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# Human Capital, Gender, and Regional Labour Market Disparities: Evidence from Türkiye's NUTS-2 Regions

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# Abstract

This study explores how regional differences in human development shape labour market outcomes across Türkiye's 26 NUTS-2 regions between 2018 and 2022. Drawing on the World Bank Human Capital Index framework, we examine three dimensions of human capital: health, education and income. We link these to employment rates, unemployment rates, labour force participation rates and earnings shares. We conduct all estimations separately for men and women using a two-way fixed-effects panel model with Driscoll–Kraay standard errors. Our findings show that health is the most consistent driver of positive labour market outcomes for both men and women, with effects systematically larger for women. Education boosts female employment and labour force participation, but is negatively associated with men's labour market attachment. This pattern reflects persistent skill mismatches in regional economies where high-skill job creation has not kept pace with rising educational attainment. Regional income growth tends to improve men's employment and reduce men's unemployment, but its effects on women are weaker and largely insignificant. Across all three dimensions, earnings gap between men and women widens. As human capital improves, more women enter labour market, but they are absorbed into lower-wage positions, leaving earnings distribution increasingly skewed in favour of men. These findings suggest that women's entry into the labour market is concentrated in lower-paid sectors, while the gains from human capital improvements are captured more strongly by men. By offering post-pandemic, spatially disaggregated evidence from an emerging economy context, this paper contributes to the regional science literature by providing sub-national evidence on the multidimensional and gender-differentiated effects of human capital on labour market outcomes across NUTS-2 regions.



**JEL Codes:** J24, J31, J71, R12, O15.


# 1. Introduction

Türkiye provides a useful regional setting for examining how uneven human capital endowments are associated with labour market differences. Despite decades of sustained economic growth and significant public investment in education and healthcare, Türkiye continues to exhibit pronounced and persistent regional inequalities that are deeply embedded in its economic and social geography. The gap between industrialized, service-oriented western provinces and predominantly agrarian, lower-income eastern regions remains one of the most structurally entrenched features of the Turkish economy. This reflects historical patterns of uneven development that national policies have repeatedly struggled to address (Erdem, 2016; Karaalp-Orhan, 2020; Karahasan & Bilgel, 2020).

These regional inequalities are closely linked to uneven human capital endowments. Educational attainment, health outcomes, and economic capacity remain unevenly distributed across Türkiye's 26 NUTS-2 regions, particularly between eastern and western regions. This shapes not only individual productivity but also the structural character of regional labour markets. Erdem (2016) shows that human capital is distributed highly unequally across Turkish regions, with eastern provinces consistently lagging behind their western counterparts in educational attainment and overall labour force quality. This

gap translates into different labour market outcomes, visible in employment rates, workforce participation, wage levels and degree to which men and women are excluded from the labour market altogether. The expansion of higher education since the mid-2000s has broadened access to tertiary credentials, but as Polat (2017) points out, returns to education and geographic distribution of higher education institutions remain heavily skewed. This makes it important to examine whether *does simply expanding the quantity of education actually produce equitable labour market gains across regions?*

The period covered in this paper coincides with a phase of acute macroeconomic turbulence and structural labour market adjustment in Türkiye. The COVID-19 pandemic delivered a severe and immediate shock to economic activity. Açıkgöz and Günay (2021) document that Türkiye experienced a sharp GDP contraction in early 2020, accompanied by significant labour market disruptions with employment losses concentrated in contact-intensive service sectors, informal employment arrangements, and among younger workers and women. But the distributional consequences of pandemic extended well beyond initial contraction. Bayar, Günçavdı and Levent (2023) show that pandemic significantly worsened unemployment, compressed household incomes and deepened poverty. These effects were regressive, falling disproportionately on lower-income households and workers with limited human capital. Tekgüç, Ünsal and Yeldan (2023) further document that both poverty and income inequality rose substantially during this period. The absence of targeted social protection responses amplified these outcomes for the most vulnerable segments of the workforce.

The pandemic's differential impact on men and women deserves particular attention in the Turkish context. Corsi and Ilkkaracan (2023) show that COVID-19 intensified pre-existing inequalities between men and women in labour markets across middle-income economies. Women faced disproportionate employment losses driven by their concentration in hospitality, retail, and domestic services — sectors that were hit hardest — as well as a surge in unpaid care responsibilities stemming from school closures and household disruptions. In Türkiye, where women's labour force participation was already structurally low before the pandemic, these dynamics risked deepening labour market exclusion and widening the earnings gap between men and women, particularly in already disadvantaged regional labour markets.

The post-pandemic recovery has been geographically uneven. Western metropolitan regions rebounded more quickly, supported by stronger institutional infrastructure and higher pre-crisis human capital stocks. By contrast, eastern and southeastern regions have followed a slower and more fragile recovery path, which is weighed down by weaker human capital endowments and a heavier dependence on informal and low-productivity employment. This concern with labour market resilience is consistent with Giannakis and Mamuneas (2022), who show that pre-crisis human capital endowments are among the strongest regional buffers against employment shocks in European NUTS-2 regions — a finding that motivates our focus on the 2018–2022 period, which spans both the pandemic shock and the uneven recovery phase in Türkiye.

Against this backdrop, we examine the relationship between regional human capital endowments and labour market outcomes across Türkiye's 26 NUTS-2 regions for 2018–2022 period. The central research

question is whether and how differences in health, education and income dimensions of human capital translate into differences in employment rates, unemployment rates, labour force participation and earning shares by men and women across Turkish regions. The question is relevant for both regional science and regional development policy. We contribute to the growing body of regional science literature that examines how multidimensional human capital indices relate to labour market performance at sub-national level, extending earlier work by Erdem (2016) and Karahasan and Bilgel (2020) into the post-pandemic period. On policy side, results directly express to Türkiye's ongoing regional development agenda, that has placed considerable emphasis on educational expansion and healthcare investment as key instruments for closing spatial gaps in economic participation and income distribution.

Regional disparities in Türkiye are not reducible to single dimension. Karaalp-Orhan (2020) provides multi-faceted socio-economic account of regional inequality of Türkiye, emphasizing that income differences, educational gaps and health disparities co-evolve and reinforce one another across NUTS-2 geography. Karahasan and Bilgel (2020) further demonstrate that spatial concentration of human capital is partly driven by market access mechanisms, whereby proximity to economic centers generates self-reinforcing agglomeration effects that deepen human capital divide between East and West. Çınar (2024) similarly shows that relatedness of regional product space shapes provincial growth trajectories. This highlights structural factors beyond aggregate human capital stocks including sectoral composition and productive diversification that mediate translation of human capital into employment and income outcomes. These findings collectively motivate a regional panel approach that allows both spatial and temporal variation to be exploited in identifying how specific dimensions of human development relate to labour market outcomes.

The differential labour market effects of human capital across men and women merit particular attention in Turkish context. Esen and Seren (2022) show that inequality between men and women in both education and employment exerts significant negative effect on economic performance. This indicates that underutilization of women's human capital carries macroeconomic as well as distributional costs. Ozer and Suna (2020) document presence of persistent skill mismatches between outputs of vocational education system and labour market demand which disproportionately affect women's ability to secure stable, well-remunerated employment. Alpaydın (2015) further highlights that higher-education level skill needs in Turkish labour markets are inadequately mapped and institutionally underrepresented, contributing to structural misalignment between educational supply and regional demand for skilled labour. Başar and Eren (2022) complement these insights by demonstrating that interregional social development differences in Türkiye are associated with distinct patterns of labour market exclusion with lower-income eastern regions exhibiting both weaker human capital stocks and more pronounced employment gaps between men and women.

