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Leveraging Fiscal Policy for Indonesia's Creative Economy: An Empirical Roadmap from Integrated Multivariate Time Series and Input-Output Analysis

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Abstract This study examines the role of government expenditure as an exogenous fiscal instrument in shaping Indonesia's creative economy by adopting a Vector Autoregressive (VAR) framework as an initial benchmark and subsequently applying a Vector Error Correction Model with exogenous variables (VECMX) combined with Input–Output (I–O) structural analysis. The empirical analysis covers nine creative economy-related sectors, namely Food and Beverage Industry, Textile and Apparel Industry, Wood Products and Weaving, Paper and Printing Industry, Furniture Industry, Food and Beverage Provision, Information and Communication, Business Services, and Other Services. The VAR benchmark provides a preliminary description of short-run interdependencies among variables, while the VECMX results reveal the existence of long-run equilibrium relationships among sectoral output, inflation, and unemployment, as indicated by statistically significant error correction terms in several sectors, although adjustment speeds differ across industries. In the short run, sectoral dynamics are largely driven by own-lag GDP effects, while inflation and unemployment exhibit weak and inconsistent influences across equations, suggesting limited and heterogeneous macroeconomic transmission at the sectoral level. Government expenditure as an exogenous variable shows varied impacts across sectors, with statistically significant effects concentrated in selected labor-intensive and service-oriented industries, whereas its effects on sectoral output and inflation remain generally marginal. Impulse response analysis further indicates that fiscal shocks transmit more strongly to labor market adjustments, particularly open unemployment, compared to output and price responses, highlighting a structurally heterogeneous transmission mechanism across subsectors of the creative economy. By integrating VAR-based preliminary dynamics with VECMX estimation and Input–Output structural linkages, the study identifies differentiated sectoral responsiveness patterns that can be grouped into Key, Potential, Developing, and Lagging sectors based on adjustment speed and intersectoral connectivity. These findings provide an evidence-based framework for targeted fiscal policy design aimed at improving employment absorption, strengthening value-chain linkages, and enhancing structural transformation, while contributing directly to Sustainable Development Goal 9 on industry, innovation, and infrastructure.

Keywords Government Expenditure, Sustainable Development Goals, Macroeconomic Dynamics, Creative Economy

AMS 2010 subject classifications 62M10, 62P20

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1. Introduction

Sustainable and inclusive economic growth is a fundamental pillar of national and global development agendas, as reflected in the Sustainable Development Goals (SDGs), particularly Goal 9, which is Industry, Innovation, and Infrastructure. In Indonesia, macroeconomic conditions are reflected through indicators such as the Gross Domestic Product (GDP), Inflation, and the open unemployment rate (OUR), all of which are influenced by fiscal policies, particularly government expenditure as a key instrument for economic stabilization and growth. Quantitative

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studies indicate a significant role for public spending in supporting infrastructure, education and financial access, which collectively impact inclusive growth and regional economic distribution [1, 2, 3].

The creative economy contributes to job creation, Innovation, and the strengthening of knowledge- and culture-based local economies. Its vast potential is visible even in informal urban areas, where Innovation emerges from actor networks and pragmatic collaboration [4]. Input-output analysis has highlighted the importance of strengthening domestic demand and production efficiency to maximize the sector's contribution [5]. The development of the digital economy further accelerates the transformation of this sector, particularly among MSMEs and private companies through Public-Private Partnerships [6]. Even during the COVID-19 pandemic, subsectors such as gaming, culinary arts, performing arts, and crafts demonstrated resilience through the use of digital platforms and the support of local tourism [7]. Nevertheless, the competitiveness of the creative economy remains influenced by factors such as digital literacy, business sustainability, and entrepreneurship, notably among women-led businesses in Sumatra, Java, and Bali [8].

According to the Ministry of Foreign Affairs, the creative economy contributed approximately USD 82 billion to Indonesia's GDP and USD 23.9 billion to its exports in 2021, accounting for about 10% of total national exports. Data from the Indonesian Creative Economy Agency in 2017 indicate that GDP contributions were dominated by culinary (41.69%), fashion (18.15%), and crafts (15.70%). In contrast, other subsectors contributed less, such as television and radio (7.78%), publishing (6.29%), architecture (2.30%), applications and games (1.77%), advertising (0.80%), music (0.47%), photography (0.45%), performing arts (0.26%), product design (0.24%), fine arts (0.22%), interior design (0.16%), film (0.16%), and visual communication design (0.06%). This imbalance indicates that value added within the officially recognized 17 creative subsectors is highly concentrated in three major subsectors, while the remaining subsectors individually account for smaller shares of total output. This structural heterogeneity motivates the need for a sector-level analytical approach rather than aggregate treatment of the entire creative economy.

This study formulates the primary research question: To what extent does government expenditure, as an exogenous variable, influence macroeconomic variables such as GDP, Inflation, and output, which determine the growth of creative economy subsectors. The selection of these endogenous variables is based on their sensitivity to household purchasing power, price stability, and labor market conditions, particularly in consumption-based subsectors such as culinary and fashion [?]. Therefore, the effect of government expenditure on these variables is crucial for designing evidence-based, inclusive, and sectoral policies.

Unlike previous approaches that relied on conventional VAR models without accounting for fiscal expectations, this study adopts the Vector Autoregressive with Exogenous Variables (VARX) model to address estimation bias caused by fiscal foresight, i.e., the anticipation of economic agents regarding government spending before its realization [9, 10]. These studies show that fiscal shocks in standard models can be misidentified if expectations are not controlled. Further findings emphasize the importance of considering the dynamic and nonlinear nature of fiscal policy transmission [?]. By using VARX, the impact of government expenditure can be analyzed more accurately in relation to the complex dynamics of macroeconomic variables and the distributed creative economy subsectors, taking into account the endogenous variables.

The relationship between government expenditure and macroeconomic dynamics is neither linear nor static. To understand it simultaneously and dynamically, a multivariate statistical approach is required that can capture interactions among variables in depth. Additionally, it is essential to examine how changes in macroeconomic variables impact the subsectors where the creative economy is developed. Therefore, this study focuses on analyzing the effect of government expenditure on GRDP, Inflation, and OUR through a VARX model, and examines its impact on the distribution of creative economy subsectors descriptively using an input-output approach.

Research on the relationship between macroeconomic variables, economic growth, and sectoral distribution in Indonesia has generally been dominated by conventional econometric approaches, such as multiple linear regression and ARIMA [11, 12, 13]. Although these methods can describe trends and linear relationships between variables, they are limited in capturing simultaneous and dynamic interactions over time. To address these limitations, several studies have adopted multivariate models such as VAR [14, 15]. However, classical VAR models do not explicitly consider the influence of exogenous variables, which can play an essential role in the dynamics of the economic system. In this context, the VARX approach offers a more flexible alternative, as it accommodates exogenous variables within the system, allowing for more accurate analysis of policy or external factors [16].

Nonlinear approaches have also been widely applied to improve the predictive accuracy of macroeconomic time series data. These include hybrid models such as ARIMA Fuzzy Time Series [12], Seasonal ARIMA ANN [11], Long Short Term Memory (LSTM) models [18], and Fractional Time Series for long memory data [18]. Artificial Neural Networks and other Soft Computing techniques are used to address heteroskedasticity and nonlinearity in relationships among economic variables [19]. Moreover, VAR and VECM approaches have been applied to understand dynamic phenomena, such as extreme weather and rainfall patterns, in Indonesia [14, 20], demonstrating the flexibility of multivariate models across various domains.

The main novelty of this study lies in applying the VARX model to analyze the role of government expenditure as an exogenous variable in influencing both economic growth and the distribution of creative economy sectors in Indonesia simultaneously and dynamically within a multivariate time series framework. This study makes a significant contribution to the literature by integrating fiscal analysis and creative economy dynamics in a more structured manner, which has been rarely addressed in system-based macroeconomic approaches. By employing VARX, the research captures the direct effects of exogenous variables, such as government spending, on the economic system without overlooking dynamic interconnections among endogenous variables, resulting in a more realistic and policy-relevant depiction of the economy.

2. Methodology

This study employs a combination of multivariate time series modeling and structural input–output analysis to examine the dynamic impact of government expenditure on macroeconomic variables and the creative economy in Indonesia. The methodology extends approaches commonly used in financial and economic volatility studies to a policy-relevant context, enabling both temporal and structural interpretations.

2.1. Data Sources and Variables

The analysis utilizes semester-level data spanning 2005–2024. Variables are categorized as follows:

- **Endogenous Variables ($\mathbf{Y}_t$)**: Gross Domestic Product (GDP), Inflation, and open unemployment rate (OUR). These variables reflect macroeconomic outcomes that respond to both internal dynamics and fiscal interventions.
- **Exogenous Variable ($\mathbf{X}_t$)**: Government expenditure, treated as an external fiscal policy instrument.
- **Sectoral Data**: GDP contributions of nine creative economy sectors, used to capture heterogeneous responses across subsectors.

All monetary values are expressed in constant 2015 IDR to adjust for Inflation. Input–Output tables from Statistics Indonesia provide intersectoral linkages for multiplier computations.

