# Productivity Slowdown, Tax Havens and MNEs' Intangibles: where is measured value creation?*

Jean-Charles Bricongne[†] Samuel Delpeuch[‡] Margarita Lopez Forero[§]

November 9, 2021

**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 drop by 3.5% in labor apparent productivity. We argue that this productivity decline, following a presence in a tax haven, is most likely explained by multinationals' tax optimization, where domestic productivity is underestimated as profits are not recorded anymore in the home country. The fall in productivity is especially strong for firms that are intensive in intangible capital and is equivalent to 4.1% (versus 2.7% for low intangible intensive firms), reflecting the fact that these types of assets are more easily shifted across countries and facilitate tax planning. Our results additionally suggest that the mismeasurement has strong dynamic effects, as the decline becomes more important the longer the firm remains in a tax haven.Finally, given these firms' weight in the economy, our results imply an 8% loss at the aggregate in terms of the level of the labor productivity throughout the whole sample period, which is equivalent to an annual loss of 9.7% in terms of the aggregate annual labor productivity growth.

JEL *classifications*: D33, F23, H26, H87, O47
*Keywords*: Tax Havens, Profit shifting FDI, Productivity slowdown, Productivity mismeasurement, Intangible capital.

---

*An earlier version of this paper circulated under the title "Productivity Slowdown and MNEs' Intangibles: where is productivity measured?". The views expressed are those of the authors and do not necessarily reflect official positions of France Stratégie or Banque de France. Margarita Lopez Forero thanks France Stratégie for financial support. This work has been carried out while she was working at France Stratégie in the framework of the French National Productivity Board. All remaining errors are ours. The authors thank useful comments from Benjamin Michallet, Aymeric Lachaux, Sébastien Turban, Vincent Vicard, Alexander Himbert, Vincent Aussilloux, Baptiste Souillard, Sébastien Laffitte, Peter Gal and seminar participants at GSIE, CEPII, Paris 1, Paris-Saclay, Banque de France, OECD, RGS, OFCE and SciencesPo. Special thanks to Anne Epaulard, Anne-Laure Delatte and Grégory Verdugo for extensive feedback. This research was supported by a French state grant to the COMUE Université Paris-Saclay (ANR-11-IDEX-0003-02).

[†]Banque de France, email: `jean-charles.bricongne@banque-france.fr`

[‡]SciencesPo, email: `samuel.delpeuch@sciences-po.fr`

[§]**Corresponding author:** Evry University/Paris-Saclay, email: `margarita.lopez@psemail.eu`

# 1 Introduction

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 cross-country transfer of intangible 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 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 costomer 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 aiming at reducing their tax bills of MNEs, 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.[1] 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-mispricing (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 in-

[1] [Haskel and Westlake, 2018].

tangible economy has provided new tools for MNEs to offshore their profits to low tax countries.[2]

Beyond measurement issues, which have long been a topic of academic debate and a concern of 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.[3] 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 Lux Leaks 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 claim 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 mismeasurements associated with the offshore world therefore appear to be consubstantial issues raising both political reforms and economic clarifications.[4]

This paper relates to the latest. Its aim boils down to a study of the relationship between micro-level tax avoidance allowed by intangible assets, firm productivity mismeasurement and domestic aggregate productivity slowdown for the case of France. As [Guvenen et al., 2017] do for the case of the US, we evaluate the distortion created by MNEs' behavior towards taxation in official

[2]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]).

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

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

French productivity statistics and the contribution of intangible capital. Thus, our analysis adds to the literature aiming at explaining the productivity growth slowdown in advanced economies and the disruptive link between intangibles and productivity.

In order to do so, 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 across firm intensity in intangible capital, 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 this decline is not captured by the firm fixed effects or the sector-year effects. 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 over-estate the negative effect of offshore profit shifting as high productivity firms have higher incentives to invest in tax havens. Furthermore, we evaluate the dynamic effects by asking whether the productivity differential for firms with presence in tax havens evolves over time. If yes, what is the mediating role of intangible capital, given that arguably these types of assets facilitate fiscal optimization as they are more easily transferred across countries and their prices are more easily alterable in intra-firm transactions. Our results show that higher shares of intangible assets indeed relate to lower productivity levels when firms establish a new presence in a tax haven country, and that the productivity differential increases with tax haven presence over time. Further, intangible capital plays a significant role in mediating the tax haven presence effect over time on productivity.

More precisely, 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 by 3.5% in labor productivity and 1.3% in total factor productivity. The fall in productivity is especially strong for firms that are intensive in intangible capital, where the level of apparent labor productivity (ALP) is on average reduced by 4.1% when a firm becomes a tax haven MNE and belongs to the high intangible intensive group of firms, while it is on average reduced by 2.7% for low intangible intensive firms. In the case of the total factor productivity (TFP), we find an average impact of -1.5% for firms above the median intangible intensity and around -0.9% for lower intangible intensive firms. 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 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 a placebo test of the "tax haven presence treatment" and given that highly productive firms self-select into tax havens, we argue that our estimates are likely to be biased toward zero, providing, therefore, a lower bound of the true productivity mismeasurement.[5]

Thus, we first show how international tax optimization by MNEs translates into a downward mismeasurement of firm productivity in high-tax countries and how intangible assets, given their "footloose" properties and the relative absence of market prices for firm-specific intangibles, facilitate the optimization strategy. Then, we quantify the aggregate implications of the firm productivity mismeasurement., which we do with the help of the firm 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. Indeed, 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.[6] Our results imply that the share of the

[5]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.

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

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; in Section **??** we develop a simple analytical framework to highlight the mismeasurement mechanism; Section 4 explains the econometric methodology, reports the empirical findings and a robustness analysis; Section 5 discusses the aggregate implications of micro level offshore profit shifting and Section 6 concludes.

## 2 Related Literature

This section briefly presents a non-exhaustive review of closely related work and compares the magnitude of our results with previous findings in the literature. First, this paper is naturally 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' off-shore profit shifting represents around 9.7% of the observed average productivity annual growth from 1997 to 2015 in France.

Additionally, new free digital products, usually funded through advertising or selling customers' information to third parties, have increasingly improved households' ability to produce non-market services for own consumption. This increasing share of consumption that has become part of 'home production' has undoubtedly increased consumers' welfare, all by being entirely excluded from GDP measurement. In accordance with the international statistical standards, platform-enabled non-market production, which increasingly replaces activities that were previously exchanged in the market economy, such as travel agencies, doesn't enter in standard measures of productivity. In this sense, [Bean, 2016] suggests that if the digital economy was fully accounted for in official statistics, the average growth rate of the UK between 2004 and 2015, would have been between 0.3 and 0.6 percentage point higher. In the case of the US, the mismeasurement of the digital sector on labor productivity growth is around 0.3 percentage point.[7]

Furthermore, globalization has allowed MNEs' production to be fragmented across different countries, which together with the increasing digitalization of the economy poses challenges to the definition of production location as it may become an ambiguous concept. Intangibles, such as intellectual property assets, which are particularly important in digital enterprises, are easily relocated and 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 took place. Even if MNEs relocating abroad for tax reasons may pertain to any sector of the economy, the digital sector is particularly subject to mismeasurement given that digital enterprises are highly intensive in intangibles making it easier for these firms to have headquarters or intellectual property in low tax jurisdictions. MNEs' relocations mismeasurement of the digital sector may be overestimated in low-tax countries and understated in high-tax jurisdictions, particularly those hosting significant operations of digital MNEs, such as the US. In this sense, the IMF states that a conservative estimate of the digital portion of MNEs' output relocated in tax havens is 0.4 percent of US GDP in 2015 [International Monetary Fund, 2018].

Finally, the academic literature and statistical offices have extensively documented measurement issues that are related to tax evasion that go beyond the digital sector 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

[7] See [International Monetary Fund, 2018] for more details on measuring the digital economy and its effects on official statistics.

–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 particular 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] seek 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. [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., 2018a]. Interstingly, 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 lies in bringing 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., 2017], who quantifies the contribution of US MNEs offshore profit shifting to the slowdown of aggregate productivity by using a *formulary apportionment* technique.[8] Their results imply that adjusting for MNEs' profit shifting raises productivity growth annually by 0.09% for 1994-2004 and by 0.24% annually for 2004-2008. The adjustment is especially strong in R&D intensive sectors, with a 0.53% increase for 2000-2008. In our case, our econometric findings imply that the level of firm labor productivity is on average reduced by 3.5% when a firm establishes in a tax haven, by 4.1% when the MNE belongs to the high intangible intensive group of firms, while it is on average reduced by 2.7% for low intangible intensive firms. For comparison with [Guvenen et al., 2017], this implies an aggregate annual labor productivity growth, which adjusted for the loss related to firm presence in tax havens throughout 1997-2015, increases by 0.06%.

[8]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 labor inputs and sales to unaffiliated entities.

# 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[9]. 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 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 (Customs, 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

[9] Excepting one person firms.

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 reported in Table 17 in the Appendix B.

The firm-level trade data are provided by the French Customs and they contain the universe of import and export flows by French firms located in the metropolitan territory. The data are collected at the 6-digit (NC6) product level, by destination and year. Size dependent reporting thresholds apply but these do not affect our sample representativeness given that we focus on MNEs and these are typically very large firms.[10]

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 millions 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 5.

Finally, in order to better capture the change in productivity levels that is due to offshore profit

[10]For more details on Customs data in France see [Bergounhon et al., 2018].

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<br>99.88 | 18,841<br>0.12 | 15,343,901<br>100.00 |
| 1 | 12,385<br>17.90 | 56,796<br>82.10 | 69,181<br>100.00 |
| Total | 15,428,445<br>99.51 | 75,637<br>0.49 | 15,504,082<br>100.00 |

*Note:* Transitions in frequencies and percentages.

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 3.

Table 3: Transitions matrix (Markov), regression sample

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

*Note:* Transitions in frequencies and percentages.

## 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 reflects output per hour worked while the latter, additionally adjusting for the contribution of capital and materials, provides a measure of technological change. More specifically, we construct these variables as follows:

- *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.[11] 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.

- *Total Factor Productivity* (TFP): is a non-parametric estimation computed by using the so-called *Multilateral Productivity Index* developed by [Caves et al., 1982] and extended by [Good et al., 1997].[12] The advantage of this method is that it is based on an index number

[11] Appendix A provides a detailed description of the construction of labor.

[12] Alternative methods for calculating productivity in the literature consist in estimating a production function

approach which provides a productivity measure defined as the deviation with respect to a reference firm. Thus, it does not require a direct estimation of technology, which implies making assumptions about the underlying production functions. More precisely, we compute the TFP index for firm $i$ at time $t$ as follows,

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

where $\text{Y}_{it}$ is real gross output of firm $i$ at time $t$, using the set of inputs X unit (labor, capital and materials). S unit is the cost share of input X unit in the total cost. The symbols with an upper bar are the corresponding measures for the reference point (the hypothetical firm). They are computed as the arithmetic mean of the corresponding firm level variables over all firms in year t. Subscripts $\tau$ and $n$ are indices for time and inputs, respectively. This methodology is particularly suited to comparisons within firm-level panel data sets as it guarantees the transitivity of any comparison between two firm-year observations by expressing each firm's input and output as deviations from a single reference point for each year. Appendix A provides a full description of the variables used to construct this measure.

