



THE SPEED OF STRUCTURAL CHANGE: ECONOMIC TRANSFORMATION VELOCITY AND GROWTH IN PERIPHERAL RURAL ECONOMIES

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ABSTRACT

This study examines the relationship between diversification, structural transformation, and economic growth in peripheral rural economies. Although diversification is widely regarded as an important component of rural development, the mechanisms through which it contributes to growth remain unclear. Existing studies often rely on static measures that capture the level of transformation rather than the pace at which structural change occurs. To address this limitation, the study introduces Economic Transformation Velocity, defined as the rate of structural upgrading between two transformation states. The analysis uses longitudinal data collected from 80 household and business units in the mountain regions of Northern Albania between 2023 and 2025, representing 74.8 per cent of the study population. The empirical framework links diversification, investment and finance, economic transformation, transformation velocity, and growth. Composite indices are constructed using Principal Component Analysis, while the hypotheses are tested through robust OLS estimation, nonlinear models, threshold analysis, bootstrap resampling, and additional robustness checks. The results show that diversification is positively associated with economic transformation but has no significant direct relationship with economic growth. Economic Transformation Velocity is more strongly associated with growth, whereas the level of transformation remains statistically insignificant. Nonlinear and threshold analyses further indicate that the growth effect strengthens as transformation velocity increases, suggesting cumulative dynamics of structural upgrading. The study contributes to development economics by distinguishing between transformation levels and transformation dynamics and by introducing Economic Transformation Velocity as an indicator of structural change. The findings suggest that rural economic development depends not only on the degree of transformation achieved, but also on the speed at which structural upgrading takes place.

Keywords: Structural transformation, Economic transformation velocity, Economic growth, Diversification, Development economics, Structural change, Rural innovation, Endogenous development

1. INTRODUCTION

Peripheral rural economies face persistent structural constraints, including limited diversification, demographic decline, restricted access to capital, and uneven territorial development. In

such settings, economic transformation is essential because traditional agricultural activities alone may no longer sustain income growth or long-term resilience.

Structural transformation theory associate's development with resource reallocation, productive diversification, and the emergence of new economic activities. Although diversification is commonly linked to resilience and adaptive capacity, its effect on economic growth remains unclear. Some studies identify growth effects, while others find that diversification generates structural change without corresponding improvements in economic performance. This inconsistency suggests that the mechanisms connecting diversification, transformation, and growth require further investigation.

A major limitation of the existing literature is its reliance on static indicators such as income, productivity, and sectoral composition. These measures capture achieved transformation levels but provide limited information about the pace of structural change. Economic units with similar transformation levels may therefore follow very different development trajectories.

This study addresses this limitation by introducing Economic Transformation Velocity, defined as the rate of structural upgrading between two transformation states. While the Economic Transformation Index measures the structural position attained by an economic unit, Economic Transformation Velocity captures the speed at which that position changes. The central proposition is that growth depends not only on the extent of transformation, but also on its velocity.

Using longitudinal data from 80 household and business units in Northern Albania from 2023 to 2025, the study develops an integrated framework linking diversification, investment and finance, economic transformation, transformation velocity, and growth. The findings indicate that diversification is positively associated with structural transformation but has no significant direct relationship with growth. Transformation velocity shows a stronger association with growth than transformation levels, while nonlinear and threshold analyses suggest that growth effects intensify at higher levels of transformation velocity.

The study makes three contributions. First, it distinguishes between transformation levels and transformation dynamics. Second, it introduces Economic Transformation Velocity as an analytical measure linking structural change to economic performance. Third, it provides evidence from a peripheral mountain economy, a context that remains underrepresented in the transformation literature. Overall, the results indicate that the pace of structural upgrading is an important dimension of rural development.

Conceptual Framework and Hypotheses

The study conceptualises rural development as a dynamic process connecting diversification, financing capacity, structural upgrading, and economic growth. Diversification may strengthen household and business units by expanding productive activities, reducing dependence on a single income source, and supporting the reallocation of resources toward activities with greater added value.

The effectiveness of diversification may depend on access to investment and finance. Internal financial resources can support productive investment, technological upgrading, and business expansion. The Investment and Finance Index is therefore expected to strengthen the relationship between diversification and economic transformation.

The framework further proposes that economic growth is more closely related to transformation dynamics than to transformation levels. A high transformation level indicates an advanced structural position, but it does not necessarily imply continued growth. By contrast, faster structural upgrading may generate cumulative improvements in productivity, resource allocation, and economic performance.

Based on these arguments, the following hypotheses are proposed:

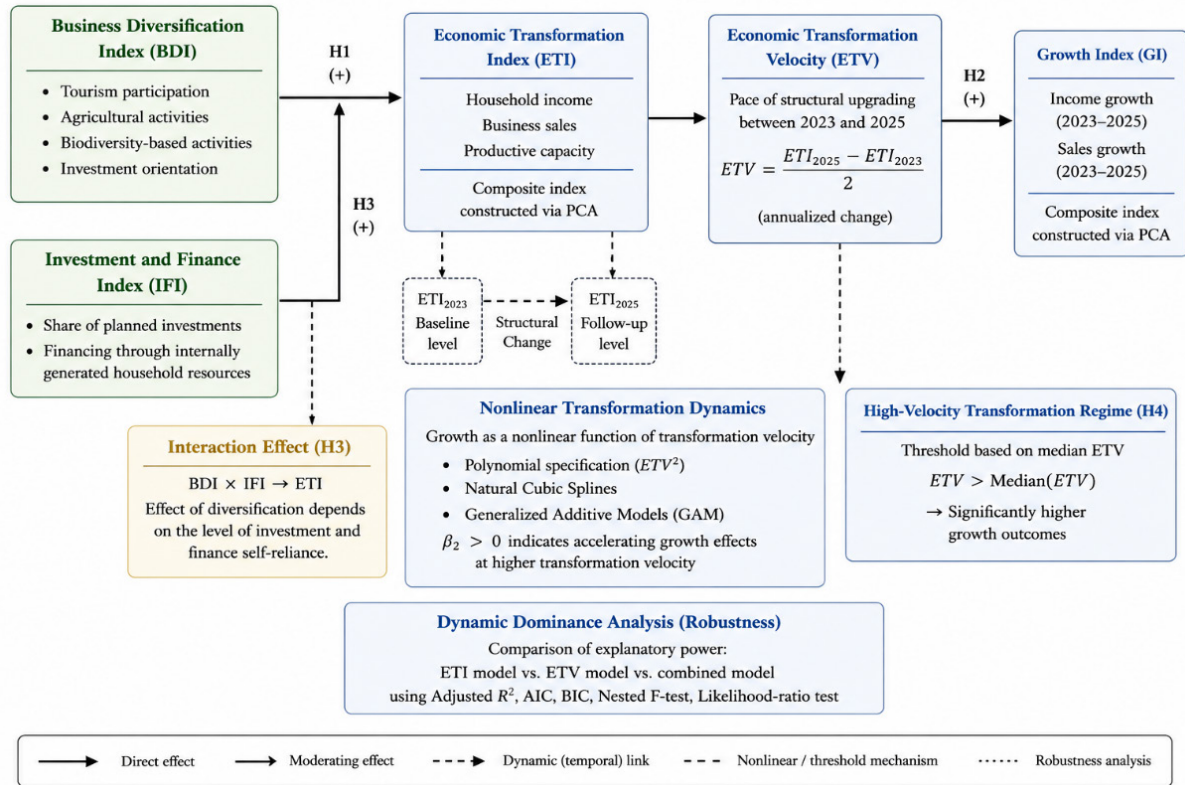
H₁: Business diversification is positively associated with structural economic transformation.

H₂: Economic Transformation Velocity is positively associated with economic growth.

H₃: Investment and finance positively moderate the relationship between diversification and economic transformation.

H₄: Household and business units operating under high transformation velocity achieve stronger growth outcomes than those with lower transformation velocity.

Figure 1. Dynamic Framework of Rural Economic Transformation



Source: The authors' own conceptual framework

Conceptual framework linking diversification, investment and finance index, economic transformation, transformation velocity, and growth. The framework distinguishes between transformation levels (ETI) and transformation dynamics (ETV), proposing that growth is primarily associated with the speed of structural upgrading rather than with transformation levels alone.

2. LITERATURE REVIEW

Structural transformation is a central mechanism through which economies move from traditional production systems toward more diversified and productive structures. In development economics, this process is commonly associated with the reallocation of labour and capital, the emergence of new economic functions, and improvements in productivity and economic performance (Saviotti, 2020; Hamilton & De Vries, 2025). In rural regions, transformation increasingly extends beyond agricultural modernisation and includes the integration of multiple productive activities that create broader development opportunities (Rustiadi et al., 2023; Sudaryanto et al., 2023; Petrescu et al., 2024; Ivashchenko, & Ivashchenko, 2025; Ha, 2026). Diversification occupies an important place in this process. Diversified households and enter-

prises are generally better able to manage economic uncertainty, expand income opportunities, and strengthen adaptive capacity (Barbieri & Mahoney, 2009; Lin, 2011; Getahun et al., 2023). The expansion of activities beyond agriculture may also support market participation and reduce dependence on traditional income sources.

Classical development theories explain economic growth through the movement of labour, capital, and entrepreneurial effort from activities with low productivity toward more productive sectors and functions (Lewis, 1954; Chenery & Syrquin, 1975). Structural transformation should therefore be understood not simply as a change in sectoral composition, but as a continuing process of productive upgrading that supports economic performance over time (McMillan & Rodrik, 2011).

