0092^a
	(0.0016)	(0.0017)	(0.0017)
$\mathbb{1}[\text{MNE}_{f,t}] = 1$	0.0074^a	0.0051^a	0.0105^a
	(0.0009)	(0.0009)	(0.0009)
Share skilled$_{f,t}$	0.2614^a	0.0579^a	0.0323^a
	(0.0035)	(0.0037)	(0.0037)
Num. affiliates$_{f,t}$	0.0005^b	0.0005^b	0.0005^b
	(0.0002)	(0.0002)	(0.0002)
Export intensity$_{f,t}$	0.0307^b	0.0223^a	0.0229^a
	(0.0097)	(0.0041)	(0.0045)
ln(employees$_{f,t}$)			-0.0748^a
			(0.0014)
$ln\text{TFP}_{f,1} \times \text{firm trend}_{ft}$	0.0323^a	-0.0365^a	-0.0353^a
	(0.0005)	(0.0010)	(0.0010)
Observations	364232	363485	363485
R^2	0.311	0.700	0.712
Adjusted R^2	0.308	0.668	0.681
Firm FE	No	Yes	Yes
2-dig. sector x year FE	Yes	Yes	Yes

Robust *s.e.* in parentheses; ^{c} $p < 0.10$, ^{b} $p < 0.05$, ^{a} $p < 0.01$.

C.2 Dummy Impact Function

Thus, this section focuses in the average change in total productivity levels in France *over time* for each additional year of presence that a given firm spends in a tax haven. More specifically, we allow for time-varying tax haven effects by specifying a "Dummy-Impact Function" as follows,

$$\begin{aligned} ln\ Prod_{fst} = & \sum_{t=1}^{T} \lambda_t\ \mathbb{1}[MNE_{ft}] + \sum_{t=1}^{T} \theta_t\ \mathbb{1}[Tax\ haven_{ft}] \\ & + \gamma\ ln\ Prod_{f,1}\ \times\ firm\ trend_{ft}\ + \alpha\ Z^{'}_{ft} \\ & +\ \delta_f + \delta_{st} + \epsilon_{ft} \end{aligned} \tag{11}$$

where $\sum_{t=1}^{T} \mathbb{1}[MNE_{ft}]$ is a set of dummy variables taking the value of 1 if the firm is an MNE in $t = 1$ and 0 otherwise, 1 if the same is true in $t = 2$ and 0 otherwise, 1 if the same is true in $t = 3$ and 0 otherwise, and so on. In the same spirit, $\sum_{t=1}^{T} \mathbb{1}[Tax\ haven_{ft}]$ 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. The rest of the equation remains unchanged with respect to the baseline equation 1. Thus, the identification of the tax haven presence impact on productivity and other covariates is purely over time and uses variation within the firm. This time, the coefficients of interest relating the tax haven presence and the change in productivity levels are given by θ_t. In this case, each year's impact is evaluated with respect to the average productivity level that the firm displayed over the years before establishing in a tax haven. It isn't therefore, a marginal effect. The results from this estimation are reported in column (1) of Table 12 and the main coefficients of interest are plotted in Figures 8 for ALP below.

The same exercise is done by but by splitting the effect between firms with high and low intensity in intangible capital echoing the interaction variable introduced in table 7. The heterogeneous effects are presented below.

Figure 7: MNE status (ALP)

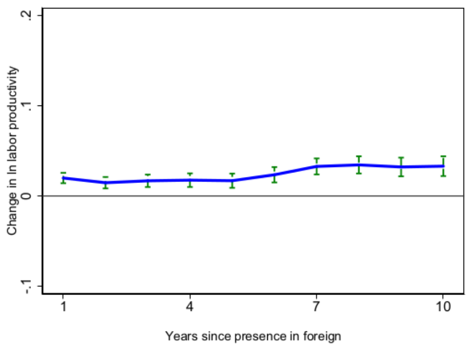


Figure 8: Presence in tax haven (ALP)

