Treasure Islands, Real Jobs? Workers and Anti-Avoidance Policies in a Tax Paradise *

Sónia Cabral[†1], Joana Garcia[‡1,2], Raquel Miranda[§1], Susana Peralta[¶3], and João Pereira dos Santos[‖4,5,6]

[1]Banco de Portugal, [2]NIPE/Universidade do Minho, [3]Nova School of Business and Economics, [4]Queen Mary University of London, [5]ISEG University of Lisbon, REM/ UECE, [6]IZA Institute of Labor Economics

February 2025

Abstract

This paper offers the first detailed characterization of the labor market in a tax paradise and the first assessment of how a reform aimed at discouraging tax avoidance affected workers in such a location. We show that incumbents were highly educated, performed specialized tasks, and benefited from a wage gap, particularly at the top. Immediately after the reform announcement, several workers exited. Stayers experienced wage increases of around 8% and a higher probability of working for several firms simultaneously. New hires earned, on average, 30% less than incumbents, frequently on temporary contracts. The results offer insights into policies promoting economic substance in low-tax jurisdictions.

Keywords: corporate tax avoidance; labor market; substance requirements; matched employer-employee data

JEL Codes: J08, H26, F23, J31, J38, J48, H30

*The authors thank Instituto Nacional de Estatística for access to the data, and Katarzyna Bilicka, Barbara Boelmann, Michael J. Böhm, Ana Rute Cardoso, Elizabeth Cascio, Cláudia Custódio, Ron Davies, Mónica Costa Dias, Emilia Gschossmann, Margarita López Forero, James Hines, Niels Johannesen, Marco Manacorda, João Pedro Martins, Miguel Portela, Pedro Portugal, Pedro Raposo, Carlos D. Santos, and Pedro Vicente, as well as participants in the Lisbon Micro Group, Osnabruck University, ISEG, and Banco de Portugal seminars, ISEG summer school, PEJ (Universidade do Minho), the conference "How can a UN Tax Convention address inequality in Europe and beyond?" at Paris School of Economics, the workshop "The Economic and Legal Implications of the Global Minimum Tax" at the Max Planck Institute for Tax Law and Public Finance, IIPF (Prague), and EEA (Rotterdam) for comments and suggestions. The analyses, opinions, and findings expressed in this article are those of the authors and do not necessarily coincide with those of Banco de Portugal or the Eurosystem. João Pereira dos Santos gratefully acknowledges financial support by UK Research and Innovation (UKRI) under the UK government's Horizon Europe funding guarantee [grant number EP/Y016718/1]. This study was funded by Fundação para a Ciência e a Tecnologia (2022.04821.PTDC). NIPE is financed by National Funds of the FCT Portuguese Foundation for Science and Technology – project UIDB/03182/2020. This work was funded by Fundação para a Ciência e a Tecnologia (UIDB/00124/2020, UIDP/00124/2020 and Social Sciences DataLab - PINFRA/22209/2016), POR Lisboa and POR Norte (Social Sciences DataLab, PINFRA/22209/2016). Any errors and omissions are the sole responsibility of the authors.

[†]scabral@bportugal.pt

[‡]jomgarcia@bportugal.pt

[§]rmmiranda@bportugal.pt

[¶]peralta@novasbe.pt

[‖]joao.santos@iseg.ulisboa.pt.

1 Introduction

In recent years, international tax avoidance activities of firms have received a great deal of attention. Media leaks such as the Panama and the Paradise papers have exposed the widespread use of low (or no) tax jurisdictions by multinational firms. Wier and Zucman (2022) quantify this phenomenon, documenting a remarkable increase in profit shifting to tax havens since 1975, with close to $1 trillion of multinational profits registered in those locations in 2019, resulting in a global loss of 10% of corporate tax revenues.

The implications of multinational companies reallocating profits to no/low tax jurisdictions extend beyond the artificial zero-sum transfer of the taxable base and can have real effects. A growing body of literature examines the real side of these strategies, such as how they shape employment, investment and the distribution of wages (see Alstadsæter et al., 2023, for a survey). These studies focus on one end of the profit-shifting strategies: the high-tax location. In contrast, far less is known about the real side of these strategies in the other side – the no/low tax locations–, likely due to high levels of secrecy and low transparency, that make data on real operations and workforce in such locations difficult to access.

This paper takes a first step toward filling that gap by utilizing administrative data for the low-tax jurisdiction of *Zona Franca da Madeira* (ZFM), a tax paradise for multinational firms in the Portuguese island of Madeira. We rely on a highly detailed longitudinal matched employer-employee dataset covering workers in Portugal, merged for the first time with an exhaustive novel list of all firms in ZFM, sourced from the Portuguese Institute of Registries and Notary.

Our contribution is twofold. First, we offer the first detailed characterization of the labor market of a low-tax jurisdiction. We go beyond the stylized fact that these places have very few workers when compared to profits (e.g Fuest et al., 2022), and offer a detailed characterization about who are the workers employed there, their skills, their tasks, and their wages. This analysis complements existing evidence about workers of profit-shifting firms located in the other end of the profit-shifting strategies – the high-tax location – (e.g. Alstadsæter et al., 2022), allowing for a more comprehensive picture of the workers of profit-shifting firms, as well as the costs that they may represent for those firms when compared to tax benefits.

The second contribution is the novel evidence on how a reform in a low-tax jurisdiction aimed at discouraging international tax avoidance affects employment and individual work-

ers in such a location. In 2012, the ZFM regime was modified by imposition of the European Commission, requiring firms to meet minimum employment requirements to continue benefiting from the reduced corporate tax rate applied in the region, which increased from 0% to 4-5%. We analyze how workers in ZFM were impacted by this reform and the type of employment that was created. Our work complements existing evidence about how reforms limiting profit shifting affect employment (e.g. Suárez Serrato, 2018), by offering evidence on the impact of the other side of these strategies (the low-tax location) and by studying, for the first time, a reform that included employment requirements.

Our results provide timely evidence to evaluate the possible impact of policies with similar traits being implemented in other jurisdictions, as well as lessons for designing such policies. One example is the introduction of employment requirements, from 2019 onwards, in no/low-tax jurisdictions such as the Cayman Islands, the Bahamas, Barbados, and Bermuda, which forced firms located in those jurisdictions to create jobs. The leading experience of ZFM informs about the possible effects of the introduction of such requirements.

The increasing prevalence of economic substance provisions is also evident in the global minimum tax agreement, particularly in the so-called "substance-based carve-outs" (e.g. Baraké et al., 2021). Under these new rules, large companies will be able to benefit from an effective tax rate below 15% (the minimum tax rate) if they have real operations (tangible assets and employees) in low-tax jurisdictions. The policy rationale is to encourage real investment in economic substance by multinational enterprises incorporated in these jurisdictions, thereby combating artificial profit shifting. Our results also provide insights to the potential effects of these policies, complementing model predictions (e.g. Johannesen, 2022) and quantitative simulations (e.g. Baraké et al., 2022).

We start our analysis by characterizing the firms that were located in the tax paradise before the reform. Our descriptive statistics underscore that the ZFM regime was essentially used by thinly staffed multinational firms with abnormally large sales. Our proxy for profits per worker (for firms with workers) reveals abnormally large profits, that in ZFM were several orders of magnitude higher than for other firms in the rest of Portugal, including the rest of the Madeira archipelago, even after controlling for standard firm observables. Therefore, firms in ZFM before the reform largely displayed the usual characteristics of firms in tax havens (e.g. Garcia-Bernardo et al., 2021, Tørsløv et al., 2022, Wier and Zucman, 2022).

We then characterize the workers employed by ZFM firms before the reform, when the corporate income tax (CIT) rate was 0% and there were no employment requirements in place.

Our analysis shows that ZFM workers have distinct attributes, by comparing them to those in the rest of Madeira and Portugal. They are, on average, more educated and more likely to be immigrants. In terms of occupations, the share of office workers, technicians and mid-level professionals and specialists in intellectual and scientific professions is particularly large relative to the rest of the country. So is the share of firm directors, which is more than double the one in the rest of the country. Therefore, workers were relatively skilled and performed relatively skilled tasks.

Wages in ZFM were meaningfully higher than in the rest of Portugal. Our results show that the distribution of wages in ZFM is less concentrated on low-wage values than in the rest of Portugal and that the average unconditional wage gap is around 60%. After controlling for a rich set of observables, this gap remains statistically significant and economically higher than 14%, and particularly high for top executives, for which it exceeds 40%. This evidence suggests that rent-sharing mechanisms may be at play, with top executives benefiting the most from the tax savings of the firm.

Despite the existence of a wage gap, our back-of-the-envelope estimates suggest that the cost of employing workers in a low-tax jurisdiction is relatively small, when compared to the tax benefits. Before the reform, we estimate that the cost of employing workers represented roughly 5% of the total tax benefits. Most theoretical contributions in the literature on international corporate tax avoidance feature profit-shifting firms that must weigh the costs of profit shifting against the benefits of a reduced tax burden (e.g. Dharmapala and Riedel, 2013, Davies et al., 2018). Our results offer a quantification of one part of those costs: the labor costs in low-tax jurisdictions. The obtained estimates suggest that these costs are relatively small when compared to tax benefits.

After a comprehensive characterization of workers in the ZFM during the pre-reform period, we investigate the impact of the 2012 reform on employment. At that time, multinational firms benefiting from a 0% CIT rate for several years had to choose between leaving the jurisdiction, facing a statutory tax rate increase to 25% (the local CIT rate), or remaining in ZFM and paying a reduced corporate tax rate of 4-5% while meeting the new employment requirements.

At the aggregate level, headcount remained relatively constant over the period 2010-2014, averaging 1685 workers. However, this stabilisation hides different margins of adjustment, which we dissect.

Initially, we focus on incumbent workers, i.e., workers of firms located in the ZFM before the reform was announced. To identify causal effects on those individuals, we first use a matching algorithm using pre-reform characteristics to select a suitable comparison group in the rest of Portugal. We then implement an event-study differences-in-differences approach by comparing their trajectories before and after the policy change for a series of outcomes.

We find that the reform led to the exit of incumbents from the Portuguese labor market immediately after the announcement in 2011, an effect primarily driven by the exit of some firms. For incumbent workers who stayed (incumbent stayers), the number of firms where each worker was employed increased starting in 2012 (when the reform was implemented), and there was a simultaneous rise in the probability of having at least one part-time contract.

Concurrently, incumbent stayers experienced an increase in their total wages (the sum of wages across all firms where they work). The wage increase was approximately 8% two years after the reform was implemented. These additional expenses with incumbents likely represented a small cost for ZFM firms. According to our back-of-the envelope calculations, they represented 0.9% of the yearly tax benefits. Therefore, firms continued to bear a relatively small cost with incumbent workers after the reform, when compared to the tax benefits.

Lastly, we characterize the types of jobs held by individuals who moved to ZFM after the reform was implemented. These individuals were more likely to have part-time jobs and temporary contracts and work for firms that were already in ZFM before the reform but had no employment, compared to incumbent stayers. They also earned wages that were, on average, 30% lower, conditional on observable characteristics. Since they disproportionately joined firms that previously had no employment, their services might not be as valued as those of incumbent stayers, who were already in ZFM when firms did not need to meet employment requirements.

Our paper is closely related to studies that look at workers from profit-shifting firms, which focus on the other side of the tax avoidance strategy: the high-tax jurisdiction (Lopez Forero, 2021, Souillard, 2022*a*,*b*, Alstadsæter et al., 2022, Davies and Scheuerer, 2023). In particular, also using employer-employee data, Alstadsæter et al. (2022) show that profit-shifting firms in Norway pay higher wages, especially in the service sector. They also find significant within-firm heterogeneity, with high-skill workers earning a higher wage premium. Souillard (2022*b*) focuses on U.S. top executives and finds that those executives receive higher wages subsequent to their firm's entry into tax havens. Our results complement these studies

looking at the other side of the profit shifting strategies and showing that wage gaps extend to those places and were also particularly large at the top.

The paper also adds to ongoing research on the impact of anti-avoidance measures on real economic activities of multinational firms. Empirical evidence is scarce and mostly limited to the effects on high-tax locations. Suárez Serrato (2018) studies a policy that limited profit shifting by US multinationals and shows that it led US multinationals to reduce employment and investment in the US. Bilicka et al. (2022) show that the introduction of a worldwide debt cap in the UK in 2010 led to a reallocation of real operations away from the UK.

More generally, we also expand upon the literature examining international corporate tax avoidance. We refer to Hines Jr (2010), Zucman (2014), Riedel (2018), Beer et al. (2020) for comprehensive surveys. A key focus of this literature has been the quantification of the amount of profits shifted to tax havens and of the amount of tax revenues that are drained from high-tax countries as a consequence (e.g. Bilicka, 2019, Tørsløv et al., 2022, Wier and Zucman, 2022). Another strand investigates instead the strategies used by multinational firms to shift profits (e.g. Buettner and Wamser, 2013, Cristea and Nguyen, 2016, Davies et al., 2018, Garcia, 2023). Our analysis is more closely related to the strand of this literature addressing the consequences of international corporate tax avoidance that go beyond its impact on tax revenues. Besides the previously mentioned contributions on the effect on wages, employment or investment on high-tax countries, this literature has addressed the consequences of international tax avoidance activities on aspects such as industry concentration and macroeconomic statistics (e.g. Suárez Serrato, 2018, Li et al., 2021, Martin et al., 2022, Guvenen et al., 2022).

The remaining of the paper is organized as follows. Section 2 describes briefly the ZFM scheme and the 2012 reform while Section 3 presents the data. Section 4 characterises ZFM firms and workers before the reform. Section 5 evaluates the impact of the reform on different margins of employment. Finally, Section 6 concludes.

2 Institutional background

The Autonomous Region of Madeira (*Região Autónoma da Madeira* in Portuguese) is a Portuguese archipelago situated in the North Atlantic Ocean, which is an integral part of the European Union, classified as an outermost region. In the late 1980's, the Madeira island started offering a tax paradise for multinational firms – the ZFM scheme (*Zona Franca da*

Madeira in Portuguese), consisting of a set of incentives, mainly of a tax nature, granted to licensed firms, implemented with the objective of attracting foreign investment and creating jobs in the region. Officially, the ZFM scheme was designed to compensate the structural handicaps that firms face in an outermost region of Europe, including remoteness, insularity, small market size, difficult topography, and climate.

