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DISCUSSION PAPER SERIES

IZA DP No. 17799

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ABSTRACT

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

What type of employment exists in low-tax jurisdictions? How are employment and individual workers affected by reforms aimed at better aligning profits with real activities? Using a unique employer-employee dataset for Zona Franca da Madeira, a tax paradise on a Portuguese island, we show that workers are highly educated, perform specialized tasks, and benefit from a wage gap, particularly at the top. A reform designed to link profits more closely with real substance resulted in worker exits, while those who remained experienced wage increases and a higher likelihood of working for multiple firms simultaneously. New hires faced more precarious conditions, earning, on average, 30% less than incumbents, often working under temporary contracts. These results offer insights into policies promoting economic substance in low-tax jurisdictions.

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

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

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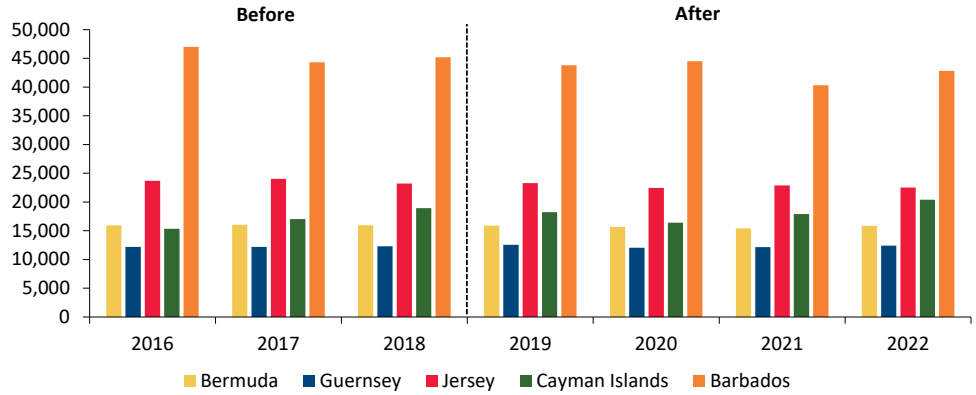
1 Introduction

Despite reporting substantial profits in tax havens, multinational firms often have minimal real economic activity in those jurisdictions (Fuest et al., 2025). To bridge this gap and respond to growing international pressure, several tax havens have introduced economic substance rules. Among other requirements, these rules mandate that multinationals employ an adequate number of qualified workers.

Although these policies have the potential to create jobs, assessing their actual impact on the labor market of tax havens is challenging. A major obstacle, as illustrated in Figure 1, is the lack of available employment data in these jurisdictions, which are often characterized by low transparency. The figure presents total employment in the sectors directly affected by the substance requirements across the tax havens that introduced these rules in 2019 and provide public data. To our knowledge, only five out of the twelve jurisdictions provide such data. The evidence in Figure 1 suggests little overall impact on total employment. However, aggregate numbers make it difficult to construct a reliable counterfactual, and key details such as worker qualifications, job roles, and wages are missing, making it nearly impossible to assess what type of jobs multinational firms maintained in tax havens before these requirements were introduced and how they have evolved under the new policies.

Figure 1: Employment in targeted sectors before and after the introduction of economic substance requirements in tax havens in 2019



Sources: Government of Bermuda (Employment Statistics), Government of Guernsey (Population, Employment and Earnings Bulletin), Government of Jersey (Labour Market Statistics), Cayman Islands Government (Labour Force Survey Reports), Barbados Statistical Service (Labour Market Statistics). Notes: Employment in sectors targeted by the substance requirements (banking, insurance, fund management, finance and leasing, headquarters business, shipping, distribution and service centers, holding companies and intellectual property business). The chart includes the five havens (out of twelve that introduced substance requirements) for which public information about employment by sector is available.

In this paper, we contribute to this debate, by addressing two research questions. First, what type of employment exists in in low-tax jurisdictions? Second, how are employment and individual workers affected by the introduction of reforms aimed at better aligning reported profits with real activities? To overcome the aforementioned data limitations, we use an employer-employee dataset covering all workers in *Zona Franca da Madeira* (ZFM), a tax paradise for multinational firms located on the Portuguese island of Madeira, offering zero or low corporate tax rates since 1987. As we show, this regime was essentially used by thinly-staffed multinational firms with abnormally large sales. Therefore, firms in ZFM before the reform exhibited the usual characteristics of firms in tax havens (e.g., Garcia-Bernardo et al., 2021, Tørsløv et al., 2022, Wier and Zucman, 2022).

The employer-employee dataset for firms in ZFM provides an unprecedented level of detail on the workforce employed in such a jurisdiction. Moreover, the ZFM's regime underwent significant changes in 2012 to better align profits with employment, making it a leading jurisdiction for studying such policies. This unique context makes the ZFM particularly well-suited for addressing our research questions.

Our contribution is twofold. We start by offering 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 of the workers employed there, their skills, their tasks, and their wages. This analysis complements existing evidence about the other end of profit-shifting strategies – the high-tax location (see Alstadsæter et al., 2024, for a survey) – 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 workers 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.

From a policy-making perspective, 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. These include not only the substance requirements but also the the so-called "substance-based carve-outs" (e.g. Baraké et al., 2021) of the global minimum tax.[1] In particular, our findings 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).

To address our first research question – what type of employment exists in low-tax jurisdictions? – we begin by comparing workers in ZFM to similar workers in the rest of Portugal before the reform, when the corporate income tax (CIT) rate was 0% and no employment requirements were in place. Our analysis reveals that ZFM workers had relatively high levels of education and performed skilled tasks. Occupations such as office workers, technicians, mid-level professionals, and specialists in intellectual and scientific fields were notably overrepresented, as was the share of firm directors – more than double that in the rest of Portugal.

Wages in ZFM were also significantly higher. Even after controlling for a rich set of observable characteristics, the wage gap remained statistically significant and economically substantial, exceeding 14% on average. For top executives, this gap was particularly pronounced, surpassing 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 wage gap, our back-of-the-envelope estimates suggest that the cost of employing workers in a low-tax jurisdiction is relatively small, roughly 5% of the tax benefits. Most theoretical contributions about international corporate tax avoidance feature 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 quantification of one part of those costs – the labor costs – suggests that they are relatively small when compared to tax benefits.

We then address our second research question – how are employment and individual workers affected by reforms aimed at better aligning profits with real activities? To that end, we explore the reform implemented in 2012. 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

[1] 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.

aggregate level, headcount remained broadly stable during the period 2010-2014. However, this stability masks 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 for several outcomes before and after the policy change.