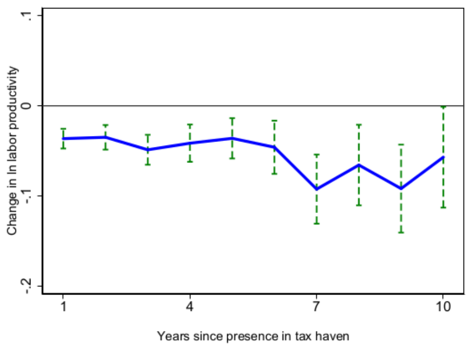


Figure 9: Low intangible intensity

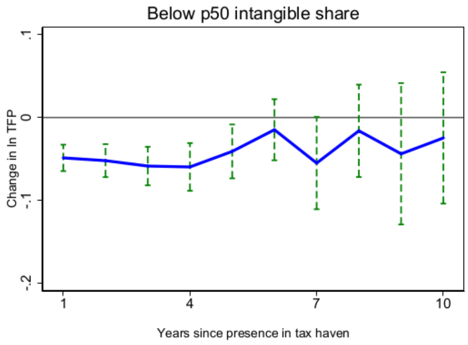


Figure 10: High intangible intensity

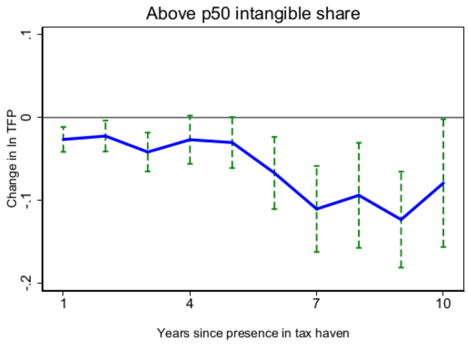


Table 12: Dummy Impact Function

	(1)	(2)
	ln labor productivity	ln TFP
$lnALP\_f,1 \times$ firm trend$_ft$	-0.0246[a]	
	(0.0003)	
$lnTFP\_f,1 \times firmtrend\_ft$		-0.0368[a]
		(0.0010)
yrstax=1	-0.0364[a]	-0.0099[a]
	(0.0056)	(0.0025)
yrstax=2	-0.0349[a]	-0.0136[a]
	(0.0070)	(0.0032)
yrstax=3	-0.0488[a]	-0.0139[a]
	(0.0085)	(0.0036)
yrstax=4	-0.0414[a]	-0.0144[b]
	(0.0105)	(0.0047)
yrstax=5	-0.0361[b]	-0.0140[b]
	(0.0114)	(0.0049)
yrstax=6	-0.0460[b]	-0.0185[b]
	(0.0151)	(0.0088)
yrstax=7	-0.0924[a]	-0.0336[a]
	(0.0195)	(0.0088)
yrstax=8	-0.0657[b]	-0.0277[b]
	(0.0228)	(0.0101)
yrstax=9	-0.0918[a]	-0.0245[b]
	(0.0249)	(0.0101)

Continued on next page

Table12– continued from previous page

	(1)	(2)
	ln labor productivity	ln TFP
yrstax=10	-0.0570[b]	-0.0210[c]
	(0.0285)	(0.0124)
yrstax=11	-0.0667[c]	-0.0188
	(0.0366)	(0.0126)
yrstax=12	-0.0122	-0.0042
	(0.0453)	(0.0134)
yrstax=13	0.0016	0.0112
	(0.0531)	(0.0207)
yrstax=14	-0.0710	-0.0041
	(0.0454)	(0.0137)
yrstax=15	-0.1177[c]	-0.0290
	(0.0647)	(0.0200)
yrstax=16	-0.1171	-0.0278
	(0.0896)	(0.0309)
yrstax=17	-0.1002	-0.0278
	(0.0904)	(0.0473)
yrsmne=1	0.0199[a]	0.0064[a]
	(0.0029)	(0.0014)
yrsmne=2	0.0147[a]	0.0071[a]
	(0.0032)	(0.0015)
yrsmne=3	0.0168[a]	0.0103[a]
	(0.0035)	(0.0016)
yrsmne=4	0.0176[a]	0.0111[a]

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Table12– continued from previous page

	(1)	(2)
	ln labor productivity	ln TFP
	(0.0039)	(0.0017)
yrsmne=5	0.0169^{a}	0.0128^{a}
	(0.0040)	(0.0018)
yrsmne=6	0.0235^{a}	0.0136^{a}
	(0.0043)	(0.0020)
yrsmne=7	0.0328^{a}	0.0195^{a}
	(0.0045)	(0.0020)
yrsmne=8	0.0345^{a}	0.0192^{a}
	(0.0049)	(0.0021)
yrsmne=9	0.0322^{a}	0.0223^{a}
	(0.0053)	(0.0022)
yrsmne=10	0.0331^{a}	0.0258^{a}
	(0.0056)	(0.0023)
yrsmne=11	0.0418^{a}	0.0273^{a}
	(0.0061)	(0.0026)
yrsmne=12	0.0574^{a}	0.0278^{a}
	(0.0064)	(0.0028)
yrsmne=13	0.0669^{a}	0.0281^{a}
	(0.0068)	(0.0030)
yrsmne=14	0.0608^{a}	0.0256^{a}
	(0.0072)	(0.0034)
yrsmne=15	0.0637^{a}	0.0283^{a}