To benefit from the ZFM tax scheme, firms have to apply for a license, and pay an application fee of 1000 euros. They are also subject to an operating fee, whose value depends on the activity of the firm. For example, currently firms pursuing international services activities are subject to an annual operating fee in the amount of 1800 euros.[1]

Until the end of 2011, firms licensed before 2003 benefited from an exemption from CIT on the income derived from transactions with non-residents entities or entities also established in ZFM, as well as exemption from withholding taxes on dividend remittances, capital gains, and payments of royalties, interest, and services. According to public information from the Portuguese Tax Authority[2], 98% of the firms had been licensed before 2003, and therefore were benefiting from those highly advantageous tax conditions.[3] Among firms located in ZFM there were subsidiaries of large multinational groups such as PepsiCo, Dell, Swatch, British American Tobacco, and Sigma-Tau Pharmaceuticals, according to the anecdotal information collected by Martins (2011).

Such advantageous regime was fully authorized by the European Commission until the end of 2011. While local policymakers hoped that it would be renewed after that year (e.g. Rocha, 2011), in May 2011 a bailout was negotiated between the Portuguese Government and the Troika of European Commission, ECB, and IMF, resulting in a Memorandum of Understanding that prevented the negotiation of its extension.[4] Multinational firms facing a 0% tax rate for several years had to choose between leaving the jurisdiction, facing a statutory tax rate increase to 25% (the local CIT rate), or remaining in ZFM and paying a reduced corporate tax rate of 4-5%[5] while meeting employment requirements. In particular, after the reform, employment requirements varied according to the firm's annual taxable income. For example, a firm with an annual taxable income up to 2 million euros was required to have at least 1 worker. A firm with such income above 26 million and lower or equal than 40 million

[1] https://www.ibc-madeira.com/en/prospective-investors.html

[2] https://info.portaldasfinancas.gov.pt/pt/dgci/divulgacao/Area_Beneficios_Fiscais/Paginas/default.aspx

[3] The remaining firms, which obtained their licenses after that date, were subject to a positive, yet low, tax rate, of 3% or 4%, depending on the year of their license.

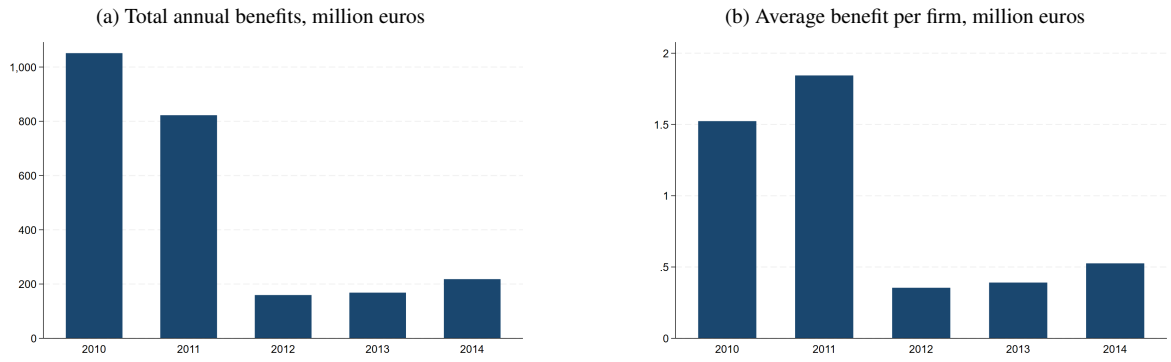
[4] The Memorandum of Understanding introduced a standstill rule to all tax benefits, blocking the creation of new items of tax benefits and the enlargement of existing items. The rule applied to all kinds of tax benefits, of a temporary or permanent nature, at the central, regional, or local level.

[5] The tax rate increased to 4% in 2012 and 5% thereafter.

euros was required to have at least 51 workers. The scheme is detailed in Table A.1.

Since 2010, the Portuguese Tax Authority provides public information about the total annual tax benefits of firms who claimed benefits of at least 1000 euros. In 2010, before the reform was announced, the tax benefits conceded in ZFM (Figure 1) exceeded 1 billion euros. Benefits per firm were substantial: around 1.5 million euros per year. Total benefits and benefits per firm declined sharply after the reform was implemented in 2012.

Figure 1: Tax benefits granted to firms in ZFM



Source: Portuguese Tax Authority. Notes: The annual series of the tax benefits associated with the ZFM are available at the website of the Tax Authority (`https://info.portaldasfinancas.gov.pt/pt/dgci/divulgacao/Area_Beneficios_Fiscais`). Only taxpayers who claimed annual tax benefits of at least 1000 are included in the list. The tax benefit is calculated using the revenue foregone method, i.e., it is based on a comparison between existing legislation and legislation without the tax break. It corresponds to a static analysis, as it assumes unchanged behavior by economic agents and ignores possible interaction with other taxes.

3 Data

Our empirical analysis benefits from micro data provided by the Portuguese National Statistical Office (Statistics Portugal). The main database is *Quadros de Pessoal* (QP, Personnel Records), a rich longitudinal matched employer-employee dataset. The data are gathered annually by the Portuguese Ministry of Labor through a survey that every firm with at least one wage-earner is obliged by law to complete. Civil servants, self-employed individuals, and household employees are not covered, and the agricultural sector has low coverage. On the other hand, for manufacturing and private service sectors, the survey covers virtually the entire population of firms and workers. Upon request, the employer is obliged to inform the workers and the workers union about the information reported in QP. This provision flags the

reliability of the information provided.[6]

The data on workers covers dimensions such as gender, age, education, occupation, tenure, nationality, and monthly wages. The reference month regarding the worker-level data is October. Information on the firms includes sector of activity, region, ownership type, and size (turnover and employment).

Firms and workers entering the QP dataset are assigned a unique identification number that allows them to be tracked over time. In addition, the worker files contain the identification number of the firms to which each worker is affiliated in a given year. This makes it possible to match firms and their workers, and to identify each worker-firm pair.

We merge the QP dataset with an exhaustive list of all firms with a license to operate in ZFM from 2009, which was made available for the first time to researchers. This list is based on the registration of firms in the Institute of Registries and Notary (IRN).[7] The list was merged with the QP database using the common anonymized firm identification number. We use QP data from 2009 (the first year for which the list of firms in ZFM is available) until 2014.[8] This sample comprises 14,918,057 workers-year, including 9,984 in ZFM. A detailed characterization of workers in ZFM before the reform was announced (2009-10) is provided in the next section. Section 5.3 describes workers that moved to ZFM after the reform was announced.

4 ZFM before the reform

4.1 ZFM firms

A stylized fact about firms in zero/low-tax jurisdictions is their small number of workers, especially compared to the level of profits reported in these locations (e.g. Fuest et al., 2022). ZFM is no exception.

Figure 2 illustrates the distribution of workers for firms in ZFM before the reform. We focus on the years 2009 and 2010, since the dataset is available as of 2009, and the reform was

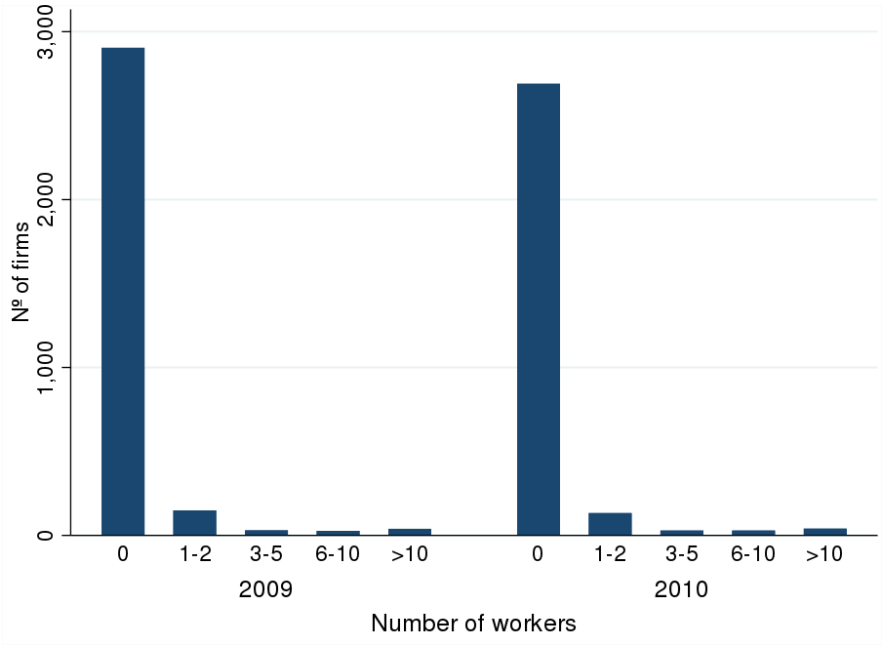
[6] QP has been used to study, *inter alia*, the gender wage gap (Card et al., 2016), the wage losses of displaced workers (Raposo et al., 2021), wage bargaining (Card and Cardoso, 2022), and the returns to schooling (Portugal et al., 2024).

[7] IRN is the government agency that provides nationwide civil identification, nationality, and passport services and also civil, land, vehicle, ship, commercial, and legal persons register services.

[8] We end the sample in 2014 as in 2015 there was another reform in ZFM, which is not the focus of this paper. Moreover, in the event study presented in Section 5.2, we extended the sample back by one year to include data from 2008. Although we do not have information on whether workers were in ZFM in 2008, we define incumbents as workers who were in ZFM in 2010, and we can observe the characteristics of those workers in 2008 in QP. This extension allows us to include an additional year in our analysis to better assess the parallel trends assumption.

announced in 2011. Although there were, on average, 3,035 firms in the ZFM in 2009-2010, only 8% of these firms appear in the QP records. Since all firms with at least one wage earner were required to complete the QP survey, this implies that more than 90% of the firms did not have workers, with "worker" defined as an individual receiving a positive wage.

Figure 2: Firms in ZFM have few workers

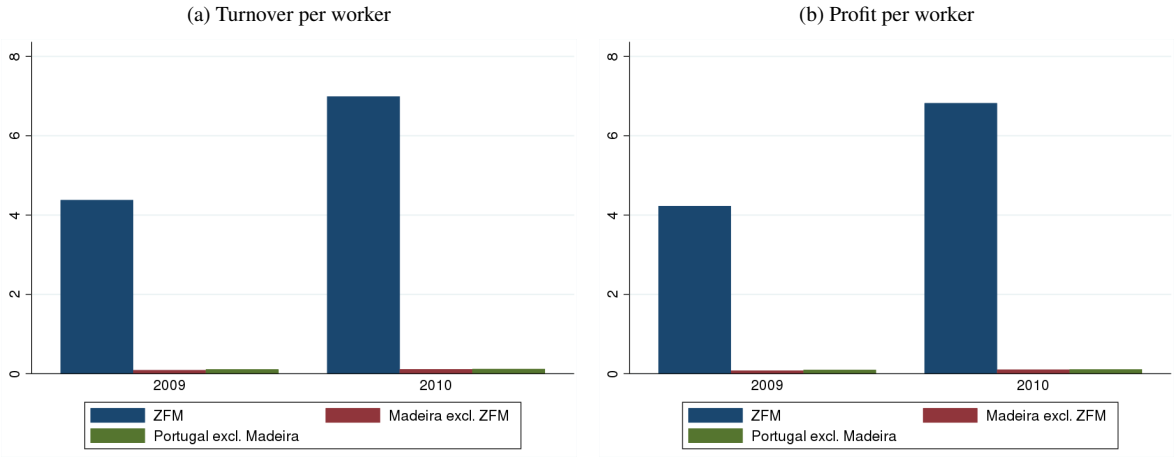


Notes: Firms are considered to have zero workers if they do not appear in the QP database, which includes all firms with at least one wage earner.

While the QP database does not provide profit figures, we construct a proxy for gross profit by subtracting the firms' wage bill from their turnover. We then measure profit per worker for firms with at least one worker. The results for this subset of firms (Figure 3) reveal that, similar to other zero or low-tax jurisdictions, average turnover (in panel a) profitability per worker (in panel b) are abnormally high, on average 50 times greater than in the rest of Madeira, and in Portugal excluding Madeira.

These results should nevertheless be interpreted with a grain of salt given that we do not have access to other costs to compute our proxy for profits. This high profitability in ZFM could partly reflect that the majority of the firms located there are branches of multinationals (Table B.1), which tend to be more profitable than domestic standalone firms (e.g. Foley et al., 2021), either because of actual profit-generating economic activity, or due to profit shifting strategies. It could also reflect the fact that the distribution of firms across economic sectors is different in ZFM than in the rest of the country (Table B.2). The sector of professional,

Figure 3: Average turnover and profit per worker of ZFM firms are several orders of magnitude larger than in the rest of Portugal



Notes: Profit per worker (in million euros) is proxied by subtracting the firm's wage bill from turnover. The sample only includes firms with workers. For a more careful econometric comparison see Table B.1 in the Appendix.

scientific, and technical services is especially relevant, comprising around 33% of the total number of ZFM firms in 2009-2010. Within this sector, two primary subsectors are particularly prominent: activities of head offices and management consultancy activities; and legal and accounting activities.

However, these observable characteristics account for only part of the disparity between the profitability per worker of ZFM firms and other firms in Madeira or in the rest of Portugal. As shown in Table B.4, after controlling for these factors, there is still a very large and significant gap in profits per worker in ZFM firms relative to firms in the rest of the country/Madeira. In a nutshell, this evidence likely reflects that these branches serve tax sheltering objectives.

4.2 ZFM workers

In 2009-10, there were on average 1,672 workers in ZFM. Those workers exhibited several distinct attributes compared to those employed in the rest of Madeira, and in Portugal excluding Madeira (Table 1). Two demographic characteristics stand out. First, workers in ZFM had higher levels of education: on average, 28% had tertiary education, compared to 11% in the rest of Madeira, and 15% in Portugal excluding Madeira. Second, the proportion of non-Portuguese nationals was higher in ZFM: 9% of workers were immigrants, compared

to 2% in Madeira and 5% in Portugal excluding Madeira.