Recent research also emphasises the multifunctional nature of rural economies. Rural development is increasingly shaped by interactions among agriculture, tourism, biodiversity related activities, local entrepreneurship, and innovation systems (Cheer, 2025; Funduk et al., 2024; Safarov et al., 2024; Nguyen, 2026). Rural revitalisation consequently depends on the ability of local economies to combine productive functions and generate complementary sources of value (Živković et al., 2025). This approach is consistent with endogenous and place-based development theories, which emphasise local resources, knowledge, and institutional capacity. Biodiversity and agricultural biodiversity are particularly relevant to rural transformation. They can strengthen resilience, reduce exposure to environmental and market shocks, and create opportunities for product differentiation and new economic activities (Lin, 2011; Et al., 2018; Bravo Peña & Yoder, 2024). Incentives for biodiversity conservation may also support additional income opportunities and sustainable territorial development (Nyanghura et al., 2024). Biodiversity can therefore function as both an environmental asset and an economic resource.

Despite broad recognition of the importance of diversification, evidence on its relationship with economic growth remains inconclusive. Some studies identify positive effects, while others show that diversification can generate structural change without corresponding improvements in economic performance (Saviotti, 2020; Sudaryanto et al., 2023). This inconsistency suggests that diversification, transformation, and growth should be treated as distinct processes. Diversification may initiate structural change, but growth depends on how effectively new activities are converted into productive outcomes.

A further limitation concerns the measurement of transformation. Existing studies commonly rely on static indicators such as income, productivity, employment composition, and sectoral structure (Hamilton et al., 2025). These measures capture the structural position achieved by an economic unit but provide limited information about the process and pace of change. Economic units with similar transformation levels may therefore follow substantially different development trajectories.

Recent contributions increasingly emphasise the temporal dimension of transformation. Elouaourti and Ibourk (2025) argue that structural change should be examined through methods that capture development processes rather than only final outcomes. McNerney et al. (2025) similarly stresses the importance of connecting short term adjustment with long term development trajectories. Other studies show that development depends not only on the extent of diversification but also on the productivity and complexity of emerging activities (Hausmann et al., 2007; Rodrik, 2013).

These arguments suggest that the pace of structural upgrading may represent an important but insufficiently examined determinant of growth. This study addresses the gap by introducing Economic Transformation Velocity, defined as the rate of structural upgrading between two transformation states. Unlike conventional indicators that measure the level of transformation,

Economic Transformation Velocity captures its dynamics and explicitly incorporates time into the analysis of structural change.

The central proposition is that economic growth depends not only on whether transformation occurs, but also on how rapidly economic units move toward more productive activities. By integrating diversification, investment and finance, transformation outcomes, and transformation velocity within a unified framework, the study contributes to research on rural transformation and development dynamics in peripheral economies (OECD, 2025).

3. METHODOLOGY

The study uses longitudinal data from 80 rural household and business units operating in the peripheral mountain regions of Northern Albania between 2023 and 2025. Of the 107 active economic units identified during fieldwork, the sample represents approximately 74.8 per cent of the study population. This high level of coverage provides a strong basis for examining diversification, transformation, and growth within the local economy.

The longitudinal design allows economic transformation to be analysed as a dynamic process rather than as a single outcome. It also enables the study to examine how changes in diversification, financing, and productive structure are associated with subsequent economic performance.

The analysis is limited to formally registered household and business units. This restriction improves the availability, consistency, and comparability of economic information across observations. Official Albanian statistics provide valuable information on agriculture, tourism, business activity, and regional development, but these data are generally reported at national, regional, or municipal levels. They do not systematically capture diversification strategies, structural upgrading, or the interaction between agriculture and tourism at the level of individual rural businesses.

Secondary data are therefore insufficient for analysing the mechanisms considered in this study, which required the collection of primary longitudinal information. The resulting dataset contains measures of productive activity, diversification, agricultural upgrading, tourism participation, business constraints, financing capacity, transformation, and growth.

The study develops a dynamic framework that distinguishes among diversification, transformation, and economic growth. Rather than if diversification directly produces growth, the framework proposes that diversification supports structural transformation, while growth is more closely associated with the speed of transformation.

The framework is formulated in a general manner so that the Economic Transformation Velocity indicator and the associated estimation approach can be applied in other rural transition economies where comparable longitudinal data are available.

Construction of Composite Indices

To capture the multidimensional character of rural economic transformation, several composite indices are constructed using Principal Component Analysis and standardised composite measures. This approach reduces dependence on individual indicators and combines related dimensions into broader analytical constructs.

The indices capture productive capacity, business diversification, agricultural upgrading, tourism integration, business constraints, economic performance, and investment and financing capacity. Together, they form the components used to construct the Economic Transformation Index and to calculate Economic Transformation Velocity. Table 1 summarises the variables and dimensions included in each index.

Table 1. Construction of Composite Indices

Index	Variables	Method
CAP	Rooms, beds, camping places, restaurant capacity (2023, 2024, 2025)	PCA
BDI	Business number, agriculture, tourism	PCA
AUI	Crop production, livestock, biodiversity activities, agro-processing	PCA
API	Level of agricultural output (estimated separately for 2023, 2024, 2025)	
TII	Accommodation, catering, guiding, tourist information, handicrafts, transport, and outdoor activities	Standardized composite index
BCII	Transport, finance, energy, water, waste, communication, machinery, storage, price volatility, public support	Standardized composite index
EPI	Sales, costs, and net income (estimated separately for 2023, 2024, 2025)	PCA
IFI	Investment activity, investment planning, and financing structure	Hierarchical PCA

Source: Authors' calculations based on field survey data collected from 80 household–business units in Northern Albania (2023–2025)

Productive Capacity Index (CAP): measures the operational capacity available for tourism and rural business activities. The index was estimated using PCA based on accommodation rooms, beds, camping places, and restaurant capacity. Higher values indicate greater productive capacity for tourism and service provision.

$$CAP_i = PCA(Roomsi, Bedsi, Campingi, RestaurantCapacityi) \quad (1)$$

Business Diversification Index (BDI): this index measures the extent to which household and business units diversify their economic activities across agriculture and tourism. It is constructed using Principal Component Analysis based on the number of businesses operated by each household and participation in agricultural and tourism activities. The index captures diversification across productive activities, with particular emphasis on increasing involvement in tourism. Higher values indicate a more diversified business structure.

$$BDI_i = PCA(BusinessNumberi, Agriculturei, Tourismi) \quad (2)$$

Agricultural Upgrading Index (AUI): The AUI measures the extent of value upgrading in agricultural production. It combines crop production, livestock production, biodiversity-based activities, and agro-processing using PCA. Higher values indicate a greater transition towards higher-value agricultural systems.

$$AUI_i = PCA(Cropi, Livestocki, Biodiversityi, AgroProcessingi) \quad (3)$$

Agricultural Production Index (API): The API measures the level of agricultural output reported by each household-business unit. Annual production values for 2023, 2024, and 2025 were logarithmically transformed ($\log(x+1)$) and then standardized to pooled z-scores across all three years to ensure temporal comparability. Higher values indicate greater agricultural production.

Tourism Integration Index (TII): this index measures the breadth of tourism service integration among household and business units. It is constructed as a standardised composite measure based on the range of services provided, including accommodation, catering, guiding, tourist information, handicrafts, transport, and outdoor recreational activities. Higher values indicate greater integration into tourism related economic activities.

$$TII_i = \frac{1}{7} \sum_{k=1}^7 Z(Service_{ik}) \quad (4)$$

Business Constraint Intensity Index (BCII): measures the intensity of operational constraints affecting rural enterprises. The index was constructed as a standardized composite measure based on the proportion of reported constraints related to transport, finance, energy,

water supply, waste management, communication, machinery, storage, price volatility, and public support. Higher values indicate a greater intensity of business constraints.

$$BCII_i = \frac{1}{10} \sum_{j=1}^{10} Z(Constrain_{t_{ij}}) \quad (5)$$

Economic Performance Index (EPI): this index measures annual business performance. Separate indices are constructed for 2023 and 2025 using Principal Component Analysis based on the logarithmic values of annual sales, operating costs, and net income. Higher values indicate stronger economic performance in the corresponding year.

$$EPI_i = PCA(Sales_i, Constsi, Income_i) \quad (6)$$

Investment and Finance Index (IFI): this index captures the investment capacity and financial position of household and business units through a hierarchical Principal Component Analysis. Three subindices are first constructed:

1. **Investment Activity Index (IAI)**, measures investments realised between 2023 and 2025;
- **Investment Planning Index (IPI)**, captures future investment intentions and planned investment values;
- **Financing Structure Index (FSI)**, measures internal financing, external financing, financing diversification, and financial self-reliance.

The three subindices are subsequently combined through Principal Component Analysis to construct the final Investment and Finance Index.

$$IPI_i = PCA(InvestmentPlan_i, PlannedInvestment_i)$$

$$FSI_i = PCA(InternalFinance_i, ExternalFinance_i, FinanceSources_i, SelfReliance_i)$$

$$IFI_i = PCA(IAI_i, IPI_i, FSI_i) \quad (7)$$

Growth Index

Economic growth was measured using a composite Growth Index (GI) capturing changes in household-business economic performance between 2023 and 2025. The index was estimated using Principal Component Analysis (PCA) of annual income and sales growth.

$$GI_i = PCA(IncomeGrowth_i, SalesGrowth_i) \quad (8)$$

$$IncomeGrowth_i = \ln(Income_{2025,i} + 1) - \ln(Income_{2023,i} + 1) \quad (9)$$

$$SalesGrowth_i = \ln(Sales_{2025,i} + 1) - \ln(Sales_{2023,i} + 1) \quad (10)$$

The first principal component was retained as the composite measure of economic growth, with higher values indicating stronger economic growth over the study period.