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 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. These results suggest that incumbents may have been used to meet employment requirements of several firms at the same time. Given anecdotal evidence (Martins, 2011) indicating that many firms in ZFM shared the same address and owners, this approach may have served as a convenient means of complying with the new requirements.

Concurrently, incumbent stayers experienced a rise in their total wages (the sum of wages across all firms where they work). The wage increase was equal to 7.5% two years after the reform was implemented. These additional expenses with incumbents represented 0.8% of the yearly tax benefits, according to our back-of-the-envelope calculations. Therefore, firms continued to bear a relatively small cost with incumbent workers after the reform, when compared to the tax benefits.

Lastly, we examine the nature of employment created after the reform. We find that individuals who moved to ZFM post-reform held more precarious jobs than incumbent stayers, with a significantly higher likelihood of temporary contracts. Even after controlling for observable characteristics, these workers earned, on average, 30% less than their incumbent counterparts.

A key factor behind the wage disparity between movers to ZFM and pre-reform workers appears to be the type of firms they joined. Movers disproportionately entered firms that previously had no employees – which we call mailbox firms – indicating that their roles may have been less valued than those of incumbent workers, who were already employed in ZFM before firms faced employment requirements.

Overall, while the total number of workers in the ZFM remained stable, it masked significant turnover. Moreover, contract types changed considerably, with the share of part-time contracts and workers employed by multiple firms more than tripling. Additionally, the proportion of temporary contracts rose by over 10 percentage points. These shifts, hidden within aggregate figures, underscore the need for detailed employment data rather than aggregate statistics, which, as we previously argued, are by themselves often difficult to obtain.

Our paper closely relates to studies examining workers from profit-shifting firms, focusing on the other side of the tax avoidance strategy: the high-tax jurisdiction (Souillard, 2022*a*,*b*, Alstadsæter et al., 2022, Davies and Scheuerer, 2023, Lopez-Forero, 2024). 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.[2]

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 characterizes 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]More generally, we also expand upon the literature that examines international corporate tax avoidance. We refer to Hines (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 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 addressing the consequences of international corporate tax avoidance that go beyond its impact on tax revenues (e.g., Suárez Serrato, 2018, Li et al., 2021, de Mooij et al., 2020, Martin et al., 2022, Guvenen et al., 2022, in addition to the above-mentioned references).

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.[3] 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.

To benefit from the ZFM tax scheme, firms have to apply for a license, and pay an application fee of 1,000 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 1,800 euros.[4]

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[5], 98% of the firms had been licensed before 2003, and therefore were benefiting from those highly advantageous tax conditions.[6]

According to the investigation summarized in the book of Martins (2011), among firms located in ZFM there were subsidiaries of large multinational groups such as PepsiCo, Dell, Swatch, British American Tobacco, and Sigma-Tau Pharmaceuticals. The anecdotal evidence collected by the author shows that many of these firms shared the same owners and were located in the same addresses. For example, the author documents that in 2011 more than 400 firms were located in a room of 100 squared meters.

The ZFM 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

[3] Appendix A offers a more detailed characterization of the island of Madeira and the ZFM framework.

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

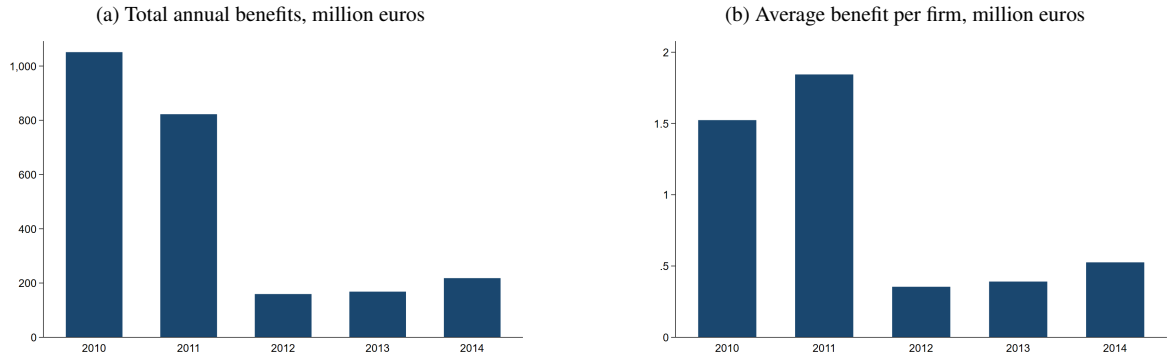
[5] https://info.portaldasfinancas.gov.pt/pt/dgci/divulgacao/Area_Beneficios_Fiscais/Paginas/default.aspx

[6] 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.

Understanding that prevented the negotiation of its extension.[7] 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%[8] 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 equal to or less than 40 million 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 1,000 euros. In 2010, before the reform was announced, the total tax benefits conceded in ZFM (Figure 2) exceeded 1 billion euros. Average benefits per firm were substantial: around 1.5 million euros per year. Notably, the largest benefit to an individual firm was more than 216 million euros, and the second-largest was over 160 million euros. There was a marked decline in both total benefits and benefits per firm following the implementation of the reform in 2012.

Figure 2: 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 1,000 euros 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.

[7] 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 types of tax benefits, of a temporary or permanent nature, at the central, regional, or local level.

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

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.[9]

The data on workers cover 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 is not extensive, as the focus of the dataset is on the workers, but it includes the sector of activity, region, share of foreign capital, 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).[10] 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.[11] The sample comprises 14,918,057 workers-year, including 9,984 in ZFM.

[9] 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).

[10] 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.

[11] 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.

4 The labor market in ZFM before the reform

In this section, we address our first research question – what type of employment exists in low-tax jurisdictions? Before diving into the analysis of the workforce, we first provide a description of firms in ZFM in Section 4.1. While our focus is on workers, and our employer-employee dataset offers far more detailed information on worker-level variables than on firm-level ones, and does not cover firms without employees, this initial characterization of ZFM firms highlights that they exhibit the typical characteristics of firms in tax havens.

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, 2025). ZFM is no exception.

Figure 3 illustrates the distribution of workers of ZFM firms before the reform (announced in 2011), i.e., in 2009 and 2010. Only 8% of the 3,035 firms appear in the QP records.[12] This implies that more than 90% of the firms did not have workers, with "worker" defined as an individual receiving a positive wage.