Table 1: Workers in ZFM exhibit several distinct attributes compared to those in the rest of Madeira/Portugal

(a) ZFM

	N	Mean	Std. dev.	p25	Median	p75
Monthly wage	3,343	1545.51	1642.99	711.00	1040.31	1740.00
Age	3,343	39.02	10.31	31.00	38.00	46.00
Female	3,343	0.48	0.50	0.00	0.00	1.00
Foreign nationality	3,343	0.09	0.28	0.00	0.00	0.00
University	3,343	0.28	0.45	0.00	0.00	1.00
Top executive	3,343	0.13	0.33	0.00	0.00	0.00
Temporary contract	3,343	0.34	0.47	0.00	0.00	1.00
Part-time contract	3,343	0.04	0.19	0.00	0.00	0.00
Number of firms	3,343	1.04	0.29	1.00	1.00	1.00
Multiple firms	3,343	0.03	0.18	0.00	0.00	0.00

(b) Madeira excluding ZFM

	N	Mean	Std. dev.	p25	Median	p75
Monthly wage	106,983	965.56	843.08	587.22	744.60	1029.40
Age	106,983	37.97	10.72	29.00	37.00	46.00
Female	106,983	0.45	0.50	0.00	0.00	1.00
Foreign nationality	106,983	0.02	0.15	0.00	0.00	0.00
University	106,983	0.11	0.31	0.00	0.00	0.00
Top executive	106,983	0.06	0.24	0.00	0.00	0.00
Temporary contract	106,983	0.28	0.45	0.00	0.00	1.00
Part-time contract	106,983	0.04	0.19	0.00	0.00	0.00
Number of firms	106,983	1.02	0.13	1.00	1.00	1.00
Multiple firms	106,983	0.01	0.12	0.00	0.00	0.00

(c) Portugal excluding Madeira

	N	Mean	Std. dev.	p25	Median	p75
Monthly wage	5,152,563	951.99	981.69	537.00	690.41	1038.43
Age	5,152,563	38.62	11.03	30.00	37.00	47.00
Female	5,152,563	0.45	0.50	0.00	0.00	1.00
Foreign nationality	5,152,563	0.05	0.22	0.00	0.00	0.00
University	5,152,563	0.15	0.36	0.00	0.00	0.00
Top executive	5,152,563	0.07	0.26	0.00	0.00	0.00
Temporary contract	5,152,563	0.28	0.45	0.00	0.00	1.00
Part-time contract	5,152,563	0.06	0.23	0.00	0.00	0.00
Number of firms	5,152,563	1.02	0.16	1.00	1.00	1.00
Multiple firms	5,152,563	0.02	0.13	0.00	0.00	0.00

Notes: Worker descriptive statistics for 2009-2010. University – workers with tertiary education. Top executive – workers whose 1-digit occupation is "Senior public administration officials, directors and senior management of companies" (code 1) in the Portuguese Classification of Occupations. Nž of firms – number of firms for which each worker works at the same time. Multiple firms – workers that work for multiple firms at the same time.

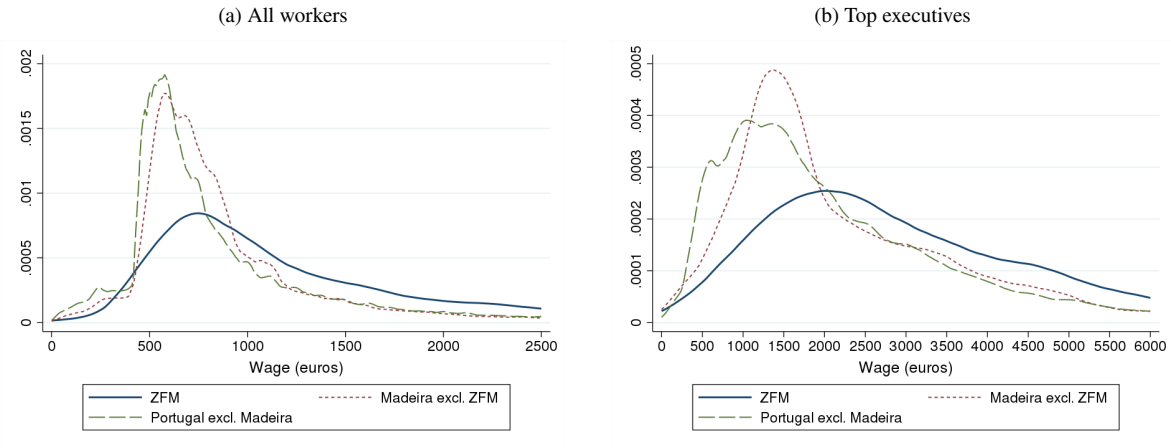
In terms of occupations (Table C.1), "office workers" was the most common at the 2-digit level of the Portuguese Classification of Occupations, comprising 20% of the workforce in ZFM, compared to 12% in the rest of Madeira, and 11% in Portugal excluding Madeira.

There was also a higher share of "other technicians and mid-level professionals" in ZFM, a category which includes various roles such as secretaries and administrative workers of financial and accounting services, and a higher share of "other specialists in intellectual and scientific professions" with the largest occupation at the 4-digit level being accountants. Firm directors constituted 7% of workers in ZFM, compared to around 3% in the rest of the country.

Regarding types of contracts, the mean share of temporary contracts was somewhat higher in ZFM relative to the rest of the country (34% vs. 28%). The share of part-time contracts was quite low (4%), like in the rest of the country. Multiple-job holding was rare, with 97% of workers employed by only one firm, consistent with national trends.

Looking at the mean wage, we see that wages in ZFM in 2009-2010 were around 60% higher than in the rest of Portugal. The distribution of wages in ZFM (Figure 4 – panel (a)) is less concentrated around the minimum wage level than in the rest of the country. Given the substantial differences in the observable characteristics of firms and workers in ZFM compared to the rest of Portugal, this comparison should be understood as only suggestive. For example, the share of multinationals was higher in ZFM, and multinationals tend to pay higher wages (e.g. Setzler and Tintelnot, 2021). Additionally, workers in ZFM had higher levels of education, which may explain part of the wage gap. This indicates the need to control for worker and firm characteristics via a Mincerian regression analysis.

Figure 4: Workers in ZFM earn higher wages - monthly wage distributions (2009-2010)



Notes: Monthly wages are calculated as the sum of all wages of each worker across firms in a given year, in euros, i.e., wages per worker-year. Top executive – workers whose 1-digit occupation is "Senior public administration officials, directors and senior management of companies" (code 1) in the Portuguese Classification of Occupations.

We estimate simple Mincerian equations including sector-year fixed effects, worker time-varying controls, and firm time-varying controls. We also consider specifications with region fixed effects to account for potential permanent differences in wages in the different Portuguese regions, including Madeira. The results in Table 2 show that, after controlling for different vectors of observables and fixed effects, there was an average wage gap associated with working in ZFM that was consistently above 14%.

Table 2: Workers in ZFM earn higher wages - Mincerian equations

	(1)	(2)	(3)	(4)	(5)
ZFM	0.204***	0.185***	0.206***	0.160***	0.140***
	(0.015)	(0.011)	(0.011)	(0.011)	(0.011)
Sector-year FE	Yes	Yes	Yes	Yes	Yes
Worker Controls	No	Yes	Yes	Yes	Yes
Firm Controls	No	No	Yes	Yes	Yes
Region FE	No	No	No	Yes	Yes
Observations	5,262,889	5,262,889	5,262,889	5,262,889	5,255,229
Adjusted R-squared	0.256	0.501	0.521	0.526	0.559

Notes: Monthly wage (in logarithm), 2009-2010. Sectors are defined at the CAE 2-digits level comprising, 86 sectors. Worker-level controls comprise age and its quadratic term, tenure and its quadratic term, gender, education (3 distinct education levels), dummy variables for immigrants, top executives, part-time workers, and workers with a temporary contract, when applicable. Firm-level controls comprise the logarithm of employment and a dummy variable measuring if the firm has at least 50% of foreign equity. Region fixed effects are defined at the NUTS2 level, comprising 7 regions, including the Madeira region. Column (5) includes occupation dummies at the 4-digit level instead of the dummy variable for top executives. We harmonized the break in the 1994 and 2010 Portuguese classifications of occupations, resulting in the loss of some observations in that process. Standard errors in parentheses are clustered at the worker level. Stars indicate significance levels of 10% (*), 5% (**), and 1% (***).

The wage gap in ZFM could arise from different sources. On the supply side of the labor market, the moral values of individuals may play a role. Previous research has suggested that workers may be willing to accept lower wages to work in more environmentally sustainable sectors (Krueger et al., 2021) or in more meaningful jobs (Cassar and Meier, 2018). Conversely, they may demand monetary compensation to work in pollution-intensive industries (Cole et al., 2009) or in jobs perceived as immoral (Schneider et al., 2020). Therefore, workers may demand a premium for participating in tax avoidance activities that may be perceived as immoral and unethical by themselves or others.

Simultaneously, from the perspective of a collective bargaining model, the higher rents that firms engaging in tax avoidance achieve through lower tax bills could be shared with workers, resulting in a positive wage gap. This mechanism is similar to that of corporate tax rate reductions on wages (e.g., Suárez Serrato and Zidar, 2016, Fuest et al., 2018, Saez et al., 2019, Carbonnier et al., 2022). It is also consistent with evidence that workers in high-tax locations employed by firms that have subsidiaries in tax havens benefit from a wage gap

relative to workers employed by other firms (Alstadsæter et al., 2022). Our results show that this wage gap extends to the other side of tax avoidance strategies: the low-tax location. As in those studies, we also find evidence that this wage gap is particularly large at the top (Figure 4 - panel (b); Table 3): for top executives the conditional gap is above 40%. The conditional wage gap is also particularly large for workers with tertiary education (24%) and for immigrants (39%).

Table 3: The wage gap in ZFM is higher for top executives, workers with tertiary education and immigrants

	(1)	(2)	(3)	(4)	(5)
ZFM	0.140***	0.0988***	0.100***	0.132***	0.116***
	(0.011)	(0.011)	(0.011)	(0.016)	(0.011)
ZFM * top executive		0.327***			
		(0.038)			
ZFM * university			0.139***		
			(0.026)		
ZFM * female				0.0149	
				(0.021)	
ZFM * foreign nationality					0.269***
					(0.047)
Sector-year FE	Yes	Yes	Yes	Yes	Yes
Worker Controls	Yes	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes
Observations	5,255,229	5,255,229	5,255,229	5,255,229	5,255,229
Adjusted R-squared	0.559	0.559	0.559	0.559	0.559

Notes: Mincer equation – Monthly wage (in logarithm), 2009-2010. Sectors are defined at the CAE 2-digits level comprising, 86 sectors. Worker-level controls comprise age and its quadratic term, tenure and its quadratic term, gender, education (3 distinct education levels), dummy variables for immigrants, top executives, part-time workers, and workers with a temporary contract, and occupation dummies (at the 4-digit level). Firm-level controls comprise the logarithm of employment and a dummy variable measuring if the firm has at least 50% of foreign equity. Region fixed effects are defined at the NUTS2 level, comprising 7 regions, including the Madeira region. The results are quantitatively similar when region fixed effects are not included (Table C.2). Standard errors in parentheses are clustered at the worker level. Stars indicate significance levels of 10% (*), 5% (**), and 1% (***).

4.3 The costs of profit shifting: labor costs

Most theoretical contributions in the literature on international corporate tax avoidance feature profit-shifting firms that must weigh the costs of profit shifting against the benefits of a reduced tax burden (e.g. Dharmapala and Riedel, 2013, Davies et al., 2018). These costs include expenses incurred in operating within tax havens, such as payments for services provided by workers located there. Quantifying these costs and comparing them with benefits is challenging, particularly in low-tax locations, as data on those workers, including their

wages, is often difficult to obtain and compare with the resulting tax benefits.

We perform a back-of-the-envelope calculation to ballpark the costs supported by firms with workers in ZFM in 2010, before the reform. Moreover, we compare them with the tax benefits publicly available for the year 2010 (Figure 1). In that year, the mean monthly wage in ZFM was 1,555 euros, with 1,782 workers employed. Given that the monthly wage in Portugal is paid 14 times annually and firms are required to pay a social security contribution of 23.75%, this results in an annual cost of approximately 48 million euros. The total tax benefits in the ZFM for that year amounted to around 1 billion euros. Thus, the cost of employing workers represented 4.6% of the total tax benefits. Considering a wage gap of 14%, approximately 5.9 million euros were paid to workers as part of this wage gap, which is 0.6% of the total tax benefits. These calculations demonstrate that, despite the existence of a wage gap, the costs associated with employing workers in low-tax jurisdictions are quite small compared to the substantial tax benefits.

5 The impact of the reform

In this section of the paper, we analyze the impact of the reform described in section 2 on various employment margins. At that time, multinational firms benefiting from a 0% CIT rate for several years had to choose between leaving the jurisdiction, facing a statutory tax rate increase to 25% (the local CIT rate), or remaining in ZFM and paying a reduced corporate tax rate of 4-5%, while meeting employment creation requirements.

Several incumbent firms present in ZFM before 2010 chose to exit the jurisdiction. Of the 2,921 incumbent firms in ZFM in 2010, only 1,348 remained by 2014. According to interviews conducted at the time, the primary driver of firm exits was the imposition of limits on taxable profits determined by the creation of employment, which was not a requirement in other low-tax jurisdictions in Europe (Palma, 2016).

We show that firms with zero workers in 2010 ("mailbox" firms) were around 30 percentage points more likely to exit ZFM after the reform in Table 4. Note that, for these firms, we do not observe their characteristics, as only firms with at least one wage earner are included in our employer-employee database. Our data source for this exercise is the list of the tax benefits provided by the Tax Authority. This limitation is, however, not particularly problematic for assessing the reform's impact on employment, as the exit of zero-employment firms does not affect employment numbers in ZFM and therefore does not directly impact our analysis.

Table 4: Firms with zero workers before the reform (mailbox firms) were more more likely to exit ZFM after the reform is announced

	(1) LPM Exit	(2) Probit Exit
Mailbox firm	0.298***	0.306***
	(0.031)	(0.034)
Observations	2,921	2,921
Adjusted R-squared	0.026	
Pseudo R-squared		0.019

Notes: The sample comprises the 2,921 firms that were in ZFM in 2010. The dependent variable is a dummy equal to 1 if the firm exits ZFM over 2011-2014, and 0 if it remains in ZFM. Mailbox firm is a firm that in 2010 employed 0 workers. LPM - linear probability model. The probit parameter refers to the average marginal effects. Standard errors in parentheses are clustered at the firm level. Stars indicate significance levels of 10% (*), 5% (**), and 1% (***).