Our study makes three primary contributions to the literature: we adopt multidimensional human capital framework which draws on World Bank Human Capital Index conceptualization. This framework simultaneously captures health, education and income dimensions at the regional level, rather than

relying on a single proxy for human capital. We focus on the 2018–2022 period, which covers the post-pandemic recovery phase and provides timely evidence on how regional human capital endowments shape labour market resilience and recovery in a time of exceptional economic volatility. Last, we examine labour market outcomes for men and women within a systematic regional framework contributing to the regional science literature on how the spatial distribution of human capital intersects with inequalities between men and women in Türkiye's labour markets.

The remainder of the paper is organized as follows. Section 2 reviews conceptual and theoretical foundations of human capital measurement, together with relevant literature on regional disparities and labour market outcomes in Türkiye and comparable international contexts. Section 3 describes data and how we construct variables. Section 4 outlines our empirical strategy. Section 5 presents and interprets estimation results. Section 6 concludes with policy implications and directions for future research.

## 2. Theoretical Framework and Literature Review

# 1.1. Human Capital: Concept, Measurement and Multidimensional Frameworks

Human capital refers to the productive capacities embedded in individuals — encompassing the knowledge, skills, competencies, and health attributes through which economic value is generated. Rooted in the foundational contributions of Schultz (1961) and Becker (1964), the concept treats investment in people as analytically analogous to investment in physical capital: resources directed toward education, training, and healthcare yield future returns in the form of higher productivity and earnings. This theoretical framing has proven remarkably durable, and the accumulated empirical literature broadly supports the view that human capital constitutes a central determinant of both individual labour market outcomes and aggregate economic performance. That said, operationalizing human capital for empirical and policy purposes remains a genuinely contested and technically demanding endeavour — one that has prompted scholars to advance a wide range of measurement frameworks in an effort to capture its multiple dimensions (Folloni & Vittadini, 2010; Liu & Fraumeni, 2020; Abraham & Mallatt, 2022).

Folloni and Vittadini (2010) offer a comprehensive survey of human capital measurement approaches, identifying three broad methodological traditions: cost-based methods, which value human capital by the resources invested in its formation; income-based methods, which capitalize the future earnings stream attributable to human capital; and indicator-based approaches, which construct composite indices from observable proxies such as educational attainment, school enrollment, and health outcomes. Cost-based methods reflect the inputs channeled into human capital formation, yet fall short of capturing the productive value of the resulting stock. Income-based methods — developed most systematically in the lifetime income framework of Jorgenson and Fraumeni (1989) and later extended by Liu and Fraumeni (2020) — offer economically coherent valuations, but are sensitive to the quality of earnings data and the choice of discount rate assumptions. Indicator-based composite indices, by contrast, are more readily

applicable at the regional and sub-national level, where micro-level earnings data are often unavailable or unreliable. They also allow for transparent cross-regional comparison of human capital endowments (Bassi & McMurrer, 2008).

The World Bank Human Capital Index (HCI), introduced in 2018 and detailed in Kraay (2018, 2019) and Corral et al. (2021), represents one of the most widely used recent applications of the composite index approach. The HCI measures human capital child born today can expect to attain by age eighteen, given prevailing education and health conditions, combining five indicators — child survival rates, expected years of quality-adjusted schooling, harmonized test scores, adult survival rates and stunting prevalence — into single index scaled between zero and one. Its conceptual architecture has been adapted by growing number of researchers for sub-national and regional analysis, providing structured framework for decomposing human capital into its health and education components and linking these to productivity and labour market outcomes (Kraay, 2019). Our study draws on HCI framework to construct regional human capital indicators for Türkiye's NUTS-2 regions, using regional data on life expectancy, educational attainment and income as proxies for health, education and income dimensions of human capital, respectively. Dańska-Borsiak (2023) applies a comparable composite indicator approach to examine human capital convergence across European NUTS-2 regions, confirming that indicator-based indices are tractable and informative for regional panel analyses — an approach closely aligned with the methodology adopted in this study.

The health and survival dimensions of human capital have attracted growing theoretical and empirical interest. Grossman (1972) provided the foundational framework, conceptualizing health as a durable capital stock that depreciates over time but can be replenished through investment. Bleakley (2010) and Bloom and Canning (2003) extended this logic by demonstrating that better health enhances the productivity of time spent in schooling, reduces absenteeism, and prolongs individuals' productive working lives — positioning health as a direct constituent of human capital rather than a mere welfare outcome. Schultz (2003) offers robust empirical support for this view, documenting significant associations between health status and both educational attainment and labour market earnings across developing economies. Madsen (2016) broadens the temporal scope, showing that improvements in health and longevity have served as central drivers of human capital accumulation across two centuries of economic development. Azarnert (2006) adds a demographic dimension, demonstrating that declines in child mortality strengthen parental incentives to invest in child quality, thereby producing a dynamic feedback between survival rates and human capital formation. Collectively, these contributions highlight the need to incorporate health and survival into composite human capital indices, given that educational and income measures alone cannot fully reflect the productive capacity embedded within a population.

## 1.2. Human Capital, Economic Growth and Labour Market Outcomes

The theoretical relationship between human capital and economic growth was formalized in the endogenous growth models of Lucas (1988) and Romer (1989), both of which placed human capital

accumulation at the center of the growth process. Lucas (1988) developed a model in which investment in education generates externalities capable of sustaining long-run growth, while Romer (1989) emphasized the role of human capital in driving technological innovation and knowledge production. Caballé and Santos (1993) extended this framework to examine the joint accumulation of physical and human capital, demonstrating that the optimal allocation of time across work, education, and leisure determines the balanced growth path. Taken together, these theoretical contributions established that human capital is not merely a private input into production, but a source of aggregate externalities — ones that provide a rationale for public investment in education and health.

The empirical literature broadly confirms a positive association between human capital indicators and economic performance. Bucci, Prettner, and Prskawetz (2019) synthesize evidence that complementarities between health, education, and demographic change are empirically meaningful — and that analyses concentrating on a single dimension are likely to understate the total effect. Islam (2020) and Bah (2023) offer panel data evidence from developing country contexts confirming a positive human capital–growth nexus, while Dias and Tebaldi (2012) show that the institutional environment mediates the growth effects of human capital. For Türkiye specifically, Gömleksiz and Özşahin (2017) confirm that human capital — measured by the share of tertiary education graduates — exerts a statistically significant and positive effect on regional per capita income across the 26 NUTS-2 regions, consistent with endogenous growth theory.

The theoretical link between human capital and individual labour market outcomes is grounded in the Mincerian framework and its extensions. Higher human capital endowments raise the marginal product of labour, increasing both the wage that employers are willing to offer and the reservation wage at which workers choose to participate. This mechanism predicts that individuals with greater human capital — whether measured by years of schooling, educational quality, or health status — should command higher wages, experience lower unemployment, and exhibit higher rates of labour force participation. Sahn and Alderman (1988) offer an early empirical confirmation of these relationships in a developing country context, showing that human capital investments in education and health simultaneously raise wages and shape labour supply decisions. Guvenen, Kuruscu, and Ozkan (2014) extend this analysis to a cross-country framework, documenting that the interaction between human capital taxation, wage inequality, and labour supply carries meaningful distributional implications that vary considerably across institutional settings.

