*Iranian Economic Review, 29(3), 1163-1185*
*DOI: 10.22059/IER.2023.347250.1007515*

RESEARCH PAPER

# The Role of "Related Variety" in Regional Economic Development of Iran: Employment Growth or Economic Productivity?

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Received: 20 September 2022, Revised: 10 December 2022, Accepted: 30 December 2022, Published: 30 September 2025
Publisher: The University of Tehran Press.


## Abstract

This study, aims to examine the impact of related variety on regional economic development in Iran. The study constructed an index for the concept of related variety based on spatial productivity indicators and the production pattern in the input-output model. The findings reveal that Tehran, Bushehr, and Gilan provinces have the highest related variety indicator values. Additionally, the correlation analysis between this indicator and economic performance indicators suggests a direct, albeit not particularly strong, linear relationship between them. Furthermore, the causal relationship analysis, using the related variety indicator as the independent variable, demonstrates that related variety significantly contributes to regional employment growth. However, its impact on productivity growth in economic activities is not statistically significant. Therefore, the author recommends that regional development policies prioritize enhancing a diverse range of related activities to facilitate knowledge and experience spillover, particularly if the goal is to increase employment rates. This approach should be considered over a narrow focus on specialization policies and the creation of growth poles based solely on relative advantages.

**Keywords:** Agglomerative Economy, Regional Economic Growth, Related Variety, Urbanization Economy.
**JEL Classification:** R11, R12.

## 1. Introduction

In many regional development plans, economic growth is identified as a fundamental and essential goal. Key indicators, such as increased productivity and employment, are employed to gauge regional economic growth (Feser et al., 2008; Delgado et al., 2014). Strategies promoting localization and urbanization economies are introduced as effective approaches for achieving this objective

(Stimson et al., 2006). However, regional disparities arising from factors like relative advantages, central or peripheral positions, the level of welfare services, and urbanization present numerous challenges to spatial decision-makers in choosing the right development strategy.

Research has shown that urbanization and localization economies, both considered agglomerative economies (Hoover, 1937), can lead to different forms of knowledge spillover and regional production flows, each contributing to economic growth in distinct ways (Feser and Sweeney, 2000; Eberts and McMillen, 1999). Locational economies, which encourage industry specialization in specific areas, and the clustering of activities, result in knowledge spillover among similar economic sectors, thereby enhancing economic productivity. In contrast, urbanization economies signify a diversity of activities and the transfer of knowledge between different sectors (Dinc, 2015).

The concept of "related variety" emerged in 2007, raising the initial question: "Do regions benefit more from a variety of economic activities or from specialization in economic activities?" This concept underscores the importance of knowledge spillover among various activities, not limited to a single activity group. It also emphasizes the relevance of activities that facilitate this knowledge transfer. Related industries sharing common institutional and structural foundations in value-added production have a higher capacity for knowledge transfer. This dynamic flow of knowledge and innovation trade-offs leads to the creation of new combinations of knowledge and products, facilitating regional employment (Frenken et al., 2007).

Understanding this concept is crucial as it can guide policymaking for regional economic growth, especially in situations where the production industry and activity specialization are under threat. Empowering diverse and related economic activities in these regions can effectively stimulate regional economic growth. With these considerations in mind, this study aims to test this hypothesis within the economic system of urban regions in Iran. The study focuses on "urban regions" as the analytical units, defined as official political regions aligning with provincial boundaries and corresponding to spatial planning documents at this level due to the availability of organized economic and institutional data.

In the initial section, I provide a comprehensive explanation of the theoretical framework, aiming to facilitate a profound comprehension of the "related variety" concept. Subsequently, I delve into the foundational theories that support this concept. Specifically, I expound upon the agglomerative economy theory in the context of related variety and the portfolio theory concerning

unrelated variety. Moving on to the following section, I lay out the methodological framework employed to formulate the related variety indicator and detail the process by which it will be applied in the case study. Lastly, the study culminates in the presentation of analysis findings. These findings are instrumental in elucidating the role played by the related variety indicator in influencing employment and the growth rate of economic productivity in urban regions of Iran.

## 2. Literature Review

### 2.1 Regional Economic Development and the Concept of Related Variety

Numerous contemporary theories of urban economic development place significant emphasis on knowledge and innovation as the cornerstones of sustainable regional progress (Mahmoudpour and Daneshpour, 2015; Dadashpour and Yousefi, 2016; Jomehpoor et al., 2017; Sheykh Zeynaddin et al., 2014; Hedayatifard and Rozenblat, 2019). These theories underscore the pivotal role of knowledge flow in driving and sustaining regional development. The concept of "related variety" made its debut in 2007 in articles by Frenken at the University of Austria (Fitjar et al., 2017). This concept was initially introduced with the fundamental question of whether regions derive greater benefit from a diversity of economic activities or from specialization in specific economic activities (Glaeser et al., 1992; Frenken, 2007). Speculative research was undertaken to explore whether the production of a wide array of products and services significantly contributes to a region's economic vitality (Content et al., 2019; Al-Marhubi, 2000; Brenner et al., 2017; Cadot et al., 2011; Essletzbichler, 2007). Advocates of this proposition contend that variety fosters knowledge spillover among different economic activities. This concept has evolved in alignment with the contemporary growth theory, which posits that knowledge spillover transpires not only within an economic sector but also across distinct and diverse economic sectors (Frenken et al., 2007; Hausmann and Hidalgo, 2011; Hidalgo and Hausmann, 2009; Fitjar et al., 2017; Hedayatifard and Heydari, 2019). Furthermore, recognizing that knowledge spillover is geographically limited, disparities in regional growth can be attributed to qualitative distinctions in the economic landscape at the regional level.