2.2. VARX and VECMX Model Specification

Dynamic interactions among the endogenous variables in Indonesia's creative economy are modeled using a Vector Autoregressive model with exogenous variables (VARX). This specification enables the simultaneous examination of interdependencies among multiple time series while accounting for the influence of external policy variables. The general form of a VARX(p, q) model is defined as:

$$\mathbf{Y}_t = \mathbf{c} + \sum_{i=1}^{p} \mathbf{A}_i \mathbf{Y}_{t-i} + \sum_{j=0}^{q} \mathbf{B}_j \mathbf{X}_{t-j} + \mathbf{u}_t, \tag{1}$$

where:

- $\mathbf{Y}_t \in \mathbb{R}^{k \times 1}$ is the vector of k endogenous variables, comprising sectoral Gross Regional Domestic Product (GDP), the inflation rate (INF), and the Open Unemployment Rate (OUR) for each of the nine creative economy sectors. The system is estimated separately for each sector, allowing for sector-specific dynamics.
- $\mathbf{X}_t \in \mathbb{R}^{m \times 1}$ is the vector of m exogenous variables. In this study, government expenditure (GovExp) serves as the primary exogenous policy variable, reflecting fiscal interventions.
- p and q are the lag orders for the endogenous and exogenous variables, respectively. Their optimal lengths are determined through rigorous selection criteria to balance model fit and parsimony.
- $\mathbf{c} \in \mathbb{R}^{k \times 1}$ is a vector of constants, capturing the baseline level of each endogenous variable.
- $\mathbf{A}_i \in \mathbb{R}^{k \times k}$ is the matrix of coefficients for the i-th lag of the endogenous variables, capturing the autoregressive structure and cross-variable effects within the system (e.g., how past unemployment affects current output).
- $\mathbf{B}_j \in \mathbb{R}^{k \times m}$ is the matrix of coefficients for the j-th lag of the exogenous variables, measuring the contemporaneous and lagged impact of government expenditure on each endogenous variable.
- $\mathbf{u}_t \sim N(\mathbf{0}, \Sigma_u)$ is a vector of serially uncorrelated residuals (innovations) with a mean of zero and a constant, positive-definite covariance matrix Σ_u. This matrix captures the unexplained co-movements between the endogenous variables after accounting for their own history and exogenous influences.

The selection of the optimal lag orders (p, q) is critical to avoid misspecification. We employ the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC) to guide this selection. The AIC tends to favor more parameter-rich models to achieve a better fit, while the BIC imposes a more substantial penalty for additional parameters, promoting parsimony. The final lag structure is chosen to minimize these criteria, ensuring the model adequately captures the data-generating process without overfitting.

In addition to the VARX specification, this study extends the analysis by considering a Vector Error Correction Model with exogenous variables (VECMX) to account for possible long-run equilibrium relationships among the endogenous variables. The VECMX framework is appropriate when the variables are non-stationary in levels but cointegrated, allowing the model to capture both short-run dynamics and long-run equilibrium adjustments while still incorporating external policy influences.

The general form of a VECMX(p, q) model is expressed as:

$$\Delta \mathbf{Y}_t = \mathbf{c} + \Pi \mathbf{Y}_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta \mathbf{Y}_{t-i} + \sum_{j=0}^{q} \mathbf{B}_j \mathbf{X}_{t-j} + \mathbf{u}_t, \tag{2}$$

where $\Delta \mathbf{Y}_t$ is the vector of first-differenced endogenous variables capturing short-run dynamics, while $\Pi \mathbf{Y}_{t-1}$ represents the error correction term, with $\Pi = \alpha\beta'$. In this decomposition, β denotes the cointegrating vectors that capture long-run equilibrium relationships among the variables, and α represents the adjustment coefficients that measure the speed at which the system returns to equilibrium after a shock. The matrices Γ_i capture short-run dynamic interactions among the differenced endogenous variables.

The vector $\mathbf{X}_t$ represents the exogenous variables, in this study proxied by government expenditure (GovExp), which captures fiscal policy interventions affecting the creative economy sectors. The coefficients $\mathbf{B}_j$ measure the contemporaneous and lagged effects of these exogenous variables on the endogenous system. The error term $\mathbf{u}_t$ is assumed to be white noise with zero mean and a constant covariance matrix.

The inclusion of the VECMX framework allows the model to capture deviations from long-run equilibrium relationships among sectoral GDP, inflation, and unemployment in Indonesia's creative economy. The error correction mechanism ensures that short-run disequilibria are gradually corrected over time, while exogenous fiscal policy shocks are allowed to influence both short-run adjustments and long-run dynamics.

While the VARX model focuses on short-run dynamic interactions and the effects of exogenous variables, the VECMX specification provides a more comprehensive framework by incorporating long-run equilibrium relationships among the variables. Therefore, the VECMX model is employed as a robustness extension to validate the findings obtained from the VARX analysis.

2.2.1. Impulse Response Function (IRF) Analysis To trace the dynamic causal effects of fiscal policy shocks, we compute Impulse Response Functions (IRFs). An IRF measures the response of the entire vector of endogenous variables, $\mathbf{Y}_{t+h}$, at future horizon h, to a one-standard-deviation shock (or Innovation) in the exogenous variable, government expenditure, at time t. This is formally expressed as:

$$\mathrm{IRF}_h = \frac{\partial \mathbf{Y}_{t+h}}{\partial \epsilon_t^X}, \tag{3}$$

where ϵ_t^X represents the shock to government expenditure. To compute these responses, the estimated VARX model is converted into its equivalent Moving Average (MA) representation, which expresses the endogenous variables as a weighted sum of all past and present shocks:

$$\mathbf{Y}_t = \boldsymbol{\mu} + \sum_{i=0}^{\infty} \boldsymbol{\Psi}_i \mathbf{u}_{t-i}, \quad \text{with} \quad \boldsymbol{\Psi}_0 = \mathbf{I}_k, \quad \boldsymbol{\Psi}_i = \sum_{j=1}^{\min(i,p)} \mathbf{A}_j \boldsymbol{\Psi}_{i-j}. \tag{4}$$

Here, $\boldsymbol{\mu}$ is the unconditional mean of $\mathbf{Y}_t$, and the $\boldsymbol{\Psi}_i$ matrices are the MA coefficients that precisely quantify the effect of a shock i periods ago on the current value of $\mathbf{Y}_t$. The IRF for a shock to government expenditure is derived from this sequence. To account for estimation uncertainty and provide a range of plausible effects, we employ a residual-based bootstrap simulation with 1,000 replications. This non-parametric method involves repeatedly re-sampling the estimated residuals, re-estimating the model, and recomputing the IRFs for each replication. The resulting distribution of IRF paths is used to construct 95% confidence intervals, allowing us to assess the statistical significance of the estimated responses at each horizon.

2.2.2. Forecast Error Variance Decomposition (FEVD) Complementing the IRF analysis, Forecast Error Variance Decomposition (FEVD) is used to quantify the relative importance of different structural shocks in explaining the forecast error variance of the endogenous variables over various time horizons. This decomposition reveals the proportion of the h-step-ahead forecast error variance for each endogenous variable that is attributable to shocks originating from each variable in the system, including the exogenous government expenditure shock. The FEVD is calculated from the MA representation of the VARX model.

The contribution of the shock to variable k to the forecast error variance of variable j at horizon h is given by:

$$\mathrm{FEVD}_{j,k}(h) = \frac{\sum_{s=0}^{h-1} (\mathbf{e}_j' \boldsymbol{\Psi}_s \Sigma_u \mathbf{e}_k)^2}{\sum_{s=0}^{h-1} (\mathbf{e}_j' \boldsymbol{\Psi}_s \Sigma_u \boldsymbol{\Psi}_s' \mathbf{e}_j)}, \tag{5}$$

where $\mathbf{e}_j$ and $\mathbf{e}_k$ are selection vectors (column vectors of the identity matrix) that pick out the j-th and k-th variables, respectively. The numerator accumulates the squared contributions of shocks to variable k (transmitted through the MA matrices $\boldsymbol{\Psi}_s$ and the covariance structure Σ_u) to the forecast error of variable j. The denominator is the total forecast error variance of variable j at horizon h. The FEVD thus provides a normalized measure, ranging from 0 to 1, indicating the proportion of variance explained by each shock source. In our context, a high FEVD share for the government expenditure shock in explaining sectoral GDP or OUR variance would indicate that fiscal policy is a dominant source of fluctuations in that sector.

2.3. Input–Output (I-O) Analysis

To complement the time-series analysis and understand the structural and sectoral interdependencies within Indonesia's creative economy, we employ Input–Output (I-O) analysis. This methodology, based on the seminal work of Wassily Leontief, utilizes national or regional input-output (I-O) tables to map the flow of goods and services between all sectors of the economy over a given period. The core of the analysis is the matrix of technical coefficients, $\mathbf{A} = [a_{ij}]$, where each element a_{ij} represents the amount of input from sector i required to produce one unit of output in sector j. These coefficients capture the direct production requirements and interdependence between sectors.