The relationship between education and wage inequality has been a central concern in the labour economics literature. Tinbergen (1972) established the foundational argument that technological change continuously raises demand for skilled labour, and that the evolution of wage inequality reflects the relative pace of human capital supply and technological demand. Mincer (1996) documents a widening of wage inequality driven by skill-biased technological change and confirms the skill-premium mechanism at the regional level. For Türkiye, Patrinos, Psacharopoulos, and Tansel (2019, 2021) estimate private and social returns to education and find rates broadly comparable to those in other middle-income economies, though with notable variation across education levels and time periods.

Tansel and Bodur (2012) demonstrate, using quantile regression, that wage returns to education in Türkiye are heterogeneous across the earnings distribution, with higher returns concentrated at the upper quantiles. Aydemir and Kırdar (2017), exploiting a major compulsory schooling reform, find modest returns at lower education levels — suggesting that the wage effects of schooling vary considerably depending on the quality and level of education attained. Acar and Dogruel (2012) situate Turkish wage inequality within a comparative MENA regional perspective, documenting that structural change and educational expansion interact in complex ways to shape distributional outcomes.

The literature also highlights the importance of skill-matching between human capital supply and labour market demand. Handel (2003) documents that over-education and under-employment are pervasive phenomena that reduce returns to human capital investment and generate inefficiencies in labour allocation. Fasih (2008) and Cellini and Chaudhary (2014) further show that education and training programmes must be designed with employer demand in mind, and that the institutional context mediates the relationship between credentials and earnings. These insights are particularly relevant to the Turkish context, where the rapid expansion of higher education enrollment has raised growing concerns about graduate unemployment and skill mismatches. Özaydin, Metin, and Kurnaz (2009) find that educational credentials exert considerable influence on hiring decisions in Türkiye, while Alpaydın (2015) highlights that higher-education-level skill needs in Turkish labour markets are institutionally underrepresented — contributing to a structural misalignment between educational supply and regional demand. Özer and Suna (2020) similarly document persistent skill mismatches in the vocational education system, which disproportionately affect women's ability to secure stable, well-remunerated employment.

## 1.3. Regional Disparities and Human Capital Concentration in Türkiye

The spatial dimension of human capital has emerged as an important field of inquiry within regional economics, motivated by the observation that regional concentrations of skilled labour generate agglomeration externalities that amplify productivity differences between locations. Faggian, Modrego, and McCann (2019) provide an authoritative overview of this literature, highlighting that the geographic clustering of high-skill workers creates knowledge spillovers, thicker labour markets, and higher returns to human capital investment — all of which reinforce the concentration of economic activity in more advanced regions. Fischer et al. (2009) provide econometric evidence that human capital exerts a significant and positive effect on regional labour productivity across European regions, with spatial spillover effects suggesting that the productivity benefits of human capital investment extend beyond the investing region. Xu and Li (2020) confirm similar patterns in China, demonstrating that innovative human capital contributes to interprovincial income convergence — but that spatial econometric methods are necessary to account for underlying spillover structures. More recently, Sanchis-Llopis (2025) confirms these patterns for a broader set of 121 NUTS-2 regions, finding that human capital exerts direct positive effects on regional labour productivity, though partially offset by negative spatial spillovers across neighbouring regions. Eriksson and Hansen (2013) further find that regions specialized

in high-skill industries exhibit both higher human capital stocks and faster human capital accumulation, generating a self-reinforcing cycle of spatial inequality that is particularly relevant to the Turkish regional context.

The spatial dimension of regional inequality in Türkiye has been documented extensively. Karaalp-Orhan (2020) offers a multi-faceted socio-economic account of regional inequality, emphasizing that income differences, educational gaps, and health disparities co-evolve and reinforce one another across the NUTS-2 geography. Karahasan and Bilgel (2020), drawing on the New Economic Geography framework, demonstrate that regions with greater proximity to economic centers accumulate considerably more human capital — and that centralized regional development policies in Türkiye have largely failed to address the underlying market-driven mechanisms perpetuating these disparities. Kirankabeş and Arik (2014) analyze industrial clustering in Turkish regions and find that spatial agglomeration reinforces human capital disparities, as skilled workers and knowledge-intensive industries concentrate in western metropolitan regions while eastern provinces remain dependent on lower-productivity activities. Erdem (2016) similarly documents that human capital is distributed highly unequally across Turkish regions, with eastern provinces consistently lagging behind in educational attainment and overall labour force quality. Çınar (2024) shows that the relatedness of regional product space shapes provincial growth trajectories, highlighting that structural factors beyond aggregate human capital stocks — including sectoral composition and productive diversification — mediate the translation of human capital into employment and income outcomes.

At the regional panel level, Güçlü (2017) conducts a spatial econometric analysis of regional unemployment disparities across the 26 NUTS-2 regions of Türkiye for 2004–2013, identifying educational attainment as the strongest determinant of unemployment — with higher proportions of workers with secondary and tertiary education associated with substantially lower unemployment rates both within regions and in adjacent areas, reflecting considerable cross-regional spillovers. Eriş-Dereli and Pinar (2025) examine convergence in skilled labour force shares across Turkish regions between 2005 and 2022 and find an absence of overall convergence, with two distinct convergence clubs: one comprising high-skilled western regions and another consisting of lower-skilled eastern regions. This persistent regional polarization in human capital reinforces the structural east–west divide documented in the broader inequality literature and provides direct motivation for a regional panel framework that exploits spatial and temporal variation in human capital endowments. Başar and Eren (2022) complement these findings by demonstrating that interregional social development differences are associated with distinct patterns of labour market exclusion — with lower-income eastern regions exhibiting both weaker human capital stocks and more pronounced employment gaps between men and women. Polat (2017) further shows that returns to education and the distribution of higher education institutions remain regionally skewed, raising a fundamental question: does the quantitative expansion of tertiary education actually translate into equitable labour market gains across regions?

The impact of external labour market shocks on regional human capital dynamics is illustrated by Çakır, Erbay, and Kırdar (2023), who examine the effect of Syrian refugee inflows on the human capital

accumulation of working-age native children across the NUTS-2 regions over 2004–2015. Their findings indicate that refugee inflows considerably altered schooling decisions and labour market attachment in ways that varied systematically across men and women and parental education level. This highlights how external shocks interact with existing human capital disparities and structural inequalities between men and women in Turkish regional labour markets.

## 1.4. Gaps in Labour Market Outcomes: Human Capital, Occupational Segregation and Structural Constraints

The differential labour market effects of human capital across men and women represent a central concern in the Turkish context, given the country's structurally low female labour force participation and persistent earnings gaps. Esen and Seren (2022) show that inequality between men and women in both education and employment exerts a considerable negative effect on economic performance in Türkiye, indicating that the underutilization of women's human capital carries macroeconomic as well as distributional costs. ILO research similarly documents that disparities between men and women in labour market outcomes persist across middle-income countries even as aggregate human capital indicators improve — particularly in economies characterized by occupational segregation and informal employment. These are patterns clearly reflected in Türkiye's regional labour markets, where women's employment remains heavily concentrated in informal and part-time positions that carry lower earning shares relative to men.