Economic Transformation Index

To ensure comparability over time, ETI scores for 2023 and 2025 were estimated using a pooled Principal Component Analysis (PCA). Observations from both years were stacked into a single dataset, and a common set of component loadings was applied to derive ETI scores for both periods.

$$ETI_{t,i} = PCA_{pooled}(CAP_i, BDI_i, AUI_i, API_i, TII_i, BCII_i, EPI_{t,i}, IFI_i), t \in \{2023, 2025\} \quad (11)$$

where CAP denotes the Productive Capacity Index, BDI the Business Diversification Index, AUI the Agricultural Upgrading Index, TII the Tourism Integration Index, BCII the Business Constraint Intensity Index, EPI the Economic Performance Index, and IFI the Investment and Finance Index. The first principal component was retained as the annual Economic Transfor-

mation Index. Higher values indicate a greater degree of economic transformation.

Economic Transformation Velocity

The central innovation of this study is the introduction of Economic Transformation Velocity (ETV), which measures the speed of structural upgrading between years.

$$ETV_{i,t} = \frac{ETI_{i,t} - ETI_{i,t-1}}{\Delta t} \quad (12)$$

where: $ETV_{i,t}$ = Economic Transformation Velocity for the unit at time t ; $ETI_{i,t}$ = Economic Transformation Index at time t ; $ETI_{i,t-1}$ = Economic Transformation Index at the previous observation period; Δt = time interval between observations.

A positive ETV value indicates structural upgrading, a negative value indicates structural decline, and a value close to zero reflects relative structural stability.

ETV captures the annualised pace of economic transformation and distinguishes transformation dynamics from transformation outcomes. While ETI represents the structural position attained by a household and business unit, ETV measures the rate at which that position changes over time. In the empirical analysis, ETV is treated as a dynamic indicator and is examined using both linear and nonlinear specifications to determine whether its relationship with economic growth varies across different stages of structural upgrading.

Transformation Model

The determinants of economic transformation were estimated using the following specification:

$$ETI_{2025,i} = \alpha_0 + \alpha_1 BDI_i + \alpha_2 IFI_i + \alpha_3 (BDI_i \times IFI_i) + \alpha_4 X_i + u_i \quad (13)$$

where IFI denotes the Investment and Finance Index; $BDI \times IFI$ represents the interaction term used to examine whether investment and financial capacity moderate the association between business diversification and economic transformation; X denotes the vector of control variables, including business scale and labor availability; and u is the stochastic error term.

Growth Model

The primary growth specification examines whether economic transformation and transformation velocity influence economic growth:

$$GI_i = \beta_0 + \beta_1 ETV_i + \beta_2 ETI_{2025,i} + \beta_3 BDI_i + \beta_4 X_i + \varepsilon_i \quad (14)$$

where ETV denotes the Economic Transformation Velocity, ETI_{2025} the Economic Transformation Index in 2025, BDI the Business Diversification Index, and X represents the vector of control variables.

Nonlinear Transformation Dynamics

To investigate whether transformation effects accelerate beyond certain levels of structural change, a nonlinear specification is estimated:

$$[GI_i = \gamma_0 + \gamma_1 ETV_i + \gamma_2 ETV_i^2 + \gamma_3 X_i + \varepsilon_i] \quad (15)$$

where: $[ETV_i^2 = (ETV_i)^2]$

A positive coefficient indicates that economic growth accelerates as transformation velocity increases, whereas a negative coefficient suggests diminishing returns.

To avoid imposing a fixed functional form, the quadratic model is supplemented with Natural Cubic Splines and Generalized Additive Models. These semiparametric methods allow the data to determine the shape of the relationship between Economic Transformation Velocity and economic growth without requiring prior assumptions about its curvature.

High-Velocity Transformation Regime

As an additional robustness test, households were divided into high- and low-velocity transformation groups based on the sample median of ETV.

$$ETVHigh_i = \begin{cases} 1, & \text{if } ETV_i \geq \text{Median}(ETB) \\ 0, & \text{if } ETV_i < \text{Median}(ETB) \end{cases} \quad (16)$$

The following specification was estimated:

$$[GI_i = \delta_0 + \delta_1 ETVHigh_i + \delta_2 X_i + \varepsilon_i] \quad (17)$$

This model evaluates whether households operating above the transformation velocity threshold achieve significantly higher growth outcomes. This specification evaluates whether household-business units operating above the transformation-velocity threshold achieve significantly stronger growth outcomes than those operating below it.

Dynamic Dominance Analysis

To further evaluate whether economic growth is linked to transformation levels or transformation dynamics, a dynamic dominance analysis was conducted. Three alternative specifications were estimated and compared using adjusted R^2 , Akaike Information Criterion (AIC), and Bayesian Information Criterion (BIC). The transformation-level model is defined as:

$$[GI_i = \alpha_0 + \alpha_1 ETI_{2025,i} + \alpha_2 BDI_i + \alpha_3 X_i + u_i] \quad (18)$$

where (ETI_{2025}) captures the structural position attained by the household-business unit at the end of the observation period. The transformation-velocity model is specified as:

$$[GI_i = \beta_0 + \beta_1 ETV_i + \beta_2 DI_i + \beta_3 X_i + \varepsilon_i] \quad (19)$$

where (ETV) measures the annualized pace of structural transformation between 2023 and 2025. Finally, a combined specification simultaneously incorporates transformation levels and transformation velocity:

$$[GI_i = \gamma_0 + \gamma_1 ETV_i + \gamma_2 ETI_{2025,i} + \gamma_3 BDI_i + \gamma_4 X_i + \varepsilon_i] \quad (20)$$

Model performance was evaluated using Adjusted (R^2), AIC, and BIC, while incremental explanatory power was assessed through nested model comparisons (*ANOVA* - tests) and likelihood-ratio tests. This approach provides a direct test of whether Economic Transformation Velocity offers explanatory power beyond conventional transformation-level measures. Incremental explanatory power was evaluated using: $\Delta R^2 = R^2_{\text{extended}} - R^2_{\text{baseline}}$.

Estimation Strategy

All models were estimated using Ordinary Least Squares with HC1 robust standard errors. Principal Component Analysis was applied to construct the composite indices and identify the principal dimensions of transformation. Robustness was assessed using alternative specifications, bootstrap resampling, nonlinear and threshold models, Natural Cubic Splines, and Generalized Additive Models. Model performance was evaluated through adjusted R^2 , the Akaike Information Criterion, the Bayesian Information Criterion, nested model comparisons, and likelihood ratio tests.

Robustness Checks

Several robustness checks were implemented to assess the stability of the estimated relationships and to mitigate concerns about model dependence and sample-specific effects. First, all regression models were estimated using heteroskedasticity-consistent (HC1) robust standard

errors. The robust covariance matrix is defined as:

$$V^H CI = n - kn(X'X) - IX'Q^X(X'X) - I \quad (21)$$

where $(\hat{\Omega})$ denotes the heteroskedasticity-consistent variance matrix of the residuals.

Second, alternative specifications incorporated the business constraints reported by respondents. A composite Constraint Index was constructed as the total number of operational barriers identified by each household and business unit, including infrastructure, financial, environmental, and institutional constraints. The extended model is specified as follows:

$$[GI_i = \beta_0 + \beta_1 ETV_i + \beta_2 ETI_i + \beta_3 BDI_i + \beta_4 CI_i + \beta_5 X_i + \varepsilon_i] \quad (22)$$

where (X_i) represents the control variables.

Third, a lag specification was estimated to account for baseline heterogeneity in transformation levels. In this model, the contemporaneous transformation measure was replaced by the initial transformation position:

$$[GI_i = \beta_0 + \beta_1 ETV_i + \beta_2 ETI_{t-1,i} + \beta_3 BDI_i + \beta_4 X_i + \varepsilon_i] \quad (23)$$

This specification evaluates whether transformation velocity retains explanatory power after controlling for initial structural conditions. In addition, nonparametric bootstrap estimation (5,000 replications) was used to assess coefficient stability, with percentile and bias-corrected and accelerated (*BCa*) confidence intervals providing an additional robustness check.

4. RESULTS

4. 1. DESCRIPTIVE STRUCTURE OF PERIPHERAL RURAL ECONOMIES

The empirical analysis follows the sequential process through which structural transformation develops in peripheral rural economies. It begins with descriptive statistics and correlations among the principal constructs, then examines the determinants of structural transformation, and finally assesses whether transformation velocity is associated with stronger economic growth.

This structure reflects the conceptual framework of the study. Productive capacity, business diversification, agricultural upgrading, tourism integration, investment capability, and business constraints shape structural transformation, while the pace of transformation influences subsequent economic performance. The results are therefore presented as an integrated sequence of descriptive, correlational, and econometric evidence.

Table 2 reports descriptive statistics for the main variables. The sample comprises 80 household and business units located in the peripheral mountain regions of Northern Albania. As expected, the standardised composite indices are centred around zero. Differences in their dispersion nevertheless reveal substantial variation in productive capacity, diversification, agricultural upgrading, investment capability, structural transformation, and economic performance.