On the flip side, a crucial consideration lies in the interconnection of various types of knowledge. Scholars contend that knowledge spillovers predominantly occur between sectors that share similar knowledge and are thus related (Hidalgo et al., 2007). To delineate this notion of relatedness, Fernandez et al. (2016) identify three distinct mechanisms. The first pertains to contingency and

complementarity in the production of a commodity or activity. The second revolves around similarity or the sharing of akin skills, while the third centers on local synergy arising from co-spatiality. All three of these mechanisms wield a significant influence on the creation or elimination of new employment opportunities.

Analytical findings reveal that in urban regions, newly emerging jobs are intricately connected with pre-existing ones, underscoring a state of interdependency (Van Dam and Frenken, 2022; Janssen and Frenken, 2019). In a similar vein, research indicates that regions exhibiting relatedness in terms of specialized sectors and complementary roles tend to experience more robust growth than areas that specialize in unrelated sectors (Frenken et al., 2007).

The concept of related variety also intertwines with the theory of the product lifecycle, which carries spatial and geographical implications. This theory posits that emerging industries characterized by high rates of innovation in the product itself tend to generate employment across diverse urban areas. In contrast, mature industries with high innovation rates in the production processes often enhance productivity in suburban and specialized regions (Content and Frenken, 2016; Neffke et al., 2011). Additionally, the concept of related variety is closely linked to the idea of the product space. Hidalgo et al. (2007) highlight that countries achieve development by diversifying their exports over time. The approach involves exporting products that are in some way related to the products they have previously exported, creating a form of product proximity value. This occurs because, when a country specializes in exporting a particular product, the institutional and infrastructural conditions necessary for producing and exporting related products are already in place (Hidalgo et al., 2007; Hausmann and Klinger, 2007). When applied to urban regions, these regions strive to establish clusters in products for which the production technology is already available. Consequently, the concept of related variety comprises two pivotal components: the "variety" of economic activities and the "relatedness" of economic activities, with each contributing uniquely to the process of economic development in urban regions.

### 2.2 “Related Variety” in the Regional Economic Structure

To substantiate the concept of related variety in terms of knowledge spillover, various researchers have presented supporting theories, including agglomerative economies (Frenken et al., 2007; Brachert and Kubis, 2011), theories by Jacobs (1969), MAR (an acronym for Marshall (1920), Arrow (1962), and Romer (1990)), Porter (1996), and portfolio theory (Montgomery, 1994). These theories

collectively offer insights into dimensions of knowledge spillover and regional economic growth. The MAR approach places emphasis on the specialized knowledge and skills within specific sectors, considering them as sources of innovation and economic growth. Michael Porter, on the other hand, acknowledges the role of specialized knowledge but also highlights how local competition encourages firms to innovate, positively influencing growth and firm survival. Jacobs offers a different perspective by recognizing the importance of local competition while asserting that various industrial sectors within a region provide access to diverse knowledge based on their individual industrial environments. This diversity of knowledge leads to knowledge spillover and, consequently, economic growth (Brachert and Kubis, 2011). Content and Frenken (2016) elucidate these two approaches while highlighting the dichotomy between the theories of MAR and Jacobs that underlie the concept of related variety. MAR's theoretical approach revolves around the notion of spatial economy, formed by the agglomeration of firms in an industry, which optimizes the production process and fosters increased productivity through knowledge specialization. Critics of this approach contend that while it can lead to economic development through enhanced productivity, it doesn't necessarily result in the creation of new jobs (Boschma and Iammarino, 2009). Conversely, Jacobs's approach defines innovation as the integration of various forms of knowledge in novel ways, culminating in the development of new products, services, and employment opportunities (Content and Frenken, 2016; Castaldi et al., 2015). It's worth noting that a thorough understanding of the concept of agglomerative economies and the sources of economic creation can lay the groundwork for a more comprehensive grasp of the related variety concept.

