Econovia
Journal of Economic Strategy and Developmen

Vol. 1 | Issue 1 | March 2026

Demographic Aging and the Reconfiguration of Global Labor Markets: Toward a Theory of Workforce Scarcity

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Article History:
Submitted: 27-09-2025
Approved: 08-12-2025
Published: 02-03-2026

OPEN ACCESS
Available at the open access journal:
https://sciedex.com/econovia

Abstrak

Population aging is reshaping the structure of global labor markets, yet existing research often examines its economic consequences through fragmented perspectives focused on productivity decline, fiscal pressure, or labor supply contraction. This article advances an integrative conceptual framework that explains how demographic aging triggers a structural reconfiguration of labor markets through the emergence of workforce scarcity. Drawing on demographic economics, labor market theory, and organizational adaptation literature, the study synthesizes prior research to develop a multi-level explanation of how shrinking working-age populations transform the dynamics of labor allocation, firm strategy, and institutional arrangements. The proposed framework conceptualizes workforce scarcity not merely as a demographic outcome but as a structural condition that reorganizes labor demand, skill formation, technological substitution, and cross-border labor mobility. By integrating insights across demographic and economic research streams, the article develops a theory of workforce scarcity that clarifies the mechanisms through which aging societies reshape labor market equilibrium. The framework contributes to the literature by offering a coherent theoretical foundation for understanding how demographic aging reorganizes labor market structures and firm behavior in advanced and emerging economies.

Keywords

demographic aging; workforce scarcity; labor market reconfiguration; demographic economics; labor supply dynamics; global labor markets

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1. Introduction

Population aging has emerged as one of the most consequential structural transformations shaping contemporary economic systems. Over recent decades, declining fertility rates and rising life expectancy have significantly altered the age composition of populations across both developed and emerging economies. As a result, the proportion of individuals aged 65 and above continues to increase while the share of prime-age workers gradually declines. According to projections from the United Nations (2022), the global population aged 65 and older is expected to more than double between 2020 and 2050. These demographic shifts are no longer confined to advanced economies such as Japan or Germany but increasingly characterize many middle-income countries, including China. Consequently, demographic aging is now widely recognized as a structural force shaping long-term economic transformation.

A growing body of research in demographic economics has examined the macroeconomic consequences of population aging. Early contributions emphasized the role of demographic structure in shaping intergenerational transfers and dependency ratios within aging societies (Lee & Mason, 2011). Subsequent studies demonstrate that demographic change influences economic performance through multiple channels, including labor supply reductions, human capital dynamics, and productivity shifts (Bloom, Canning, & Fink, 2010; Maestas, Mullen, & Powell, 2016). Empirical evidence suggests that increases in the share of older individuals in the population may slow productivity growth and reduce overall economic dynamism (Feyrer, 2007; Maestas *et al.*, 2016). Together, these studies highlight the importance of demographic structure as a fundamental determinant of macroeconomic trajectories.

Parallel to this macroeconomic literature, labor economics has explored how demographic aging affects labor market behavior and institutional arrangements. Scholars have documented several adjustments within aging labor markets, including rising labor force participation among older workers, delayed retirement, and reforms to pension systems designed to sustain fiscal balance (Gruber & Wise, 2004; Coile, Milligan, & Wise, 2020). Policy debates increasingly focus on extending working lives and encouraging greater labor force participation among underrepresented groups as strategies to mitigate the economic pressures associated with population aging.

Another stream of research within organizational studies and human resource management has investigated how firms respond to aging workforces. This literature examines topics such as age diversity in organizations, knowledge transfer between generations, age discrimination in hiring practices, and the development of age-inclusive employment policies (Fasbender & Wang, 2017; Zwick, 2015; Beier *et al.*, 2024). These studies demonstrate that demographic change increasingly shapes firm-level employment strategies, particularly in relation to talent retention, skill renewal, and the management of age-diverse workforces.

Recent research has also emphasized the interaction between demographic change and technological transformation. Some scholars argue that labor scarcity associated with aging populations may accelerate the adoption of automation technologies and other labor-saving innovations. For example, Acemoglu and Restrepo (2017, 2020) show that countries experiencing faster demographic aging tend to invest more heavily in robotics and automation technologies. Similarly, broader debates on the future of work highlight how technological change and demographic pressures jointly reshape employment structures and task composition within modern economies (Autor, 2015; Autor *et al.*, 2022).

Despite the rapid expansion of research on demographic aging, the literature provides no unified explanation of how aging populations structurally transform labor markets. Demographic economics primarily analyzes aging through macro-level indicators such as dependency ratios and fiscal sustainability (Lee & Mason, 2011; Bloom *et al.*, 2010). Labor economics, in contrast, focuses on behavioral adjustments including retirement decisions,

labor force participation, and wage responses (Gruber & Wise, 2004; Maestas *et al.*, 2016). Meanwhile, organizational and technological research examines firm-level adaptation through human resource strategies and automation investments (Autor, 2015; Acemoglu & Restrepo, 2020). Although each stream offers important insights, they rarely converge into a coherent theoretical explanation of how demographic aging generates persistent labor market pressures even in the presence of institutional adjustments and technological substitution. This fragmentation leaves a critical gap in understanding the mechanisms through which demographic transitions reshape labor market structures.

A particularly important limitation concerns the absence of a clearly articulated mechanism linking demographic change with persistent labor market pressures. Existing studies often assume a direct relationship between population aging and labor shortages, yet empirical evidence reveals a more complex reality. In many advanced economies, labor force participation among older workers has increased and technological adoption has accelerated, yet firms continue to report persistent difficulties in recruiting skilled labor. This suggests that demographic aging does not simply reduce the number of workers but alters the structural mechanisms through which labor markets allocate and reproduce human capital. Without a clear conceptual mechanism explaining this process, the literature struggles to explain why labor market tensions persist even in contexts where institutional reforms and technological substitution are actively expanding labor supply. As a result, the relationship between demographic aging and labor market restructuring is often assumed rather than conceptually specified.

This theoretical ambiguity becomes increasingly problematic as demographic transitions intensify across both advanced and emerging economies. Declining fertility rates reduce the inflow of younger cohorts while rising longevity extends the presence of older workers in the labor force. These demographic dynamics simultaneously affect the quantity of available labor, the reproduction of skills across generations, and the efficiency with which labor markets match workers to evolving economic opportunities. Consequently, demographic aging generates structural pressures that cannot be fully explained by conventional labor shortage models. Understanding these dynamics requires a theoretical framework capable of explaining how demographic transitions reshape labor allocation systems and organizational responses within modern labor markets.

