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Regional Labour Market Concentration and Wages: Evidence from Portugal

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REGIONAL LABOUR MARKET CONCENTRATION AND WAGES:
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*Two roads diverged in a yellow wood,
And sorry I could not travel both
And be one traveler, long I stood
And looked down one as far as I could
To where it bent in the undergrowth;*

*Then took the other, as just as fair,
And having perhaps the better claim,
Because it was grassy and wanted wear;
Though as for that the passing there
Had worn them really about the same,*

*And both that morning equally lay
In leaves no step had trodden black.
Oh, I kept the first for another day!
Yet knowing how way leads on to way,
I doubted if I should ever come back.*

*I shall be telling this with a sigh
Somewhere ages and ages hence:
Two roads diverged in a wood, and I—
I took the one less traveled by,
And that has made all the difference.*

Robert Frost

Abstract

Wage-setting power has come to the attention of policymakers and economists in recent years. One of the possible channels in which firms can exercise this power is through labour market concentration. The degree to which a few firms dominate the labour market is a crucial issue to study, mainly when workers' outcomes, such as wages, can be influenced. Therefore, this dissertation aims to provide evidence on the relationship between regional labour market concentration and wages in Portugal. Using the Herfindahl-Hirschman index (HHI), I document national and regional industrial concentration trends from 2010 through 2021. Both national and regional industrial concentration reach peak levels during the European sovereign debt crisis and generally decline afterward. Additionally, there is evidence of industry or regional variation in both trends. I employ a fixed effects estimation strategy to estimate the effects of regional labour market concentration on wages. Increased regional industrial concentration is associated with an increase in mean real wage, even though of reduced magnitude. When studying market inequality, I find that increased regional industrial concentration is associated with a decrease in the 90/10 and 90/50 inequality ratios and an increase in the 50/10 inequality ratio. Further analysis of key earnings percentiles suggests that smaller positive changes in the top of the earnings distribution primarily drive the decrease in overall inequality. These findings provide evidence of the importance of considering demographic, institutional, and socioeconomic characteristics when studying the relationship between labour market concentration and wages, suggesting that the consensus on the negative relationship between both may not hold in all labour markets.

JEL codes: J31, J42

Keywords: Labour market concentration, Herfindahl-Hirschman index, Regional industrial concentration, Wages

Resumo

Nos últimos anos, o poder de fixação dos salários tem merecido a atenção dos decisores políticos e dos economistas. Um dos canais possíveis através dos quais as empresas podem exercer este poder é a concentração do mercado de trabalho. O grau em que algumas empresas dominam o mercado de trabalho é uma questão crucial a estudar, principalmente quando os salários dos trabalhadores podem ser influenciados. Assim, esta dissertação tem como objetivo fornecer evidência sobre a relação entre a concentração regional do mercado de trabalho e os salários em Portugal. Utilizando o índice de Herfindahl-Hirschman (HHI), documentei tendências de concentração industrial nacional e regional de 2010 a 2021. Tanto a concentração nacional como a regional atingem níveis máximos durante a crise da dívida soberana europeia e, em geral, diminuem posteriormente. Além disso, há evidências de variação industrial ou regional em ambas as tendências. Utilizo uma estratégia de estimação de efeitos fixos para estimar os efeitos da concentração regional do mercado de trabalho sobre os salários. O aumento da concentração regional está associado a um aumento do salário médio, ainda que de magnitude reduzida. Ao estudar a desigualdade no mercado, concluo que o aumento da concentração industrial regional está associado a uma diminuição dos rácios de desigualdade 90/10 e 90/50 e a um aumento do rácio de desigualdade 50/10. Uma análise mais aprofundada dos principais percentis dos rendimentos sugere que as alterações positivas mais pequenas no topo da distribuição dos rendimentos são a principal causa da diminuição da desigualdade global. Estas conclusões demonstram a importância de ter em conta as características demográficas, institucionais e socioeconómicas quando se estuda a relação entre a concentração do mercado de trabalho e os salários, sugerindo que o consenso sobre a relação negativa entre ambos pode não ser válido em todos os mercados de trabalho.

Códigos JEL: J31, J42

Palavras-chave: Concentração do Mercado de Trabalho, Índice de Herfindahl-Hirschman, Concentração Industrial Regional, Salários

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List of Abbreviations

CAE: Classification of Economic Activities

CPI: Consumer Price Index

DOJ: Department of Justice

FUA: Functional Urban Area

HHI: Herfindahl-Hirschman index

LMA: Lisbon Metropolitan Area

NUTS: Nomenclature of Territorial Units for Statistics

OLS: Ordinary Least Squares

QP: “Quadros de Pessoal”

USA: United States of America

I. Introduction

Labour markets are places where supply and demand forces interact to determine employment rates and wage levels. Although these forces theoretically tend to an equilibrium, an alternative view of imperfect labour markets dates back to the 20th century. Robinson (1933) developed an imperfect competition scenario where firms can have wage-setting power by being a single labour buyer in a given labour market and conceiving the term “monopsony.”

In recent years, policymakers have been interested in the subject. The Council of Economic Advisers, which advises the President of the United States of America (USA) on economic matters, issued a full brief on labour market monopsony (Council of Economic Advisers, 2016). Alongside this interest, researchers have been finding growing empirical evidence of declining labour share of income (Autor et al., 2020) while markups and profits increase (de Loecker et al., 2020). All this evidence supports Robinson’s framework.

Labour market concentration is a potential channel of monopsonistic power. This concept refers to the degree to which a small number of firms dominate the hiring market in a particular labour market. To the best of my knowledge, Martins and Melo (2023) provide the first study of labour market concentration and its relationship with wages in Portugal, specifically applied to local labour markets. My dissertation aims to complement their research.

In this work, I document trends in national and regional labour market concentration between 2010 and 2021 using the “Quadros de Pessoal” (i.e., Personal Records, in English) – QP data set. I define regional labour markets as a pair between 4-digit Classification of Economic Activities (CAE) industry codes and Nomenclature of Territorial Units for Statistics (NUTS) 2 spatial aggregation level, since more disaggregated geographical units are unavailable. I use the Herfindahl-Hirschman index (HHI) constructed with employment shares to measure employer concentration. Furthermore, I approach the question of whether labour market concentration affects wages using the Portuguese regional spatial level instead of the local one, allowing me to provide a more macro view of wages and labour market concentration than what has been studied.

The difference in national and regional industrial employment concentration trends has been minimal. Both trends reached their peak concentration level in 2012 and declined since then.

The main divergence between the trends was in the last years of analysis. While the national industrial concentration trend experienced a sharp decline, the regional industrial concentration trend decreased by little. Robustness tests are performed to further understand which forces primarily drive the national and regional trends. Industry or regional variation is also documented in both trends.

Furthermore, I employ a fixed effects estimation strategy to disentangle the relationship between regional labour market concentration and wages. Surprisingly, an increase in regional labour market concentration is associated with an increase in wages. More specifically, a 1 percent increase in regional labour market concentration is associated with a 0.105 percent increase in mean real hourly earnings, *ceteris paribus*. This result suggests that a macro perspective of labour market concentration has less effect, in terms of magnitude, than a more local approach. Analyses on earnings inequality suggest that increased regional industrial concentration is associated with a decrease in the 90/10 and 90/50 inequality ratios and an increase in the 50/10 ratio. Further investigation on key earnings percentiles indicates that the top of the earnings distribution does not keep up with the wage growth of the bottom, decreasing overall inequality.

The positive association between regional labour market concentration and wages contradicts the results of most previous studies. Many reasons may have influenced it. First, I solely employ a fixed effects estimation strategy because none of the usual instrumental variables used in the literature were significant at a 5 percent confidence level. Therefore, I can not be sure that my regressor is exogenous. Second, using a more aggregate spatial level may increase the difficulty in establishing a unique transmission channel between the dependent and independent variable. Nevertheless, one has to consider that the positive association may be adequate because of the Portuguese context. A logical reason for this is that the Portuguese economy is mainly composed of small and medium businesses that do not have significant market power to set workers' wages due to high levels of union coverage, therefore pressuring wage floors up.

My dissertation's findings contribute to the narrow literature on the Portuguese labour market concentration by documenting national and regional employer concentration trends from 2010 to 2021. In addition, this dissertation contributes to the broader literature on labour market concentration by using regional labour markets instead of local ones to estimate the effects of employer concentration on wages. The results of the latter

contribution may suggest a new view on the relationship between labour markets and wages. A relationship in which the results can broadly vary depending on the specific context of each labour market. Lastly, this work also contributes with new contradictory evidence to the monopsony literature, a literature that has been prone to selective reporting (Sokalova and Sorensen, 2021).

The rest of my dissertation proceeds as follows. Section II discusses labour market concentration, focusing on how the literature has usually defined labour markets, an employer concentration measure and previous results of the relationship between wages and labour market concentration. Section III discusses the data, sample, and my employer concentration measure. Section IV presents trends in national and regional employer concentration. Section V describes my estimation strategy and report results. Section VI discusses the results and concludes.

II. Labour Market Concentration

The study of labour markets encompasses different aspects of their dynamics. Recently, special attention has been given to the possible existence of employers' monopsonistic power. If so, it would mean that firms indeed have some wage-setting power. In his latest review article about monopsony, Manning (2021) argues about two methods to model the monopsony power of firms, one of them designated as "New Classical Monopsony". According to Manning (2021), "Implicit in these models is the idea that only a small number of firms are offering a particular package of wages and amenities." (p.7). Krueger and Ashenfelter (2022) show evidence in the franchise sector that firms offering similar wages and amenities also collude to suppress competition for workers. This behaviour suggests the existence of market power and indicates that the "New Classical Monopsony" models may be adequate to study wage-setting power. Card (2022) argues that the evidence accumulated in the past 3 decades suggests wage-setting power should not be negligible. Labour market concentration is one channel of the "New Classical Monopsony" model.

To calculate concentration levels in a labour market, there is first a need to define what is a labour market and which market concentration measure to use. Although deciding which level of geographic aggregation and market concentration measure are appropriate is beyond the scope of this dissertation, this section aims to delve into how previous research has been determining both topics, their implications, and what has been documented as the relationship between labour market concentration and wages.

A. Labour Market Definition

The definition of a labour market is central to determining the level of labour market concentration. Usually, this definition is based on a pair of geographical and sector units. Since there is not only one definition of a labour market, the level of aggregation in both units varies from one definition to another. Indeed, the decision on the aggregation levels impacts the concentration level in a market. For instance, Azar et al. (2020) indirectly and Rinz (2022) directly state that more disaggregated pairs tend to have higher concentration levels than aggregated pairs. Research on the USA labour markets (Arnold, 2021; Azar et al., 2020; Azar et al., 2022; Benmelech et al., 2022; Prager & Schmitt, 2021; Qiu & Sojourner, 2023; Rinz, 2022) has used commuting zones and counties as the spatial aggregation level. Differently, research on the European countries labour markets (Abel et al., 2020; Bassanini

et al., 2023; Colombo & Mercato, 2021; Doldini et al., 2021; Doldini et al., 2022; Doldini et al., 2023; Martins & Melo, 2023) have used different geographical units, ranging from commuting zones to NUTS 2 and 3. The divergence in the studies extends to the number of spatial units in each study. While the number of USA commuting zones has been around 700 in the past decades, the number of NUTS 3 (more disaggregated than NUTS 2) regions in Portugal and Italy is 30 and 107, respectively. This difference may help explain the disparity in labour market concentration between the USA and Europe.

Another source of variation in the definition of a labour market is the choice of the sector unit. Most of the literature has been utilizing an occupation unit (Azar et al., 2020; Azar et al., 2022; Bassanini et al., 2023; Martins & Melo, 2023; Qiu & Sojourner, 2023) which ranges from 3 to 6 digits, and an industry unit (Abel et al., 2020; Arnold, 2021; Benmelech et al., 2022; Colombo & Mercato, 2021; Rinz, 2022) which ranges from 2 to 4 digits. Some argue that these sector units have limitations. Doldini et al. (2023) reason that some occupations in one industry may also be performed in other industries, and some occupations have skills that can be translated into other occupations. Therefore, to the best of my knowledge, Doldini et al. (2023) is the first study to use a “task cluster” sector unit based on information on job task content from O*NET.

To further understand the implication of different definitions of labour markets, Martins and Melo (2023) perform a sensitivity exercise. They explore 7 alternative ways to define labour markets. In conclusion, different measurement approaches result in different levels of employer concentration.

B. Employer Concentration Measure

The employer concentration measure is how researchers calculate the level of labour market concentration in a given market. As for the labour market definition, many methods can measure employer concentration. The Herfindahl-Hirschman index has been the primary approach used by researchers in recent years. This method derives from the Industrial Organization literature, commonly used to calculate levels of product market concentration.

