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Global Unemployment Dynamics and Labour Market Transformation: A Multidimensional Analysis

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Abstract. This study examines global labour market and unemployment trends from 2001 to 2025 through a systematic review and factor analysis approach. Key determinants of unemployment, including youth unemployment, gender inequality, educational attainment, policy responses, technological disruption, and post-pandemic labour market conditions, were analysed using data from selected countries representing different income groups and regions. Principal Component Analysis (PCA) and *k*-means clustering were employed to identify underlying patterns and cross-country variations in unemployment dynamics. The findings show that unemployment is shaped by the interaction of demographic, structural, technological, and institutional factors. Labour market segmentation remains evident through persistent challenges related to youth unemployment, gender disparities, and education-to-employment transitions. Rapid technological advancement, digitalisation, automation, and artificial intelligence have accelerated workforce transformation, creating both employment opportunities and skill mismatch challenges. The COVID-19 pandemic further intensified labour market disruption and highlighted the importance of effective policy responses in supporting employment recovery. Technological disruption, youth unemployment, and post-pandemic labour market adjustments emerged as key factors influencing unemployment patterns across countries. The study contributes to a broader understanding of global unemployment by integrating the perspectives of labour market segmentation, strategic workforce transformation, and institutional policy dynamics. The findings provide evidence-based insights for policymakers and offer strategic recommendations to support Malaysia's workforce resilience, digital readiness, and sustainable employment growth.

Keywords. Labour market, unemployment, factor analysis, Principal Component Analysis, K-means clustering, policy intervention

JEL Classification: C18, C38

1.0 Introduction

Unemployment remains one of the most pressing global issues, affecting millions of individuals around the world, and thus contributing to serious impediments to economic growth and social stability. Though several countries employ means to enhance job creation and improve the participation of a workforce in labour markets, the problem is subsistent in developed and

developing countries all over the time. Causes of unemployment are various and complex from the influence of technological advances and automation, down through economic recessions and pandemic situations such as COVID-19 outbreak. Analysis of contributing factors in this regard becomes crucial in creating potential solutions for long-standing pandemic consequences for individuals, society and nation in general. As such, this research attempts to investigate the factors driving unemployment trends. Unemployment serves as both a gauge and a mirror of the general well-being of an economy. The connection between unemployment and important economic measures like GDP growth, inflation rates and interest rates has been widely acknowledged (Sirot et al., 2024). However, the specific factors influencing unemployment patterns are usually quite intricate. The global issues such as youth unemployment, gender inequality, technological advancements, mismatch and underemployment in education and shifting skills and global economic upheavals all play a role in shaping unemployment levels. In the past decades, changes such as automation, the rise of the gig economy, and increased trade openness have transformed labor markets on a global scale. According to International Labour Organization (ILO) reported that there are additional two million workers expected to be looking for jobs in 2024 which is slightly 0.1% globally, and Artificial Intelligence (AI) and automation will take 6% of US jobs by 2030.

Past research on unemployment primarily looked at aspects such as expansion or population characteristics. Nonetheless, there is a demand for strategies that explore how various factors interact to impact unemployment patterns as time goes by. Factor examination, a technique used to spot connections between visible variables provides a potent means to comprehend these complex connections. Through examining the interrelationships between demographic and policy-related factors, this study aims to provide deeper insights into global unemployment patterns and their key driving forces. This study investigates unemployment conditions before and after the COVID-19 pandemic, in addition to the youth unemployment as a persistent and critical global issue. Adopting a comprehensive, global perspective allows for a more holistic understanding of the unemployment phenomenon. The discussion of the unemployment issue is categorized into three key dimensions:

i. Labour market segmentation – focusing on structural inequalities, particularly gender disparities and youth unemployment, which continue to shape labour market outcomes across regions.
ii. Strategic workforce segmentation – examining the effects of technological disruption on employment, including shifting workforce demands and the temporal patterns of unemployment associated with automation and AI adoption.
iii. Institutional policy dynamics – analyzing the role of policy responses in shaping labour market resilience, particularly in the post-pandemic context where recovery trajectories differ significantly across economies.

Given the uncertainty and growing concern surrounding global unemployment trends, it is crucial to understand the evolving patterns, particularly in the context of the pre- and post-pandemic periods and the rapid emergence of the Artificial Intelligence (AI) industry. There are some questions that remain unclear on the pattern of unemployment issue. The pattern revealed from our analysis may shed some light potentially to tackle and solve some issues that arise due to unemployment. It is noteworthy that the temporal trajectory of unemployment transformation

reveals dynamic and evolving patterns across different periods, and this will be elaborated further in Section 4. This study particularly seeks to address the following research questions:

- **RQ1: What have the global unemployment trends for the past 25 years?**
  The six-year period marks a critical turning point in employment dynamics, capturing both the pre- and post-COVID-19 pandemic phases, alongside the rapid evolution of digital transformation that has reshaped job creation and labour market structures.

- **RQ2: What are the key factors contributing to global unemployment?**
  This study investigates multiple determinants, including gender inequality, educational attainment, and country income status, alongside other structural and socio-economic factors that influence labour market outcomes.

- **RQ3: What are the policy interventions and strategic recommendations can effectively address the identified unemployment factors, specifically tailored to Malaysians?**
  Compared to other countries in the region, Malaysia faces not only unemployment challenges but also a growing issue of underemployment among fresh graduates entering the workforce. The findings of this study provide valuable insights into shaping employment strategies and policy interventions, contributing to the development of the National Human Resources Blueprint for the next decade.

The investigation was conducted to address the proposed research questions. First, a systematic review of global unemployment trends from 2019 to 2024 was undertaken to identify emerging patterns and outline the key contributing factors. These factors were analyzed using a thematic approach to gain deeper insights into their impact on unemployment. This paper is organized as follows.

Section 2 reviews recent developments in unemployment research and identifies the research gap. There is lack of study for unemployment trends and the analysis. Particularly, in the lense of global unemployment. Section 3 presents the analytical framework and methodology employed. A systematic review with PRISMA model study has been conducted to understand the unemployment trends. Methods such as Principal Component Analysis (PCA) and k-means clustering have been employed for factor analysis. Section 4 presents the results of the factor analysis, with detailed discussion of the key factors identified, including temporal dynamics, technological disruption, youth unemployment, gender inequality, policy responses, and post-pandemic labour market conditions. Section 5 addresses research questions and discusses how the findings contribute to proposing employment intervention policy and strategic implementation for Malaysian. Section 6 concludes.

2.0 Background study

The reviewed studies provide important insights into global unemployment when examined through the lenses of labour market segmentation, strategic workforce transformation, and institutional theory. From a labour market segmentation perspective, the literature consistently highlights that unemployment is unevenly distributed across different groups. Studies such as Alkatheri and Saad (2019) and Huang et al. (2024) identify education mismatch and demographic factors as key drivers, particularly affecting youth and graduates. Similarly, Wong (2022) and

Kumar and Shobana (2024) emphasize the vulnerability of young individuals due to structural barriers, limited work experience, and skill misalignment. These findings reinforce the notion that unemployment is not uniform but segmented according to age, education level, and employability characteristics. From the perspective of strategic workforce transformation, the studies demonstrate that unemployment is shaped by broader economic and structural changes. Alkatheri and Saad (2019) and Huang et al. (2024) emphasize the impact of technological advancement, COVID-19 disruptions, and labour supply changes. These contributions show that unemployment evolves over time in response to economic transitions, technological progress, and external shocks, reflecting a dynamic and continuously transforming labour market. In terms of institutional theory, the reviewed literature underscores the importance of policy interventions and governance structures in shaping employment outcomes. Kumar and Shobana (2024) discuss various labour market policies and government programmes aimed at addressing unemployment, including skill development initiatives and employment schemes. Alkatheri and Saad (2019) further stress the role of education and training systems in preparing individuals for the labour market. These findings suggest that institutional frameworks play a critical role in mitigating unemployment and facilitating labour market adjustment.

Despite these significant contributions, several research gaps remain. First, the existing literature is largely fragmented and often limited to specific countries or regions, with little emphasis on cross-country or global comparative analysis. Second, while youth unemployment is widely discussed, there is insufficient exploration of broader labour market segmentation, particularly regarding gender inequality and other marginalized groups. Third, the role of technological transformation, especially advanced digitalization and artificial intelligence, is not deeply examined, with existing studies relying on limited proxies such as automation indicators. Fourth, although policy interventions are frequently mentioned, there is a lack of rigorous empirical evaluation of their effectiveness, particularly at the micro level. Finally, there is limited comprehensive analysis of the temporal transition between pre- and post-COVID-19 periods, which is essential for understanding the evolving nature of global unemployment. These gaps highlight the need for a more integrated, comparative, and forward-looking approach, which this study seeks to address.