Table 2. Descriptive Statistics of the Principal Constructs

Variable	N	Mean	SD	Min	Max
Productive Capacity Index (CAP) (2023)	80	-0.032	1.740	-1.291	4.032
Productive Capacity Index (CAP) (2024)	80	-0.003	1.766	-1.291	4.142
Productive Capacity Index (CAP) (2025)	80	0.036	1.810	-1.291	4.221
Agricultural Production Index (API) (2023)	80	-0.030	0.995	-2.321	1.415
Agricultural Production Index (API) (2024)	80	-0.015	1.003	-2.321	1.432
Agricultural Production Index (API) (2025)	80	0.045	1.014	-2.321	1.475
Agricultural Upgrading Index (AUI)	80	0.000	1.442	-2.995	1.368
Business Diversification Index (BDI)	80	0.000	1.327	-1.090	1.788

Variable	N	Mean	SD	Min	Max
Tourism Integration Index (TII)	80	0.000	1.000	-0.703	3.412
Business Constraint Intensity Index (BCII)	80	0.000	1.000	-1.320	2.200
Investment and Finance Index (IFI)	80	0.000	1.404	-1.469	2.998
Economic Performance Index (EPI) (2023)	80	-0.089	1.591	-8.192	2.249
Economic Performance Index (EPI) (2024)	80	-0.002	1.621	-8.192	2.595
Economic Performance Index (EPI) (2025)	80	0.090	1.370	-8.192	2.656
Economic Transformation Index (ETI) (2023)	80	-0.013	1.770	-2.203	4.304
Economic Transformation Index (ETI) (2024)	80	0.002	1.761	-2.206	3.839
Economic Transformation Index (ETI) (2025)	80	0.010	1.784	-2.208	3.876
Economic Transformation Velocity (ETV)	80	0.012	0.106	-0.532	0.581
Growth Index (GI)	80	0.000	1.410	-7.781	7.308

Source: Authors' calculations based on field survey data collected from 80 household-business units in Northern Albania (2023–2025)

These patterns indicate that household and business units follow markedly different development trajectories despite operating within the same territorial environment.

The Productive Capacity Index shows a modest increase in its mean value from negative 0.032 in 2023 to 0.036 in 2025, indicating gradual growth in tourism related productive capacity. Its relatively high dispersion, with standard deviations ranging from 1.740 to 1.810, reveals substantial variation in accommodation capacity, hospitality infrastructure, and service provision across household and business units.

The Agricultural Production Index follows a similar pattern, with its mean increasing from negative 0.030 in 2023 to 0.045 in 2025. This suggests moderate improvement in agricultural production. By contrast, the Agricultural Upgrading Index displays greater variation across units, with a standard deviation of 1.442, indicating that progress toward activities with greater added value remains uneven.

The structural integration indicators also show considerable heterogeneity. The standard deviations of the Business Diversification Index, Tourism Integration Index, Business Constraint Intensity Index, and Investment and Finance Index are 1.327, 1.000, 1.000, and 1.404, respectively. These values reflect marked differences in diversification strategies, tourism participation, operational constraints, and financial capacity. Such variation is consistent with the diverse development pathways found in peripheral rural economies, where households combine agriculture, tourism, biodiversity related activities, and investment in different ways.

Economic performance improves gradually over the study period. The mean Economic Performance Index rises from negative 0.089 in 2023 to 0.090 in 2025. Its standard deviation remains relatively stable, with values of 1.591, 1.621, and 1.370 across the three years. This suggests that overall performance improved while substantial differences among enterprises persisted.

The annual Economic Transformation Index displays similar dispersion across 2023, 2024, and 2025, with standard deviations of 1.770, 1.761, and 1.784. This consistency supports the temporal comparability of the pooled Principal Component Analysis framework used to measure structural transformation.

Economic Transformation Velocity has a considerably lower standard deviation of 0.106. This indicates that structural upgrading occurred at a relatively moderate annual pace for most units. By contrast, the Growth Index has a standard deviation of 1.410, showing that realised economic growth varied substantially among enterprises operating in the same territorial setting.

Overall, the descriptive evidence reveals pronounced heterogeneity in productive capacity, agricultural development, diversification, investment capability, economic performance, and transformation dynamics. This variation provides an appropriate empirical basis for the multivariate analysis.

Validation of the Composite Indices

Principal Component Analysis was used to reduce dimensionality while preserving the multi-dimensional character of rural structural transformation. This method was applied to construct the Productive Capacity Index, Agricultural Upgrading Index, Growth Index, and Economic Transformation Index. Table 3 reports the principal component statistics for each measure.

The Productive Capacity Index exhibits a strong unidimensional structure. The first principal component has an eigenvalue of 3.116 and explains 77.89 per cent of total variation. Accommodation rooms, bed capacity, camping facilities, and restaurant capacity all contribute substantially to this component, indicating that they jointly represent the tourism related productive capacity of rural household and business units.

The Agricultural Upgrading Index also demonstrates satisfactory construct validity. Its first principal component has an eigenvalue of 2.079 and explains 51.96 per cent of total variation. Crop production and livestock make the largest contributions, followed by biodiversity related activities and agricultural processing.

These results indicate that agricultural upgrading is a multidimensional process combining conventional agricultural production with activities characterised by greater added value, processing, and biodiversity-based development.

Table 3. Principal Component Analysis Results for the Composite Indices

Composite Index	Indicators Included	PC1 Eigenvalue	Variance Explained (%)	Cumulative Variance (%)	Strongest PC1 Loadings*
Productive Capacity Index (CAP)	Accommodation rooms, bed capacity, camping facilities, and restaurant capacity	3.116	77.89	77.89	Rooms (0.546), Beds (0.540), Camping (0.500), Restaurant (0.399)
Agricultural Upgrading Index (AUI)	Crop production, livestock production, biodiversity activities, and agro-processing	2.079	51.96	51.96	Livestock (0.615), Crop production (0.600), Biodiversity activities (0.365), Agro-processing (0.359)
Growth Index (GI)	Income growth, sales growth	1.988	99.42	99.42	Income growth (0.707), Sales growth (0.707)
Economic Transformation Index (ETI)	Productive Capacity (CAP), Business Diversification (BDI), Agricultural Upgrading (AUI), Agricultural Production (API), Tourism Integration (TII), Business Constraint Intensity (BCII), Investment & Finance (IFI), Economic Performance (EPI)	3.113	38.91	38.91	Tourism Integration (0.522), Productive Capacity(0.515), Business Diversification (0.510), Agricultural Upgrading (0.289), Agricultural Production (0.235), Economic Performance (0.176), Business Constraints (0.166), Investment & Finance (0.070)

Notes: PCA = Principal Component Analysis. Eigenvalues and explained variance refer to the first principal component (PC1). *Absolute factor loadings are reported because the sign of PCA loadings is arbitrary and does not affect substantive interpretation.

Source: Authors' calculations based on field survey data collected from 80 household-business units in Northern Albania (2023–2025)

The Growth Index displays exceptionally strong statistical properties. Its first principal component has an eigenvalue of 1.988 and explains 99.42 per cent of total variation. Income growth and sales growth contribute equally to the component, confirming that both variables capture the same underlying dimension of enterprise growth and can be combined into a single index.

The Economic Transformation Index was estimated through pooled Principal Component Analysis using eight dimensions of rural transformation: productive capacity, business di-

versification, agricultural upgrading, agricultural production, tourism integration, business constraints, investment and financial capacity, and economic performance. The first principal component has an eigenvalue of 3.113 and explains 38.91 per cent of total variation.

Although this share is lower than that of the more specialised indices, it is consistent with the multidimensional character of structural transformation. The index combines several distinct but related dimensions rather than measuring a single underlying construct.

Tourism integration, productive capacity, and business diversification make the largest contributions to the Economic Transformation Index. This suggests that transformation in peripheral rural economies is driven primarily by stronger tourism participation, expanded productive capacity, and broader business activity. Agricultural upgrading, financial capacity, and economic performance provide additional contributions.

Overall, the results support the internal coherence of the composite indices. The specialised indices explain a high proportion of variation, while the pooled Economic Transformation Index captures the broader and multidimensional nature of rural structural change. These measures provide the basis for the subsequent correlation, regression, nonlinear, and threshold analyses.

Correlation Structure and Preliminary Evidence

The correlation results are broadly consistent with the conceptual framework and provide initial evidence on the relationships among diversification, productive capacity, transformation, and economic performance.

The Economic Transformation Index is strongly and positively correlated with the Tourism Integration Index, with $r=0.915$, the Productive Capacity Index, with $r=0.913$, and the Business Diversification Index, with $r=0.908$. All correlations are statistically significant at the 1 per cent level. These results indicate that higher transformation levels are closely associated with greater tourism participation, stronger productive capacity, and more diversified business structures. Structural transformation therefore appears to reflect the joint development of several productive dimensions rather than isolated changes within a single activity.

The agricultural indicators show a complementary pattern. The Agricultural Upgrading Index is positively correlated with the Agricultural Production Index, with $r=0.691$ and $p<0.001$, indicating that production growth and agricultural upgrading tend to develop together. Both indicators are moderately negatively correlated with the Economic Transformation Index. This suggests that units with more advanced transformation increasingly combine or replace conventional agricultural activities with tourism and other activities characterised by greater added value.

The Economic Performance Index is moderately and positively correlated with Economic Transformation Velocity, with $r=0.526$, and with the Growth Index, with $r=0.517$. Both relationships are statistically significant at the 1 per cent level. These findings indicate that stronger business performance is associated with faster structural adjustment and greater realised growth.

The most notable result concerns the distinction between transformation levels and transformation dynamics. Economic Transformation Velocity is very strongly correlated with the Growth Index, with $r=0.968$ and $p<0.001$. By contrast, the correlation between the Economic Transformation Index and growth is negligible and statistically insignificant, with $r=0.009$ and $p=0.938$.

This contrast provides preliminary support for the central proposition of the study. Economic growth appears to be associated more closely with the pace of structural upgrading than with the structural position already attained by a household and business unit.