To address this gap, this article develops the concept of workforce scarcity as a central mechanism linking demographic aging with the structural reconfiguration of labor markets. Workforce scarcity refers to a structural condition in which demographic change reduces the availability, quality, and allocative efficiency of effective labor supply. By conceptualizing labor scarcity as a multidimensional phenomenon rather than a temporary imbalance, this study proposes a multi-level framework explaining how demographic aging reshapes labor markets through a sequence of mechanisms involving labor supply contraction, skill reproduction dynamics, and matching frictions. Through this framework, the article integrates insights from demographic economics, labor market theory, and organizational research to provide a more systematic explanation of how aging societies transform the structure and functioning of global labor markets.

The diagram below clarifies the theoretical architecture connecting demographic change to labor market restructuring. It positions workforce scarcity as the central mechanism through which demographic aging reshapes labor market structures and organizational behavior. By organizing the causal logic into sequential stages, the figure highlights how demographic shifts propagate through labor supply dynamics and institutional responses to produce structural transformations in global labor markets.

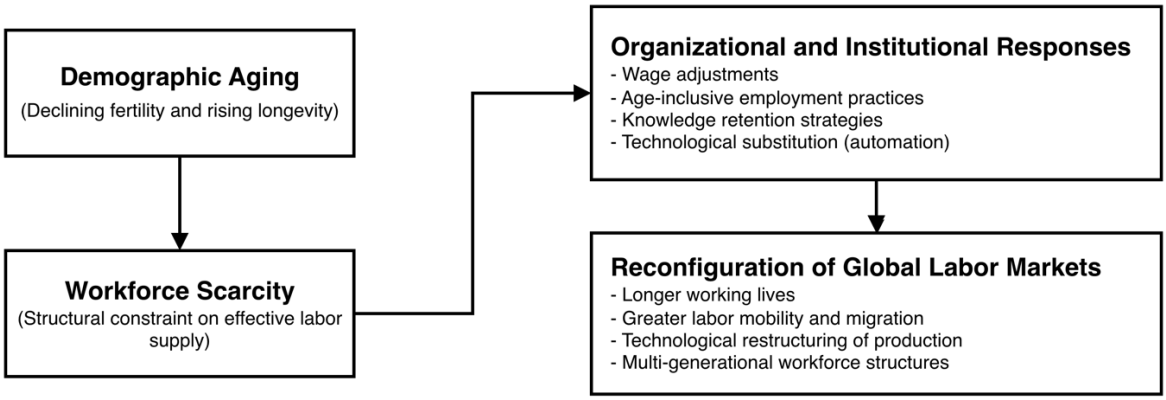

Figure 1. Conceptual Framework Linking Demographic Aging and Labor Market Reconfiguration
Source: Developed by the authors

Figure 1 outlines the theoretical architecture through which demographic change reshapes labor market structures. The framework positions demographic aging as the structural driver that generates workforce scarcity by constraining the effective supply of labor. In response to these pressures, organizations and institutions adopt adaptive strategies—including wage adjustments, age-inclusive employment practices, knowledge retention mechanisms, and technological substitution—which collectively contribute to the broader reconfiguration of global labor markets. Through this mechanism-based structure, Figure 1 clarifies how demographic transitions propagate through economic and organizational systems to transform employment dynamics.

2. Literature Review

Demographic aging has increasingly attracted scholarly attention across multiple academic domains, including demographic economics, labor economics, organizational behavior, and technological change. Although each stream of literature provides valuable insights into the consequences of aging populations, the existing research remains fragmented. Studies often focus on specific outcomes—such as economic growth, labor force participation, retirement patterns, or technological adoption—without systematically integrating these insights into a coherent theoretical explanation of how demographic aging restructures labor markets. This section reviews the main strands of literature relevant to demographic aging and labor markets in order to identify the theoretical foundations and limitations that motivate the development of the workforce scarcity framework proposed in this study.

2.1 Demographic Transition and Population Aging

The theoretical foundation for understanding population aging lies in demographic transition theory, which explains the long-term shift from high fertility and high mortality regimes to low fertility and low mortality societies (Lee, 2003). This transition, which unfolded gradually over the past two centuries in many industrialized economies, has fundamentally altered the age structure of populations. As fertility rates decline and life expectancy increases, the proportion of older individuals within the population rises, leading to an increase in the old-age dependency ratio and a relative contraction of the working-age population.

Empirical evidence confirms that population aging is becoming a global phenomenon. According to the United Nations (2022), the number of individuals aged 65 and above is projected to more than double by mid-century. While early stages of demographic transition produced demographic dividends by expanding the share of working-age populations, later stages are characterized by demographic aging and declining labor force growth (Bloom *et al.,* 2010). As a consequence, many economies are entering a demographic phase in which labor supply growth slows or even reverses.

The literature has emphasized several macroeconomic implications of this transition. Population aging affects economic performance through changes in labor supply, savings behavior, human capital investment, and fiscal sustainability (Bloom *et al.,* 2015; Lee & Mason, 2011). In particular, aging societies face increasing pressure on pension systems and healthcare expenditures as the ratio of retirees to workers rises. While these studies provide important insights into the macroeconomic consequences of demographic change, they primarily focus on aggregate economic outcomes rather than the mechanisms through which aging reshapes labor markets.

2.2 Aging and Economic Growth

A substantial body of research has investigated the relationship between demographic structure and economic growth. These studies typically examine how variations in population age composition influence productivity, innovation, and overall economic performance. One influential line of research argues that demographic aging may slow economic growth by reducing the supply of prime-age workers and altering the productivity profile of the labor force (Feyrer, 2007; Maestas *et al.*, 2016).

Empirical evidence supports the view that age structure plays an important role in shaping economic outcomes. Feyrer (2007), for instance, finds that productivity growth is strongly associated with the age distribution of the workforce, particularly the share of middle-aged workers who tend to exhibit peak productivity. Similarly, Maestas *et al.* (2016) demonstrate that increases in the proportion of older individuals in the population can reduce GDP per capita growth by affecting both labor force participation and productivity dynamics.

Beyond productivity effects, demographic aging also influences innovation and technological progress. Research on inventive activity suggests that the likelihood of breakthrough innovations tends to peak during middle age, implying that shifts in workforce age composition may affect the overall pace of technological development (Jones, 2010). At the same time, some scholars argue that demographic aging may stimulate innovation by creating incentives for labor-saving technologies (Prettner, 2013). These findings indicate that the relationship between aging and economic growth is complex and mediated by multiple mechanisms.