Aldan (2021) investigates the relationship between women's labour force participation and the wage gap between men and women using regional data from Türkiye over 2009–2018, finding that rising female labour force participation is paradoxically associated with a widening earnings differential relative to men. This counterintuitive result reflects compositional effects: as more women enter the workforce, they tend to be absorbed into lower-wage and less-protected positions which in turn widens the earnings gap. Corsi and Ilkkaracan (2023) further show that COVID-19 intensified pre-existing inequalities between men and women in labour markets across middle-income economies, with women facing disproportionate employment losses driven by their concentration in hospitality, retail, and domestic services, as well as a surge in unpaid care burdens. In Türkiye, where women's labour force participation was already structurally low before the pandemic, these dynamics deepened labour market exclusion and widened the earnings gap throughout the post-2020 period.

The post-pandemic recovery has been geographically uneven. Western metropolitan regions rebounded more quickly, supported by more diversified economic bases, stronger institutional infrastructure, and higher pre-crisis human capital stocks, while eastern and southeastern regions followed a slower and more fragile recovery path. Evidence from this period is consistent with the broader literature on human capital as a buffer against labour market shocks: regions with higher pre-pandemic education and health indices were better positioned to sustain employment levels and limit wage losses during the contraction. Women's employment recovery has been slower and more heavily concentrated in informal

arrangements — contributing to the widening of the earnings gap observed in post-2020 data, a pattern that provides meaningful context for interpreting the empirical results presented in this study.

## 1.5. Positioning of Our Study

The literature reviewed above reveals several important gaps that our paper aims to address. First, majority of existing empirical work on Türkiye focuses either on single labour market outcome — typically employment or unemployment — or on single dimension of human capital, most commonly educational attainment. We adopt more comprehensive framework by simultaneously examining employment rates, unemployment rates, labour force participation and earning shares by men and women as outcomes of interest. We use multidimensional human capital index that incorporates health, education and income dimensions. Second, existing literature on Türkiye largely relies on pre-2018 data, predating period of significant labour market volatility associated with post-2018 exchange rate crisis, the COVID-19 pandemic and subsequent recovery phase. By covering the 2018–2022 period, the present study provides timely evidence on human capital–labour market linkages during period of exceptional macroeconomic turbulence. Third, while dimension of human capital across men and women effects on labour market outcomes is noted in several studies, it has not been systematically analyzed in regional panel framework for Türkiye. Our paper contributes to this gap by estimating models separately for men and women across all outcome variables, enabling direct comparison of how health, education and income dimensions of human capital differentially shape labour market outcomes across NUTS-2 regions.

# 3. Data

The empirical analysis draws on a balanced panel dataset covering the period 2018–2022 for Türkiye's 26 NUTS-2 regions. This regional framework provides both spatial and temporal variation, enabling the study to examine differences in labour market outcomes across regions and over time. The primary labour market indicators — employment rate, unemployment rate, and labour force participation (LFP) rate — are obtained from the Household Labour Force Survey (HLFS) conducted by the Turkish Statistical Institute (TurkStat). These statistics are compiled in accordance with International Labour Organization (ILO) standards and harmonized with Eurostat definitions, ensuring methodological consistency and international comparability.

Table 1 summarizes the variables used in the analysis. The dependent variables represent key labour market outcomes, including employment, unemployment, labour force participation and earnings shares by men and women. The earnings gap is defined as difference between earnings of men and women.

Table 1
Description and Definition of Variables

| **Employment Rate** | **Percentage of population (15+) currently employed.** |
|---|---|
| Unemployment Rate | The percentage of labour force that is unemployed and actively seeking work. |
| LFP Rate | Labour Force Participation rate; ratio of labour force to 15 + population. |
| Earning Share | Ratio of average earnings of men and women to total regional average earnings (%) |
| Earning Gap | The numerical difference between men's and women's earnings. |
| Life Expectancy | Proxy for regional health; average number of years newborn is expected to live. |
| Education Index | Proxy for human capital; combines expected years of schooling and achievement tests. |
| Income Index | Regional economic capacity and per capita income indicators. |
| Job Vacancy Rate | Total number of job vacancies normalized by regional population. |
| Job Placement Rate | Number of successful job placements via İŞKUR normalized by population. |
| Registered Unemployment | Number of individuals registered as unemployed at İŞKUR (normalized). |
| Workplace Density | Total number of active workplaces in region normalized by population. |
| GDP Growth | Annual percentage growth rate of regional Gross Domestic Product. |
| Youth Unemployment | Unemployment rate for population aged 25–34. |
| Youth LFP Rate | Labour force participation rate for population aged 25–34. |

The main explanatory variables capture three core dimensions of human development: health, education, and income. These indicators are constructed in line with the conceptual framework of the World Bank's Human Capital Index (HCI), which evaluates the productivity potential of individuals based on prevailing health and education conditions.

The health dimension is proxied by the life expectancy index, which reflects regional health conditions and longevity outcomes. The education dimension measures regional human capital accumulation by combining information on expected years of schooling and educational achievement indicators. The income dimension represents regional economic capacity and is derived from regional income indicators reported by TurkStat.

To complement the survey-based labour market indicators, additional variables are drawn from the administrative records of the Turkish Employment Agency (İŞKUR). These include the number of job vacancies, job placements, and registered unemployment. Together, these administrative indicators offer

additional insight into labour market activity and institutional matching mechanisms. Finally, regional Gross Domestic Product (GDP) data are incorporated to capture overall economic capacity and regional business cycle fluctuations — allowing the empirical analysis to control for differences in regional economic conditions that may influence labour market outcomes.

Table 2 presents descriptive statistics for the dependent, independent, and control variables used in the empirical analysis. The statistics provide an overview of regional variation in labour market outcomes and human development indicators across Türkiye's NUTS-2 regions.

A first observation concerns the substantial gap between men and women in labour market participation and employment. The average labour force participation rate for men stands at 69.7%, while the corresponding rate for women is considerably lower at 32.5%. A similar disparity is evident in employment outcomes: the mean employment rate for men is 62.3%, compared with only 28.0% for women. These figures reflect persistent differences in labour market attachment across regions. Unemployment rates also differ noticeably across men and women. The average unemployment rate is 10.7% for men and 14.2% for women. Women's unemployment also exhibits greater dispersion across regions, as reflected by a higher standard deviation and larger maximum values — suggesting that women's labour market outcomes are more sensitive to regional economic conditions.

Distributional indicators further highlight these disparities. The average earnings share for men sits slightly above the regional mean at 103.46, while the corresponding figure for women is 91.72. The average earnings gap — defined as the difference between men's and women's earnings shares — stands at − 11.74 percentage points. The wide range observed across regions indicates that the degree of earnings inequality varies substantially from one region to another.