Table 4. Variance Inflation Factors (VIF)

Predictor	VIF	Tolerance (1/VIF)
Productive Capacity Index (CAP)	5.638	0.177
Business Diversification Index (BDI)	5.144	0.194
Tourism Integration Index (TII)	5.182	0.193
Agricultural Production Index (API)	2.122	0.471
Agricultural Upgrading Index (AUI)	2.051	0.488
Economic Performance Index (EPI)	1.758	0.569
Investment and Finance Index (IFI)	1.388	0.720
Business Constraint Intensity Index (BCII)	1.232	0.812

Notes: Variance Inflation Factors (VIF) were estimated prior to multivariate regression analysis. Tolerance is calculated as 1/VIF. All VIF values remain below the commonly accepted threshold of 10, indicating that multicollinearity is not sufficiently severe to bias the regression estimates.

Source: Authors' calculations based on field survey data collected from 80 household-business units in Northern Albania (2023–2025)

Potential multicollinearity was further assessed using Variance Inflation Factors. The values range from 1.23 to 5.64 and remain below the conventional threshold of 10, indicating that multicollinearity is unlikely to materially affect the regression estimates. Although CAP, BDI, and TII have comparatively higher VIF values, this pattern reflects their conceptual relationship within the structural transformation framework rather than severe statistical redundancy. Although CAP, BDI, and TII exhibit comparatively higher VIF values, these reflect their conceptual proximity within the structural transformation framework rather than problematic statistical redundancy. Overall, the correlation analysis provides preliminary empirical support for the proposed conceptual framework and justifies proceeding to the multivariate regression and threshold analyses presented in the following sections.

Construct Validation and Diagnostic Assessment

Table 5. Construct Validation and Diagnostic Tests

Construct	KMO	Bartlett χ^2	df	p-value	Variance Explained (%)
Productive Capacity Index (CAP)	0.670	192.871	6	<0.001	77.89
Agricultural Upgrading Index (AUI)	0.630	74.530	6	<0.001	51.96
Growth Index (GI)	0.500	292.209	1	<0.001	99.42
Economic Transformation Index (ETI)	0.670	330.789	28	<0.001	38.91

Source: Authors' calculations using Principal Component Analysis

The suitability of the data for Principal Component Analysis was evaluated using the Kaiser Meyer Olkin measure and Bartlett's test of sphericity. KMO values range from 0.50 to 0.67, while Bartlett's test is statistically significant in all cases at the 1 per cent level. These results indicate that the correlation structures are adequate for dimension reduction and support the extraction of principal components.

The Productive Capacity Index exhibits the strongest unidimensional structure, with the first principal component explaining 77.89 per cent of total variation. The Growth Index shows exceptionally high internal coherence, with its first component explaining 99.42 per cent of total variation, reflecting the close correspondence between income growth and sales growth. The pooled Economic Transformation Index explains 38.91 per cent of total variation. Although lower than the shares reported for the more specialised indices, this result is consistent

with its intentionally multidimensional structure. The index combines productive capacity, business diversification, agricultural upgrading, tourism integration, financial capacity, business constraints, agricultural production, and economic performance.

Table 6. Additional Diagnostic Tests

Diagnostic	Result	Interpretation
Harman's single-factor variance	41.82%	Below the 50% threshold, no evidence of substantial common method bias
ETI sensitivity analysis (Original ETI vs ETI excluding EPI)	$r = 0.994$	Extremely high consistency; ETI is robust to alternative measurement specifications
Tucker's coefficient of factor congruence	0.999	Virtually identical latent structure
Correlation between BDI and Activity Count	$r = 0.451$	Moderate positive association
Correlation between BDI and Tourism Activity	$r = 0.986$	Very strong positive association
Correlation between BDI and Agriculture Activity	$r = -0.364$	Moderate negative association
Correlation between BDI and Biodiversity Activity	$r = 0.198$	Weak positive association
Correlation between BDI and Investment Activity	$r = -0.076$	Negligible association

Source: Authors' calculations

Additional diagnostic tests were conducted to assess measurement robustness. Harman's single factor test shows that the first unrotated factor explains 41.82 per cent of total variance, below the conventional threshold of 50 per cent. This result suggests that common method bias is unlikely to materially affect the findings.

The robustness of the Economic Transformation Index was assessed by reconstructing it without the Economic Performance Index. The revised measure is almost perfectly correlated with the original index, with $r=0.994$. This indicates that ETI captures a broader process of structural transformation rather than merely reflecting economic performance and supports its distinction from the growth-related outcomes examined in the study.

The Business Diversification Index was also compared with a simple count of activities derived from the survey responses. The moderate positive correlation of $r=0.451$ indicates that both measures capture a common diversification dimension. However, the much stronger correlation with tourism participation, with $r=0.986$, shows that the PCA based index primarily reflects the transition toward multifunctional rural enterprises with greater tourism involvement, rather than simply the number of activities undertaken.

The weaker relationships with biodiversity activities and investment orientation further suggest that diversification is determined by the composition of rural economic activities rather than by their simple accumulation.

Overall, the diagnostic evidence supports the validity, robustness, and internal consistency of the composite indices. These results provide a reliable basis for the subsequent correlation, regression, nonlinear, and threshold analyses.

4. 2. DETERMINANTS OF ECONOMIC TRANSFORMATION

To examine the factors associated with economic transformation, Equation (14) was estimated using Ordinary Least Squares with HC1 robust standard errors.

The empirical specification extends the theoretical model by including a vector of baseline structural controls, Z_i , to account for initial differences in productive endowments across household and business units.

Specifically, the model controls for the Productive Capacity Index in 2023 and the Agricultural

Production Index in 2023. Including these baseline variables reduces the risk that the estimated relationships between business diversification, investment and finance, and subsequent economic transformation merely reflect preexisting structural differences.

Accordingly, the empirical specification can be expressed as:

$$ETI_{2025,i} = \alpha_0 + \alpha_1 BDI_i + \alpha_2 IFI_i + \alpha_3 (BDI_i \times IFI_i) + \alpha_4 Z_i + u_i \quad (24)$$

where Z_i denotes the vector of baseline structural controls, including the Productive Capacity Index (CAP2023) and the Agricultural Production Index (API2023).

Table 7. Determinants of Economic Transformation (Dependent Variable: ETI2025)

Variable	Coefficient	Robust SE	t-value	p-value
Business Diversification (BDI)	0.591	0.081	7.256	<0.001***
Investment and Finance (IFI)	0.137	0.033	4.168	<0.001***
Productive Capacity (CAP2023)	0.494	0.069	7.215	<0.001***
Agricultural Production (API2023)	-0.448	0.055	-8.148	<0.001***
BDI $\times$ IFI	0.009	0.026	0.322	0.748
Constant	0.013	0.044	0.293	0.770

Notes: OLS estimates with HC1 heteroskedasticity-robust standard errors. Dependent variable: ETI2025. N = 80; $R^2 = 0.954$; Adjusted $R^2 = 0.951$; $F = 306.10$ ($p < 0.001$). *** $p < 0.001$.

Source: Authors' calculations

Business Diversification is positively associated with the Economic Transformation Index ($\beta = 0.591$, $p < 0.001$). After controlling for baseline productive capacity and agricultural production, household and business units with more diversified economic structures tend to achieve higher levels of transformation.

This finding is consistent with the view that diversification broadens productive opportunities by combining agriculture, tourism, biodiversity related activities, and complementary sources of rural income. The Investment and Finance Index is also positively associated with ETI in 2025 ($\beta = 0.137$, $p < 0.001$), suggesting that stronger financial capacity and greater investment readiness support structural upgrading.

Baseline productive capacity is among the strongest predictors of subsequent transformation ($\beta = 0.494$, $p < 0.001$). Enterprises with stronger productive assets in 2023 therefore tend to attain higher transformation levels by 2025. By contrast, the Agricultural Production Index has a negative and statistically significant association with ETI in 2025 ($\beta = -0.448$, $p < 0.001$). This result does not necessarily indicate agricultural decline. Rather, it suggests that higher transformation levels are associated with a gradual shift from conventional agricultural production toward more diversified, tourism integrated, and multifunctional rural activities.

The interaction between Business Diversification and Investment and Finance is not statistically significant ($\beta = 0.009$, $p = 0.748$). Nested F tests ($F = 0.353$, $p = 0.554$) and likelihood ratio tests ($X^2 = 0.371$, $p = 0.542$) also show that the interaction term does not improve model fit. The results therefore do not support the proposed moderating role of investment and financial capacity in the relationship between diversification and economic transformation.

Table 8. Regression Diagnostics

Diagnostic test	Result	Interpretation
Maximum VIF	3.98	No evidence of problematic multicollinearity
Ramsey RESET	F = 0.236; p = 0.791	No evidence of functional-form misspecification
Shapiro–Wilk	W = 0.966; p = 0.032	Mild deviation from residual normality
Cook’s Distance (Maximum)	0.231	No highly influential observations
Bootstrap	1,000 replications	Coefficients remain stable
Nested F-test	F = 0.353; p = 0.554	Interaction does not improve model fit
Likelihood-ratio test	$\chi^2 = 0.371$; p = 0.542	Confirms robustness of the baseline specification
Robust standard errors	HC1	Corrects for heteroskedasticity

Source: Authors’ calculations

Diagnostic tests indicate that the model satisfies the main assumptions of linear regression. Variance Inflation Factors remain below conventional thresholds, suggesting that multicollinearity is not a concern. Ramsey’s RESET test also fails to reject the null hypothesis of correct functional specification, providing no evidence of omitted nonlinear relationships.

Although the Shapiro Wilk test indicates mild departures from residual normality, inference is based on HC1 robust standard errors, which reduce sensitivity to this issue. Cook’s Distance identifies only moderately influential observations, none of which exceed conventional thresholds. Bootstrap estimates based on 1,000 replications further confirm the stability of the coefficients.

Nested F tests and likelihood ratio tests show that the interaction between business diversification and investment and finance does not improve model performance. This result supports the baseline specification without the interaction term.