**2.3 Agglomerative Economy and Related Variety**

The theory of agglomerative economy centers on the fundamental concept that economic activities cluster together due to the advantages derived from the physical proximity and co-spatial presence of firms (Davids and Frenken, 2018). Within this framework, there exist four distinct sources of agglomerative economies:

The first source, Internal Scale Increases, revolves around the economic benefits that stem from the growth of firms to a larger scale, leading to reduced production costs through serving a broader market. In this context, the spatial dimension is not a primary concern, except for the fact that the presence of large firms in a particular location necessitates the concentration of local employment

factors. Sectoral External Economies also, pertains to the benefits experienced by local firms within a specific sector and is often referred to as spatial or Marshallian economies. Within an activity cluster, these external economies originate from the establishment of labor markets, the development of specialized suppliers, and the emergence of knowledge spillover among firms (McCann, 2005). Urbanization economies as the third source, represent external economies that are unrelated to specific economic sectors and result from the size and population density of a city. This form of external economy is tied to the macro-level processes of urban accumulation and is independent of the city's industrial structure. Prominent entities such as universities, industrial laboratories, business organizations, and other knowledge-producing institutions within the city act as sources of these economic benefits (O'Sullivan, 2009). And finally, Jacobs Economy denotes the economic benefits that are accessible to all firms within a given geographic area. This economy gains its name from the diversity of industries co-located in a single urban region, fostering opportunities for interactions such as replication, modification, and the recombination of ideas. Significant innovations often arise from the amalgamation of knowledge across diverse industries. The close geographic proximity of firms operating in various sectors facilitates this recombination. Functional specialization within homogeneous industries, especially when in close proximity to one another, fosters spatial interdependence, resulting in advantages for all firms located in that area. Hence, diversity in economic activities inherently amplifies knowledge and innovation spillover (Dink, 2015; McCann, 2005).

Taking into account these four sources of agglomerative economy, Frenken et al. (2007) introduced the question of whether knowledge spillover primarily arises when an area specializes in a few specific sectors (spatial economy), or when it hosts a wide array of economic sectors (the Jacobs economy), or if it predominantly results from the city itself and its population density (urbanization economy). The answer to this question is that, in fact, any form of agglomerative economy can emerge as a consequence of knowledge spillover, whether it's firms learning from other firms within the same industry (spatial economy) or from diverse firms in different industries (the Jacobs economy), or even from the concentration of various stakeholders like universities, government bodies, and consumers (Content and Frenken, 2016).

**2.4 The Portfolio Theory and Unrelated Variety**

The portfolio theory originated in business economics (Montgomery, 1994). So, it is used in evaluating the effect of the variety of products on the growth and profitability of the firm. However, the principle stated in this theory, suggesting that variety reduces risk, has also been used for regional development theories. Regional variety can be a portfolio strategy to protect regional income against sudden shocks such as oil price fluctuations, commercial warfare, radical innovations in production, and so on. Even if the inter-regional immigration of labor force is high, economic shocks reduce the economic growth, because they reduce the agglomerative economy. Therefore, variety at the regional level reduces regional unemployment and increases the economic growth of the region, whereas specialization can increase the risk of unemployment and reduce the economic growth (Frenken et al., 2007; Brachert et al., 2011). The important point is that in this theory, "unrelated variety" is emphasized. Contrary to related variety (in terms of market or technology), unrelated variety is a criterion for risk confrontation, so that if unrelated variety is high in a region, occurrence of change in an economic sector will have a slight impact on the economy of the region, whereas specialization in one or more industries, or, in other words, the creation of variety, can lead to more vulnerability in the regional economy (Content and Frenken, 2016; Boschma, 2015; Diodato and Weterings, 2015). Boschma and Capone (2015) examined the institutional context of relatedness and unrelatedness, and found out that relatedness often occurs in countries where economy is the coordinated with the market, and unrelatedness exists in countries with free economies (Boschma and Capone, 2015).

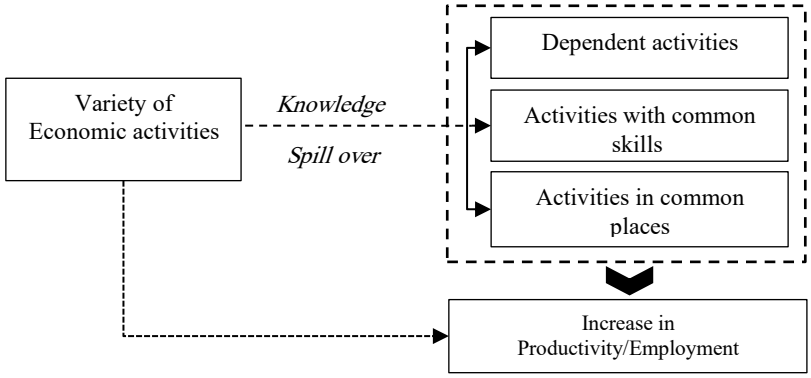


**Figure 1.** Analytical Model of Related Variety and its Role in Regional Economic Development

**Source**: Research finding.

## 3. Research Methodology

In order to develop a criterion for measuring related variety in urban regions, the two concepts of "economic diversity" and "relatedness" of economic sectors have been considered. Economic diversity has been investigated through the level of specialization of activities in regions. For this purpose, the spatial coefficient indicator of economic activities in each province of Iran has been used. Also, in order to measure the level of relatedness of economic activities with one another, according to Fernon's approach (2007) the technology of value added production in economic activities was considered. Accordingly, using the input-output model, the value added production formula in an economic activity was considered with various combinations of economic activities, and then the matrix of the proximity of production technologies, or the production formulae for each of the activities, was calculated. In this approach, it is assumed that activities that have similar technology, composition and formulae in value added production, are related (Hidalgo et al., 2018). In this way, the related variety indicator for each region has been calculated through the following steps:

### 3.1 First Step: Developing the Related Variety Indicator

Developing the related variety indicator is formulated in the two sub-steps of calculating the location coefficient for dimension of diversity/specialization, as well as calculation of relatedness for the other aspect of this indicator:

#### 3.1.1 Calculating the Location Coefficient

Using the location coefficient, major economic activities that are specialized are identified in urban regions. The location coefficient calculates employment in a specified activity (i) in the spatial unit — province — (m), and compares it with the corresponding ratio in the reference unit — country. The location coefficient higher than 1 reflects the specialization of the activity in the given spatial unit. The final set of specialized jobs for each spatial unit reflects common skills and relative advantage of labor force in that area.

$$\text{A) } LQ_i^{(m)} = \frac{x_i^{(m)} / \sum_i x_i^{(m)}}{\sum_m x_i^{(m)} / \sum_m \sum_i x_i^{(m)}}$$

$x_i^{(m)}$ *The number of workers in job i in city m*

The output of this step helps to consider only specialized activities in each urban region in calculating the related variety.

**3.1.2 Calculating the Relatedness of Economic Activities**

Using the input-output table, the value-added ratio of each of the economic activities used as input in the production of value added in a specific activity is calculated. Thus, the set of value added ratios of various economic activities in a specific activity is considered to be a production formula for that activity in the form of a vector. Then, using a proximity criterion based on the calculation of correlation between the resultant production vectors, the proximity matrix is calculated. The reason for the use of correlation criterion instead of methods such as Euclidean, Minkowski, and Manhattan distance is emphasizing similarity, and not lack of similarity, in the given indicator.

B) $V_i = \sum_{j=1}^{n} V_j$: $v_{ij} = \frac{V_j}{V_i}$ : $P_i = \{v_{j1}.v_{j2}.v_{j3}.vj_4 \ldots .v_{jn}\}$

$v_{ij}$: *The share of added value of activity j in the production of activity i*

$P_i$ : *The production vector of activity i*

C) $RP_{ij} = \frac{\sum_{i=1}^{N}(Y-\bar{Y})(X-\bar{X})}{\sqrt{\sum_{i=1}^{N}(Y_i-\bar{Y})^2 \sum_{i=1}^{N}(x_i-\bar{x})^2}}$

$:R_{ij}$ *The correlation between production vector of i and production vector of j*

Then the correlation indicator of activities (i,j) for each spatial unit (m) and for specialized activities in the urban region is weighted with the help of the number of employees in each activity, and standardized by division into of the total number of employees:

D) $RV_{ij}^{(m)} = \frac{(e_i^{(m)}+e_j^{(m)})RP_{ij}}{2\sum_{k=1}^{m} e_k^{(m)}}$

Where *m* is the spatial unit of province, $n^m$ is the number of jobs in province *m* and $ei^{(m)}$ is the number of workers in activity *i* in province *m*. In this way, the related variety *RV* is weighted with the average number of employees in two related jobs through links, and is standardized through the total number of employees.

For each province, the sum of related variety of specialized activities is calculated and considered as the related variety indicator of the entire province.

E) $T^{(m)} = \sum_{i<j}^{s^{(m)}} RV_{ij}^{(m)}$

Then through the extremum standardization method, the index is normalized as specified in equations F and G:

F) $\dot{x}_{ij} = \frac{x_{ij-}\ x_{jmin}}{x_{jmax-}x_{jmin}}$ G) $\dot{x}_{ij} = \frac{x_{jmax-}\ x_{ij}}{x_{jmax-}x_{jmin}}$

where, i denotes the province number; j denotes the related variety number; $\dot{x}_{ij}$refers to the normalized value of index j in province i; $x_{ij}$refers to the measured value of index j in province I; $x_{jmax}$and $x_{jmin}$refer to the maximum and minimum measured values of index j, respectively.

### 3.2 Second Step: Investigating the Role of Related Variety in Productivity and Growth of Employment

In the next step, the role of related variety in productivity and employment growth are investigated through linear regression analysis.

**Table 1.** Data Required in Analyzing the Role of Related Variety in Regional Employment and the Productivity Rate of Economic Activities

| **Index** | **Sources of Data** |
|---|---|
| Employee growth Ratio (2006-2016) | Census statistics |
| Productivity ratio of economic activities (2006-2016) | Census statistics<br>Regional counting information.<br>Statistics of central bank |

F) $\mathrm{PR_m} = {\sum_{i=1}^{n} \mathrm{L_i}}\Big/{\sum_{i=1}^{n} \mathrm{V}}$

$L_i$ : *The number of employees in activity i*

$V_i$ : *The amount of Added value of activity i*

In order to improve the accuracy of the model, three control variables are considered. Infrastructure, socio-cultural index and innovation capacity are included as the independent variables. The infrastructure index also been constructed based on the level of access to infrastructure such as electricity, water and sanitation, telephone, internet, gas, roadways, and housing production units per thousand people. The social-cultural variable has also been constructed based on indices such as the share of public libraries, cultural and artistic centers, per capita sports facilities, the share of healthcare and medical centers, health houses, population growth rate, urbanization, and the level of political participation in the provinces (Sadeghi and Masoudi Nadoushan, 2018). The innovation capacity index is also constructed based on the ration of master, PhD and postdoc graduates, the number of R&D and research centers, educated employments, entrepreneurs, specialized labor and literacy rate (Hedayatifard and Heidari, 2019).