This article examines labour market dynamics over a 25-year period from 2001 to 2025, highlighting temporal patterns in global employment trends. It employs factor analysis to decompose key drivers of labour market change, including technological disruption, youth unemployment, gender inequality, policy responses, and post-pandemic labour market adjustments. The analysis draws on data from multiple regions, with particular focus on the Asia–Pacific region and the Americas, providing a comparative perspective on how these factors shape unemployment across different economic contexts.

3.0 Methodology

The methodology of this study comprises two complementary components. First, a systematic review is conducted to examine the temporal patterns and dynamic evolution of global labour markets, with particular attention to pre- and post-pandemic transitions. Second, factor analysis is employed to address the identified research gaps by empirically decomposing key drivers of unemployment, thereby providing deeper insights into the structural relationships underlying global labour market changes.

3.1 Data resources and materials

The data is collected from The World Bank, in which the characteristics of the selected countries are tabulated in Table 3.1. The selected countries were chosen to provide a diverse and comprehensive representation of different levels of economic development and geographical regions. Based on the World Bank's income classification, the sample includes high-income countries (Japan, Spain, and the United States), upper-middle-income countries (China, Malaysia, Jordan, and South Africa), and lower-middle-income countries (India, Kenya, and Senegal). This variation enables comparative analysis across countries with different economic structures, labour market conditions, and levels of workforce development. The countries represent six major world regions: East Asia and the Pacific, Europe and Central Asia, North America, the Middle East and North Africa, South Asia, and Sub-Saharan Africa. The inclusion of countries from diverse regional contexts allows for the examination of how institutional, economic, demographic, and labour market factors influence unemployment patterns and workforce challenges in different settings. The selected countries also exhibit substantial variation in GNI per capita, ranging from lower-middle-income economies such as Senegal and Kenya to high-income economies such as the United States and Japan. This diversity is particularly relevant for analysing issues related to unemployment, labour market segmentation, skill mismatches, digital transformation, and workforce upskilling, as these challenges may manifest differently across income groups and stages of economic development. Consequently, the selected sample provides a robust basis for identifying common trends, contextual differences, and policy implications across countries with varying socioeconomic characteristics.

Table 3.1: Characteristics of selected countries by income level and region

Income Classification	**Region**	**Countries**	**GNI per capital (US$)**
High Income	East Asia & Pacific	Japan	38,340
	Europe & Central Asia	Spain	37,120
	North America	United States	88,810
Upper-Middle Income	East Asia & Pacific	China, Malaysia	14,230,
	Middle East & North Africa	Jordan	5,260
	Sub-Saharan Africa	South Africa	6,270
Lower-Middle Income	South Asia	India	2,760
	Sub-Saharan Africa	Kenya, Senegal	2,200, 1,780

3.2 Systematic Review

After identifying the main factors contributing to unemployment in the contemporary context, relevant keywords were identified, and search strings were formulated to retrieve academic literature from the Lens.org and Scopus databases. These databases were chosen as our primary databases due to their scholarly reliability, coverage, and accessibility. Figure 1 illustrates how the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) model was systematically applied to optimize the literature review process. The model comprises three main phases, namely identification, screening, and inclusion.

During the identification phase, a total of 3550 papers were retrieved from the Lens.org and Scopus databases using the predefined search strings presented in Table 3. Following the removal of 745 duplicate records, 2805 unique records remained for screening. During the screening phase, titles and abstracts were assessed against the predefined eligibility criteria. Consequently, 2655 records were excluded because they were outside the scope of this review, leaving 150 articles for full-text assessment. In the inclusion phase, the full texts of the remaining articles were carefully evaluated for relevance and methodological suitability. Following the assessment, 101 articles were excluded because they did not sufficiently address the research objectives, lacked adequate methodological rigor, or did not provide substantive evidence relevant to the study. Consequently, 49 articles that met all the eligibility criteria and provided meaningful insights into the research topic were included in the final systematic review.

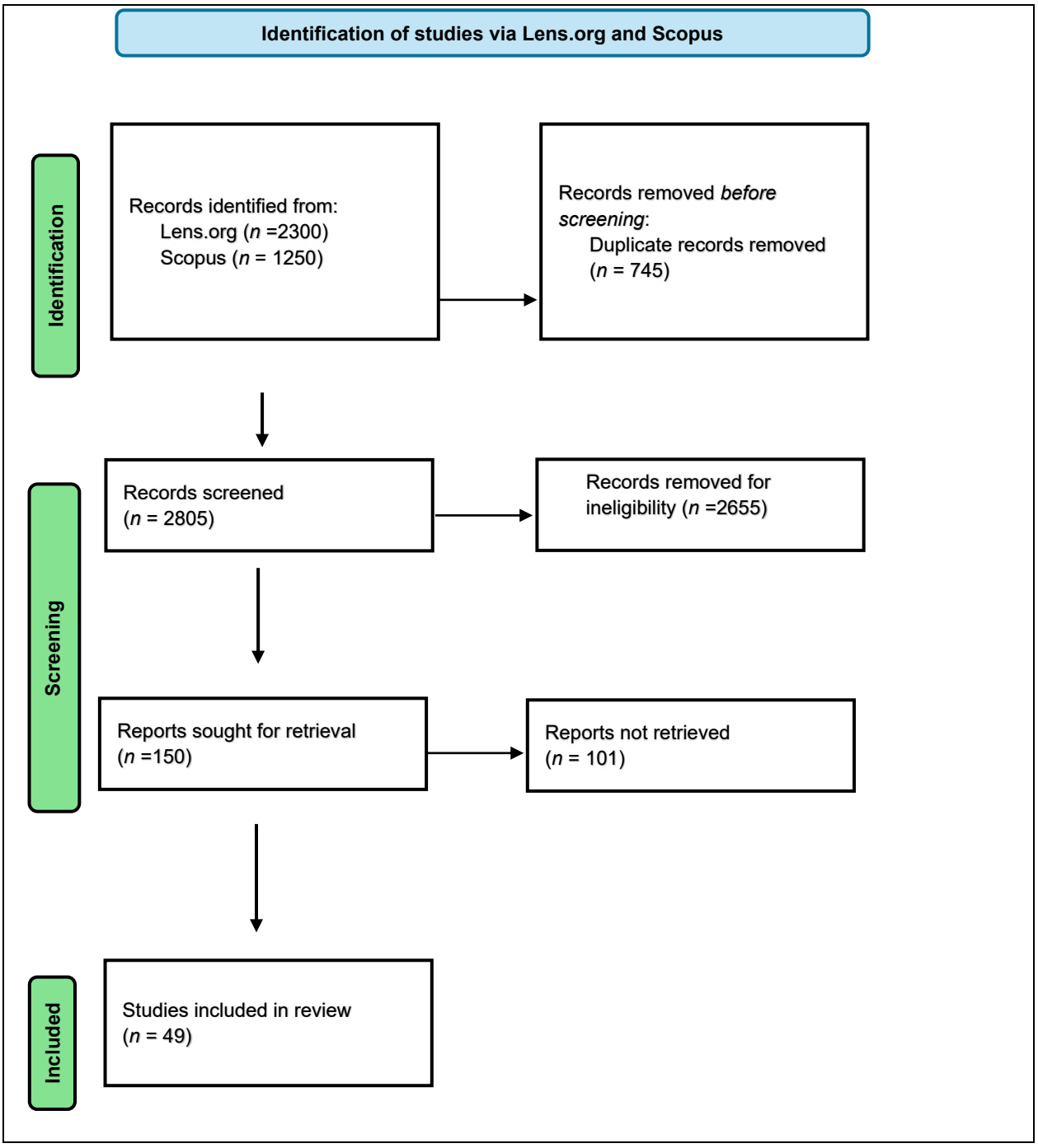


Figure 3.1: The PRISMA model used for systematic review

Table 3.2: Search Strategy and Inclusion/Exclusion Criteria

Databases	Lens.org and Scopus
Keywords	"unemployment", "youth unemployment", "how artificial intelligence affects unemployment", "unemployment inequality", "post covid unemployment"
Year of publication	2019 - 2024
Inclusion criteria	Studies that examined unemployment, its determinants, causes, impacts, or policy interventions.
Exclusion criteria	Studies that focused on unrelated labour market topics, such as job satisfaction, workplace performance, or entrepreneurship, without addressing unemployment.