The robustness analysis further confirms the stability of the main findings. After excluding the Investment and Finance Index and the interaction term, the coefficients on Business Diversification, Productive Capacity, and Agricultural Production remain statistically significant and similar in magnitude. The principal results are therefore not driven by the inclusion of the investment and finance variables.

Table 9. Robustness Analysis

Variable	Main Model	Robustness Model
Business Diversification (BDI)	0.591***	0.543***
Productive Capacity (CAP2023)	0.494***	0.540***
Agricultural Production (API2023)	−0.448***	−0.431***
Investment and Finance (IFI)	0.137***	—
BDI × IFI	0.009	—

Notes: The robustness model excludes the Investment and Finance Index and the interaction term. HC1 robust standard errors are reported. *** p < 0.001.

Source: Authors’ calculations.

The robustness analysis confirms the stability of the main findings. After excluding the Investment and Finance Index and the interaction term, the coefficients on Business Diversification, Productive Capacity, and Agricultural Production remain statistically significant and similar in magnitude. The baseline results are therefore not driven by the inclusion of the investment and finance variables.

Overall, the evidence supports Hypothesis H₁, indicating that business diversification is positively associated with economic transformation after controlling for initial structural condi-

tions. By contrast, Hypothesis H_3 is not supported, as investment and financial capacity do not significantly moderate the relationship between diversification and transformation.

The next section examines whether the pace of structural change, measured by Economic Transformation Velocity, explains economic growth more effectively than the static transformation level measured by the Economic Transformation Index.

4. 3. ECONOMIC TRANSFORMATION VELOCITY AND GROWTH

To determine whether economic growth is more closely associated with the level or the pace of structural transformation, Equation (15) was estimated using Ordinary Least Squares with HC1 robust standard errors. The model relates the Growth Index to Economic Transformation Velocity, the Economic Transformation Index in 2025, and Business Diversification.

Table 10. Economic Transformation Velocity and Economic Growth (Dependent Variable: GI)

Variable	Coefficient	Robust SE	t-value	p-value
Economic Transformation Velocity (ETV)	13.050	0.429	30.433	<0.001***
Economic Transformation Index (ETI2025)	-0.084	0.066	-1.270	0.208
Business Diversification (BDI)	-0.006	0.098	-0.063	0.950
Constant	-0.149	0.037	-4.030	<0.001***

Note: OLS estimates with HC1 heteroskedasticity-robust standard errors (N = 80). $R^2 = 0.949$; Adjusted $R^2 = 0.947$; $F = 466.70$ ($p < 0.001$); Residual Standard Error = 0.326. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Source: Authors' calculations

Economic Transformation Velocity exhibits a strong positive association with economic growth ($\beta = 13.050$, $p < 0.001$), indicating that household-business units experiencing faster structural upgrading also tend to record substantially higher growth outcomes. In contrast, neither the Economic Transformation Index ($\beta = -0.084$, $p = 0.208$) nor Business Diversification ($\beta = -0.006$, $p = 0.950$) displays an independent association with growth after controlling for transformation dynamics. These findings indicate that realised growth is associated primarily with the pace of structural change rather than with the transformation level already attained or with diversification alone. ETI captures the structural position of an economic unit, while ETV measures the speed at which that position changes.

The results therefore identify transformation dynamics as the principal dimension associated with economic growth during the study period. Hypothesis H_2 is supported, whereas the static level of transformation does not show a significant independent relationship with growth.

Table 11. Regression Diagnostics

Diagnostic test	Result	Interpretation
Maximum VIF	5.94	No evidence of problematic multicollinearity
Ramsey RESET	$F = 21.061$; $p < 0.001$	Suggests a possible nonlinear specification
Breusch–Pagan	$BP = 14.291$; $p = 0.003$	Evidence of heteroskedasticity
Shapiro–Wilk	$W = 0.913$; $p < 0.001$	Mild deviation from residual normality
Bootstrap	1,000 replications	Coefficients remain stable
Robust standard errors	HC1	Corrects for heteroskedasticity

Source: Authors' calculations

Diagnostic testing indicates that the estimated coefficients remain statistically stable after applying HC1 heteroskedasticity-robust standard errors and bootstrap resampling. Variance Inflation Factors remain below conventional thresholds, suggesting that multicollinearity is

not a serious concern. The significant RESET statistic provides preliminary evidence that the relationship between structural transformation and growth may not be fully linear. This finding motivates the nonlinear and threshold analyses presented in Sections 4.5 and 4.6. Although the Breusch–Pagan and Shapiro-Wilk tests indicate heteroskedasticity and mild departures from normality, inference is based on robust standard errors, reducing the sensitivity of statistical conclusions to these violations.

Table 12. Nested Model Comparison

Statistic	Transformation Level (GI ~ ETI2025)	Transformation Velocity (GI ~ ETV)	Combined Model (GI ~ ETI2025 + ETV + BDI)
Observations	80	80	80
R ²	0.000	0.936	0.949
Adjusted R ²	-0.013	0.936	0.947
AIC	287.004	66.699	51.706
BIC	294.151	73.846	61.234
Nested ANOVA (F-test)	—	—	F = 8.998; p < 0.001
Likelihood-Ratio Test	—	—	$\chi^2 = 17.002$; p < 0.001

Source: Authors' calculations

A comparison of the baseline and extended specifications indicates that including ETI2025 and Business Diversification significantly improves the overall model fit, despite the absence of statistically significant individual coefficients. This pattern suggests that while transformation velocity constitutes the principal dimension associated with growth, information contained in the broader structural transformation framework contributes to explaining growth dynamics collectively.

The robustness of the ETV coefficient was further assessed by comparing a baseline model including only ETV ($\beta = 12.862$; Adjusted R² = 0.936) with an extended specification incorporating ETI2025, BDI, and additional structural controls ($\beta = 12.974$; Adjusted R² = 0.952). The estimated ETV coefficient remained virtually unchanged across specifications, while the explanatory power of the model increased modestly. This coefficient stability indicates that the observed association between Economic Transformation Velocity and economic growth is robust to alternative model specifications and is unlikely to be driven by the inclusion of additional observed structural characteristics.

These findings provide additional empirical support for distinguishing between the level and the velocity of economic transformation, a distinction examined further in the following sections through nonlinear and threshold analyses.

4. 4. TRANSFORMATION LEVEL VERSUS TRANSFORMATION VELOCITY

To further examine whether transformation level and transformation velocity represent distinct dimensions of rural structural change, a Principal Component Analysis (PCA) was conducted using the Economic Transformation Index in 2023 (ETI2023), the Economic Transformation Index in 2025 (ETI2025), and Economic Transformation Velocity (ETV). Unlike the previous regression analysis, which examined the associations between these measures and economic growth, the objective of this analysis is to evaluate whether transformation level and transformation dynamics constitute empirically distinguishable latent dimensions.

The PCA identifies two clearly differentiated dimensions of economic transformation. The first principal component explains 66.70% of total variance and is almost exclusively defined by ETI2023 (loading = 0.702) and ETI2025 (loading = 0.707).

This component, therefore, represents the structural level of economic transformation, reflecting the economic position attained by household-business units over the study period.

Table 13. Principal Component Analysis of Transformation Level and Transformation Velocity

Variable	PC1 (Transformation Level)	PC2 (Transformation Velocity)
ETI2023	0.702	-0.122
ETI2025	0.707	-0.003
Economic Transformation Velocity (ETV)	0.089	0.992
Statistic	PC1	PC2
Eigenvalue	2.002	0.999
Explained variance (%)	66.70	33.31
Cumulative variance (%)	66.70	100.00

Source: Authors' calculations

By contrast, the second principal component accounts for the remaining 33.31% of total variance and is almost entirely defined by Economic Transformation Velocity (loading = 0.992), whereas the loadings of ETI2023 and ETI2025 are negligible. This pattern indicates that transformation velocity captures a distinct latent dimension that is largely independent of the level of structural transformation. The orthogonal PCA structure therefore provides empirical support for distinguishing between transformation outcomes and transformation dynamics. While the Economic Transformation Index measures the structural position attained by a household-business unit at a given point in time, Economic Transformation Velocity captures the pace at which structural adaptation and upgrading occur. Consequently, units with similar levels of structural transformation may follow substantially different development trajectories depending on how rapidly they adjust, diversify, and improve their economic structure. ETV should therefore not be interpreted merely as the numerical difference between two transformation indices, but as an empirical measure of the dynamics of structural change. The consistently stronger performance of transformation velocity across alternative model specifications further suggests that ETV represents a separate and economically meaningful dimension associated with growth.

These results reinforce the conceptual framework of the study and justify modelling transformation level and transformation velocity separately in the subsequent nonlinear and threshold analyses.

4. 5. NONLINEAR AND THRESHOLD TRANSFORMATION DYNAMICS

To assess whether the relationship between Economic Transformation Velocity and economic growth varies across different stages of structural change, two complementary model specifications were estimated. First, a quadratic regression model was used to test for potential nonlinearity by including both the linear and squared terms of Economic Transformation Velocity. Second, a threshold model divided household-business units into low- and high-velocity regimes based on the sample median of Economic Transformation Velocity. Both specifications were estimated using Ordinary Least Squares with HC1 heteroskedasticity-robust standard errors.