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

with inputs capital ($K$), labor ($L$) and materials ($M$) to explain output ($Y$) and then retrieving the residual. Various strategies aiming at accounting for the endogeneity of labor have been proposed. The most widely used is [Wooldridge, 2009], which is a modification of the approach proposed by [Levinsohn and Petrin, 2003] and [Ackerberg et al., 2015] to control for unobserved productivity shocks using intermediate inputs.

for capital-intensive firms and sectors. As previously mentioned, TFP measures control for a broader set of inputs than ALP.

### 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 levels in the whole market economy by firm type, from 1997 to 2015, as measured by ALP and TFP, respectively. Firms are classified according to their presence abroad in year $t$, where firm $i$ is classified as an MNE if she has a foreign 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.[13]

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 is 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

[13]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.

starts to become a relatively high-tax country.[14]

Figure 1: ALP levels


Figure 2: TFP levels

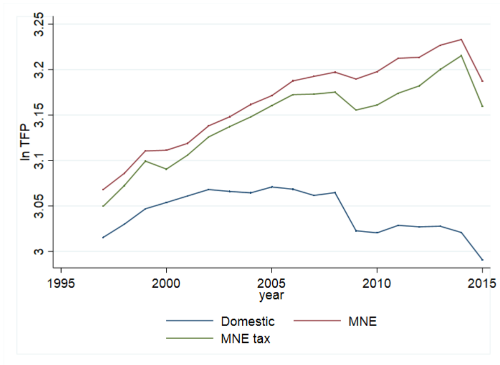



Figure 3: ALP evolution

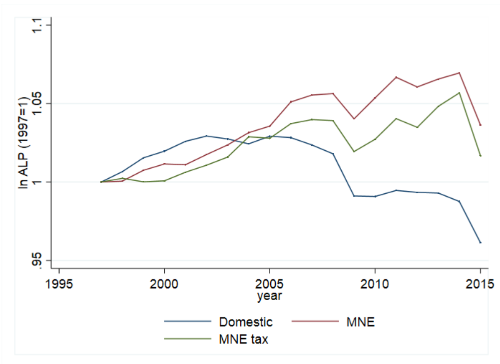
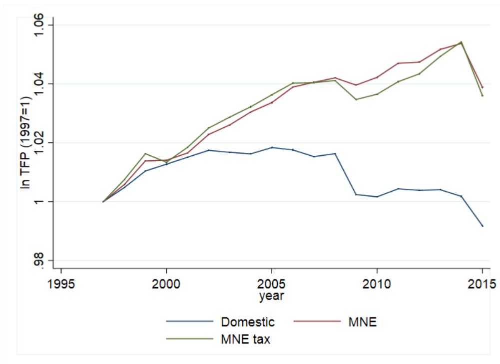



Figure 4: TFP evolution




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 3 and 4 for ALP and TFP, respectively. 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

[14]See Figure 11 in the Appendix.

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 11 in the Appendix, 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.[15]

In this context, it comes as no surprise that tax haven MNEs proliferate in France in the past years. Table 4 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, 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.[16] 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

[15]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).

[16]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.

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".

Table 4: Distribution of MNEs over time

| | 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.

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 Tables 1 and 15, 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 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), recently proposed by [Melitz and Polanec, 2015], a refined version of the static original decomposition [Olley and Pakes, 1996] (OP). A detailed explanation of the DOPD methodology is provided in the Appendix C.

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

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

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

Table 6: ALP Dynamic Olley-Pakes Decomposition with/without MNE in tax havens

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

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

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 TFP, is 8 percentage points (pp) lower than when they are included (7.95 versus 15.96). On top of this, their contribution to the aggregate is essentially explained by the allocative efficiency term, which is almost 13 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 ALP.

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 (as reported in Table 14 in Appendix B), 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 Mechanisms and channels of mismeasurment

Before turning to the empirical analysis, it is worth mentioning the channels through which firms can shift part of their profit in low-tax jurisdictions and how these tax planning strategies might affect the measurement of productivity at the firm level in France. We can broadly distinguish four different ways in which profit shifting can lead to mismeasurment 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. Another important vehicle for tax optimization is the strategic localisation of corporate debt: interest payments from affiliates situated in low-tax jurisdiction related parties in tax haven reduces the overall tax bill. Insofar our measure of value-added does not incorporate finance costs.[17] Lastly, recent evidences (see [Laffitte and Toubal, 2019]) show that MNEs can directly set-up contracts in order record part of their sales in tax havens. Sales shifting no longer affects 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.[18]

## 4.2 Tax Havens Presence, Productivity and Intangibles

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 at each time 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.

[17] Value added in our case is defined based on the commercial margin and not on net income excluding any variation that would be due to finance costs

[18] In order to clarify the patterns just described, we develop a simple model of global sourcing where domestic firms can contract with an affiliate located in a tax haven in section E.

Within a differences-in-differences framework we begin by estimating the *average effect over the sample period* of tax haven presence on the level of productivity in subsection 4.2. Within the same framework, with the help of two alternative strategies we then test the conditionality of this effect on intangible assets: an interaction term and regressions on separate samples. Next we turn to the analysis of the *dynamics of the productivity effect* of tax haven firm presence and its conditional effect on intangible assets within a "Dummy-Impact Function" in section 4.3. Finally, in subsection 4.4 we include two robustness check by implementing a placebo test on the tax haven dummy and by computing the share of negative wights associated to our average treatment effects obtained in the baseline regressions, we then present a discussion on the main threats to causality and the eventual direction of the resulting bias.[19]

**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 $s$ 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

[19] 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.

whether firm $f$ is present in a tax haven (either with a parent or an affiliate company) in year $t$ and 0 otherwise. $ln\,Prod_{f,1} \times firmtrend_{ft}$ 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.[20] 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.[21] $Z'_{ft}$ is time-varying firm-level vector of controls (the share of skilled labor and the number of affiliates abroad). $\delta_f$ and $\delta_{st}$ 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, $\epsilon_{ft}$ 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.[22]

We expect the coefficient of the tax haven dummy, $\beta_2$, to be negative and significant, according to the theoretical predictions. The results from this baseline specification are displayed in column (2) in Tables 7 and 8 for ALP and TFP, respectively. A variant of this regression is reported in column (1), where firm fixed effects are dropped. Given that our preferred specification 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, $\beta_2$ 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).

[20]See [Fons-Rosen et al., 2021] for more details.
[21]See Table 14 in Appendix B for detailed statistics.
[22]See [Abadie et al., 2017] for a recent contribution on when and how standard errors be clustered should.

The next question that we ask, is whether the productivity effect of tax haven presence is mediated by firms' intangible assets intensity facilitating offshore profit shifting. To answer this we condition our results to depend on firms' intangibles intensity by implementing two different strategies: interaction terms and separate samples. In this sense, 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,

$$\begin{aligned} ln\,Prod_{fst} =& \beta_1\, \mathbb{1}[MNE_{ft}] + \beta_2\, \mathbb{1}[Tax\,haven_{ft}] \\ &+ \beta_3\, \mathbb{1}[Tax\,haven_{ft}] \times \mathbb{1}[Intansh_f \geq p50\,Intansh] \\ &+ \gamma\, ln\,Prod_{f,1} \times firm\,trend_{ft} + \alpha\, Z^{'}_{ft} \\ &+ \delta_f + \delta_{st} + \epsilon_{ft} \end{aligned} \tag{2}$$

where $\mathbb{1}[Intansh_f \geq p50\,Intansh]$ is a dummy variable indicating whether the firm belongs to the high or low intangibles intensity group, where the latter is defined with respect to the median value.[23] Note that given the fixed-effects estimator, the main effect of this variable is not identified provided that it is constant over time but its interaction term with $\mathbb{1}[Tax\,haven_{ft}]$ can be identified, given its variation over time. Again, as with $\beta_2$, we expect the coefficient of this interaction, $\beta_3$, 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 (3) in Tables 7 and 8 for ALP and TFP, respectively.

Alternatively, our second strategy consists in re-estimating equation 1 for firms whose average share of intangible assets is above and separately for those below the median value share of intan-

[23]More specifically, $Intanshf \geq p50\,Intansh$ indicates that the average share of intangible assets (over total assets) of firm $f$ over the whole period is above the median intangible share of assets in the sample. Where,

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

and where $p50\,Intansh$ is the median value observation (not average) of intangibles share observed over the whole sample period.

gible assets observed in the sample period (using the same condition defining intangible intensity in the interaction term in the first strategy). In this case, we expect $\beta_2$ to be stronger (more negative) for the sample of intangible intensive firms. The results from this second strategy are presented in Table 9.

**Results.** As expected, the baseline estimation results of equation 1 display a negative $\beta_2$ which is statistically significant at the highest levels for both productivity measures. 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. In the case of ALP, the tax haven effect is around -3.5%, while it is around -1.2% for TFP, as deducted from column (2) in Tables 7 and 8, respectively.[24] 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 that are sector and year specific.

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 lower measured productivity in France than firms who are not in a tax haven, which can either be domestic or MNEs firms (-4.4% for ALP and -1.1% for TFP). From the stylized facts in Figures 1 and 2 it should come as no surprise that tax haven MNEs display a lower domestic productivity than other MNEs. Indeed, this is a result which is in line with the model predictions and with

[24] Recall that the percentage effect of a dummy in a log-linearized dependent variable is given by: $100[exp(\beta)-1]$, where $\beta$ is the estimated coefficient of the dummy variable. For instance, for the coefficient of $1[Tax\ haven]$ in column (2) in Table 7: [exp(-0.0357) -1] is equal to -3.507.

the literature on MNE profit shifting. Nonetheless, in light of the literature and our stylized facts, it may at first appear surprising that tax haven MNEs display lower average productivity levels than domestic firms. The reason for this, is that our regression sample kept only firms who are MNEs at some point of the sample period and thus, we are identifying the effect among firms who are already the most productive firms among the universe of firms.[25]

Table 7: Apparent Labor Productivity Baseline Regressions

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

Standard errors in parentheses
All regressions include time-varying firm controls, robust standard errors in parentheses
$^c$ $p < 0.10$, $^b$ $p < 0.05$, $^a$ $p < 0.001$

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],

[25]Indeed, when we estimate the between-firm variant of equation 1 on the universe of firms, the significance of $\beta_2$ disappears. Table 18 in the Appendix D reports ALPS pooled regressions on the universe of firms.

Table 8: Total Factor Productivity Baseline Regressions

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

Standard errors in parentheses

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

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

[Criscuolo and Martin, 2009] and [Fons-Rosen et al., 2021]). In terms of magnitudes, we find a TFP effect of becoming an MNE in our sample is around 0.4% (and 0.6% 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.[26] 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.

Finally, is the tax haven mediated by intangibles intensity? More specifically, we aim at testing whether firms who are more intangible intensive are also better able to shift their profits abroad and see a stronger decline in their domestic measured productivity. The results for this test are presented in column (3) in Tables 7 and 8 (for ALP and TFP, respectively) for the first strategy relying on an interaction term and in Table 9 for the second strategy where we instead run the baseline equation on separate samples (we only present the within-firm regressions for both strategies). Our estimation results suggest that is indeed the case that, on average, firms whose average share of intangibles is above the median share, display lower productivity levels when they become tax haven MNEs. This is confirmed with both strategies and with both productivity measures at high levels of statistical significance for both the main effects and the interaction term (either at the 99% or 95% confidence level).