From this matrix, we derive the Leontief inverse matrix, which is fundamental for assessing both direct and indirect (total) economic linkages:

$$\mathbf{L} = (\mathbf{I} - \mathbf{A})^{-1} = \mathbf{I} + \mathbf{A} + \mathbf{A}^2 + \mathbf{A}^3 + \dots. \tag{6}$$

Here, $\mathbf{I}$ is the identity matrix. Each element l_{ij} of the Leontief inverse matrix $\mathbf{L}$ quantifies the total output from sector i required, both directly and indirectly through the production chain, to satisfy one unit of final demand for the product of sector j. The power series expansion illustrates that $\mathbf{L}$ accounts for the infinite rounds of intermediate input requirements throughout the economy.

To identify key sectors within the creative economy, we compute two normalized linkage indices from the Leontief inverse. The **Backward Linkage Index (IBL)** for sector j measures the extent to which its production is dependent on inputs from other sectors (both within and outside the creative economy), indicating its role as a demand-puller for the economy:

$$IBL_j = \frac{\sum_{i=1}^{n} l_{ij}}{\bar{l}}, \quad \text{where} \quad \bar{l} = \frac{1}{n^2}\sum_{i=1}^{n}\sum_{j=1}^{n} l_{ij}. \tag{7}$$

Conversely, the **Forward Linkage Index (IFL)** for sector i measures the extent to which other sectors rely on its output as an input for their own production, indicating its role as a key supplier to the economy:

$$IFL_i = \frac{\sum_{j=1}^{n} l_{ij}}{\bar{l}}. \tag{8}$$

In both formulas, $\bar{l}$ is the average of all elements in the Leontief inverse matrix, serving as a benchmark for the economy-wide average level of total linkage. A sector with an IBL or IFL greater than one is considered to have above-average linkage strength. Sectors with both indices above one are classified as ”key sectors” due to their strong and balanced influence on the rest of the economy, both as buyers and sellers of intermediate inputs. The integration of these structural linkage metrics with the dynamic responsiveness from the VARX models forms the core of our integrated sectoral classification and policy matrix.

2.4. Sectoral Classification (Klassen Typology)

Sectors are classified based on IBL and IFL following Klassen's quadrants:

- **Key Sectors (Quadrant I):** IBL ¿ 1 and IFL ¿ 1. High backward and forward linkages; critical both upstream and downstream.
- **Potential Sectors - Forward-oriented (Quadrant II):** IFL $>$ 1 but IBL $\leq$ 1. High forward linkage; potential to stimulate downstream sectors.
- **Potential Sectors - Backward-oriented (Quadrant III):** IBL ¿ 1 but IFL $\leq$ 1. High backward linkage; potential to strengthen upstream supply.
- **Lagging Sectors (Quadrant IV):** IBL $\leq$ 1 and IFL $\leq$ 1. Low structural influence.

2.5. Integration of VARX and I-O Analysis

By combining IRF and FEVD from VARX with I-O multipliers, sectors are identified that are both dynamically responsive to fiscal policy and structurally crucial in the economy.

3. Experimental Results

This section presents the empirical findings of our integrated analysis of Indonesia's creative economy. The investigation proceeds sequentially, beginning with a descriptive overview of the semester-level dataset, followed by the critical mapping of creative economy subsectors to formal Input–Output (I-O) classifications. Subsequent subsections detail the dynamic results from the VARX models, including parameter estimation, impulse response analysis, and forecast error variance decomposition, as well as the structural insights derived from Input–Output analysis. These complementary strands of evidence are then synthesized into a unified sectoral classification framework.

3.1. Data Description

The empirical analysis utilizes a balanced time-series dataset comprising semester-level observations from 2005 to 2024, yielding a total of 40 time periods. The dataset is constructed from multiple official sources, primarily the Badan Pusat Statistik (BPS) of Indonesia.

Although Indonesia formally institutionalized its creative economy framework in the 2010s, creative-related economic activities have been consistently recorded in national industrial statistics prior to formal policy recognition. Sectoral measurement in this study relies on harmonized industrial classifications (KBLI codes) published by BPS, allowing retrospective construction of nine creative economy subsectors over the full 2005–2024 period. This harmonization ensures classification consistency across time. Data for 2024 represent realized official releases, not projections.

The endogenous variables in the VARX models include real Gross Domestic Product (GDP) for nine specific creative economy subsectors, aggregate national GDP, the national inflation rate (INF), and the open unemployment rate (OUR). All monetary values, including sectoral GDP and government expenditure, are expressed in constant 2005 Indonesian Rupiah (IDR) to control for price changes and ensure intertemporal comparability. The primary exogenous policy variable is real government expenditure ($GovExp$), serving as the fiscal instrument whose impact is assessed.

Summary statistics reveal substantial heterogeneity across sectors and time. Consumption-oriented sectors demonstrate greater resilience during downturns, whereas sectors associated with investment or discretionary expenditure exhibit stronger cyclical sensitivity. The inflation and unemployment series capture macroeconomic conditions throughout the full sample period, including both stable phases and episodes of economic stress. The semester-level frequency is selected to increase the effective number of observations for time-series estimation while avoiding excessive high-frequency volatility, thereby providing a balanced framework for medium-term fiscal policy analysis.

To ensure consistency between the econometric and structural analyses, each creative economy subsector is mapped to its corresponding classification in the BPS Input–Output table. The detailed correspondence is presented in Table 1.

Table 1 clarifies how the diverse activities within Indonesia's creative economy are consolidated into nine national input–output (I-O) sectors used in the empirical analysis. Although the creative economy comprises numerous subsectors, the VARX models focus on these nine sectors, namely I-13, I-15, I-17, I-18, I-26, I-41, I-42, I-48, and I-52, because they provide consistent time-series GDP data and can be directly matched to the BPS I-O classification. The aggregation follows the structure of the official national accounts and is conducted for data consistency purposes. It does not assume behavioral or technological homogeneity within each consolidated sector. The remaining creative subsectors are therefore subsumed within these broader I-O categories due to classification constraints in the available statistical data.

The mapping shows that several creative activities are grouped within the same I-O sector, reflecting limitations of the national classification system rather than identical economic characteristics. For example, multiple digital and media-related activities are included in Information and Communication (I-42), while various design- and knowledge-intensive activities are classified within Business Services (I-48). Consequently, the estimated VARX responses should be interpreted as average sectoral dynamics at the aggregated I-O level, rather than as isolated effects for individual creative subsectors.

The selected nine sectors represent the portions of the creative economy that can be consistently identified within the national I-O framework and time-series data availability. Consumer-oriented sectors, such as Food and Beverage Industry (I-13) and Food and Beverage Services (I-41), are closely linked to household demand and labor absorption. Manufacturing-related sectors, including Textile and Apparel (I-15), Wood and Craft (I-17), Paper and Printing (I-18), and Furniture (I-26), capture production activities with supply-chain linkages. Service-oriented

Table 1. Mapping of Creative Economy Subsectors to BPS I-O Sectors

Creative Economy Subsector	I-O Code	BPS I-O Sector Description
Culinary	I-41	Food and Beverage Provision
	I-13	Food and Beverage Industry
Fashion	I-15	Textile and Apparel Industry
Craft (Kriya)	I-17	Wood, Wood Products, and Weaving
	I-26	Furniture Industry
Film, Animation, and Video	I-42	Information and Communication (film/video production)
Advertising	I-48	Business Services (advertising)
Interactive Games	I-42	Information and Communication (software/game development)
Architecture	I-48	Business Services (architecture)
Fine Arts	I-52	Other Services (fine arts, galleries, painters)
Performing Arts	I-52	Other Services (performing arts, stage music, theater)
Music	I-52	Other Services (music production, concerts)
Applications	I-42	Information and Communication (digital app development)
Photography	I-48	Business Services (professional photography)
Publishing	I-18	Paper and Printing Industry
Product Design	I-48	Business Services (industrial/product design)
Interior Design	I-48	Business Services (interior design)
Television and Radio	I-42	Information and Communication (broadcasting)
Visual Communication	I-48	Business Services (graphic design, illustration, branding)

sectors, such as Information and Communication (I-42), Business Services (I-48), and Other Services (I-52), reflect knowledge- and innovation-driven activities.

However, this grouping is primarily a statistical aggregation necessary for empirical implementation, and it should not be interpreted as evidence that these sectors constitute a structural core of the entire creative economy. By anchoring the analysis to these nine I-O sectors, the study ensures consistency between the VARX specification and the national Input–Output classification. The results are therefore interpreted strictly at the aggregated sector level, and broader inferences about unobserved creative subsectors are beyond the scope of this study.

3.2. Model Diagnostics

To ensure the appropriateness of the VARX specification, unit root tests were conducted using the Augmented Dickey-Fuller (ADF) procedure for all variables at level form and after first differencing. Stationarity is a fundamental requirement in VAR-based models because non-stationary series may lead to spurious regressions and unreliable impulse response and variance decomposition results.

The initial test results show that most sectoral GRDP variables and government expenditure were non-stationary at level, while inflation and unemployment rate were relatively stationary. Therefore, logarithmic first differencing was applied to GRDP sectors and government expenditure, whereas first differencing was applied to inflation and unemployment rate.

After transformation, all variables became stationary at the 5% significance level. This confirms that the transformed dataset satisfies the stationarity assumption and is suitable for subsequent VARX estimation.

The results indicate that several variables were integrated of order one, I(1), since they were non-stationary at level but became stationary after first differencing. Therefore, the VARX model was estimated using stationary transformed series.