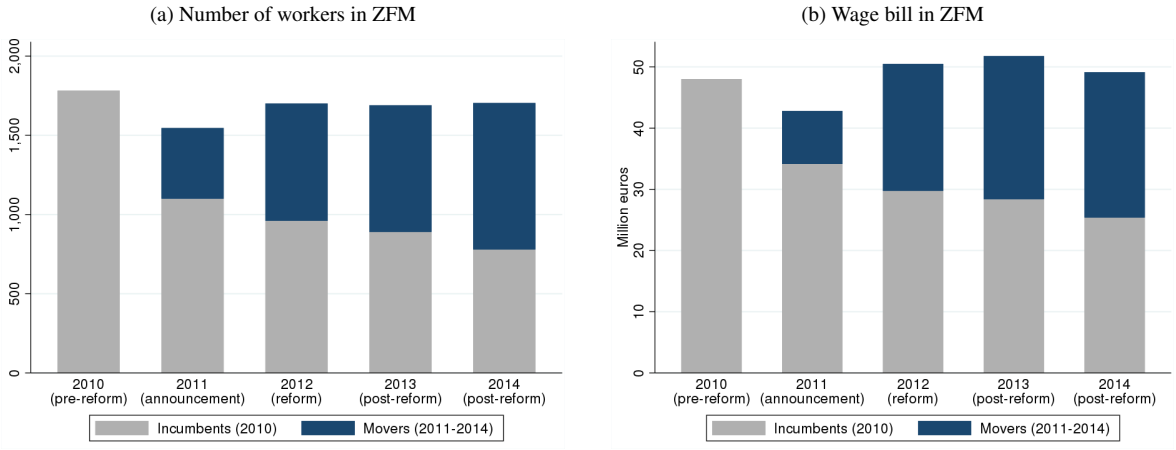
We start by characterizing the evolution of total employment and the wage bill in ZFM in subsection 5.1. We then turn to how the reform impacted incumbents and study the type of employment created after the reform.

5.1 Aggregate employment

Figure 5 panel (a) presents the evolution of employment in ZFM between 2010 and 2014. The total number of workers remained remarkably constant during this period, with an average of 1,685 workers. Similarly, the wage bill in ZFM was relatively stable in that period (Figure 5 panel (b)).

In addition, the evidence in Figure 5 panel (a) suggests that the evolution of employment after the reform announcement aggregates a significant level of employee turnover. Of the 1,782 workers in ZFM in 2010, more than 680 left immediately from this year to the next. Although we continue to observe a decline in the number of incumbent stayers in the following years, the intensity of the drain diminished over time. At the same time, several new workers were employed in ZFM after the reform was announced. In 2014, there were 925 workers that moved to ZFM after 2010. We analyze these dynamics more thoroughly in the following subsections, by focusing first on incumbents (in subsection 5.2) and then on movers (in subsection 5.3).

Figure 5: Employment levels and the wage bill of firms in ZFM remained stable over time



Notes: Incumbents – workers that were employed in ZFM in 2010. Wage bill – sum of monthly wages paid by ZFM firms each year, multiplied by 14 and by 1.2375 to account for the mandatory employer's social security contribution. For these calculations, we are assuming that workers observed in October remain in the firm for the full year.

5.2 Incumbents

To assess the causal impact of the reform on incumbent workers, we implement an event study difference-in-differences approach. To build the group of treated workers, we start with all workers in ZFM in 2010, before the reform is announced. We then require that these workers are aged between 25 and 55 years in 2010, so that they have a stronger labor market attachment. This gives us 1,507 workers. For the potential group of control workers, we start with all workers that in 2010 are outside ZFM and that are between 25 and 55 years old. We further require that they are always outside ZFM throughout 2009-2014.[9]

We then match treated and control workers on pre-treatment (2010) observables, relying on our rich administrative dataset. For age and wages, we use Coarsened Exact Matching (Iacus et al., 2012). To this end, we construct separate strata for 10 deciles. On wages, we also create separate bins for the 99th and 99.9th percentiles. We then match treated workers to control group workers for each of these bins, while additionally requiring them to work in the same 2-digit sector of activity, and have the same gender, education level (basic or less than basic, secondary and post-secondary, and university), part-time status, and immigrant status. Using this method, we are able to match 93% incumbent workers in ZFM in 2010 with 181,824 comparison workers. We re-weight observations in the regression analysis to account for the fact that there are many more control than treated workers and ensure that the

[9] If there are spillovers to workers in Madeira, but outside of ZFM, our estimates may provide a lower-bound for the impact of the reform. In Appendix E, we show that the results are similar if we exclude workers in Madeira from the control group.

estimates reflect the intended target population more accurately. More computational details as well as descriptive statistics for treated and control groups are provided in Appendix D.

We then conduct event study difference-in-differences regressions for worker i in year t as follows:

$$y_{it} = \beta_1 Treated_i + \sum_{t=2008, t\neq 2010}^{2014} \eta_t \times Treated_i \times Year_t + \gamma_t + \varepsilon_{it}, \quad (1)$$

where y_{it} is the outcome of interest. The dummy variable $Treated_i$ equals one for treated individuals – those that in 2010 were working in a ZFM firm. The parameters of interest are η_t, and γ_t are year fixed effects. The error term is ε_{it}. Robust standard errors are clustered at the 2010 firm level (Bertrand et al., 2004, Abadie et al., 2023).

The difference-in-differences estimates rely on two main assumptions (Roth et al., 2023). The first is that there are no anticipation effects before the shock. To be conservative, we show all results setting the omitted period to 2010, before the announcement of the reform, to mitigate possible anticipation concerns that could have changed the behavior of agents. The second is that outcomes of workers in ZFM and their matched comparison group, in the absence of treatment, would evolve in a parallel trend. Even if we only have information on licensed ZFM firms from 2009 onwards, we can still observe outcome variables of the 2010 matched treated and control workers in 2008 in QP. We include data for 2008 by extending the sample backwards by one year, in order to set up an event study specification that allows us to report supporting evidence for this assumption (Roth, 2022).

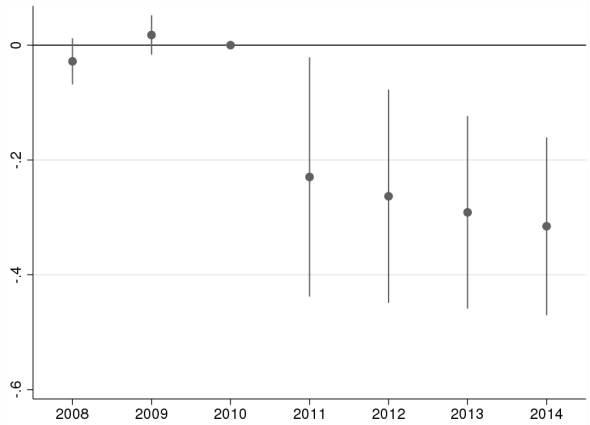
5.2.1 Exit

We first present the results on the probability of staying in the Portuguese labor market (as reported in QP dataset) in Figure 6. In this context, an exit could mean that the worker started a job in general government, began working for himself, became inactive, unemployed, emigrated, or died.

We find that workers in ZFM are 23 percentage points more likely to leave in the year when the reform was announced (2011) than their matched peers. Moreover, these effects are persistent until 2014. On average over 2011-2014, workers in ZFM were 27 percentage points more likely to exit the Portuguese labor market. Combining these findings with firm-level descriptive statistics, we conclude that this exodus is largely driven by firms leaving ZFM: for most worker exits, the firm also exits. The reform was announced in May 2011 and we

report comforting evidence that the parallel trends' assumption is likely to hold. As QP data is recorded in October, the large effect observed already in 2011 indicates that even though these firms had workers in ZFM (and therefore were not just "mailboxes"), they were fast and flexible in reacting to the May 2011 announcement and in deciding whether to continue their activities there.

Figure 6: The reform led to an increased exit from the Portuguese labor market



Notes: The figure depicts the regression results of equation 1. The dependent variable is a dummy variable equal to 1 if the worker is in the Portuguese labor market, and 0 otherwise. Point estimates with 95 percent confidence intervals. Standard errors are clustered at the 2010 firm level.

The response of employment of incumbent workers reflects the increase in the corporate tax rate from 0% until the end of 2011 to an average of 4.7% during 2012-14 (4% in 2012 and 5% in 2013-14). It is also influenced by the new employment requirements, which can be seen as a further "tax" on the firm. For example, an average firm before the reform, with 7 workers and a gross profit of 27 million euros, would need to create 44 additional jobs to meet the new requirements, assuming the gross profit proxy equaled taxable profit. Considering this extra cost as a tax on the firm, if the firm hired workers at same wage as before (1545.51 euros as in Table 1 panel a), this firm would face an increase in its effective tax rate from 0 to 8.9%.[10] This approximation suggests a semi-elasticity of employment of incumbent workers to the effective tax rate of 3.1 ($0.27/0.089$, where 0.27 is the average probability of leaving the Portuguese labor market after the reform).[11]

[10] Computed as $1 -$ (Post-tax profit with 51 workers after reform/Profit before reform). The average profit before the reform is $26,985,380$. We estimate the post-tax profit with 51 workers after reform, i.e. an increase of 44 workers, as $(26,985,380 - 1,545.51 \times 14 \times 1.2375 \times 44) \times (1 - 0.047)$ considering 14 annual payments and including social security contributions paid by the firm.

[11] Suárez Serrato (2018) estimate a semi-elasticity of 1.20-1.44 of US employment with respect to the effective tax rate, in the context of a policy that limited the ability of US multinationals to shift profits to affiliates in Puerto Rico. Bilicka et al. (2022) obtained a semi-elasticity of UK employment of 2.2 when analyzing the response to the UK worldwide debt cap in 2010. Our results differ from these analyses as we do not estimate the overall response of employment of exposed firms, but rather the response of employment of incumbent workers.

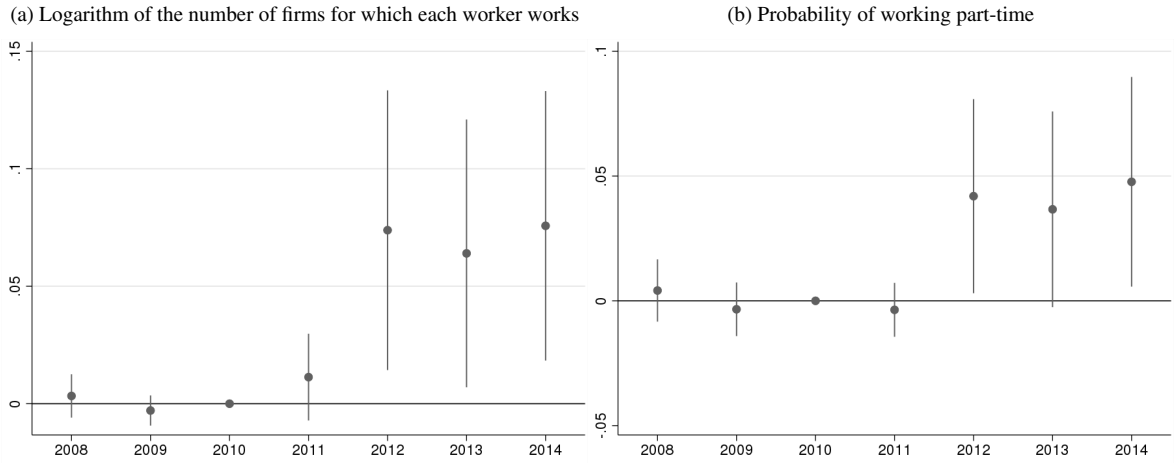
5.2.2 Incumbent stayers

We now restrict the sample to workers that stay in ZFM after the reform (incumbent stayers) and estimate the effect of the reform on their job characteristics and wages.

Figure 7 shows the impact of the reform on the number of firms for which each worker works and on the probability of having at least one part-time contract. Again, we present comforting evidence that the parallel trends' assumption is likely to hold.

We observe that the number of firms where incumbent stayers work increases in 2012, the first year the reform is implemented. Simultaneously, incumbent stayers are around 5 percentage points more likely to start at least one part-time employment contract compared to their matched counterparts outside ZFM.

Figure 7: The reform led to an increase in multiple job-holding and part-time employment for incumbents in ZFM, conditional on staying in the Portuguese labor market



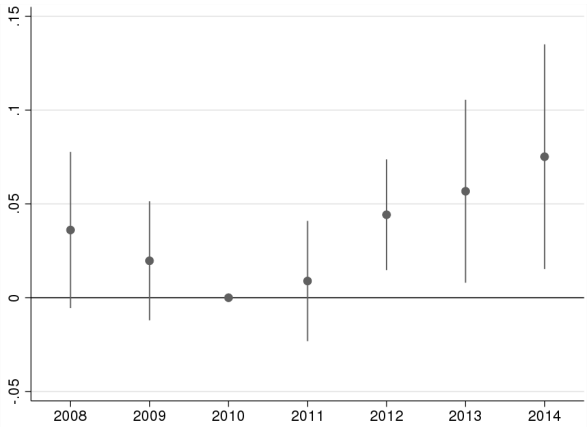
Notes: The figure depicts the regression results of equation 1. The dependent variables are indicated in the title of each panel. Point estimates with 95 percent confidence intervals. Standard errors are clustered at the 2010 firm level.

We study the wage effects of the reform on incumbent stayers in Figure 8. Note that we consider the sum of all wages in different firms for each worker. Our findings highlight that, conditional on staying employed in Portugal, these workers witnessed their salary increase *vis-à-vis* workers in the comparison group, a difference that seems to be increasing until 2014.

We perform a back-of-the-envelope calculation to ballpark the additional wage costs with incumbents. In 2014, two years after the reform was implemented, the wages of treated workers were 8% higher. Considering a mean wage of incumbents of 1,881 euros in 2014

and that there were 779 incumbents in that year, this represents an additional yearly cost with wages (including social security contributions paid by the firm) of approximately 1.9 million euros. The total tax benefits granted to ZFM firms in that year were around 218 million euros. Therefore, the additional cost with incumbent workers represents only 0.9% of the tax benefits granted to all ZFM firms.

Figure 8: The reform led to a wage increase for incumbents in ZFM, conditional on staying in the Portuguese labor market



Notes: The figure depicts the regression results of equation 1. The dependent variable is the logarithm of the sum of monthly wages of each worker across firms, in euros. Point estimates with 95 percent confidence intervals. Standard errors are clustered at the 2010 firm level.

In a nutshell, our findings show an increase in the number of jobs each worker holds, along with a higher probability of these workers adopting part-time contracts. Concurrently, they experienced an increase in their total wages. When interpreting these results, one must bear in mind that some firms located in ZFM shared exactly the same address and had the same ultimate owners, according to anecdotal information collected by Martins (2011). A practical strategy for ZFM firms to fulfill their new job requirements could then be to utilize existing workers and distribute them across multiple entities. Our results align with the possibility that such a strategy was used.

5.3 Movers

In this section, we study the type of employment created after the reform was announced. We focus on the workers who were employed in ZFM after the reform was announced but were not there in 2010 (i.e., they were not incumbents). We label these workers as *movers*. On average between 2011 and 2014, the stock of movers is equal to 728 workers. Descriptive statistics for these workers are presented in Table 5.