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

For the case of the interaction term strategy (equation 2), the total effect of becoming a tax haven MNE is given by $\beta_2$ for firms with lower shares of intangible and by $\beta_2 + \beta_3$ for intangible intensive firms. Estimates in column (3) in Table 7 indicate that the level of ALP is on average reduced by 4.1% when a firm becomes a tax haven MNE and belongs to the high intangibles intensive group, while it is on average reduced by 2.7% for a firm whose intangible intensity is below the sample median.[27] As expected, when there are non-linear effects, the main tax haven presence effect, $\beta_2$, is slightly reduced in magnitude if one controls for the conditionality on intangibles intensity, with respect to the baseline estimation in column (2), which provides the average effect for all firms. In the baseline result we had an average tax haven effect on ALP of -3.5% while it now becomes -4.1% for intangible intensive firms and -2.7% for firms with lower shares of intangibles. In the case of TFP, although to a lower extent, results in column (3) in Table 8 point in the same direction by suggesting that intangible intensive firms display lower productivity levels when they become tax haven MNEs than in the baseline regressions in column (2). In this case we find an average impact of -1.5% for firms above the median intangible intensity and around -0.9% for lower intangible intensive firms (while the average effect for all firms in the baseline regression was -1.2%).

Turning to the separate samples strategy in Table 9, we again find support for the hypothesis that intangible assets facilitate offshore profit shifting. The first two columns report estimates of equation 1 for ALP, in (1) for the sample of firms with intangible shares below the median value and (2) for firms above the median value. The respective results for TFP are reported in columns (3) and (4). The different estimates of $\beta_2$ across the different samples point to a statistically significant (at the 1% level) average decline in the level of productivity when a firm becomes a tax haven MNE, which tantamount to 2.8% for ALP if the firm belongs to the low intangible intensive group and to 3.6% when the firm belongs to the high intangible intensive group. In the case of TFP, the corresponding average decline is 0.9% for firms below the median value of intangible shares and 1.2% for firms above the median. This strategy's point estimates are quite close in magnitude to those provided by the interaction terms strategy.

[27] For instance, in the case of ALP in column (3) in Table 7 one has that -2.66 -1.43 = -4.08. Where [exp(-0.027) -1] is equal to -2.66 and [exp(-0.014) -1] is equal to -1.43.

Interestingly, coefficients related to MNE (not present in a tax haven) and Number of foreign affiliates lose now all significance for the sample of firms below intangible intensity share median for ALP and for TFP, respectively. An explanation for this is the stringent fixed effects included in the regressions: once time invariant and time-varying sector specific effects are accounted for, very little heterogeneity is left. The MNE dummy among these specific firms must be strongly correlated with different determinants of the evolution of the productivity at the level of the sector (such as technology and demand shocks or changes in regulation). This result comforts us in the robustness of the results concerning our variable of interest, which remains statistically significant at conventional levels across all samples.

Before turning to the analysis of dynamic effects in next section, it is convenient mentioning some caveats about the intangibles shares measure and the reason why a dummy defining high and low shares was chosen over a continuous measure. Intangible assets, in particular in the way they are measured in firms' balance-sheet data, display very little variation over time and are highly correlated with firms' presence in tax havens. Indeed, the literature has emphasized that these assets are very difficult to measure and accordingly they are very poorly captured in firms' balance-sheets.[28] Intangible assets intensity may also be highly correlated with sector specific characteristics and technology shocks and therefore, most of the variance must be subsumed in the firm or sector-year fixed effects. Hence, including a continuous measure instead of the chosen dummy results in a negative impact of intangibles when conditioned to tax haven presence, but is never statistically significant at conventional levels.

All in all, our estimates strongly support the model predictions and imply that international tax optimization affects productivity measurement, which should be underestimated in high tax countries. Our results suggest that foreign presence in a tax haven country is robustly associated

[28]See for instance [Haskel and Westlake, 2018] and [Corrado et al., 2016]. As a matter of fact, given that intangibles are poorly measured at the firm level, there have been recent efforts to construct sectoral level measures (country and year specific). These efforts include INTAN-invest and the latest version of EUKLEMS, where roughly the idea is to take into account "today's resources that are set aside and used to expand tomorrow's production capacity" such as "computerized databases, RD, design, brand equity, firm-specific training, and organizational efficiency", as proposed by [Haskel and Westlake, 2018].

to a drop in firm productivity levels (within estimates) and to lower productivity levels (between estimates), as measured in France. Additionally, the impact appears to be mediated by firms' intangible intensity, pointing to a higher ability to shift profits abroad thanks to intangibles' attributes. This involves for instance, allowing firms to decouple capital location from production location (e.g. intellectual property rights) and to conveniently define asset prices involved in intra-firm transactions depending on cross-country tax differentials (i.e. intangibles often make obsolete the "arm's-length principle" after which intra-firm transactions should be done at prevailing market price, given that many of them are never traded externally and firms can chose whatever price suits them).

Table 9: Baseline Regressions on Separate Samples

| | (1)<br>ln ALP<br>Below p50 Intg. | (2)<br>ln ALP<br>Above p50 Intg. | (3)<br>ln TFP<br>Below p50 Intg. | (4)<br>ln TFP<br>Above p50 Intg. |
|---|---|---|---|---|
| $ln\, ALP_{f,1} \times firm\, trend_{ft}$ | -0.0227$^{a}$ | -0.0260$^{a}$ | | |
| | (0.0006) | (0.0005) | | |
| $ln\, TFP_{f,1} \times firm\, trend_{ft}$ | | | -0.0352$^{a}$ | -0.0368$^{a}$ |
| | | | (0.0015) | (0.0013) |
| $\mathbb{1}[MNE_{ft}]$ | -0.0000 | 0.0091$^{b}$ | 0.0038$^{b}$ | 0.0035$^{b}$ |
| | (0.0031) | (0.0028) | (0.0015) | (0.0013) |
| Share skilled$_{ft}$ | 0.1295$^{a}$ | 0.1637$^{a}$ | 0.0497$^{a}$ | 0.0642$^{a}$ |
| | (0.0111) | (0.0089) | (0.0062) | (0.0050) |
| $\mathbb{1}[Tax\ haven_{ft}]$ | -0.0288$^{a}$ | -0.0368$^{a}$ | -0.0090$^{b}$ | -0.0121$^{a}$ |
| | (0.0060) | (0.0052) | (0.0029) | (0.0024) |
| Num. Affiliates$_{ft}$ | 0.0028$^{a}$ | 0.0015$^{b}$ | 0.0001 | 0.0005$^{b}$ |
| | (0.0006) | (0.0005) | (0.0005) | (0.0002) |
| Observations | 164287 | 225499 | 157291 | 208009 |
| Adjusted $R^2$ | 0.684 | 0.645 | 0.664 | 0.647 |
| Firm FE | Yes | Yes | Yes | Yes |
| 2-dig. sector X year FE | Yes | Yes | Yes | Yes |

Standard errors in parentheses

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

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

### 4.3 Tax Havens, Intangibles and Productivity Dynamics

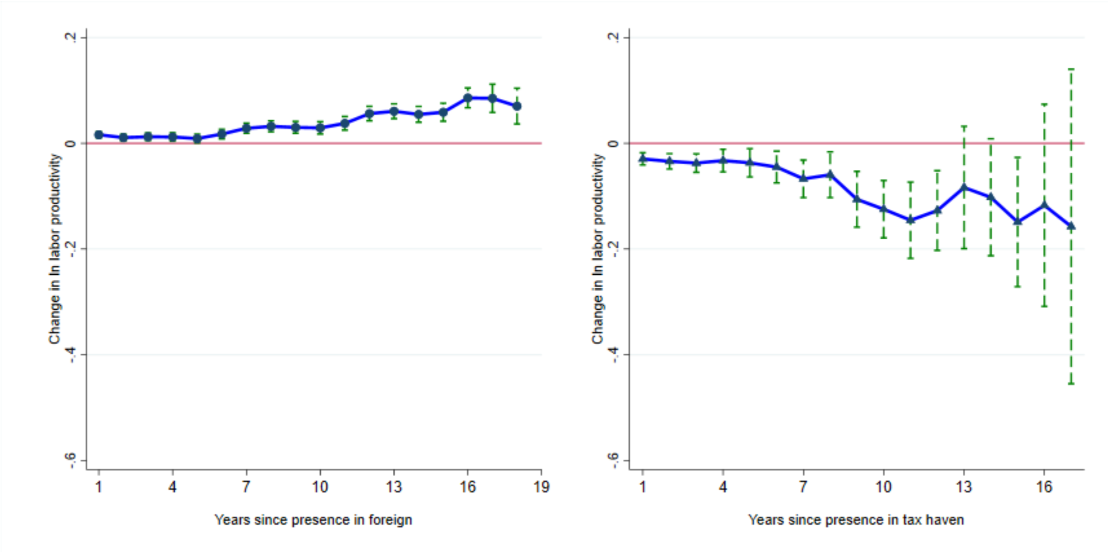
**Empirical strategy.** In order to explore the dynamic effect of tax haven presence on firm productivity, we allow the impact to vary with the number of years of the tax haven presence. Thus, this section focuses in the average change in total productivity levels in France *over time* for each additional 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,

$$\begin{aligned} ln\ Prod_{fst} = & \sum_{t=1}^{T} \lambda_t\ \mathbb{1}[MNE_{ft}] + \sum_{t=1}^{T} \theta_t\ \mathbb{1}[Tax\ haven_{ft}] \\ & + \gamma\ ln\ Prod_{f,1}\ \times\ firm\ trend_{ft}\ + \alpha\ Z^{'}_{ft} \\ & +\ \delta_f + \delta_{st} + \epsilon_{ft} \end{aligned} \tag{3}$$

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 $\theta_t$. 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 Table 19 in the Appendix D and the main coefficients of interest are plotted in Figures 5 and 6, for ALP and TFP, respectively.

In order to assess the differential tax haven impact due to intangibles intensity in the impact function, equation 3 is then separately estimated for firms above and below the median intangible share value, as in the previous section. Results from these estimations are reported in Table 20 in the Appendix D and the coefficients of interest are plotted in Figures 7 and 8 for ALP and TFP, respectively.

Figure 5: Foreign Presence and Labor Productivity Dynamics

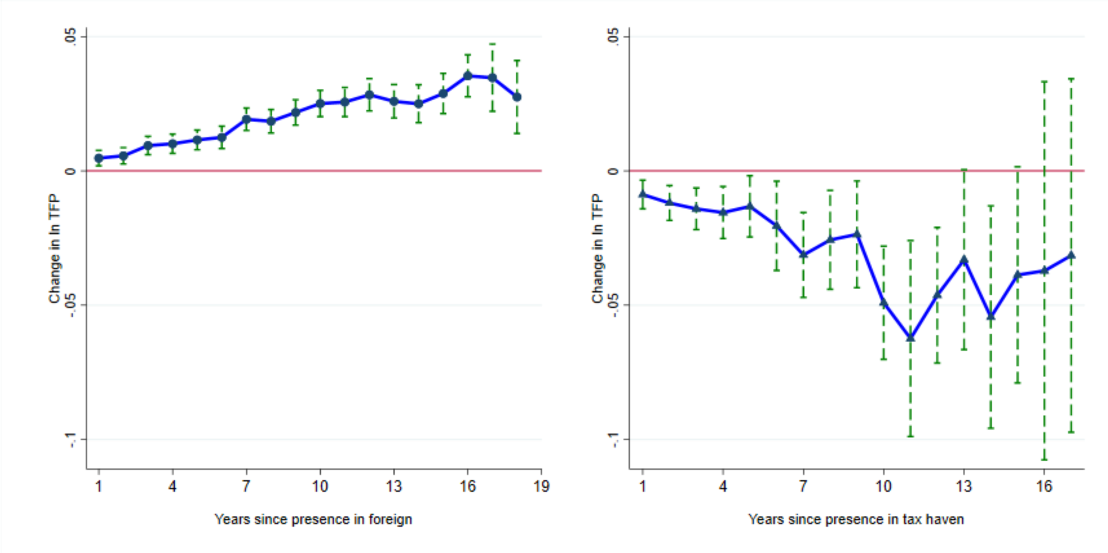



Note: Plot of estimated coefficients of year dummies indicating MNE presence and MNE tax haven presence (solid blue line) and the corresponding CI (dashed green lines).