The HHI is based on the sum of squared shares of a given labour market. These shares can take the form of different possibilities that affect the level of concentration calculated. For instance, concentration levels based on HHI constructed with employment shares and new hire shares could lead to different levels of labour market concentration simply because

although firms have employees, not all firms have had new hires in the past 6/12 months. Since fewer firms actively participate in the labour market, using new hire shares would lead to higher concentration levels (supporting Manning's "New Classical Monopsony" way to study labour markets). Martins and Melo (2023) indeed find that, for the same definition of labour market, HHI constructed with new hire shares has constantly had higher levels of concentration than HHI constructed with employment shares in Portugal over the last 3 decades.

Some researchers have also adopted alternative ways of constructing the HHI. Arnold (2021) incorporates worker flows in different industries as the weight of employment shares. To the best of my knowledge, this flow-adjusted concentration is the first concentration measure that brings together the industry and occupation unit of the labour market definition puzzle. Azar et al. (2020) and Azar et al. (2022), using data from online job platforms, calculate USA labour market concentration levels with job openings shares rather than employment shares. They argue that vacancies are a better instrument of the likelihood of a job seeker receiving a job offer. This alternative also has limitations since not every firm may be hiring at any given time, much less post its openings on online job platforms. For instance, Azar et al. (2022) uses data from the CareerBuilder.com website, which, according to them, contains only 35 percent of the total number of vacancies in the USA in January 2011. Table 1 summarizes previous studies' labour market definition and concentration measure.

Table 1*Summary of Previous Studies' Labour Market Definition and Concentration Measure*

Authors	Country	Labour Market Definition	Concentration Measure
Abel et al. (2020)	United Kingdom	NUTS 2-Industry	HHI using employment shares
Arnold (2021)	United States of America	Commuting Zones-Industry	Flow-adjusted HHI using employment shares
Azar et al. (2020)	United States of America	Commuting Zones-Occupation	HHI using vacancy shares
Azar et al. (2022)	United States of America	Commuting Zones-Occupation	HHI using vacancy shares
Bassanini et al. (2023)	Denmark, France, Germany, Italy, Portugal, and Spain	FUAs/NUTS 3-Occupation	HHI using new hire shares
Benmelech et al. (2022)	United States of America	Commuting Zones-Industry	HHI using employment shares
Colombo and Mercato (2021)	Italy	NUTS 3-Industry	HHI using employment shares
Doldini et al. (2021)	Norway	Commuting Zones-Job Task	HHI using employment shares
Doldini et al. (2023)	Norway	Commuting Zones-Job Task	HHI using employment shares
Martins and Melo (2023)	Portugal	NUTS 3-Occupation	HHI using employment shares and new hire shares
Prager and Schmitt (2021)	United States of America	Commuting Zone-Year	HHI using employment shares
Qiu and Sojourner (2023)	United States of America	Commuting Zones-Occupation	HHI using employment shares
Rinz (2022)	United States of America	Commuting Zones-Industry	HHI using employment shares

Source: Own elaboration.

Notes: This table shows the labour market definition and concentration measure of previous studies.

C. Labour Market Concentration and Wages

In the labour market concentration literature, there is almost an empirical consensus that as employer concentration increases, wages decrease. According to Manning (2021), Azar et al. (2022) study revived the use of HHI as a measure of labour market concentration. In their research, Azar, Marinescu, and Steinbaum use CareerBuilder.com data, which regards the USA labour market from 2010 to 2013, to explore how widespread labour market power truly is and how much it affects wages. They define local labour market as a pair of commuting zones and 6-digit occupation codes. Using HHI with vacancy shares, they find that an interquartile increase in concentration levels is associated with a 5 percent to 17 percent decline in posted wages. Other studies have found estimates with similar magnitude. Furthermore, they also suggest that mergers in highly concentrated labour markets can potentially increase labour market power. Arnold (2021) fills this gap in the literature.

In his research, Arnold (2021) studies how mergers and acquisitions and local labour market concentration affects workers. Also, using USA data from 1999 to 2009, he disentangles impacts from within-firm and market-level effects, tradable and non-tradable industries, and changes in different levels of labour market concentration. Using an event study design, he finds that mergers that positively predicted impacts on employer concentration decrease workers' earnings, with greater impact in already concentrated local labour markets. Tradable industries also experience this pattern. Lastly, he observes a decrease in market-level earnings in the top-ventile merger-induced concentration changes. As Card (2022) shares his opinion that event study designs provide the best available evidence, other researchers have also implemented this empirical strategy. For instance, Prager and Schmitt (2021) use mergers in the hospital industry as events to analyse wage trajectories after hospital mergers. They find evidence of reduced wage growth when the merger induces a large increase in concentration.

Studies on Nordic European countries have also used event study designs. Doldini et al. (2023) explore mass layoffs and establishment closures in Norway as shocks to local labour demand. Although the exogeneity argument of these events is debatable because of possible firms' internal strategic decisions (e.g., restructuring, market demand, profitability), workers who experience mass layoffs or establishment closures suffer annual earnings declines of nearly 2 percent relative to the mean after the event.

Even though, to the best of my knowledge, no event study designs are available for Southern, and Western Europe, Bassanini et al. (2023) provide the first comparable cross-country

evidence in the labour market concentration literature. Aiming to analyse how comparable are the effects of labour market concentration across countries, they gather data from Denmark, France, Germany, Italy, Portugal, and Spain, and construct comparable measures of employer concentration using HHI based on new hire shares, defining local labour markets as a pair of FUAs/NUTS 3 and 4-digit occupation codes. Since they deal with different labour market institutional settings, controlling for potential covariates such as productivity and product market concentration is crucial. In this regard, their estimation strategy includes firm-by-municipality-by-year fixed effects. In conclusion, they find similar elasticities of wages with respect to labour market concentration for those different countries, ranging from -0.019 to -0.029. Although controlling for productivity and product market concentration is essential, only some studies can access a rich data set to implement this research design. Some researchers need to be more creative regarding their approach.

Benmelech, Bergman, and Kim are some of these creative researchers. To address the productivity issue, which is central in the analysis of wage determination, they focus their study on the USA manufacturing industry (Benmelech et al., 2022). The Annual Survey of Manufacturers and the Census of Manufacturers allow them to construct productivity covariates, such as labour productivity at the establishment level. In general, their results provide evidence of a negative relationship between wages and labour market concentration. Furthermore, they also try to disentangle how unionization affects their baseline results. Even though the USA labour market is characterized by low collective bargaining coverage rates, by interacting a union coverage rate covariate with the local labour market concentration, they find that unionization weakens the negative relationship between labour market concentration and wages. Would this evidence still hold in a different institutional setting? For instance, in continental Europe, unions set wage floors rather than determine wages (see Addison et al., 2023 for more details).

Doldini et al. (2021) investigate this issue. Using a sample of full-time workers in Norway between the ages of 16 and 64 from 2001 and 2015, they utilise tax reforms to union due deductions as exogenous shocks to unionization. The authors find that union density, interacted with HHI based on employment shares as a proxy for labour market concentration, is associated with wage increases. In addition, they explore heterogeneity, and in competitive markets, the evidence indicates a possible inequality-enhancing effect of unionization on wages, selecting winners and losers.

Indeed, one may expect that labour market concentration affects the wages of different workers differently. Qiu and Sojourner (2023) also investigate the impact of labour market concentration on wages disentangling workers' characteristics. Their findings suggest that increased labour market concentration is worse for older workers. Rinz (2022) goes one step further and investigates possible heterogeneous effects of employer concentration on the earnings distribution. His evidence shows that most of the changes in the 90/10 inequality ratio come from shifts in the bottom of the distribution, suggesting that low-income workers are the ones most affected by increases in labour market concentration. By using an empirical strategy that allows for earnings and demographic heterogeneity, Rinz (2022) surprisingly finds that higher employer concentration is associated with decreases in the gender earnings gap.

In summary, most studies exploring the relationship between wages and labour market concentration suggest the existence of wage-setting power on the firm's side. Although this result can be theoretically logical, one may not be sure as previous empirical research on wages has already found evidence against its theoretical framework (see Card & Krueger, 1993). Regarding the monopsony literature, Sokalova and Sorensen (2021) findings, in their meta-analysis, suggest the occurrence of selective reporting of estimates. In the labour market concentration literature, the way one defines labour markets could be the channel for selective reporting since there is no "correct" definition of labour market.

III. Data, Sample, and Measurement

A. Data

The data I use in this dissertation is from the QP data set. This longitudinal matched employer-employee data set for Portugal is collected from a compulsory survey that covers virtually all firms, establishments, and wage earners in Portugal. The public administrative institution responsible for the survey is the Portuguese Ministry of Labour and Social Solidarity. The survey is filled out annually, and the reference month is October. Data of the QP covers firms', establishments', and workers' characteristics, such as industry, sales, location, number of workers, number of establishments, base wage (i.e., gross monthly wage for normal work hours), as well as regular benefits (e.g., corporate food subsidy, accommodation, or transport) and irregular benefits (e.g., profit sharing). In addition, standard and extra working hours for each employee in the reference month are documented. One limitation of the data, specifically regarding my dissertation, is that the most disaggregated level of firm location available is NUTS 2 (e.g., North, Center, Alentejo), which will also be called "regional level". This limitation forces the study of labour market concentration from the local to the regional level, which inherently influences concentration levels, as previously stated. Furthermore, the QP data set does not contain data on public service workers.

B. Sample Construction

My sample is built on two previous works. The first one is from Carneiro et al. (2012), which also use the QP data set. Like them, I include the full-time workers who earned at least 80 percent of the minimum wage. In addition, the sample focuses on workers from all 4-digit industries mapped by the Portuguese CAE, aged between 18 and 66, who worked at least 140 hours in the reference month. The sample period goes from 2010 to 2021, covering different economic cycles (both in the world and Portuguese economy) over these 12 years. In addition, foreign-located firms and firms without CAE classification were excluded from the analysis. These changes led me to 27,180,233 full-time worker observations over the sample period and 514,579 unique firms between 2010 and 2021.

The second work is from Rinz (2022). Using data sets covering the USA, he aggregates the data at the local labour market level to perform his analysis. To be explicit regarding my

analysis, I aggregate the sample at the regional labour market level, which is an interaction between NUTS 2 regions, containing 7 Portuguese regions, and the 4-digit industry CAE classification. I documented 2,990 different regional labour markets between 2010 and 2021¹.

C. Measurement

In regards to the employer concentration measure, following the literature, I employ the HHI as my measure of employer concentration:

$$HHI_{l(i,r),t} = \sum_{j=1}^{N(l,t)} Share_{j,t}^2, \quad (III.1)$$

in which $HHI_{l(i,r),t}$ is the HHI measure for the regional labour market l in year t . The number of firms employing workers in that industry, region, and year is characterized by $N(l,t)$, and $Share_{j,t}$ is 100 times the employment of firm j in year t divided by the employment in the respective regional labour market l in which the firm is inserted. HHI values range from 0 – no employer concentration – to 10,000 – maximum employer concentration.

¹ Two descriptive statistic tables are on Appendix A. One for the whole period of analysis and another for each year.

IV. Trends in the Portuguese Industrial Concentration

Considering I want to capture the concentration experienced by the average worker instead of the average market, I performed the following analyses with employment-weighted HHIs. Not accounting for the regional labour market stock of employment tends to bias the analyses towards higher concentration values. Since the Portuguese economy mainly comprises small and family businesses that employ few workers, the upward bias could be substantial due to these characteristics.

Figure 1 supports this explanation. It presents the HHI distribution varying the methodology to construct the index. Figure 1A presents unweighted HHIs, and Figure 1B presents HHIs constructed using total market employment as weights. The former has peak HHI values near the 10,000 mark, the highest possible concentration level. For illustrative purposes, many markets would have had HHI values above the 2,500 USA Department of Justice (DOJ) threshold during the 12 years of analyses based on Figure 1A. These regional labour markets would be considered highly concentrated.

Nevertheless, weighting HHIs using total market employment shows a different picture. Based on Figure 1B, most previously concentrated markets are less concentrated now. There is no peak at the 10,000 value mark. Instead, the peak is now near the 0 concentration level. This change suggests that, indeed, the majority of the concentrated markets are structured with businesses that employ a low number of workers. Descriptive statistics containing unweighted and weighted HHI can be found in the Appendix A.

Previous research has also documented this discrepancy in employer concentration levels between unweighted and weighted measures. Martins and Melo (2023) document that the unweighted HHI mean can be as high as nearly 6 times the weighted mean. In addition, Azar et al. (2020) find that an unweighted measure of HHI is associated with a 60 percent fraction of highly concentrated markets, while a weighted measure is associated with only a 16 percent fraction of highly concentrated markets.