Table 5: Characteristics and type of jobs of movers (2011-2014)

	N	Mean	Std. dev.	p25	Median	p75
Monthly wage	2,912	1517.49	6896.77	670.73	832.27	1400.00
Age	2,912	37.32	9.92	29.00	36.00	44.00
Female	2,912	0.30	0.46	0.00	0.00	1.00
Foreign nationality	2,912	0.15	0.36	0.00	0.00	0.00
University	2,912	0.33	0.47	0.00	0.00	1.00
Top executive	2,912	0.14	0.35	0.00	0.00	0.00
Temporary contract	2,912	0.67	0.47	0.00	1.00	1.00
Part-time contract	2,912	0.14	0.34	0.00	0.00	0.00
Number of firms	2,912	1.33	1.71	1.00	1.00	1.00
Multiple firms	2,912	0.11	0.31	0.00	0.00	0.00
Workers of 2010 mailboxes	2,912	0.43	0.49	0.00	0.00	1.00

Notes: Worker descriptive statistics for 2011-2014. University – workers with tertiary education. Top executive – workers whose 1-digit occupation is "Senior public administration officials, directors and senior management of companies" (code 1) in the Portuguese Classification of Occupations. Nž of firms – number of firms for which each worker works at the same time. Multiple firms – workers that work for multiple firms at the same time. Workers of 2010 mailboxes – workers employed by a firm that was already present in ZFM in 2010 without employment.

The majority of movers (42%) came to ZFM to work in at least one pre-reform "mailbox" firm (i.e, a company that was already registered in ZFM before 2011, but with no employment records). Simultaneously, a substantial portion (37%) went to, at least, one pre-reform ZFM firm with employment, while 24% of these individuals start working in at least one firm that did not exist in QP before the reform.[12]

We examine how the employment profiles of movers differ when compared to the incumbent stayers analyzed in the previous section. Specifically, we focus our attention on all ZFM workers between 2011 and 2014. For worker i in year t, we estimate the following equation:

$$y_{it} = \beta Mover_{it} + \gamma_{st} + \varepsilon_{it}, \tag{2}$$

where y_{it} is the outcome of interest: a part-time employment status indicator, a temporary contract indicator, the log of the count of firms, a multiple job-holder indicator, an indicator for workers employed by pre-reform mailboxes, and the log of wage (summed across firms when the worker is employed by more than one firm). β is the coefficient of interest and *Mover* takes value one if the worker was not in ZFM in the last pre-reform year (2010) and started working there in the period of analysis. γ_{st} are sector-year fixed effects and ε_{it} is the error term. Standard errors are clustered at the worker level.

We report how different are the jobs of movers *vis-à-vis* the jobs of incumbent stayers in ZFM in Table 6. We find that movers are, on average, more likely to hold part-time jobs

[12]These percentages sum to more than one due to part-time work arrangements.

and sign temporary contracts.[13] While we do not find that they work in more firms at the same time than incumbents, we detect that they are 19.5% more likely to work for mailbox firms. These firms did not report employment in the pre-reform period and, to benefit from the reduced CIT rate, they were forced to hire workers.

In Table 7, we compare the wages of movers with those of incumbent stayers. We find that movers earn lower salaries, a result that is consistent across specifications with different vectors of controls, and suggesting a wage gap between 40% and 26%. As movers tend to go disproportionately more to mailbox firms, that did not have workers before the reform, their services might not be as valued as those of workers in non-mailbox firms.

Table 6: Movers are more likely to have part-time and temporary contracts and to work for mailbox companies

	(1) Part-time	(2) Temporary contr.	(3) No of firms (ln)	(4) Multiple firms	(5) Pre-reform mailbox
Mover	0.0539***	0.315***	-0.00673	0.0156	0.195***
	(0.016)	(0.022)	(0.022)	(0.014)	(0.018)
Sector-Year FE	Yes	Yes	Yes	Yes	Yes
Observations	6,623	6,623	6,623	6,623	6,623
Adjusted R-squared	0.226	0.359	0.177	0.216	0.503

Notes: The table reports the regression results from equation 2. Sectors are defined at the CAE 2-digits level, comprising 86 sectors. Standard errors in parentheses are clustered at the worker level. Stars indicate significance levels of 10% (*), 5% (**), and 1% (***).

Table 7: Movers earn lower wages than incumbent stayers (2011-2014)

	(1)	(2)	(3)	(4)	(5)
Mover	-0.395***	-0.355***	-0.284***	-0.277***	-0.264***
	(0.029)	(0.034)	(0.033)	(0.033)	(0.034)
Sector-Year FE	No	Yes	Yes	Yes	Yes
Worker Controls	No	No	Yes	Yes	Yes
Firm Controls	No	No	No	Yes	Yes
Observations	6,641	6,623	6,623	6,623	6,603
Adjusted R-squared	0.070	0.289	0.478	0.485	0.542

Notes: Logarithm of monthly wage. Sectors are defined at the CAE 2-digits level, comprising 86 sectors. Worker-level controls comprise age and its quadratic term, tenure and its quadratic term, gender, education (3 distinct education levels), dummy variables for foreign nationality, top executives, part-time workers, and workers with a temporary contract. Firm-level controls comprise the logarithm of employment and a dummy variable measuring if the firm has at least 50% of foreign equity. Column (5) includes occupation dummies (at the 4-digit level) instead of the dummy variable for top executives. Standard errors in parentheses are clustered at the worker level. Stars indicate significance levels of 10% (*), 5% (**), and 1% (***).

[13] When interpreting these results, one should bear in mind that movers exhibit different demographic characteristics than incumbent stayers. In table H.7 in the Appendix, we show that movers are, on average, less likely to be females, more likely to be immigrants, are around 4 years younger, and are more likely to hold an university degree.

6 Conclusion and policy implications

In this paper, we offer the first detailed characterization of the labor market in a tax paradise. We also investigate how a reform aimed at discouraging international tax avoidance affected different employment margins in such a location. We overcome the usual barrier of data opacity by relying on rich employer-employee data for firms in *Zona Franca da Madeira*, a low-tax jurisdiction located in the Portuguese island of Madeira.

We argue that our findings are important to understand how zero/ low tax jurisdictions may be affected by international tax reforms if we want to reach feasible agreements. We draw two main policy messages from our results. The first is that sophisticated firms in the fiscal space adjust very swiftly to both meet and circumvent the spirit of policies aimed at reducing tax avoidance, with quick repercussions on workers. In ZFM, the reform led to an increase in worker exit from the Portuguese labor market, right after the reform was announced in 2011, and before its implementation in 2012. This suggests that firms can quickly adjust their operations when incentivized to do so, even when they are not merely "mailbox" entities and have actual employees.

This behavior challenges the common perception that firms may take time to adjust their real activities to policies that aim at increasing economic substance. In particular, simulations that compute the impact of substance-based carve-outs on taxable profits often assume that employment and assets will remain largely unchanged across jurisdictions. While these assumptions are made for simplicity, our results suggest that they may diverge in non-trivial terms from the actual distribution of taxable profits and miss a lot of action in behavioral responses from the firms (e.g. Baraké et al., 2022).

The second policy-making message has to do with the importance of definition of "job" and of effective monitoring. The 12 no/low-tax jurisdictions that implemented employment requirements in recent years (Bermuda, United Arab Emirates, Guernsey, Isle of Man, Jersey, Turks and Caicos Islands, Cayman Islands, Barbados, British Virgin Islands, Bahrain, Anguilla, and Bahamas) require that firms have an adequate number of (qualified) employees proportionate to the level of activity, which is a relatively vague requirement. While the employee count is based on the number of full-time equivalents, potentially mitigating the use of multiple job-holders, this requires strict monitoring if the ultimate goal is to better align profits with actual employment.

References

Abadie, A., Athey, S., Imbens, G. W. and Wooldridge, J. M. (2023), 'When Should You Adjust Standard Errors for Clustering?', *The Quarterly Journal of Economics* **138**(1), 1–35.

Alstadsæter, A., Davies, R. B., Parenti, M. and Toubal, F. (2023), The Real Effects of Tax Havens, Working Paper 21/2023, University College Dublin (UCD) Centre for Economic Research.

Alstadsæter, A., Johannesen, N., Herry, S. L. G. and Zucman, G. (2022), 'Tax evasion and tax avoidance', *Journal of Public Economics* **206**, 104587.

Alstadsæter, A., Bjørkheim, J. B., Davies, R. B. and Scheuerer, J. (2022), Pennies from Haven: Wages and Profit Shifting, CESifo Working Paper 9590, CESifo.

Baraké, M., Chouc, P.-E., Neef, T. and Zucman, G. (2022), 'Revenue Effects of the Global Minimum Tax Under Pillar Two', *Intertax* **50**(10), 689–710.

Baraké, M., Neef, T., Chouc, P.-E. and Zucman, G. (2021), Minimizing the Minimum Tax? The Critical Effect of Substance Carve-Outs, Note 1, The EU Tax Observatory.

Beer, S., de Mooij, R. and Liu, L. (2020), 'International Corporate Tax Avoidance: A Review of the Channels, Magnitudes, and Blind Spots', *Journal of Economic Surveys* **34**(3), 660–688.

Bertrand, M., Duflo, E. and Mullainathan, S. (2004), 'How Much Should We Trust Differences-In-Differences Estimates?', *The Quarterly Journal of Economics* **119**(1), 249–275.

Bilicka, K. A. (2019), 'Comparing UK Tax Returns of Foreign Multinationals to Matched Domestic Firms', *American Economic Review* **109**(8), 2921–2953.

Bilicka, K., Qi, Y. and Xing, J. (2022), 'Real responses to anti-tax avoidance: Evidence from the UK Worldwide Debt Cap', *Journal of Public Economics* **214**, 104742.

Buettner, T. and Wamser, G. (2013), 'Internal debt and multinational profit shifting: Empirical evidence from firm-level panel data', *National Tax Journal* **66**(1), 63–95.

Carbonnier, C., Malgouyres, C., Py, L. and Urvoy, C. (2022), 'Who benefits from tax incentives? The heterogeneous wage incidence of a tax credit', *Journal of Public Economics* **206**(C).

Card, D. and Cardoso, A. R. (2022), 'Wage Flexibility under Sectoral Bargaining', *Journal of the European Economic Association* **20**(5), 2013–2061.

Card, D., Cardoso, A. R. and Kline, P. (2016), 'Bargaining, sorting, and the gender wage gap: Quantifying the impact of firms on the relative pay of women', *The Quarterly journal of Economics* **131**(2), 633–686.

Cassar, L. and Meier, S. (2018), 'Nonmonetary Incentives and the Implications of Work as a Source of Meaning', *Journal of Economic Perspectives* **32**(3), 215–238.

Cole, M. A., Elliott, R. J. and Lindley, J. K. (2009), 'Dirty money: Is there a wage premium for working in a pollution intensive industry?', *Journal of Risk and Uncertainty* **39**(2), 161–180.

Cristea, A. D. and Nguyen, D. X. (2016), 'Transfer Pricing by Multinational Firms: New Evidence from Foreign Firm Ownerships', *American Economic Journal: Economic Policy* **8**(3), 170–202.

Davies, R. B., Martin, J., Parenti, M. and Toubal, F. (2018), 'Knocking on Tax Havens Door: Multinational Firms and Transfer Pricing', *Review of Economics and Statistics* **100**(1), 120–134.

Davies, R. B. and Scheuerer, J. (2023), Tax Haven Use and Employment Decisions: Evidence from Norway, Mimeo, University College Dublin.

Dharmapala, D. and Riedel, N. (2013), 'Earnings shocks and tax-motivated income-shifting: Evidence from European multinationals', *Journal of Public Economics* **97**, 95–107.

Foley, C. F., Hines., J. R. and Wessel, D., eds (2021), *Global Goliaths: Multinational Corporations in the 21st Century Economy*, Brookings Institution Press, Washington, D.C.

Fuest, C., Hugger, F. and Neumeier, F. (2022), 'Corporate profit shifting and the role of tax havens: Evidence from German country-by-country reporting data', *Journal of Economic Behavior & Organization* **194**, 454–477.

Fuest, C., Peichl, A. and Siegloch, S. (2018), 'Do Higher Corporate Taxes Reduce Wages? Micro Evidence from Germany', *American Economic Review* **108**(2), 393–418.

Garcia-Bernardo, J., Janskỳ, P. and Tørsløv, T. (2021), 'Multinational corporations and tax havens: evidence from country-by-country reporting', *International Tax and Public Finance* **28**, 1519–1561.

Garcia, J. (2023), 'Multinationals and services imports from havens: when policies stand in the way of tax planning', *IMF Economic Review* pp. 1–38.

Guvenen, F., Jr., R. J. M., Rassier, D. G. and Ruhl, K. J. (2022), 'Offshore Profit Shifting and Aggregate Measurement: Balance of Payments, Foreign Investment, Productivity, and the Labor Share', *American Economic Review* **112**(6), 1848–1884.

Hines Jr, J. R. (2010), 'Treasure islands', *Journal of Economic Perspectives* **24**(4), 103–126.

Iacus, S. M., King, G. and Porro, G. (2012), 'Causal Inference without Balance Checking: Coarsened Exact Matching', *Political Analysis* **20**(1), 1–24.

Johannesen, N. (2022), 'The global minimum tax', *Journal of Public Economics* **212**, 104709.

Krueger, P., Metzger, D. and Wu, J. (2021), The Sustainability Wage Gap, Research Paper Series 21-17, Swiss Finance Institute.

Li, Q., Ma, M. S. and Shevlin, T. (2021), 'The effect of tax avoidance crackdown on corporate innovation', *Journal of Accounting and Economics* **71**(2-3), 101382.

Lopez Forero, M. (2021), 'Aggregate Labor Share and Tax Havens: things are not always what they seem', *Available at SSRN 4201609* .

Martin, J., Parenti, M. and Toubal, F. (2022), Corporate tax avoidance and sales: micro evidence and aggregate implications, CEPR Discussion Paper DP15060, Centre for Economic Policy Research.

Martins, J. P. (2011), *Suite 605 A história secreta de centenas de empresas que cabem numa sala de 100 m2*, SmartBook.

Palma, C. C. (2016), 'Características fundamentais do novo regime do Centro Internacional de Negócios da Madeira', *Contabilista* **193**, 27–33.

Portugal, P., Reis, H., Guimarães, P. and Cardoso, A. R. (2024), 'What Lies behind the Returns to Schooling: The Role of Labor Market Sorting and Worker Heterogeneity', *The Review of Economics and Statistics* pp. 1–45.

Raposo, P., Portugal, P. and Carneiro, A. (2021), 'The Sources of the Wage Losses of Displaced Workers', *Journal of Human Resources* **56**(3), 786–820.