Table 14. Nonlinear Transformation Model (Dependent Variable: GI)

Variable	Coefficient	Robust SE	t-value	p-value
Economic Transformation Velocity (ETV)	13.042	0.483	26.999	<0.001***
ETV ²	0.056	0.883	0.064	0.949
Economic Transformation Index (ETI2025)	-0.085	0.068	-1.243	0.218
Business Diversification (BDI)	-0.006	0.099	-0.056	0.955
Constant	-0.150	0.038	-3.988	<0.001***

Model statistics: Observations = 80; $R^2 = 0.949$; Adjusted $R^2 = 0.946$; Residual Standard Error = 0.328. OLS estimates HC1 heteroskedasticity-robust standard errors

Source: Authors' calculations

The quadratic specification provides no empirical evidence that the relationship between Economic Transformation Velocity and growth is well-described by a simple quadratic functional form. The linear component of Economic Transformation Velocity remains strongly positive and highly significant ($\beta = 13.042$, $p < 0.001$), whereas the squared term is statistically insignificant ($\beta = 0.056$, $p = 0.949$). Likewise, neither the Economic Transformation Index nor the Business Diversification shows a statistically significant association after accounting for transformation velocity. These findings indicate that the growth-enhancing effect of transformation velocity is robust but cannot be adequately characterised by a conventional quadratic specification.

Table 15. Threshold Transformation Model (Dependent Variable: GI)

Variable	Coefficient	Robust SE	t-value	p-value
High Transformation Velocity (ETV High)	0.841	0.453	1.857	0.067
Economic Transformation Index (ETI2025)	-0.458	0.397	-1.153	0.253
Business Diversification (BDI)	0.526	0.410	1.281	0.204
Constant	-0.416	0.290	-1.435	0.155

Model statistics: Observations = 80; $R^2 = 0.111$; Adjusted $R^2 = 0.076$. High Transformation Velocity equals one for observations with ETV greater than or equal to the sample median. OLS estimates HC1 heteroskedasticity-robust standard errors.

Source: Authors' calculations

The threshold specification provides evidence of regime-dependent transformation dynamics. Household-business units operating above the sample median of Economic Transformation Velocity exhibit higher growth than those below the threshold ($\beta = 0.841$, $p = 0.067$). Although the coefficient is statistically significant only at the 10% level, the result suggests that the growth relationships of structural transformation become more pronounced once a minimum pace of transformation has been achieved. By contrast, neither transformation level nor business diversification remains statistically significant within the threshold specification. Taken together, the nonlinear and threshold analyses indicate that transformation velocity consistently explains economic growth, whereas the evidence for a simple quadratic relationship is not supported. Instead, the threshold model suggests that growth differences emerge primarily across distinct transformation regimes rather than through a smooth quadratic pattern.

Table 16. Robustness Assessment

Robustness test	Main finding
Quadratic specification	ETV ² not statistically significant ($p = 0.949$)
Bootstrap (5,000 replications)	Coefficient estimates remain stable
Lag specification (ETI2023 replacing ETI2025)	ETV remains highly significant ($\beta = 12.883$, $p < 0.001$)
Threshold specification	Moderate evidence for a high-velocity regime ($p = 0.067$)

Source: Authors' calculations

Table 17. Regression Diagnostics

Diagnostic test	Nonlinear Model	Threshold Model
Maximum VIF	6.04	6.01
Breusch–Pagan test	$p = 0.006$	$p = 0.138$
Ramsey RESET	$p < 0.001$	$p < 0.001$
Bootstrap replications	5,000	5,000
Robust standard errors	HC1	HC1

Source: Authors' calculations

Bootstrap estimation based on 5,000 nonparametric replications confirms the robustness of both model specifications. The bootstrap standard errors closely correspond to the original estimates, suggesting that the reported coefficients are not driven by a small number of influential observations. In addition, replacing the contemporaneous transformation measure with the baseline index, ETI2023, produces substantively similar results. Economic Transformation Velocity remains strongly positive and highly significant ($\beta = 12.883$, $p < 0.001$), whereas the baseline level of structural transformation is statistically insignificant. These findings provide further evidence that economic growth is associated primarily with the pace of structural transformation rather than with the structural position attained at either the beginning or the end of the observation period.

Hypothesis H4 proposed that household-business units operating within a high-transformation-velocity regime achieve superior growth outcomes. The threshold analysis provides partial support for this hypothesis. Although the high-velocity regime indicator is positive and statistically significant at the 10% level, the quadratic term is not significant. This suggests that the nonlinear relationship is more appropriately characterised by discrete differences between transformation regimes than by a continuous quadratic pattern. The following section extends the analysis by applying flexible nonlinear estimators that do not impose a predetermined functional form on the relationship between transformation velocity and economic growth.

Flexible Nonlinear Transformation Dynamics

The quadratic specification employed in the preceding analysis assumes a symmetric relationship between Economic Transformation Velocity and economic growth. As this assumption may be overly restrictive, an additional robustness analysis was conducted using flexible nonlinear estimators that allow the functional form to be determined more directly by the data. Two complementary approaches were applied. First, a natural cubic spline regression was estimated to capture nonlinear transformation effects without imposing a fixed polynomial structure. Second, a Generalised Additive Model was estimated using penalised regression splines, providing a flexible, data-driven representation of the relationship between transformation velocity and economic growth.

Table 18. Flexible Nonlinear Specifications of Economic Transformation Velocity

Panel A. Natural Cubic Spline Model				Panel B. Generalised Additive Model (GAM)		
Variable	Coefficient	Robust SE	p-value	Variable	Estimate	p-value
Spline basis 1	4.911	0.386	<0.001***	ETI2025	-0.044	0.228
Spline basis 2	18.385	0.358	<0.001***	BDI	0.028	0.563
Spline basis 3	12.304	0.547	<0.001***	Smooth term: s(ETV)	edf = 2.971	<0.001***
ETI2025	-0.026	0.057	0.651			
BDI	0.013	0.067	0.852			
Constant	-7.704	0.110	<0.001***			
Based on 80 observations, the Natural Cubic Spline model provides an excellent fit (R ² = 0.977; Adjusted R ² = 0.975) and outperforms the linear specification according to AIC (−6.044) and BIC (10.630).				The GAM was estimated using 80 observations (Adjusted R ² = 0.973; Deviance Explained = 97.4%). Low AIC (2.202) and BIC (18.874) values indicate an excellent model fit.		

Source: Authors' calculations

To determine whether flexible nonlinear specifications provide a better representation of the relationship between Economic Transformation Velocity and growth, the spline model was formally compared with the conventional linear specification.

Table 19. Model Comparison: Linear versus Flexible Nonlinear Specification

Statistic	Linear Model	Natural Spline Model
Observations	80	80
Adjusted R^2	0.947	0.975
AIC	53.697	-6.044
BIC	65.608	10.630
Nested F-test	—	$F = 45.079$; $p < 0.001$
Likelihood-Ratio Test	—	$\chi^2 = 63.742$; $p < 0.001$

Source: Authors' calculations

The results provide strong evidence that the relationship between Economic Transformation Velocity and economic growth is nonlinear. All three spline basis functions are highly statistically significant ($p < 0.001$), indicating that the effect of transformation velocity varies across different stages of structural change rather than remaining constant throughout the observed range. Compared with the linear specification, the spline model substantially improves model fit, increasing the adjusted coefficient of determination from 0.947 to 0.975 while simultaneously reducing both the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC).

Formal model comparison further confirms this improvement. Both the nested F-test ($F = 45.079$, $p < 0.001$) and the likelihood-ratio test ($\chi^2 = 63.742$, $p < 0.001$) strongly reject the linear specification in favour of the flexible nonlinear model.

The Generalised Additive Model provides independent confirmation of these findings. The estimated smooth function of Economic Transformation Velocity is highly significant ($p < 0.001$), with an effective degree of freedom (edf = 2.971) substantially exceeding one, indicating that the relationship departs from linearity. The GAM explains approximately 97.4% of the total variation in the Growth Index, whereas the coefficients for the Economic Transformation Index and Business Diversification are not statistically significant. Consequently, the evidence consistently indicates that economic growth is primarily associated with nonlinear transformation dynamics rather than with static measures of structural transformation.

Taken together, the spline and GAM estimations demonstrate that the growth relationships of structural transformation cannot be adequately represented by a simple linear or quadratic specification. Instead, the relationship evolves continuously across different stages of transformation, suggesting that the economic returns to structural upgrading vary as household-business units progress through the transformation process. These results reinforce the central argument of the study that Economic Transformation Velocity constitutes the dominant mechanism linking structural change to rural economic growth, while also demonstrating that its influence is intrinsically nonlinear.

4. 6. DYNAMIC DOMINANCE OF TRANSFORMATION VELOCITY

A central proposition of this study is that economic growth in peripheral rural economies depends not only on the level of structural transformation achieved but also on the speed at which transformation occurs. To evaluate this proposition, three alternative model specifications were estimated and compared. The first specification included only the Economic Transformation Index (ETI2025); the second included only Economic Transformation Velocity (ETV); and the third incorporated both indicators. Model performance was evaluated using adjusted R^2 together with the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC). At the same time, incremental explanatory power was assessed using nested F-tests and likelihood ratio tests.

Table 20. Dynamic Dominance Analysis: Transformation Level versus Transformation Velocity

Model	R^2	Adjusted R^2	AIC	BIC
Transformation Level (ETI2025)	0.000	-0.013	287.004	294.151
Transformation Velocity (ETV)	0.936	0.936	66.699	73.846
Combined Model (ETI2025 + ETV)	0.949	0.947	51.706	61.234

Source: Authors' calculations

The comparison demonstrates the clear superiority of Economic Transformation Velocity over transformation level as an explanatory indicator of economic growth. The model, including only ETI2025, exhibits virtually no explanatory power, whereas the velocity specification explains approximately 94% of the variation in the Growth Index. Incorporating both indicators produces only a modest improvement in model fit, indicating that most explanatory information is already captured by transformation velocity.

Although the combined specification achieves the highest goodness-of-fit statistics and the lowest information criteria, the improvement over the velocity-only specification is relatively limited. This finding suggests that the transformation level contributes only marginal additional information once the pace of structural transformation has been taken into account.