## 4. Findings

To investigate regional economic diversity, the location coefficient has been employed to assess the degree of specialization in regional economic activities. The examination of specialization levels in the provinces of Iran reveals that agricultural and construction activities exhibit the highest likelihood of specialization among other activities, with a greater demand for employment in these two sectors compared to others. Education, ranking third with a 40% probability of specialization, signifies the focus of the service sector on education and learning, serving as an input for production sectors such as industry. An analysis of the spatial distribution of specialized activities among regions reveals that the provinces of Bushehr, Tehran, and Gilan host the largest number of specialized activities, indicating a diversity of activities, value-added processes, and capital production in these areas. It's worth noting that both Bushehr and Gilan are coastal provinces, benefiting from natural coastal resources that offer the potential for specialization in a wide range of economic activities, including tourism, agriculture, fisheries, transportation, and more. To examine the interrelationships between economic activities, I have considered the intermediate consumption of each economic activity using data from the input-output table. Intermediate consumption reveals how economic activities interact with one another, as different consumption combinations determine the production pattern and capital production formula for each economic activity. This approach allows us to identify each economic activity's contribution to economic production within the intermediate consumption matrix (Table 2).

As anticipated, the results highlight the primary role of wholesale and retail activities in shaping the economic production structure. Real estate and mining, on the other hand, rely on financial intermediary processes (Table 2). When we examine the table vertically, it illustrates the production vector for each major group of activities, showing how the ratios of various activities combine to create the final value added. In line with Frenken et al. (2007), one aspect of the relatedness of economic activities centers on the similarity in the structure and pattern of production. Consequently, the next step involves evaluating the level of structural similarity among economic activities through correlation analysis of the vectors representing value-added production. The findings indicate that "transport and storage" and "construction" activities exhibit the highest degrees of similarity in terms of value-added production structure. Meanwhile, educational activities involve the least input and intermediate consumption for the production of value added in economic sectors. This suggests that, due to the high level of activity specialization based on employment criteria (Table 2), a significant proportion of the labor force does not contribute to the flow of value-added production (Table3).

**Table 2.** Intermediate Consumption Matrix; The Ratio of Economic Activities in the Production of Major Economic Groups

| Input-Output table | health and social work input | education input | public administration input | real state input | finance input | transportation and inventory input | hotel and restaurant input | wholesale and trade input | building consruction input | water, electricity and gass input | industry input | mining input | agricultural input | other services input |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| agriculture | 5.1 | 0.1 | 2.5 | 0.0 | 0.2 | 0.3 | 8.8 | 0.2 | 0.1 | 0.6 | 1.7 | 0.7 | 4.5 | 0.4 |
| mining | 0.0 | 0.1 | 0.0 | 0.7 | 0.0 | 0.1 | 0.1 | 0.1 | 0.4 | 8.7 | 4.1 | 0.3 | 0.2 | 0.1 |
| Industry | 1.1 | 0.1 | 1.2 | 1.4 | 0.5 | 1.2 | 1.2 | 1.4 | 2.1 | 0.9 | 1.8 | 0.5 | 0.9 | 1.6 |
| Water, Electricity and Gas | 2.2 | 1.4 | 1.0 | 0.7 | 1.9 | 1.1 | 0.4 | 1.0 | 0.3 | 3.2 | 1.0 | 2.0 | 0.6 | 3.1 |
| building construction | 0.4 | 1.4 | 0.6 | 1.3 | 0.1 | 0.6 | 1.6 | 0.8 | 0/8 | 1.2 | 0.1 | 0.3 | 0.2 | 1.2 |
| wholesale and Trade | 14.9 | 3.8 | 26.3 | 11.2 | 17.2 | 18.6 | 12.7 | 14.2 | 16.9 | 21.4 | 16.9 | 3.8 | 16.9 | 7.7 |
| Hotel and restaurants | 0.0 | 35.3 | 3.2 | 1.0 | 2.6 | 1.4 | 0.0 | 0.9 | 0.1 | 1.0 | 0.0 | 1.8 | 0.0 | 0.1 |
| Transportation and inventory | 2.4 | 2.0 | 2.4 | 2.4 | 2.3 | 5.2 | 1.9 | 5.0 | 4.1 | 2.3 | 2.4 | 2.9 | 4.6 | 2.3 |
| Finance | 5.2 | 6.6 | 4.6 | 16.1 | 17.3 | 3.4 | 4.7 | 5.7 | 3.3 | 2.0 | 2.8 | 23.5 | 4.5 | 6.1 |
| Real state | 0.4 | 8.2 | 1.5 | 1.3 | 4.3 | 2.3 | 0.2 | 1.3 | 0.2 | 1.5 | 1.8 | 2.8 | 0.7 | 4.1 |
| Public administration | 1.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 | 0.7 | 0.0 | 0.1 | 0.0 | 0.6 |
| Education | 0.3 | 2.5 | 0.4 | 0.3 | 1.9 | 0.4 | 0.0 | 0.5 | 0.0 | 1.0 | 0.2 | 0.1 | 1.1 | 4.3 |
| Health and social work | 3.8 | 4.2 | 1.0 | 0.3 | 1.1 | 0.3 | 0.0 | 0.1 | 0.0 | 0.4 | 0.0 | 0.9 | 0.2 | 0.1 |
| other service activities | 0.0 | 0.1 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.8 |