Riedel, N. (2018), 'Quantifying International Tax Avoidance: A Review of the Academic Literature', *Review of Economics* **69**(2), 169–181.

Rocha, D. (2011), 'Jardim diz que o Governo vai manter a zona franca da Madeira', https://www.publico.pt/2011/08/29/economia/noticia/jardim-diz-que-o-governo-vai-manter-a-zona-franca-da-madeira-1509655. accessed: 11.07.2024.

Roth, J. (2022), 'Pretest with Caution: Event-Study Estimates after Testing for Parallel Trends', *American Economic Review: Insights* **4**(3), 305–322.

Roth, J., SantAnna, P. H., Bilinski, A. and Poe, J. (2023), 'What's trending in difference-in-differences? A synthesis of the recent econometrics literature', *Journal of Econometrics* **235**(2), 2218–2244.

Saez, E., Schoefer, B. and Seim, D. (2019), 'Payroll Taxes, Firm Behavior, and Rent Sharing: Evidence from a Young Workers' Tax Cut in Sweden', *American Economic Review* **109**(5), 1717–1763.

Schneider, F. H., Brun, F. and Weber, R. A. (2020), Sorting and Wage Premiums in Immoral Work, CESifo Working Paper Series 8456, CESifo.

Setzler, B. and Tintelnot, F. (2021), 'The Effects of Foreign Multinationals on Workers and Firms in the United States', *The Quarterly Journal of Economics* **136**(3), 1943–1991.

Souillard, B. (2022*a*), 'Corporate tax cuts and firm employment: A match made in haven?', *Economics Letters* **219**, 110835.

Souillard, B. (2022*b*), Profit Shifting, Employee Pay, and Inequalities: Evidence from US-Listed Companies, CESifo Working Paper 9720, CESifo.

Suárez Serrato, J. C. and Zidar, O. (2016), 'Who Benefits from State Corporate Tax Cuts? A Local Labor Markets Approach with Heterogeneous Firms', *American Economic Review* **106**(9), 2582–2624.

Suárez Serrato, J. C. (2018), Unintended Consequences of Eliminating Tax Havens, NBER Working Paper 24850, National Bureau of Economic Research.

Tørsløv, T., Wier, L. and Zucman, G. (2022), 'The Missing Profits of Nations', *The Review of Economic Studies* **90**(3), 1499–1534.

Wier, L. S. and Zucman, G. (2022), Global Profit Shifting, 1975-2019, NBER Working Paper 30673, National Bureau of Economic Research.

Zucman, G. (2014), 'Taxing across borders: Tracking personal wealth and corporate profits', *Journal of Economic Perspectives* **28**(4), 121–148.

Appendices

A Further institutional details

Table A.1: Employment requirements after ZFM's reform in 2012

Jobs	Taxable Income Ceiling
1-2	2 000 000
3-5	2 600 000
6-30	16 000 000
31-50	26 000 000
51-100	40 000 000
>100	150 000 000

Table A.2: Ten ZFM firms with higher annual tax benefits in 2010 and 2014, in million euros

2010		
Fiscal number	Name	Benefit
511112610	LIVERMORE- CONSULTADORIA E SERVIÇOS, LDA (ZONA FRANCA DA MADEIRA)	216.9
511099770	ALJARDI SGPS LDA	160.0
511076274	ITASANT SOC GESTORA DE PARTICIPAÇÕES SOCIAIS SOC UNIPESSOAL LDA ZONA FRANCA DA MADEIRA	78.3
511134452	BROADSTREET GIBRALTAR - CONSULTADORIA E PROJECTOS LDA ZONA FRANCA DA MADEIRA	76.3
511124112	MALPENSA CONSULTADORIA E SERVIÇOS LDA	48.4
503512443	PT VENTURES, SGPS S.A. (ZONA FRANCA DA MADEIRA)	40.2
511250762	CSN IBÉRIA, LDA (ZONA FRANCA DA MADEIRA)	23.0
511108648	MOTA INTERNACIONAL - COMERCIO E CONSULTADORIA ECONOMICA LDA	18.7
511119461	ARCELORMITTAL TRADING UNPESSOAL LDA ZONA FRANCA DA MADEIRA	18.2
511245173	FARRUGIA COMERCIO INTERNACIONAL E SERVIÇOS LDA ZONA FRANCA DA MADEIRA	17.1
2014		
Fiscal number	Name	Benefit
511069790	SAIPEM PORTUGAL COMERCIO MARITIMO SOC UNIPESSOAL LDA	53.1
511245173	ELOALIANÇA - SERVIÇOS INTERNACIONAIS LDA (ZONA FRANCA DA MADEIRA)	47.7
511176767	LILAZ - TRADING INTERNACIONAL LDA ZONA FRANCA DA MADEIRA	9.4
503512443	PT VENTURES, SGPS S.A. (ZONA FRANCA DA MADEIRA)	7.1
511049021	TDO-INVESTIMENTO E GESTÃO, (ZONA FRANCA DA MADEIRA)	4.8
510099661	AFG - S A ZONA FRANCA DA MADEIRA	3.9
511134690	SONASURF INTERNACIONAL - SHIPPING LDA ZONA FRANCA DA MADEIRA	3.9
511147171	PONTICELLI ANGOIL - SERVIÇOS PARA A INDUSTRIA PETROLIFERA S A	3.9
511164360	BOURBON OFFSHORE INTEROIL SHIPPING - NAVEGAÇÃO LDA ZONA FRANCA DA MADEIRA	3.9
511178220	HPEIK V SGPS LDA (ZONA FRANCA DA MADEIRA)	3.4

Notes: Source: Portuguese Tax Authority. Notes: The annual series of the tax benefits associated with the ZFM are available at the website of the Tax Authority (`https://info.portaldasfinancas.gov.pt/pt/dgci/divulgacao/Area_Beneficios_Fiscais`). Only taxpayers who claimed annual tax benefits of at least 1000 are included in the list. The tax benefit is calculated using the revenue foregone method, i.e., it is based on a comparison between existing legislation and legislation without the tax break. It corresponds to a static analysis, as it assumes unchanged behavior by economic agents and ignores possible interaction with other taxes.

B Firms in ZFM before the reform

Table B.1: Firm descriptive statistics – 2009-2010 (firms with workers)

(a) ZFM

	N	Mean	Std. dev.	p25	Median	p75
Number of workers	476	7.22	16.74	1.00	2.00	7.00
Wage bill (million euros)	476	0.18	0.39	0.01	0.04	0.17
Turnover (million euros)	476	27.17	127.29	0.02	0.54	3.93
Turnover per worker (million euros)	476	5.51	24.82	0.02	0.13	1.14
Gross profit (million euros)	476	26.99	127.21	-0.00	0.42	3.72
Gross profit per worker (million euros)	476	5.49	24.82	-0.00	0.11	1.12
Equity (million euros)	476	11.11	75.72	0.01	0.01	0.37
Equity per worker (million euros)	476	4.32	41.94	0.00	0.00	0.06
Percentage foreign equity	476	51.83	49.36	0.00	99.00	100.00
Foreign firm	476	0.52	0.50	0.00	1.00	1.00

(b) Madeira excluding ZFM

	N	Mean	Std. dev.	p25	Median	p75
Number of workers	11,374	9.49	51.03	1.00	3.00	6.00
Wage bill (million euros)	11,374	0.16	1.48	0.01	0.03	0.08
Turnover (million euros)	11,374	0.89	7.03	0.05	0.13	0.37
Turnover per worker (million euros)	11,374	0.10	0.48	0.02	0.04	0.08
Gross profit (million euros)	11,374	0.74	5.97	0.02	0.09	0.28
Gross profit per worker (million euros)	11,374	0.09	0.48	0.01	0.03	0.07
Equity (million euros)	11,374	0.43	12.35	0.01	0.01	0.03
Equity per worker (million euros)	11,374	0.03	0.84	0.00	0.00	0.00
Percentage foreign equity	11,374	0.44	6.38	0.00	0.00	0.00
Foreign firm	11,374	0.00	0.07	0.00	0.00	0.00

(c) Portugal excluding Madeira

	N	Mean	Std. dev.	p25	Median	p75
Number of workers	553,949	9.48	96.48	1.00	2.00	6.00
Wage bill (million euros)	553,949	0.15	2.20	0.01	0.03	0.07
Turnover (million euros)	553,949	1.33	37.36	0.04	0.12	0.36
Turnover per worker (million euros)	553,949	0.11	3.45	0.02	0.04	0.09
Gross profit (million euros)	553,949	1.18	36.09	0.02	0.09	0.28
Gross profit per worker (million euros)	553,949	0.10	3.45	0.01	0.03	0.08
Equity (million euros)	553,949	0.39	21.26	0.00	0.01	0.02
Equity per worker (million euros)	553,949	0.05	5.47	0.00	0.00	0.00
Percentage foreign equity	553,949	1.18	10.47	0.00	0.00	0.00
Foreign firm	553,949	0.01	0.11	0.00	0.00	0.00

Notes: Wage bill – sum of monthly wages paid by ZFM firms each year, multiplied by 14 and by 1.2375 to account for the mandatory employer's social security contribution. Gross profit – turnover minus wage bill. Foreign firm – has at least 50% of foreign equity.

Table B.2: Broad sectors of activity of firms in Portugal, % of the number of firms – 2009-2010

Description	Code CAE	ZFM	Madeira excl. ZFM	Portugal excl. Madeira
Primary	A+B	0.6	1.3	4.6
Manufacturing	C	6.9	7.1	12.9
Electricity, gas, water	D+E	1.7	0.2	0.3
Construction	F	2.3	14.4	13.3
Wholesale and retail trade	G	29.6	27.1	27.6
Transportation and storage	H	5.5	4.2	3.6
Accommodation and food	I	–	19.2	11.5
Information and communication	J	3.8	0.8	1.2
Finance and insurance	K	7.1	0.8	1.0
Real estate	L	1.7	2.5	2.2
Professional and other activities	M	33.4	6.1	6.8
Administrative activities	N	6.3	3.1	2.5
Other	O+P+Q+R+S+T+U	1.1	13.3	12.4
Total		100	100	100

Table B.3: Broad sectors of activity of firms in ZFM, % – 2009-2010

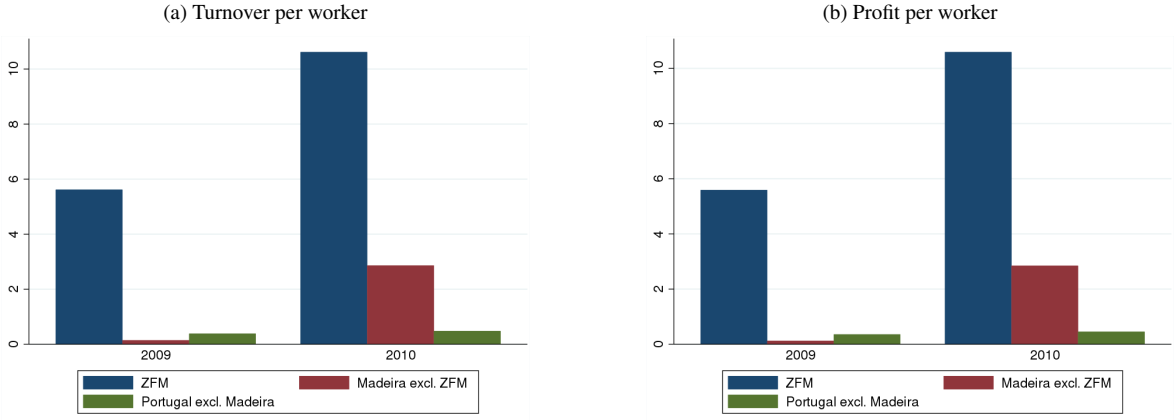
Description	Code CAE	Number of firms	Employment	Turnover
Primary	A+B	0.6	0.6	1.4
Manufacturing	C	6.9	21.2	1.4
Electricity, gas, water	D+E	1.7	2.4	0.4
Construction	F	2.3	2.7	1.0
Wholesale and retail trade	G	29.6	25.0	69.0
Transportation and storage	H	5.5	2.4	4.7
Accommodation and food	I	–	–	–
Information and communication	J	3.8	3.6	2.1
Finance and insurance	K	7.1	5.6	4.2
Real estate	L	1.7	0.3	0.0
Professional and other activities	M	33.4	19.9	12.8
Administrative activities	N	6.3	6.7	2.5
Other	O+P+Q+R+S+T+U	1.1	9.5	0.5
Total		100	100	100

Table B.4: Gross profit per worker (firms with workers, ln) – 2009-2010

	(1)	(2)	(3)	(4)
ZFM	2.353***	1.969***	1.640***	1.704***
	(0.160)	(0.149)	(0.144)	(0.145)
Sector-Year FE	No	Yes	Yes	Yes
Firm Controls	No	No	Yes	Yes
Region FE	No	No	No	Yes
Observations	491,144	491,143	491,143	491,143
Adjusted R-squared	0.002	0.200	0.203	0.209

Notes: Sectors are defined at the CAE 2-digits level, comprising 86 sectors. Firm controls: a dummy variable measuring if the firm has at least 50% of foreign equity. Region fixed effects are defined at the NUTS2 level, comprising 7 regions, including the Madeira region. Standard errors in parentheses are clustered at the firm level. Stars indicate significance levels of 10% (*), 5% (**), and 1% (***).

Figure B.1: Average turnover and profit per worker of foreign firms in ZFM are several orders of magnitude larger than in the rest of Portugal



Notes: Profit per worker (in million euros) is proxied by subtracting the firm's wage bill from turnover. The sample only includes foreign firms with workers (in each location). Foreign firm – has at least 50% of foreign equity. The results for Madeira excluding ZFM should be interpreted with caution given the reduced number of firms considered (30 firms in 2009 and 20 firms in 2010).

C Workers in ZFM before the reform

Table C.1: Top 5 occupations in ZFM (2 digits, %) – 2009-2010

	ZFM	Madeira excl. ZFM	Portugal excl. Madeira
Office workers	19.6	11.6	11.2
Other technicians and mid-level professionals	8.7	4.1	4.7
Unskilled service and commercial workers	8.7	10.8	8.8
Other specialists in intellectual and scientific professions	8.2	1.5	2.4
Firm directors	7.0	2.5	3.4

Table C.2: Robustness to Table 3

	(1)	(2)	(3)	(4)	(5)
ZFM	0.199***	0.159***	0.162***	0.194***	0.179***
	(0.011)	(0.010)	(0.011)	(0.016)	(0.010)
ZFM * top executive		0.323***			
		(0.038)			
ZFM * university			0.130***		
			(0.026)		
ZFM * female				0.0117	
				(0.021)	
ZFM * foreign nationality					0.234***
					(0.046)
Sector-year FE	Yes	Yes	Yes	Yes	Yes
Worker Controls	Yes	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes	Yes
Region FE	No	No	No	No	No
Observations	5,255,229	5,255,229	5,255,229	5,255,229	5,255,229
Adjusted R-squared	0.554	0.554	0.554	0.554	0.554

Notes: This table replicates the results of Table 3, without including region fixed effects.