Table 2
Descriptive Statistics

| Variables | Mean | Std. Dev. | Min | Max | Skew. | Kurt. |
|---|---|---|---|---|---|---|
| LFP Rate (Men) | 69.734 | 3.507 | 60 | 78.9 | − .206 | 3.442 |
| LFP Rate (Women) | 32.464 | 5.95 | 17.4 | 43.5 | − .356 | 2.614 |
| Unemployment Rate (Men) | 10.684 | 5.204 | 3.7 | 32.7 | 1.865 | 6.928 |
| Unemployment Rate (Women) | 14.164 | 5.831 | 4.7 | 42.1 | 1.73 | 7.831 |
| Employment Rate (Men) | 62.329 | 5.223 | 40.4 | 75 | -1.136 | 5.573 |
| Employment Rate (Women) | 28.0 | 5.911 | 11.9 | 40.4 | − .442 | 3.0 |
| Earning Share (Men) | 103.462 | 3.067 | 97.128 | 112.061 | .273 | 3.088 |
| Earning Share (Women) | 91.723 | 7.662 | 68.65 | 109.781 | − .279 | 4.218 |
| Earning Gap | -11.739 | 10.657 | -43.215 | 12.653 | − .26 | 3.882 |
| Life Expectancy Index | 89.285 | 1.233 | 86.476 | 92.359 | .289 | 2.77 |
| Education Index | 77.074 | 4.061 | 65.693 | 85.206 | − .869 | 3.549 |
| Income Index | 81.913 | 5.215 | 70.973 | 92.862 | − .084 | 2.525 |
| Open Vacancy | 2429.682 | 983.603 | 694.262 | 4884.182 | .236 | 2.77 |
| Job Placement (Men) | 907.88 | 301.701 | 256.801 | 1739.349 | − .391 | 3.97 |
| Job Placement (Women) | 465.394 | 218.993 | 95.031 | 860.536 | − .059 | 1.849 |
| Unemployment (Registered Men) | 2198.687 | 615.018 | 1486.603 | 3872.298 | 1.199 | 3.856 |
| Unemployment (Registered Women) | 2382.571 | 569.549 | 1310.69 | 3996.958 | 1.209 | 4.704 |
| Workplace Density | 2052.191 | 736.924 | 714.005 | 3843.776 | .019 | 2.549 |
| Regional GDP Growth | 4.432 | 5.305 | -19.517 | 21.294 | .213 | 7.116 |
| Youth Unemployment Rate (age 25–34) | 14.175 | 4.792 | 6.7 | 32.9 | 1.679 | 6.642 |
| Youth LFP Rate (age 25–34) | 68.611 | 6.037 | 49.1 | 80.8 | − .602 | 3.07 |

Turning to the human development indicators, the life expectancy index displays relatively limited regional variation, with a mean of 89.28 and a small standard deviation. In contrast, the education and income indices exhibit greater dispersion. The education index ranges from 65.69 to 85.20, while the income index ranges from 70.97 to 92.86 — indicating considerable regional differences in educational attainment and economic capacity. The administrative labour market indicators drawn from İŞKUR

similarly reveal notable regional variation. The number of open vacancies, job placements, and registered unemployment differ substantially across regions, reflecting differences in labour demand and institutional labour market activity. Workplace density likewise varies widely, pointing to an uneven geographic distribution of economic activity. Finally, regional GDP growth shows considerable volatility during the sample period, with values ranging from sharp contractions to rapid expansions. Youth labour market indicators also exhibit substantial variation, with the youth unemployment rate averaging 14.2% and reaching markedly higher levels in some regions.

Overall, the descriptive statistics indicate substantial regional heterogeneity in both labour market conditions and human development indicators — providing the empirical basis for the panel data analysis presented in the sections that follow.

# 4. Empirical Strategy

The empirical literature reviewed above employs a variety of methodological approaches to examine the relationship between human capital and labour market outcomes at the regional level. Panel data models — particularly fixed-effects and dynamic panel specifications — are the predominant approach, offering the ability to control for unobserved regional heterogeneity and time-invariant characteristics that may confound cross-sectional estimates. Spatial panel models, as employed by Güçlü (2017) and Karahasan and Bilgel (2020), represent a methodological advance over standard panel approaches by explicitly accounting for spatial autocorrelation and spillover effects between neighboring regions.

Several studies employ composite index approaches to measure human capital at the regional level, constructing multidimensional indicators that combine education, health, and income components — an approach closely aligned with the methodology adopted in this study. The use of the World Bank HCI framework as conceptual basis for constructing regional human capital indicators represents a contribution of this literature to broader field of regional economics, allowing cross-regional and cross-country comparisons on a standardized basis.

Dynamic panel estimators, including Arellano-Bond difference GMM and Blundell-Bond system GMM, are widely used in regional growth and human capital convergence literature to address endogeneity concerns arising from persistence of human capital stocks over time. The two-way fixed-effects specification with Driscoll-Kraay standard errors is consistent with this methodological tradition. This provides robust inference in presence of heteroskedasticity, autocorrelation and cross-sectional dependence — all of which are identified diagnostic concerns in Turkish regional panel data.

To examine the relationship between human development and regional labour market outcomes, empirical analysis employs two-way fixed effects panel data model. This specification allows estimation to control for unobserved time-invariant regional characteristics as well as common macroeconomic shocks affecting all regions over time.

The baseline empirical specification can be expressed as:

$$LMO_{ry}^{g} = \beta_0 + \beta_1 * \left(HDI_{iry}\right) + \partial * X_{ry} + \pi_r + \alpha_y + \epsilon_{ry}$$

1

where $LMO_{ry}$ represents designated labour market outcome (e.g., employment rate, unemployment rate, labour force participation, or earning share) for gender $g$ (0 for men, 1 for women) in NUTS-2 region $r$ at year y. The variable $HDI_i$ denotes specific human development proxy being evaluated, namely life expectancy, education, or income index. The vector $X_{ry}$ encompasses robust set of time-varying regional control variables. Furthermore Year (α), region (π), denote region and time fixed effects, respectively, which are incorporated to strictly absorb time-invariant spatial heterogeneities and unobserved aggregate macroeconomic shocks. Finally, $\epsilon_{ry}$ is idiosyncratic error term, capturing all remaining unobserved factors that vary at region-year level but are not explicitly specified in model.

Prior to estimation of baseline models, several diagnostic tests were conducted to determine appropriate panel data specification. A Hausman specification test was first applied to evaluate whether random effects or fixed effects estimator would be more appropriate. The test results rejected null hypothesis that individual effects are uncorrelated with regressors, supporting the use of the fixed effects specification. Additional diagnostic tests were performed to assess potential econometric issues in the panel structure. The Modified Wald test for group-wise heteroskedasticity indicated the presence of heteroskedasticity across regional units. The Wooldridge test for autocorrelation in panel data detected first-order serial correlation in the error terms. Furthermore, the Pesaran cross-sectional dependence test revealed substantial cross-sectional correlation across regions, which may arise from economic linkages, migration flows, or common policy shocks affecting regional labour markets.

Given the simultaneous presence of heteroskedasticity, serial correlation, and cross-sectional dependence, conventional standard errors may yield biased statistical inference. To address these issues, the estimation employs Driscoll–Kraay standard errors, which are robust to heteroskedasticity, autocorrelation, and cross-sectional dependence in panel data settings. The empirical models also include a set of control variables capturing regional labour market conditions and macroeconomic dynamics. These controls comprise regional GDP growth to account for cyclical economic fluctuations, normalized labour market indicators drawn from İŞKUR administrative records — such as job vacancies, job placements, registered unemployment, and workplace density — and youth labour market indicators. Together, these variables help isolate the structural effects of human development from short-term economic shocks and regional labour market conditions. A potential concern in this framework is reverse causality between human development indicators and labour market outcomes. However, several features of our data and specification limit this concern. Life expectancy, educational attainment, and income indices are slowly evolving regional characteristics that are unlikely to respond to short-run labour market fluctuations within our five-year window. Moreover, the two-way fixed effects specification absorbs both time-invariant regional endowments and aggregate annual shocks, substantially reducing the scope for omitted variable bias. As a robustness check, we re-estimated all models using one-year

lagged values of the human development indicators; results remain qualitatively unchanged, providing further confidence in the direction and stability of the estimated effects.

