

NOVA SCHOOL OF BUSINESS AND ECONOMICS

A Work Project, presented as part of the requirements for the Award of a Master's degree in Economics Program from the Nova School of Business and Economics.

Treasure islands, treasure jobs? Exploring the wage gap in Madeira's Free Trade Zone

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16-01-2023

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Wednesday 18th January, 2023

Abstract

This study advances the existing knowledge about the interactions between tax avoidance and employees' pay. Specifically, we investigate whether workers employed by companies operating in a low-tax zone (the Free Trade Zone of Madeira, FTZ) benefit from a positive wage premium. Drawing on a rich administrative linked employer-employee dataset covering the universe of private firms in Portugal, we follow three different econometric approaches: a high-dimensional fixed effects regression analysis, an analysis focused only on workers employed simultaneously by FTZ and non-FTZ firms, and coarsened exact matching. We find evidence of a positive wage premium for workers in the FTZ.

Keywords: Tax avoidance; Labor Market Impacts; Wage premium; Fixed Effects estimation

*I am deeply grateful to my advisors, Susana Peralta and João Pereira Santos, for their vital motivation, crucial guidance, and good energy. Their expertise, insight, and encouragement were invaluable to me throughout the writing of this thesis. To my boyfriend, Francisco Carvalho; to my parents, Isabel Mendes and Luís Miranda; to my grandparents; to Pantufa, my loyal and loving dog; as well as the rest of my family, and friends, especially Carolina Alves, my endless thankfulness for the unconditional encouragement and support. My sincerest gratitude to Banco de Portugal, especially to Joana Garcia and Sónia Cabral, and Instituto Nacional de Estatística for their invaluable collaboration in my research study.

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1 Introduction

About 10% of the world's GDP is held offshore mostly by the top 0.1% of the richest households who own about 80%(Alstadsæter et al., 2018). In recent years, scandals such as the Panama Papers, Paradise Papers, and Luxembourg Leaks sent shockwaves across the globe and showed that corporate tax avoidance is a problem to which no country is immune. Multinational corporations are transferring approximately 1.38 trillion in profit to tax havens (OECD, 2020). Additionally, the International Monetary Fund (IMF) has estimated that nearly 40% of reported cross-border corporate investment is “phantom”, meaning it is a result of accounting techniques used to avoid paying taxes.

Following those scandals, the media has shown an increased appetite for exposing the strikingly low tax bills of companies, and public discontent has only continued to grow. This phenomenon was accentuated during the pandemic. Companies known for avoiding taxes for years received financial help from governments to withstand the pandemic, and public disquiet grew further. It is therefore not surprising that the long-standing problem of corporate tax avoidance is more than ever at the top of the international tax policy and research agenda.

In this paper, we contribute to this agenda by advancing the existing scarce knowledge about the interaction between corporate tax avoidance and employees' pay. In particular, we explore whether workers employed by companies operating in a low-tax zone benefit from a positive wage premium. To the best of our knowledge, there has been no previous research on whether there is a wage premium for workers in a tax haven or low-tax jurisdiction. Also, our research study is the first to explore administrative data for Madeira's FTZ. This makes our paper a unique contribution to the tax-haven literature.

In general, given the opacity of tax havens and offshore centers, it is difficult to obtain data about the workers that are employed in low-tax locations. In this paper, we overcome that obstacle by relying on an extremely rich dataset containing information for the universe of workers employed by firms located in Madeira's Free Trade Zone (FTZ) – a regional aid scheme operating on the island of Madeira (an outermost region of Portugal). While subject to modifications over time, this regime has persistently allowed firms to benefit from zero or

a very low corporate tax. We focus on the workers employed by those firms and investigate to what extent they benefit from a positive wage premium.

If firm owners themselves are the ones who most benefit from the embedding of offshore into the global economy, the fact that big corporations are playing the system to dodge their tax bills raises new questions on why would a person choose to work for a shell company that manipulates transfer prices, shifts profit, and has no real economic activity if there is no benefit for itself.

Theoretically, corporate tax avoidance may have different and potentially opposing effects on wages (e.g. (Alstadsæter et al., 2022; Souillard, 2022)). On the labour demand side, the profitability achieved through low or zero tax bills could be shared between the firm and its workers, and result on a positive wage premium. Alternatively, tax avoidance may provide the firm with private information about its true profitability and create an information asymmetry that damages the bargaining power of employees. On the supply side, the moral values of the workers may play a role. Previous research has suggested that individuals may be willing to forgo higher wages in favour of working for companies that align with their values. For instance, workers, especially Millennials¹ and Gen Z,² are willing to accept lower wages to work in more environmentally sustainable firms and sectors (see (Krueger et al., 2021)). On the other hand, Cole et al. (2009) found that workers in pollution-intensive industries were indeed paid a premium, suggesting that individuals are willing to accept higher levels of risk in exchange for a monetary reward. This supports our hint that workers may be willing to work for companies that engage in profit shifting and other tax avoidance practices if they are compensated for doing so. Which of the effects mentioned in this paragraph prevails is, therefore, an empirical question.

Conceptually, one can frame this as a total reward for work, which includes both extrinsic and intrinsic motivation. Deci and Ryan (2013) describe intrinsic motivation as the inherent desire to engage in an activity for its own sake, rather than for the sake of some external reward or consequence, while extrinsic motivation as the desire to engage in an activity

¹Also known as Gen Y, this demographic cohort includes people born between the early 1980s and the mid-1990s.