After ensuring that all transformed variables were stationary, the next step was to determine the optimal lag length for the VARX model. Lag selection is crucial because too few lags may leave residual autocorrelation, while too many lags may lead to overparameterization, especially under a relatively small sample size.

Table 2. ADF Unit Root Test Results Before and After First Differencing

	Level Form			After First Differencing		
Variable	ADF Stat.	p-value	Decision	ADF Stat.	p-value	Decision
GDP13	3.0662	0.9900	Non-stationary	-3.4327	0.0190	Stationary
GDP15	-0.2844	0.9500	Non-stationary	-5.1004	0.0100	Stationary
GDP17	-2.5991	0.1030	Non-stationary	-3.2912	0.0260	Stationary
GDP18	0.7550	0.9900	Non-stationary	-3.2095	0.0310	Stationary
GDP26	-0.9807	0.7600	Non-stationary	-4.7292	0.0100	Stationary
GDP41	1.0188	0.9900	Non-stationary	-2.9444	0.0480	Stationary
GDP42	2.8417	0.9900	Non-stationary	-2.9799	0.0450	Stationary
GDP48	1.7660	0.9900	Non-stationary	-3.5424	0.0150	Stationary
GDP52	1.8867	0.9900	Non-stationary	-4.2424	0.0100	Stationary
Inflation	-4.9387	0.0100	Stationary	-5.9874	0.0100	Stationary
OUR	-2.9811	0.0450	Stationary	-3.7424	0.0120	Stationary
GovExpenditure	-0.6669	0.8400	Non-stationary	-4.3139	0.0100	Stationary

The optimal lag order was evaluated using four standard information criteria: Akaike Information Criterion (AIC), Hannan-Quinn Criterion (HQ), Schwarz Criterion (SC/BIC), and Final Prediction Error (FPE). The results are presented in Table 3.

Table 3. Lag Order Selection Criteria

Criterion	Lag 1	Lag 2	Lag 3	Lag 4
AIC(n)	-64.7077	-76.4105	$-\infty$	$-\infty$
HQ(n)	-62.5141	-72.3607	$-\infty$	$-\infty$
SC(n)	-58.3530	-64.6787	$-\infty$	$-\infty$
FPE(n)	1.19×10^{-28}	1.94×10^{-32}	NaN	0

The results indicate numerical instability for lag orders 3 and 4, shown by infinite values ($-\infty$), undefined prediction error (NaN), and zero FPE. Such outcomes usually occur because the model becomes overparameterized relative to the sample size.

Therefore, lag 2 was selected as the optimal lag length because it provides the lowest finite values for AIC, HQ, and SC among feasible models, while avoiding overfitting problems observed at higher lag orders. This choice is also more appropriate for a small-sample VARX framework. Hence, the subsequent estimation, stability analysis, IRF, and FEVD were conducted using a VARX(1) or VARX(2) specification.

To ensure that the estimated VARX models satisfy the stability condition, an eigenvalue stability test was conducted for each sectoral model. A VARX system is considered dynamically stable when all inverse roots of the characteristic polynomial lie strictly inside the unit circle, i.e., all root moduli are less than one ($|z| < 1$). This condition is essential because only stable systems generate valid and convergent Impulse Response Functions (IRF) and Forecast Error Variance Decomposition (FEVD).Table 4 reports the complete inverse roots obtained from each sectoral VARX model. The results show that all estimated roots across the nine sectoral models are below one. Therefore, all models satisfy the stability requirement and are appropriate for dynamic interpretation.

Based on these findings, all sectoral VARX specifications are stable, implying that shocks to the system dissipate over time and do not lead to explosive behavior. Hence, the subsequent IRF and FEVD analyses can be interpreted reliably.

To evaluate the adequacy of the estimated VARX models, diagnostic checks were conducted focusing on residual serial correlation and the exogeneity of government expenditure. The Portmanteau test is used to examine whether the residuals are free from autocorrelation, where a p-value greater than 0.05 indicates that the residuals behave as white noise and the selected lag structure is appropriate. In addition, Granger causality tests are employed to assess the weak exogeneity of government expenditure by testing whether macroeconomic variables (GDP, inflation, and interest rate) have predictive power over government expenditure. The results of these diagnostic tests are summarized in Table 5.

Table 4. VAR Stability Test Results (Complete Inverse Roots)

Sector	Root 1	Root 2	Root 3	Root 4	Root 5	Root 6	Decision
GDP13	0.5916	0.5604	0.5146	0.5146	0.3097	0.3097	Stable
GDP15	0.5731	0.5731	0.3709	0.3327	0.3315	0.3315	Stable
GDP17	0.5766	0.4748	0.3760	0.3760	0.2593	0.2593	Stable
GDP18	0.5809	0.5586	0.5586	0.2924	0.2924	0.0802	Stable
GDP26	0.4956	0.4956	0.2981	0.2981	0.1524	0.0491	Stable
GDP41	0.5695	0.5281	0.5281	0.3656	0.3656	0.0921	Stable
GDP42	0.5237	0.4474	0.3903	0.3903	0.2203	0.2203	Stable
GDP48	0.5945	0.5945	0.4576	0.4576	0.1964	0.1964	Stable
GDP52	0.4479	0.4372	0.4372	0.3319	0.2078	0.2078	Stable

Table 5. Residual Autocorrelation and Exogeneity Test Results

Sector	Residual Autocorrelation (Portmanteau)		Exogeneity (Granger Causality p-values)			Exogeneity Status
	p-value	Decision	GDP→GOV	INF→GOV	OUR→GOV	
GDP13	0.8906	No Autocorrelation	0.0694	0.9058	0.6094	Weakly Exogenous
GDP15	0.9853	No Autocorrelation	0.1021	0.3913	0.0006	Not Exogenous
GDP17	0.8931	No Autocorrelation	0.2911	0.9934	0.5539	Weakly Exogenous
GDP18	0.9705	No Autocorrelation	0.0494	0.9296	0.6322	Not Exogenous
GDP26	0.9157	No Autocorrelation	0.0529	0.5383	0.6509	Weakly Exogenous
GDP41	0.9211	No Autocorrelation	0.0000	0.8098	0.3544	Not Exogenous
GDP42	0.9277	No Autocorrelation	0.0199	0.9347	0.8674	Not Exogenous
GDP48	0.8563	No Autocorrelation	0.0000	0.4744	0.0438	Not Exogenous
GDP52	0.9242	No Autocorrelation	0.2117	0.7661	0.5717	Weakly Exogenous

The results indicate that all sectoral models pass the residual autocorrelation test, as all p-values exceed the 0.05 significance level. This suggests that the selected lag structure is sufficient and that the residuals are serially uncorrelated.

Regarding exogeneity, government expenditure is found to be weakly exogenous in several sectors (GDP13, GDP17, GDP26, and GDP52), indicating no strong feedback effects from macroeconomic variables. However, in other sectors (GDP15, GDP18, GDP41, GDP42, and GDP48), the presence of significant Granger causality suggests that government expenditure may not be strictly exogenous. In other words, the diagnostic results support the validity of the VARX specification, although some sectoral heterogeneity in exogeneity is observed.

To examine the existence of long-run equilibrium relationships among GDP, inflation, and unemployment within each sectoral system, the Johansen trace cointegration test is applied to the nine VARX-based sectoral models. The test is conducted under a constant term specification without deterministic trend in the cointegration space.

The results indicate that all sectoral systems exhibit at least one cointegrating relationship at the 5% significance level based on the trace statistics for the null hypotheses $r = 0$ and $r \leq 1$. Although the restriction $r \leq 2$ is not consistently rejected across all sectors, the evidence supports the presence of long-run equilibrium relationships among the variables, thereby justifying the use of a VECM framework for subsequent dynamic analysis.

The Johansen test provides consistent evidence of long-run relationships across all nine sectoral systems. This confirms that the variables are cointegrated and supports the specification of a Vector Error Correction Model (VECM) for capturing both short-run dynamics and long-run equilibrium adjustments in the subsequent analysis.

3.3. Estimated Multivariate Time Series Parameters and Government Expenditure Effects

This subsection reports the estimated parameters of the VECMX models, covering both endogenous variables and the effects of government expenditure as the exogenous fiscal instrument.