Despite these contributions, much of the literature treats aging primarily as a macroeconomic variable influencing aggregate economic outcomes. The mechanisms through which demographic aging translates into structural changes within labor markets remain relatively underexplored. As a result, the link between population aging and labor market transformation often remains implicit rather than explicitly theorized.

2.3 Labor Market Dynamics in Aging Economies

Labor economics provides another important perspective on the consequences of demographic aging. Scholars in this field have examined how aging populations influence labor supply, retirement behavior, wage dynamics, and labor market institutions. A key focus of this research has been the response of individuals and policy systems to increasing longevity.

One prominent theme concerns the extension of working lives. As life expectancy increases and pension systems face fiscal pressure, many countries have implemented policies designed to delay retirement and encourage continued labor force participation among older individuals (Gruber & Wise, 2004; Coile *et al.*, 2020). Empirical evidence suggests that these reforms have indeed contributed to rising employment rates among older workers in several advanced economies.

Another area of research examines how demographic aging affects labor market participation and mobility. Older workers often face different labor market conditions

compared to younger cohorts, including lower mobility rates and greater sensitivity to institutional incentives such as pension eligibility (Boersch-Supan, 2003). These dynamics can influence the allocation of labor across sectors and firms, potentially affecting productivity and economic efficiency.

However, while labor economics research provides important insights into behavioral responses to demographic change, it rarely conceptualizes labor shortages as a structural outcome of demographic transformation. Instead, labor shortages are often treated as temporary market imbalances or sector-specific phenomena rather than as systemic features of aging labor markets. Consequently, the literature offers limited theoretical integration between demographic shifts and the emergence of persistent labor scarcity.

2.4 Workforce Aging and Organizational Adaptation

In parallel with developments in labor economics, research in organizational behavior and human resource management has increasingly examined the implications of workforce aging within firms. This literature focuses on how organizations manage age-diverse workforces, retain experienced employees, and adapt their employment practices in response to demographic change.

One important theme concerns age diversity within organizations. Studies have shown that age-diverse teams may enhance knowledge transfer and organizational learning, particularly when older workers contribute experience and institutional knowledge while younger workers provide new skills and perspectives (Ilmakunnas & Ilmakunnas, 2011; Zwick, 2015). These findings suggest that demographic diversity can influence productivity at the organizational level.

Another line of research examines the role of age-related biases and discrimination in shaping labor market outcomes. Older workers often face negative stereotypes regarding adaptability, technological competence, and productivity, which can affect hiring decisions and career opportunities (Fasbender & Wang, 2017). Such biases may reduce the effective utilization of available human capital within aging societies.

More recent research has explored age-inclusive human resource practices that enable organizations to better integrate older employees into the workforce. These practices include flexible work arrangements, lifelong learning programs, and career development opportunities tailored to later career stages (Beier *et al.*, 2024). While these studies provide valuable insights into organizational responses to workforce aging, they typically examine firm-level dynamics without explicitly linking them to broader demographic transformations in labor markets.

2.5 Technology, Automation, and Labor Substitution

Technological change represents another important dimension of the relationship between demographic aging and labor markets. As labor supply growth slows, firms may increasingly adopt automation technologies to compensate for declining labor availability. Research in this area has highlighted the interaction between demographic pressures and technological substitution.

Acemoglu and Restrepo (2017) propose that demographic aging may accelerate the adoption of automation technologies by increasing the relative scarcity of labor. Their analysis suggests that countries experiencing faster aging tend to invest more heavily in robotics and other labor-saving technologies. This perspective implies that technological change may partially offset the economic consequences of declining labor supply.

Similarly, broader debates on the future of work emphasize how automation and artificial intelligence are transforming labor markets by altering task structures and employment

patterns (Autor, 2015; Autor *et al.*, 2022). Technological adoption can reshape labor demand by replacing routine tasks while simultaneously creating new skill requirements.

However, although this literature recognizes that labor scarcity may influence technological adoption, it rarely integrates demographic change, labor market dynamics, and organizational adaptation into a unified theoretical framework. The interaction between demographic aging and labor market restructuring therefore remains insufficiently conceptualized.

2.6 Research Gap

The review above reveals that existing scholarship has generated extensive knowledge about the economic and organizational implications of demographic aging. Nevertheless, the literature remains theoretically fragmented across several domains. Demographic economics focuses primarily on macroeconomic consequences, labor economics emphasizes behavioral and institutional responses, organizational research examines firm-level adaptation, and technological studies analyze automation dynamics. These strands of research often proceed independently, resulting in limited conceptual integration.

The following table synthesizes the major strands of literature reviewed in the article and clarifies how the proposed workforce scarcity framework integrates them. By explicitly identifying the analytical focus and limitations of prior research streams, the table positions the present study within the broader theoretical landscape and highlights its integrative contribution.

Table 1. Integration of Prior Literature and Theoretical Positioning of the Workforce Scarcity Framework

Literature Stream	Primary Focus in Prior Research	Key Limitation	Extension Offered by the Workforce Scarcity Framework
Demographic Economics	Examines how population aging influences macroeconomic outcomes such as economic growth, dependency ratios, savings behavior, and fiscal sustainability.	Focuses primarily on aggregate economic indicators without specifying mechanisms linking demographic change to labor market restructuring.	Reinterprets demographic aging as a structural driver that generates labor market pressures through workforce scarcity mechanisms.
Labor Economics	Investigates labor supply dynamics, retirement behavior, wage adjustments, and institutional responses to aging populations.	Often treats labor shortages as temporary market imbalances rather than structural outcomes of demographic transitions.	Conceptualizes workforce scarcity as a persistent condition produced by labor supply contraction, skill reproduction lag, and matching frictions.
Organizational and HRM Research	Explores firm-level adaptation to aging workforces, including age diversity management, knowledge transfer, and age-inclusive HR practices.	Focuses mainly on internal organizational practices without linking these adaptations to broader demographic transformations in labor markets.	Connects firm-level workforce strategies to structural demographic pressures shaping labor availability and skill reproduction.
Technology and Automation Literature	Analyzes how automation, robotics, and artificial intelligence influence employment structures and task composition.	Often treats technological change as an autonomous driver of labor market transformation rather than as a response to demographic pressures.	Positions technological adoption as a strategic response to workforce scarcity generated by demographic aging.