Continued on next page

Table12– continued from previous page

	(1)	(2)
	ln labor productivity	ln TFP
	(0.0080)	(0.0035)
yrsmne=16	0.0874^{a}	0.0344^{a}
	(0.0089)	(0.0037)
yrsmne=17	0.0874^{a}	0.0363^{a}
	(0.0128)	(0.0061)
yrsmne=18	0.0764^{a}	0.0279^{a}
	(0.0165)	(0.0067)
Share skilled_f,t	0.1445^{a}	0.0579^{a}
	(0.0067)	(0.0037)
Num. affiliates_f,t	0.0017^{a}	0.0005^{b}
	(0.0005)	(0.0002)
Export intensity_f,t	0.0015	0.0223^{a}
	(0.0009)	(0.0041)
Observations	386564	363506
R^2	0.701	0.700
Adjusted R^2	0.668	0.668
F	147.2708	51.9775

Robust *s.e.* in parentheses; ^{c} $p < 0.10$, ^{b} $p < 0.05$, ^{a} $p < 0.01$.

C.3 Lists of tax havens

Table 13: List of tax havens

	Dharmapala-Hines	Oxfam	IMF	Consensus
Albania		✓		
Andora	✓		✓	✓
Anguilla	✓	✓	✓	✓
Antigua-and-Barbuda	✓	✓	✓	✓
Antilles (Netherlands)	✓	✓	✓	✓
Aruba		✓	✓	✓
Bahamas		✓		
Bahrain	✓	✓	✓	✓
Barbados	✓		✓	✓
Belize	✓		✓	✓
Bermuda		✓	✓	✓
Bosnia & Herzegovina		✓		
British Virgin Island	✓	✓		✓
Canada		✓		
Cayman Islands	✓		✓	✓
Curacao		✓		
Cyprus			✓	✓
Cook Islands	✓		✓	✓
Costa Rica			✓	
Djibouti			✓	✓
Dominica	✓		✓	✓
Feroe Islands		✓		
Gibraltar	✓		✓	✓
Greenland		✓		
Grenada	✓			
Guam		✓	✓	✓
Guernesey	✓		✓	✓
Hong-Kong	✓	✓	✓	✓
Isle of Man	✓		✓	✓
Ireland	✓	✓	✓	✓
Israel			✓	✓
Japan (Japananese Offhsore Market)	✓			
Jersey	✓	✓	✓	✓
Jordan	✓		✓	✓
Lebanon	✓		✓	✓
Liberia	✓		✓	✓
Liechtenstein	✓		✓	✓

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Table 13 – continued from previous page

	Dharmapala-Hines	Oxfam	IMF	Consensus
Luxembourg	✓	✓	✓	✓
Macao	✓		✓	✓
Malaysia			✓	✓
Maldives	✓			✓
Malta	✓	✓	✓	✓
Northern Mariana Islands			✓	
Marshall Islands	✓	✓	✓	✓
Mauricius		✓		
Montenegro		✓		
Micronesia			✓	
Monaco	✓		✓	✓
Montserrat	✓		✓	✓
Nauru		✓	✓	✓
Niue		✓	✓	✓
Netherlands		✓	✓	✓
Oman		✓		
Palau		✓		
Panama	✓		✓	✓
Philippines			✓	✓
Serbia		✓		
Saint Lucia	✓		✓	✓
Saint Kitts	✓			
Saint Vincent	✓			
Samoa			✓	
Seychelles			✓	
Singapor	✓	✓	✓	✓
Switzerland	✓	✓	✓	✓
Taiwan		✓		
Trinidad and Tobago		✓		
Thailand			✓	
Turks and Caicos Islands	✓		✓	✓
Uruguay			✓	
UAE		✓		
Vanuatu	✓	✓	✓	✓
Number of countries	41	35	53	45

C.4 Event study - Tables and robustness checks

When the control for real activity (log of number of employees) is removed, the pattern remains similar with a slight modification of the pre-trend.