Table 7 shows that own-lag GDP effects are not consistently significant across sectors. Although some coefficients indicate short-run persistence, most lag-one effects are statistically insignificant and vary in magnitude,

Table 6. Summary of Johansen Cointegration Test Results Across Sectors

Sector	**Trace r=0**	**Trace $r \leq 1$**	**Trace $r \leq 2$**	**Conclusion**
GDP13	Significant	Significant	Not always significant	Cointegration exists
GDP15	Significant	Significant	Significant	Cointegration exists
GDP17	Significant	Significant	Not always significant	Cointegration exists
GDP18	Significant	Significant	Borderline	Cointegration exists
GDP26	Significant	Significant	Significant	Cointegration exists
GDP41	Significant	Significant	Not always significant	Cointegration exists
GDP42	Significant	Significant	Borderline	Cointegration exists
GDP48	Significant	Significant	Borderline	Cointegration exists
GDP52	Significant	Significant	Significant	Cointegration exists

Table 7. VECMX Endogenous Coefficient Estimates

	Lag-1			Lag-2		
Variable	GDP_{t-1}	INF_{t-1}	OUR_{t-1}	GDP_{t-2}	INF_{t-2}	OUR_{t-2}
	-0.1125	-11256.83	-2723.55	0.0343	-3450.21	-2468.14
GDP_{13}	(0.479)	(0.032)	(0.239)	(0.853)	(0.325)	(0.310)
	0.1735	-750.61	-699.51	-0.2967	-45.75	-730.91
GDP_{15}	(0.373)	(0.681)	(0.355)	(0.121)	(0.969)	(0.382)
	-0.1755	-1911.06	-508.41	0.0563	-653.61	-220.79
GDP_{17}	(0.361)	(0.163)	(0.366)	(0.761)	(0.461)	(0.711)
	-0.1269	-366.44	-389.85	0.0675	-84.36	-205.75
GDP_{18}	(0.511)	(0.623)	(0.226)	(0.732)	(0.867)	(0.574)
	-0.0548	671.83	79.74	-0.2891	257.18	121.85
GDP_{26}	(0.758)	(0.052)	(0.612)	(0.100)	(0.283)	(0.474)
	0.0671	-293.00	-1687.53	-0.1983	-367.02	-1499.58
GDP_{41}	(0.710)	(0.868)	(0.150)	(0.429)	(0.771)	(0.127)
	0.0466	3714.23	-1187.03	-0.1795	739.73	-537.68
GDP_{42}	(0.811)	(0.104)	(0.236)	(0.312)	(0.637)	(0.629)
	0.0790	198.10	-944.67	-0.1110	178.88	-1762.15
GDP_{48}	(0.665)	(0.893)	(0.294)	(0.607)	(0.866)	(0.056)
	-0.1791	-7272.84	-1012.99	-0.1493	-2226.35	-2643.12
GDP_{52}	(0.319)	(0.025)	(0.432)	(0.421)	(0.287)	(0.055)

suggesting heterogeneous rather than uniform dynamics. At lag two, nearly all GDP coefficients remain insignificant, indicating that adjustment processes are largely short-lived. Inflation and unemployment (OUR) effects on sectoral GDP are generally weak and unstable across sectors. Inflation is only occasionally significant (e.g., GDP13 and GDP52), but without a consistent direction. Similarly, unemployment shows limited and sporadic significance, particularly at lag two. These results indicate that sectoral output dynamics in the creative economy are primarily driven by internal sector-specific factors rather than systematic macroeconomic influences.

While, the estimated effects of government expenditure are reported in Table 8.

Table 8. VECMX Estimates: Error Correction, Intercept, and Exogenous Coefficients

Variable	ECT	Intercept	GovExpenditure
GDP13	0.0107 (0.0012)	-17128.66 (0.0020)	0.0615 (0.0000)
GDP17	0.0090 (0.072)	-1753.64 (0.205)	0.0028 (0.380)
GDP26	-0.0034 (0.177)	1157.10 (0.009)	-0.0018 (0.045)
GDP52	0.0219 (0.025)	-6316.92 (0.006)	0.0256 (0.0004)

Notes: Values in parentheses are p-values

The results reported in Table 8 indicate heterogeneous responses of endogenous variables to government expenditure shocks across creative economy sectors. For sectoral output, the estimated error correction terms (ECT) exhibit mixed statistical significance across equations, indicating that not all sectors adjust toward long-run equilibrium at the same speed. While some sectors such as GDP13 and GDP52 show statistically significant adjustment coefficients at conventional levels, several other sectors display insignificant ECT terms, suggesting weak or delayed long-run adjustment mechanisms in those industries.

The intercept terms are generally statistically significant in several sectoral equations, indicating the presence of non-zero deterministic components in the short-run dynamics. However, the magnitude and significance of these intercepts vary considerably across sectors, implying heterogeneous baseline growth or structural differences in sectoral output levels rather than uniform deterministic trends.

The effects of government expenditure on sectoral output are generally positive in some sectors but statistically significant only in a limited number of cases. Notably, GDP13 shows a highly significant positive response ($p < 0.01$), while several other sectors such as GDP42, GDP52, and GDP26 exhibit marginal or weak significance. In contrast, a substantial number of sectors display statistically insignificant responses, indicating that fiscal expansion does not uniformly translate into immediate output gains across the creative economy subsectors. This suggests that the fiscal transmission channel operates unevenly across sectors depending on their structural characteristics.

Inflation responses to government expenditure shocks remain consistently statistically insignificant across all sectoral models, with p-values generally well above conventional significance thresholds. The estimated coefficients are close to zero in magnitude, indicating that fiscal expansion does not generate meaningful short-run inflationary pressure within the creative economy. This suggests either weak price pass-through or stable inflation expectations that absorb fiscal disturbances without strong sectoral price adjustments. These findings indicate that government expenditure primarily affects the creative economy through selective and heterogeneous short-run output adjustments rather than through uniform inflationary effects. The adjustment dynamics captured by the ECT terms further suggest that long-run equilibrium correction is sector-specific, reinforcing the importance of heterogeneity in fiscal policy transmission across Indonesia's creative economy subsectors.

3.4. VECM Model Formation for Sectoral GDP

Separate VECM models are estimated for each of the nine selected sectors: Food and Beverage Industry (I-13), Textile and Apparel Industry (I-15), Wood, Wood Products, and Weaving (I-17), Paper and Printing Industry (I-18), Furniture Industry (I-26), Food and Beverage Provision (I-41), Information and Communication (I-42), Business Services (I-48), and Other Services (I-52). Endogenous variables include sectoral GDP (GDP_i), inflation (INF), and open unemployment rate (OUR), while government expenditure ($GovExp$) serves as an exogenous shock. The general VECMX specification of GDP is:

$$\begin{aligned}\Delta GDP_{i,t} \quad = \quad & c_i + \lambda_i ECT_{i,t-1} + \sum_{j=1}^{p-1} \alpha_{ij} \Delta GDP_{i,t-j} + \sum_{k=1}^{p-1} \beta_{ik} \Delta INF_{t-k} + \sum_{l=1}^{p-1} \gamma_{il} \Delta OUR_{t-l} \\ & + \sum_{m=0}^{q} \delta_{im} \Delta GovExp_{t-m} + u_{i,t}\end{aligned} \tag{9}$$

where the subscript i denotes the creative economy sector index, corresponding to national account sectors $(I\text{-}13, I\text{-}15, \ldots, I\text{-}52)$, while t represents the time dimension measured in semesters. The parameters p and q indicate the optimal lag lengths for endogenous and exogenous variables, respectively, as determined by standard information criteria.

The estimated equations for the nine VECMX models are specified below. Each equation explains the contemporaneous sectoral GDP as a function of its own lagged values, lagged values of Inflation (INF), the open unemployment rate (OUR), and the contemporaneous government expenditure (GovExp).

Food & Beverage (I-13):

$$\begin{aligned}\Delta GDP_{13,t} \quad = \quad & 0.0107\,ECT_t - 17128.66 - 0.1125\,GDP_{13,t-1} - 11256.83\,INF_{t-1} \\ & -2723.55\,OUR_{t-1} + 0.0343\,GDP_{13,t-2} - 3450.21\,INF_{t-2} - 2468.14\,OUR_{t-2} \\ & +0.0615\,GovExp_t + \varepsilon_{13,t}\end{aligned} \tag{10}$$

Textile & Apparel (I-15):

$$\begin{aligned}\Delta GDP_{15,t} \quad = \quad & 0.0077\,ECT_t - 48.895 + 0.1735\,GDP_{15,t-1} - 750.61\,INF_{t-1} \\ & -699.51\,OUR_{t-1} - 0.2967\,GDP_{15,t-2} - 45.75\,INF_{t-2} - 730.91\,OUR_{t-2} \\ & +\varepsilon_{15,t}\end{aligned} \tag{11}$$

Wood & Craft (I-17):

$$\begin{aligned}\Delta GDP_{17,t} \quad = \quad & 0.0090\,ECT_t - 1753.64 - 0.1755\,GDP_{17,t-1} - 1911.06\,INF_{t-1} \\ & -508.41\,OUR_{t-1} + 0.0563\,GDP_{17,t-2} - 653.61\,INF_{t-2} - 220.79\,OUR_{t-2} \\ & +0.0028\,GovExp_t + \varepsilon_{17,t}\end{aligned} \tag{12}$$

Paper & Printing (I-18):

$$\begin{aligned}\Delta GDP_{18,t} \quad = \quad & 0.0120\,ECT_t - 264.61 - 0.1269\,GDP_{18,t-1} - 366.44\,INF_{t-1} \\ & -389.85\,OUR_{t-1} + 0.0675\,GDP_{18,t-2} - 84.36\,INF_{t-2} - 205.75\,OUR_{t-2} \\ & +\varepsilon_{18,t}\end{aligned} \tag{13}$$

Furniture (I-26):

$$\begin{aligned}\Delta GDP_{26,t} \quad = \quad & -0.0034\,ECT_t + 1157.10 - 0.0548\,GDP_{26,t-1} + 671.83\,INF_{t-1} \\ & +79.74\,OUR_{t-1} - 0.2891\,GDP_{26,t-2} + 257.18\,INF_{t-2} + 121.85\,OUR_{t-2} \\ & -0.0018\,GovExp_t + \varepsilon_{26,t}\end{aligned} \tag{14}$$