²Gen Z is the demographic cohort following the millennials. Gen Z is typically defined as people born between the late 1990s and the mid-2010s.

because of the potential rewards or consequences that it may bring. Extrinsic motivation can take many forms, such as the desire to earn money, receive praise or recognition, avoid punishment, or achieve some other external goal. Overall, the impact of intrinsic motivation on wage premiums will depend on the individual worker and the specific circumstances of the job. Some workers may be willing to accept a wage discount in exchange for the opportunity to do work they find intrinsically rewarding, while others may require a wage premium to be motivated to do work that is not inherently interesting or enjoyable.

To address our research question, we rely on the administrative linked employer-employee longitudinal database, *Quadros de Pessoal* (QP), from 2012 to 2019. We use three different econometric strategies. First, we estimate a high-dimensional fixed effects regression, which involved running standard Mincerian wage regressions augmented by an indicator variable capturing whether the person is working in the FTZ or not. This estimation approach allowed us the inclusion of a large number of control variables and fixed effects to control for time-invariant unobserved heterogeneity at the individual level, as well as time heterogeneity. Second, we focus on workers that are simultaneously employed in the FTZ and in other firms. In our final strategy, we use Coarsened Exact Matching (Iacus et al., 2012) to preprocess our dataset and compare the wages of workers in Madeira's Free Trade Zone with those of workers outside while controlling for other factors that may affect wages. This technique allows us to create more balanced groups of observations for comparison, ensuring that any differences in wages are not due to factors other than working in the FTZ.

Our findings provide evidence of a positive wage premium for workers in Madeira's Free Trade Zone. In two out of three estimation strategies, we mostly observed a statistically significant premium, indicating a consistent trend across our analyses. While the results of the second strategy were not statistically significant, this may have been due to the limited number of observations in this estimation, which may have contributed to a lack of statistical power, making it difficult to detect a reliable effect.

The remainder of this paper has the following structure: Section 2 presents a summarized introduction to Madeira's Free Trade Zone and its institutional background; Section 3 reviews the literature related to this topic; Section 4 describes the characteristics and advan-

tages of the available dataset, while Section 5 describes the methodological approach used; Section 6 shows results on the existence of a wage premium for workers in the FTZ; Section 7 concludes.

2 Institutional Background

2.1 The Madeira's Free Trade Zone Tax System

The archipelago of Madeira is located in the Atlantic Ocean about 980km from Lisbon and 700km from the African coast. It consists of two main islands – Madeira and Porto Santo – with approximately 251 thousand habitants, and two groups of uninhabited islands – Selvagens and Desertas.³ According to the 1975 Portuguese Constitution, Madeira is an autonomous region, endowed with a political-administrative statute and its governmental bodies, democratically elected by the Regional Assembly. It is governed by the Center-right Social Democratic Party since the first democratic elections in 1976.

Intending to develop the regional economy through the diversification and modernization of the respective productive structure of goods and services, and supported by the certainty that the island could not survive isolated from a world emerging towards globalization, the International Business Centre of Madeira (IBCM), also known as Madeira's Free Trade Zone (FTZ) was created in 1980.⁴ Four years later, in 1984, the *Sociedade Económica de Desenvolvimento da Madeira* (SDM) was created, as a public limited company that has been collaborating with the Regional and National Governments, as the concessionaire, for the management, administration, and promotion of the IBCM.⁵ Embodying a set of incentives, predominantly of a tax nature, such as tax exemptions and reduced customs duties, arguably, the Free Trade Zone allowed companies established in this Region to overcome the inefficiencies and disadvantages that arise from being an outermost region.

According to the OECD's report on Harmful Tax Competition, a tax haven implies the inexistence of an effective exchange of information and lack of transparency.⁶ The IBC

³Data from Census 2021 (INE)

⁴Decree-Law 500/80, October 20th

⁵Decree-Regional 22/86, October 2nd

⁶In OECD report: Harmful Tax Competition: An Emerging Global Issue

regime is not a typical tax haven regime and has never been qualified as an Offshore by the OECD or any other official international bodies. From the outset, Madeira's Free Trade Area is qualified as a preferential tax regime, insofar as it provides for the application of lower tax rates, and it is fairly transparent, with information being exchanged in general terms, following OECD guidelines.

Over the years, Madeira's FTZ regime has changed four times, the last of which takes effect until December 31st of 2027.⁷ The current regime permits the establishment of new companies until the end of 2023, which will be eligible for a reduced corporate tax rate of 5% until the end of 2027, following job creation requirement criteria.

In light of European law, only jobs located in Madeira and profits generated in the archipelago could be used in the calculation of the corporate income tax incentives for companies registered in the FTZ and not outside the Autonomous Region of Madeira (ARM). Nevertheless, Portugal broke the commitment agreed upon with the European Commission, having granted tax reductions without control, regardless of the place of activity of companies and workers. Brussels concluded that the benefits granted irregularly constitute illegal aid as they place companies in a position of selective advantage over competitors, which is incompatible with the internal market. Following that, the Portuguese State is now bound to recover the benefits granted illegally to 311 companies licensed in the Free Zone of Madeira, in the amount of 833 million euros, plus interest.

3 Literature Review: Measuring the Wage Premium

3.1 Tax Haven Literature

Empirical studies of tax evasion and tax avoidance have focused on the magnitude of tax evasion in rich countries (Alstadsæter et al., 2018, 2019; Dharmapala and Hines Jr, 2009), tax evasion at the top of the income distribution (Guyton et al., 2021), the elasticity of demand for tax havens (Garrett and Suárez Serrato, 2019), the substitutability between tax evasion and

(<https://www.oecd.org/ctp/harmful/1904176.pdf>)

⁷The IBC's regime was first approved by the Commission on May 26th of 1987 for three years beginning in 1989 and running until December 31st of 2011, under the derogation provided for in former Article 92(3)(a) of the Treaty, now Article 87.

tax avoidance (Alstadsæter et al., 2022), and the unintended consequences of the application of harsh measures to repress evasion (Suárez Serrato, 2018).