**Results**. Regression estimates in Table 19 show strong dynamic effects of the dummy impact function, suggesting that offshore income shifting has a negative impact on domestic firm productivity levels which increases over time. This is true for both productivity measures and again the impact is stronger for ALP than for TFP. These results are better visualized in Figures 5 and 6, where we plot the estimated coefficients of year dummies indicating MNE tax haven presence, with their corresponding confidence intervals (CI). Estimated coefficients of year dummies related to MNE presence are also plotted as a benchmark.

The main message arising from both figures is that the negative relation between productivity and tax haven presence becomes stronger over time, while the exact opposite is true for a foreign presence, where the positive effect increases over time. Additionally, the confidence intervals significantly widen with each additional year of tax haven presence, while they remain relatively narrow for MNE (and where the effect is statistically significant until the last year). In the case

Figure 6: Foreign Presence and TFP Dynamics



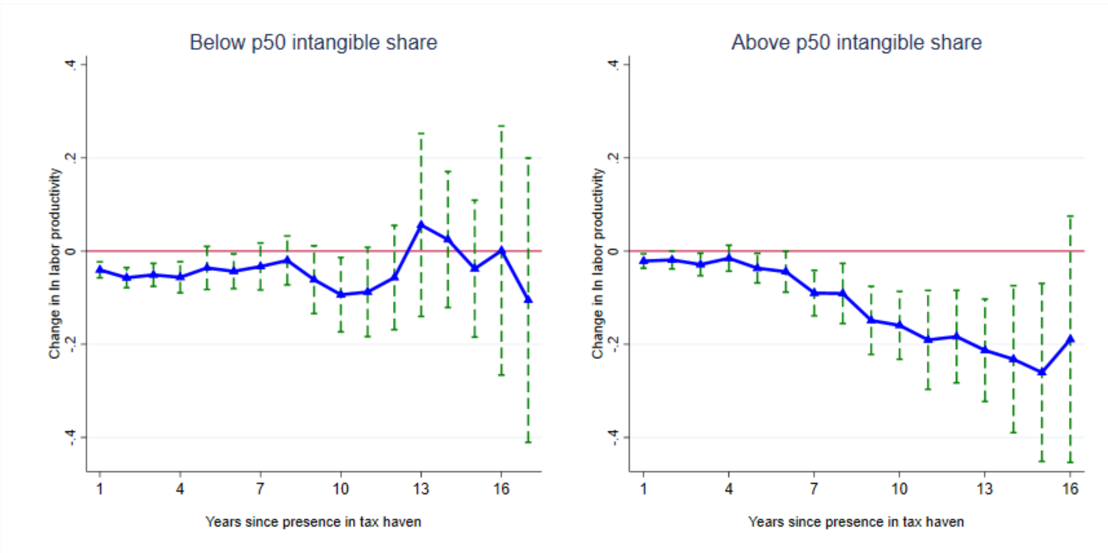

Note: Plot of estimated coefficients of year dummies indicating MNE presence and MNE tax haven presence (solid blue line) and the corresponding CI (dashed green lines).

of ALP, the tax haven effect ceases to be statistically significant (i.e. the confidence interval includes the value of 0) around the 13th year of tax haven presence and around the 15th year for TFP. Nonetheless, starting from the 10th year, there are very few observations left -which explains the sharp increase in the CI after this point- and the estimated coefficients are not informative anymore. Another salient message from these figures is that while the positive MNE effect increases with time and always remains statistically significant at the highest levels, the magnitude of the tax haven MNE impact is considerably bigger. For instance, after 10 years of presence in a tax haven, ALP attains an average 11.7% drop with respect to the years before the presence while the positive impact after 10 years of being an MNE tantamount to 3%. For TFP, there is also a consequential difference with -4.8% for 10 years as a tax haven MNE and 2.5% for 10 years as an MNE.

How does the effect evolve over time? Given the wide CI after the 12th year, we comment only up to the 11th year. For ALP, the first year with respect to the years prior to becoming a tax haven MNE results in an average decline of 2.9%; if the firm remains 5 years the equivalent differential with respect to the years prior to the tax haven presence is -3.6%; and the effect attains an average -14.5% for firms remaining 11 years. In the case of TFP, the first year implies an average differential (again relative to the years before the tax haven presence) of -0.9%, the 5th year translates into a -3.6% differential and 11 years into a -6.1% difference.

If one recalls the baseline results in previous section where the average effect relating the tax haven presence and productivity was -3.5% for ALP and -1.2% for TFP, one may wonder why these appear to be so low relative to the dynamic effects found in this section. The reason for this is that firms with few years (and low impact on productivity) weight significantly more on the average baseline effect than firms that remain long as a tax haven MNE (with high impact on productivity), because these firms are relatively few and their observations in the beginning of the sample also contribute to the stronger weights during the first years.

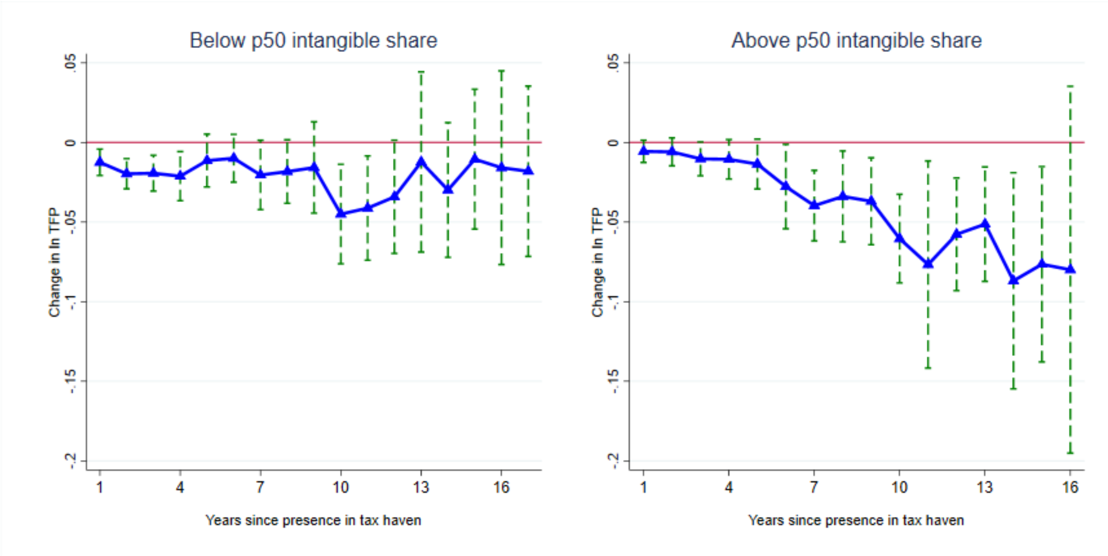
Figure 7: Foreign Presence, Intangibles and Labor Productivity Dynamics




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

Finally, when we again ask whether these dynamic effects are different for high and for low intangible intensive firms, the estimated tax haven MNE coefficients (of separate regressions for each group of firms) plotted in Figures 7 and 8 confirm the hypothesis for ALP and for

Figure 8: Foreign Presence, Intangibles and TFP Dynamics




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

TFP, respectively.[29] The left panel of each figure displays the dynamic effect for low intangible intensive firms and the right panel for high intangible intensive ones. Again, the CI become wider over time given that fewer and fewer firms are observed in tax havens the longer the time span, all the more as the sample is now divided in two groups. The main message from both figures is that in the case of low intensive firms, the statistical significance of the tax haven presence impact on productivity starts to fade away after 4 years, as measured by ALP and TFP. Whereas for firms belonging to the high intangible intensive sample, the effect remains negative, statistically significant over time and also higher in magnitude. Remaining 11 years as a tax haven MNE translates into an average TFP decline of 4.04% for firms below the median intangible share and into a 7.38% drop for firms above the median. The tax haven impact for ALP is -8.4% for firms below the median while it attains an average -17.35% for firms above the mean.

Now, the following section presents a robustness check, together with a discussion around the main threats to causality in our estimations and the implications for our conclusions.

[29]See Table 20 in the Appendix D for details on these estimated coefficients.

### 4.4 Identification strategy scrutiny

**Placebo Test.** 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 (for the whole sample and then separately for firms above and below the median intangible share intensity) and 2 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 predicted by the theoretical mechanisms exposed in section 4.2.

The results from this test are displayed in Tables 10 and 11 for the baseline regression where we assess the productivity effect of the placebo tax haven dummy and its interaction with the indicator for high or low intangible intensity. Finally, placebo results for the second strategy where the baseline equation is estimated separately for high and low intangible intensive firms are reported in Table 12. The new set of $\beta_2$ and $\beta_3$ across all estimations provide strong support for our main findings given that, without exception, the placebo tax haven dummy and its interactions are not significant anymore at any level of acceptance.

**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.

Table 10: Placebo Test with Baseline Apparent Labor Productivity Regressions

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

Standard errors in parentheses
All regressions include time-varying firm controls, robust standard errors in parentheses
$^c$ $p < 0.10$, $^b$ $p < 0.05$, $^a$ $p < 0.001$

**Causality Discussion.** 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 $\beta_2$. 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

Table 11: Placebo Test with Baseline TFP Regressions

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

Standard errors in parentheses

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

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

Table 12: Placebo Test with Separate Samples Regressions

| | (1)<br>ln ALP<br>Below p50 Intg. | (2)<br>ln ALP<br>Above p50 Intg. | (3)<br>ln TFP<br>Below p50 Intg. | (4)<br>ln TFP<br>Above p50 Intg. |
|---|---|---|---|---|
| $ln\, ALP_{f,1} \times firm\, trend_{ft}$ | -0.0227$^{a}$ | -0.0260$^{a}$ | | |
| | (0.0006) | (0.0005) | | |
| $ln\, TFP_{f,1} \times firm\, trend_{ft}$ | | | -0.0352$^{a}$ | -0.0368$^{a}$ |
| | | | (0.0015) | (0.0013) |
| $\mathbb{1}[MNE_{ft}]$ | -0.0048$^{c}$ | 0.0025 | 0.0023$^{c}$ | 0.0013 |
| | (0.0029) | (0.0027) | (0.0014) | (0.0012) |
| Share skilled$_{ft}$ | 0.1296$^{a}$ | 0.1639$^{a}$ | 0.0497$^{a}$ | 0.0642$^{a}$ |
| | (0.0111) | (0.0089) | (0.0062) | (0.0050) |
| $\mathbb{1}[Tax\ haven\ Placebo_{ft}]$ | 0.0027 | -0.0036 | 0.0012 | -0.0020 |
| | (0.0038) | (0.0035) | (0.0017) | (0.0016) |
| Num. Affiliates$_{ft}$ | 0.0027$^{a}$ | 0.0015$^{a}$ | 0.0001 | 0.0005$^{b}$ |
| | (0.0006) | (0.0004) | (0.0005) | (0.0002) |
| Observations | 164287 | 225499 | 157291 | 208009 |
| Adjusted $R^2$ | 0.684 | 0.645 | 0.664 | 0.647 |
| Firm FE | Yes | Yes | Yes | Yes |
| 2-dig. sector X year FE | Yes | Yes | Yes | Yes |

Standard errors in parentheses

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

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

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. Nonetheless, provided that highly productive firms self-select into tax havens, 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.[30] 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.