Food Services (I-41):

$$\begin{aligned}\Delta GDP_{41,t} \quad = \quad & -0.0119\,ECT_t - 129.49 + 0.0671\,GDP_{41,t-1} - 293.00\,INF_{t-1} \\ & -1687.53\,OUR_{t-1} - 0.1983\,GDP_{41,t-2} - 367.02\,INF_{t-2} - 1499.58\,OUR_{t-2} \\ & +\varepsilon_{41,t}\end{aligned} \tag{15}$$

Information & Communication (I-42):

$$\begin{aligned}\Delta GDP_{42,t} \quad = \quad & 0.0067\,ECT_t + 4554.56 + 0.0466\,GDP_{42,t-1} + 3714.23\,INF_{t-1} \\ & -1187.03\,OUR_{t-1} - 0.1795\,GDP_{42,t-2} + 739.73\,INF_{t-2} - 537.68\,OUR_{t-2} \\ & +\varepsilon_{42,t}\end{aligned} \tag{16}$$

Business Services (I-48):

$$\begin{aligned}\Delta GDP_{48,t} \quad = \quad & -0.0048\,ECT_t - 655.10 + 0.0790\,GDP_{48,t-1} + 198.10\,INF_{t-1} \\ & -944.67\,OUR_{t-1} - 0.1110\,GDP_{48,t-2} + 178.88\,INF_{t-2} - 1762.15\,OUR_{t-2} \\ & +\varepsilon_{48,t}\end{aligned} \tag{17}$$

Other Services (I-52):

$$\begin{aligned}\Delta GDP_{52,t} \quad = \quad & 0.0219\,ECT_t - 6316.92 - 0.1791\,GDP_{52,t-1} - 7272.84\,INF_{t-1} \\ & -1012.99\,OUR_{t-1} - 0.1493\,GDP_{52,t-2} - 2226.35\,INF_{t-2} - 2643.12\,OUR_{t-2} \\ & +0.0256\,GovExp_t + \varepsilon_{52,t}\end{aligned} \tag{18}$$

The estimated VECMX equations indicate strong persistence in sectoral GDP dynamics across all nine creative economy sectors. The coefficients on the first lag of sectoral GDP are positive and close to or above unity, reflecting substantial inertia and path dependence in production activities. This persistence is particularly pronounced in service-oriented sectors such as Food Services (I-41) and Business Services (I-48), where output adjustments tend to be gradual and strongly influenced by past performance. In contrast, the second lag of sectoral GDP generally exhibits smaller and less systematic effects, suggesting that most dynamic adjustments occur within a one-semester horizon. This pattern implies that sectoral output responds rapidly to shocks but does not display prolonged cyclical memory beyond the short run.

The effects of macroeconomic conditions and fiscal policy on sectoral GDP display considerable heterogeneity. Inflation coefficients vary in sign and magnitude across sectors, with positive values observed in consumption-linked sectors such as Food and Beverage Industry (I-13), while negative coefficients appear in technology- and knowledge-intensive activities such as Information and Communication (I-42). This variation suggests that inflation influences sectoral output through different channels, including demand conditions and cost pressures. The coefficients on the open unemployment rate are predominantly negative at the first lag, particularly in labor-intensive sectors, indicating that higher unemployment is associated with weaker output performance. Government expenditure enters most equations with a positive but relatively small coefficient, implying that fiscal policy provides limited direct support to sectoral output. The effect is more visible in domestically oriented service sectors, whereas its role is minimal in more innovation-driven sectors. These results highlight the importance of accounting for sector-specific structures when evaluating the transmission of fiscal policy within the creative economy.

3.5. Dynamic Effects of Fiscal Policy: Impulse Response Analysis

To visualize the temporal impact of fiscal shocks, we examine the Impulse Response Functions (IRFs) from the estimated VECMX models. Figure 1 presents the responses of three key endogenous variables–sectoral GDP, Inflation, and the open unemployment rate (OUR)–to a one-standard-deviation positive shock in government expenditure across the nine creative economy sectors over a 10-period horizon. The solid line represents the point estimate, while the shaded area denotes the 95% confidence band derived from bootstrap methods.

The dynamic responses exhibit clear heterogeneity across sectoral clusters in terms of direction, magnitude, and persistence. First, for labor-intensive service sectors such as Food & Beverage (I-13), Furniture (I-26), and Food Services (I-41), fiscal shocks generate an immediate and economically meaningful decline in unemployment. The response appears within the first few periods and gradually diminishes over the medium-term horizon, indicating short- to medium-run persistence. Sectoral GDP in these sectors responds positively, although the magnitude is relatively small and the effect tends to taper off after several semesters. Inflation responses remain close to zero throughout the horizon, suggesting no systematic price pressure.

Second, in manufacturing-oriented sectors such as Textile & Apparel (I-15) and Paper & Printing (I-18), unemployment responses are weaker and in some cases move in the opposite direction, while GDP effects remain modest. These responses are generally short-lived and do not exhibit strong persistence beyond the early horizons, indicating limited transmission of fiscal stimulus to these sectors.

Third, in innovation- and knowledge-oriented sectors such as Information & Communication (I-42) and Business Services (I-48), the IRFs show relatively muted output and employment responses. Any observed effects are small in magnitude and tend to dissipate quickly, reflecting weaker short-run sensitivity to aggregate fiscal shocks.

Finally, in the Other Services sector (I-52), responses across GDP, inflation, and unemployment are generally limited in magnitude and display low persistence, reinforcing the view that fiscal transmission varies substantially across structural contexts.

Overall, the IRF results indicate that government expenditure primarily affects labor market dynamics rather than generating sustained output expansion or inflationary pressures. The magnitude of responses is heterogeneous across sectors, while the persistence of effects is generally moderate and concentrated in labor-intensive clusters.

3.6. Forecast Error Variance Decomposition (FEVD) Analysis

To complement the impulse response analysis and quantify the relative importance of shocks, we examine the Forecast Error Variance Decomposition (FEVD). The FEVD results, presented in Figure 2, report the proportion

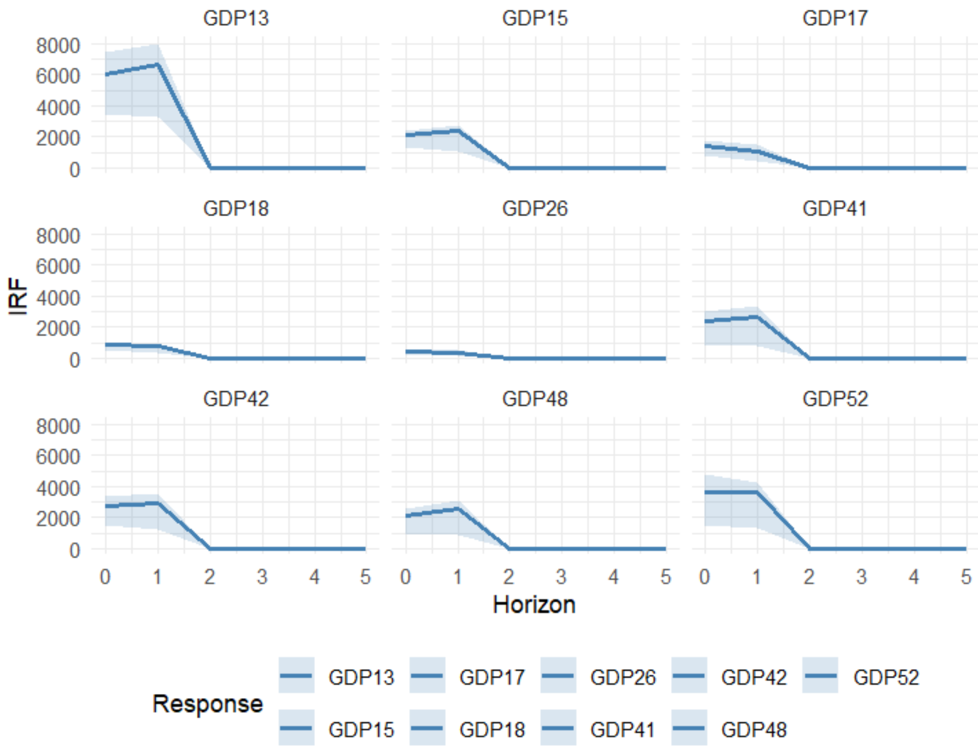

Figure 1. Impulse Response Functions to a Government Expenditure Shock

of forecast error variance in sectoral GDP, Inflation, and OUR attributable to government expenditure shocks and other endogenous shocks over a 10-period horizon.

The FEVD results reinforce the dynamic patterns observed in the IRFs. Across most sectors, the dominant source of variation in sectoral GDP is own-sector shocks, typically accounting for the majority of forecast error variance. This indicates that internal structural factors play a central role in driving sectoral fluctuations.

Government expenditure shocks contribute relatively modestly to GDP variance but play a more noticeable role in explaining fluctuations in the open unemployment rate, particularly in labor-intensive sectors such as I-13, I-15, and I-41. Moreover, the contribution of fiscal shocks to unemployment variance tends to increase over longer horizons (periods 4–10), suggesting that the employment channel exhibits greater medium-term relevance than the output channel.