# 5. Results and Discussion

Table 3 reports estimation results for employment outcomes. The findings indicate that different dimensions of human development affect men's and women's employment in distinct ways.

Table 3
Effect of Human Development Indicators on Employment Rate

| **Variables** | **Employment Rate (Men)** | **Employment Rate (Men)** | **Employment Rate (Women)** | **Employment Rate (Women)** |
|---|---|---|---|---|
| Life Expectancy | 2.260*** | 2.021*** | 1.741*** | 2.267*** |
| | (0.362) | (0.404) | (0.180) | (0.196) |
| Education | -0.267 | -0.697*** | 0.413*** | 0.246** |
| | (0.384) | (0.0919) | (0.0731) | (0.0603) |
| Income | 1.358*** | 0.360** | 0.751** | 0.194** |
| | (0.101) | (0.0990) | (0.165) | (0.0471) |
| Constant | -230.1** | -100.1* | -220.8*** | -166.2*** |
| | (56.16) | (39.20) | (29.88) | (13.22) |
| Outcome Mean | 62.329 | 62.329 | 28.001 | 28.001 |
| | (5.223) | (5.223) | (5.911) | (5.911) |
| Observations | 130 | 130 | 130 | 130 |
| Controls | N | Y | N | Y |

All estimations include regional fixed effects and robust set of controls for economic and labour market conditions. Economic growth (YoY) is included to control for annual transitory economic shocks. To account for regional scale effects, labour market indicators—including job vacancies, job placements, registered unemployment and total workplace density—are normalized by regional population. Furthermore, youth unemployment rate (ages 25–34) is included to control for structural rigidities affecting aggregate employment rate. Standard errors are Driscoll-Kraay robust to heteroskedasticity, autocorrelation and cross-sectional dependence. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

The life expectancy index shows positive and statistically significant relationship with employment for both men and women. Regions with higher health outcomes tend to exhibit higher employment rates. The magnitude of effect is particularly pronounced for women, suggesting that improvements in health conditions may facilitate greater labour market participation among women workers. Better health

conditions can reduce work interruptions, improve productivity and increase capacity of individuals to remain active in labour market. This finding is consistent with Grossman's (1972) health capital model: in regions where life expectancy is higher, workers face fewer health-related absences and sustain longer productive careers. For women specifically, better regional health infrastructure is likely to reduce the double burden of informal care provision, lowering the opportunity cost of labour market entry and supporting sustained employment. The education index exhibits heterogeneous effects between men and women. While education is positively associated with women's employment, it shows negative association with men's employment. This pattern may reflect structural imbalances between educational attainment and labour market demand. In particular, rising educational attainment without a corresponding expansion in high-skill employment opportunities may reduce employment probabilities for certain groups of workers. One possible interpretation is consistent with the credential inflation literature (Handel, 2003): as the supply of educated workers outpaces the structural transformation of regional labour markets — particularly in eastern NUTS-2 regions where manufacturing and high-skill services remain underdeveloped — higher qualifications increasingly fail to translate into employment gains for men. The income index is positively associated with men's employment, indicating that economically stronger regions tend to generate more employment opportunities for men. The estimated effect on women's employment, however, is weaker and statistically insignificant — a difference that may reflect the sectoral structure of regional economies, where employment growth is often concentrated in sectors that traditionally employ a larger share of male workers.

Table 4 presents estimation results for unemployment rates. The results indicate that relationship between human development indicators and unemployment also differs between men and women.

Table 4
Effect of Human Development Indicators on Unemployment Rate

| Variables | Unemployment Rate (Men) | Unemployment Rate (Men) | Unemployment Rate (Women) | Unemployment Rate (Women) |
|---|---|---|---|---|
| Life Expectancy | -1.607*** | -2.506*** | -1.022** | -2.644*** |
| | (0.332) | (0.177) | (0.328) | (0.284) |
| Education | -0.335 | 0.0389 | -0.687* | -0.511 |
| | (0.486) | (0.440) | (0.313) | (0.308) |
| Income | -0.914*** | -0.144** | -0.414* | 0.223 |
| | (0.0720) | (0.0454) | (0.180) | (0.174) |
| Constant | 254.8** | 204.3*** | 192.2** | 161.8*** |
| | (60.15) | (29.87) | (53.71) | (8.589) |
| Outcome Mean | 10.684 | 10.684 | 14.164 | 14.164 |
| | (5.204) | (5.204) | (5.831) | (5.831) |
| Observations | 130 | 130 | 130 | 130 |
| Controls | N | Y | N | Y |

All estimations include regional fixed effects and robust set of controls for economic and labour market conditions. Economic growth (YoY) is included to control for annual transitory economic shocks. To account for regional scale effects, labour market indicators—including job vacancies, job placements, registered unemployment and total workplace density—are normalized by regional population. Furthermore, youth labour force participation rate (ages 25–34) is included to control for structural rigidities affecting aggregate unemployment rate. Standard errors are Driscoll-Kraay robust to heteroskedasticity, autocorrelation and cross-sectional dependence. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

The life expectancy index is negatively associated with unemployment rates for both men and women — regions with better health outcomes tend to exhibit lower unemployment levels. This suggests that improvements in health conditions may enhance labour market attachment and reduce the probability of unemployment. The education index presents a more complex picture. For men, higher education levels are associated with slightly higher unemployment rates, although the magnitude of the effect remains limited. One possible explanation is that rising educational attainment may increase the number of job seekers with higher skill expectations, which are not always matched by available job opportunities. This may reflect a reservation wage effect. Since the mid-2000s, Türkiye has experienced a rapid expansion in university enrolment. In regions with limited high-skill employment capacity, this expansion may lengthen job-search durations among degree-holders. For women, the estimated effect of education on

unemployment is weaker and statistically insignificant — suggesting that education may influence women's labour market outcomes primarily through participation and employment decisions rather than unemployment dynamics. The income index is associated with lower unemployment among men, reflecting stronger labour demand in economically more developed regions. In contrast, the estimated effect on women's unemployment remains statistically insignificant. The absence of a significant income effect on women's unemployment likely reflects the structural segmentation of regional labour markets: economic growth in Türkiye's NUTS-2 regions has historically been concentrated in construction, manufacturing, and export-oriented sectors with male-dominated employment profiles, leaving women's unemployment largely unresponsive to aggregate income gains (Aldan, 2021).

Taken together, these findings indicate that regional economic development and health conditions are important factors in reducing unemployment, while the role of education appears to be more complex and differs between men and women.

Table 5 reports estimation results for labour force participation rates. The results reveal strong relationship between health conditions and labour market participation.