Turning to the industrial concentration trends, I first compare the national and the regional ones. Figure 2A presents the average HHI across national 4-digit CAE industries for 2010–2021. From 2010 to 2012, there is an increase in average concentration by nearly 15 percent. Coincidentally, these years are marked by the European sovereign debt crisis, in which Portugal

was heavily affected (de Sousa et al., 2014). Average concentration only started to decline in later years.

Panel A

Panel B

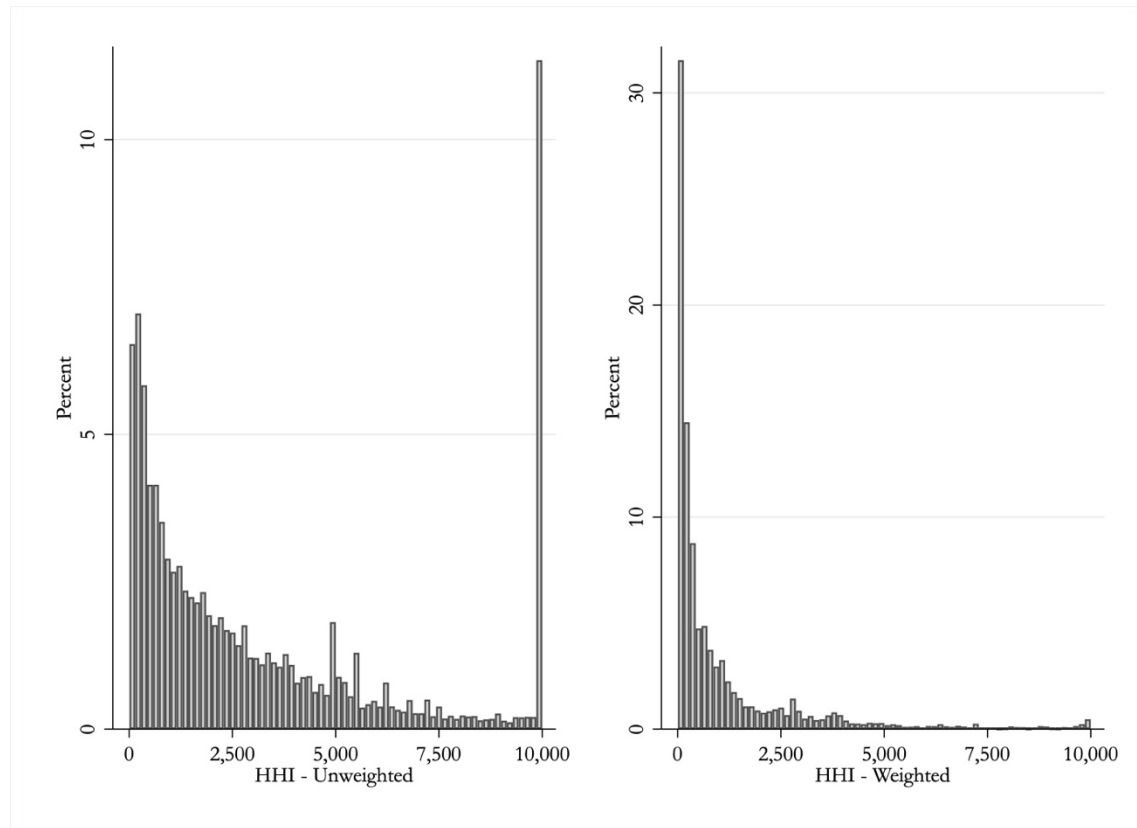


Figure 1

Distribution of Unweighted and Weighted HHI values

Source: “Quadros de Pessoal” data set. Own elaboration.

Notes: Figure plots histograms of HHI values at the regional labour market level considering all years of analysis. Panel A contains unweighted HHI values and Panel B contains weighted HHI values. Total market employment is used as weights.

Figure 2B presents the average regional industrial concentration trend, using HHI, across the pair region-industry, again measured by NUTS 2 and 4-digit CAE industry code. Regional labour market average concentration experiences a similar trend compared to the national one. The main difference is in the last years of the analysis. Here, the average concentration seems to stabilize or have a little decrease. Another point to notice is the magnitude of the industrial concentration levels. The average regional concentration level is more than double

the average national concentration level. Unweighted national and regional trends are on Appendix B.

Panel A

Panel B

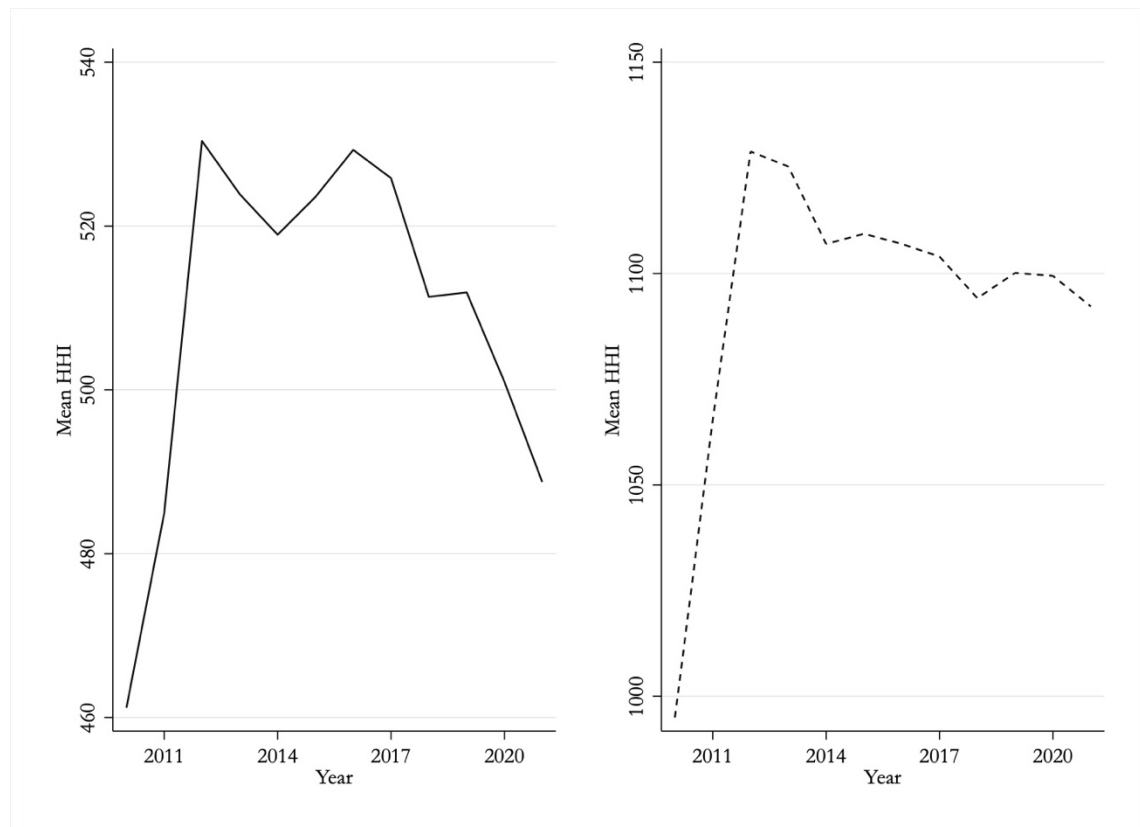


Figure 2

Trends in Industrial Concentration, 2010–2021

Source: “Quadros de Pessoal” data set. Own elaboration.

Notes: Figure plots the mean HHI across national 4-digit CAE industries in Panel A and NUTS 2 regions 4-digit CAE industries in Panel B, for each year, 2010–2021. Total market employment is used as weights.

To further understand industrial concentration levels, we can compare the average HHI with other measures of employment concentration, such as the top 20 firms employment concentration ratio. Figure 3, indeed, proceeds with this analysis². Figure 3A presents the national average HHI concentration on the left y-axis against the mean share of employment of the top 20 firms in Portugal on the right side of the y-axis. A similar trend between the

² Appendix C contains the same analysis but with the top 4 firms employment concentration ratio instead.

two measures across time suggests that the average national HHI is highly influenced by within-industry concentration.

Figure 3B presents the average regional HHI on the left side of the y-axis against the same top 20 firms employment concentration measure. Unlike the national comparison, the regional one does not maintain the same trend over the years between the two measures. This finding suggests that other mechanical aspects related to the construction of the average regional HHI may influence as much as within-market concentration.

After the previous analyses, two questions remain: what other factors may influence industrial concentration levels measured by HHI? And how do they impact the national and regional concentration trends? I attempt to answer these questions by deconstructing the average HHIs and performing a counterfactual exercise similar to Rinz (2022). The average national concentration can be written as:

$$\overline{HHI}_t^N = \sum_i Share_{i,t} \cdot HHI_{i,t} \quad (IV.1)$$

where $Share_{i,t}$ is the share of national employment for industry i in time t (i.e., industry composition) and $HHI_{i,t}$ is the within-industry HHI. Figure 4A presents the actual trend in national HHI (which is first presented in Figure 2A), as well as two counterfactual national trends: one allowing only for within-industry concentration to vary over the years ($Share_{i,t}$ is equal to its level in 2011 in all periods) and another one allowing for only industry composition to vary over the years ($HHI_{i,t}$ is equal to its level in 2011 in all periods). The counterfactual that allows for within-industry HHI variation seems to have the most similar behaviour to the actual national average trend. This corroborates with the findings related to Figure 3A, suggesting that the national average HHI is highly influenced by within-industry concentration.

I also perform the same exercise with the regional concentration trend. As discussed, this counterfactual may shed some light on why the regional concentration trend and the top 20 firms employment share, two concentration measures, diverge at the end of the analysis period in Figure 3B. The average regional concentration can be written as:

$$\overline{HHI}_t^L = \sum_r \sum_i RgShare_{r,t} \cdot RgIndShare_{i,r,t} \cdot HHI_{i,r,t} \quad (IV.2)$$

where $RgShare_{r,t}$ is the national population share for region r in time t (i.e., population share), $RgIndShare_{i,r,t}$ is the employment share of industry i in region r in time t (i.e., region-industry employment share composition), and $HHI_{i,r,t}$ is the within-market HHI.

Panel A

Panel B

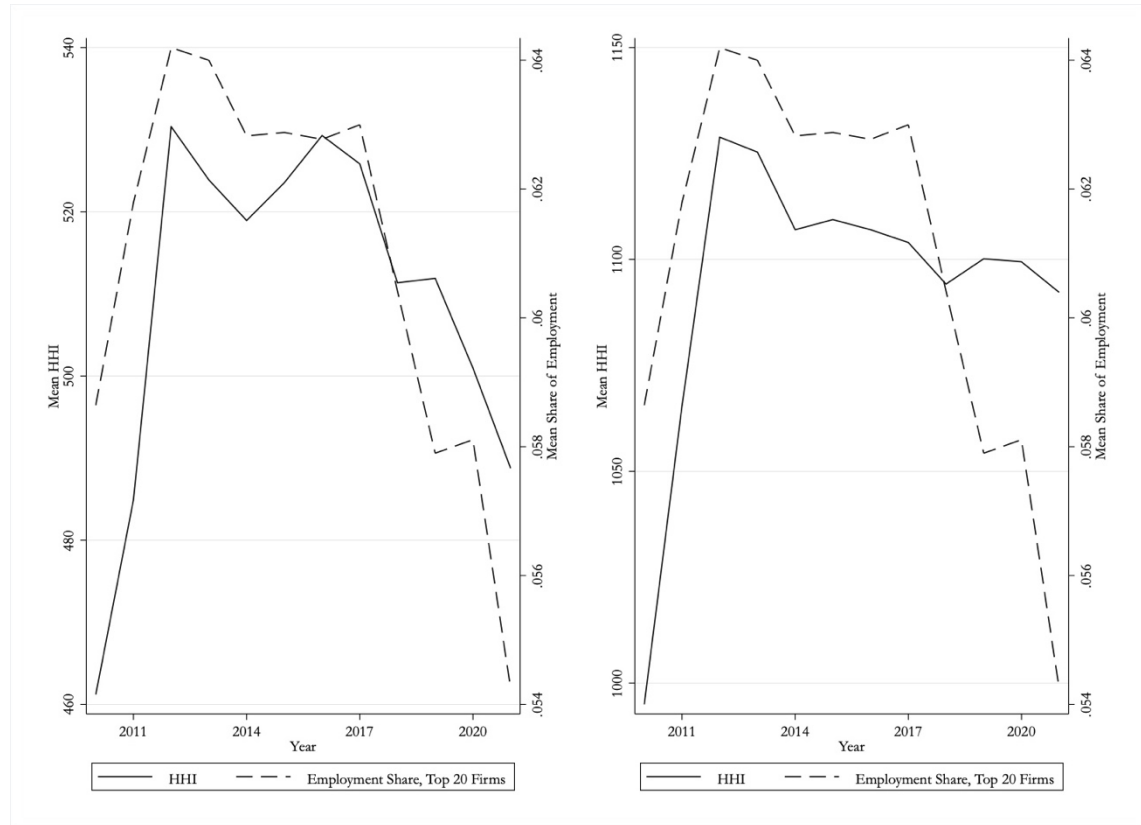


Figure 3

Trends in Industrial Concentration and Employment Share, Top 20 Firms

Source: “Quadros de Pessoal” data set. Own elaboration.