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

$$\begin{aligned} ln\ Prod_{fst} = & \sum_{j=2}^{J} \sigma_j\ \mathbb{1}[Lag\ j]_{ft} + \sum_{k=1}^{K} \eta_t\ \mathbb{1}[Lead\ k]_{ft} \\ & + \rho\, MNE_{ft}\ + \gamma\, ln\ Prod_{f,1}\ \times\ firm\, trend_{ft} \\ & + \alpha\, Z'_{ft} + \ \delta_f + \delta_{st} + \epsilon_{ft} \end{aligned} \tag{4}$$

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, are defined as follows,

[30]This is because the most productive firms go to tax havens, as we saw in the descriptive statistics in Table 1 and in Table 14 in the Appendix B.

$$(Lag\,J)_{st} \;=\; \mathbb{1}[\,t\;\leq\;Event_f\;-\;J]$$

$$(Lag\,j)_{st} \;=\; \mathbb{1}[\,t\;=Event_f-j]\;for\,j\;\in\{1,...,J-1\}$$

$$(Lead\,k)_{st} \;=\; \mathbb{1}[\,t\;=Event_f\;+\;k]\;for\,k\;\in\{1,...,K-1\}$$

$$(Lag\,K)_{st} \;=\; \mathbb{1}[\,t\;\geq\;Event_f\;+\;K]$$

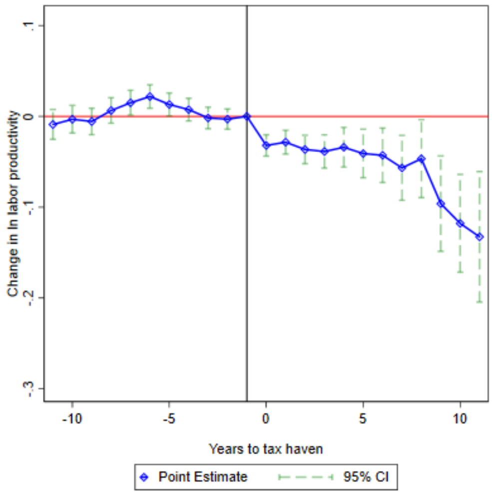
The final lags and leads accumulate lags and leads beyond periods J and K, in our case we set them equal to 11 years. As indicated in equation 4, the reference period with respect to which we compare the effect of tax haven entry is $j = 1$, which is the year before the event. As before, we include a set of time-varying observables in $Z^{'}$, we control for the fact of becoming an MNE, for any mean-reversion of productivity and, of course, for observable 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 a causal effect. The results of the event study design are plotted in Figures 9 and 10 for ALP and TFP, respectively.

In both cases we observe a clear downward negative trend after the tax haven entry, as we did in the previous specifications, although with slightly smaller coefficient magnitudes and estimated with less precision, in particular for TFP. In what concerns the years prior to the tax haven entry, we find that their point estimates fluctuate around zero, with the exception of $t-6$, where the coefficient is positive and significantly different from zero, although very small in magnitude. The absence of any clear pre-treatment trend make us confident about the fact that our treatment captures the productivity effect of entering into a tax haven and not any other confounding effect.[31] Finally, when we repeat the same design only on firms that are, at some point, present in a tax haven, or in other words, only on the treated, we find that a negative pre-treatment trend

[31] This is even clearer, given that when repeating the exercise where instead of defining the event as the tax haven entry, we definite it with respect to the MNE status and we don't verify the common parallel trend assumption. Results are not displayed but are available upon request.

appears.[32] This emphasizes the fact that firms self-select in tax-havens and that MNEs that are not present in tax havens are an appropriate control group providing a good counterfactual.

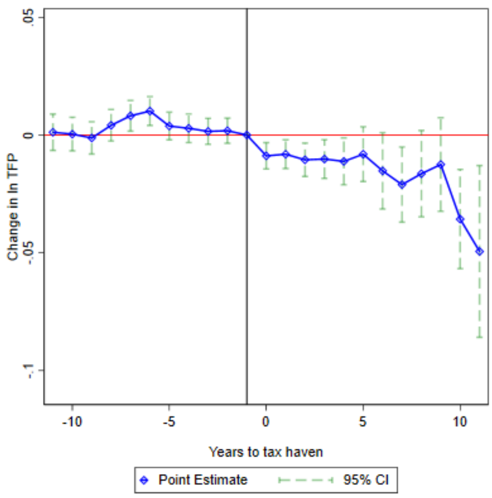
Figure 9: Conditional common pre-trend (ALP)




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

[32]Results not displayed but available upon request.

Figure 10: Conditional common pre-trend (TFP)




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

## 5 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.[33] 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

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

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 productivity ($Prod_t$) 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 $\omega_{it}$ 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.[34] 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

[34] 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:

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

Such exact aggregation using total factor productivity appears to be more cumbersome. See [Van Biesebroeck, 2008] for details.

follows,

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

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,

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

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 13 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 tantamount to 34.7 euros per hour in 1997 and 38.8 in 2015.[35] Thus, we observe an increase of 4.1 euros per hour in aggregate labor productivity levels between 1997 and 2015.

[35] 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.[36] 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 13: 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

[36]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).[37]

[37]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.

## 6 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., 2017] do for the case of the US, that official French productivity statistics are significantly distorted by MNEs' behavior, particularly in firms and sectors which are intensive in intangible capital.

For this, we propose a simple theoretical framework in which intangible capital allows a geographical decoupling of production and benefits and evaluate the contribution of the micro-level fiscal optimization to the aggregate productivity slowdown. 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 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, consistent with the literature and the theoretic predictions, the effect is especially strong in firms that are intensive in intangible capital, arguably because this type of assets is more easily transferred across countries and facilitates transfer-mispricing.

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. Finally, our findings are robust to a placebo tax haven presence treatment and given the self-selection of high productive firms into tax havens, our estimates are likely to be biased toward zero. This in turn means that our results provide a lower bound of productivity mismeasurement due to tax optimization of MNEs in France.

# References


[Abadie et al., 2017] Abadie, A., Athey, S., Imbens, G. W., and Wooldridge, J. (2017). When should you adjust standard errors for clustering? Technical report, National Bureau of Economic Research.

[Acemoglu and Restrepo, 2018] Acemoglu, D. and Restrepo, P. (2018). The race between man and machine: Implications of technology for growth, factor shares, and employment. *American Economic Review*, 108(6):1488–1542.

[Ackerberg et al., 2015] Ackerberg, D. A., Caves, K., and Frazer, G. (2015). Identification properties of recent production function estimators. *Econometrica*, 83(6):2411–2451.

[Aghion et al., 2018] Aghion, P., Bergeaud, A., Boppart, T., and Bunel, S. (2018). Firm dynamics and growth measurement in france. *Journal of the European Economic Association*, 16(4):933–956.

[Aitken and Harrison, 1999] Aitken, B. J. and Harrison, A. E. (1999). Do domestic firms benefit from direct foreign investment? evidence from venezuela. *American economic review*, 89(3):605–618.

[Antràs and Helpman, 2004] Antràs, P. and Helpman, E. (2004). Global sourcing. *Journal of Political Economy*, 112(3):552–80.

[Antràs and R.Yeaple, 2013] Antràs, P. and R.Yeaple, S. (2013). Multinational firms and the structure of international trade. Working Paper 18775, National Bureau of Economic Research.

[Arnold and Javorcik, 2009] Arnold, J. M. and Javorcik, B. S. (2009). Gifted kids or pushy parents? foreign direct investment and plant productivity in indonesia. *Journal of International Economics*, 79(1):42–53.

[Baily et al., 1992] Baily, M. N., Hulten, C., Campbell, D., Bresnahan, T., and Caves, R. E. (1992). Productivity dynamics in manufacturing plants. *Brookings papers on economic activity. Microeconomics*, 1992:187–267.

[Balsvik and Haller, 2010] Balsvik, R. and Haller, S. A. (2010). Picking "lemons" or picking "cherries"? domestic and foreign acquisitions in norwegian manufacturing. *Scandinavian Journal of Economics*, 112(2):361–387.

[Bean, 2016] Bean, C. R. (2016). *Independent review of UK economic statistics.* HM Treasury.

[Bergounhon et al., 2018] Bergounhon, F., Lenoir, C., and Mejean, I. (2018). A guideline to french firm-level trade data. Technical report, mimeo Polytechnique.

[Bernard et al., 2003] Bernard, A. B., Eaton, J., Jensen, J. B., and Kortum, S. (2003). Plants and productivity in international trade. *American economic review*, 93(4):1268–1290.

[Bernard et al., 1995] Bernard, A. B., Jensen, J. B., and Lawrence, R. Z. (1995). Exporters, jobs, and wages in us manufacturing: 1976-1987. *Brookings papers on economic activity. Microeconomics*, 1995:67–119.

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

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

[Corrado et al., 2016] Corrado, C., Haskel, J., Jona-Lasinio, C., and Iommi, M. (2016). Intangible investment in the eu and us before and since the great recession and its contribution to productivity growth. Technical report, EIB Working Papers.

[Criscuolo and Martin, 2009] Criscuolo, C. and Martin, R. (2009). Multinationals and us productivity leadership: evidence from great britain. *The Review of Economics and Statistics*, 91(2):263–281.

[Damgaard et al., 2019] Damgaard, J., Elkjaer, T., and Johannesen, N. (2019). *What is real and what is not in the global FDI network?* International Monetary Fund.

[Davies et al., 2018a] Davies, R., Martin, J., Parenti, M., and Toubal, F. (2018a). Knocking on tax haven's door: Multinational firms and transfer pricing. *The Review of Economics and Statistics*, 100(1):120–134.

[Davies et al., 2018b] Davies, R. B., Martin, J., Parenti, M., and Toubal, F. (2018b). Knocking on Tax Haven's Door: Multinational Firms and Transfer Pricing. *The Review of Economics and Statistics*, 100(1):120–134.

[De Chaisemartin and d'Haultfoeuille, 2020] De Chaisemartin, C. and d'Haultfoeuille, X. (2020). Two-way fixed effects estimators with heterogeneous treatment effects. *American Economic Review*, 110(9):2964–96.

[Dixit and Stiglitz, 1977] Dixit, A. K. and Stiglitz, J. E. (1977). Monopolistic Competition and Optimum Product Diversity. *American Economic Review*, 67(3):297–308.

[Fisman and Wei, 2004] Fisman, R. and Wei, S.-J. (2004). Tax rates and tax evasion: evidence from "missing imports" in china. *Journal of political Economy*, 112(2):471–496.

[Fons-Rosen et al., 2021] Fons-Rosen, C., Kalemli-Ozcan, S., Sørensen, B. E., Villegas-Sanchez, C., and Volosovych, V. (2021). Quantifying productivity gains from foreign investment. *Journal of International Economics*, 131:103456.

[Good et al., 1997] Good, D. H., Nadiri, M. I., and Sickles, R. C. (1997). *Index Number and Factor Demand Approaches to the Estimation of Productivity*, chapter 2, pages 13–74. John Wiley Sons, Ltd.

[Gordon et al., 2016] Gordon, R. J. et al. (2016). *The Rise and Fall of American Growth: The US Standard of Living since the Civil War.* Princeton University Press.