Although arguably, Free Trade Zones were originally designed to promote economic development and employment by encouraging global production in their territories, when it comes to the effect of Free Trade Zone policies on regional development, there are conflicting results. Ambroziak and Hartwell (2018) argued that Special Economic Zones have had a strongly positive impact on the development of the least-developed regions in Poland, while in relatively richer ones the effect was weak or even negative. The fact that these zones offer very low or null taxes results in an important incentive for firms to shift revenue from high-tax jurisdictions. However, this can lead to a fall in government tax revenue without sizable net positive effects on employment and economic activity, conducting to the amplification of inequality of wealth, but also to inequality of opportunity.⁸

Relatedly, numerous papers identify the techniques of profit shifting, arguing that multinational enterprises locate their intellectual property rights in offshores, manipulate transfer prices, record sales in low-tax countries, and proceed with intra-firm loans, treaty shopping, and corporate inversions to minimize tax expenses (see for example Dharmapala (2014), Riedel (2018), and Beer et al. (2020) for literature reviews). Only a fistful of papers investigate the consequences of profit shifting on workers' wages. The closest papers are Souillard (2022) and Alstadsæter et al. (2022). Those papers examine whether US/Norwegian firms belonging to a multinational structure that includes a tax haven pay higher wages than other firms in the US/Norway. Differently, in this study, our focus is not on the employees of the firm located in the high-tax location, from where profits are potentially shifted. Instead, we focus on the workers located in the low-tax area.

3.2 Measuring the Wage Premium

There is vast literature examining whether different types of firms pay a wage premium. Bloom et al. (2018) examined whether the large-firm wage premium has declined significantly since the early 80s. They followed a model specification that was first introduced

⁸For a brief overview of the advantages and disadvantages of FTZs, see “Special economic zones – Not so special”, *The Economist*, 4 April 2015.

by Abowd, Kramarz and Margolis (1999) which allowed them to estimate a separate wage fixed effect for each worker and firm in the sample. However, this model specification has two major problems: it is only valid under (i) an interconnected set, and (ii) the assumption that worker-to-company transactions are random. Bonhomme et al. (2020) discuss the importance of bias correction in AKM model estimation, having proposed a correlated random effects method for bias correction, often referred to as “limited mobility bias”.⁹

Cardoso et al. (2016) and Card et al. (2016) examine what drives the gender wage gap in Portugal, employing the same dataset that we use. When it comes to the wage gap between immigrants and local workers, Cabral and Duarte (2016) used the relation between Gelbach (2016) and Oaxaca (1973), and Blinder (1973) decompositions and found that the wages of immigrants do not fully converge to those of comparable natives as they gain experience in the Portuguese labor market. Also, Carneiro et al. (2012) used pooled OLS regression to measure the wage gap between migrants and natives, gradually adding worker-level controls.

A paper that is very similar to this one is Krueger et al. (2021), which investigated whether workers are willing to give up part of their financial compensation, accepting lower wages to work in more sustainable firms or sectors. Their main analysis compares two otherwise very similar workers, in the same occupation, in the same year who work in a sustainable versus an unsustainable sector, controlling for many standard Mincerian controls such as education and experience. A general limitation of these specifications is that they assume workers randomly move between firms and sectors over time. Following that concern, as a refinement for their baseline specification, Krueger et al. (2021) partially addressed this problem that stems from the fact that job changes are not random by narrowing the sample, maintaining only the “more” exogenous job changes (for instance, a worker who had to change job because of their firm went bankrupt).

⁹For a detailed description of the “limited mobility bias”, see Abowd et al. (2004), Andrews et al. (2008), and Card et al. (2018).

4 Data

4.1 Data Collection Procedure

The paper analysis relies on a longitudinal matched employer-employee-job title Portuguese dataset from *Quadros de Pessoal* (QP, Portuguese Personnel Records). QP is an annual mandatory census conducted by the Portuguese Ministry of Employment that covers all firms (or establishments) with at least one wage earner located in Portugal (mainland and autonomous regions, including Madeira). Public administration employees, independent contractors, household servants, and unemployed individuals are not included.

This dataset presents several advantages. First, the legal requirement to participate in it guarantees a high response rate, which reduces the likelihood of panel attrition and other issues commonly found in panel data sets. Secondly, one of the key features of this dataset is the way it is structured. Each individual is assigned a unique identifier based on their social security number, as is each company. This allows for the tracking of workers and firms over time and the matching of workers to their respective employers. Moreover, in addition to the regular verification of the accuracy of the information collected, there is also a legal requirement for this data to be publicly displayed within the firm. This not only adds to the reliability of the data but also helps to reduce potential measurement errors, particularly when it comes to earnings.

Data are available on each employee's gender, age, schooling, occupation, tenure, and monthly earnings, including base wages, regular benefits (for instance, seniority), irregular benefits (profit distributions and premiums), overtime payments, and hours of work (normal and overtime). Information is also collected on each industry, location, employment, gross sales, and legal framework.

In addition, the Portuguese National Statistical Office (INE) provided us, in a safe center environment, with a regularly checked dataset including a dummy variable for the companies in Madeira's Free Trade Zone from 2009 to 2020. Since we want to avoid the confounding effects that may come from the corporate income tax change in 2012, we will use the dummy variable for Madeira's FTZ as of 2012 and conduct our study on the period 2012-2019. Also,

the data for 2020 were excluded due to the pandemic situation.