Notes: Figure plots the mean HHI across national 4-digit CAE industries in Panel A and NUTS 2 regions 4-digit CAE industries in Panel B, for each year, 2010–2021. Both trends are against the share of employment of the top 20 firms in terms of employment in Portugal. Total market employment is used as weights.

Figure 4B presents the actual trend in regional HHI and three counterfactual regional trends: one allowing only for variation in population shares (i.e., $RgShare_{r,t}$), one allowing only for variation of the region-industry employment share composition (i.e., $RgIndShare_{i,r,t}$), and one allowing only for variation in regional concentration (i.e., $HHI_{i,r,t}$) over the years.

As suspected, there is a difference between the actual regional trend and the counterfactual that only allows changes in regional concentration. Although the latter experiences a steep decline, the actual trend remains at similar levels to previous years. It seems that the region-industry composition plays an essential role in determining the regional concentration trend. In the last years of the analysis, while population shares and regional concentration enforce downward pressure on the average regional concentration, the region-industry composition counteracts by shaping the trend's stability. One implication may be that region-industry concentration is not the best proxy for industrial concentration at the regional level. Nevertheless, further investigation of this possibility is out of the scope of this dissertation.

Panel A

Panel B

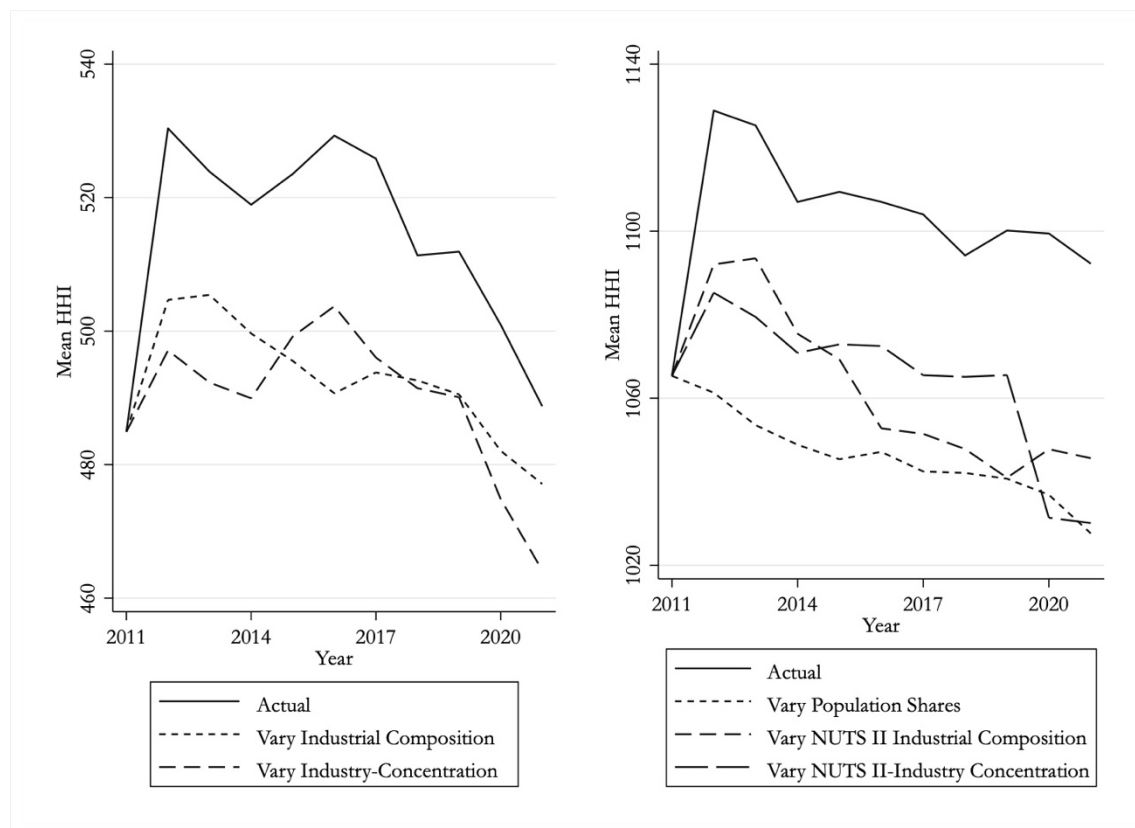


Figure 4

Decomposition of Industrial Concentration Trends, 2011–2021

Source: “Quadros de Pessol” data set. Own elaboration.

Notes: Figure plots the mean HHI across national 4-digit CAE industries in Panel A and NUTS 2 regions 4-digit CAE industries in Panel B, for each year, 2011–2021, and decomposes it as stated accordingly to Equation (IV.1) for Panel A and Equation (IV.2) for Panel B. Total market employment is used as weights.

Before focusing solely on regional concentration, I highlight the national trend by exploring possible heterogeneity. Specifically, Figure 5 uses CAE 1-digit industry classification³ to disentangle national concentration and observe how the national industrial concentration trend has evolved over the years across a broader industry classification level. First, many CAE 1-digit industries' trends do not vary much (e.g., A, F, L). Second, some industries have experienced a downward trend over the years. This is the case for industries D, H, J, and others. Two outliers may be identified from Figure 5. Industry B seems to be the industry with the upward trend with the highest magnitude, almost reaching an HHI of 2000 in the last period. Industry U appears to be the one with the highest trend variance, possibly surpassing the 2,500 DOJ mark and falling to lower levels than the first year.

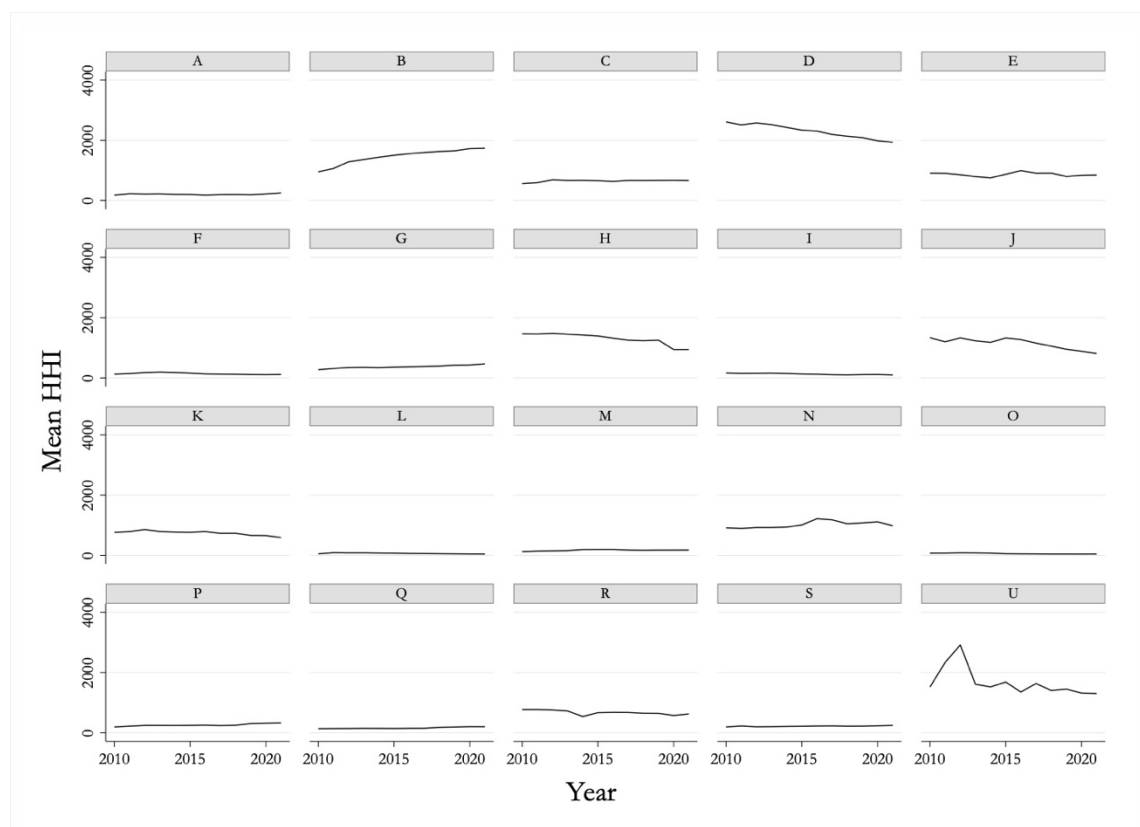


Figure 5

National Industrial Concentration Trend by 1-digit CAE Industries, 2010–2021

Source: “Quadros de Pessoal” data set. Own elaboration.

Notes: Figure plots the mean HHI across national 4-digit CAE industries, for each year, 2010–2021, by 1-digit CAE industries. List of 1-digit CAE industries according to their labels are on the Appendix D. Total 4-digit CAE industry employment is used as weights.

³ Appendix D contains a table with 1-digit CAE industry codes and its respective description.

Furthermore, none of the CAE 1-digit industries match the national average concentration trend’s shape. This may happen because of the magnitude of the numbers on the y-axis, which does not show the minor nuances of trends. Nevertheless, Figure 5 suggests that heterogeneity exists in the average national concentration trend, which may also be the case for the average regional concentration trend. If so, these results will align with the literature (see Benmelech et al., 2022).

Focusing now on the average regional concentration trend, I explore heterogeneity across NUTS 2 regions. Figure 6 presents the regional trend for each of the 7 regions: North, Algarve, Center, LMA – Lisbon Metropolitan Area, Alentejo, Azores, and Madeira.

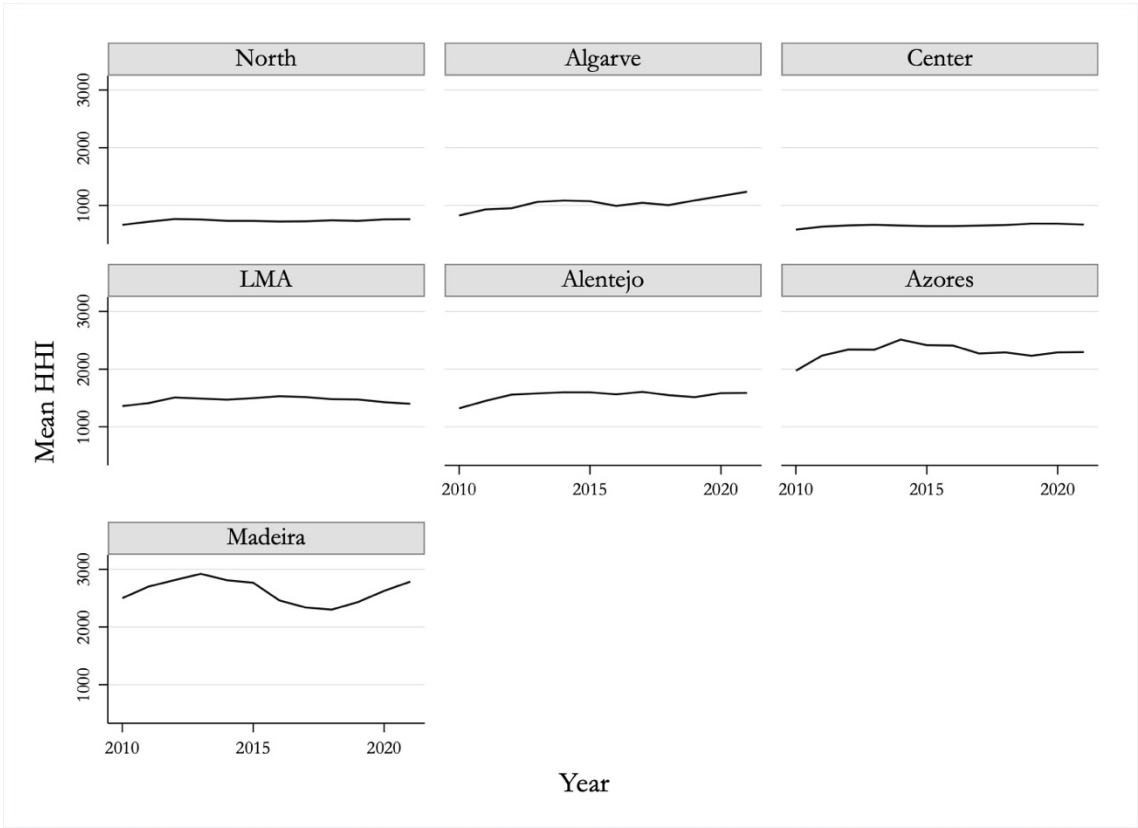


Figure 6
Regional Industrial Concentration Trend by NUTS 2 Regions, 2010–2021

Source: “Quadros de Pessoal” data set. Own elaboration.
Notes: Figure plots the mean HHI across national 4-digit CAE industries and NUTS 2 regions, for each year, 2010–2021, by NUTS 2 regions. Total market employment is used as weights.