Table 5
Effect of Human Development Indicators on Labour Force Participation Rate

| Variables | LFP Rate (Men) | LFP Rate (Men) | LFP Rate (Women) | LFP Rate (Women) |
|---|---|---|---|---|
| Life Expectancy | 1.346** | 1.766** | 1.801*** | 2.511*** |
| | (0.446) | (0.475) | (0.247) | (0.328) |
| Education | -0.577** | -0.814*** | 0.399*** | 0.266** |
| | (0.131) | (0.0916) | (0.0316) | (0.0807) |
| Income | 0.830*** | 0.393** | 0.742** | 0.429** |
| | (0.133) | (0.102) | (0.176) | (0.110) |
| Constant | -73.87 | -81.09 | -219.8*** | -217.2*** |
| | (55.74) | (45.48) | (29.55) | (23.23) |
| Outcome Mean | 69.734 | 69.734 | 32.464 | 32.464 |
| | (3.507) | (3.507) | (5.950) | (5.950) |
| Observations | 130 | 130 | 130 | 130 |
| Controls | N | Y | N | Y |

All estimations include regional fixed effects and robust set of controls for economic and labour market conditions. Economic growth (YoY) is included to control for annual transitory economic shocks. To account for regional scale effects, labour market indicators—including job vacancies, job placements, registered unemployment and total workplace density—are normalized by regional population. Furthermore, youth unemployment rate (ages 25–34) is included to control for structural rigidities affecting labour force participation rate. Standard errors are Driscoll-Kraay robust to heteroskedasticity, autocorrelation and cross-sectional dependence. Standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1

The life expectancy index is positively associated with participation rates for both men and women. The magnitude of effect is again larger for women, suggesting that improvements in health conditions may reduce barriers to labour market entry and support greater women's participation. The education index also exhibits differences between men and women. Higher education levels are associated with lower participation rates for men but higher participation rates for women. This finding points to differences in labour market incentives and occupational opportunities between men and women. In particular, higher education may raise the expected returns to labour market participation for women. The negative education effect for men is less intuitive but may reflect a discouraged worker mechanism operating through extended job search: in regions where the regional job structure has not kept pace with rising educational credentials, more educated men are more likely to exit the labour force temporarily rather than accept employment below their qualification level — a pattern documented more broadly in middle-income economies by Guvenen et al. (2014). The income index has a positive effect on men's

participation but a limited effect on women's — an outcome that may again reflect the sectoral composition of regional economic growth and differences in labour demand across industries.

Overall, the results suggest that health improvements play an important role in expanding labour market participation, while the effects of education and income vary by gender and regional labour market structure.

Table 6 presents estimation results for earnings-related indicators. The findings indicate significant relationship between earnings dynamics and underlying dimensions of human development.

Table 6
Effect of Human Development Indicators on Average Earnings

| **Variables** | **Earning Gap** | **Earning Gap** | **Earning Share (Men)** | **Earning Share (Women)** |
|---|---|---|---|---|
| Life Expectancy | 1.876*** | 1.959*** | 0.583*** | -1.369*** |
| | (0.108) | (0.276) | (0.123) | (0.148) |
| Education | 1.659*** | 1.503*** | 0.298*** | -1.201*** |
| | (0.158) | (0.190) | (0.0545) | (0.130) |
| Income | 1.094*** | 0.770*** | 0.304*** | -0.465** |
| | (0.142) | (0.155) | (0.0228) | (0.119) |
| Constant | -373.1*** | -316.0*** | 5.003 | 321.6*** |
| | (14.53) | (9.074) | (8.159) | (2.074) |
| Outcome Mean | 11.739 | 11.739 | 103.462 | 91.723 |
| | (10.657) | (10.657) | (3.067) | (7.662) |
| Observations | 130 | 130 | 130 | 130 |
| Controls | N | Y | Y | Y |

While earning share refers to ratio of men's or women's specific average earnings to total average earnings, earning gap denotes difference between men's and women's earning shares. All estimations include regional fixed effects and robust set of controls for economic and labour market conditions. Economic growth (YoY) is included to control for annual transitory economic shocks. To account for regional scale effects, labour market indicators—including job vacancies, job placements, registered unemployment and total workplace density—are normalized by regional population. Furthermore, youth unemployment rate (ages 25–34) is included to control for structural rigidities affecting average earnings. Standard errors are Driscoll-Kraay robust to heteroskedasticity, autocorrelation and cross-sectional dependence. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

The results indicate that improvements in human development indicators are associated with systematic changes in distribution of earnings between men and women. In particular, higher levels of

life expectancy, education and income are positively associated with men's earning share, while corresponding coefficients for women's earning share are negative and statistically significant. As result, estimated coefficients for earnings gap are positive, indicating that improvements in these human development indicators are linked to widening difference between men's and women's earnings shares. The effect of life expectancy suggests that regions with better health outcomes experience an increase in relative share of men's earnings, accompanied by decline in women's share. Although improved health conditions may support broader labour market participation, distribution of income gains appears to be uneven across men and women. A plausible mechanism is occupational channelling: as health conditions improve and more women enter the labour force, the additional female workers are absorbed disproportionately into informal service employment and part-time positions — sectors with structurally lower wages — while men capture the productivity gains associated with health improvements in higher-paying formal sectors. A similar pattern emerges for education index. While higher educational attainment is generally associated with improved labour market outcomes, results suggest that increases in regional education levels are correlated with larger difference in earnings shares between men and women. This finding may reflect differences in occupational structures and the concentration of men and women in sectors with different earning potentials. This is consistent with the glass-ceiling interpretation advanced by Aldan (2021) for the Turkish case: educational expansion draws more women into the labour market, but horizontal occupational segregation — the concentration of female employment in education, health, and administrative services — prevents educational gains from closing the earnings gap. Men, by contrast, remain overrepresented in higher-wage manufacturing, construction, and managerial occupations where the earnings premium to education is substantially larger. The income index shows a positive and significant relationship with the earnings gap: regions with stronger economic capacity tend to exhibit higher earnings shares for men relative to women. This pattern may be related to the sectoral composition of regional economic activity, where higher-paying industries often employ a larger proportion of male workers.

Overall, the findings indicate that improvements in human development indicators are associated not only with changes in labour market participation and employment, but also with shifts in the distribution of earnings between men and women across regions.

The results show that human development affects regional labour market outcomes in different ways across men and women. While conventional economic theory suggests that human capital accumulation improves labour market efficiency, the two-way fixed effects estimations indicate that the benefits of human development are neither evenly distributed nor equally shared between men and women. Improvements in regional health, education, and income alter the composition of the workforce and generate distributional effects — particularly in terms of wage disparities between men and women and men's withdrawal from the labour force.

The health component of human development, proxied by regional life expectancy, emerges as the most consistent positive factor within the Turkish labour market. The results indicate that improvements in health significantly increase employment and labour force participation for both men and women while

reducing unemployment. The effect is particularly strong for women, suggesting that better health conditions and improved health infrastructure ease domestic care burdens and allow more women to participate in the labour market. However, this expansion in women's labour supply comes with a distributional imbalance. While more women enter the workforce, the resulting economic gains are largely captured by male workers — widening the earnings gap. This pattern suggests that women's new employment is concentrated in lower-wage and labour-intensive sectors, limiting the impact of increased participation on women's overall earnings share.