3.3 Factor Analysis

3.3.1 Principal Component Analysis (PCA)

Principal Component Analysis (PCA) is a multivariate statistical technique used to reduce the dimensionality of a dataset while retaining as much information as possible. PCA transforms a large set of correlated variables into a smaller number of uncorrelated components, known as principal components, which explain the maximum variance in the data. In this study, PCA is employed to identify the key underlying factors associated with unemployment and labour market conditions across the selected countries. By reducing data complexity, PCA facilitates the interpretation of patterns and relationships among multiple socioeconomic and labour market indicators while minimizing redundancy among variables.

3.3.2 *K*-means Clustering

K-means clustering is an unsupervised machine learning technique used to group observations into clusters based on similarities in their characteristics. The algorithm partitions data into a predefined number of clusters (k), such that observations within the same cluster are more similar to each other than to those in other clusters. In this study, K-means clustering is applied to classify countries into distinct groups based on the principal components and selected labour market indicators. This approach enables the identification of countries with similar unemployment profiles, workforce characteristics, and labour market challenges, thereby facilitating comparative analysis and supporting the development of targeted policy recommendations.

4.0 Results and Discussion

4.1 Labour Market Trend

Year 2001 - 2009

Drawing on the systematic review, the findings reveal significant transformations in the labour market over the past 25 years. Beginning in the early 2000s, labour market discourse increasingly emphasized **labour market segmentation**, with particular attention to youth and women's employment. Over time, persistent gender barriers and the growing influence of automation on labour market entry have further widened structural inequalities across regions, reshaping employment patterns worldwide. Labor markets in developing countries, such as China, began undergoing significant transformations due to technological advancements and shifting supply chains. Studies like The Dynamic Demand for Capital and Labor in Chinese Firms (1998-2007) found that while companies adjusted labor and capital simultaneously, economic reforms created opportunities and challenges for workers. The adoption of automation reshaped the labor landscape, particularly affecting semi-skilled workers. Furthermore, there were gender bias in corporate lending and leadership roles. Female entrepreneurs faced significant challenges in accessing credit due to bias against women in decision-making positions within banks and financial institutions. The global financial crisis underscored the risks of biased lending practices. Banks started considering the use of "soft information" to address gender bias in lending, helping female loan officers make more fair decisions based on relationship-driven insights (Bose et al., 2024). In India, studies also indicated a high rate of labor force exit for Indian women, affected by factors like household income and social norms. These transitions were especially pronounced for married women, who faced cultural and economic barriers that influenced labor force entry and exit (Sarkar et al., 2019).

Financial crisis which happened in 2008 significantly impacted the world, resulting in high youth unemployment rates and limited job opportunities. This led to a "scarring" effect on long-term employability and income (Kim, 2024). Therefore, growing attention was paid to the challenges faced by marginalized youth, including those with disabilities and from lower socioeconomic backgrounds. Speaking of youth unemployment, studies in Jordan showed that youth unemployment was exacerbated by skills mismatches and limited government investment, creating significant barriers to job creation and economic stability (Akram et al., 2020). Hence, Policymakers and researchers began addressing these barriers to workforce entry (Jetha et al., 2022).

Year 2010-2018

Between 2010 and 2018, **workforce segmentation** is shifted to involve in automation. technological advances shifted employment from factories to digital platforms, creating new opportunities while displacing traditional jobs, especially for middle-skilled workers in emerging and developed economies. Technological advancements in the manufacturing and services sectors had a mixed impact on employment especially in India. Capital goods imports and information technology contributed to job creation in certain industries but concerns about the displacement of lower-skilled workers grew. The uneven distribution of technology-driven jobs became evident, as automation increasingly influenced global labor markets. Emerging economies faced increasing pressure due to technological changes in developed countries. (Díaz Pavez & Martínez-Zarzoso, 2021) found that foreign automation had a greater impact on reducing employment in emerging economies than domestic automation. By 2016, China became the world's largest user of industrial robots, driven by rising labor costs and governmental policies. Automation in manufacturing created both opportunities and challenges for workers (Cheng et al., 2019). Although automation

increased productivity, it raised concerns about job displacement in labour-intensive industries. Moreover, the rise of digital transformation began reshaping the job market, demanding new skills and reducing traditional roles, which particularly affected young people lacking work experience or digital skills (Jetha et al., 2023). In countries like Kazakhstan, youth migration increased as young people sought better opportunities due to limited local job options and social stratification (Matzhanova et al., 2021). Programs like England's Talent Match aimed to support marginalized youth by addressing employment barriers and providing adaptable pathways into the workforce (Sanderson, 2019). During this period, the rise of gig economy led to an increase in precarious and temporary jobs, which disproportionately impacted young adults and created cycles of unstable employment (Jetha et al., 2022). Gender inequality in workplace remains challenging. In developing countries, women were more likely to be in vulnerable, informal employment roles without benefits or protections, often working as unpaid family contributors (Lo Bue et al., 2022). Le Barbanchon et al. (2020) stated that in countries like France, data showed that women's preference for shorter commutes influenced wage offers and career choices, contributing to a persistent gender wage gap as women often accepted lower pay in exchange for proximity to home so that it is easier for them to take care of house chores.

Year 2019 – present

The COVID-19 pandemic created an unprecedented shock to global labor markets. It fundamentally reshaped employment structures through widespread job losses, particularly in service-, retail- and tourism-related industries, while simultaneously accelerating the adoption of remote work. This rapid shift exposed skill gaps among workers who lacked digital and automation-related competencies, leading to heightened job displacement and labour market vulnerability. Canada saw a dramatic 15% drop in employment and a 32% decline in hours worked within weeks (Jones et al., 2020). Similarly, Italy experienced a significant decrease in new hires and a temporary surge in layoffs before government interventions, such as a ban on layoffs and eased access to short-time work compensation, mitigated these effects (Casarico & Lattanzio, 2022). Informal workers in India faced even harsher impacts, with only 43% of informal workers remaining employed by April 2020, compared to 72% for formal workers (Kotia et al., 2021). **Institutional policy** has been rapidly implemented based on the quick response by temporary unemployment surged, and the future of the businesses remained uncertain and struggled to survive and recover. During the COVID-19 pandemic, governments worldwide implemented extensive institutional labour-market policies to mitigate employment shocks and income losses. Job retention measures such as short-time work, furlough schemes, and wage subsidies were widely adopted to preserve employer–employee relationships and prevent mass layoffs (Eichhorst et al., 2022; International Labour Organization [ILO], 2022). At the same time, unemployment benefits and social assistance programmes were expanded, with eligibility extended to self-employed, informal, and gig-economy workers to strengthen income protection (ILO, 2021; Gentilini et al., 2021). Governments also introduced business support measures, including grants, tax deferrals, and credit guarantees, particularly targeting small and medium-sized enterprises in severely affected sectors (Organisation for Economic Co-operation and Development [OECD], 2020). As the pandemic accelerated digitalisation, active labour market policies increasingly focused on reskilling and employment re-entry, especially for young and displaced workers, highlighting the critical role of institutional frameworks in enhancing labour-market resilience during periods of crisis (ILO, 2022; OECD, 2021).

The COVID-19 pandemic represents a major turning point in global labour markets. Companies started adoting hybrid and remote work policies, structural shifts emerged in work settings. Research on Microsoft employees revealed reduced inter-departmental collaboration and a shift toward more stable, siloed networks, highlighting potential challenges for innovation and information flow in remote settings (Yang et al., 2022). The pandemix heightened awareness of digital transformation, prompting firms and workers alike to adapt more rapidly to emerging technologies, new work arrangements, shifting skill requirements in the post-pandemic labour market, and accelerated the emergence of the AI era in the labour market.