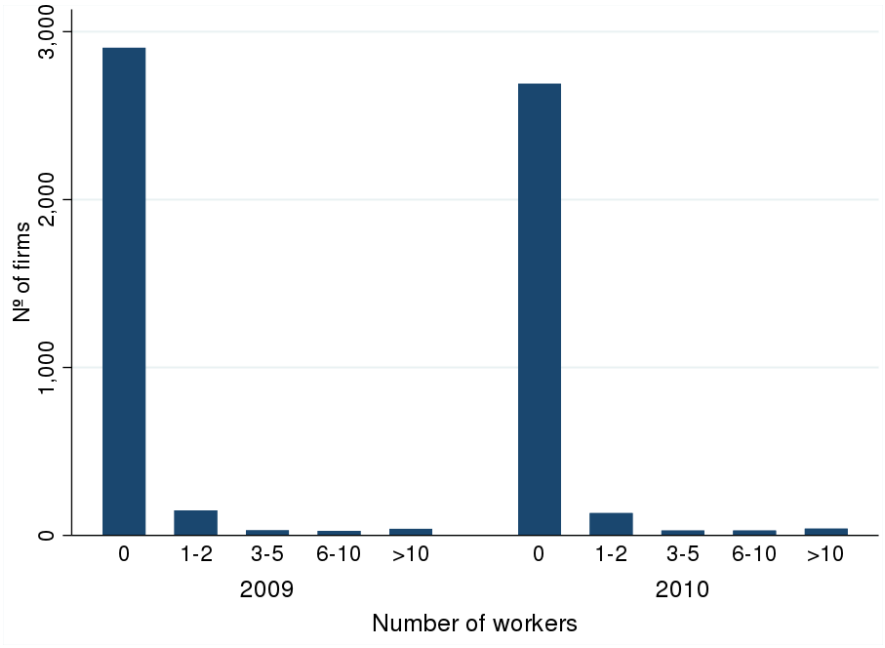
While the QP database does not provide profit figures, we construct a proxy for gross profit by subtracting the firms' wage bill from their turnover. The results for the subset of firms with at least one worker (Figure 4) reveal that, similar to other zero or low-tax jurisdictions, average profitability is abnormally high, on average 50 times higher than in the rest of Madeira, and than 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. In the same figure, we present qualitatively similar evidence based on turnover per worker.

The high profitability in ZFM could partly reflect that the majority of the firms are foreign owned (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. However, Figure B.1 in the Appendix shows that the profits of foreign firms in the ZFM are also several orders of magnitude larger than those of foreign firms located elsewhere in Portugal.

The greater profitability of ZFM firms may also reflect differences in the distribution of

[12] The average number of ZFM firms in 2009 and 2010 is 3,035.

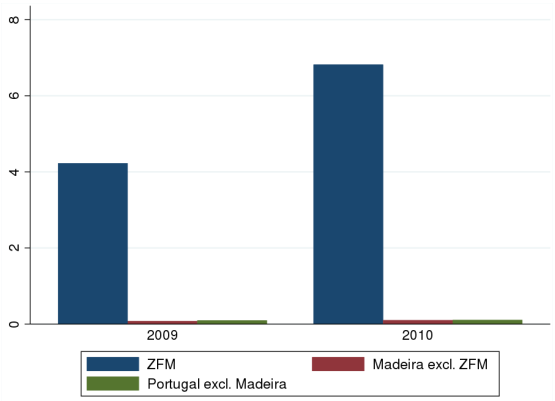
Figure 3: Firms in ZFM have few workers



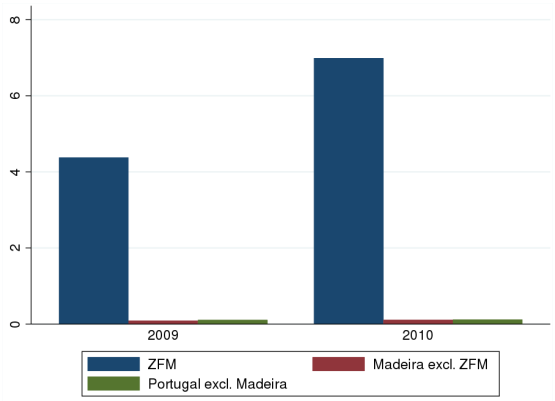
Notes: Firms are considered to have zero workers if they do not appear in the QP database, which includes all firms with at least one wage earner.

Figure 4: Average profit and turnover per worker of ZFM firms are several orders of magnitude larger than in the rest of Portugal

(a) Profit per worker



(b) Turnover per worker



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.

firms across sectors between the ZFM and the rest of the country (Table B.2 and B.3 in the Appendix). The sector of professional, 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 sub-sectors 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 firms serve tax sheltering objectives and have the usual characteristics of firms located in tax havens.

4.2 ZFM workers

Who are the workers employed by this highly profitable firms? In 2009-2010, there were on average 1,672 workers per year in ZFM, with distinct attributes compared to those employed in the rest of Madeira, and in Portugal excluding Madeira (Table 1). Two demographic characteristics stand out: workers in ZFM had higher levels of education, and the proportion of non-Portuguese nationals was higher in ZFM.

Table C.1 in the Appendix shows that service occupations are more common in ZFM than elsewhere. The most common occupation at the 2-digit level of the Portuguese Classification of Occupations was "office workers", comprising almost 20% of the workforce in ZFM. 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 the types of contracts, the average 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 and multiple-job holding was quite low, as in the rest of the country.

Wages in ZFM in 2009-2010 were around 60% higher than in the rest of Portugal. The distribution of wages in ZFM (Figure 5 - 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 only as suggestive. For example, the share of foreign-owned firms was higher in ZFM, and those firms tend to pay higher wages (e.g., Setzler and Tintelnot, 2021).

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

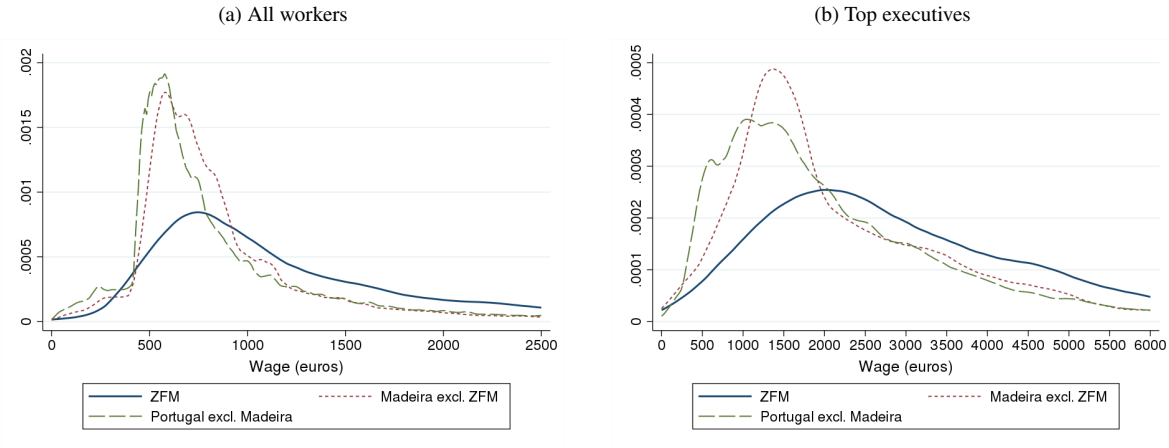
	N	Mean	Std. dev.	p25	Median	p75
Monthly wage	5,152,563	951.99	981.69	537.00	690.41	1038.43
Age	5,152,563	38.62	11.03	30.00	37.00	47.00
Female	5,152,563	0.45	0.50	0.00	0.00	1.00
Foreign nationality	5,152,563	0.05	0.22	0.00	0.00	0.00
University	5,152,563	0.15	0.36	0.00	0.00	0.00
Top executive	5,152,563	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-year 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. 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.