A key structural finding of analysis concerns role of regional education. For men, higher educational attainment does not translate into higher employment; instead, it is associated with lower labour force participation. The negative and statistically significant coefficients in men's employment and participation models suggest that increases in regional education levels may not always be matched by corresponding labour market opportunities. One possible explanation is the presence of skill mismatches between qualifications of labour force and structure of regional labour demand. In regions where economic activity remains concentrated in lower- or medium-skill sectors, expansion of educational attainment may not immediately generate additional employment opportunities for highly educated workers. As a result, some individuals may delay entry into labour market or remain outside labour force while searching for employment that matches their qualifications. Overall, these findings suggest that improvements in educational attainment alone may not be sufficient to strengthen men's labour market outcomes unless accompanied by structural changes in regional labour demand and expansion of higher-skilled employment opportunities.

For women, the education dynamic operates differently. Higher educational attainment increases both women's employment and labour force participation, but is simultaneously associated with a decline in women's earnings share — so that the wage gap between men and women widens even as women's participation grows. This divergence points to the persistence of occupational segregation and glass-ceiling effects across the NUTS-2 regions. Even as women attain higher levels of education, their employment remains concentrated in lower-paid service occupations and administrative positions that do not carry the wage premiums associated with male-dominated sectors such as STEM, manufacturing, and executive management. In this sense, education facilitates entry into the labour market but does not ensure equal returns in terms of earnings.

Finally, the income index, which captures regional economic capacity, reinforces existing structural imbalances. Regional economic expansion reduces men's unemployment and increases men's labour force participation, but does not significantly reduce women's unemployment. Moreover, income growth is associated with a widening earnings gap in favour of male workers — suggesting that the employment opportunities generated by regional economic growth are concentrated in male-dominated industries. Overall, the results indicate that improvements in human development indicators alone are insufficient to produce equitable labour market outcomes. Policies therefore need to focus not only on expanding human capital, but also on improving the alignment between education and labour demand, reducing occupational segregation, and addressing wage disparities between men and women.

# 6. Conclusion and Policy Implications

This study examines the relationship between human development and regional labour market outcomes across Türkiye's 26 NUTS-2 regions over the 2018–2022 period, using a two-way fixed effects panel data model. The three core dimensions of human development — health, education, and income — are analyzed in relation to employment rates, unemployment rates, labour force participation rates, and earnings shares for men and women separately. The results indicate that the effects of human development on labour market outcomes are neither uniform across dimensions nor evenly shared between men and women — with the distribution of gains from human capital improvements varying substantially across regions and population groups.

The health dimension, proxied by the life expectancy index, consistently emerges as the strongest predictor of positive labour market outcomes. Higher regional health levels are significantly associated with greater employment, lower unemployment, and higher labour force participation for both men and women — with effects that are systematically larger for women. The education index presents a structurally more complex picture: higher regional educational attainment is positively associated with women's employment and participation but negatively associated with men's, pointing to a persistent mismatch between the qualifications produced by the education system and the types of employment available in regional labour markets. The income index is positively associated with men's employment and participation, but its effects on women are weaker — and its association with the earnings gap is positive, indicating that regional economic growth in Türkiye tends to widen rather than close the difference between men's and women's earnings shares. Across all three dimensions, improvements in human development indicators are associated with a widening earnings gap between men and women, confirming that the benefits of human capital accumulation accrue disproportionately to male workers while women's labour market gains remain structurally constrained by occupational segregation and sectoral concentration in lower-wage employment.

These findings carry direct policy implications. The consistently strong relationship between regional health conditions and labour market outcomes — particularly for women — makes a compelling case for prioritizing investment in health infrastructure, especially in eastern NUTS-2 regions where life expectancy indices fall markedly below the national average. Targeted interventions in primary healthcare, maternal health services, and community health programs are likely to generate significant labour market inclusion effects alongside their direct welfare benefits. Health policy should therefore be recognized not merely as social expenditure, but as a core component of regional labour market strategy.

On education policy, the results indicate that expanding educational attainment without addressing the structural alignment between the education system and regional labour demand is unlikely to generate the expected employment gains — particularly for men. In regions where economic activity remains concentrated in low-skill sectors, an accumulation of tertiary education graduates risks generating skill-mismatch unemployment rather than employment growth. Vocational education and training programs

should be redesigned in close coordination with regional employers and development agencies to ensure that graduates enter labour markets where their qualifications are genuinely in demand. For women, the findings highlight that educational attainment alone is not enough: anti-discrimination enforcement, pay transparency measures, and active support for women's access to higher-paying occupations are necessary complements to education investment if the returns to schooling are to be distributed more equitably between men and women.

On regional development policy, the substantial and persistent disparities in human development indicators across NUTS-2 regions underscore the need for regionally differentiated strategies rather than uniform national frameworks. Eastern regions require intensive public investment in health infrastructure, basic education quality, and economic diversification. Western metropolitan regions, where skill-mismatch unemployment is a more pressing concern, require a different set of interventions focused on higher education quality and high-skill job creation. Importantly, the finding that regional economic growth widens the earnings gap between men and women suggests that the sectoral composition of growth matters as much as its aggregate magnitude. Development strategies that prioritize sectors with more balanced employment profiles — including healthcare, education, and information technology — are more likely to produce equitable labour market outcomes than strategies concentrated in traditionally male-dominated industries.

This study has several limitations that should be acknowledged. The analysis is conducted at the NUTS-2 level, which masks considerable within-region heterogeneity. The sample period coincides with exceptional macroeconomic volatility — including the 2018 currency crisis, the COVID-19 pandemic, and the subsequent inflation surge — which may limit the generalizability of the findings to more stable conditions. The human development indicators used are composite regional averages that do not capture within-region inequalities in access to health and education services. Additionally, the labour market outcomes examined do not directly address informality or job quality, both of which are particularly relevant to women's employment in Türkiye.

Future research could extend the analysis in several directions. First, provincial-level (NUTS-3) data from TurkStat — once fully harmonised across the post-2022 period — would allow finer identification of within-region heterogeneity that the current NUTS-2 framework necessarily obscures. This is particularly relevant for large and internally diverse regions such as TR10 (İstanbul) and TRC1 (Gaziantep), where intra-regional inequality in both human capital endowments and labour market outcomes is likely to be substantial. Second, the 2018–2022 window, while analytically rich, covers a period of exceptional macroeconomic turbulence; extending the panel to incorporate post-2023 data would enable examination of whether the relationships identified here persist under more stable conditions or reflect crisis-specific dynamics. Third, Oaxaca-Blinder or RIF decomposition methods could be applied to TurkStat's Household Labour Force Survey microdata to more precisely identify the channels — occupational sorting, sectoral concentration, or returns to credentials — through which human capital improvements translate into earnings disparities between men and women at the regional level. Finally, the absence of spatial spillover modelling in the current framework — a deliberate choice given the panel

dimensions — represents a natural extension: a spatial Durbin or spatial error model applied to a longer regional panel would allow explicit testing of whether human capital externalities cross NUTS-2 boundaries, as the work of Güçlü (2017) on unemployment spillovers suggests they might.

## Declarations

# Author Contribution

H.İ. conceptualized the study, developed the empirical methodology, and performed the statistical analysis. A.D. contributed to the theoretical framework, literature review, and interpretation of results. E.Y. contributed to data collection, variable construction, and manuscript preparation. All authors reviewed and approved the final manuscript.

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