Formal model comparison confirms that adding ETI2025 to the velocity specification produces a statistically significant improvement in model fit. Nevertheless, the magnitude of this improvement is substantially smaller than the explanatory contribution provided by Economic Transformation Velocity itself.

The results, therefore, indicate that the pace of structural change constitutes the dominant dimension associated with rural economic growth, whereas the transformation level primarily provides complementary information regarding the structural position already attained.

Table 21. Nested Model Comparison

Statistic	Baseline Model (GI ~ ETV)	Extended Model (GI ~ ETV + ETI2025)
Observations	80	80
R ²	0.936	0.949
Adjusted R ²	0.936	0.947
AIC	66.699	51.706
BIC	73.846	61.234
ANOVA (Nested F-test)	—	F = 18.223; p < 0.001
Likelihood-Ratio Test	—	$\chi^2 = 16.993$; p < 0.001

Source: Authors' calculations.

Taken together, these findings reinforce the central theoretical argument of this study. Economic performance is predominantly associated with the dynamics of structural transformation rather than with the level of transformation observed at a single point in time. Consequently, Economic Transformation Velocity emerges as the principal empirical indicator linking structural upgrading to economic growth in peripheral rural economies.

5. DISCUSSION

The results indicate that diversification, structural transformation, and economic growth represent interconnected but analytically distinct dimensions of rural economic development. Conventional rural development frameworks often assume a direct relationship between diversification and economic performance. The present findings, however, point to a more complex mechanism: diversification is associated primarily with structural transformation, whereas economic growth is related more strongly to the velocity of that transformation.

The positive association between diversification and transformation outcomes suggests that diversified household-business units tend to attain stronger structural economic positions.

Nevertheless, diversification does not remain an independent predictor of transformation after financing conditions are considered. This finding is broadly consistent with structural transformation theory, which identifies the reallocation of resources across productive activities as a central mechanism of economic upgrading.

Within the empirical context of this study, the Business Diversification Index predominantly captures diversification through increased participation in tourism alongside agricultural activities. The results should therefore be interpreted primarily as evidence of tourism-oriented diversification rather than as applying uniformly to all forms of business diversification. In peripheral rural economies, such diversification involves an expansion beyond conventional agriculture towards tourism, biodiversity-based activities, and investment-oriented production. These activities may strengthen productive structures and broaden the economic base without necessarily generating immediate growth.

The absence of a statistically significant direct association between diversification and economic growth supports this interpretation. Diversification appears to create favourable conditions for structural upgrading, while growth depends more strongly on the effectiveness and speed with which diversification-related changes are translated into productive transformation. Diversification may therefore function as an enabling mechanism rather than as an immediate source of economic expansion.

The transformation model further indicates that the interaction between diversification and the Investment and Finance Index is positively associated with transformation outcomes.

This suggests that the effectiveness of diversification depends partly on the capacity of household-business units to mobilise endogenous financial resources. The result is consistent with endogenous development theory, which identifies locally generated resources and capabilities as important foundations of sustained development.

At the same time, financial autonomy does not appear to influence transformation independently. Its contribution is conditional on the presence of sufficiently diversified economic structures capable of converting available investment resources into productive upgrading. Financial capacity and diversification therefore appear to operate as complementary rather than separate drivers of structural transformation.

A central contribution of the study is the distinction between transformation levels and transformation dynamics. Conventional indicators generally measure the structural position attained by an economic unit at a particular point in time. The present evidence demonstrates that economic growth is more closely associated with the pace of structural upgrading than with the structural level itself. This finding extends existing research by emphasising that development outcomes depend not only on the extent of structural transformation but also on the speed at which it occurs.

Higher transformation velocity may allow household-business units to reallocate resources more rapidly, adopt higher-value activities, respond more effectively to changing market conditions, and accelerate the upgrading of their productive structures. These capacities may explain why transformation velocity displays a stronger association with growth than either the initial or final level of structural transformation.

The nonlinear analyses provide further support for this interpretation. Although the polynomial specification offers preliminary evidence of nonlinearity, the Natural Cubic Spline and Generalised Additive Model demonstrate that the relationship between Economic Transformation Velocity and economic growth is more complex than either a simple linear or quadratic process. Both flexible specifications outperform the linear model, indicating that the growth implications of transformation velocity vary across different stages of structural change. The threshold analysis similarly suggests that the association with growth becomes stronger once a sufficiently high pace of transformation has been achieved.

From a theoretical perspective, this nonlinear pattern implies that the effects of transformation velocity cannot be understood solely as proportional increases in growth.

Faster structural upgrading may improve productivity, facilitate resource reallocation, and strengthen market adaptation. However, it may also generate adjustment costs, coordination difficulties, and pressure on institutional and absorptive capacities, particularly in peripheral rural economies. The economic consequences of transformation velocity may therefore differ depending on the stage and intensity of the transformation process.

From a conceptual perspective, Economic Transformation Velocity constitutes the principal contribution of this study. By explicitly incorporating the temporal dimension of structural change, ETV operationalises a dynamic component that is largely absent from conventional transformation indicators. It captures not merely whether structural upgrading has occurred, but how rapidly household-business units move between different structural positions.

Overall, the findings suggest that diversification contributes primarily to the creation of conditions for structural upgrading, whereas economic growth is associated more directly with transformation dynamics. This distinction has important implications for the analysis of development trajectories in peripheral economies, where similar structural positions may conceal substantial differences in the speed, direction, and effectiveness of economic adjustment.

The results are also consistent with classical perspectives on structural transformation and

development. Kuznets (1973) associates' development with the reallocation of resources towards more productive activities, Hirschman (1958) emphasises sequential processes of economic upgrading, and Myrdal (1957) highlights cumulative mechanisms of growth and structural change. The positive association between Economic Transformation Velocity and growth supports these perspectives while extending them by demonstrating that development depends not only on structural change itself but also on the pace at which it unfolds.

In this sense, ETV provides a dynamic indicator of structural transformation and introduces a temporal dimension that has received comparatively limited attention in the literature. Although the findings consistently show that ETV is strongly associated with economic growth, the study is intended primarily to establish ETV as a dynamic measure rather than to identify the causal mechanisms through which transformation velocity affects growth.

Future research should therefore examine whether productive efficiency, capital accumulation, labour reallocation, innovation adoption, market integration, or institutional capacity mediate the relationship between transformation velocity and economic performance. Such mechanisms should be investigated using larger, multi-period longitudinal datasets capable of capturing the timing, sequencing, and persistence of structural change.

6. CONCLUSION

This study examined the relationships among diversification, investment and financing conditions, economic transformation, transformation velocity, and growth among household-business units operating in the peripheral mountain regions of Northern Albania. The findings show that diversification is positively associated with economic transformation but has no significant direct relationship with economic growth. Growth is instead associated primarily with the pace of structural transformation rather than with the level of transformation attained. The empirical results demonstrate that Economic Transformation Velocity (ETV) provides greater explanatory power for economic growth than conventional measures of structural transformation. While the Economic Transformation Index captures the structural position attained by a household-business unit, ETV measures the speed at which structural upgrading occurs. The nonlinear and threshold analyses further indicate that the association between transformation velocity and growth varies across different stages of structural change and becomes stronger at higher rates of upgrading. These findings support the view that structural transformation should be analysed as a dynamic process rather than solely as a static outcome. From a theoretical perspective, the study contributes to the structural transformation literature by introducing ETV as an analytical construct that operationalises the temporal dimension of economic change.

Existing approaches generally focus on transformation levels, sectoral composition, or productivity outcomes, whereas ETV explicitly captures the pace of movement between structural positions. The concept therefore extends conventional transformation analysis by providing a dynamic framework for examining the relationships among diversification, structural upgrading, and economic growth. The findings also have implications for rural development policy. Policies aimed at promoting economic development in peripheral regions should not focus exclusively on expanding the range of economic activities. Although diversification remains an important foundation for structural upgrading, the results indicate that growth is associated more strongly with the speed at which household-business units transition towards higher-value and more productive activities. Policy measures that strengthen innovation adoption, access to finance, market integration, entrepreneurial capabilities, investment capacity, and institutional adaptability may therefore be particularly important for accelerating structural upgrading and improving long-term development trajectories. Several limitations should be

acknowledged. First, the analysis includes only formally registered household-business units and may therefore underrepresent informal activities that remain economically significant in peripheral rural regions. Second, the study is confined to a specific mountain area in Northern Albania, which limits the generalisability of the findings to other territorial and institutional contexts. Third, the two-year observation period does not permit an assessment of longer-term transformation trajectories, persistence, or reversal. Fourth, the study focuses on identifying associations between transformation dynamics and economic growth rather than establishing the causal mechanisms underlying these relationships. Formal mediation analysis was therefore beyond the scope of the present research. Although the robustness analyses show that the results remain stable across alternative specifications, bootstrap estimation, and flexible non-linear models, the observational research design does not permit formal causal identification. The findings should consequently be interpreted as robust empirical associations rather than as evidence of causal effects. Future research should test the applicability of ETV across different geographical, sectoral, and institutional settings. Larger multi-period longitudinal datasets would make it possible to examine the timing, sequencing, persistence, and causal implications of structural transformation more rigorously. Further studies should also investigate whether productivity gains, capital accumulation, labour reallocation, innovation adoption, market integration, financial capacity, or institutional quality mediate the relationship between transformation velocity and economic growth. Overall, the findings identify transformation dynamics as an important but insufficiently examined dimension of rural economic development. By distinguishing the structural position attained from the pace at which structural upgrading occurs, the study establishes Economic Transformation Velocity as a promising analytical framework for future research on diversification, structural transformation, and economic growth.

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