Additionally, ZFM workers had higher levels of education. This indicates the need to control for worker and firm characteristics via a Mincerian regression analysis.

We estimate Mincerian equations including sector-year fixed effects, worker time-varying

Figure 5: 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.

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. Monthly wages are calculated as the sum of all wages of each worker across firms in a given year, i.e., wages per worker-year. 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. 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 (clustering the errors at the firm level yields identical results). 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 5 - 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 foreign workers (39%).

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

	(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 foreign nationality, 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 in the Appendix). Standard errors in parentheses are clustered at the worker level (clustering the errors at the firm level yields identical results). 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, especially in low-tax locations, where data on workers, including their wages, are often difficult to obtain and compare to 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 2). 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 on employment and individual workers

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 job creation requirements.

Almost half of the 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 (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. 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.

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.

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

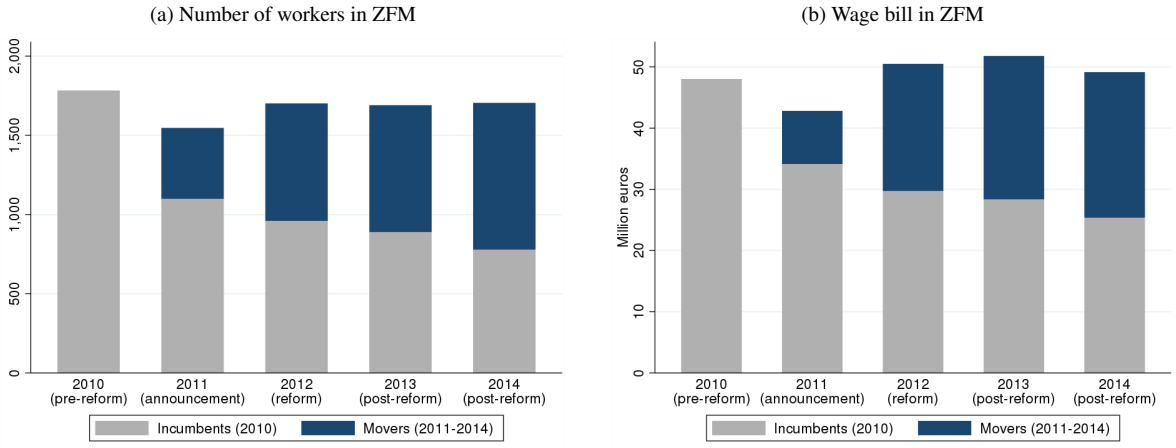
Notes: The sample comprises the 2,921 firms that were in ZFM in 2010. The dependent variable is a dummy equal to 1 if the firm exits ZFM over 2011-2014, and 0 if it remains in ZFM. Mailbox firm is a firm that in 2010 employed 0 workers. LPM - linear probability model. The probit parameter refers to the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

5.1 Aggregate employment

Figure 6 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 6 panel (b)).

In addition, the evidence in Figure 6 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 (subsection 5.2) and then on movers (subsection 5.3).

Figure 6: 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.[13]

To strengthen the parallel trends assumption, we match treated and control workers on pre-treatment (2010) observables, relying on our rich administrative dataset. The identifying assumption is conditional independence, that is that treatment status is random conditional on those observables. 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 foreign nationality status. Using this method, we are able to match 93% incumbent workers in ZFM in 2010

[13] 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 F, we show that the results are similar if we exclude workers in Madeira from the control group.

with 181,824 comparison workers. We re-weight observations in the regression analysis to account for the fact that there are more control than treated workers. 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).

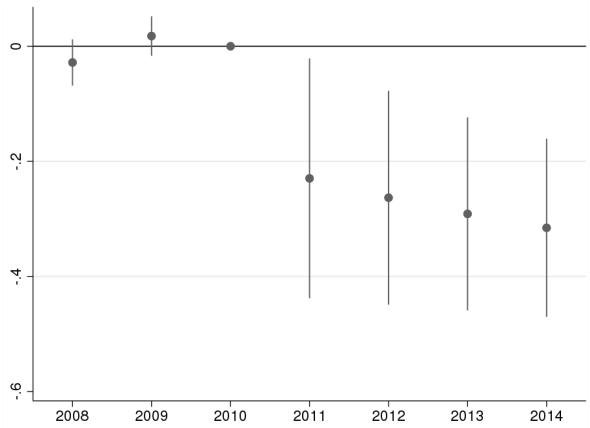
5.2.1 Exit

We first present the results on the probability of staying in the Portuguese labor market (as reported in QP dataset) in Figure 7. 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 are recorded in October, the large effect observed already in 2011 indicates that, even though these firms had workers in the 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, with quick repercussions on workers.

Figure 7: The reform led to an increased exit of ZFM workers 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% in 2012-2014 (4% in 2012 and 5% in 2013-2014). 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%.[14] 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).[15]

[14]Computed as $1 -$ (Post-tax profit with 51 workers after reform/Profit before reform). The average profit before the reform is $26,985,380$ euros. 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.