**Source**: Research finding.

**Table 3.** Proximity Matrix Using the Correlation Criterion among Production Vectors in Each Group of Economic Activities, 2006-2007

| the correlation criterion among production vectors | agriculture | mining | Industry | Water, Electricity and Gas | building construction | wholesale and Trade | Hotel and restaurant | Transportation and inventory | Finance | Real state | Public administration | Education | Health and social work | other service activities |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| agriculture | 1 | 0.24 | 0.93 | 0.84 | 0.96 | 0.95 | 0.91 | 0.95 | 0.75 | 0.65 | 0.95 | -0.11 | 0.95 | 0.70 |
| mining | 0.24 | 1 | 0.14 | 0.03 | 0.20 | 0.39 | 0.25 | 0.19 | 0.76 | 0.87 | 0.18 | 0.10 | 0.28 | 0.55 |
| Industry | 0.93 | 0.14 | 1 | 0.97 | 0.96 | 0.91 | 0.79 | 0.95 | 0.70 | 0.58 | 0.95 | -0.12 | 0.88 | 0.66 |
| Water, Electricity and Gas | 0.84 | 0.03 | 0.97 | 1 | 0.89 | 0.82 | 0.67 | 0.88 | 0.60 | 0.48 | 0.89 | -0.10 | 0.78 | 0.56 |
| building construction | 0.96 | 0.20 | 0.96 | 0.89 | 1 | 0.97 | 0.78 | 0.99 | 0.75 | 0.64 | 0.97 | -0.08 | 0.90 | 0.70 |
| wholesale and Trade | 0.95 | 0.39 | 0.91 | 0.82 | 0.97 | 1 | 0.76 | 0.97 | 0.85 | 0.77 | 0.94 | -0.02 | 0.88 | 0.79 |
| Hotel and restaurants | 0.91 | 0.25 | 0.79 | 0.67 | 0.78 | 0.76 | 1 | 0.76 | 0.64 | 0.58 | 0.82 | -0.16 | 0.90 | 0.53 |
| Transportation and inventory | 0.95 | 0.19 | 0.95 | 0.88 | 0.99 | 0.97 | 0.76 | 1 | 0.75 | 0.62 | 0.97 | 0.00 | 0.88 | 0.72 |
| Finance | 0.75 | 0.76 | 0.70 | 0.60 | 0.75 | 0.85 | 0.64 | 0.75 | 1 | 0.96 | 0.75 | 0.11 | 0.75 | 0.86 |
| Real state | 0.65 | 0.87 | 0.58 | 0.48 | 0.64 | 0.77 | 0.58 | 0.62 | 0.96 | 1 | 0.62 | 0.03 | 0.65 | 0.77 |
| Public administration | 0.95 | 0.18 | 0.95 | 0.89 | 0.97 | 0.94 | 0.82 | 0.97 | 0.75 | 0.62 | 1 | 0.05 | 0.93 | 0.68 |
| Education | -0.11 | 0.10 | -0.12 | -0.10 | -0.08 | -0.02 | -0.16 | 0.00 | 0.11 | 0.03 | 0.05 | 1 | -0.14 | -0.11 |
| Health and social work | 0.95 | 0.28 | 0.88 | 0.78 | 0.90 | 0.88 | 0.90 | 0.88 | 0.75 | 0.65 | 0.93 | -0.14 | 1 | 0.64 |
| other service activities | 0.70 | 0.55 | 0.66 | 0.56 | 0.70 | 0.79 | 0.53 | 0.72 | 0.86 | 0.77 | 0.68 | -0.11 | 0.64 | 1 |

**Source**: Research finding.

The results of this matrix have been standardized using the level of employment in each of the activities in each province, and ultimately, its sum has made the level of "related variety" for urban regions (Fig. 2). Thus, the provinces of Tehran, Gilan, and Bushehr have the highest levels of related variety indicator, respectively. Also, the provinces of West Azerbaijan, Qazvin and Hamedan have the lowest level of related variety, respectively.