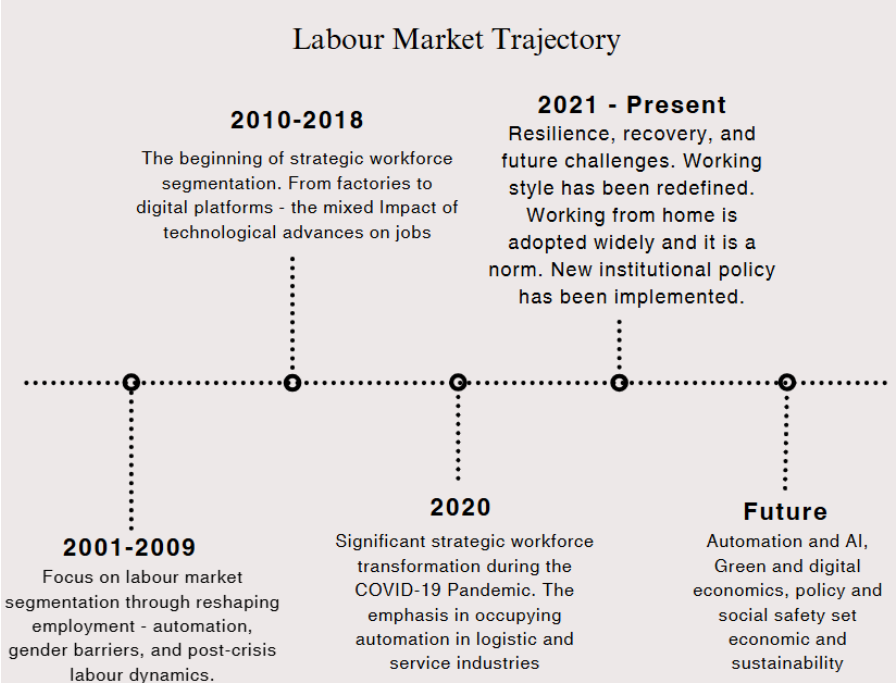


Figure 4.1 Labour market trajectory for 2001 to present

4.2 Factor Analysis

Factor analysis was employed to examine the underlying relationships between unemployment and selected labour market determinants. The analysis considered education level, country income classification, gender inequality, industry structure, and youth unemployment as key variables to assess their relative contribution to variations in global unemployment patterns. This approach enables the study to identify the most influential dimensions shaping unemployment across different economic and regional contexts. First, an overall factor analysis was conducted to examine the collective contribution of these determinants to unemployment. This was followed by a comparative assessment to determine how each factor varies across countries and income groups, thereby providing a clearer understanding of the structural, demographic, and institutional dimensions influencing global unemployment outcomes.

Unemployment Overview

The PCA biplot indicates that technological disruption is a major source of variation across the selected countries, as reflected by its strong loading on the positive side of Dim1, which explains 61.7% of the total variance. Countries such as Senegal, China, and Malaysia are positioned in the direction of the technological disruption vector, suggesting that their labour

market patterns are more closely associated with technology-driven transformation. In contrast, countries such as Jordan, South Africa, and Spain are located away from this vector, indicating a weaker association with technological disruption and a stronger relative connection to other labour market dimensions, such as policy response, youth unemployment, and post-pandemic labour market adjustment. The second dimension, which explains 24.6% of the variance, is mainly represented by gender inequality, with India positioned closely to this factor. Overall, the PCA results suggest that technological disruption is a key differentiating factor in global labour market transformation, but its influence varies significantly across countries and interacts with other structural factors such as gender inequality and post-pandemic labour market conditions.

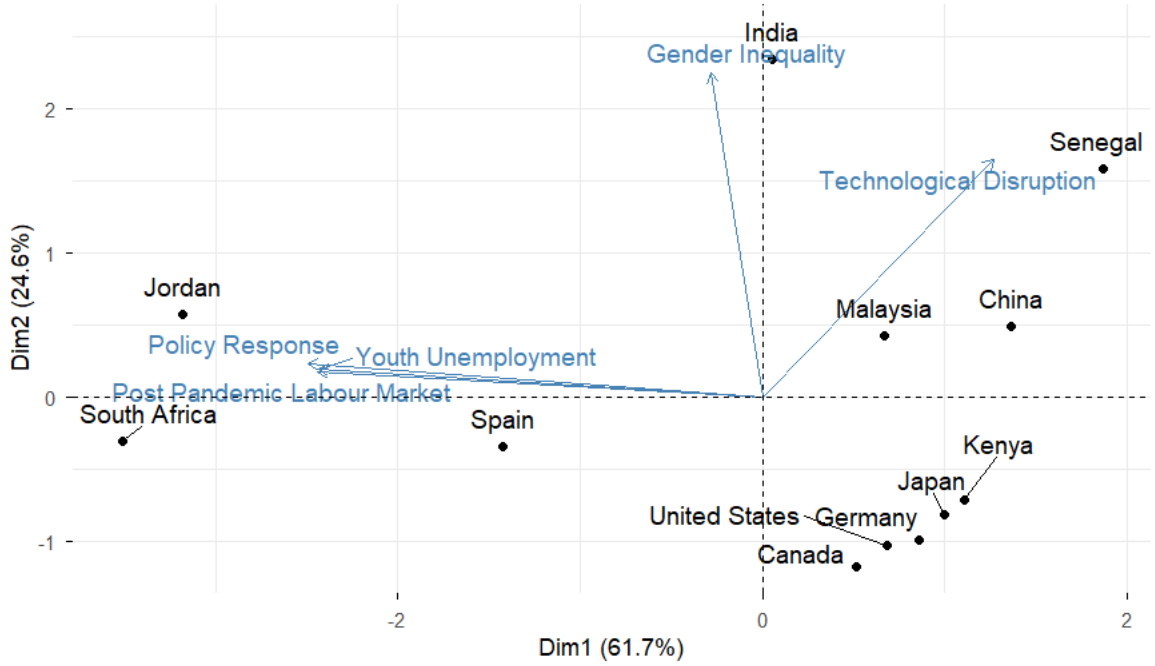


Figure 4.2 Factor analysis of the unemployment overview

Education Level

The results highlight a strong temporal shift in unemployment patterns, with the first two dimensions explaining 98.3% of the total variance. Dim1, which accounts for 91.9% of the variance, is strongly associated with unemployment across education levels, suggesting that education-related unemployment is the dominant source of variation over time. The earlier years from 2001 to 2008 are positioned on the negative side of Dim1, indicating a weaker association with education-based unemployment. In contrast, the years after 2015, particularly 2019 to 2023, are located on the positive side of Dim1, reflecting the growing importance of unemployment among educated workers. The pandemic years, especially 2020 and 2021, are closely aligned with unemployment among those with intermediate education, while 2019 and 2023 show stronger association with advanced-education unemployment. Overall, the PCA suggests that education level has become an increasingly important dimension in explaining unemployment patterns, particularly during and after the COVID-19 labour market disruption.

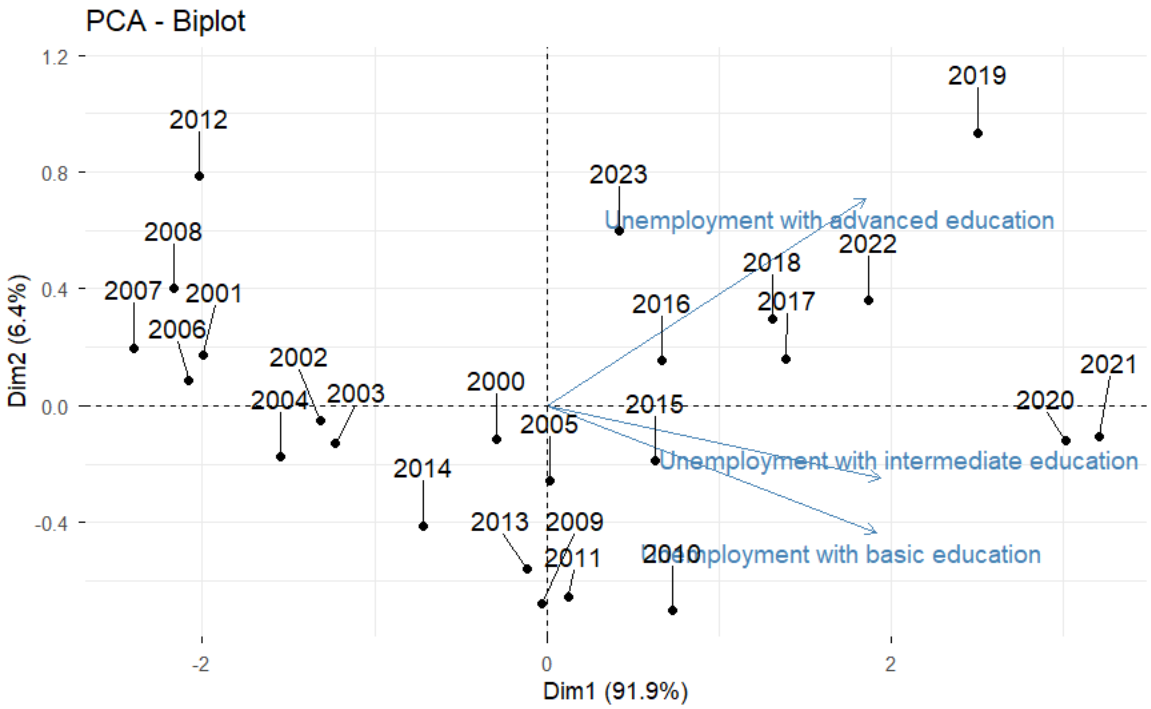


Figure 4.3: Education level analysis in unemployment

Gender Inequality

Figure 4.4 displays the relationship between male and female employment-to-population ratios over time. Dim1 explains a significant 84.4% of the variation, while Dim2 accounts for 15.6%, indicating that most of the data trends can be captured by these two dimensions. From the plot, the male and female employment-to-population ratios are positioned at opposite ends along Dim1. This suggests that these two factors are strongly contrasting in their impact. A year moving towards the male employment ratio would likely see a decrease in female employment, and vice versa. Looking at the interaction between years and employment factors, earlier years seem to be positioned closer to the male employment ratio, suggesting that in those periods, male employment rates were relatively higher. In contrast, more recent years appear to shift toward the female employment ratio especially the years after 2016, indicating a possible trend toward increasing female workforce participation. The year 2020 stands out as an exceptional observation, reflecting the labour market disruption caused by the COVID-19 pandemic. A gradual shift in employment structure over time is observed, with female employment becoming a more prominent factor in explaining post-pandemic labour market dynamics.