Source: Developed by the author

Table 2 clarifies the theoretical positioning of the article by demonstrating how the workforce scarcity framework integrates previously fragmented research streams. By linking demographic economics, labor market theory, organizational adaptation, and technological change within a unified explanatory structure, Table 2 highlights the integrative contribution of the study and reinforces the argument that demographic aging operates as a structural force reshaping labor market dynamics.

A key limitation of existing studies is the absence of a clearly defined theoretical mechanism linking demographic aging to structural transformations in labor markets. While many studies acknowledge that aging populations may produce labor shortages, the concept of labor scarcity is rarely theorized in a systematic manner. Most analyses implicitly assume that demographic change leads directly to labor market pressures without specifying the mechanisms through which these pressures emerge.

This article addresses this gap by introducing the concept of workforce scarcity as a structural mechanism connecting demographic aging with labor market restructuring. By conceptualizing workforce scarcity as a multidimensional condition involving quantitative labor supply contraction, skill reproduction dynamics, and labor market matching frictions, this study integrates insights from demographic economics, labor economics, and organizational research into a unified theoretical framework. The next section develops this conceptual framework and explains how workforce scarcity contributes to the reconfiguration of global labor markets.

3. Methodology

This study develops a conceptual explanation of how demographic aging contributes to the restructuring of global labor markets through the mechanism of workforce scarcity. Because the objective of the article is theory development rather than empirical testing, the research adopts a conceptual methodology that integrates insights from multiple streams of literature. Conceptual research is particularly appropriate when existing scholarship is theoretically fragmented and when new mechanisms or constructs must be articulated to explain emerging phenomena (MacInnis, 2011; Jaakkola, 2020). In this context, the methodology focuses on synthesizing prior research, identifying theoretical inconsistencies, and constructing an integrative framework that connects demographic change with labor market dynamics and organizational responses.

3.1 Research Design: Conceptual Theory-Building Approach

The research design follows a theory-building approach aimed at developing new conceptual relationships between demographic change and labor market transformation. Conceptual articles play a critical role in advancing academic knowledge by integrating previously disconnected literatures, clarifying constructs, and proposing theoretical mechanisms that can guide future empirical research (MacInnis, 2011; Jaakkola, 2020).

In this study, the theory-building process involves three stages. First, the study reviews and synthesizes key strands of literature related to demographic transition, labor economics, organizational adaptation, and technological change. Second, it identifies conceptual gaps in existing scholarship, particularly the absence of a clearly defined mechanism explaining how demographic aging translates into structural labor market pressures. Third, the study develops the concept of workforce scarcity and proposes a conceptual framework that links demographic aging with labor market restructuring through a series of theoretical mechanisms.

This approach allows the study to move beyond descriptive observations of aging populations and toward a more systematic explanation of how demographic forces reshape economic institutions and labor market structures.

3.2 Integrative Literature Review

To construct the theoretical framework, this study employs an integrative literature review methodology. Integrative reviews are designed to synthesize diverse research streams in order to develop new conceptual insights and theoretical models (Snyder, 2019). Unlike traditional narrative reviews that summarize existing findings, integrative reviews aim to generate new theoretical understanding by identifying patterns, contradictions, and gaps across bodies of literature.

The literature reviewed in this study spans several interdisciplinary domains, including demographic economics, labor market theory, organizational behavior, human resource management, and technological change. These domains were selected because demographic aging affects labor markets through multiple mechanisms operating at different analytical levels. By integrating insights across these disciplines, the study seeks to develop a comprehensive conceptual framework capable of explaining the broader implications of demographic change.

The literature synthesis process focused on identifying studies that contribute to understanding at least one of the following dimensions: (1) demographic changes in population age structures, (2) labor market responses to aging populations, (3) organizational adaptation to workforce aging, and (4) technological substitution and automation in response to labor scarcity. The selected literature includes both foundational theoretical contributions and recent empirical studies that reflect contemporary developments in aging labor markets.

3.3 Analytical Strategy: Multi-Level Conceptualization

The analytical strategy adopted in this research is based on a multi-level conceptualization of demographic change and labor market transformation. Demographic processes originate at the macro level through population-level shifts in fertility, mortality, and longevity. These changes subsequently influence labor market dynamics at the meso level by altering labor supply structures, skill availability, and labor mobility patterns. Finally, firms and organizations respond at the micro level by adjusting employment practices, technological adoption, and workforce management strategies.

By explicitly incorporating multiple levels of analysis, the study seeks to bridge the gap between macro-level demographic trends and micro-level organizational behavior. Previous research has often examined these levels independently, which has contributed to theoretical fragmentation in the literature. The multi-level approach adopted here enables a more comprehensive explanation of how demographic aging produces structural pressures that propagate throughout labor markets and organizations.

The analysis therefore conceptualizes demographic aging as the structural driver, workforce scarcity as the central mechanism, and labor market restructuring as the resulting outcome. Organizational responses and technological adoption are incorporated as mediating processes that shape how workforce scarcity manifests within different institutional and economic contexts.

3.4 Conceptual Framework Development

Building on the integrative literature review and multi-level analytical perspective, the final stage of the methodology involves developing a conceptual framework that explains the relationship between demographic aging and labor market transformation. Conceptual frameworks in theory-building research serve to clarify relationships among constructs and provide a structured representation of theoretical mechanisms (Jaakkola, 2020).

The framework developed in this study positions workforce scarcity as the key construct linking demographic aging with labor market restructuring. Workforce scarcity is

conceptualized as a multidimensional condition emerging from demographic changes that reduce the quantity, quality, and allocative efficiency of effective labor supply. Three primary mechanisms are identified through which demographic aging generates workforce scarcity: labor supply contraction, skill reproduction lag, and labor market matching frictions.

These mechanisms are then connected to organizational and institutional responses, including wage adjustments, workforce retention strategies, age-inclusive employment practices, and technological substitution through automation. Together, these responses contribute to the broader reconfiguration of labor markets in aging societies.

The conceptual framework developed through this methodological process provides a theoretical foundation for future empirical research examining demographic change, labor market transformation, and organizational adaptation. By clarifying the mechanisms through which demographic aging affects labor markets, the framework aims to advance scholarly understanding of workforce dynamics in aging economies while offering a structured agenda for subsequent empirical investigation.

4. Conceptual Development

Building on the literature synthesis and the methodological approach outlined earlier, this section develops the core conceptual argument of the article. The analysis proposes workforce scarcity as the central theoretical construct linking demographic aging with the structural reconfiguration of labor markets. Rather than treating labor shortages as temporary market imbalances or sector-specific phenomena, the framework conceptualizes workforce scarcity as a structural outcome emerging from demographic transitions. The section proceeds by defining the concept of workforce scarcity, identifying the mechanisms through which demographic aging generates labor scarcity, and explaining how these dynamics trigger organizational responses and broader labor market restructuring.