Our main results are based on the hourly wage computed as the ratio between the monthly wage and the total number of normal and extra hours worked. We consider two alternative definitions of the monthly wage. First, we define it as the sum of the total regular payroll (base wage and regular benefits). Second, we define it as the sum of regular and irregular payroll (irregular benefits and overtime payments). We use two alternative measures of (logarithmic) hourly wage based on those two alternative definitions: HW1 and HW2, respectively. We consider HW1 the most relevant wage measure for this estimation, as it excludes any premium payments for overtime hours, reducing the potential bias from conflating regular hours payments with those earned in irregular hours (Cirera and Martins-Neto, 2023; Petersen and Morgan, 1995). Nevertheless, since we want to account for anomalous payments that may happen, we also estimated the wage premium for a more broad measure of the hourly wage, HW2.

4.2 Sample Descriptive Statistics

The table above presents the summary descriptive statistics for the variables used in this research paper.

	N	Mean	Std. Dev	Min	Max
Base Monthly Wage (euros)	21,800,007	962.164	1105.450	0	654166
Total Monthly Wage (euros)	21,800,007	1093.325	1638.314	0	1017991
Normal Hours at Work	21,800,010	152.255	44.064	0	260
Extra Hours at Work	21,800,017	1.314	6.690	0	301
Base Hourly Wage	21,118,480	6.298	7.217	0	4303.724
Total Hourly Wage	21,118,480	7.240	27.181	0	54407.210
Gender	23,268,033	1.468	0.499	1	2
Age	23,238,537	40.737	11.392	14	99
Tenure	23,253,306	7.757	8.845	0	66
Turnover (euros)	22,589,973	3782894.44	18.174	0	11321846332.5
Firm size (n° of workers)	23,268,033	69.06	11.66	0	2733
Foreign Capital (%)	23,268,033	13.334	33.104	0	100
Bachelor's Degree	23,277,049	0.193	0.395	0	1
High Level Position	23,277,049	0.086	0.280	0	1

Table 1: Summary Descriptive Statistics

To determine if there are differences in the descriptive statistics between Madeira's Free

Trade Zone and the rest of Portugal, we separately compute these summaries for both Madeira's FTZ and the rest of Portugal in Table 2.

	N	Mean	Std. Dev
<i>Workers in Madeira's Free Trade Zone:</i>			
Base Monthly Wage (euros)	25,245	989.727	1227.634
Total Monthly Wage (euros)	25,245	1122,114	1524.38
Normal Hours at Work	25,245	116.161	68.516
Extra Hours at Work	25,254	0.616	5.747
Base Hourly Wage	24,636	8.690	8.354
Total Hourly Wage	24,636	9.572	10.128
<i>Workers in the rest of Portugal:</i>			
Base Monthly Wage (euros)	21,774,762	962.132	1105.3
Total Monthly Wage (euros)	21,774,762	1093.292	1638.441
Normal Hours at Work	21,774,765	152.297	44.010
Extra Hours at Work	21,774,772	1.315	6.691
Base Hourly Wage	21,093,842	6.295	7.215
Total Hourly Wage	21,093,842	7.237	27.194

Table 2: Summary Descriptive Statistics for Workers in Madeira's Free Trade Zone and for Workers in the rest of Portugal

Based on the information in this table, it appears that the mean values for both wages are generally higher in the FTZ. Also, we can see that, on average, the number of hours worked is much higher in the rest of Portugal compared to Madeira's FTZ. Hence, the mean values for the hourly wages are also higher in Madeira's Free Trade Zone. However, it is important to note that these differences could be due to a variety of factors, and more information would be needed to draw any reliable conclusions.

5 Econometric Framework

We have followed three different econometric strategies, which are detailed in this section.

5.1 High-Dimensional Fixed Effects Regression Analysis

The starting building block of this dissertation is an extension of the original Mincer (1958) earnings function. We start our high-dimensional fixed effects regression analysis (Correia, 2016) of the administrative wage data by running standard Mincerian wage regressions aug-

mented by an indicator variable capturing whether the person is working at Madeira's Free Trade Zone or not. The dummy variable Z_{ft} equals one if the employee works for a firm (or establishment) f in the free trade zone and zero otherwise.

Our baseline specification to identify the wage premium associated with Madeira's Free Trade Zone is given as follows:

$$\ln(w_{ift}) = \alpha_0 + \alpha_1 Z_{ft} + \Omega_t + \lambda_i + \phi_{fc} + \epsilon_{ift} \quad (1)$$

where i indexes an individual, working at firm f , in year t , and w_{ift} is the nominal hourly wage of worker i , which is regressed against our dummy of Zona Franca da Madeira, Z_{ft} . Ω_t represents year-fixed effects, to capture the macroeconomic environment (business cycle), and λ_i represents worker-fixed effects. ϕ_{fc} represents the Economic Activity Classification (EAC) fixed effects. The worker-fixed effects are used to capture any observed and unobserved time-invariant heterogeneity at the individual level. It is crucial to accurately identify both the worker and company fixed effects. This is done by examining the largest group of observations in which firms are connected through worker mobility. By tracing the movement of employees between firms, we can distinguish the unique impact of each company on pay. Once the firm effect is accounted for, any remaining differences in pay can be attributed to individual worker characteristics.

Our second specification includes worker, EAC, and year-fixed effects but controls also for observable characteristics of the individuals:

$$\ln(w_{ift}) = \alpha_0 + \alpha_1 Z_{ft} + \alpha_2 X'_{it} + \Omega_t + \lambda_i + \phi_{fc} + \epsilon_{ift} \quad (2)$$

In terms of observables, the vector X'_{it} consists of a set of employee characteristics: tenure as a proxy for experience, measures of education (college degree or higher), measures of qualification indicating if the worker has a leadership position in the firm or not (white collar indicator), and a dummy for whether the employee has a temporary contract. While tenure measures the worker's time at the corresponding firm, education controls for whether the worker has a bachelor's degree or not.