The K-means clustering results in Figure 4.5 suggest that the selected countries can be separated into two distinct groups based on the level of gender inequality in the labour market. Countries located closer together on the horizontal axis share similar gender inequality patterns, while countries positioned farther apart indicate stronger differences in gender-related labour market outcomes. Cluster 1 represents countries with relatively similar and lower-to-moderate gender inequality scores. These countries may have more balanced labour market participation between men and women, stronger institutional support, or better access to employment opportunities for women. In contrast, Cluster 2 represents countries with comparatively higher gender inequality, suggesting greater disparities in labour market participation, employment opportunities, or structural barriers affecting women's access to decent work. From a labour market

segmentation perspective, the clustering indicates that gender inequality remains an important factor differentiating countries. Countries in the higher-inequality cluster may face stronger gender-based employment segmentation, where women are more likely to be concentrated in informal, vulnerable, or lower-paid work. Meanwhile, countries in the lower-inequality cluster may demonstrate relatively stronger progress in reducing gender barriers in employment.

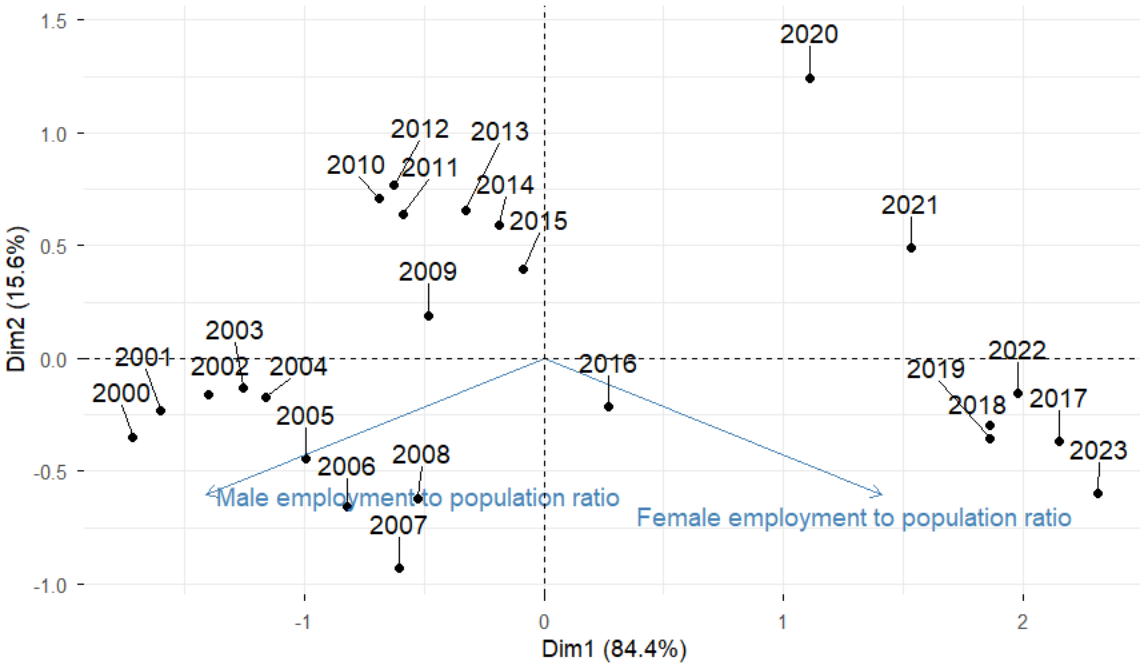


Figure 4.4: Gender Inequality analysis in unemployment

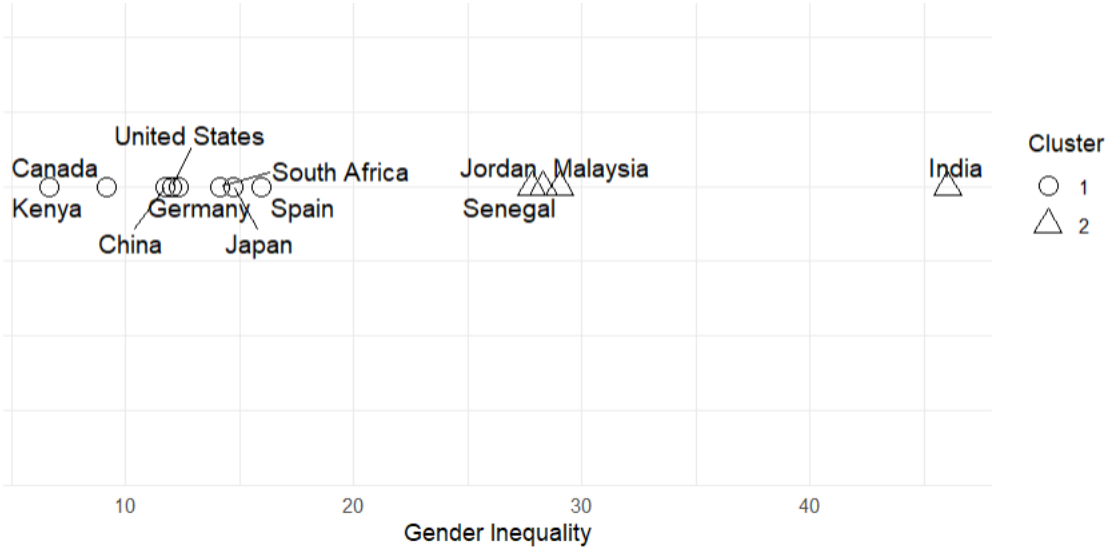


Figure 4.5: Comparative analysis of Gender inequality in various countries

Employment trend in heavy industry and services

A strong temporal transformation in employment structure has been revealed, with Dim1 explaining 96.5% of the total variance. The analysis indicates a clear shift from heavy industry employment in the early 2000s toward service-sector employment in the later years. The positioning of 2000–2008 on the negative side of Dim1 suggests a stronger association with heavy industry, whereas the clustering of 2017–2023 on the positive side indicates the growing dominance of service-sector employment. The opposing directions of the industry and services vectors further suggest a structural reallocation of labour from industrial sectors to services. The overall results highlight a long-term labour market transformation characterized by declining reliance on heavy industry and increasing dependence on service-based employment.