4.1 Conceptualizing Workforce Scarcity

The existing literature frequently refers to “labor shortages” in discussions of aging societies, yet the concept is rarely defined with theoretical precision. In many policy debates, labor shortages are treated as temporary imbalances between labor supply and labor demand within specific industries. However, demographic aging introduces structural pressures that extend beyond short-term labor market fluctuations. Declining fertility rates and increasing longevity gradually reshape the size and composition of the labor force, creating persistent changes in labor supply dynamics (Lee, 2003; United Nations, 2022).

To capture this structural dimension, this study introduces the concept of workforce scarcity, defined as a systemic condition in which demographic change reduces the availability, quality, and allocative efficiency of effective labor supply. Unlike traditional notions of labor shortages that focus solely on the numerical availability of workers, workforce scarcity reflects a broader transformation in the functioning of labor markets. It encompasses not only the decline in the number of working-age individuals but also the evolving skill composition of the labor force and the institutional frictions that affect labor allocation.

This conceptualization builds upon insights from demographic economics and labor market theory. Research has shown that population aging affects labor supply growth and alters the distribution of workers across age cohorts, which in turn influences productivity and economic performance (Bloom *et al.*, 2010; Maestas *et al.*, 2016). At the same time, aging societies may experience changes in the effective utilization of human capital due to institutional barriers, retirement policies, and age-related discrimination in hiring (Fasbender & Wang, 2017). These dynamics suggest that labor scarcity cannot be understood purely as a numerical shortage but must be conceptualized as a multidimensional structural phenomenon.

Accordingly, workforce scarcity is conceptualized in this study as comprising three interrelated dimensions: quantitative scarcity, qualitative scarcity, and allocative scarcity. Quantitative scarcity refers to the decline in the size of the working-age population relative to the total population. Qualitative scarcity refers to the mismatch between the skills demanded by evolving economic sectors and the skills available within aging labor forces. Allocative scarcity refers to inefficiencies in the matching and mobility of labor across firms and sectors. Together, these dimensions provide a more comprehensive understanding of how demographic aging generates persistent pressures within labor markets.

The table below clarifies the conceptual structure of workforce scarcity by distinguishing its three analytical dimensions. Presenting these dimensions in tabular form helps stabilize the construct definition and prevents conceptual ambiguity regarding how demographic aging constrains labor supply.

Table 2. Dimensions of Workforce Scarcity

Dimension	Definition	Primary Source of Scarcity	Labor Market Implication
Quantitative Scarcity	A structural decline in the number of available workers relative to labor demand due to shrinking working-age populations.	Labor supply contraction caused by declining fertility and slower entry of younger cohorts into the labor force.	Reduced labor force growth, tighter labor markets, and increased competition among firms for workers.
Qualitative Scarcity	A mismatch between the skills available within the labor force and the competencies required by evolving economic sectors.	Skill reproduction lag resulting from slower renewal of specialized knowledge and technological capabilities.	Skill shortages in technologically advanced industries and increasing demand for retraining and lifelong learning.
Allocative Scarcity	Inefficiencies in the distribution and mobility of labor across firms, sectors, and regions.	Labor market matching frictions arising from institutional constraints, mobility limitations, and hiring biases.	Reduced efficiency of worker–job matching and persistent vacancies despite available labor supply.

Source: Author's conceptualization

Table 1 clarifies the multidimensional nature of workforce scarcity by distinguishing quantitative, qualitative, and allocative forms of labor constraints. This conceptual differentiation helps avoid reducing labor shortages to a purely numerical issue and instead highlights how demographic change affects the size, capability, and allocation of the labor force simultaneously. By specifying these dimensions explicitly, Table 1 strengthens the analytical foundation of the workforce scarcity framework and prepares the subsequent discussion of the mechanisms through which demographic aging restructures labor markets.

The diagram below elaborates the generative mechanisms through which demographic aging produces structural workforce scarcity. Rather than treating labor shortages as a single-dimensional outcome, the framework decomposes the process into three distinct mechanisms—labor supply contraction, skill reproduction lag, and labor market matching frictions. This structure clarifies how demographic shifts translate into persistent constraints on effective labor supply.

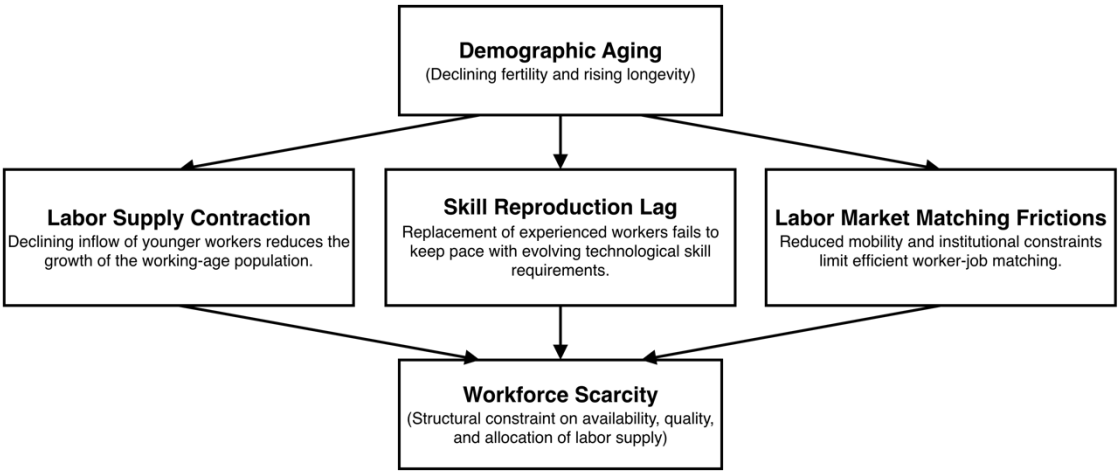

Figure 2. Mechanisms Generating Workforce Scarcity
Source: Author's conceptualization

Figure 2 clarifies the mechanisms through which demographic aging generates structural workforce scarcity. Three interconnected processes translate demographic change into labor market constraints. Labor supply contraction reduces the inflow of younger workers into the labor force, while skill reproduction lag emerges when the transfer and renewal of competencies fail to keep pace with evolving technological demands. At the same time, labor market matching frictions—arising from reduced mobility and institutional constraints—limit the efficient allocation of available workers across firms and sectors. The convergence of these mechanisms produces workforce scarcity as a multidimensional condition affecting the availability, quality, and allocation of effective labor supply.