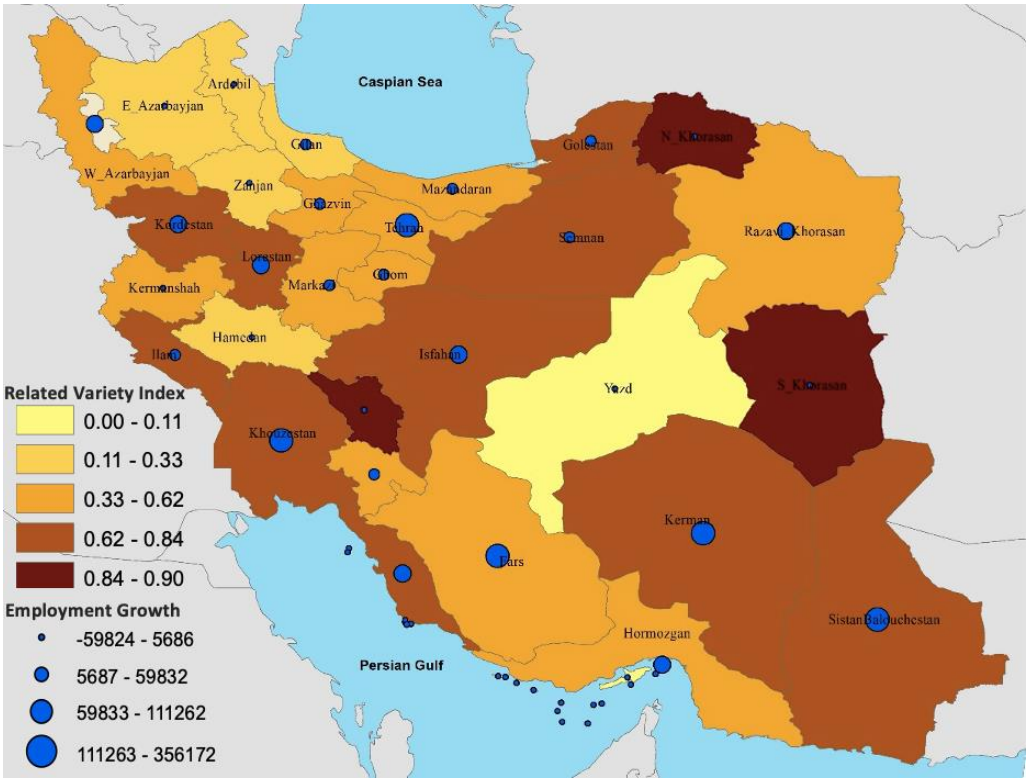


**Figure 2.** The Spatial distribution of Related Variety Index
**Source**: Research finding.

It is expected that with an increase in the diversity of interrelated economic activities, the likelihood of knowledge transfer between various economic activities would increase. As a result, potential production costs would decrease, ultimately leading to an increase in economic productivity. It is also expected that with an increase in the related variety index, the possibility of creating employment opportunities and the emergence of new jobs in provinces would increase. The analysis of the relationship between regional economic development variables, including employment growth rate and productivity growth, and the related variety index has shown that there is a significant linear relationship between employment

growth rate and related diversity. However, there is no significant linear relationship between productivity growth and related diversity. The causal relationship between the related diversity index and regional development indices was examined through two regression models. In these models, the variables of productivity growth and employment growth during the period 2006-2016 were considered as dependent variables, while the related variety index was considered as the independent variable. In order to enhance the model's accuracy, three control variables, namely infrastructure, innovation capacity, and socio-cultural status, were included. This analysis aimed to assess how the related diversity index relates to changes in productivity and employment over the specified time frame while controlling for the influence of infrastructure, education, and socio-cultural factors.

The findings indicate that while the model shows a causal relationship between the related diversity index and employment growth (Sig.=0.001), this relationship is not statistically significant for economic productivity growth in the provinces of Iran (Sig.=0.466 at 5% confidence level). In other words, the diversity of interrelated economic activities appears to have a meaningful impact on employment growth but does not have a statistically significant impact on economic productivity growth in the Iranian provinces. The obtained model suggests that regions that had diverse and interrelated economic activities in 2006 experienced significant employment growth during the ten-year period. Additionally, the control variable of technical and communication infrastructure has also been found to have a significant positive impact on employment generation. This is despite the fact that social-cultural indices and the indices related to production innovation capacity, which measure the number of research and development centers, the percentage of highly educated individuals, and the literacy rate, do not have a significant impact on employment growth in the provinces.

**Table 5.** ANOVA Test Results for Testing the Role of Related Variety in the Growth Rate of Economic Productivity

| | Model | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 53.117 | 4 | 13.279 | .924 | .466[b] |
| | Residual | 359.379 | 25 | 14.375 | | |
| | Total | 412.496 | 29 | | | |

a. Dependent Variable: Productivity_Growth

b. Predictors: (Constant), Related_Variety, Socio_Cultural, Infrastructure, Innovation_Capacity

**Source**: Research finding.

**Table 6.** ANOVA Test Results for Testing the Role of Related Variety in Employment Growth

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 21.171 | 4 | 5.293 | 6.391 | .001[b] |
| | Residual | 20.703 | 25 | .828 | | |
| | Total | 41.874 | 29 | | | |

a. Dependent Variable: Employment_Growth

b. Predictors: (Constant), Related_Variety, Innovation_Capacity, Infrastructure, Socio_Cultural