Inflation variance is largely explained by its own innovations and macroeconomic shocks, with fiscal shocks contributing minimally. This confirms the limited price effects identified in the IRF analysis.

Overall, the FEVD findings indicate that fiscal policy has a more persistent explanatory role in labor market dynamics than in sectoral output or inflation, consistent with the impulse response evidence and supporting the interpretation that employment represents the primary transmission channel within Indonesia's creative economy.

3.7. An Integrated Policy Framework: Synthesizing Dynamic Responses and Structural Linkages

The empirical findings from the VECMX models and the structural insights derived from the input–output (I-O) analysis are not independent strands of evidence. Instead, they represent two complementary analytical dimensions: the VECMX models capture the dynamic and causal effects of fiscal shocks on sectoral employment and output, while the I-O framework reveals the underlying production structure that shapes the transmission and persistence of these effects. Integrating these perspectives allows the analysis to move beyond statistical significance toward

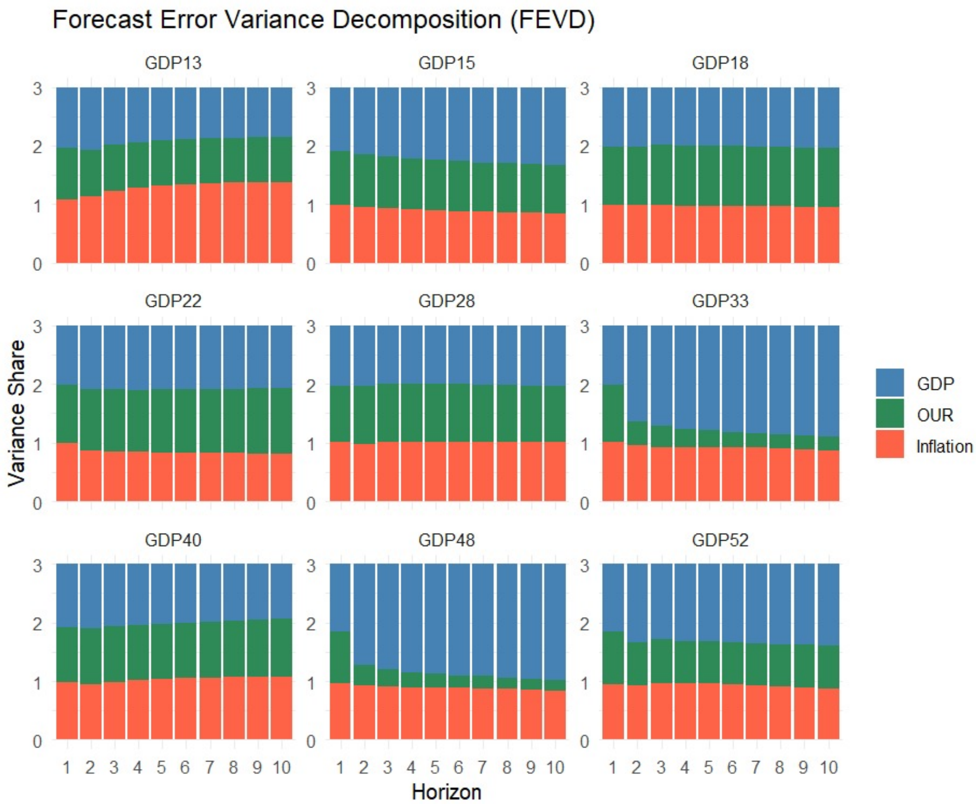

Figure 2. Forecast Error Variance Decomposition (FEVD) for Nine Sectors

an explanation of *why* fiscal policy generates heterogeneous sectoral responses and *how* policy instruments should be differentiated accordingly.

Within this integrated framework, government expenditure plays a dual role. In the VECMX specification, fiscal spending enters as an exogenous policy shock that directly affects sectoral GDP and employment dynamics. In the I–O structure, however, government expenditure primarily operates through sectors with high backward linkages (IBL), where increased public demand stimulates upstream input suppliers and amplifies multiplier effects across production networks. As a result, the magnitude and persistence of fiscal impacts observed in the VECMX estimates are systematically conditioned by the sectoral IBL profile.

Sectors characterized by higher backward linkages exhibit stronger and more persistent GDP responses to government expenditure shocks, as public spending increases intermediate demand and activates broader supply chains. In contrast, sectors with weak backward integration tend to display more muted and short-lived responses, even when VECMX coefficients are statistically significant. This indicates that fiscal policy effectiveness in driving sectoral GDP growth is not solely determined by the size of government expenditure, but by the extent to which such spending is structurally absorbed through domestic production linkages.

Accordingly, modeling sectoral GDP dynamics without accounting for differences in IBL risks conflating short-run demand effects with structurally grounded growth mechanisms. By integrating IBL information into the interpretation of VECMX results, the analysis clarifies that heterogeneous fiscal responses across creative economy sectors are rooted in their position within the national production system. Government expenditure thus functions as a catalytic instrument whose impact depends on sector-specific linkage intensity rather than as a uniform stimulus across sectors.

Figure 3 provides the structural foundation of this integration by mapping creative-economy-related sectors according to their backward (IBL) and forward (IFL) linkage indices. The dispersion of sectors across the four

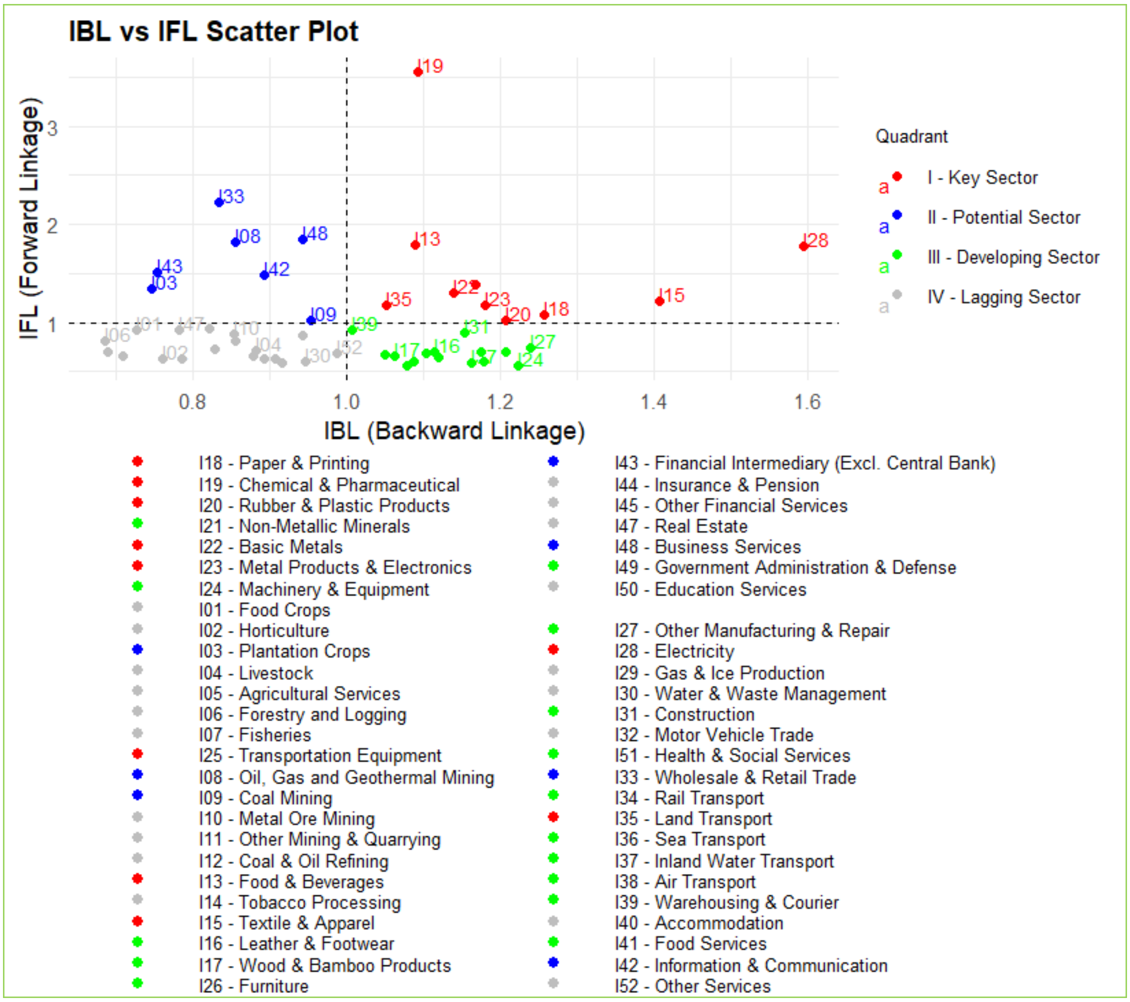

Figure 3. Structural Classification of Creative Economy Sectors Based on I-O Linkages

quadrants highlights a pronounced structural heterogeneity within the creative economy. Sectors located in the upper-right quadrant (IBL>1, IFL>1) exhibit strong upstream and downstream connections, indicating their central role in propagating demand and supply shocks throughout the production network. These sectors are structurally positioned to generate large multiplier effects when stimulated by fiscal policy.