Both archipelagos (i.e., Azores and Madeira) show higher HHI levels when compared to the other regions. Madeira’s case is even more perplexing, with its trend experiencing a non-

linear growth. In the first years, the region of Madeira experiences an upward trend in its industrial concentration levels, reaching the trend's peak in 2013. From there until 2018, industrial concentration decreases to its minimum level during the analysis period. Nevertheless, Madeira's industrial concentration has bounced back in the last three years to a higher degree than in 2010.

Continental Portugal experiences smoother trends, with the Center and North regions maintaining HHI levels below the four-digit mark. On the contrary, Alentejo and LMA keep, at the analysis period, industrial concentration levels higher than one thousand. The Algarve region is the only continental one to change its industrial concentration from 3-digit to 4-digit (or vice-versa) levels.

Figure 7 presents the Portuguese NUTS 2 regions map, with its respective HHI value during the first observation period. The North and Center regions have the lowest HHI, while LMA and Alentejo have the highest HHI levels of continental Portugal. The Algarve region has the median HHI level among the five continental regions. In addition, Figure 7 also includes the Portuguese archipelagos. Madeira and Azores islands have higher HHI levels than all continental Portuguese regions.

Figure 8 presents the change in HHI levels from 2010 to 2021 in all regions. Although both LMA and Alentejo are the regions with the highest HHI levels in continental Portugal in 2010, LMA almost do not increase its industrial concentration levels 11 years later. On the contrary, still focusing on continental Portugal, Alentejo is the second region with the highest increase in HHI. The North and Center regions also experienced a rise in average regional industrial concentration, and the Algarve excelled, in terms of HHI increase, not only in the continental regions but also in pair with the archipelagos. Figure 8 also includes the HHI change in the archipelagos Portuguese regions, with the Azores island having increased its industrial concentration level more than the Madeira island.

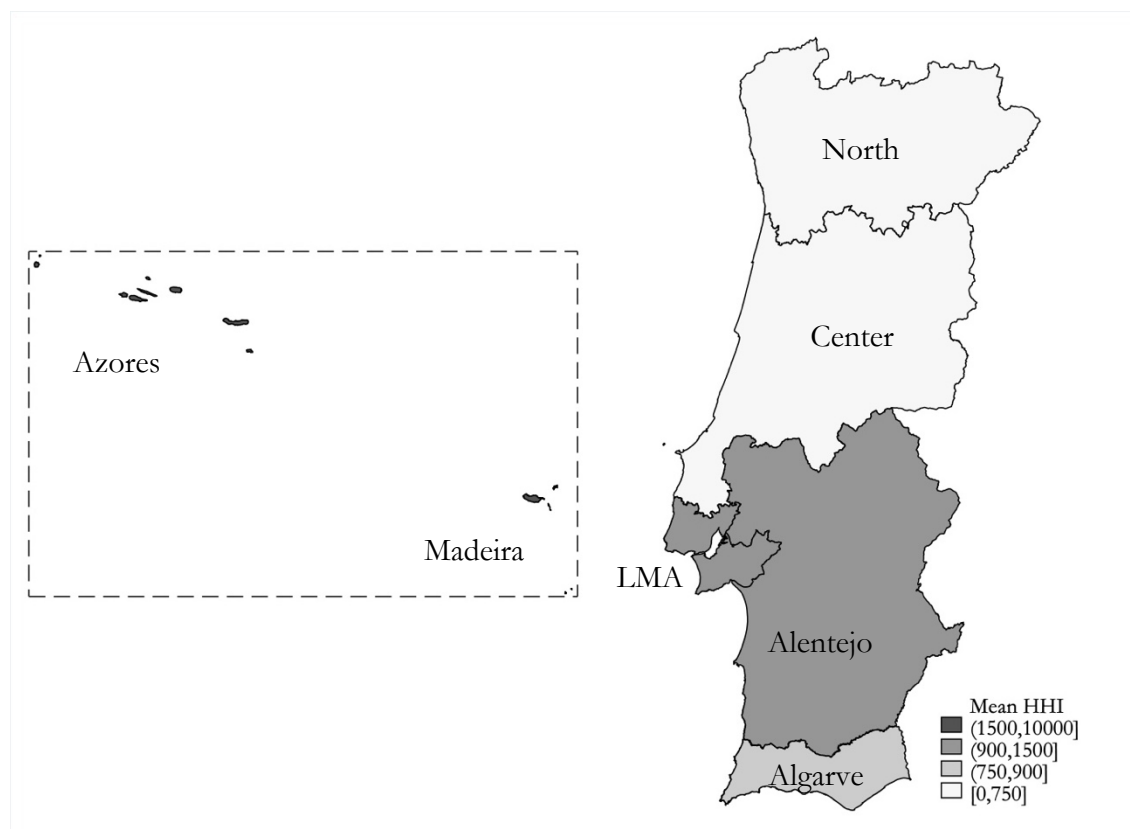


Figure 7

Average Regional Concentration across Regions, 2010

Source: “Quadros de Pessoal” data set. Own elaboration.

Notes: Map plots the level HHI across national 4-digit CAE industries and NUTS 2 regions in 2010, by NUTS 2 regions. Total market employment is used as weights.

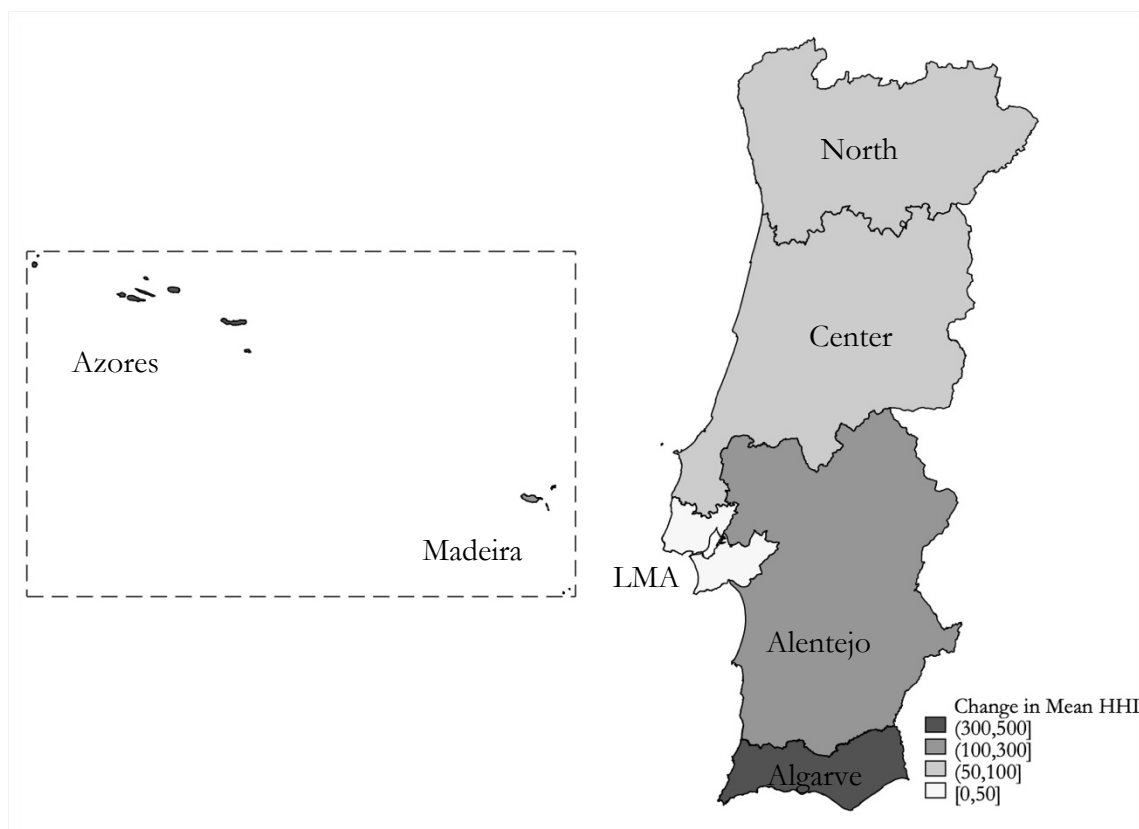


Figure 8

Change in Average Regional Concentration across Regions, 2010–2021

Source: “Quadros de Pessoal” data set. Own elaboration.

Notes: Map plots the change in HHI across national 4-digit CAE industries and NUTS 2 regions, 2010–2021, by NUTS 2 regions. Total market employment is used as weights.

V. Estimation

To study the relationship between regional labour concentration and wages, my baseline specification is as follows:

$$\log(y_{i,r,t}) = \alpha + \beta \cdot \log(HHI_{i,r,t}) + \delta \cdot (i, r, t) + \varepsilon_{i,r,t} \quad (V.1)$$

where i indicates 4-digit CAE industries, r indicates NUTS 2 regions, and t indicates year. The dependent variable $\log(y_{i,r,t})$ is the log of the mean real hourly earnings in a regional market in a given year, and $\log(HHI_{i,r,t})$ is the log of the HHI in that regional market in the same year. $\delta \cdot (i, r, t)$ corresponds to possibly interacted fixed effects among industries, regions, and year, and $\varepsilon_{i,r,t}$ is the error term.

A. Pre-estimation Tests

The above specification strategy emerges from the literature and I performed some pre-estimation tests. The latter was optional, but since I aggregated the data at the regional market level, I had fewer observations than at the worker level. These pre-estimation test results corroborated with the literature's specification strategy.

First, I perform the Breusch–Pagan (1979) and Cook–Weisberg (1983) test for heteroskedasticity. With a p-value of 0.0000, I rejected the null hypothesis of constant variance in the error term. Figure 10 presents a graph of the residuals against the fitted values to investigate this matter further. The graph corroborates with the Breusch–Pagan/Cook–Weisberg tests' result.

Next, I explored the possibility of serial correlation in my data. The Wooldridge test for autocorrelation in panel data (see Drukker, 2003; Wooldridge, 2002) accused a p-value of 0.0000, rejecting the null hypothesis of no first-order autocorrelation. The heteroskedasticity and serial correlation results influenced my decision about clustered standard errors and weighting.

Furthermore, I also performed Hausman's (1978) specification test to check whether a fixed- or random-effects model is more appropriate. Based on a p-value of 0.0000, I rejected the null hypothesis that a random-effects model adequately models regional-market-level effects. Therefore, a fixed-effects model was more appropriate given my specification.

Instrumental variables are a common estimation strategy in the labour concentration literature. I proceeded with an endogeneity test to further understand the need given our sample. The Durbin-Wu-Hausman, proposed by Davidson and MacKinnon (1993), was then performed with three possible instruments: a one-year lagged HHI, an instrument based on the HHI in other regions except for the respective region itself with the same industry in the same year (similar to Rinz, 2022) and an instrument based on the number of firms in the same industry but in other regions (similar to Azar et al., 2022 and Martins & Melo, 2023). Nevertheless, none of the instruments were significant at a 5 percent confidence level.