**Source**: Research finding.

**Table 7.** Regression Coefficients Table

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | -2.829 | 1.177 | | -2.403 | .024 |
| | Socio_Cultural | 1.424 | 2.301 | .096 | .619 | .542 |
| | Innovation_Capacity | -.556 | 1.021 | -.085 | -.545 | .591 |
| | Infrastructure | 8.261 | 2.061 | .585 | 4.009 | .000 |
| | Related_Variety | 1.596 | .742 | .311 | 2.152 | .041 |

a. Dependent Variable: Employment_Growth

**Source**: Research finding.

The findings of this analysis support Jacobs's criticism. According to the MAR approach, with the specialization of economic activities and the advent of locational economies, the production process is optimized by increased productivity. Meanwhile, with the existence of related variety, which is followed by the flow of a combination of various types of knowledge in the region, new combinations of products and services can be created which are necessitated by emergence of new jobs. Therefore, related variety can lead to employment increase in Iranian urban regions. This issue gains importance when regional policies aim at employment or increasing productivity in specialized production. In situations where the policy making objective is increasing regional employment the strategy of diversifying complementary and related economic activities will play an important role in achieving the desired goal and regional development.

## 5. Conclusion

The concept of related variety is a new concept rooted in business economics and has been introduced in the theories of regional economic development since 2007. The main challenge is how specialization and diversity of economic activities can lead to economic growth. The core of this concept is the possibility of emergence

of knowledge spill-over among various economic sectors instead of only one specialized group. This concept, on the other hand, has been supplemented by the ideas of researchers on the possibility of transferring knowledge among sections that are not similar and are diverse and yet have common contexts. The combination of these two points has led to the development of the concept of related variety as an indicator of regional economic development. Those who agree with this concept emphasize the importance of related variety in regional employment. In this view, locational economies and specialization lead to increased productivity, and thus to the regional economic development, while the related variety of economic activities leads to employment growth. This can affect a large number of urban regional policy challenges. In situations where many Iranian regional development strategies are indicative of specialization and concentration of economic activities and creation of growth poles to increase development shrinkage and locational economies, establishing the foundation for the formation of related variety in economic activities can be an effective step in increasing regional employment and achieving regional development goals. This research has attempted to examine how this hypothesis works in the economic systems of the urban regions in Iran. For this purpose, first the related variety indicator has been developed by using employment data in major activity groups and location coefficient technique in order to emphasize the diversity of economic activities in the region, and then the input-output model to emphasize the relatedness of the activities to one another. The results have shown that the provinces of Bushehr, Tehran, and Gilan, have the largest number of specialized activities, which implicitly reflects diversity in the economic structure of the region. Also, through using the input-output model to extract the production pattern, relying on intermediate consumption in each activity group, it was found that wholesale and retail activities and financial intermediaries are among the main activities effective in the value added production formula in the major activity groups. The correlation among the production formula vectors in the proximity matrix has shown that transportation-storage and constructional activities has the highest level of similarity and, on the other hand, educational activity has the lowest significance in the value added production structure. Meanwhile, the highest level of employment is accumulated in educational activities, reflecting that a high level of regional employment lays outside the production cycle. Finally, after combining these considerations, the final related-variety indicator showed that the provinces of Tehran, Bushehr, and Gilan enjoy the highest level of related variety. In the next step, investigation of the relationship between this indicator

and economic growth indicators such as productivity and employment growth rates through the linear correlation test showed a direct and positive relationship between employment growth and related variety index. The causal relationship test for these two sets of indicators for explaining the function of related variety in economic growth indicators has shown that in the Iranian urban regions, related variety is effective in regional employment growth, while, in terms of growth of productivity, the test results have not been significant. Thus, the hypothesis that related variety can be effective in increasing regional employment in a positive way is supportable in studying the regional economic system of Iran, and therefore, it can guide regional policies to increase the variety of related activities for the expansion of employment capacities and growth of economic indicators. This is especially important in situations where the production chain is faced with ambiguity and problems. Hance, in regions where production capacities and infrastructures are not fully provided and the costs of external economies is more than locational economies for specialization, the use of diversification strategies for economic activities, and in particular the identification and empowerment of related industries, will play an effective role in the regional economic growth. However, despite the expectation that the mechanism through which related diversity contributes to employment generation is the creation of new jobs via the transfer of knowledge between economic sectors, it seems that this pathway is not easily traceable in urban areas in Iran. This is because the transfer of knowledge was expected to occur through the performance of innovation-producing firms and a knowledge-based economic flow. This is in contrast to the finding that innovation capacity, driven by the performance of educated human resources and research centers, was not identified as significant factors in employment generation. Therefore, explaining how related diversity affects employment generation in urban areas of Iran appears challenging. Indeed, this topic can be further explored in future research to gain a deeper understanding of the relationship between related diversity and employment generation in urban areas of Iran. Additional studies and analyses may provide valuable insights into the mechanisms at play and shed light on the factors that influence job creation and knowledge transfer in the context of economic diversity.

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**Cite this article:** Hedayatifard, M. (2025). The Role of "Related Variety" in Regional Economic Development of Iran: Employment Growth or Economic Productivity? *Iranian Economic Review, 29*(3), 1163-1185.