By contrast, sectors in the upper-left quadrant (IBL < 1, IFL > 1) are characterized by relatively weak dependence on domestic inputs but strong forward linkages, suggesting that their outputs are intensively used by other sectors. This pattern is typical of knowledge- and technology-based activities, where growth is less constrained by immediate input demand but strongly linked to downstream users.

The lower-right quadrant (IBL > 1, IFL < 1) captures sectors with substantial labor absorption and input demand but limited downstream integration, implying that fiscal stimulus may generate short-term employment gains without fully translating into broader structural spillovers. Finally, sectors clustered in the lower-left quadrant (IBL < 1, IFL < 1) exhibit weak integration on both dimensions, reflecting limited production linkages despite their potential cultural or social significance.

3.8. Potential Structural Extensions Beyond Core Creative Sectors

This classification is restricted to the nine creative economy subsectors included in the VECMX estimation. Although the input–output table covers a broader set of 51 sectors, the empirical analysis in this study focuses on a selected subset that represents core creative and high-impact economic activities.

Based on the integration of input–output linkage analysis and sectoral mapping, the nine VECMX-estimated sectors are classified into four structural clusters: *Key*, *Potential*, *Developing*, and *Lagging* sectors. This classification reflects differences in production embeddedness, upstream–downstream linkages, and the degree of responsiveness to fiscal policy instruments.

It should be noted that this structural classification is not intended as a full economy-wide taxonomy, but rather as a sector-specific interpretation derived from the VECMX sample. From this perspective, the classification serves as both a descriptive and analytical framework to understand heterogeneous fiscal transmission across creative-related sectors.

This perspective aligns with Indonesia's long-term strategic vision for the creative and digital economy, which emphasizes strengthening competitiveness, increasing value added, and fostering innovation-driven growth.

The classification results based on backward and forward linkage indices (IBL and IFL) indicate heterogeneous structural characteristics across the nine VECMX sectors.

Table 9. Classification of VECMX Sectors Based on I-O Linkages

Sector	IBL	IFL	Cluster
GDP13	1.090	1.789	Key
GDP15	1.407	1.216	Key
GDP17	1.063	0.658	Potential
GDP18	1.257	1.078	Key
GDP26	1.089	0.606	Potential
GDP41	1.104	0.687	Potential
GDP42	0.893	1.484	Developing
GDP48	1.050	0.675	Potential
GDP52	0.988	0.681	Lagging

The distribution indicates that the VECMX captures all structural categories, reflecting heterogeneity in production linkages within the creative economy subset.

To further examine the relationship between structural position and dynamic fiscal transmission, the linkage indicators are related to the impulse response outcomes generated from the VECMX models within a cross-sectional validation framework. This approach enables the structural characteristics of each sector to be interpreted alongside their respective dynamic responses to fiscal shocks.

Table 10. Association between IRF Responses and Input–Output Linkages

Linkage Indicator	IRF Response	Correlation (r)	Interpretation
Backward Linkage (iBL)	Open Unemployment Rate	-0.595	Moderate negative relationship
Forward Linkage (iFL)	Inflation	-0.229	Weak negative relationship

The results indicate a systematic association between production linkages and dynamic fiscal transmission. Sectors with stronger backward linkages tend to exhibit more pronounced responses in the unemployment channel, suggesting that upstream production dependence amplifies labor-market sensitivity to macroeconomic shocks. In contrast, forward linkages show a relatively weak association with inflation responses, implying that downstream integration plays a limited role in transmitting price-level adjustments within the VECMX framework. Overall, these findings provide preliminary empirical evidence supporting a structural consistency between input–output linkages and VECMX-based dynamic responses. However, this relationship is derived from a reduced-form cross-sectional validation and does not constitute a fully structural integration between the two frameworks.

These findings are further synthesized into a structural policy interpretation. Key sectors exhibit strong bidirectional linkages, making them highly responsive to fiscal interventions. Potential sectors show strong upstream dependence, suggesting that fiscal policy can generate short-term employment effects. Developing sectors are more influenced by ecosystem and infrastructure factors, while lagging sectors exhibit limited structural integration, implying weaker fiscal transmission.

Table 11. Integrated Policy Response Matrix

Cluster	Empirical Profile	Strategic Rationale	Recommended Instruments
Key	IBL>1, IFL>1	Strong production integration and high spillover potential	Procurement, tax incentives, supply-chain financing
Potential	IBL>1, IFL<1	Strong upstream dependence but limited downstream absorption	Skills training, matching grants, digital platforms
Developing	IBL<1, IFL>1	Innovation-driven with strong downstream orientation	R&D support, digital infrastructure, incubation
Lagging	IBL<1, IFL<1	Weak integration in production networks	Cultural funding, tourism support, social programs

Table 11 summarizes the integrated structural and dynamic interpretation of the nine VECMX sectors by linking input–output structures with fiscal transmission mechanisms derived from the VECMX framework.

3.9. Discussion Towards a Differentiated Fiscal Strategy

The matrix reveals a fundamental empirical insight: fiscal transmission within Indonesia's creative economy is heterogeneous across sectors, indicating that policy responses should account for structural differences rather than adopting a uniform approach. The VECMX results show that government expenditure shocks generate relatively stronger and more consistent effects on employment than on output or inflation in several sectors, while the input–output linkage analysis highlights variation in sectoral embeddedness within production networks. Together, these findings support a differentiated interpretation of fiscal effectiveness across clusters.

First, the results suggest a refinement of policy evaluation metrics. Since the empirical evidence indicates that employment responses are more pronounced than sectoral output responses, policymakers may consider placing greater emphasis on labor market outcomes when assessing short- to medium-term fiscal impacts in the creative economy. This interpretation is grounded in the observed dynamic responses and does not imply that output effects are absent, but rather that they are comparatively smaller within the current sample. Such an emphasis is broadly consistent with inclusive growth objectives, including employment creation and productive labor absorption.

Second, the sectoral classification framework derived from input–output linkages provides a structured way to interpret heterogeneity in fiscal responses. Sectors with stronger backward linkages and higher labor absorption tend to display more visible employment responses in the IRF analysis, while sectors with weaker linkage structures show more muted effects. Accordingly, the policy matrix presented in this study should be understood as a prioritization framework based on empirical patterns of responsiveness and structural position. It is intended to guide relative attention across clusters rather than to prescribe specific budget allocations or fiscal targets. Any reallocation of resources across sectors would involve trade-offs and should be evaluated with complementary cost–benefit and institutional analyses.

Third, the proposed framework acknowledges that the analysis identifies dynamic associations between fiscal shocks and sectoral outcomes, but it does not directly evaluate the effectiveness of specific policy instruments.

Measures such as regulatory sandboxes, infrastructure investment, or targeted support programs are discussed as structurally consistent options for sectors with particular linkage characteristics, rather than as empirically tested interventions. Establishing the causal impact of these instruments would require dedicated program evaluation, pilot studies, or micro-level data.

Finally, the observed sectoral heterogeneity may reflect structural differences in labor intensity, production organization, and network integration. While available data support the interpretation of differential responses, future research incorporating direct measures of labor shares, nonlinear specifications, or interaction terms between fiscal shocks and linkage indices would further strengthen the analysis. The integrated VECMaX–IO framework therefore provides an evidence-based foundation for sectoral prioritization, while recognizing the limitations inherent in aggregate time-series and structural classification approaches.

4. Conclusion and Policy Implications

This study develops an integrated VECMX and input–output linkage framework to examine the transmission of fiscal policy within Indonesia's creative economy. The empirical results demonstrate that government expenditure generates heterogeneous effects across sectors. While output and inflation responses are generally limited, employment dynamics exhibit stronger and more consistent reactions in several sectors. These findings highlight the importance of considering structural sectoral characteristics when evaluating fiscal policy effectiveness. The impulse response and variance decomposition analyses further indicate that sector-specific shocks explain a substantial portion of output variability, while fiscal shocks play a more pronounced role in employment fluctuations. This pattern suggests that the primary short- to medium-term transmission channel of fiscal policy within the creative economy operates through labor market adjustments rather than immediate output expansion.

The integration of input–output linkage analysis provides additional structural context for interpreting these dynamic results. Sectors with stronger production linkages tend to exhibit more pronounced transmission effects, reflecting their position within domestic supply networks. Conversely, sectors with weaker linkage structures display more muted responses, emphasizing the importance of structural embeddedness in shaping fiscal effectiveness. Overall, the findings support the development of a differentiated fiscal strategy tailored to sectoral characteristics. Rather than adopting uniform interventions, policy design should account for variations in labor intensity, linkage strength, and structural integration. Such an approach enhances the efficiency of public resources while maintaining alignment with national development priorities.

Future research may extend this framework by incorporating direct measures of labor intensity, examining alternative specifications of fiscal transmission, and conducting subnational analyses to capture regional heterogeneity. Additional methodological refinements, including nonlinear modeling approaches, may further deepen understanding of structural fiscal dynamics within the creative economy. The integrated VECMX–IO framework contributes both methodological innovation and policy-relevant insights. By combining dynamic econometric analysis with structural production linkages, the study provides a coherent evidence base for interpreting sectoral fiscal responses and designing more targeted economic strategies. The policy implications presented in this study are intended to guide strategic prioritization rather than to prescribe specific fiscal allocations or budgetary targets.

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