Table 14: Event Study

	(1)	(2)
	ln labor productivity	ln labor productivity
$1[\text{MNE}]_{f,t}$=1	0.0097^{a}	0.0292^{a}
	(0.0020)	(0.0019)
Share skilled$_{f,t}$	0.1449^{a}	0.0640^{a}
	(0.0066)	(0.0062)
Export intensity$_{f,t}$	0.0015	0.0017
	(0.0009)	(0.0011)
Num. affiliates$_{f,t}$	0.0020^{a}	0.0021^{a}
	(0.0005)	(0.0006)
$ln\, ALP_{f,1} \times firm\, trend_{ft}$	-0.0244^{a}	-0.0226^{a}
	(0.0003)	(0.0003)
$ln\, Employees_{f,t}$		-0.2542^{a}
		(0.0023)
Lag 7	-0.0102^{b}	-0.0374^{a}
	(0.0051)	(0.0049)
Lag 6	0.0229^{a}	0.0035
	(0.0065)	(0.0060)
Lag 5	0.0195^{b}	0.0023
	(0.0062)	(0.0058)
Lag 4	0.0024	-0.0088
	(0.0061)	(0.0057)
Lag 3	-0.0027	-0.0092^{c}
	(0.0059)	(0.0055)
Lag 2	-0.0028	-0.0061
	(0.0055)	(0.0052)

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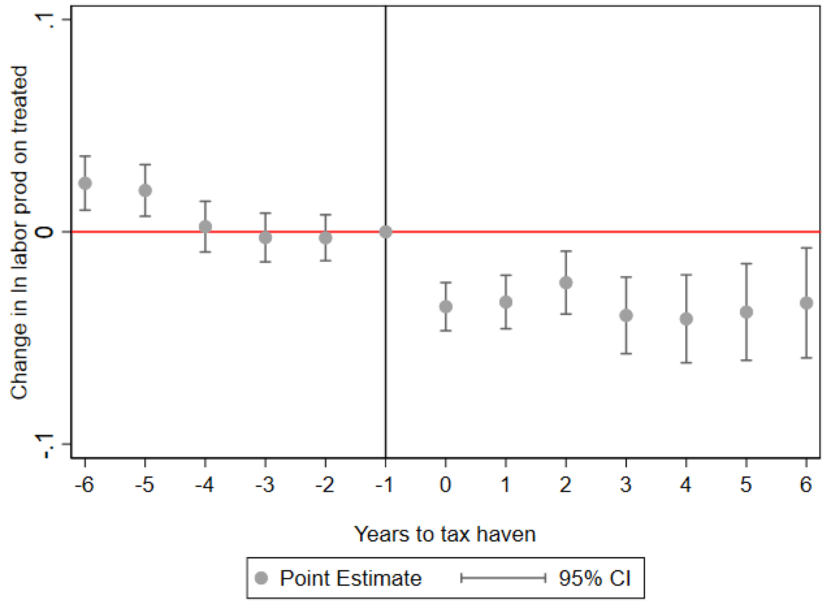
Table 14 – continued from previous page

	(1)	(2)
	ln labor productivity	ln labor productivity
Lead 0	-0.0352[a]	-0.0463[a]
	(0.0058)	(0.0054)
Lead 1	-0.0331[a]	-0.0433[a]
	(0.0064)	(0.0061)
Lead 2	-0.0239[b]	-0.0363[a]
	(0.0076)	(0.0072)
Lead 3	-0.0394[a]	-0.0566[a]
	(0.0092)	(0.0086)
Lead 4	-0.0410[a]	-0.0501[a]
	(0.0106)	(0.0099)
Lead 5	-0.0378[b]	-0.0537[a]
	(0.0116)	(0.0108)
Lead 6	-0.0335[b]	-0.0435[a]
	(0.0132)	(0.0125)
Lead 7	-0.0242[c]	-0.0377[b]
	(0.0131)	(0.0124)
Observations	386387	386387
R^2	0.700	0.730
Adjusted R^2	0.667	0.701
Firm FE	Yes	Yes
2-dig. sector x year FE	Yes	Yes

Robust *s.e.* in parentheses; [c] $p < 0.10$, [b] $p < 0.05$, [a] $p < 0.01$.

Figure 11: Event study (ALP)



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