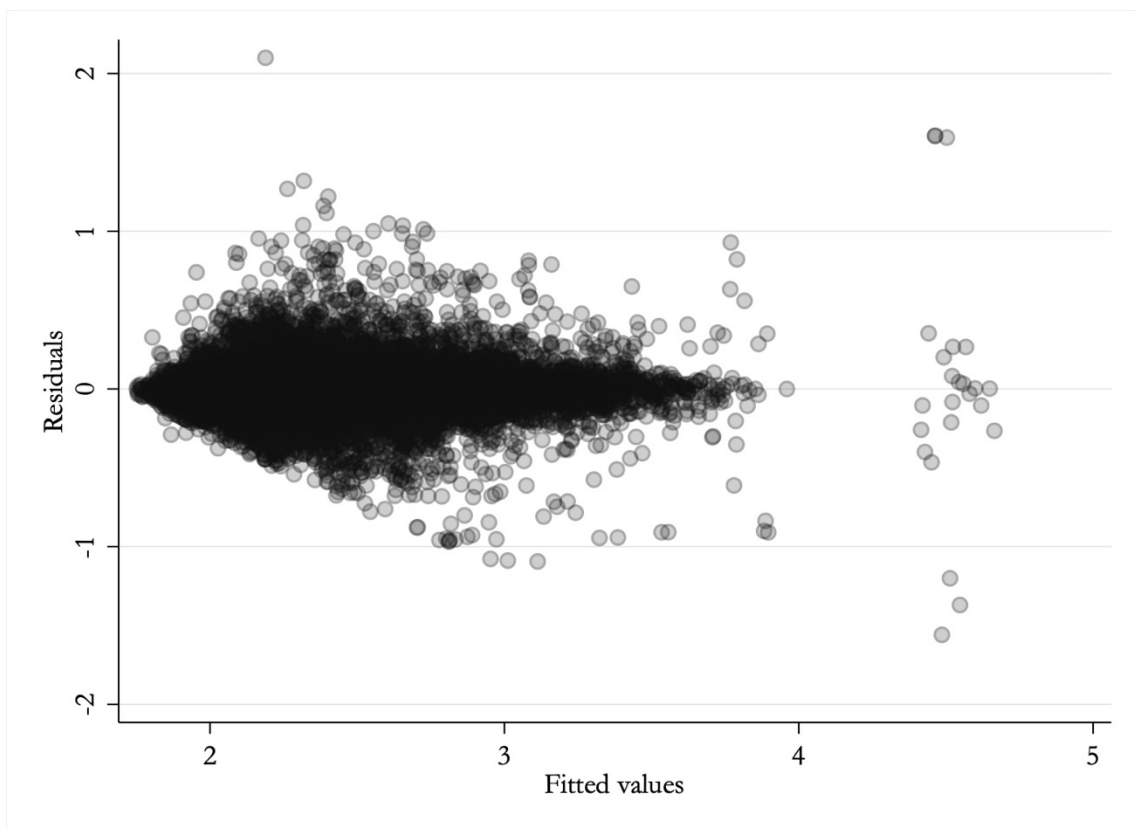


Figure 9

Residual-versus-Fitted values, based on Equation (V.1)

Source: “Quadros de Pessoal” data set. Own elaboration.

Notes: Figure plots residual-versus-fitted values. Equation (V.1). Unweighted regression.

B. Main Results

Estimates from the baseline model are reported in Table 2. In column (1), a 1 percent increase in regional labour market’s HHI level is associated with a 0.105 percent increase in

mean real hourly earnings of the respective regional labour market, *ceteris paribus*. The estimation strategy in column (1) possibly suffers from omitted variable bias that would influence the coefficient of interest. The addition of year fixed effects in column (2) does not change the coefficient. Column (3) introduces a market (industry-region pair) fixed effects. This introduction alters the coefficient of interest, dropping it from 0.105 to 0.040. Regional shocks may also be a source of bias in my estimation. Therefore, in column (4), I added a year-region fixed effects. By column (4), a 1 percent increase in regional labour market's HHI level is associated with a 0.038 percent increase in mean real hourly earnings of the respective regional labour market, everything else equal. Indeed, the decrease in the value of the coefficient of interest due to the addition of market and year-region fixed effects suggests that omitted variable bias positively influences the results of columns (1) and (2).

Table 2
Effects of Regional Industrial Concentration on Mean Real Hourly Earnings

Variables	(1)	(2)	(3)	(4)
log(HHI)	0.105*** (0.010)	0.105*** (0.010)	0.040*** (0.009)	0.038*** (0.009)
constant	2.820*** (0.050)	2.820*** (0.050)	2.601*** (0.032)	2.595*** (0.031)
Observations	32659	32659	32582	32582
R-squared	0.245	0.267	0.954	0.977
Weighted	1	1	1	1
Year FEs	0	1	0	0
Market FEs	0	0	1	1
Year x Region FEs	0	0	0	1

Clustered standard errors are in parentheses

*** p<.01, ** p<.05, * p<.1

Source: “Quadros de Pessoal” data set.

Notes: Table reports fixed effects regression estimates of the effect of regional labour market concentration, as measured by HHI, on log mean real hourly earnings, constructed from the QP data set. Columns represent different regressions, which include the indicated fixed effects and weighting or not in that regression. Standard errors were clustered at the regional labour market level. Table was created using *asdoc*, a Stata program written by Shah (2018).

Based on column (4), my preferred estimation strategy, and to better illustrate HHI's effect on mean real hourly earnings, an increase in regional labour market's HHI level by 10 percent

(almost the increased value of the average regional industrial concentration level from 2010 to 2021) is associated with a 0.36 percent increase in mean real hourly earnings, *ceteris paribus*. Although of irreverent magnitude, the coefficients in all columns are statistically significant at a 1 percent confidence level⁴. Weighting regressions diminishes the impact of monopsonistic markets (i.e., markets in which the HHI level is equal to 10,000). See Appendix F for results of weighted estimates excluding monopsonistic markets.

One may argue that my baseline specification of the relationship between earnings and regional industrial concentration is not correctly specified. A possible argument is that wages for the current year are set on the year before. In this case, wage-setting may not be influenced by current regional industrial concentration levels but instead by the levels in the year $t-1$. The following section addresses this concern.

C. Robustness Check – One-Year Lagged Main Independent Variable

Table 3 presents the results of a different baseline specification. In this case, the unique difference is in the main independent variable. Here, I used a one-year lagged variable of the $\log(\text{HHI})$ instead of the current value. Table 3 shows that my main estimation results are robust to a different specification strategy. All estimated coefficients in Table 3 are positive, statistically significant at a 1 percent confidence level, and of similar magnitude to Table 2 results.

Another debatable point may be about how my dependent variable was constructed. Since the mean real hourly earnings is a constructed definition of wage based on QP data, some may argue that the results may not be robust to alternative wage definitions. The following section explores this concern.

⁴ Results are robust to unweighted regressions. See Appendix E for results.

Table 3*Effects of one-year lagged Regional Industrial Concentration on Mean Real Hourly Earnings*

Variables	(1)	(2)	(3)	(4)
log(HHIt-1)	0.104*** (0.010)	0.103*** (0.010)	0.029*** (0.008)	0.024*** (0.008)
constant	2.816*** (0.050)	2.815*** (0.050)	2.563*** (0.028)	2.546*** (0.026)
Observations	29373	29373	29327	29327
R-squared	0.242	0.266	0.953	0.978
Weighted	1	1	1	1
Year FEs	0	1	0	0
Market FEs	0	0	1	1
Year x Region FEs	0	0	0	1

Clustered standard errors are in parentheses

*** p<.01, ** p<.05, * p<.1

Source: “Quadros de Pessoal” data set.

Notes: Table reports fixed effects regression estimates of the effect of one-year lagged regional labour market concentration, as measured by HHI, on log mean real hourly earnings, constructed from the QP data set. Columns represent different regressions, which include the indicated fixed effects and weighting or not in that regression. Standard errors were clustered at the regional labour market level. Table was created using asdoc, a Stata program written by Shah (2018).

D. Robustness Check – Different Wage Definition

Using my preferred estimation strategy, column (4) of Table 2 was re-estimated with two new wage definitions. One was the mean real monthly earnings, which is the mean real monthly total payroll (i.e., base wage plus regular benefits and overtime pay) of a regional labour market. The other was the mean real monthly wage, which only encompasses a regional labor market's mean real base pay. All wage definitions were deflated using the CPI.

Table 4 presents the results of this robustness check. The results are indeed robust to the two new alternative measures of wage. Independently of how wage is defined, all coefficients have the same sign, a similar level of magnitude, and are statistically significant at a 1 percent confidence level.

Table 4*Effects of Regional Industrial Concentration on Different Wage Definitions*

Variables	log(mean real hourly earnings) (1)	log(mean real monthly earnings) (2)	log(mean real monthly wage) (3)
log(HHI)	0.038*** (0.009)	0.030*** (0.008)	0.026*** (0.008)
constant	2.595*** (0.031)	7.643*** (0.029)	6.847*** (0.028)
Observations	32582	32582	32582
R-squared	0.977	0.981	0.979
Weighted	1	1	1
Year FEs	0	0	0
Market FEs	1	1	1
Year x Region FEs	1	1	1

Clustered standard errors are in parentheses

*** p<.01, ** p<.05, * p<.1

Source: “Quadros de Pessoal” data set.

Notes: Table reports fixed effects regression estimates of the effect regional labour market concentration, as measured by HHI, on different definitions of wages, constructed from the QP data set. Columns represent different regressions, which include the indicated fixed effects and weighting or not in that regression. Standard errors were clustered at the regional labour market level. Table was created using asdoc, a Stata program written by Shah (2018).

Although the mean real hourly earnings is a solid benchmark to assess the impact of HHI levels on earnings, the literature has shown that it is unlikely that labour market concentration equally impacts earnings across the earnings distribution.

E. Model Extension – Wage Inequality and Key Earnings Percentiles

To understand the HHI’s effect on the earnings distribution, I used earnings inequality ratios within regional labour markets as dependent variables. Table 5 reports estimates for three earnings percentile ratios, namely 90/10, 90/50, and 50/10. The real hourly earnings variable, at the worker level, was used to construct the inequality ratios. All regressions were unweighted since my new dependent variable is not a group-mean anymore.

Table 5
Effects of Regional Industrial Concentration on Earnings Inequality

Variables	90/10 (1)	90/50 (2)	50/10 (3)
log(HHI)	-0.033*** (0.008)	-0.046*** (0.006)	0.012*** (0.004)
constant	0.721*** (0.016)	0.438*** (0.012)	0.283*** (0.008)
Observations	32582	32582	32582
R-squared	0.792	0.694	0.752
Weighted	0	0	0
Year FEs	0	0	0
Market FEs	1	1	1
Year x Region FEs	1	1	1

Clustered standard errors are in parentheses

*** p<.01, ** p<.05, * p<.1

Source: “Quadros de Pessoal” data set.

Notes: Table reports fixed effects regression estimates of the effect regional labour market concentration, as measured by HHI, on three different ratios of earnings inequality, constructed from the QP data set. The 90/10 ratio was constructed by dividing the real hourly earnings of the worker at the 90th percentile by the one in the 10th in the same market. This methodology applies to the other inequality ratios. Columns represent different regressions, which include the indicated fixed effects and weighting or not in that regression. All coefficients represent elasticities. Standard errors were clustered at the regional labour market level. Table was created using asdoc, a Stata program written by Shah (2018).

In columns (1) and (2), a 1 percent increase in regional industrial concentration is associated with decreases of about 0.033 percent and 0.046 percent for the 90/10⁵ and 90/50 ratios, respectively, everything else equal. Differently from the previous two ratios, the 50/10 ratio coefficient is positively associated with regional industrial concentration levels. The elasticity is 0.012. These results suggest that changes in the top of the earnings distribution do not keep up with changes in the middle and bottom of the distribution. In other words, it seems that top earners are primarily affected by increases in regional industrial concentration levels. Nevertheless, one question remains: are these effects positive or negative across the earnings distribution?

⁵ Results of overall inequality (90/10 ratio) is robust to other measures of overall inequality such as 80/20 and 75/25 ratios. See Appendix G for results.

To further explore the results above, I re-estimated my preferred estimation on key earnings percentiles (i.e., 10th, 30th, 50th, 70th, and 90th). Figure 10⁶ presents the estimation results.

First, all key earnings percentiles are positively associated with regional industrial concentration levels. In addition, the middle of the earnings distribution is the most positively affected. Although still positively associated with regional industrial concentration, the top end of the earnings distribution has the weakest association. This supports the previous suggestion that top earners are primarily affected by increases in regional industrial concentration, even though not by declining earnings, but by not increasing as much as the other distribution areas.