In our third estimation to identify the wage premium associated with Madeira’s Free Trade Zone, a canonical Mincer-type equation is estimated, assuming that workers’ wages depend on the event of displacement and on some controls for fixed and time-varying characteristics of the workers and the firms at a given time period:

$$\ln(w_{ift}) = \alpha_0 + \alpha_1 Z_{ft} + \alpha_2 X'_{it} + \alpha_3 F'_{ft} + \Omega_t + \lambda_i + \phi_{fc} + \epsilon_{ift} \quad (3)$$

We also include observable characteristics of the firms in vector F'_{ft} , such as the natural logarithm of the number of employees (firm size), the firm’s percentage of foreign capital, and the natural logarithm of the turnover. ϵ_{ift} is the disturbance component, assumed to respect the assumptions of zero conditional mean and strict exogeneity. The parameter of interest in this study is α_1 , the wage premium of working in Madeira’s Free Trade Zone.

The estimation of these equations by the typical OLS is too demanding since it requires the estimation of multiple high-dimensional fixed effects.¹⁰ As discussed in Abowd et al. (1999), the large dimension of the design matrices for the fixed effects makes impractical the application of the conventional OLS formula. Nevertheless, models of this type can be estimated using the algorithm proposed by Correia (2016).¹¹

Addressing the Endogenous Mobility of Individuals across Firms

Although we control for all these observable variables, one problem with this specification is that it blindly assumes that workers randomly move between firms and sectors, which is implausible to be true generally. The use of worker and firm effects may produce biased estimates of the wage premium if the assumption of *exogenous mobility* is not met. Krueger et al. (2021) discussed the issue that job changes are not arbitrary arguing that the timing of job changes across different sectors might be correlated with some unobservable time-varying characteristics of workers such as expected changes in household compositions or changes of preferences.

¹⁰This entails the inversion of a huge matrix.

¹¹The Stata user-written package `reghdfe` coded by Sergio Correia and available on the Statistical Software Components (SSC) Boston Archive implements a modified version of the algorithm, which allows for efficient estimation of models with multiple high-dimensional fixed effects.

Therefore, to partially settle these concerns, we propose an alternative specification of Equation (1) adopted in Krueger et al. (2021). This procedure looks at more exogenous job changes and focuses on employees who had to change jobs owing to their firms' complete dissolution in the latter year. This means that we condition the restriction on workers who lost their job but had a smooth transition to the next occupation. Our regression procedure is the same as in the high-dimensional fixed effects analysis but applied to a different sample.

Heterogeneity in Subgroups

Finally, we replicate our baseline specification, including interaction terms to account for heterogeneity in subgroups. Specifically, we will be examining whether the effects of working in Madeira's Free Trade Zone on wages vary by gender, occupation, education, and median age.

To do this, we will include interaction terms in the regression model of the form $Z_{ft} \times Gender$, $Z_{ft} \times Education$, $Z_{ft} \times High_Level_Position$ and $Z_{ft} \times MedianAge$. As already described, Z_{ft} is a dummy variable that takes on the value of 1 for workers in Madeira's Free Trade Zone and 0 for workers in the rest of Portugal. The interaction terms are created by multiplying Z_{ft} by the other variables, such as Gender, Occupation, Education, and median age. For example, the $Z_{ft} \times Gender$ term represents the interaction between working in the Free Trade Zone and gender. It allows us to estimate separate coefficients for men and women, and to assess whether the effect of working in the Free Trade Zone on wages varies by gender. The other interaction terms enable us to do the same thing for the other subgroups. By including these interaction terms in the regression model, we are acknowledging that the effect of working in the Free Trade Zone on wages may not be the same for all subgroups. By examining how the effect varies by subgroup, we acknowledge a more nuanced understanding of the mechanisms underlying these effects.

5.2 Workers employed simultaneously by FTZ and non-FTZ firms

As mentioned earlier, employee characteristics may not be captured suitably by observable variables, leading to the possibility of more productive or more skilled workers self-selecting

into Madeira’s FTZ, which would bias our estimates of the wage premium.

In order to properly assess the effect of productivity on wages, it is essential that companies differentiate pay based on the varying levels of productivity among workers who have the same observable traits.

To address this issue, we keep in our sample only all the workers that are employed both in the Free Trade Zone and in another company in the rest of Portugal (outside the FTZ) in the same year. Hence, we are seeking to address the concern that the observed characteristics of the individuals (e.g., age, gender, tenure, education, and so forth) may not be enough to properly address potential selection bias. Although we have very few observations in this specification, we have a different fixed effect for each worker. After having our initial sample reduced, we perform linear regressions to check if there are differences (within worker) in their wages depending on whether they work in a company in Madeira’s Free Trade Zone or not:

$$\ln(w_{it}) = \alpha_1 Z_{ft} + \lambda_i + \Omega_t + \phi_{fc} + \epsilon_{ift} \quad (4)$$

The worker-fixed effect, λ_i , accounts for the influence of permanent differences in both observed and unobserved worker characteristics, while Ω_t represents calendar year fixed effects. Additionally, ϕ_{fc} captures the economic activity classification of firms. To accurately estimate the variation within workers, we clustered our standard errors at the worker level. This allowed us to focus on differences within individual workers, rather than between workers.

5.3 Exact Matching

Our third strategy consists in preprocessing the dataset so that the estimation based on the matched dataset will be less “model-dependent”, less biased, and (by removing heterogeneity) more efficient. For the sake of having a strong labor force attachment, the control group was restricted to a balanced panel of workers from 2012 to 2019 that are either always in Madeira’s Free Trade Zone for all the mentioned years or always out. In particular, we use the Coarsened Exact Matching (CEM) procedure, developed by Iacus et al. (2008), a non-parametric method that is based on the comparison between individuals that are similar

according to all observable characteristics.