D Firms in ZFM after the reform

Table D.1: Descriptive statistics of ZFM firms – 2011-2014 (firms with workers)

(a) All ZFM firms

	N	Mean	Std. dev.	p25	Median	p75
Number of workers	2,386	3.59	9.29	1.00	1.00	2.00
Wage bill (million euros)	2,386	0.07	0.24	0.00	0.01	0.03
Turnover (million euros)	2,386	9.91	77.40	0.00	0.06	1.05
Turnover per worker (million euros)	2,386	3.25	29.10	0.00	0.04	0.48
Gross profit (million euros)	2,386	9.84	77.32	-0.00	0.04	0.97
Gross profit per worker (million euros)	2,386	3.23	29.09	-0.00	0.02	0.46
Percentage foreign equity	2,386	74.71	43.04	45.00	100.00	100.00
Foreign firm	2,386	0.75	0.43	0.00	1.00	1.00

(b) 2010 Mailboxes

	N	Mean	Std. dev.	p25	Median	p75
Number of workers	1,400	1.92	6.18	1.00	1.00	1.00
Wage bill (million euros)	1,400	0.02	0.08	0.00	0.00	0.01
Turnover (million euros)	1,400	4.33	24.21	0.00	0.00	0.36
Turnover per worker (million euros)	1,400	2.53	16.62	0.00	0.00	0.27
Gross profit (million euros)	1,400	4.31	24.20	-0.00	-0.00	0.35
Gross profit per worker (million euros)	1,400	2.52	16.61	-0.00	-0.00	0.26
Percentage foreign equity	1,400	81.96	38.04	100.00	100.00	100.00
Foreign firm	1,400	0.82	0.39	1.00	1.00	1.00

(c) 2010 ZFM firms with employment

	N	Mean	Std. dev.	p25	Median	p75
Number of workers	651	7.36	13.20	1.00	2.00	7.00
Wage bill (million euros)	651	0.21	0.39	0.01	0.06	0.22
Turnover (million euros)	651	25.07	142.27	0.11	0.67	4.24
Turnover per worker (million euros)	651	5.90	49.95	0.04	0.15	1.18
Gross profit (million euros)	651	24.86	142.14	0.05	0.52	4.14
Gross profit per worker (million euros)	651	5.88	49.94	0.02	0.14	1.13
Percentage foreign equity	651	59.93	48.50	0.00	100.00	100.00
Foreign firm	651	0.60	0.49	0.00	1.00	1.00

(d) New ZFM firms

	N	Mean	Std. dev.	p25	Median	p75
Number of workers	335	3.24	8.81	1.00	1.00	2.00
Wage bill (million euros)	335	0.05	0.16	0.00	0.00	0.02
Turnover (million euros)	335	3.78	17.66	0.00	0.08	0.75
Turnover per worker (million euros)	335	1.07	3.69	0.00	0.05	0.40
Gross profit (million euros)	335	3.73	17.61	-0.00	0.07	0.62
Gross profit per worker (million euros)	335	1.06	3.69	-0.00	0.03	0.40
Percentage foreign equity	335	73.10	44.05	0.00	100.00	100.00
Foreign firm	335	0.73	0.44	0.00	1.00	1.00

Notes: Wage bill – sum of monthly wages paid by ZFM firms each year, multiplied by 14 and by 1.2375 to account for the mandatory employer's social security contribution. Gross profit – turnover minus wage bill. Foreign firm – has at least 50% of foreign equity. 2010 Mailboxes – firms that were already present in ZFM in 2010 but without employment; 2010 ZFM firms with employment – firms that were already present in ZFM in 2010 with employment; New ZFM firms - firm that were not present in ZFM in 2010 (with or without employment).

Table D.2: Broad sectors of activity of firms in ZFM, % – 2011-2014

Description	Code CAE	Number of firms	Employment	Turnover
Primary	A+B	0.3	0.5	1.5
Manufacturing	C	2.4	12.0	1.4
Electricity, gas, water	D+E	0.9	3.4	0.6
Construction	F	1.4	7.9	2.1
Wholesale and retail trade	G	23.4	17.4	40.1
Transportation and storage	H	9.4	6.0	14.9
Accommodation and food	I	0.3	0.1	0.0
Information and communication	J	3.5	5.4	5.0
Finance and insurance	K	3.6	5.1	3.1
Real estate	L	2.3	0.9	0.0
Professional and other activities	M	45.4	28.1	26.4
Administrative activities	N	6.8	12.2	4.8
Other	O+P+Q+R+S+T+U	0.3	1.0	0.0
Total		100.0	100.0	100.0

E Impact of the reform on incumbent workers: matching procedure and descriptive statistics

To build the group of treated workers, we start with all workers in ZFM in 2010, before the reform is announced. This gives us 1,782 workers. We then require that these workers are aged between 25 and 55 years in 2010, so that they have a stronger labor market attachment, and drop the 30 workers that work simultaneously at ZFM and non-ZFM firms. This gives us 1,507 workers.

For the potential group of control workers, we start with all workers that in 2010 are in Portugal, but outside ZFM. This gives us 2,567,535 workers. As for treated workers, we require that they are between 25 and 55 years old in 2010. We further require that they are always outside ZFM throughout 2009-2014. This gives us 2,120,068 workers.

We then match treated and control workers on pre-treatment (2010) observables. For age and wages, we use Coarsened Exact Matching. To this end, we construct separate strata for 10 deciles. On wages, we also create separate bins for the 99th and 99.9th percentiles. We then match treated workers to control group workers for each of these bins, while additionally requiring them to work in the same 2-digit sector of activity, and have the same gender, education level (basic or less than basic, secondary and post-secondary, and university), part-time status, immigrant status. In doing so, we can match 93% of treated workers, using 9% of control group workers.

After matching, our sample contains 183,222 workers. Of these, 1,398 are treated and 181,824 are controls. Descriptive statistics about these workers are provided in Table E.1.

For the analysis of the impact of the reform on incumbent stayers, we further restrict the potential group of treated workers to workers that stay in the Portuguese labor market throughout 2010-2012. This gives us 839 workers.

We then match these restricted group of treated workers with control workers, using the same pre-treatment (2010) observables. In doing so, we can match 91% of treated workers, using 5% of control group workers.

After matching, our sample contains 81,779 workers. Of these, 762 are treated and 81,017 are controls. Note that we re-weight observations in the regression analysis to account for the fact that there are many more control than treated workers and ensure that the estimates reflect the intended target population more accurately.

Table E.1: Descriptive statistics for treated and control group after matching

(a) Treated workers

	N	Mean	Std. dev.	p25	Median	p75
Monthly wage	1,398	1512.56	1471.04	736.79	1053.21	1730.02
Age	1,398	38.88	8.19	32.00	38.00	45.00
Female	1,398	0.53	0.50	0.00	1.00	1.00
Foreign nationality	1,398	0.05	0.23	0.00	0.00	0.00
University	1,398	0.30	0.46	0.00	0.00	1.00
Top executive	1,398	0.12	0.33	0.00	0.00	0.00
Temporary contract	1,398	0.34	0.47	0.00	0.00	1.00
Part-time contract	1,398	0.02	0.15	0.00	0.00	0.00
Number of firms	1,398	1.03	0.24	1.00	1.00	1.00
Multiple firms	1,398	0.02	0.13	0.00	0.00	0.00

(b) Control workers

	N	Mean	Std. dev.	p25	Median	p75
Monthly wage	181,824	1509.24	1547.78	733.15	1060.94	1732.75
Age	181,824	38.88	8.16	32.00	38.00	46.00
Female	181,824	0.53	0.50	0.00	1.00	1.00
Foreign nationality	181,824	0.05	0.23	0.00	0.00	0.00
University	181,824	0.30	0.46	0.00	0.00	1.00
Top executive	181,824	0.15	0.36	0.00	0.00	0.00
Temporary contract	181,824	0.16	0.37	0.00	0.00	0.00
Part-time contract	181,824	0.02	0.15	0.00	0.00	0.00
Number of firms	181,824	1.02	0.13	1.00	1.00	1.00
Multiple firms	181,824	0.02	0.13	0.00	0.00	0.00

Notes: Control workers – weighted descriptive statistics, using the weights from matching. University – workers with tertiary education. Top executive – workers whose 1-digit occupation is "Senior public administration officials, directors and senior management of companies" (code 1) in the Portuguese Classification of Occupations. Nž of firms – number of firms for which each worker works at the same time. Multiple firms – workers that work for multiple firms at the same time.

Table E.2: Descriptive statistics for treated and control group after matching: restricting treated workers to those that stay in the Portuguese labor market in 2010-2012

(a) Treated workers

	N	Mean	Std. dev.	p25	Median	p75
Monthly wage	762	1605.39	1372.93	899.66	1200.00	1835.52
Age	762	38.33	8.11	32.00	37.00	44.00
Female	762	0.46	0.50	0.00	0.00	1.00
Foreign nationality	762	0.04	0.19	0.00	0.00	0.00
University	762	0.33	0.47	0.00	0.00	1.00
Top executive	762	0.13	0.34	0.00	0.00	0.00
Temporary contract	762	0.24	0.43	0.00	0.00	0.00
Part-time contract	762	0.02	0.13	0.00	0.00	0.00
Number of firms	762	1.02	0.27	1.00	1.00	1.00
Multiple firms	762	0.01	0.12	0.00	0.00	0.00

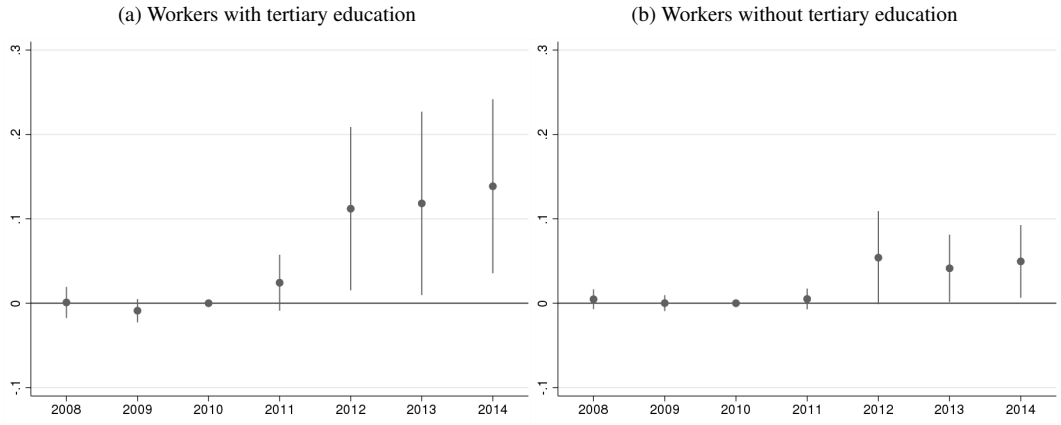
(b) Control workers

	N	Mean	Std. dev.	p25	Median	p75
Monthly wage	81,017	1602.53	1418.41	893.18	1196.35	1840.10
Age	81,017	38.36	8.06	32.00	37.00	44.00
Female	81,017	0.46	0.50	0.00	0.00	1.00
Foreign nationality	81,017	0.04	0.19	0.00	0.00	0.00
University	81,017	0.33	0.47	0.00	0.00	1.00
Top executive	81,017	0.17	0.37	0.00	0.00	0.00
Temporary contract	81,017	0.14	0.34	0.00	0.00	0.00
Part-time contract	81,017	0.02	0.13	0.00	0.00	0.00
Number of firms	81,017	1.02	0.17	1.00	1.00	1.00
Multiple firms	81,017	0.02	0.14	0.00	0.00	0.00

Notes: Control workers – weighted descriptive statistics, using the weights from matching. University – workers with tertiary education. Top executive – workers whose 1-digit occupation is "Senior public administration officials, directors and senior management of companies" (code 1) in the Portuguese Classification of Occupations. Nž of firms – number of firms for which each worker works at the same time. Multiple firms – workers that work for multiple firms at the same time.

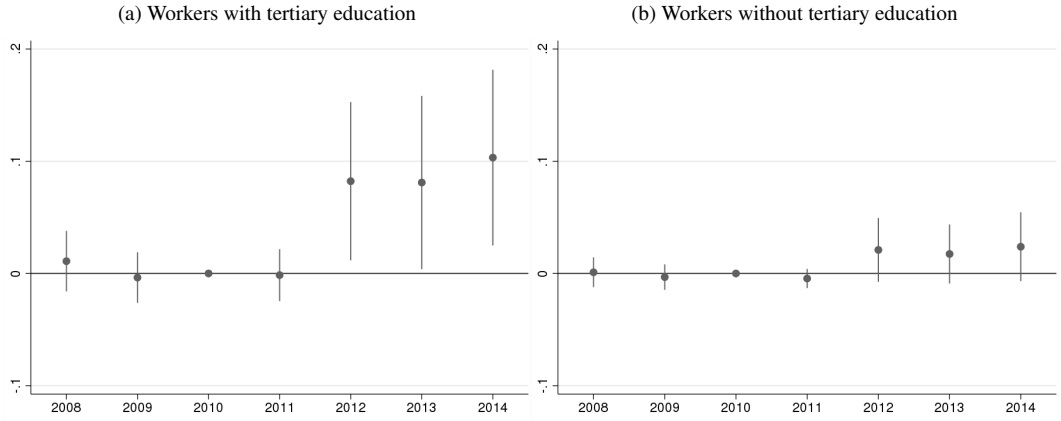
F Impact of the reform on incumbent workers: heterogeneity

Figure F.1: Number of firms of each worker



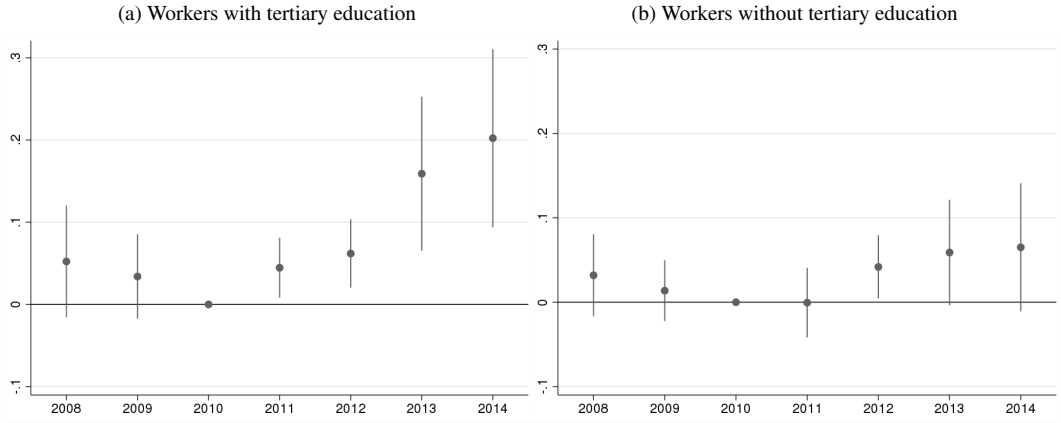
Notes: The figure depicts the regression results of equation 1. Separate regressions for each type of worker. The dependent variable is the logarithm of the number of firms for which each worker works. Point estimates with 95 percent confidence intervals. Standard errors are clustered at the 2010 firm level.