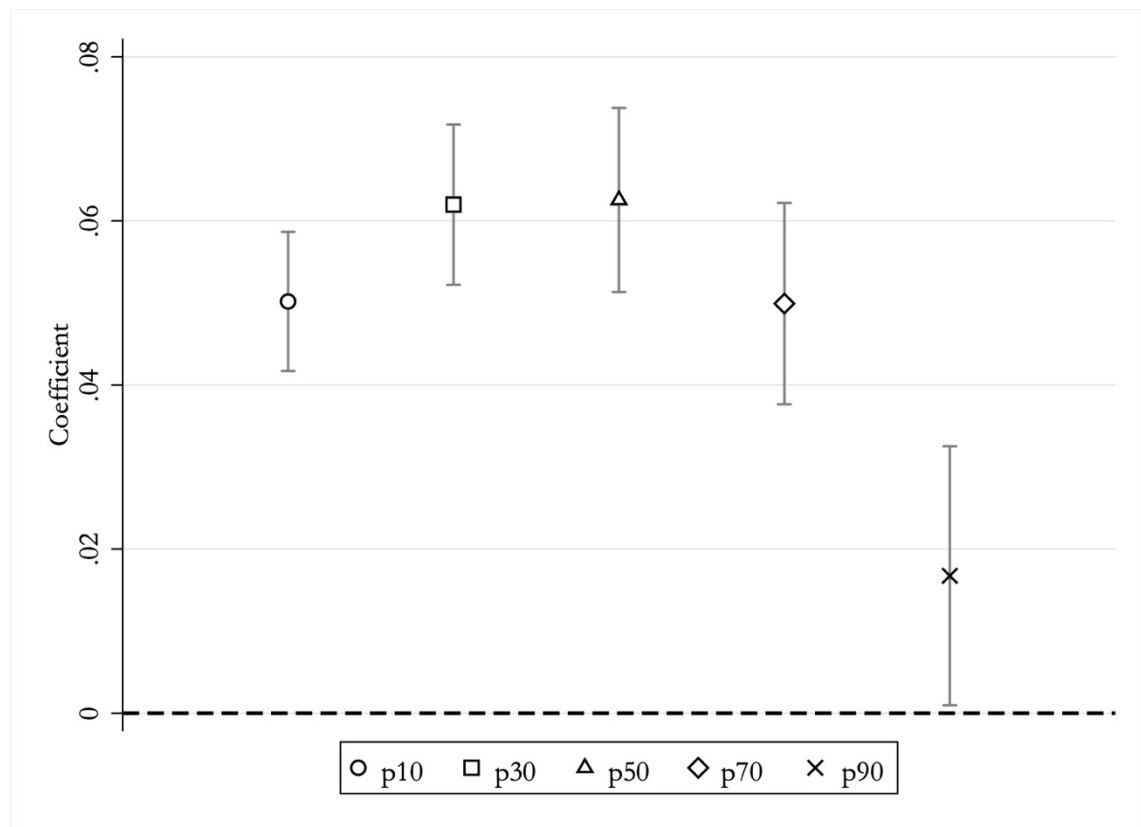


Figure 10
Effects of Industrial Concentration on Key Earnings Percentiles

Source: “Quadros de Pessoal” data set. Own elaboration.

Notes: Figure plots coefficients and 95 percent confidence intervals from regressions of the log of the values of key earnings percentiles within regional labour markets on the log of regional industrial concentration, measured as HHI. Coefficients represent elasticities. Regressions include market and region by year fixed effects. Standard errors were clustered at the regional labour market level. Regressions are unweighted.

⁶ Regression table of Figure 10 is available on Appendix H.

F. Model Extension – Product Market Concentration

In the USA, past research indicates that concentration in product markets has been increasing in past decades (see Autor et al., 2020; Grullon et al., 2019). This has raised concern about the possible influence of concentrated product markets in labour markets. One advantage of my data is that the QP contains information regarding firms' sales. This data allowed me to calculate the market share of each firm, and then calculate the HHI based on sales and use it as my proxy for product market concentration. Table 6 presents my preferred estimation strategy with the product market concentration additional variable. The regional product market HHI coefficient is positive and statistically significant at a 5 percent confidence level. Furthermore, the coefficient on regional industrial concentration remained positive, yet it decreased.

Table 6

Effects of Regional Industrial Concentration on Mean Real Hourly Earnings Controlling for Product Market Concentration

Variables	(1)
log(HHI)	0.033*** (0.009)
log(Product HHI _{t-1})	0.006** (0.003)
constant	2.598*** (0.037)
Observations	29836
R-squared	0.978
Weighted	1
Year FEs	0
Market FEs	1
Year x Region FEs	1

Clustered standard errors are in parentheses

*** p<.01, ** p<.05, * p<.1

Source: "Quadros de Pessoal" data set.

Notes: Table reports fixed effects regression estimates of the effect of regional labour market concentration, as measured by HHI, on log mean real hourly earnings, and controlling for product market concentration, constructed from the QP data set. Product market concentration is based on 4-digit CAE industries concentration, as measured by HHI using firms' one-year lagged sales. Total market employment is used as weights. Standard errors were clustered at the regional labour market level. Table was created using asdoc, a Stata program written by Shah (2018).

VI. Discussion and Conclusion

The study of industrial concentration trends resulted in some insights. Despite the similar behaviour, national and regional industrial concentration trends diverged in the last years of the analysis, and regional employer concentration levels increased by almost 10 percent by 2021, primarily due to increases in concentration levels during the European sovereign debt crisis. Martins and Melo (2023) also perform this analysis in their research of the Portuguese labour market. Using HHI based on employment shares, they document a decreasing trend between 1985 and 2019. When comparing only to the period of analysis I use, they report an increasing trend in concentration levels. The opposite happens when they use an HHI based on new hire shares. Studying the United Kingdom, another European country, Abel et al. (2020) document a decrease in industrial concentration levels over 2 decades. Furthermore, I provide counterfactual evidence of how different forces have influenced national and regional trends. I also perform a series of analyses to further understand the level of heterogeneity in both trends and document some variation across regions or industries, also registered by Abel et al. (2020) and Benmelech et al. (2022).

My findings that regional labour market concentration is associated with increases in mean real hourly earnings are inconsistent with previous findings in the literature. This inconsistency may arise from many issues. First, I do not find a suitable instrument for my estimation strategy. Although I try recurring instruments from previous research, none are statistically significant at a 5 percent confidence level. Therefore, changes in regional industrial concentration may arise endogenously. The endogeneity issue is a plausible hypothesis since economic changes that affect employer concentration may also affect wages. For instance, when Rinz (2022) uses an OLS estimation strategy, he finds a positive association between local labour market concentration and earnings. However, when instrumenting local labour market concentration, the estimated coefficient changes to a negative value. Nevertheless, instrumenting *per se* may not be the only factor since Azar et al. (2020) find a negative relationship between wages and local labour market concentration using OLS.

Second, the unavailability of more disaggregated spatial levels in my data may also contribute to the inconsistent findings. In this case, although I present more of a macro view of the relationship between labour market concentration and wages, it becomes harder to establish a unique transmission channel between concentration and wages because of the broader

definition of labour markets. Moreover, as the magnitude of my estimates suggests, the macro perspective of labour market concentration has little impact on wages.

There may be a case where my findings are adequate, although they contradict the literature. As stated earlier, the Portuguese economy is characterized by small and family businesses with few workers. Due to unionization, these firms lack the market power to determine workers' salaries. Some previous studies have found that labour market concentration intersected with unionization increases wages (see Abel et al., 2020; Benmelech et al., 2022; Doldini et al., 2021). Although I do not directly include a union covariate in my empirical strategy, the presence of unions may be implicit presently due to the high reach of unions in Portugal. In addition, each region's socioeconomic and demographic characteristics may have a crucial role in shaping the dynamic between regional labour market concentration and wages. For instance, some specific areas in the North and LMA regions are characterized by highly qualified workers, and firms that need these talents in more concentrated markets may still have to push wages up due to higher labour demand. This rationale is based on Hotelling's principle of minimum differentiation (Hotelling, 1929). Therefore, the relation between labour market concentration and wages may vary depending on the specific context in which the labour market is defined, including regions', workers', and firms' characteristics and also regulatory policies in effect.

The robustness checks, using a one-year lagged HHI as independent variable and different wage constructions, indicate that my results are robust to different specifications and measures. Furthermore, although my inequality ratio extension results are inconsistent with previous research on USA labour markets, the findings are consistent with Martins and Melo (2023) within local labour markets inequality estimations. Using an instrument, they find that local labour market concentration is associated with a decrease in the 90/10 and 90/50 inequality ratios and an increase, even though not statistically significant, in the 50/10 inequality ratio. Their results support my hypothesis that the relationship between labour market concentration and wages may vary depending on each studied labor market's institutional, socioeconomic, and demographic characteristics because they also study the Portuguese labour market. The regression on key earnings percentiles shows that the decrease in inequality ratios mainly comes from the top of the earnings distribution, which does not keep up with the earnings growth of the middle and bottom of the distribution. Lastly, the estimated coefficient on product market concentration is positive and statistically

significant at a 5 percent confidence level, consistent with Benmelech et al. (2022) and Qiu and Sojourner (2023) findings.

Since the study of the relationship between labour market concentration and wages emerged in recent years, future research should focus on gathering evidence of this relationship from labour markets of more different characteristics. Understanding the impact of labour market's demographic, institutional, and socioeconomic attributes on labour market dynamics would further enhance the knowledge of monopsonistic power.

VII. Appendices

Appendix A: Descriptive Statistics Tables

Table 7

Descriptive Statistics

	N	Mean	SD	Min	Max
Year	32659.0	2015.5	3.4	2010.0	2021.0
Number of cells	32659.0	1470.1	856.6	1.0	2990.0
HHI (unweighted)	32659.0	3198.6	3216.9	5.7	10000.0
HHI (weighted)	32659.0	1093.2	1763.5	5.7	10000.0

Source: “Quadros de Pessoal” data set.

Notes: Total market employment is used as weights. Table was created using asdoc, a Stata program written by Shah (2018).

Table 8
Descriptive Statistics by Year

	N	Mean	SD	Min	Max
2010					
Number of cells	2721.0	1468.3	853.8	1.0	2990.0
HHI (unweighted)	2721.0	2991.3	3159.9	5.7	10000.0
HHI (weighted)	2721.0	995.0	1710.4	5.7	10000.0
2011					
Number of cells	2733.0	1472.1	855.3	1.0	2990.0
HHI (unweighted)	2733.0	3203.8	3244.2	8.0	10000.0
HHI (weighted)	2733.0	1065.4	1760.1	8.0	10000.0
2012					
Number of cells	2711.0	1467.7	853.6	1.0	2990.0
HHI (unweighted)	2711.0	3242.7	3251.2	8.3	10000.0
HHI (weighted)	2711.0	1128.9	1816.6	8.3	10000.0
2013					
Number of cells	2711.0	1470.7	855.1	1.0	2990.0
HHI (unweighted)	2711.0	3228.4	3242.8	7.9	10000.0
HHI (weighted)	2711.0	1125.3	1801.2	7.9	10000.0
2014					
Number of cells	2726.0	1468.9	855.7	1.0	2990.0
HHI (unweighted)	2726.0	3253.0	3243.7	8.2	10000.0
HHI (weighted)	2726.0	1107.0	1782.6	8.2	10000.0
2015					
Number of cells	2720.0	1468.5	856.9	1.0	2990.0
HHI (unweighted)	2720.0	3246.1	3244.4	7.8	10000.0
HHI (weighted)	2720.0	1109.4	1774.9	7.8	10000.0
2016					
Number of cells	2715.0	1466.8	856.0	1.0	2990.0
HHI (unweighted)	2715.0	3194.1	3197.9	7.3	10000.0
HHI (weighted)	2715.0	1107.0	1792.2	7.3	10000.0
2017					
Number of cells	2752.0	1463.6	855.8	1.0	2990.0
HHI (unweighted)	2752.0	3248.2	3235.9	7.4	10000.0
HHI (weighted)	2752.0	1104.0	1784.2	7.4	10000.0

	N	Mean	SD	Min	Max
2018					
Number of cells	2737.0	1471.5	859.0	1.0	2990.0
HHI (unweighted)	2737.0	3189.3	3187.9	7.3	10000.0
HHI (weighted)	2737.0	1094.2	1757.2	7.3	5084.0
2019					
Number of cells	2716.0	1474.0	859.1	1.0	2990.0
HHI (unweighted)	2716.0	3208.2	3202.8	7.7	10000.0
HHI (weighted)	2716.0	1100.2	1747.0	7.7	10000.0
2020					
Number of cells	2715.0	1475.5	859.9	1.0	2990.0
HHI (unweighted)	2715.0	3189.1	3203.2	9.2	10000.0
HHI (weighted)	2715.0	1099.5	1741.2	9.2	10000.0
2021					
Number of cells	2702.0	1473.5	860.5	1.0	2990.0
HHI (unweighted)	2702.0	3189.2	3185.1	10.2	10000.0
HHI (weighted)	2702.0	1092.2	1708.5	10.2	10000.0

Source: “Quadros de Pessoal” data set.

Notes: Total market employment is used as weights. Table was created using asdoc, a Stata program written by Shah (2018).