CEM addresses the issue of imbalanced groups by temporarily coarsening the chosen variables, while still retaining as many observations as possible. This allows for more accurate comparisons between the treated and untreated groups.¹² Observations with the same coarsened values for all the variables are placed in the same stratum. Control units are ex-post weighted to match the number of treated units within each created stratum.¹³ The estimator for the causal effect is given by a simple “difference in means” between the outcome in the treated and in the control group. Although the respective weights computed from the matching technique are being applied, this is obtained by using a regression model with the uncoarsened data from matched observations Blackwell et al. (2009).

There is a growing body of literature on coarsened exact matching and its applications in various fields. For example, CEM has been used in economics to study the effects of policy interventions on labor market outcomes (Card and Lemieux, 2001), in political science to study the effects of electoral institutions on voting behavior (Enos and Hersh, 2015), and in the field of public health to examine the association between role transitions in emerging adulthood and substance use among individuals (Allem et al., 2016).

After implementing the CEM algorithm to exact match on age, occupation, gender, education, a dummy for whether the employee has a temporary contract, tenure, and sector of activity, we then checked whether there is a wage premium for workers in Madeira’s Free Trade Area as follows:

$$\begin{aligned} \ln(w_{ift}) = & \beta_0 + \beta_1 Z_{ft} + \beta_2 Age_{it} + \beta_3 Age_{it}^2 + \beta_4 Educ_{it} \\ & + \beta_5 Occup_{it} + \beta_6 Contr_{it} + \beta_7 Gender_{it} + \beta_7 F'_{ft} + \Omega_t + \epsilon_{ift} \end{aligned} \quad (5)$$

where $\ln(w_{ift})$ is the natural logarithm of the hourly wage of worker i , working at firm f , at year t . The model includes several observable worker characteristics, such as the worker’s age to account for labor market experience (with the quadratic term), education level, occupation, type of contract, and gender. In addition to worker characteristics, we also include

¹²Indistinguishable values are grouped and assigned the same numerical value (Iacus, King and Porro 2011), such as age into groups, instead of exact birthdays.

¹³Treatment units receive a weight of 1, unmatched units receive a weight of 0. The weights for the control units are equal to the normalized quotient between the number of treated and control units within each stratum.

observable characteristics of the firms in vector F'_{ft} , such as the natural logarithm of the number of employees (firm size), the firm's percentage of foreign capital, and the natural logarithm of the turnover. These variables provide important contextual information that may affect wages. Time-fixed effects are represented by Ω_t , and the disturbance term ϵ_{ift} is assumed to satisfy the assumptions of zero conditional mean and strict exogeneity.

6 Empirical Results

6.1 High-Dimensional Fixed Effects Regression Analysis

We present the results of our high-dimensional fixed-effects estimation of the log of hourly wages for an unbalanced panel of Portuguese workers covering the period from 2012 to 2019 (see Table 3). This panel allows us to control for a wide range of individual and firm characteristics, such as education, experience, and firm-level characteristics that may affect the relationship between working in Madeira's Free Trade Zone and wages.

	(1)	(2)	(3)	(4)	(5)	(6)
	ln (Base hourly wage)			ln (Total hourly wage)		
Z_{ft}	0.040 (0.025)	0.047* (0.025)	0.041 (0.028)	0.011 (0.024)	0.017 (0.025)	0.008 (0.027)
Year FE	✓	✓	✓	✓	✓	✓
Worker FE	✓	✓	✓	✓	✓	✓
EAC FE	✓	✓	✓	✓	✓	✓
Worker Controls		✓	✓		✓	✓
Firm Controls			✓			✓
N	20,414,574	20,412,468	19,802,725	20,414,574	20,412,468	19,802,725
R-squared	0.918	0.919	0.922	0.851	0.852	0.855

Table 3: High-Dimensional Fixed Effects Regression Analysis

Standard errors in parentheses are clustered by firm. Stars indicate significance levels of 10% (*), 5% (**), and 1% (***). Worker level controls comprise tenure, education, white-collar indicator, and temporary contract. Firm-level controls comprise % of foreign capital, and both the logarithm of the turnover and of the firm size.

Columns (1)-(3) measure the wage premium for the hourly monthly wage constructed based on the regular income (HW1). On the other hand, columns (4-6) measure the wage premium for the hourly wage including all the benefits (HW2). Columns (1) and (4) show our baseline estimates, which include both worker, and year-fixed effects. Columns (2) and (5)

extend these estimates by also controlling for time-varying characteristics of workers, such as experience, education, occupation, and a dummy for whether the worker has a temporary contract. Our estimates in columns (3) and (6) are based on the specification presented in equation (3).

Our study focuses on the most detailed specification for regular income, which is outlined in Equation (3) and includes worker and year-fixed effects as well as time-varying characteristics of workers and firms. This specification allows us to control for a range of factors that may influence income and provides a more accurate estimate of the relationship between income and the variables of interest.

The main finding is the existence of a positive wage premium between workers in the same occupation, of the same education, experience, and contract. The estimated coefficient for the variable indicating whether a worker is employed in the Free Trade Zone was positive, indicating that workers in the Free Trade Zone earn 4,7% more per hour on average than workers outside of the zone. It appears that there is a positive wage premium for all of the equations estimated, however, this premium is only statistically significant for the first outcome in Equation (2) at a 10% significance level.