[15]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-

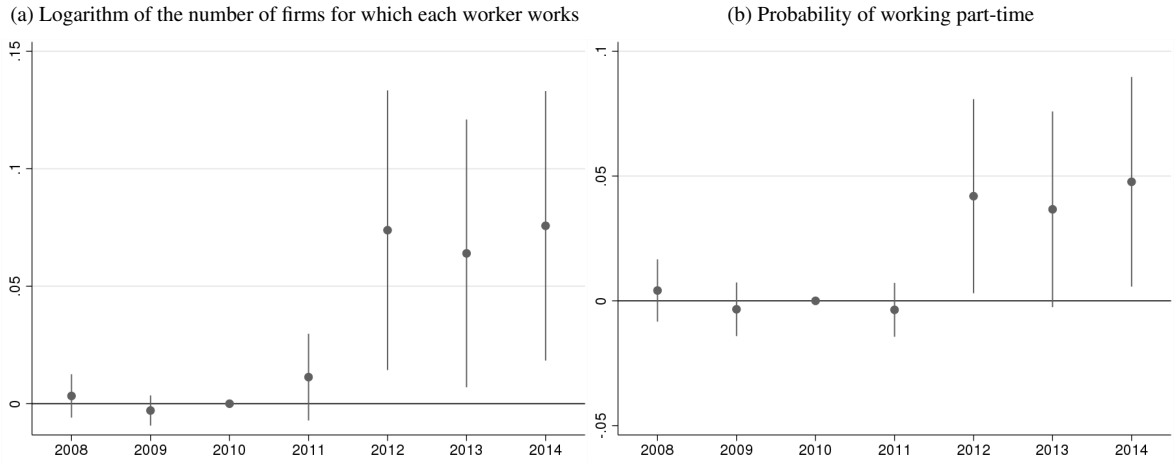
5.2.2 Incumbent stayers

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 8 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 have at least one part-time contract compared to their matched counterparts outside ZFM. The results in Appendix E indicate that these effects are more pronounced among workers with tertiary education.

Figure 8: 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.

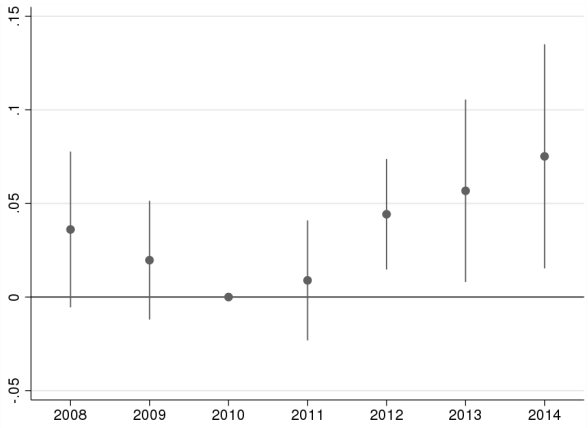
We study the wage effects of the reform on incumbent stayers in Figure 9. Note that we consider the sum of all wages in different firms for each worker. Our findings highlight that, conditional on staying employed in Portugal, these workers witnessed their salary increase *vis-à-vis* workers in the comparison group, a difference that seems to be increasing until 2014. In 2014, two years after the reform was implemented, the wages of treated workers were 7.5% higher than those of untreated workers. This wage premium for incumbent stayers

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.

in the ZFM is especially large for university graduates, approximately 20% in 2014 (Figure E.3 in the Appendix).

Considering a mean wage of incumbents of 1,881 euros in 2014 and that there were 779 incumbents in that year, the estimated wage premium of 7.5% represents an additional yearly cost with wages (including social security contributions paid by the firm) of approximately 1.8 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 0.8% of the tax benefits granted to all ZFM firms.

Figure 9: 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. 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 announcement but were not there in 2010 (i.e., they are not incumbents). We label these workers as *movers*. On average between 2011 and 2014, the stock of movers is equal to 728 workers. The main descriptive statistics for these workers are presented in Table 5.[16]

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-year 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. Workers of 2010 mailboxes – workers employed by a firm that was already present in ZFM in 2010 without employment.

The majority (64%) of movers to the ZFM did not come from other Portuguese firms, indicating that they either came from abroad or were in Portugal but non-employed.[17] Regarding their destination, the majority (42%) went to work in at least one pre-reform "mailbox" firm (i.e, a company that was already registered in ZFM in 2010 but with no employment records). Simultaneously, a substantial portion (37%) went to, at least, one pre-reform ZFM firm with employment.[18] Descriptive statistics for these groups of ZFM workers are presented in Table G.1 in the Appendix.

We examine how the employment profiles of the movers differ when compared to the incumbent stayers analyzed in the previous section. Specifically, we focus our attention on all ZFM

[16] In table G.2 in the Appendix, we show that, conditionally on being in the same sector-year, movers were, on average, less likely to be females, more likely to have foreign nationality, were around 4 years younger, and were more likely to hold a university degree.

[17] Given the nature of the QP dataset, non-employment in Portugal, as referred to in this paper, could represent unemployment or inactivity, as well as self-employment, civil servant positions, or household work.

[18] 24% of movers worked in at least one firm that did not exist in QP before the reform. These percentages sum to more than one due to part-time work arrangements.

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 and sign temporary contracts. 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.

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

	(1)	(2)	(3)	(4)	(5)
	Part-time	Temporary contr.	No of firms (ln)	Multiple firms	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% (***).

In Table 7, we compare the wages of movers with those of incumbent stayers, while also controlling for various time-varying worker and firm characteristics. We find that movers earn lower salaries, a result that is consistent across specifications with different vectors of controls and suggests a wage gap between 26% and 40%. As movers tend to go disproportionately more to mailbox firms, their services might not be as valued as those of workers in non-mailbox firms. Consistent with this interpretation, the wage gap is higher for movers that joined mailbox firms. As reported in Table G.3 in the Appendix, for those workers the gap is around 50%.

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% (***).

5.4 Taking stock of the impact of the reform on employment

In this section, we assess the overall evolution of employment and the types of contracts held by workers in the ZFM after the reform. Table 8 compares the stock of workers and their contract attributes in 2010, prior to the reform announcement, and in 2014, three years afterward.

Table 8: Main characteristics of ZFM workers in 2010 and 2014

	2010	2014
N	1,782	1,704
Monthly wage (euros)	1,555.2	1,664.6
Temporary contract (%)	34.6	45.8
Part-time contract (%)	4.0	13.4
Multiple firms (%)	3.6	11.5

Notes: Descriptive statistics for the stock of ZFM workers in 2010 and 2014. Average values in each year. Multiple firms – workers that work for multiple firms at the same time.

While the total number of ZFM workers remained stable, this masks significant turnover, with approximately half the workforce changing, as shown earlier in Figure 6, panel (a). The average monthly wage did not rise significantly; however, once again, the composition of the workforce matters. As discussed in Sections 5.2 and 5.3, incumbent stayers experienced wage increases, whereas movers tended to earn comparatively lower wages, particularly when joining mailbox firms.

Although aggregate employment numbers and the total wage bill show little change, signifi-

cant shifts are evident in the variables that capture the types of contracts. Indeed, we observe an increase of more than 10 percentage points in the share of temporary contracts and a more than three-fold increase in the share of part-time contracts. Moreover, the share of workers employed by multiple firms also increases by more than a three-fold factor.

Overall, despite the apparent stability suggested by total employment figures, the structure of the labor market in the ZFM changed substantially. These shifts, hidden within aggregate figures, highlight the need for detailed employment data instead of aggregate statistics, which, as we noted in the Introduction, are by themselves often difficult to obtain when the jurisdiction of interest is a low-tax jurisdiction.