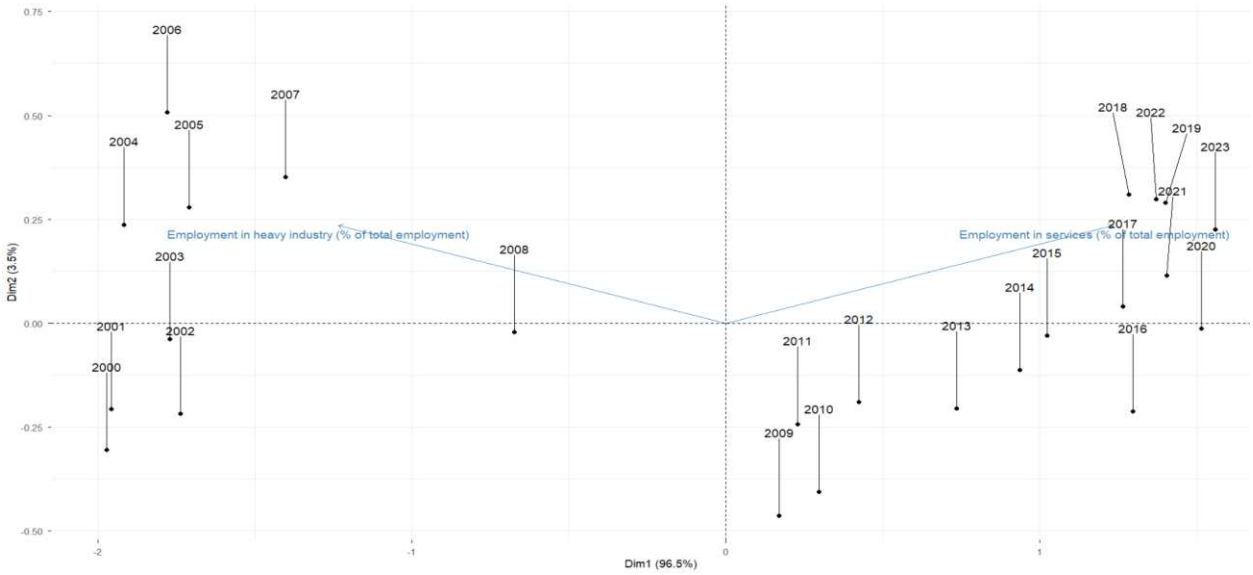


Figure 4.6: Employment trend analysis in heavy industry and services

Youth unemployment

Figure 4.7(a) indicates that youth unemployment became a more prominent labour market issue over time, with Dim1 explaining 96.8% of the total variance. Earlier years from 2000 to 2008 are positioned on the negative side of Dim1, suggesting a weaker association with youth unemployment. In contrast, years after 2009 shift toward the positive side, indicating stronger youth unemployment patterns. The gender-specific vectors show that female and male youth unemployment are both important contributors, although they differ slightly along Dim2. Female youth unemployment is more strongly associated with years such as 2013–2016, 2020, and 2021, while male youth unemployment is more closely linked with years such as 2010, 2017, and 2018. The year 2020 stands out clearly on the far-right and upper side of the plot. This suggests that 2020 was an exceptional year, strongly associated with youth unemployment, particularly female youth unemployment. This is likely reflective of the COVID-19 labour market shock, when young workers faced significant employment disruption. Youth unemployment has intensified over time, indicating the need for stronger and more targeted policy responses to address this growing labour market challenge.

Figure 4.7(b) provided an additional analysis of youth unemployment with respect to countries. The K-means clustering classifies youth unemployment into two clusters (groups of country), i.e. lower-to-moderate youth unemployment and higher youth unemployment. The K-

means clustering results classify the selected countries into two distinct groups based on youth unemployment. Khoo et al. (2022) modelled youth unemployment trend of Malaysia, and here the extended study to compare the trend among the countries. Cluster 2 represents countries with relatively low to moderate youth unemployment, including Japan, Germany, China, Malaysia, Canada, the United States, Kenya, Senegal, and India. Although India records a higher value than most countries in this cluster, it remains closer to the moderate-unemployment group than to the high-unemployment group. In contrast, Cluster 1 consists of Spain, Jordan, and South Africa, which show considerably higher youth unemployment levels. The separation of these countries indicates that youth unemployment is not evenly distributed across economies and remains a more critical labour market challenge in certain countries. These findings suggest the need for targeted policy responses, particularly in countries with persistently high youth unemployment.

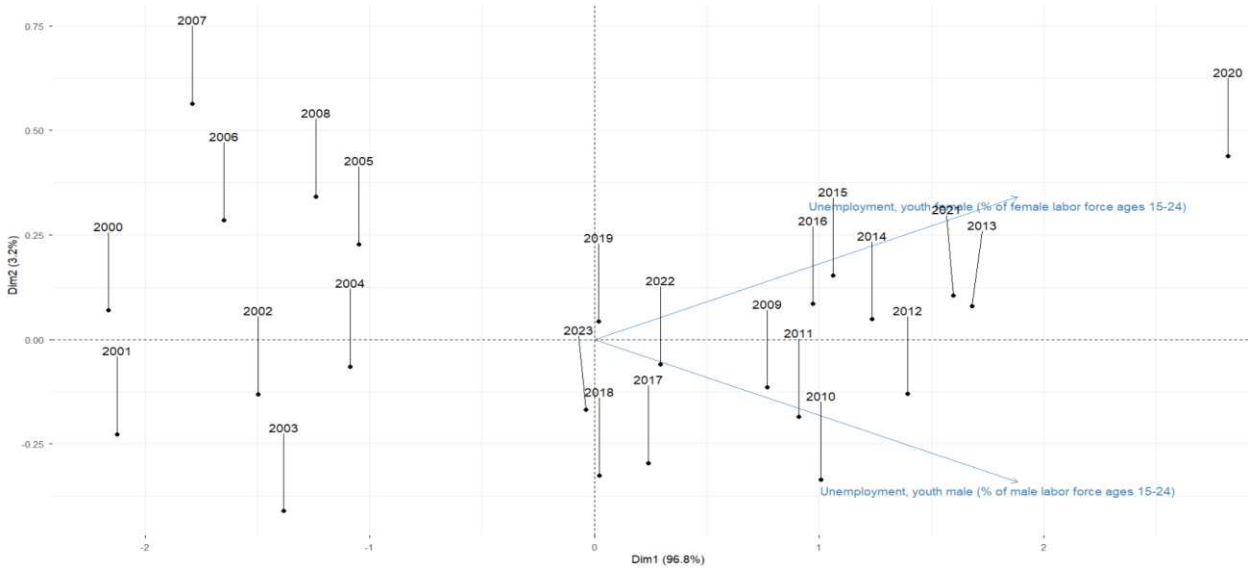


Figure 4.7(a): Youth unemployment trend analysis

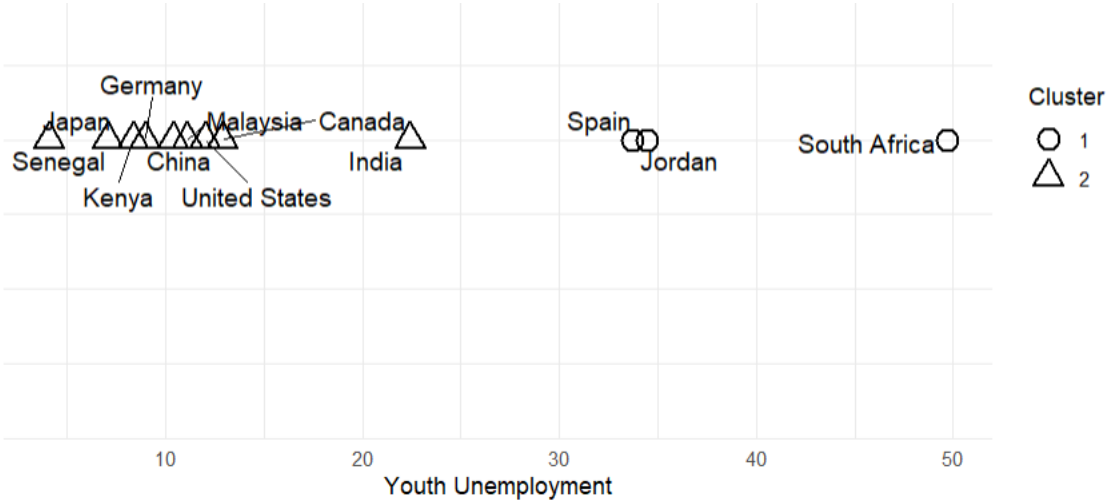


Figure 4.7(b): Youth unemployment of respective countries

Policy Responses

The K-means clustering results classify the selected countries into two distinct groups based on policy response. Cluster 2 consists of countries with relatively lower-to-moderate policy response levels, including Japan, Kenya, Senegal, China, Germany, Malaysia, Canada, the United States, and India. In contrast, Cluster 1 comprises Spain, South Africa, and Jordan, which demonstrate stronger policy response patterns. The separation of these countries suggests that institutional responses to labour market challenges vary significantly across countries. Countries in Cluster 1 may have implemented stronger or more extensive policy interventions, possibly in response to more severe unemployment pressures, youth unemployment, or post-pandemic labour market disruptions. Overall, the clustering highlights the unevenness of institutional policy responses across different national labour market contexts.