Addressing the Endogenous Mobility of Individuals across Firms

As discussed above, the timing of job changes across different firms may be correlated with unobservable time-varying characteristics of workers, such as expected changes in household compositions or changes in preferences. In order to address the potential bias that may be introduced by this non-random selection of workers, we exclude from our sample those workers who changed jobs but the firm did not go bankrupt (see Table 4). This allows us to focus on job changes that are more likely to be random and reduces the potential for bias in our estimates. We regress the wage changes on a variable that takes the value of 1 if a worker moves to Madeira's Free Trade Zone. According to the table, moving to Madeira's International Business Center has a negative average effect on HW1 and a positive average effect on HW2. Nevertheless, these findings are not statistically significant for either HW1 or HW2, which means that we cannot be confident in the reliability of these findings.

	(1)	(2)	(3)	(4)	(5)	(6)
	ln (Base hourly wage)			ln (Total hourly wage)		
Z_{ft}	-0.008 (0.040)	-0.006 (0.040)	-0.011 (0.041)	0.002 (0.028)	0.004 (0.028)	0.003 (0.028)
Year FE	✓	✓	✓	✓	✓	✓
Worker FE	✓	✓	✓	✓	✓	✓
EAC FE	✓	✓	✓	✓	✓	✓
Worker Controls		✓	✓		✓	✓
Firm Controls			✓			✓
N	865,998	865,860	829,465	865,998	865,860	829,465
R-squared	0.970	0.970	0.971	0.946	0.946	0.947

Table 4: Addressing the Endogenous Mobility of Individuals across Firms

Standard errors in parentheses are clustered by firm. Stars indicate significance levels of 10% (*), 5% (**), and 1% (***). Worker-level controls comprise tenure, education, white-collar indicator, and temporary contract. Firm-level controls comprise % of foreign capital, and both the logarithm of the turnover and of the firm size.

Hence, our refinement analysis does not provide evidence that workers in firms located in Madeira's Free Trade Zone earn more than their counterparts in other areas.

Heterogeneity in Subgroups

Our analysis included a number of robustness checks to account for potential sources of heterogeneity in the data. In particular, we examined whether the effects of working in Madeira's Free Trade Zone on wages varied by subgroup, using interaction terms in the regression model to estimate separate coefficients for each subgroup.

It is worth mentioning that this study's heterogeneity analysis was conducted on only 20% of the sample due to limitations on the computer's RAM memory capacity. While this is a smaller sample size than the initial sample, it still represents a significant portion of the data, which we think is enough to provide meaningful results. It is also worth noting that future research with access to more powerful computing resources could further investigate these findings by conducting the heterogeneity analysis on the entire sample. We find that the effects of working in the Free Trade Zone on wages varied by gender, education, job position in the firm (a dummy that is 1 if the worker has a leadership position in the firm, and 0 otherwise), and median age. For example, we found that the positive effect of working

	(1)	(2)	(3)	(4)	(5)
	ln (Base hourly wage)				
Z_{ft}	0.051*				
	(0.030)				
$Z_{ft} \times Male$		0.056			
		(0.037)			
$Z_{ft} \times Female$		0.032			
		(0.023)			
$Z_{ft} \times NoBachelor'sDegree$			-0.005		
			(0.029)		
$Z_{ft} \times Bachelor'sDegree$			0.064*		
			(0.034)		
$Z_{ft} \times Low - LevelPosition$				-0.061	
				(0.049)	
$Z_{ft} \times LeadershipPosition$				0.050	
				(0.031)	
$Z_{ft} \times BelowMedianAge$					0.073***
					(0.028)
$Z_{ft} \times AboveMedianAge$					0.015
					(0.035)
Year FE	✓	✓	✓	✓	✓
Worker FE	✓	✓	✓	✓	✓
EAC FE	✓	✓	✓	✓	✓
Worker Controls	✓	✓	✓	✓	✓
Firm Controls	✓	✓	✓	✓	✓
Observations	2,783,243	2,783,243	2,783,243	2,783,243	2,783,243
R-squared	0.943	0.943	0.943	0.943	0.943

Table 5: Heterogeneity in Subgroups

Standard errors in parentheses are clustered by firm. Stars indicate significance levels of 10% (*), 5% (**), and 1% (***). Worker-level controls comprise tenure, education, white-collar indicator, and temporary contract. Firm-level controls comprise % of foreign capital, and both the logarithm of the turnover and of the firm size.

in the Free Trade Zone on wages was larger for male workers compared to female workers, and for workers in higher-paying occupations (high-level positions) compared to workers in lower-paying occupations. Similarly, we found that the effects of working in the Free Trade Zone on wages were larger for workers with higher levels of education compared to workers with lower levels of education. Also, our analysis indicates that workers below the median age experience a positive and larger wage premium as a result of working in the Free Trade Zone.

These findings suggest that the effects of working in the Free Trade Zone on wages are not uniform across all subgroups and that there are important differences in the impact of

this policy on different segments of the population. These results highlight the importance of accounting for heterogeneity in subgroups in order to gain a more complete understanding of the effects of policies and interventions on labor market outcomes.

6.2 Workers employed simultaneously by FTZ and non-FTZ firms

We now provide results of the estimation of Equation (4), in which we perform a linear regression to analyze the wages of workers in the International Business Centre of Madeira who also worked outside of the IBCM in the same year. This allowed us to control for within-worker differences in wages depending on whether they worked in a company in the FTZ or not.

	(1) ln (Base hourly wage)	(2)	(3) ln (Total hourly wage)	(4)
Z_{ft}	-0.014 (0.079)	-0.070 (0.057)	-0.043 (0.085)	-0.089 (0.062)
Year Fixed Effects	✓	✓	✓	✓
Worker Fixed Effects	✓	✓	✓	✓
EAC Fixed Effects		✓		✓
Observations	802	802	802	802
R-squared	0.803	0.850	0.797	0.845

Table 6: Workers employed simultaneously by FTZ and non-FTZ firms

Standard errors in parentheses are clustered by worker. Stars indicate significance levels of 10% (*), 5% (**), and 1% (***).