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 linking profits more closely to real substance 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 on 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 and that this understanding is essential for achieving feasible international 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 (e.g., Baraké et al., 2022).

The second policy-making message has to do with the importance of the definitions of "job" and effective monitoring. The twelve 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 firms to 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.

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Appendices

A Further institutional details

The Madeira archipelago is located in the Atlantic Ocean about 520km from the African coast, 805km from the closest point in the European coast (the Portuguese town of Sagres, in Algarve) and 1,000 km from the capital of Portugal, Lisbon (approximately a one-and-a-half-hour flight). It consists of two main islands (*Madeira* and *Porto Santo*) with approximately 251 thousand habitants, and two groups of small uninhabited islands – *Selvagens* and *Desertas*.[19] The biggest island is the island of Madeira that has an area of 741km squared, 57km long and 22km wide. According to the Portuguese constitution, the Madeira archipelago is an autonomous region, endowed with a political-administrative statute and its own governmental bodies, democratically elected by the regional assembly.

The autonomous region of Madeira (*Região Autónoma da Madeira* in Portuguese) is an integral part of the European Union (EU), classified as an outermost region. The EU counts nine outermost regions, which are geographically very distant from the European continent: French Guiana, Guadeloupe, Martinique, Mayotte, Reunion Island and Saint-Martin (France); Azores, Madeira (Portugal); The Canary Islands (Spain).[20] The EU legislation allows for specific measures and provisions to help these regions address the major challenges they face due to their remoteness, insularity, small size, difficult topography and climate, as well as economic dependence on a reduced number of products.

The International Business Centre of Madeira (*Centro Internacional de Negócios da Madeira* - CINM in Portuguese), also known as Madeira Free Trade Zone (*Zona Franca da Madeira* - ZFM in Portuguese), was created formally in the 1980s as a tool of regional economic policy.[21] It consists of a set of incentives, mainly of a tax nature, granted with the objective of attracting investment into Madeira to modernize, diversify and internationalize the regional economy.

The ZFM is managed, administered, and promoted by the *Sociedade de Desenvolvimento da Madeira* (SDM) on behalf of the regional government. SDM was created in 1984 by public and private investors and, in 1987, it was granted the public concession of the ZFM for a

[19] Population data from Census 2021 (Statistics Portugal).

[20] See `https://ec.europa.eu/regional_policy/policy/themes/outermost-regions_en` for details

[21] Decree-Law 500/80, October 20th – creation of ZFM; Regulatory Decree 53/82, August 23th – legal and fiscal regulation applicable to ZFM.

period of 30 years. In January 2021, SDM became fully owned by the regional government of Madeira. SDM receives and issues, in articulation with the regional government, the licenses for firms to operate in ZFM. The responsibilities of SDM include also the construction of the infrastructures in the Industrial Free Trade Zone of Madeira.

Following Portugal's accession to the European Economic Community in 1986, the entire legal framework of the ZFM was presented and approved by European authorities. Hence, the favorable operational and fiscal conditions of the ZFM have been offered under a preferential tax regime, fully recognized and approved by the European Commission (EC) within the framework of state aid for regional purposes and according to the terms of the Treaties concerning ultra-peripheral regions.

The ZFM regime has changed several times since its creation. The first regime was approved by the EC in 1987 and was subject to several re-approvals and extensions over the years with the same features. Regime I consisted of a broad set of tax benefits, including a total exemption from corporate income tax, as well as exemptions from withholding taxes on dividend remittances, capital gains, and payments for royalties, interest, and services. This set of benefits was effective until December 31st of 2011 for entities registered in ZFM before 2003.

An important change to the ZFM occurred in May 2011 with the signing of the Memorandum of Understanding between Portugal and the Troika of the EC, ECB, and IMF, resulting in a substantial rollback of tax benefits and exemptions in the ZFM from 2012 onward. The corporate tax rate increased to 4% in 2012 and 5% thereafter and employment requirements were introduced, which depend on the taxable income of the firm, as detailed in Table A.1. This is the reform that we examine in this paper: the 2012 change to the ZFM regime, which required firms to meet minimum employment requirements to retain access to the region's preferential corporate tax rate that went up from 0% to 4%-5%.

Table A.1: Requirements imposed by the ZFM's reform in 2012

Number of jobs	Taxable base 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

The present tax regime was approved by the EC in 2015, which is why we end our period of analysis in 2014, thus excluding the impact of this more recent change in the legislation. The current regime permits the establishment of new firms until the end of 2026, which will be eligible for a reduced corporate tax rate of 5% until the end of 2028 up to a ceiling of their annual taxable base linked to the number of jobs created. A key difference of the current regime is that the EC has imposed a maximum limit on the benefits: 20.1% of the annual gross added value, 30.1% of the annual labor costs, or 15.1% of the annual turnover.

At present, ZFM comprises three sectors of investment: the Industrial Free Trade Zone, the International Shipping Register - MAR and the International Services. All firms licensed in ZFM benefit from an 80% reduction applicable to stamp duty, municipal property tax and property transfer tax, regional and municipal surtax, as well as any other local taxes. The ZFM service firms can be physically located anywhere on the island. The reduced tax rate is applicable to profits derived from operations exclusively carried out with non-resident entities or with other ZFM firms. There are no restrictions on the development of service activities with Portuguese firms, which are taxed at the general corporate tax rate in Madeira.

The Industrial Free Trade Zone (IFTZ) is located 8 km from Madeira's international airport and spans 138 hectares, serving as a site for production, assembly, and warehousing operations. The IFTZ is adjacent to Madeira's new commercial port, facilitating efficient cargo handling. Production and assembly activities carried out by firms in the IFTZ benefit from the reduced tax rate also in operations with Portuguese residents. The general tax rate applies to income derived from pure warehousing activities with resident entities that do not involve production, transformation, or assembly operations.

The International Shipping Register of Madeira - MAR was created under the framework of the ZFM to attract new shipowners and vessels. All international conventions ratified by Portugal are fully applicable to MAR and, as a result, it has never been considered a "flag of convenience". With the exception of fishing vessels, MAR accepts the registration of all types of commercial vessels, including oil rig platforms, as well as commercial and pleasure yachts. The wages of the crew of commercial vessels and yachts registered in MAR are exempt from personal income tax. Foreign crew members are also not obliged to contribute to the Portuguese social security regime, provided they have an alternative protection system.[22] It is not mandatory to incorporate a firm in the ZFM to proceed with the registration of a ship in MAR, although some form of legal representation must be nominated. The tax regime of

[22] Portuguese nationals must be covered by the general Portuguese social security regime. A total contribution rate of 2.7% is applicable, of which 2.0% is borne by the employing entity and 0.7% by the employee.

the ZFM fully applies to all duly licensed shipping companies, regardless of whether they have vessels registered in MAR.