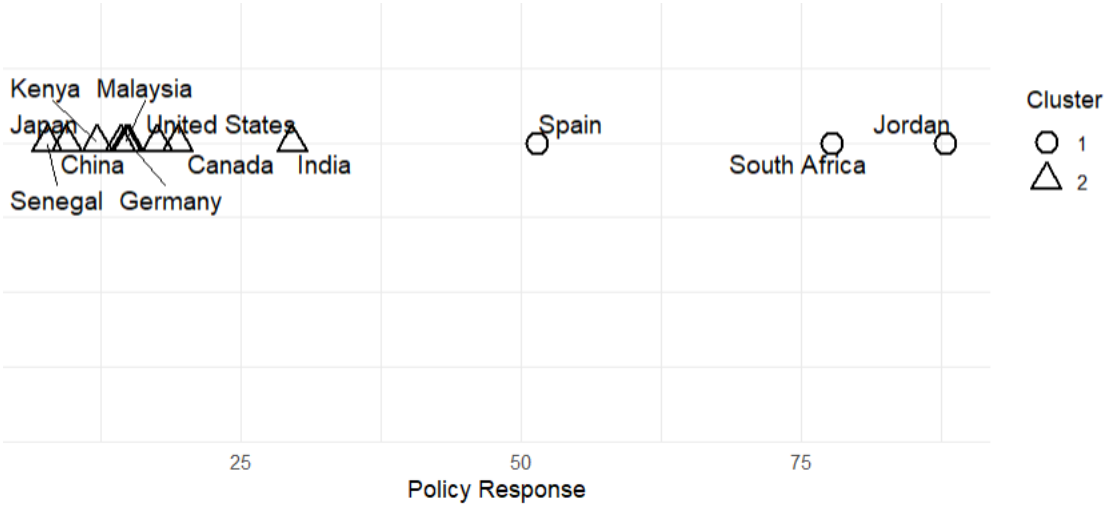


Figure 4.8: Policy responses

Post-pandemic Labour Market

Figure 4.9 shows a clear clustering pattern across the selected countries. Most countries, including Malaysia, Japan, Germany, China, Canada, India, Kenya, Senegal, and the United States, are grouped closely in Cluster 2, indicating that these economies share relatively similar levels of post-pandemic employment condition in the labour market. These countries have similar patterns of labour market adjustment in response to digitalization, automation, and changing skill requirements. From a **strategic workforce segmentation** perspective, Cluster 2 reflects labour markets undergoing skill-based restructuring. Workers with digital, technical, and adaptable skills are more likely to benefit from new opportunities in transforming labour market, while workers in routine, semi-skilled, and low-digital-skill occupations may face greater vulnerability. Spain appears within the same cluster but is positioned further to the right, suggesting a higher post-pandemic disruption score compared with the other Cluster 2 countries. But enjoying moderate state in unemployment market. In contrast, Jordan and South Africa form Cluster 1, located far to the right of the distribution, indicating that these countries experience a much stronger degree of unemployment rates, slower job recovery, or different workforce structures after the pandemic.

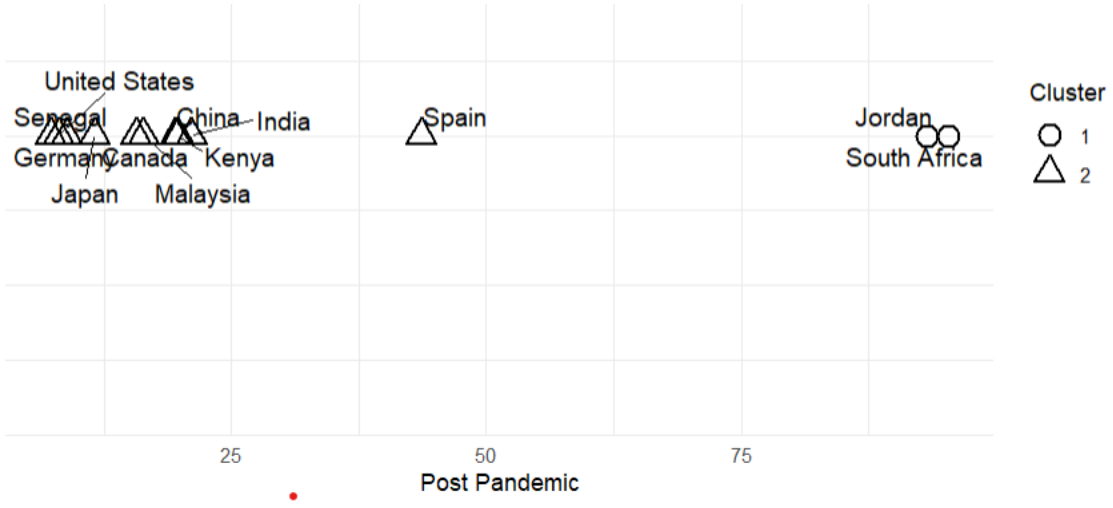


Figure 4.9: Post-pandemic labour market of the countries

Technological Disruption

Figure 4.10 presents the K-means clustering of countries based on technological disruption. The countries positioned further to the right indicate higher disruption in the labour market. The results show three distinct patterns in technology disruption. The countries such as the United States, Jordan, Canada, Germany, Japan, Spain, South Africa, and Malaysia are concentrated on the left side of the plot, mostly below 0.25, indicating relatively low technological disruption compared with the others. Although Malaysia is slightly further to the right than most countries in this group, it remains within the low-disruption cluster. While Kenya and India are positioned in the middle range, around 0.55 to 0.70, suggesting a moderate level of technological disruption. This indicates that their labour markets may be experiencing stronger digital and technological shifts comparatively. On the other hand, China and Senegal, which are positioned farthest to the right, around 1.20. This indicates the highest level of technological disruption among the selected countries. Their separation from other countries suggests that technological change may be exerting a stronger influence on labour market restructuring, skill demand, and employment transformation.

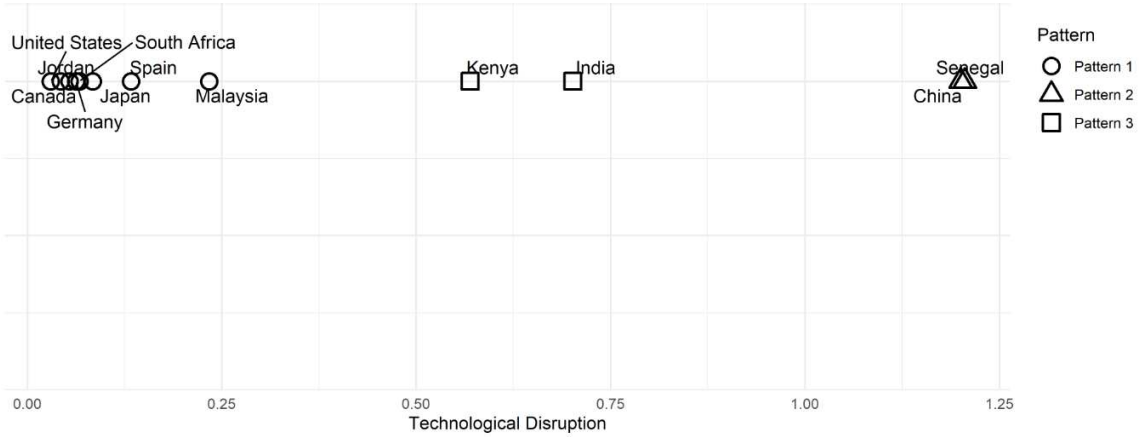


Figure 4.10: Technological Disruption

5.0 Bird's-eye Perspective

5.1 Global Labour Market Transformation

The factor analysis suggests that global unemployment is shaped by a combination of demographic, structural, technological, and institutional forces. Rather than being driven by a single factor, unemployment patterns emerge from the interaction between labour market segmentation, workforce transformation, and policy responses. The findings show that youth unemployment, education-related unemployment, gender inequality, technological disruption, and post-pandemic labour market changes operate together to explain variations in unemployment across countries and income groups.

1. Labour Market Segmentation

From the perspective of labour market segmentation, the findings indicate that unemployment is unevenly distributed across different social and demographic groups. Youth unemployment remains one of the most persistent challenges, with younger workers facing greater vulnerability due to limited experience, skill mismatch, and weaker labour market attachment. At the same time, education level appears as an important factor, as rising unemployment among educated workers suggests that higher educational attainment does not automatically guarantee employment. This point to a widening between qualifications and labour market demand. Gender inequality further reinforces labour market segmentation, as women continue to face barriers especially in women in India, related to labour force participation, occupational access, wage inequality, and informal or vulnerable employment. In this dimension, the analysis shows that unemployment is not experienced equally, but is structured by age, education, and gender.

2. Strategic Workforce Segmentation

From the perspective of strategic workforce segmentation, the results highlight how technological disruption and industry transformation are reshaping employment structures. The shift from traditional industry-based employment toward service-oriented, digital, and technology-driven sectors has changed the type of skills demanded in the labour market. Countries with higher technological disruption show stronger signs of workforce restructuring, while others experience more moderate or gradual transitions. This suggests that workers with digital, technical, and adaptable skills are increasingly positioned to benefit from emerging opportunities, whereas workers in routine, low-skilled, or traditional occupations face higher risks of displacement. The post-pandemic labour market has further accelerated this transformation through remote work, digital platforms, automation, and AI adoption. Thus, strategic workforce segmentation reflects a growing divide between workers who can adapt to technological change and those who remain exposed to employment vulnerability.