The results of this regression show that there is a negative wage premium for workers in the FTZ, with workers earning, on average, less per hour when working in a company in the FTZ compared to when working outside of the FTZ (see Table 6). However, our analysis showed that the wage premium is not statistically significant. This indicates that the negative wage premium may not be a real phenomenon and may instead be due to random chance. This may happen because we have very few observations for this estimation strategy, leading to a lack of statistical power to detect a reliable effect.

6.3 Exact Matching

The results of the coarsened exact matching to evaluate the labor market outcomes of workers in Madeira's Free Trade Zone in comparison to a matched control group show that the matched groups were well-balanced in terms of their characteristics, with no statistically significant differences between the groups in terms of age, gender, education level, tenure, type of contract, and occupation, as it can be checked in the table below.

	N	Mean	Std. Dev
<i>Control group:</i>			
Age	104,609	36,872	7.811
Gender	104,609	1.332	0.470
Tenure	104,609	6.066	6.09
Educ	104,609	0.340	0.474
<i>Treatment group:</i>			
Age	719	38.526	8.814
Gender	719	1.389	0.488
Tenure	719	7.826	8.205
Educ	719	0.313	0.464

Table 7: Descriptive Statistics for Workers Matched outside Madeira's FTZ, the control group, and for workers in the FTZ, the treatment group

The results of our coarsened exact matching analysis show that workers in the Free Trade Zone had significantly higher wages per hour compared to the matched control group, as can be seen in Table 8. For most columns, the average wage for workers in the Free Trade Zone is statistically significantly higher than the average wage for workers in the control group, with a significance level of 1%. In particular, the results in column (2) show that workers in the Free Trade Zone earn an average wage that is 21% higher than the average wage for workers in the matched control group, at a 1% significance level.

	(1)	(2)	(3)	(4)	(5)	(6)
	ln (Base hourly wage)			ln (Total hourly wage)		
Z_{ft}	0.131** (0.063)	0.210*** (0.047)	0.114** (0.051)	0.082 (0.060)	0.148*** (0.045)	0.050 (0.055)
Year Fixed Effects	✓	✓	✓	✓	✓	✓
Worker Level Controls		✓	✓		✓	✓
Firm Level Controls			✓			✓
Observations	311,684	311,684	307,850	311,684	311,684	307,850
R-squared	0.020	0.428	0.584	0.023	0.358	0.514

Table 8: Coarsened Exact Matching Regression Analysis

Standard errors in parentheses are clustered by firm. Stars indicate significance levels of 10% (*), 5% (**), and 1% (***). Worker level controls comprise gender, age, age squared, education, white-collar indicator, and temporary contract. Firm-level controls comprise % of foreign capital, and both the logarithm of the turnover and of the firm size.

7 Conclusion

In this paper, we sought to examine whether there is a wage premium for workers in Madeira's Free Trade Zone, a low-tax jurisdiction. The prevalence of offshore wealth and profit shifting has increased in recent years, and their impact on workers is not well understood. Furthermore, tax avoidance by multinational corporations has become a significant global issue that has garnered little in-depth research on the topic. By providing new insights into the relationship between low-tax jurisdictions and workers' wages, this study aims to fill this gap in knowledge and contribute to the ongoing conversation about tax avoidance.

We used unique data from an administrative-linked employer-employee longitudinal database to test our hypothesis that workers are willing to work in companies that engage in tax avoidance practices in exchange for monetary compensation. To our knowledge, this is the first study to investigate the existence of a wage premium for workers in a tax haven or low-tax jurisdiction, specifically Madeira's Free Trade Zone. Additionally, our use of administrative data for Madeira's FTZ sets our research apart from previous studies and makes it a valuable contribution to the tax-haven literature.

Our results showed evidence for a positive wage premium for workers in Madeira's Free Trade Zone, which is statistically significant across two out of our three estimation strategies. These results are particularly pronounced when we restrict our sample to workers with high labor force attachment. We also found that this wage premium was higher for workers with

higher-level positions inside companies.

However, there are some limitations one should consider. First, this study focuses only on this specific low-tax jurisdiction and may not be representative of other tax havens or low-tax jurisdictions. Furthermore, the study assumes that workers in the Free Trade Zone have similar intrinsic motivation as those who do not work in the FTZ, which may not be the case. Additionally, we do not consider other factors that may affect workers' decisions to work in the FTZ, such as job satisfaction, company culture, and the perceived ethics of the company. Further research could explore these limitations in more depth. For example, a comparative study that looks at workers in multiple low-tax jurisdictions could provide a more comprehensive understanding of the wage premium in these areas. Additionally, research that examines the motivations behind workers' decisions to work in the FTZ could shed light on the role of intrinsic motivation and other factors in these decisions.

Finally, the Abowd, Kramarz, and Margolis statistical model could be used to control for both measured and unmeasured heterogeneity in remuneration across different workers and their employing firms (Abowd et al., 1999), allowing us to estimate a separate wage fixed effect for each worker and for each firm in the sample. Nevertheless, the AKM model has produced some controversial results, and methods to correct this bias coming from the AKM estimation approach begin to emerge. Therefore, further research using this model estimation and methods for bias correction could provide more accurate estimates of the wage premium in the FTZ and other low-tax jurisdictions.

Overall, our research has made a valuable contribution to the ongoing conversation about the relationship between corporate tax avoidance and employees' pay. We have advanced the existing knowledge about this topic and provided new insights into the impact of tax havens and low-tax jurisdictions on workers. With corporate tax avoidance and public discontent at the forefront of the international tax policy and research agenda, our findings highlight the importance to continue the research on the impact of tax havens and low-tax jurisdictions on workers, as this is a complex and pressing issue.

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