The website of SDM (`https://www.ibc-madeira.com/en`) provides more detailed information on the current ZFM regime, including the applicable legal documents, formalities, fees, procedures and requirements for company formation.

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: Firm-year descriptive statistics. 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

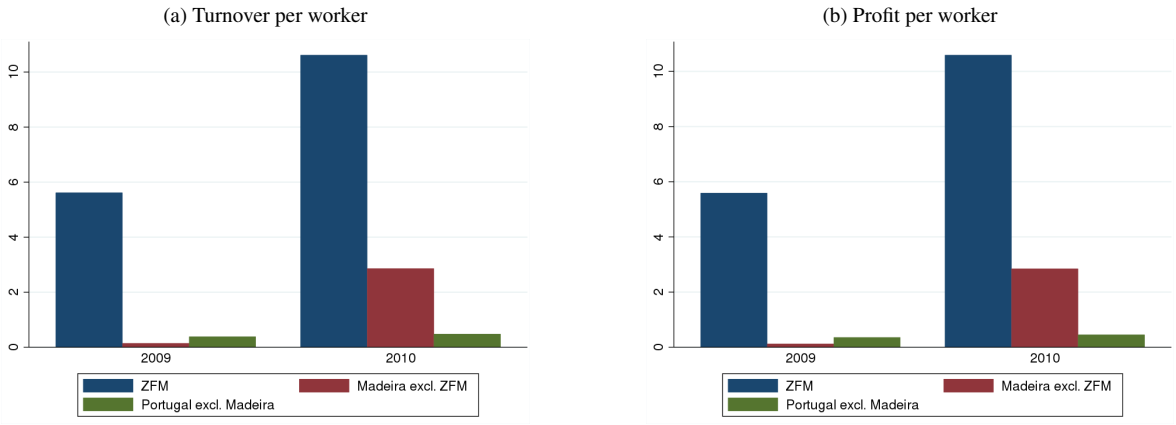
Description	Code CAE	Number of firms	Employment	Turnover
Primary	A+B	0.6	0.6	1.4
Manufacturing	C	6.9	21.2	1.4
Electricity, gas, water	D+E	1.7	2.4	0.4
Construction	F	2.3	2.7	1.0
Wholesale and retail trade	G	29.6	25.0	69.0
Transportation and storage	H	5.5	2.4	4.7
Accommodation and food	I	–	–	–
Information 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 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 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 (CEM). 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, foreign nationality 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 for these workers in 2010 are provided in Table D.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. Table D.2 presents descriptive statistics for these workers in 2010.

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 D.1: Descriptive statistics for treated and control group after matching (2010)

(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 the CEM 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. 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.

Table D.2: Descriptive statistics for treated and control group after matching (2010): 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

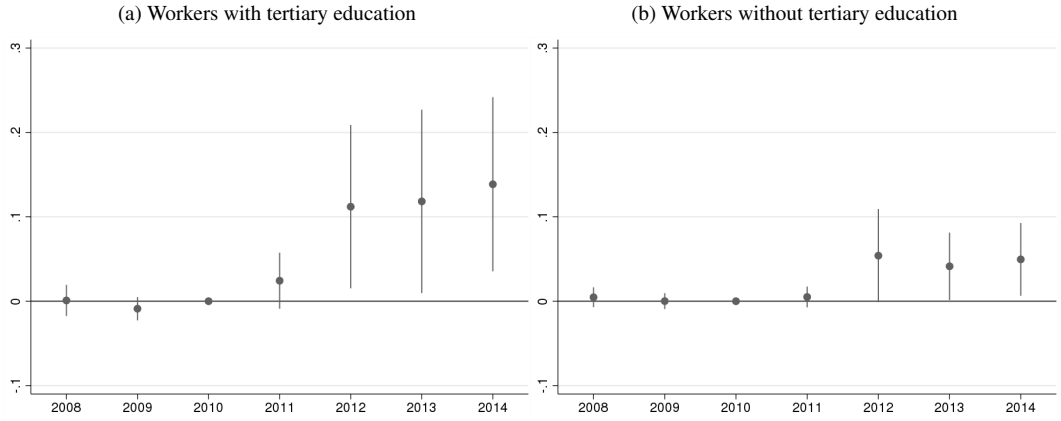
(b) Control workers

	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 the CEM 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. 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.

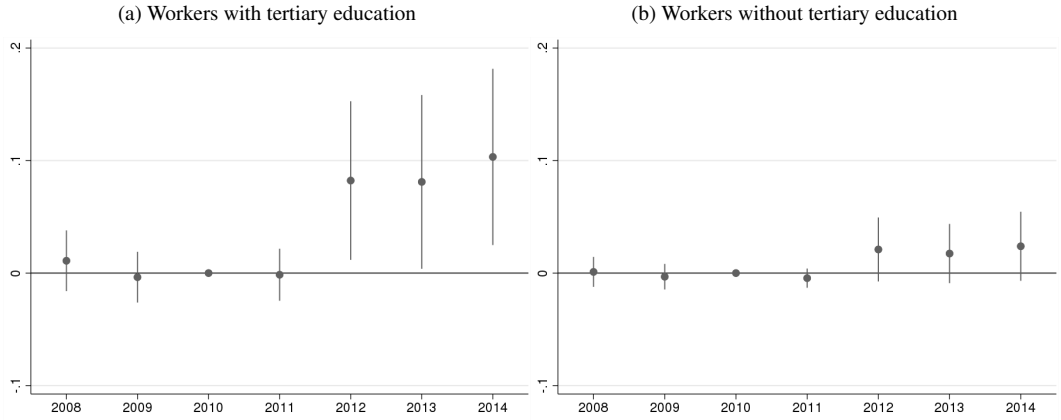
E Impact of the reform on incumbent workers: heterogeneity by education level