4.2 Mechanisms Linking Demographic Aging and Workforce Scarcity

The emergence of workforce scarcity can be understood through several mechanisms that connect demographic change with labor market dynamics. The first mechanism is labor supply contraction, which occurs when the size of prime-age cohorts declines relative to earlier generations. As fertility rates fall, fewer individuals enter the labor market in subsequent decades, gradually reducing the growth rate of the labor force. Empirical studies have demonstrated that aging populations can significantly slow labor force growth and reduce economic output through this channel (Bloom *et al.*, 2010; Maestas *et al.*, 2016).

The second mechanism is skill reproduction lag, which arises when the replacement of experienced workers with younger cohorts fails to keep pace with the changing skill requirements of the economy. Aging societies often face difficulties maintaining a continuous supply of workers with the necessary competencies for technologically advanced sectors. While older workers possess valuable experience and institutional knowledge, they may also face barriers in adapting to rapidly evolving technological environments. Conversely, younger cohorts entering the labor market may not yet possess the accumulated experience required for complex roles. These dynamics can create skill gaps that exacerbate workforce scarcity even when aggregate labor supply appears sufficient (Jones, 2010; Zwick, 2015).

The third mechanism is matching frictions within labor markets. Labor markets do not allocate workers perfectly across jobs, and demographic aging may amplify these frictions. Older workers often exhibit lower geographic and occupational mobility, partly due to family commitments, accumulated firm-specific human capital, or institutional constraints such as pension eligibility (Boersch-Supan, 2003). In addition, age-related biases in hiring practices may further restrict the employment opportunities available to older individuals (Fasbender & Wang, 2017). These factors reduce the efficiency with which available labor resources are allocated across firms and sectors, thereby contributing to allocative scarcity.

Together, these three mechanisms—labor supply contraction, skill reproduction lag, and matching frictions—illustrate how demographic aging can produce structural labor scarcity even when unemployment rates remain relatively low. The interaction of these mechanisms highlights the need for a more nuanced understanding of labor market dynamics in aging societies.

4.3 Organizational Responses to Workforce Scarcity

As workforce scarcity emerges within labor markets, organizations are compelled to adapt their employment strategies and workforce management practices. Firms facing tighter labor markets often respond by increasing wages, enhancing working conditions, and implementing retention strategies aimed at maintaining experienced employees. Such responses reflect the growing competition among firms for limited human capital resources.

The diagram below extends the conceptual framework by explaining how workforce scarcity triggers adaptive responses within organizations and institutions, ultimately reshaping the structure of labor markets. By distinguishing organizational strategies from technological and institutional adjustments, the framework clarifies the pathways through which labor scarcity translates into broader structural transformation.

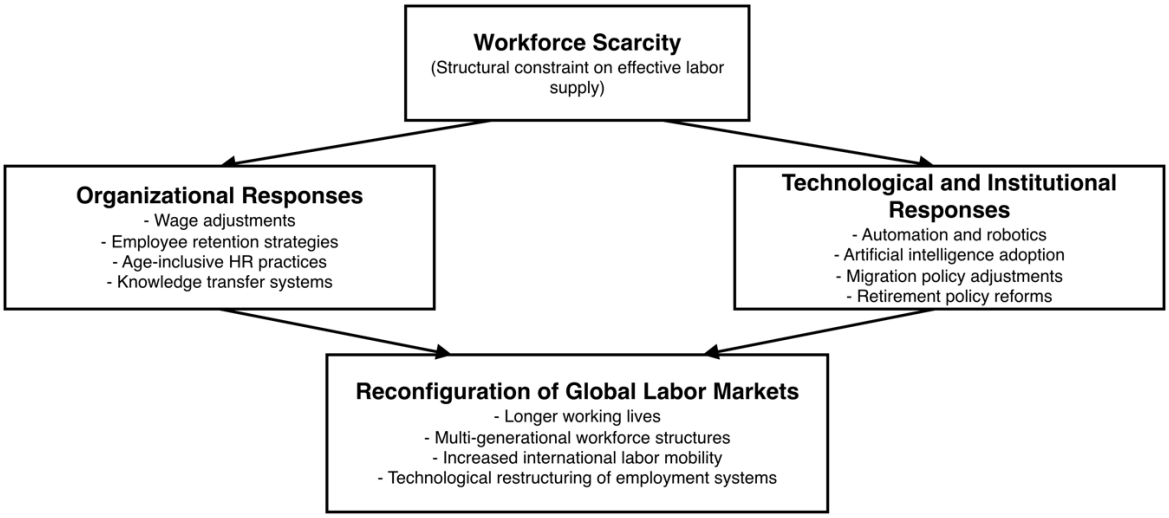

Figure 3. Adaptive Responses to Workforce Scarcity and the Reconfiguration of Labor Markets
Source: Developed by the authors

Figure 3 explains how workforce scarcity generates adaptive responses that reshape labor market structures. Organizations respond by adjusting employment strategies, including wage adjustments, retention policies, age-inclusive human resource practices, and knowledge transfer mechanisms that extend the productive participation of experienced workers. At the same time, technological and institutional responses—such as automation, artificial intelligence adoption, migration policy adjustments, and retirement reforms—alter the institutional environment in which labor markets operate. The combined effects of these responses contribute to the broader reconfiguration of global labor markets, including longer working lives, increased labor mobility, and the emergence of multi-generational employment systems.

Research in organizational behavior and human resource management suggests that firms are increasingly adopting age-inclusive employment practices to better integrate older workers into their workforce. These practices include flexible working arrangements, phased retirement programs, and lifelong learning initiatives designed to maintain employability among older employees (Beier *et al.*, 2024). By enabling workers to remain productive for longer periods, these strategies help mitigate the effects of labor supply contraction.

Another important organizational response involves knowledge retention and transfer mechanisms. Older workers often possess substantial tacit knowledge accumulated through years of experience. Firms may therefore implement mentoring systems, intergenerational teams, and structured knowledge-sharing practices to ensure that critical expertise is not lost as employees approach retirement. Studies have shown that age-diverse teams can enhance productivity and innovation when organizations effectively manage knowledge exchange between generations (Ilmakunnas & Ilmakunnas, 2011).