Figure F.2: Probability of working part-time



Notes: The figure depicts the regression results of equation 1. Separate regressions for each type of worker. The dependent variable is a dummy variable equal to 1 if the worker has a part-time contract, and 0 otherwise. Point estimates with 95 percent confidence intervals. Standard errors are clustered at the 2010 firm level.

Figure F.3: Monthly wages



Notes: The figure depicts the regression results of equation 1. Separate regressions for each type of worker. The dependent variable is the logarithm of the sum of monthly wages of each worker across firms, in euros. Point estimates with 95 percent confidence intervals. Standard errors are clustered at the 2010 firm level.

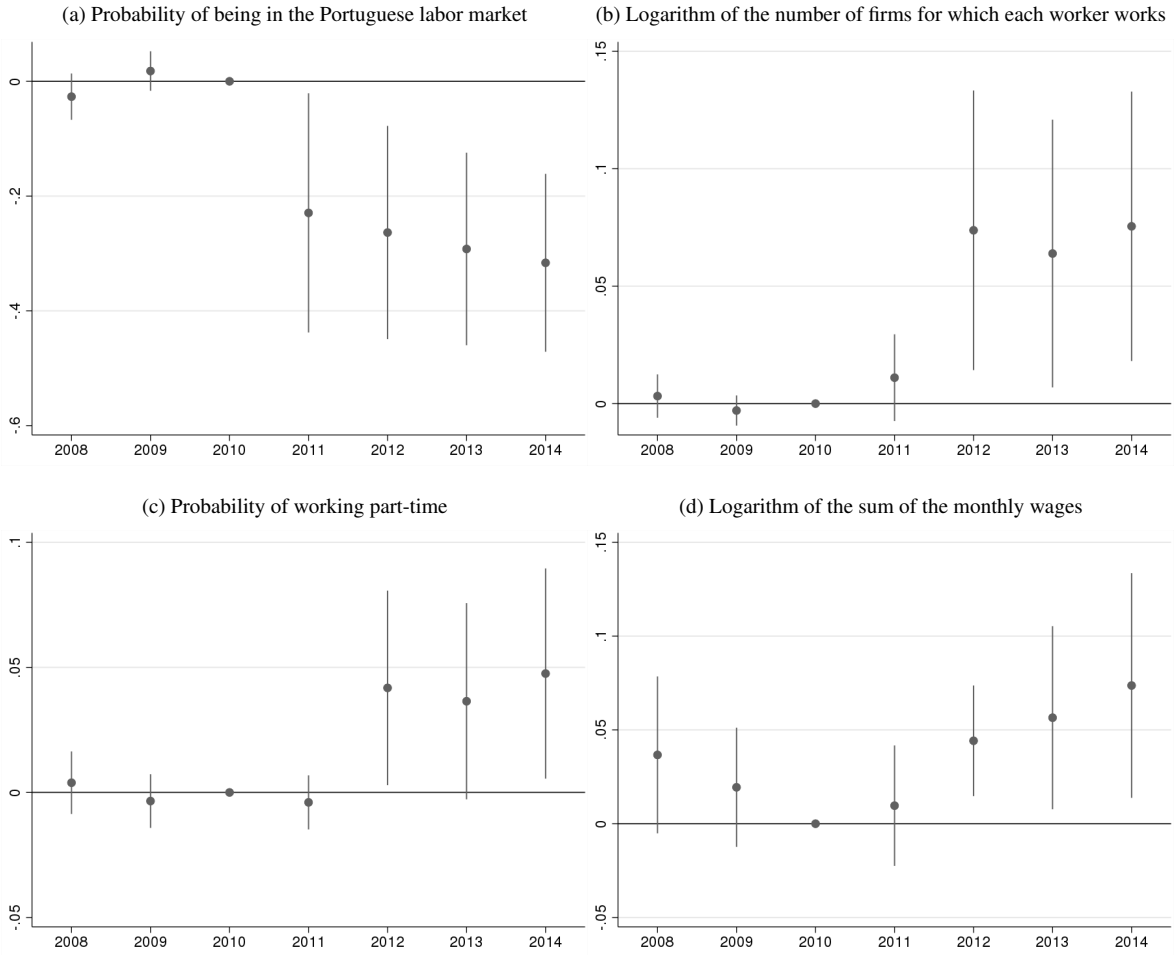
G Impact of the reform on incumbent workers: robustness

In our control group, we consider workers who are always outside ZFM. This group includes workers in Madeira, provided they are not in ZFM.

To account for potential spillover effects on workers in Madeira outside of ZFM, we perform a robustness test by excluding these workers from our control group. After matching, our sample contains 178,004 workers: 1,398 treated (as in the baseline) and 176,606 controls. When we further restrict the potential group of treated workers to those who remain in the Portuguese labor market throughout 2010-2012, our sample contains 79,974 workers. Of these, 762 are treated (as in the baseline) and 79,212 are controls.

The results of the impact of the reform are very similar to those of the baseline analysis, as documented below.

Figure G.1: Robustness exercise



Notes: The figure depicts the regression results of Equation 1. The control group only includes workers outside of Madeira. The dependent variables are indicated in the title of each panel. Point estimates with 95 percent confidence intervals. Standard errors are clustered at the 2010 firm level.

H Movers: further results

Table H.1: Top 10 occupations in ZFM (2 digits, %) – 2011-2014

	ZFM	Incumbents	Movers
Office workers	22.3	22.4	22.3
Other specialists in intellectual and scientific professions	10.0	12.0	7.5
Labourers, craftsmen and similar workers	8.1	1.1	17.1
Firm directors	7.4	8.7	5.7
Metallurgical, metal-mechanical workers and similar workers	7.0	5.7	8.5
Machine operators and assembly workers	6.3	9.7	2.0
Other technicians and mid-level professionals	6.1	6.7	5.3
Receptionists, cashiers, ticket clerks and similar workers	6.0	6.6	5.2
Physical science, maths and engineering specialists	5.3	4.1	6.9
Unskilled service and commercial workers	5.0	5.6	4.3

Notes: The first column refers to all ZFM workers in 2011-2014. Incumbents – workers already employed in ZFM in 2010. Movers – workers not employed in ZFM in 2010 that started working for a ZFM firm in 2011-2014.

Table H.2: Characteristics and type of jobs of movers to 2010 mailboxes (2011-2014)

	N	Mean	Std. dev.	p25	Median	p75
Monthly wage	1,243	1240.08	7104.81	610.00	676.40	1000.00
Age	1,243	38.64	9.75	31.00	38.00	45.00
Female	1,243	0.27	0.45	0.00	0.00	1.00
Foreign nationality	1,243	0.13	0.34	0.00	0.00	0.00
University	1,243	0.28	0.45	0.00	0.00	1.00
Top executive	1,243	0.12	0.32	0.00	0.00	0.00
Temporary contract	1,243	0.68	0.47	0.00	1.00	1.00
Part-time contract	1,243	0.23	0.42	0.00	0.00	0.00
Number of firms	1,243	1.66	2.35	1.00	1.00	1.00
Multiple firms	1,243	0.20	0.40	0.00	0.00	0.00

Notes: Worker descriptive statistics for 2011-2014. University – workers with tertiary education. Top executive – workers whose 1-digit occupation is "Senior public administration officials, directors and senior management of companies" (code 1) in the Portuguese Classification of Occupations. Number of firms – number of firms for which each worker works at the same time. Multiple firms – workers that work for multiple firms at the same time. Sample of workers employed by a firm that was already present in ZFM in 2010 without employment.

Table H.3: Characteristics and type of jobs of movers to 2010 ZFM firms with employment (2011-2014)

	N	Mean	Std. dev.	p25	Median	p75
Monthly wage	1,054	2262.80	11340.91	743.94	1035.52	1674.40
Age	1,054	36.04	9.99	28.00	35.00	42.00
Female	1,054	0.35	0.48	0.00	0.00	1.00
Foreign nationality	1,054	0.13	0.34	0.00	0.00	0.00
University	1,054	0.40	0.49	0.00	0.00	1.00
Top executive	1,054	0.17	0.38	0.00	0.00	0.00
Temporary contract	1,054	0.64	0.48	0.00	1.00	1.00
Part-time contract	1,054	0.10	0.29	0.00	0.00	0.00
Number of firms	1,054	1.39	2.26	1.00	1.00	1.00
Multiple firms	1,054	0.09	0.28	0.00	0.00	0.00

Notes: Worker descriptive statistics for 2011-2014. University – workers with tertiary education. Top executive – workers whose 1-digit occupation is "Senior public administration officials, directors and senior management of companies" (code 1) in the Portuguese Classification of Occupations. Number of firms – number of firms for which each worker works at the same time. Multiple firms – workers that work for multiple firms at the same time. Sample of workers employed by a firm that was already present in ZFM in 2010 with employment.

Table H.4: Characteristics and type of jobs of movers to new ZFM firms (2011-2014)

	N	Mean	Std. dev.	p25	Median	p75
Monthly wage	713	1225.12	1129.66	674.30	800.00	1500.00
Age	713	37.12	9.82	29.00	36.00	44.00
Female	713	0.29	0.45	0.00	0.00	1.00
Foreign nationality	713	0.20	0.40	0.00	0.00	0.00
University	713	0.34	0.47	0.00	0.00	1.00
Top executive	713	0.11	0.32	0.00	0.00	0.00
Temporary contract	713	0.68	0.47	0.00	1.00	1.00
Part-time contract	713	0.15	0.36	0.00	0.00	0.00
Number of firms	713	1.48	2.20	1.00	1.00	1.00
Multiple firms	713	0.12	0.32	0.00	0.00	0.00

Notes: Worker descriptive statistics for 2011-2014. University – workers with tertiary education. Top executive – workers whose 1-digit occupation is "Senior public administration officials, directors and senior management of companies" (code 1) in the Portuguese Classification of Occupations. Number of firms – number of firms for which each worker works at the same time. Multiple firms – workers that work for multiple firms at the same time. Sample of workers employed by a firm that was not present in ZFM in 2010 (with or without employment).

Table H.5: Characteristics and type of jobs of movers from out of sample to ZFM firms (2011-2014)

	N	Mean	Std. dev.	p25	Median	p75
Monthly wage	1,850	1336.63	1892.62	626.00	839.21	1341.91
Age	1,850	36.74	10.52	28.00	35.00	44.00
Female	1,850	0.32	0.47	0.00	0.00	1.00
Foreign nationality	1,850	0.22	0.42	0.00	0.00	0.00
University	1,850	0.36	0.48	0.00	0.00	1.00
Top executive	1,850	0.15	0.36	0.00	0.00	0.00
Temporary contract	1,850	0.67	0.47	0.00	1.00	1.00
Part-time contract	1,850	0.16	0.36	0.00	0.00	0.00
Number of firms	1,850	1.32	1.56	1.00	1.00	1.00
Multiple firms	1,850	0.10	0.30	0.00	0.00	0.00
Workers of 2010 mailboxes	1,850	0.45	0.50	0.00	0.00	1.00

Notes: Worker descriptive statistics for 2011-2014. University – workers with tertiary education. Top executive – workers whose 1-digit occupation is "Senior public administration officials, directors and senior management of companies" (code 1) in the Portuguese Classification of Occupations. Number of firms – number of firms for which each worker works at the same time. Multiple firms – workers that work for multiple firms at the same time. Sample of workers not present in QP in 2010 and employed by a ZFM firm in 2011-2014.

Table H.6: Characteristics and type of jobs of movers from out of ZFM to ZFM firms (2011-2014)

	N	Mean	Std. dev.	p25	Median	p75
Monthly wage	1,062	1832.55	11140.19	674.30	801.45	1452.90
Age	1,062	38.33	8.68	32.00	38.00	44.00
Female	1,062	0.25	0.44	0.00	0.00	1.00
Foreign nationality	1,062	0.03	0.17	0.00	0.00	0.00
University	1,062	0.29	0.45	0.00	0.00	1.00
Top executive	1,062	0.12	0.32	0.00	0.00	0.00
Temporary contract	1,062	0.68	0.46	0.00	1.00	1.00
Part-time contract	1,062	0.10	0.30	0.00	0.00	0.00
Number of firms	1,062	1.34	1.94	1.00	1.00	1.00
Multiple firms	1,062	0.12	0.33	0.00	0.00	0.00
Workers of 2010 mailboxes	1,062	0.39	0.49	0.00	0.00	1.00

Notes: Worker descriptive statistics for 2011-2014. University – workers with tertiary education. Top executive – workers whose 1-digit occupation is "Senior public administration officials, directors and senior management of companies" (code 1) in the Portuguese Classification of Occupations. Number of firms – number of firms for which each worker works at the same time. Multiple firms – workers that work for multiple firms at the same time. Sample of workers present in QP but not in ZFM in 2010 and employed by a ZFM firm in 2011-2014.

Table H.7: Worker's demographics, 2011-2014

	(1)	(2)	(3)	(4)
	Female	Foreign nationality	Age	University
Mover	-0.0987***	0.0947***	-4.383***	0.0790***
	(0.025)	(0.016)	(0.500)	(0.023)
Sector-Year FE	Yes	Yes	Yes	Yes
Observations	6,623	6,623	6,623	6,623
Adjusted R-squared	0.163	0.213	0.130	0.239

Notes: The table reports the regression results from Equation (2). Sectors are defined at the CAE 2-digits level, comprising 86 sectors. Standard errors in parentheses are clustered at the worker level. Stars indicate significance levels of 10% (*), 5% (**), and 1% (***).