3. Institutional Policy Dynamics

From the perspective of institutional policy dynamics, the findings show that policy responses play a critical role in shaping labour market resilience. Countries with stronger policy response patterns are likely responding to more severe unemployment pressures, youth labour market challenges, or post-pandemic disruptions. Institutional interventions such as wage support, unemployment protection, reskilling programmes, youth employment schemes, and digital workforce development are essential in reducing labour market vulnerability. However, the variation across countries suggests that policy capacity and effectiveness remain uneven. In this sense, institutional

policy does not merely respond to unemployment; it also shapes the ability of workers and firms to adjust to structural and technological change. Stronger and more targeted policy responses are therefore necessary to address youth unemployment, gender inequality, education mismatch, and post-pandemic workforce restructuring.

5.2 Policy Intervention and Strategic recommendation for Malaysia

Malaysia's labour market has shown strong post-pandemic recovery, with the unemployment rate declining to 3.2% in 2024, below the pre-pandemic level of 3.3% in 2019. Labour force participation also increased to 70.6%, indicating improving labour market engagement. However, structural concerns remain, particularly in relation to youth unemployment, graduate underemployment, skills mismatch, and technology-driven job restructuring (DOSM, 2025). These issues are closely aligned with the priorities of Malaysia's National Human Resources Policy Framework 2024–2030, which emphasizes skills training, employment equity, wage compensation, vulnerable workforce groups, employment mismatch, gig workers, and the impact of emerging technologies such as artificial intelligence on the labour market (Human Resources Development Fund [HRDF], 2018).

Within the context of labour market segmentation, policy interventions in Malaysia should prioritise vulnerable groups, particularly youth, women, fresh graduates, and individuals engaged in precarious forms of employment. The findings suggest that unemployment is not evenly distributed, but is shaped by age, education level, gender, and employability gaps. Youth unemployment remains a critical concern, as it is reported to be the highest compared with other age groups (Khoo et al., 2022). This issue is further compounded by Malaysia's demographic transition, as the country is expected to become an ageing nation by 2030, increasing the need to strengthen youth labour market participation and productivity. In addition, fresh graduates continue to face challenges related to skills mismatch and underemployment. For instance, the proportion of graduates earning RM3,000 and above remains limited, raising concerns over income adequacy amid rising living costs and inflation. At the same time, the gap between the number of high-skilled jobs created and the growing number of graduates from public and private universities has intensified labour market competition. This challenge is likely to become more pronounced as digitalisation and automation continue to reshape job requirements. Therefore, Malaysia's human resource policy direction should prioritize graduate employability programmes, industry-based training, technical and vocational education and training, digital upskilling, work-interest assessment analysis such as RIASEC, and gender-inclusive employment initiatives. These measures are essential to improving employment equity, reducing labour market mismatch, and strengthening Malaysia's future workforce resilience.

From the perspective of strategic workforce segmentation, Malaysia needs to prepare workers for automation, digitalisation, and AI-driven transformation. The World Bank highlights that automation in Malaysia is closely associated with routine-task occupations, indicating that semi-skilled and low-skilled workers may face higher exposure to technological displacement. Thus, policy recommendations should focus on lifelong learning, digital reskilling, AI readiness, green economy skills, robotics, and 5G-related capabilities. This direction is consistent with Malaysia's target to achieve a 35% skilled workforce by 2030 and with national efforts to mobilize skills training initiatives across society.

Addressing institutional policy challenges in Malaysia requires stronger coordination among education providers, industry stakeholders, employers, and government agencies to reduce skill mismatches and facilitate continuous workforce upskilling and reskilling. Unemployment

data are readily available through the Department of Statistics Malaysia (DOSM); however, greater efforts are needed to translate these data into evidence-based insights that can inform strategic decision-making in skills planning, workforce alignment, and human capital development. Addressing youth unemployment requires the incorporation of targeted strategies into future national human resource development blueprints. These strategies should extend beyond technical competencies to include assessments of talent characteristics, career interests, and job-person fit, which are critical factors influencing employability and career sustainability. Furthermore, greater emphasis should be placed on digital skills development, as well as training related to artificial intelligence (AI), automation, and emerging technologies, to ensure that the workforce remains relevant in an increasingly digital economy. Strengthened collaboration between the Ministry of Higher Education, industry stakeholders, employers, and relevant government agencies is also essential to improve the alignment between educational outcomes and labour market demands, thereby mitigating skill mismatches and reducing the rising incidence of youth unemployment. This is also consistent with Malaysia's digital transformation agenda under MyDIGITAL and the Malaysia Digital Economy Blueprint, which aims to build a digitally driven, high-income economy, strengthen the national talent pool, and reduce the digital divide.

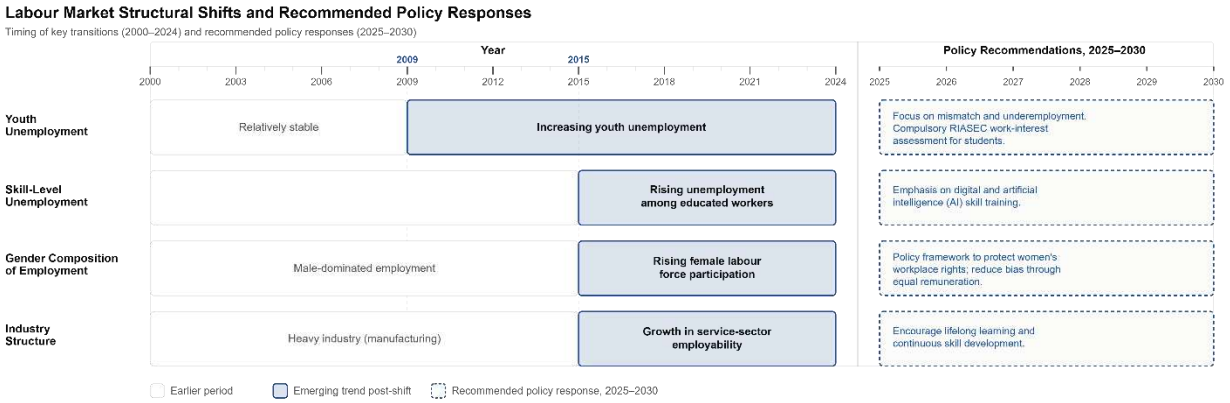


Figure 5.1: Labor market structure in Malaysia and recommended policy responses

6.0 Concluding Remark

This systematic review provides a comprehensive examination of global unemployment trends and their underlying determinants by synthesising evidence from 49 studies published between 2019 and 2024. The review identified five dominant themes: technological disruption, post-pandemic labour market transformation, policy responses, gender inequality, and youth unemployment. Among these themes, technological advancement and COVID-19-related labour market disruptions emerged as particularly prominent, which reflects the increasing complexity of employment dynamics in an era characterised by digital transformation and economic uncertainty. Technological advancement, including automation, digitalisation, and artificial intelligence, has generated new employment opportunities while simultaneously intensifying challenges related to skill mismatch and workforce displacement. Similarly, the COVID-19 pandemic exposed existing vulnerabilities within labour markets, which disproportionately affected young workers, women, and individuals in less secure employment sectors. These findings reinforce the importance of considering unemployment through a multidimensional perspective that integrates labour market

segmentation, human capital development, technological adaptation, and institutional policy capacity.

Additionally, this study also highlights the importance of temporal and contextual considerations in understanding labour market evolution, particularly during the period from 2019 to 2024, when global employment systems experienced unprecedented disruption and recovery. The findings suggest that effective unemployment mitigation requires coordinated strategies involving governments, employers, educational institutions, and individuals. The insights provide valuable implications for strengthening workforce resilience, accelerating digital readiness, enhancing industry–education alignment, and supporting sustainable employment growth.

Future research could expand the evidence base by incorporating additional databases, international datasets, and policy reports from governmental and non-governmental organisations. Furthermore, it would be interesting to employ advanced quantitative approaches, including econometric modelling, machine learning, and predictive analytics, to examine the complex relationships among unemployment determinants and identify emerging patterns. These approaches would complement systematic review findings by providing deeper insights into the magnitude, interactions, and predictive capacity of different unemployment drivers. By integrating multidisciplinary perspectives and data-driven methodologies, future research can contribute to the development of more adaptive and evidence-based labour market policies.

Declaration of generative AI and AI-assisted technologies in the manuscript preparation process

During the preparation of this work, the author(s) used Claude by Anthropic for polishing grammar purposes. The author(s) reviewed and edited the output as needed and took full responsibility for the content of the published article.

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