[Guadalupe et al., 2012] Guadalupe, M., Kuzmina, O., and Thomas, C. (2012). Innovation and foreign ownership. *American Economic Review*, 102(7):3594–3627.

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

[Hall, 1988] Hall, R. E. (1988). The relation between price and marginal cost in us industry. *Journal of political Economy*, 96(5):921–947.

[Haskel and Westlake, 2018] Haskel, J. and Westlake, S. (2018). *Capitalism without capital: The rise of the intangible economy.* Princeton University Press.

[Helpman et al., 2004a] Helpman, E., Melitz, M. J., and Yeaple, S. R. (2004a). Export versus FDI with Heterogeneous Firms. *The American Economic Review*, 94(1):300–316.

[Helpman et al., 2004b] Helpman, E., Melitz, M. J., and Yeaple, S. R. (2004b). Export versus fdi with heterogeneous firms. *American Economic Review*, 94(1):300–316.

[International Monetary Fund, 2018] International Monetary Fund, I. (2018). Measuring the digital economy.

[Kant, 1988] Kant, C. (1988). Endogenous transfer pricing and the effects of uncertain regulation. *Journal of International Economics*, 24(1):147–157.

[Laffitte and Toubal, 2019] Laffitte, S. and Toubal, F. (2019). A fistful of dollars? foreign sales platforms and profit shifting in tax havens. Working Papers 2019-02, CEPII.

[Lane and Milesi-Ferretti, 2011] Lane, P. R. and Milesi-Ferretti, G. M. (2011). Cross-border investment in small international financial centres. *International Finance*, 14(2):301–330.

[Lane and Milesi-Ferretti, 2018] Lane, P. R. and Milesi-Ferretti, G. M. (2018). The external wealth of nations revisited: international financial integration in the aftermath of the global financial crisis. *IMF Economic Review*, 66(1):189–222.

[Levinsohn and Petrin, 2003] Levinsohn, J. and Petrin, A. (2003). Estimating production functions using inputs to control for unobservables. *The review of economic studies*, 70(2):317–341.

[Liu, 2008] Liu, Z. (2008). Foreign direct investment and technology spillovers: Theory and evidence. *Journal of Development Economics*, 85(1-2):176–193.

[Martin et al., 2020] Martin, J., Parenti, M., and Toubal, F. (2020). Corporate tax avoidance and industry concentration. *London, Centre for Economic Policy Research, July 2020.*

[Mayer and Ottaviano, 2007] Mayer, T. and Ottaviano, G. I. (2007). *The Happy Few: The internationalisation of European firms. New facts based on firm-level evidence. Bruegel blueprint series, Volume 3, November 2007.*

[Melitz, 2003] Melitz, M. J. (2003). The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity. *Econometrica*, 71(6):1695–1725.

[Melitz and Polanec, 2015] Melitz, M. J. and Polanec, S. (2015). Dynamic olley-pakes productivity decomposition with entry and exit. *The Rand journal of economics*, 46(2):362–375.

[Olley and Pakes, 1996] Olley, G. S. and Pakes, A. (1996). The dynamics of productivity in the telecommunications equipment industry. *Econometrica*, 64(6):1263–1297.

[Pavcnik, 2002] Pavcnik, N. (2002). Trade liberalization, exit, and productivity improvements: Evidence from chilean plants. *The Review of Economic Studies*, 69(1):245–276.

[Smarzynska Javorcik, 2004] Smarzynska Javorcik, B. (2004). Does foreign direct investment increase the productivity of domestic firms? in search of spillovers through backward linkages. *American economic review*, 94(3):605–627.

[Summers, 2014] Summers, L. H. (2014). Us economic prospects: Secular stagnation, hysteresis, and the zero lower bound. *Business economics*, 49(2):65–73.

[Tørsløv et al., 2018] Tørsløv, T. R., Wier, L. S., and Zucman, G. (2018). The missing profits of nations. Technical report, National Bureau of Economic Research.

[Van Biesebroeck, 2008] Van Biesebroeck, J. (2008). Aggregating and decomposing productivity. *Review of Business and Economics*, 53(2):122–146.

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

[Wooldridge, 2009] Wooldridge, J. M. (2009). On estimating firm-level production functions using proxy variables to control for unobservables. *Economics letters*, 104(3):112–114.

# Appendix A Main variables used in TFP computation

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 $\delta_t$ 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 $\tau_t$ 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 Descriptive statistics

Table 14: Distribution of firms type by TFP deciles (proportions of total)

| TFP dec. | Domestic | MNE non Tax haven | MNE Tax haven |
|---|---|---|---|
| 1 | 9.64 | 3.49 | 4.01 |
| 2 | 9.97 | 4.51 | 5.11 |
| 3 | 10.06 | 5.91 | 6.93 |
| 4 | 10.08 | 9.16 | 9.82 |
| 5 | 10.08 | 9.16 | 9.82 |
| 6 | 10.07 | 10.87 | 11.49 |
| 7 | 10.05 | 12.84 | 12.71 |
| 8 | 10.03 | 14.69 | 13.73 |
| 9 | 10.02 | 16.1 | 14.33 |
| 10 | 10.01 | 14.9 | 13.36 |

TFP deciles are defined based on the whole sample.
Source: FICUS-FARE-LIFI.

Table 15: Employment and value added share of tax haven MNEs in total economy

| | Average 1997-2015 | 1997 | 2015 |
|---|---|---|---|
| Employment | 12.7 | 14.3 | 11.4 |
| Value added | 16.1 | 19.6 | 16.4 |

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

Table 16: Total Employment and value added tax haven MNEs

| | Average 1997-2015 | 1997 | 2015 |
|---|---|---|---|
| Tax haven MNE employment | 1 558 985 | 1 359 957 | 1 583 659 |
| Tax haven MNE value added | 108 529 | 87 531 | 134 315 |
| Total employment | 12 239 148 | 9 494 977 | 13 842 753 |
| Total value added | 679 394 | 447 060 | 821 361 |

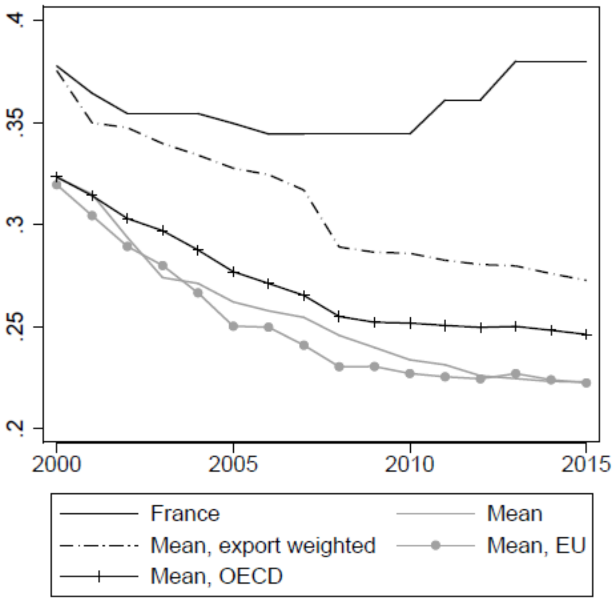
Source: Authors' calculations using LIFI and FICUS-FARE databases. Value added in million euro.

Table 17: Tax haven jurisdictions as defined by the IMF

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

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

Figure 11: Statutory Corporate tax rate France and partners




Source: [Vicard, 2019]

# Appendix C 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.[38] 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,

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

Where the change of aggregate productivity $\Phi$ of individual firms $\phi_i$ 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 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).

[38] 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 $\Phi$ 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 $\phi_i$.

# Appendix D Additional Tables

Table 18: Baseline Apparent Labor Productivity Regressions on Universe of firms

| | (1) ln ALP | (2) ln ALP | (3) ln ALP |
|---|---|---|---|
| $MNE_{ft}$ | $0.348^a$ | $0.0358^a$ | $0.0273^a$ |
| | (0.00355) | (0.00240) | (0.00294) |
| $Tax\ haven_{ft}$ | -0.00546 | $-0.0141^a$ | $-0.0115^b$ |
| | (0.00596) | (0.00361) | (0.00449) |
| $Intang.\ share_{ft}$ | 0.00894 | 0.00185 | 0.00182 |
| | (0.00698) | (0.00145) | (0.00143) |
| $Share\ skilled_{ft}$ | $0.605^a$ | $0.0657^a$ | $0.0656^a$ |
| | (0.00240) | (0.00166) | (0.00166) |
| $ln\ ALP_{f,1}\ \times\ firm\ trend_{ft}$ | $0.0232^a$ | $-0.0232^a$ | $-0.0216^a$ |
| | (0.0000940) | (0.0000940) | (0.0000954) |
| $Tax\ haven_{ft} \times\ Intang.\ share_{ft}$ | | | -0.0136 |
| | | | (0.0140) |
| $N$ | 15241949 | 15100090 | 15100090 |
| $R^2$ | 0.044 | 0.695 | 0.695 |
| Firm FE | No | Yes | Yes |
| 2-dig. sector X year FE | Yes | Yes | Yes |

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

Table 19: Productivity Dynamics and Foreign Presence

| | (1) ln TFP | (2) ln ALP |
|---|---|---|
| $ln\ TFP_{f,1}\ \times\ firm\ trend_{ft}$ | $-0.0363^a$ | |
| | (0.0009) | |
| $ln\ ALP_{f,1}\ \times\ firm\ trend_{ft}$ | | $-0.0249^a$ |
| | | (0.0004) |
| yrstax=1 | $-0.0088^b$ | $-0.0295^a$ |

Continued on next page

**Table19– continued from previous page**

| | (1) | (2) |
|---|---|---|
| | ln TFP | ln ALP |
| | (0.0027) | (0.0059) |
| yrstax=2 | -0.0120[a] | -0.0341[a] |
| | (0.0033) | (0.0074) |
| yrstax=3 | -0.0141[a] | -0.0374[a] |
| | (0.0040) | (0.0089) |
| yrstax=4 | -0.0155[b] | -0.0327[b] |
| | (0.0049) | (0.0109) |
| yrstax=5 | -0.0132[b] | -0.0369[b] |
| | (0.0058) | (0.0136) |
| yrstax=6 | -0.0205[b] | -0.0449[b] |
| | (0.0085) | (0.0153) |
| yrstax=7 | -0.0313[a] | -0.0672[a] |
| | (0.0081) | (0.0182) |
| yrstax=8 | -0.0257[b] | -0.0595[b] |
| | (0.0094) | (0.0221) |
| yrstax=9 | -0.0236[b] | -0.1060[a] |
| | (0.0101) | (0.0269) |
| yrstax=10 | -0.0491[a] | -0.1247[a] |
| | (0.0107) | (0.0277) |
| yrstax=11 | -0.0624[a] | -0.1455[a] |
| | (0.0186) | (0.0368) |
| yrstax=12 | -0.0463[a] | -0.1272[a] |