Appendix B: Unweighted Trends in Industrial Concentration

Panel A

Panel B

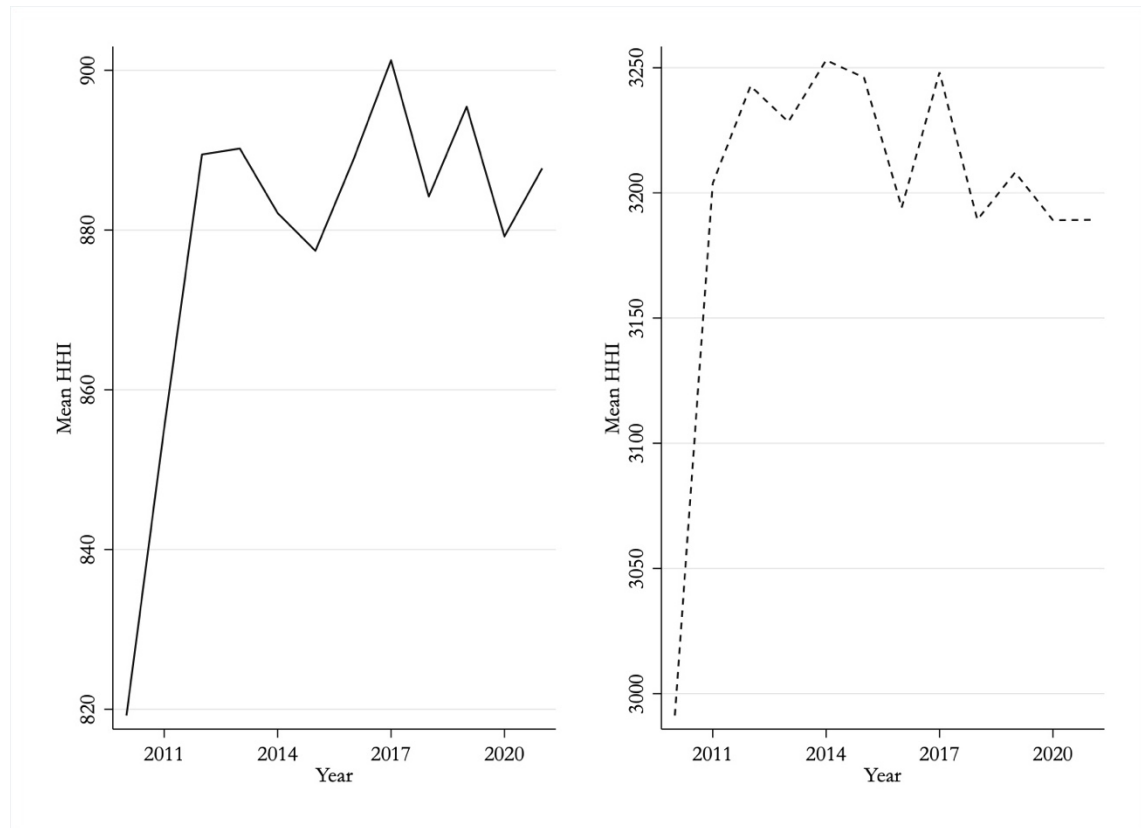


Figure 11

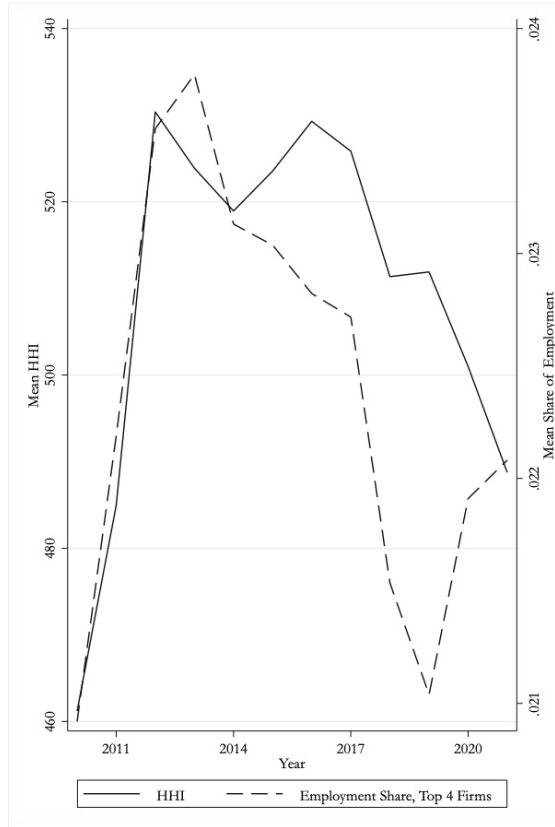
Unweighted Trends in Industrial Concentration, 2010–2021

Source: “Quadros de Pessoal” data set. Own elaboration.

Notes: Figure plots the unweighted mean HHI across national 4-digit CAE industries in Panel A and NUTS 2 regions 4-digit CAE industries in Panel B, for each year, 2010–2021.

Appendix C: Top 4 Firms Concentration Ratio

Panel A



Panel B

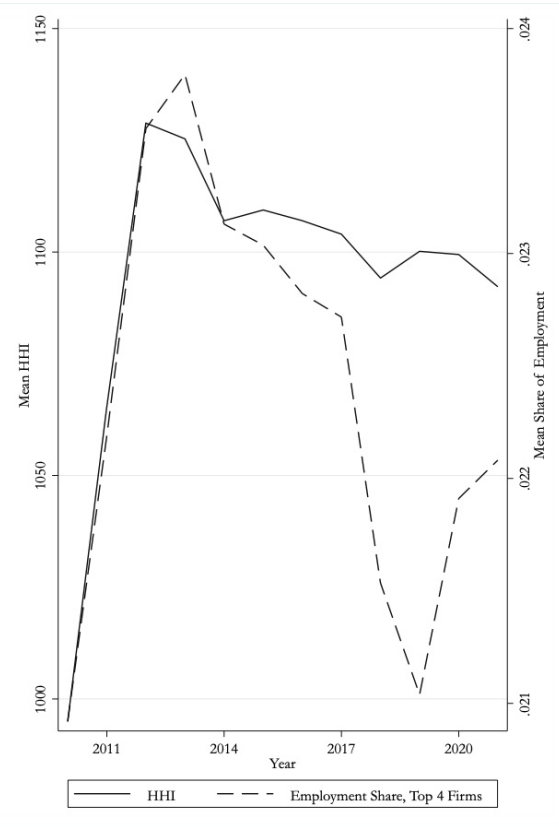


Figure 12

Trends in Industrial Concentration against Employment Share, Top 4 Firms

Source: “Quadros de Pessoal” data set. Own elaboration.

Notes: Figure plots the mean HHI across national 4-digit CAE industries in Panel A and NUTS 2 regions 4-digit CAE industries in Panel B, for each year, 2010–2021. Both trends are against the share of employment of the top 4 firms in terms of employment in Portugal. Total market employment is used as weights.

Appendix D: 1-digit CAE Industry Codes and Description

Table 9

1-Digit CAE Industry Codes and Description

Code	Description
A	Agriculture, farming of animals, hunting and forestry
B	Mining and quarrying
C	Manufacturing
D	Electricity, gas, steam, cold and hot water and cold air
E	Water collection, treatment and distribution; sewerage, waste management and remediation activities
F	Construction
G	Wholesale and retail trade; repair of motor vehicles and motorcycles
H	Transportation and storage
I	Accommodation and food service activities
J	Information and communication activities
K	Financial and insurance activities
L	Real estate activities
M	Consultancy, scientific and technical activities
N	Administrative and support service activities
O	Public administration and defence; compulsory social security
P	Education
Q	Human health and social work activities
R	Arts, entertainment, sports and recreation activities
S	Other service activities
T	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use
U	Activities of extraterritorial organisations and bodies

Source: INE. Own elaboration.

Notes: This table shows all 1-digit CAE industry codes and its respective description.

Appendix E: Main Estimation with Unweighted Regressions

Table 10

Effects of Regional Industrial Concentration on Mean Real Hourly Earnings – Unweighted

Variables	(1)	(2)	(3)	(4)
log(HHI)	0.024*** (0.004)	0.024*** (0.004)	0.046*** (0.006)	0.046*** (0.005)
constant	2.409*** (0.011)	2.409*** (0.011)	2.451*** (0.011)	2.450*** (0.010)
Observations	32659	32659	32582	32582
R-squared	0.009	0.033	0.849	0.874
Weighted	0	0	0	0
Year FEs	0	1	0	0
Market FEs	0	0	1	1
Year x Region FEs	0	0	0	1

Clustered standard errors are in parentheses

*** p<.01, ** p<.05, * p<.1

Source: “Quadros de Pessoal” data set.

Notes: Table reports fixed effects regression estimates of the effect of regional labour market concentration, as measured by HHI, on log real hourly mean earnings. Columns represent different regressions, which include the indicated fixed effects and weighting or not in that regression. All regressions are unweighted. Standard errors were clustered at the regional labour market level. Table was created using asdoc, a Stata program written by Shah (2018).

Appendix F: Main Estimation Excluding Monopsonistic Markets

Table 11

Effects of Regional Industrial Concentration on Mean Real Hourly Earnings Excluding Monopsonistic Markets

Variables	(1)	(2)	(3)	(4)
log(HHI)	0.105*** (0.011)	0.105*** (0.011)	0.040*** (0.009)	0.039*** (0.009)
constant	2.821*** (0.050)	2.820*** (0.050)	2.601*** (0.032)	2.595*** (0.031)
Observations	28990	28990	28907	28907
R-squared	0.244	0.266	0.954	0.977
Weighted	1	1	1	1
Year FEs	0	1	0	0
Market FEs	0	0	1	1
Year x Region FEs	0	0	0	1

Clustered standard errors are in parentheses

*** p<.01, ** p<.05, * p<.1

Source: “Quadros de Pessoal” data set.

Notes: Table reports fixed effects regression estimates of the effect of regional labour market concentration, as measured by HHI, on log real hourly mean earnings. Columns represent different regressions, which include the indicated fixed effects and weighting or not in that regression. Total market employment is used as weights. Monopsonistic markets (i.e., HHI = 10,000) were excluded. Standard errors were clustered at the regional labour market level. Table was created using asdoc, a Stata program written by Shah (2018).

Appendix G: Preferred Estimation on 80/20 and 75/25 Inequality Ratios

Table 12

Effects of Regional Industrial Concentration on Other Earnings Inequality Ratios

Variables	80/20 (1)	75/25 (2)
log(HHI)	-0.020*** (0.006)	-0.017*** (0.006)
constant	0.479*** (0.012)	0.383*** (0.010)
Observations	32582	32582
R-squared	0.754	0.722
Weighted	0	0
Year FEs	0	0
Market FEs	1	1
Year x Region FEs	1	1

Clustered standard errors are in parentheses

*** p<.01, ** p<.05, * p<.1

Source: “Quadros de Pessoal” data set.

Notes: Table reports fixed effects regression estimates of the effect regional labour market concentration, as measured by HHI, on three different ratios of earnings inequality, constructed from the QP data set. The 80/20 ratio was constructed by dividing the real hourly earnings of the worker at the 80th percentile by the one in the 20th in the same market. This methodology applies to the other inequality ratio. Columns represent different regressions, which include the indicated fixed effects and weighting or not in that regression. All coefficients represent elasticities. Standard errors were clustered at the regional labour market level. Table was created using asdoc, a Stata program written by Shah (2018).

Appendix H: Preferred Estimation on Key Earnings Percentile

Table 13

Effects of Regional Industrial Concentration on Key Earnings Percentiles

Variables	10th (1)	30th (2)	50th (3)	70th (4)	90th (5)
log(HHI)	0.050*** (0.004)	0.062*** (0.005)	0.063*** (0.006)	0.050*** (0.006)	0.017** (0.008)
constant	2.045*** (0.008)	2.189*** (0.009)	2.328*** (0.011)	2.490*** (0.012)	2.766*** (0.015)
Observations	32582	32582	32582	32582	32582
R-squared	0.784	0.829	0.842	0.842	0.842
Weighted	0	0	0	0	0
Year FEs	0	0	0	0	0
Market FEs	1	1	1	1	1
Year x Region FEs	1	1	1	1	1

Clustered standard errors are in parentheses

*** p<.01, ** p<.05, * p<.1

Source: “Quadros de Pessoal” data set.

Notes: Table reports fixed effects regression estimates of the effect regional labour market concentration, as measured by HHI, on three different ratios of earnings inequality, constructed from the QP data set. The key earnings percentiles were constructed by real hourly earnings of the worker at the respective percentile in the given regional labour market. Columns represent different regressions, which include the indicated fixed effects and weighting or not in that regression. All coefficients represent elasticities. Standard errors were clustered at the regional labour market level. Table was created using asdoc, a Stata program written by Shah (2018).

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