Technological adoption also represents a significant organizational response to workforce scarcity. Firms may invest in automation technologies, robotics, and artificial intelligence systems to compensate for declining labor availability. Evidence suggests that countries experiencing faster population aging tend to adopt automation technologies more rapidly, indicating that demographic pressures may accelerate technological substitution (Acemoglu & Restrepo, 2020). These investments enable organizations to maintain productivity despite labor supply constraints.

4.4 Reconfiguration of Global Labor Markets

The combined effects of demographic aging, workforce scarcity, and organizational adaptation ultimately contribute to the reconfiguration of global labor markets. This transformation manifests in several interconnected ways. First, aging societies are likely to experience longer working lives, as individuals remain active in the labor force for extended periods. Policy reforms aimed at raising retirement ages and encouraging later-life employment reflect this shift (Gruber & Wise, 2004).

Second, demographic pressures may increase the importance of international labor mobility. Countries experiencing severe workforce shortages may rely more heavily on migrant labor to supplement domestic labor supply. Migration policies thus become an important instrument for addressing demographic imbalances across regions (Lee & Mason, 2011).

Third, labor market structures may increasingly incorporate technological substitution. As automation technologies become more sophisticated and cost-effective, firms may replace certain labor-intensive tasks with machines or digital systems. This process may reshape the composition of employment across sectors and alter the skill requirements of the workforce (Autor, 2015; Acemoglu & Restrepo, 2020).

Finally, demographic aging may lead to the emergence of age-diverse labor markets in which multiple generations participate simultaneously in economic activity. Such environments require new institutional arrangements and organizational practices that support collaboration across age groups and maintain productivity across extended career spans.

Taken together, these developments illustrate how demographic aging can reshape labor markets at both national and global levels. By conceptualizing workforce scarcity as the central mechanism linking demographic change with labor market restructuring, this study provides a theoretical framework that integrates insights from demographic economics, labor market theory, and organizational research. The next section discusses the theoretical and practical implications of this framework and outlines directions for future research.

5. Discussion

The conceptual framework developed in this study provides a structured explanation of how demographic aging reshapes labor markets through the mechanism of workforce scarcity. The discussion integrates insights from demographic economics, labor market theory, and organizational research to highlight the theoretical implications of this framework. By positioning workforce scarcity as a central mechanism linking demographic change with labor

market restructuring, the study contributes to several strands of literature while also clarifying the broader economic and organizational consequences of population aging.

5.1 Demographic Aging as a Structural Driver of Labor Market Transformation

A key implication of the proposed framework is that demographic aging should be understood not merely as a background condition but as a structural driver of labor market transformation. Traditional demographic research has long emphasized the macroeconomic consequences of population aging, particularly in relation to dependency ratios, fiscal sustainability, and economic growth (Lee, 2003; Lee & Mason, 2011). These studies demonstrate that aging populations alter the balance between working-age individuals and retirees, thereby influencing national economic performance.

However, the results of the present conceptual analysis suggest that the influence of demographic aging extends beyond macroeconomic indicators to the structural functioning of labor markets themselves. When fertility declines and life expectancy increases, the inflow of younger workers gradually decreases while the share of older workers rises. This shift affects the size, composition, and mobility of the labor force, creating conditions in which the availability of effective labor becomes increasingly constrained. Empirical studies have shown that such demographic shifts can reduce labor force growth and slow economic expansion (Bloom, Canning, & Fink, 2010; Maestas, Mullen, & Powell, 2016). Yet the concept of workforce scarcity highlights that the consequences of demographic change are not limited to aggregate labor supply; they also involve deeper structural adjustments within labor markets.

In this sense, the framework proposed here complements earlier demographic-economic research by emphasizing the mechanisms through which demographic aging influences labor market dynamics. By conceptualizing workforce scarcity as a multidimensional phenomenon involving quantitative, qualitative, and allocative dimensions of labor supply, the study extends existing theories of demographic transition to incorporate labor market processes that have previously been underexplored.

5.2 Workforce Scarcity and Labor Market Frictions

The concept of workforce scarcity also contributes to labor economics by clarifying the mechanisms through which demographic aging generates persistent labor market pressures. Classical labor market theory typically explains employment outcomes through the interaction of labor supply and labor demand within competitive markets. In practice, however, labor markets are characterized by various frictions—including mobility constraints, skill mismatches, and institutional rigidities—that prevent perfect matching between workers and jobs (Topel, 1999).

The findings of the conceptual analysis suggest that demographic aging amplifies these frictions in several ways. First, labor supply contraction reduces the availability of workers in key age cohorts, particularly those in the prime working-age range. As a result, firms may face increasing difficulty filling vacancies even when unemployment rates remain relatively low. This dynamic has been observed in several advanced economies experiencing aging populations and declining labor force growth.

Second, the skill reproduction lag identified in the conceptual framework reflects a mismatch between evolving economic requirements and the skills available within aging labor forces. Research on human capital formation suggests that technological change can rapidly alter skill demand, while educational and training systems often adjust more slowly (Autor, 2015). Consequently, demographic aging may intensify skill shortages in technologically advanced sectors even when labor supply remains stable in aggregate terms.

Third, allocative scarcity arises from inefficiencies in the distribution of labor across sectors and firms. Older workers tend to exhibit lower mobility rates compared to younger cohorts, partly due to institutional arrangements such as pension eligibility and partly due to the accumulation of firm-specific human capital (Boersch-Supan, 2003). These mobility constraints can limit the ability of labor markets to reallocate workers to emerging sectors, thereby exacerbating labor shortages in dynamic industries.

Together, these mechanisms illustrate how demographic aging interacts with existing labor market frictions to produce persistent workforce scarcity. The concept therefore extends conventional labor shortage discussions by emphasizing the structural and multidimensional nature of labor scarcity in aging societies.

5.3 Organizational Adaptation in Aging Labor Markets

The emergence of workforce scarcity has significant implications for organizational behavior and human resource management. Firms operating in aging labor markets must adapt their workforce strategies to address declining labor availability and evolving skill requirements. The conceptual framework developed in this study highlights several key organizational responses to workforce scarcity.

One important response involves the development of age-inclusive employment practices designed to retain experienced employees and extend working lives. Research in organizational psychology indicates that age-inclusive human resource policies—such as flexible work arrangements, lifelong learning opportunities, and career development programs tailored to later life stages—can enhance the employability and productivity of older workers (Beier *et al*., 2024). These practices enable firms to maintain access to valuable human capital while mitigating the effects of demographic labor supply contraction.