Figure E.1: Number of firms of each worker



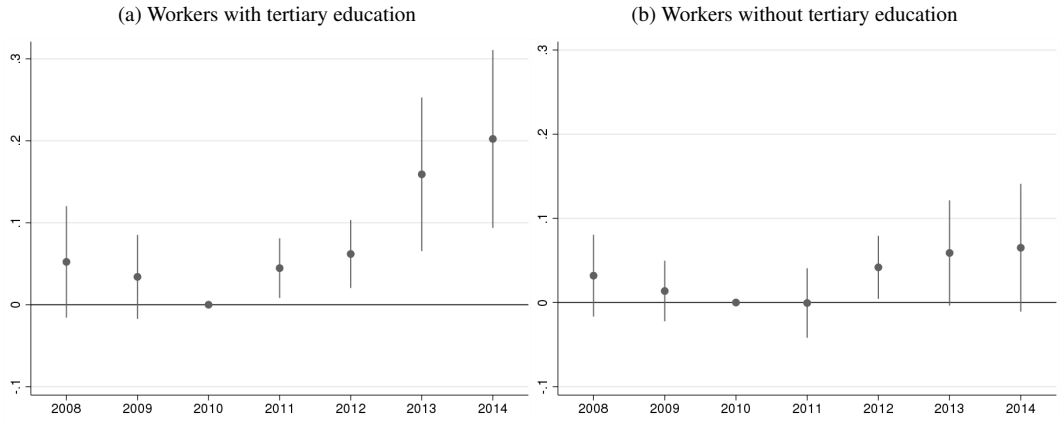
Notes: The figure depicts the regression results of equation 1 for two groups of workers. The dependent variable is the logarithm of the number of firms for which each worker works. Point estimates with 95 percent confidence intervals. Standard errors are clustered at the 2010 firm level.

Figure E.2: Probability of working part-time



Notes: The figure depicts the regression results of equation 1 for two groups of workers. 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 E.3: Monthly wages



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

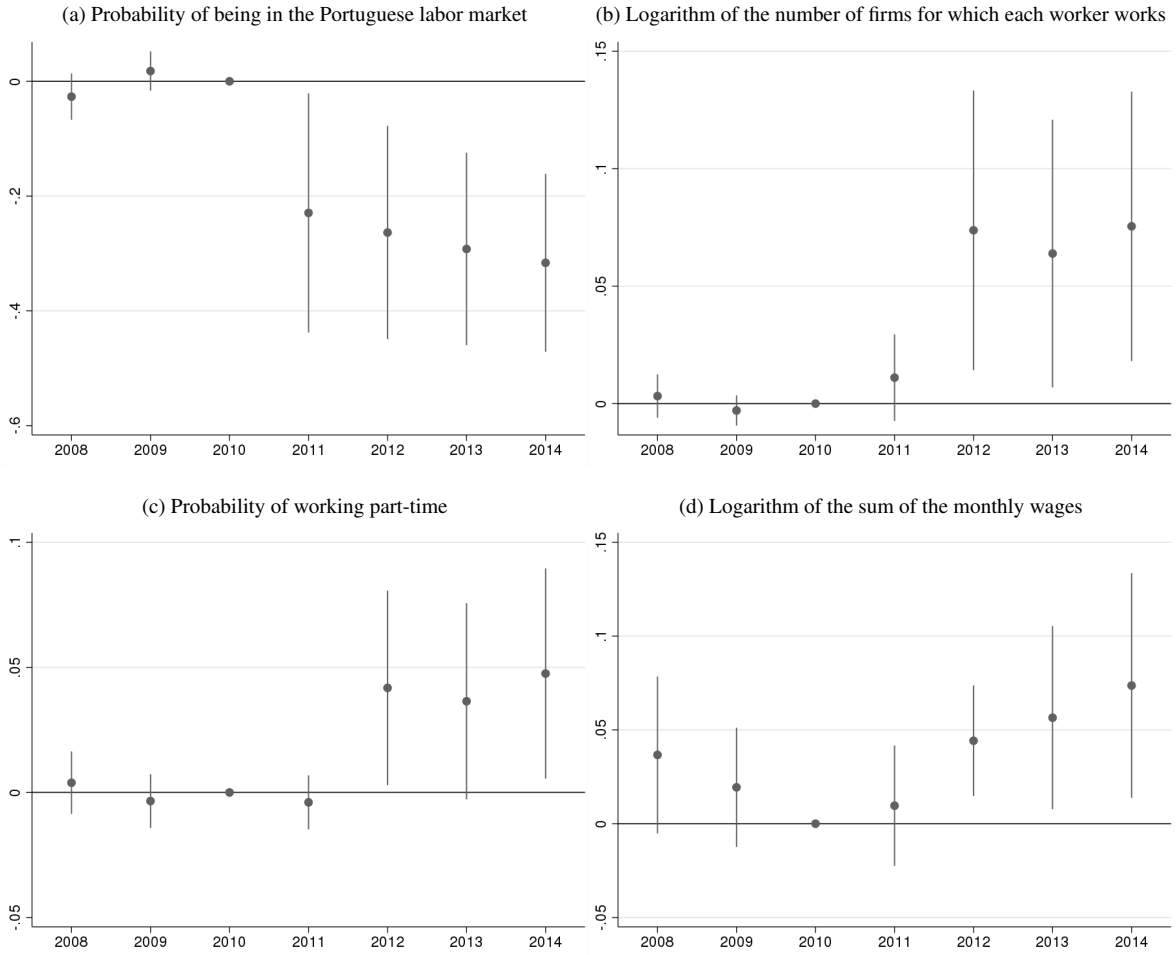
F Impact of the reform on incumbent workers: robustness

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 F.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.

G Movers: further results

Table G.1: Characteristics and type of jobs of movers (2011-2014)

(a) Movers to 2010 mailboxes

	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

(b) Movers to 2010 ZFM firms with employment

	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

(c) Movers to new ZFM firms

	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

Characteristics and type of jobs of movers (2011-2014) (continued)

(d) Movers from out of sample to ZFM firms

	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

(e) Movers from out of ZFM to ZFM firms

	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-year 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. (a) Workers employed by a firm that was present in ZFM in 2010 without employment. (b) Workers employed by a firm that was present in ZFM in 2010 with employment. (c) Workers employed by a firm that was not present in ZFM in 2010 (with or without employment). (d) Workers not present in QP in 2010 and employed by a ZFM firm in 2011-2014. (e) Workers present in QP but not in ZFM in 2010 and employed by a ZFM firm in 2011-2014.

Table G.2: Movers' demographics relative to incumbents (2011-2014)

	(1) Female	(2) Foreign nationality	(3) Age	(4) 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% (***).

Table G.3: Movers to 2010 mailboxes earn lower wages than incumbent stayers (2011-2014)

	(1)	(2)	(3)	(4)	(5)
Mover to 2010 mailbox	-0.555***	-0.528***	-0.496***	-0.459***	-0.490***
	(0.036)	(0.066)	(0.062)	(0.064)	(0.066)
Sector-Year FE	No	Yes	Yes	Yes	Yes
Worker Controls	No	No	Yes	Yes	Yes
Firm Controls	No	No	No	Yes	Yes
Observations	4,972	4,953	4,953	4,953	4,933
Adjusted R-squared	0.110	0.316	0.508	0.516	0.575

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% (***).