Continued on next page

**Table19– continued from previous page**

| | (1) | (2) |
|---|---|---|
| | ln TFP | ln ALP |
| | (0.0129) | (0.0385) |
| yrstax=13 | -0.0331[c] | -0.0836 |
| | (0.0171) | (0.0590) |
| yrstax=14 | -0.0544[b] | -0.1021[c] |
| | (0.0211) | (0.0564) |
| yrstax=15 | -0.0387[c] | -0.1490[b] |
| | (0.0205) | (0.0624) |
| yrstax=16 | -0.0372 | -0.1174 |
| | (0.0359) | (0.0976) |
| yrstax=17 | -0.0315 | -0.1574 |
| | (0.0336) | (0.1518) |
| yrsmne=1 | 0.0048[b] | 0.0161[a] |
| | (0.0015) | (0.0031) |
| yrsmne=2 | 0.0056[a] | 0.0108[b] |
| | (0.0016) | (0.0034) |
| yrsmne=3 | 0.0094[a] | 0.0124[a] |
| | (0.0017) | (0.0037) |
| yrsmne=4 | 0.0101[a] | 0.0120[b] |
| | (0.0018) | (0.0041) |
| yrsmne=5 | 0.0115[a] | 0.0090[b] |
| | (0.0019) | (0.0042) |
| yrsmne=6 | 0.0125[a] | 0.0175[a] |

Continued on next page

**Table19– continued from previous page**

| | (1) | (2) |
|---|---|---|
| | ln TFP | ln ALP |
| | (0.0021) | (0.0046) |
| yrsmne=7 | 0.0192[a] | 0.0284[a] |
| | (0.0021) | (0.0049) |
| yrsmne=8 | 0.0185[a] | 0.0321[a] |
| | (0.0022) | (0.0053) |
| yrsmne=9 | 0.0218[a] | 0.0301[a] |
| | (0.0024) | (0.0057) |
| yrsmne=10 | 0.0251[a] | 0.0292[a] |
| | (0.0025) | (0.0059) |
| yrsmne=11 | 0.0256[a] | 0.0377[a] |
| | (0.0028) | (0.0065) |
| yrsmne=12 | 0.0283[a] | 0.0562[a] |
| | (0.0031) | (0.0069) |
| yrsmne=13 | 0.0259[a] | 0.0606[a] |
| | (0.0032) | (0.0072) |
| yrsmne=14 | 0.0250[a] | 0.0548[a] |
| | (0.0036) | (0.0076) |
| yrsmne=15 | 0.0288[a] | 0.0588[a] |
| | (0.0038) | (0.0087) |
| yrsmne=16 | 0.0354[a] | 0.0859[a] |
| | (0.0040) | (0.0095) |
| yrsmne=17 | 0.0347[a] | 0.0851[a] |

Continued on next page

**Table19– continued from previous page**

| | (1) ln TFP | (2) ln ALP |
|---|---|---|
| | (0.0064) | (0.0136) |
| yrsmne=18 | 0.0275[a] | 0.0703[a] |
| | (0.0069) | (0.0173) |
| Share skilled$_{ft}$ | 0.0577[a] | 0.1504[a] |
| | (0.0039) | (0.0070) |
| Num. Affiliates$_{ft}$ | 0.0004[b] | 0.0018[a] |
| | (0.0002) | (0.0004) |
| Observations | 365352 | 389829 |
| Adjusted $R^2$ | 0.655 | 0.661 |
| Firm FE | Yes | Yes |
| 2-dig. sector X year FE | Yes | Yes |

Standard errors in parentheses

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

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

Table 20: Productivity Dynamics Intangibles and Foreign Presence

| | (1) ln TFP Below p50 Intg. | (2) ln TFP Above p50 Intg. | (3) ln ALP Below p50 Intg. | (4) ln ALP Above p50 Intg. |
|---|---|---|---|---|
| $ln\,TFP_{f,1} \times firm\,trend_{ft}$ | -0.0353[a] | -0.0370[a] | | |
| | (0.0015) | (0.0013) | | |

Continued on next page

**Table20– continued from previous page**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | ln TFP | ln TFP | ln ALP | ln ALP |
| | Below p50 Intg. | Above p50 Intg. | Below p50 Intg. | Above p50 Intg. |
| $ln\, ALP_{f,1} \times firm\, trend_{ft}$ | | | -0.0228[a] | -0.0264[a] |
| | | | (0.0006) | (0.0005) |
| yrstax=1 | -0.0125[b] | -0.0056 | -0.0403[a] | -0.0213[b] |
| | (0.0042) | (0.0036) | (0.0088) | (0.0079) |
| yrstax=2 | -0.0197[a] | -0.0059 | -0.0570[a] | -0.0189[c] |
| | (0.0048) | (0.0045) | (0.0110) | (0.0099) |
| yrstax=3 | -0.0193[a] | -0.0103[c] | -0.0510[a] | -0.0287[b] |
| | (0.0057) | (0.0054) | (0.0125) | (0.0124) |
| yrstax=4 | -0.0212[b] | -0.0106[c] | -0.0561[a] | -0.0153 |
| | (0.0079) | (0.0063) | (0.0170) | (0.0142) |
| yrstax=5 | -0.0114 | -0.0136[c] | -0.0361 | -0.0366[b] |
| | (0.0085) | (0.0080) | (0.0236) | (0.0162) |
| yrstax=6 | -0.0099 | -0.0277[b] | -0.0433[b] | -0.0441[b] |
| | (0.0077) | (0.0135) | (0.0191) | (0.0225) |
| yrstax=7 | -0.0204[c] | -0.0397[a] | -0.0330 | -0.0900[a] |
| | (0.0111) | (0.0113) | (0.0257) | (0.0249) |
| yrstax=8 | -0.0183[c] | -0.0339[b] | -0.0200 | -0.0909[b] |
| | (0.0102) | (0.0145) | (0.0268) | (0.0329) |
| yrstax=9 | -0.0157 | -0.0369[b] | -0.0613[c] | -0.1487[a] |
| | (0.0146) | (0.0139) | (0.0372) | (0.0373) |
| yrstax=10 | -0.0450[b] | -0.0604[a] | -0.0936[b] | -0.1593[a] |

Continued on next page

**Table20– continued from previous page**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | ln TFP | ln TFP | ln ALP | ln ALP |
| | Below p50 Intg. | Above p50 Intg. | Below p50 Intg. | Above p50 Intg. |
| | (0.0159) | (0.0142) | (0.0408) | (0.0372) |
| yrstax=11 | -0.0412[b] | -0.0767[b] | -0.0877[c] | -0.1906[a] |
| | (0.0167) | (0.0332) | (0.0489) | (0.0542) |
| yrstax=12 | -0.0342[c] | -0.0577[b] | -0.0567 | -0.1835[a] |
| | (0.0181) | (0.0181) | (0.0571) | (0.0506) |
| yrstax=13 | -0.0123 | -0.0513[b] | 0.0560 | -0.2129[a] |
| | (0.0289) | (0.0183) | (0.1002) | (0.0561) |
| yrstax=14 | -0.0299 | -0.0869[b] | 0.0248 | -0.2320[b] |
| | (0.0216) | (0.0346) | (0.0744) | (0.0805) |
| yrstax=15 | -0.0105 | -0.0765[b] | -0.0376 | -0.2604[b] |
| | (0.0224) | (0.0313) | (0.0749) | (0.0975) |
| yrstax=16 | -0.0159 | -0.0800 | 0.0011 | -0.1894 |
| | (0.0310) | (0.0588) | (0.1364) | (0.1348) |
| yrstax=17 | -0.0181 | | -0.1052 | |
| | (0.0273) | | (0.1557) | |
| yrsmne=1 | 0.0056[b] | 0.0038[c] | 0.0115[b] | 0.0182[a] |
| | (0.0021) | (0.0020) | (0.0045) | (0.0041) |
| yrsmne=2 | 0.0064[b] | 0.0049[b] | 0.0090[c] | 0.0118[b] |
| | (0.0023) | (0.0021) | (0.0050) | (0.0046) |
| yrsmne=3 | 0.0111[a] | 0.0079[a] | 0.0123[b] | 0.0116[b] |
| | (0.0027) | (0.0023) | (0.0056) | (0.0049) |

Continued on next page

**Table20– continued from previous page**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | ln TFP | ln TFP | ln ALP | ln ALP |
| | Below p50 Intg. | Above p50 Intg. | Below p50 Intg. | Above p50 Intg. |
| yrsmne=4 | $0.0117^{a}$ | $0.0085^{a}$ | $0.0101^{c}$ | $0.0129^{b}$ |
| | (0.0028) | (0.0024) | (0.0060) | (0.0055) |
| yrsmne=5 | $0.0113^{a}$ | $0.0111^{a}$ | 0.0033 | $0.0123^{b}$ |
| | (0.0029) | (0.0024) | (0.0064) | (0.0057) |
| yrsmne=6 | $0.0114^{a}$ | $0.0132^{a}$ | 0.0103 | $0.0228^{a}$ |
| | (0.0032) | (0.0028) | (0.0069) | (0.0062) |
| yrsmne=7 | $0.0195^{a}$ | $0.0187^{a}$ | $0.0183^{b}$ | $0.0360^{a}$ |
| | (0.0032) | (0.0028) | (0.0071) | (0.0067) |
| yrsmne=8 | $0.0179^{a}$ | $0.0182^{a}$ | $0.0142^{c}$ | $0.0456^{a}$ |
| | (0.0032) | (0.0031) | (0.0074) | (0.0073) |
| yrsmne=9 | $0.0180^{a}$ | $0.0243^{a}$ | 0.0002 | $0.0527^{a}$ |
| | (0.0037) | (0.0032) | (0.0083) | (0.0078) |
| yrsmne=10 | $0.0261^{a}$ | $0.0235^{a}$ | $0.0147^{c}$ | $0.0393^{a}$ |
| | (0.0037) | (0.0034) | (0.0087) | (0.0081) |
| yrsmne=11 | $0.0266^{a}$ | $0.0250^{a}$ | $0.0241^{b}$ | $0.0500^{a}$ |
| | (0.0040) | (0.0038) | (0.0092) | (0.0092) |
| yrsmne=12 | $0.0268^{a}$ | $0.0295^{a}$ | $0.0361^{a}$ | $0.0725^{a}$ |
| | (0.0047) | (0.0040) | (0.0102) | (0.0094) |
| yrsmne=13 | $0.0258^{a}$ | $0.0264^{a}$ | $0.0462^{a}$ | $0.0739^{a}$ |
| | (0.0046) | (0.0044) | (0.0102) | (0.0100) |
| yrsmne=14 | $0.0201^{a}$ | $0.0297^{a}$ | $0.0347^{b}$ | $0.0713^{a}$ |

Continued on next page

**Table20– continued from previous page**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | ln TFP | ln TFP | ln ALP | ln ALP |
| | Below p50 Intg. | Above p50 Intg. | Below p50 Intg. | Above p50 Intg. |
| | (0.0050) | (0.0052) | (0.0108) | (0.0107) |
| yrsmne=15 | $0.0171^{a}$ | $0.0402^{a}$ | $0.0313^{b}$ | $0.0835^{a}$ |
| | (0.0049) | (0.0057) | (0.0123) | (0.0122) |
| yrsmne=16 | $0.0273^{a}$ | $0.0436^{a}$ | $0.0595^{a}$ | $0.1088^{a}$ |
| | (0.0055) | (0.0057) | (0.0133) | (0.0136) |
| yrsmne=17 | $0.0243^{b}$ | $0.0446^{a}$ | $0.0392^{b}$ | $0.1205^{a}$ |
| | (0.0083) | (0.0094) | (0.0195) | (0.0191) |
| yrsmne=18 | $0.0240^{b}$ | $0.0305^{b}$ | 0.0365 | $0.0955^{a}$ |
| | (0.0093) | (0.0102) | (0.0228) | (0.0257) |
| Share skilled$_{ft}$ | $0.0493^{a}$ | $0.0632^{a}$ | $0.1291^{a}$ | $0.1620^{a}$ |
| | (0.0062) | (0.0050) | (0.0111) | (0.0089) |
| Num. Affiliates$_{ft}$ | 0.0001 | $0.0005^{b}$ | $0.0027^{a}$ | $0.0015^{a}$ |
| | (0.0005) | (0.0002) | (0.0006) | (0.0004) |
| Observations | 157291 | 208009 | 164287 | 225499 |
| Adjusted $R^2$ | 0.665 | 0.647 | 0.684 | 0.645 |
| Firm FE | Yes | Yes | Yes | Yes |
| 2-dig. sector X year FE | Yes | Yes | Yes | Yes |

Standard errors in parentheses

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

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

# Appendix E Conceptual Framework

## E.1 Global sourcing & tax planning

In order to rationalize the patterns described above, we develop a simple model of global sourcing where domestic firms can contract with an affiliate located in a tax haven in order to book part of their sales in low tax jurisdictions. Sales shifting is an important channel through which multinational firms can maximize their global profits and has been documented using macro data for US MNE by [Laffitte and Toubal, 2019]. As mentioned earlier, such contracts are becoming an important concern for the anti-BEPS program carried within the OECD framework. The cost of setting-up such business plan is lower for firms operating in a sector with high intensity in intangible capital since the sales can be more easily recorded artificially in low-tax jurisdiction. The model developed in this section builds on a literature on the transaction-cost theory of firms' boundaries on the one hand and on a growing literature on profit shifting on the other side. This theoretical framework aims at shedding light on two new aspects of multinational firms organisation for tax planning purposes.