Another organizational response involves strengthening knowledge transfer mechanisms within firms. Older workers often possess extensive tacit knowledge that is difficult to codify or replace. Studies have shown that age-diverse teams can enhance productivity when organizations effectively facilitate the transfer of experience from older to younger employees (Ilmakunnas & Ilmakunnas, 2011; Zwick, 2015). Such knowledge-sharing processes become increasingly important in aging societies where workforce renewal occurs more slowly.

Technological adoption represents a third strategic response to workforce scarcity. Firms may invest in automation technologies, robotics, and digital systems to compensate for declining labor supply. Evidence suggests that demographic aging may accelerate the adoption of labor-saving technologies, as firms seek alternative means of maintaining productivity when labor becomes scarce (Acemoglu & Restrepo, 2020). This interaction between demographic change and technological innovation illustrates how workforce scarcity can reshape production systems and employment structures.

5.4 Implications for the Future Structure of Labor Markets

The conceptual framework developed in this article also offers insights into the future evolution of labor markets in aging societies. Several structural transformations are likely to emerge as demographic aging intensifies over the coming decades.

First, labor markets may increasingly feature longer working lives as individuals remain economically active well beyond traditional retirement ages. Policy reforms that encourage delayed retirement and flexible employment arrangements are likely to become more common as governments attempt to maintain labor force participation among older workers (Gruber & Wise, 2004).

Second, international labor mobility may play a more significant role in balancing demographic disparities across countries. Regions experiencing severe workforce scarcity may increasingly rely on migrant labor to supplement domestic labor supply. Migration

policies therefore become a critical component of labor market adjustment in aging economies (Lee & Mason, 2011).

Third, technological substitution may become a central feature of labor market restructuring. As automation technologies become more advanced and accessible, firms may replace certain categories of labor with machines or artificial intelligence systems. While technological substitution can mitigate labor scarcity, it may also transform skill requirements and occupational structures within labor markets (Autor, 2015; Acemoglu & Restrepo, 2020).

Finally, aging societies may increasingly develop multi-generational labor markets, where workers of different age groups collaborate within extended career trajectories. Such labor markets require new institutional arrangements and organizational practices that support intergenerational cooperation, continuous skill development, and flexible employment pathways.

5.5 Theoretical Integration

The findings of this conceptual study demonstrate that demographic aging should be understood as a structural force that reshapes labor markets through the mechanism of workforce scarcity. By integrating insights from demographic economics, labor market theory, and organizational research, the study provides a more comprehensive explanation of how demographic transitions influence employment systems.

The concept of workforce scarcity thus serves as a theoretical bridge connecting macro-level demographic changes with micro-level organizational responses. This integration addresses the fragmentation observed in existing literature and offers a unified framework for analyzing labor market dynamics in aging societies. As demographic transitions continue to unfold globally, understanding the mechanisms underlying workforce scarcity will become increasingly important for scholars, policymakers, and organizational leaders seeking to navigate the challenges and opportunities associated with aging populations.

6. Conclusion

This article develops a conceptual explanation of how demographic aging reshapes labor markets through the mechanism of workforce scarcity. While previous research has extensively examined the economic implications of population aging, much of the literature has remained fragmented across several disciplinary domains, including demographic economics, labor economics, organizational behavior, and technological change. Existing studies have documented the consequences of aging populations for economic growth, productivity, retirement behavior, and technological adoption, yet they rarely provide an integrated theoretical account of how demographic change translates into structural transformations in labor markets (Bloom, Canning, & Fink, 2010; Maestas, Mullen, & Powell, 2016).

By synthesizing insights from these literatures, this study proposes workforce scarcity as a central theoretical mechanism linking demographic aging to the reconfiguration of labor markets. Workforce scarcity is conceptualized as a multidimensional condition in which demographic transitions reduce the availability, quality, and allocative efficiency of effective labor supply. The conceptual framework identifies three key mechanisms through which demographic aging generates workforce scarcity: labor supply contraction, skill reproduction lag, and matching frictions within labor markets. These mechanisms create persistent pressures that influence organizational behavior, technological adoption, and institutional responses, ultimately contributing to structural changes in employment systems.

The framework advances the literature in several ways. First, it extends demographic economic research by moving beyond aggregate macroeconomic outcomes and focusing on

the labor market mechanisms through which demographic change exerts its effects (Lee, 2003; Lee & Mason, 2011). Second, the study contributes to labor economics by clarifying the structural nature of labor scarcity in aging societies, emphasizing that labor shortages arise not only from declining labor supply but also from skill mismatches and allocative frictions within labor markets (Boersch-Supan, 2003). Third, the framework bridges the gap between macro-level demographic dynamics and micro-level organizational responses, highlighting how firms adapt through workforce management strategies, knowledge transfer practices, and technological substitution (Beier *et al*., 2024; Acemoglu & Restrepo, 2020).

Beyond its theoretical contributions, the framework also has important practical implications. For policymakers, the analysis suggests that addressing workforce scarcity requires more than policies aimed at increasing labor supply. Effective strategies must also improve the utilization of existing human capital by promoting lifelong learning, facilitating labor mobility, and reducing institutional barriers that limit the participation of older workers in the labor market. For organizations, the findings highlight the importance of developing age-inclusive employment practices, investing in knowledge transfer systems, and strategically adopting automation technologies to sustain productivity in aging labor markets.

The conceptual model proposed in this article also provides a foundation for future empirical research. Several research avenues emerge from the framework. First, empirical studies could examine the extent to which workforce scarcity manifests differently across industries and institutional contexts. Second, future research could investigate how firms adjust their workforce strategies in response to demographic labor constraints. Third, cross-national studies could explore how variations in demographic structures and labor market institutions influence the intensity and consequences of workforce scarcity.

Despite these contributions, this study is not without limitations. As a conceptual analysis, the framework relies on the synthesis of existing literature rather than empirical testing. Consequently, the theoretical propositions developed in this article require empirical validation in future research. Moreover, the analysis primarily focuses on the relationship between demographic aging and labor market dynamics in advanced economies, while the implications for emerging economies may differ depending on demographic trajectories and institutional conditions.

In conclusion, demographic aging represents one of the most significant structural transformations shaping contemporary labor markets. Understanding how demographic change influences labor market dynamics requires theoretical frameworks that integrate demographic processes with economic and organizational mechanisms. By introducing the concept of workforce scarcity and developing a multi-level framework linking demographic aging with labor market restructuring, this study contributes to a deeper understanding of how aging populations reshape the future of work.

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