- whereas the majority of recent papers on profit shifting typically introduce profit shifting through mispriced intra-firm transactions (transfer pricing) (as in [Guvenen et al., 2017]), our approach targets a special contract linking a firm and its affiliates directly shifting revenue from a jurisdiction to another. This kind of contract is all the more efficient for footloose industries such as the IT sector.[39]
- the branch of the trade literature that documents the reasons why firms operate in more than one country (see ([Antràs and R.Yeaple, 2013]) is well suited for describing sourcing decisions at arm's-length but depicts a inadequate vision of the agency costs within multinational firms. This model also gives rise to contracts splitting revenues between different entities of the multinational firms but where the interests of all entities composing the MNE are perfectly aligned. By contrast, the risk/cost of this sort of contracts comes

[39]It is worth noting that any other strategy implemented in order to shift profits to low tax jurisdictions such as intra-firm debt, transfer-pricing or simply locating intellectual property abroad, would have the same theoretical predictions and is also consistent with the empirical part of the paper. Our particular way of modeling, however, makes more explicit the fact that intangible capital facilitates profit-shifting, which is what we test in the empirical section.

from the tax authorities and the legal costs of such arrangements and not from an intrinsic principle-agent problem.

Adding a tax environment and profit shifting to the model of global sourcing developed by [Antràs and Helpman, 2004] generates interesting predictions with respect to the stylized facts described above.

## E.2 A model of profit shifting and mismeasurement of aggregate productivity

### E.2.1 General set-up

The economy is made of two sectors, one of which produces homogeneous goods (A) and the second one produces differentiated goods (D). An exogenous fraction $\mu$ of the differentiated product D and the remaining part of the income is spent on the homogeneous good A.

$$U = (1-\mu)\ln(X_A) + \mu\ln(X_D) \tag{11}$$

This type of utility function allows us to keep the share of income spent on differentiated goods constant as any increase of income will be spent on A-good whose marginal utility is higher. Within the differentiated sector, consumers allocate their income across a set $\Theta$ of varieties, d, with an elasticity of substitution between them, $\sigma$:

$$X_D = \left(\int_{d\in\Theta} x_d^{\frac{\sigma-1}{\sigma}} d(d)\right)^{\frac{\sigma}{\sigma-1}} \tag{12}$$

As in the standard Dixit-Stiglitz framework, firms charge a constant mark-up over their marginal cost (see [Dixit and Stiglitz, 1977]). Prices are therefore:

$$p(d) = \left(\frac{\sigma}{1-\sigma}\right)\frac{w}{\varphi(d)}$$

where $\varphi(d)$ indicates firms' idiosyncratic productivity and w is the wage.

### E.2.2 Production function

Final goods are only produced using labor. Firms differ in their level of core productivity à la Melitz. Firms' productivity is distributed according to a Pareto distribution G(.). The problem faced by the firm is therefore similar as in [Melitz, 2003]. Given the CES demand structure, the operating profit function of the firms writes:

$$\tilde{\pi}^{dom}(d) = \frac{XP^{\sigma-1}}{\sigma}\left[\left(\frac{\sigma}{1-\sigma}\right)\frac{w}{\varphi(d)}\right]^{1-\sigma}$$

with, X the total production of the differentiated sector and P the corresponding price index. This production is also characterized by increasing returns to scale and firms need to pay a fixed cost $f^{dom}$ in order to operate domestically. Moreover, income is taxed at the domestic tax rate $t_i$ such that net profits are given by:

$$\pi^{dom}(d) = (1-t)\left[\frac{XP^{\sigma-1}}{\sigma}\left[\left(\frac{\sigma}{1-\sigma}\right)\frac{w}{\varphi(d)}\right]^{1-\sigma}\right] - f^{dom}$$

### E.2.3 Ownership structure

Firms can open an affiliate in a tax haven as in [Helpman et al., 2004b]. Firms can decide to pay a fixed cost $f^{mne}$ (paid in domestic wages) in order to open-up an affiliate in a tax haven and then shift a part $\kappa$ of their revenues in this low-tax jurisdiction or remaining purely domestic and keeping all of their revenue domestically. The concealment cost approach adopted in equation (3) is very standard in the tax avoidance literature.[40] The specific form of square-form is aimed at keeping this theoretical framework as simple as possible but could be generalized to any convex function.

$$\pi^{mne} = (1-t)\left[(1-\kappa)p(d)x(d) - wx(d) - \frac{1}{2}w\kappa^2)\right] + (1-t_{th})\left[\kappa(p(d)x(d))\right] - f^{mne} \quad (13)$$

[40] This approach initiated by [Kant, 1988] has been often followed as, for instance, in [Davies et al., 2018b] in a framework close to ours

#### E.2.4 Tax planning

Note that in the absence of difference of environment between the domestic country and the foreign country, firms should always prefer staying purely domestic over going multinational. Conversely, for a given tax differential between domestic and foreign, firms are incentivized to open an affiliate in tax haven and to shift part of their sales offshore. From the firm's perspective, the optimal amount of sales to record offshore depends on the cost-benefit analysis. It is costly for the firm to engage in tax planning activity but it reduces the amount of tax ultimately paid. Differentiating the profit function with respect to $\kappa$, the optimal amount of revenue to be recorded in the tax haven is given by:[41]

$$\kappa^* = \frac{p(d)x(d)}{w}\left(\frac{t - t_{th}}{1 - t}\right) \tag{14}$$

The amount of revenue shifted in the tax haven:

- increases with the tax differential
- increases with the size of revenue itself

#### E.2.5 Aggregate productivity

Consistently with section 3, apparent Labor Productivity (ALP) in the domestic economy is defined as value added per worker. Value added in this model is equal to turnover, $p(d)x(d)$ since there are no intermediate inputs.

$$\begin{aligned} ALP &= \frac{1}{L}\left(\int_{\varphi dom}^{\varphi *} p(d)x(d)dG(\varphi) + \int_{\varphi *}^{\infty}(1-\kappa)p(d)x(d)dG(\varphi)\right) \\ &= \frac{1}{L}\left(\underbrace{\int_{\varphi dom}^{\infty} p(d)x(d)dG(\varphi)}_{\text{true production}} - \underbrace{\int_{\varphi *}^{\infty} \kappa p(d)x(d)dG(\varphi)}_{\text{mismeasured production}}\right) \end{aligned}$$

[41] As suggested by the empirical finding presented in section 4, the cost of profit shifting is industry-specific and is lower for firms with high intensity in intangibles

where $\varphi^{dom}$ is the productivity threshold above which firms produce domestically, $\varphi*$ is the threshold above which firms go multinational.[42]

This last equation allows us to derive a set of testable predictions. The aggregate labor productivity measured in the domestic economy decreases with the amount of revenue shifted in tax haven. The contribution of individual firms to aggregate labor productivity depends on their ownership structure. Conditional on owning an affiliate in tax haven, the contribution to aggregate productivity reduces with the tax differential and the intensity of the firm in intangible capital.

#### E.2.6 Productivity threshold and production choices

The firm enters the domestic market if and only if $\pi(d) \geq 0$. The limiting productivity threshold is given by:

$$\begin{aligned} &\pi(d) = 0 \\ &\Leftrightarrow \varphi^{ope} = w\left(\frac{\sigma}{\sigma-1}\right)\left(\frac{\sigma f^{ope}}{1-t}\right)^{1/(\sigma-1)} X^{1/(1-\sigma)} P^{-1} \end{aligned}$$

The firm is indifferent between staying domestic and engaging into tax planning activity when:

$$\begin{aligned} &\pi^{mne} - \pi^{dom} = 0 \\ &\Leftrightarrow \varphi^{*}(d) = \left(\frac{\sigma}{1-\sigma}\right) \times w \times (X)^{1/(1-\sigma)} \times P^{-1} \times \left(\sqrt{\frac{f^{mne} - f^{ope}}{\Phi}}\right)^{1/(\sigma-1)} \end{aligned}$$

At a productivity level of $\varphi^{*}$ the firm is indifferent between staying domestic and engaging into tax planning.

[42]Given the CES-demand structure presented above and by adding an explicit Pareto distribution for firms' productivity, it is possible to express these thresholds, the price index and thus the ALP in terms of exogenous parameters only as sketched in appendix E.

### E.2.7 Price index

Since profit shifting is only a paper operation, the price index is not affected by profit shifting and is trivially given by:

$$P^{1-\sigma} = X \int_{\varphi^{dom}}^{\infty} \left( \frac{\sigma}{\sigma - 1} \frac{\varphi}{w} \right)^{\sigma-1} dG(\varphi)$$

Substituting for $\varphi^{ope}$ and rearranging to isolate $P$, we get:

$$P = \lambda_1 \times \Theta \times X^{1/(1-\sigma)}$$

where $\Theta = \left( \frac{\sigma f^{ope}}{1-t} \right)^{1/(\sigma-1)-1/\rho} w^{(\rho+1-\sigma)/\rho}$ and $\lambda_1 = \left( \frac{\sigma-1}{\sigma} \right) \left( \frac{\rho}{\rho-\sigma-1} \right)^{-1/\rho}$

### E.2.8 Aggregate productivity

Consistently with section 3, apparent Labor Productivity (ALP) in the domestic economy is defined as value added per worker. Value added in this model is equal to turnover, $p(d)x(d)$ augmented by worker's compensation $wL$ divided by the number of workers.

$$\begin{aligned} ALP &= \frac{\int_a^b p(d)x(d)d\varphi + \int_a^b wL}{L} \\ &= \frac{1}{L} \left[ \left( \frac{\sigma-1}{\sigma} \right) \frac{X^{1/(\sigma-1)}P}{w} \right]^{2(\sigma-1)-\rho} \\ &\left[ \lambda_2 \left( \frac{\sigma f^{ope}}{1-t_i} \right)^{(\sigma-1-\rho)/(\sigma-1)} + \lambda_3 \left( \frac{t-t_{th}}{1-t_i} \frac{1}{w} \right) \left[ \sqrt{\frac{f^{mne}-f^{ope}}{\Phi}} \right]^{2(\sigma-1)-\rho/(\sigma-1)} \right] + Nw \end{aligned}$$