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Assessing and Forecasting the Competitiveness of Indonesian Downstream Coffee Industry

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Abstract

This study aims to identify the factors influencing the competitiveness of the Indonesian downstream coffee industry and provide a forecast through 2030. This study uses Revealed Symmetric Comparative Advantage (RSCA) and the Autoregressive Distributed Lag (ARDL) model, based on the Porter Diamond model, to identify the position and determinants of competitiveness in Indonesia's downstream coffee industry. In developing the forecasting model, this study employs three approaches: ARIMA, HP-Filter, and ARDL forecasting, utilising data from 1990 to 2023. The study indicates that Indonesia's downstream coffee industry has comparative advantages, as reflected in the continuous increase of RSCA values over the past two decades. The Porter Diamond model shows that GDP, manufacturing value-added, and foreign direct investment are key drivers of competitiveness. Coffee prices negatively affect both the short and long term, while domestic consumption negatively affects competitiveness only in the short term. Land area, however, does not show a significant effect. The forecasting results show that the competitiveness of the downstream coffee industry in Indonesia is projected to experience continued growth from 2024 to 2030.

Keywords

Business analytics, coffee industry, competitiveness, downstream, Porter Diamond Model.

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Introduction

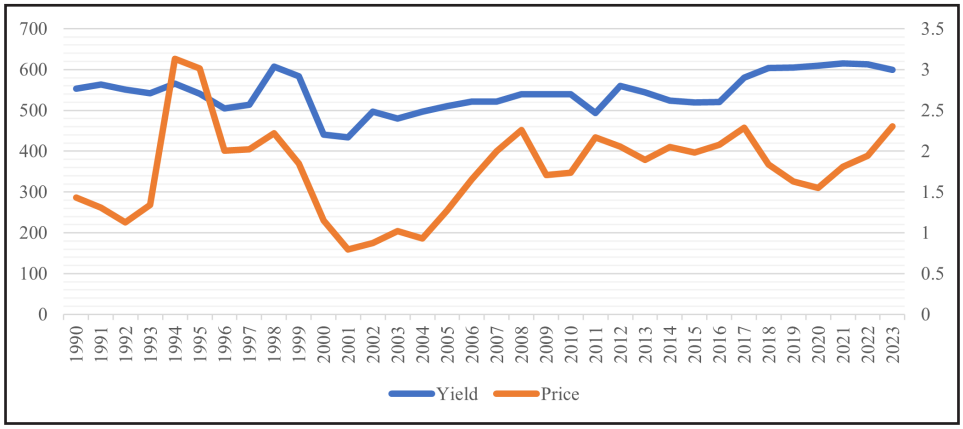
Coffee is a strategic plantation commodity for Indonesia, as this commodity serves as a smallholder farmers' income, provides industrial raw materials, plays a crucial role in rural development for sustainable agriculture, and contributes significantly to export earnings (Suryana et al., 2024). Coffee is one of the most traded agricultural commodities and has become a source of livelihood for millions of smallholders worldwide. Indonesia is the fourth-largest coffee producer in the world, with a total production of 717,000 tons (ICO, 2022). The coffee industry is a significant component of the Indonesian economy. In 2023, the Republic of Indonesia produced 774,000 tons of coffee beans, generating income for 1.89 million smallholder households (Kementerian Pertanian, 2023). As one of the world's coffee production centres, Indonesian coffee cultivation is mostly managed by smallholder farmers, covering approximately 95.71% of the total plantation area and approximately 1.23 million hectares. Indonesia has become Asia's second-largest coffee producer, and various types of high-quality coffee beans are grown across the Indonesian archipelago. Coffee has also been a prestigious commodity in Indonesia since the Dutch colonial period; at that time, coffees from Indonesia were sought in the European market (Hoffman, 2014). Along with changes in coffee drinking trends, the Indonesian coffee industry has changed its approach by developing many different types of coffee products, such as instant coffee products that are usually premixed with sugar and milk powder, in addition to regular pre-ground coffees (Ashardiono and Trihartono, 2024). Because of these changes, Sunarharum et al. (2021) underline that coffee drinks are enjoyed by people in all sectors of Indonesian society, ranging from rural to urban areas.

As the coffee market expands, Indonesian coffee producers are no longer solely focused on production for the international market; some are also starting to target the domestic market. As in countries with high coffee consumption, coffee has become an integral part of Indonesian life. This was true even before the café lifestyle trend emerged in Indonesia. For some, drinking coffee has become a morning

ritual before starting work; the day feels incomplete without a cup. With increasing demand for high-quality speciality coffee in the international market, the Indonesian government has slowly pushed for an increase in coffee production and processing in recent years. Coffee reaches around 400 billion cups annually, making it a highly valued beverage and a significant global trade commodity (Sachs et al., 2019). Export competitiveness defined as the ability of a product to enter foreign markets successfully. The strength of a nation's competitiveness is determined, among other things, by its capability to employ its superior resources to reinforce its position in world competition (Innayatuhibbah, Rahayu and Ferichani, 2024). Porter's theory of competitiveness outlines four key factors that influence the competitiveness of companies and industries within a nation. These factors include the availability of production factors, both basic and advanced, demand and quality requirements from end consumers, supporting industries in the supply chain, as well as strategy, market structure, and business rivalry in the industry (Porter, 1991).

The coffee industry in Indonesia has a strategic role in driving national economic growth. However, the competitiveness of Indonesian coffee, especially in the downstream sector, still presents various challenges. According to Tampubolon et al. (2023), the competitiveness of the downstream sector of the Indonesian coffee industry remains weak, as evidenced by an export structure dominated by raw coffee beans, low processing innovation, and limited penetration into premium markets that prioritise quality and added value. The dependence on Robusta commodities with minimal processing also exacerbates Indonesia's position as a raw material supplier for developed countries that dominate the market for high-value processed products (Rosiana et al., 2018). The absence of a downstream policy makes it difficult for small businesses to meet global requirements such as certification, quality consistency, and product origin tracking. Fragmentation between subsystems in the agribusiness chain, weak quality standardisation, and the lack of strong local brands also became significant obstacles to strengthening downstream competitiveness in the international market (Widyantini, 2019). Figure 1 shows that the Indonesian coffee industry's upstream and downstream sectors face high volatility. Sharp price fluctuations from year to year reflect downstream market instability, while upstream productivity volatility indicates suboptimal management and innovation in value-added creation. Instability on both sides suggests that the Indonesian coffee industry lacks resilience and strong competitiveness, particularly on the downstream side of the industry.

In the globalisation era, competition is increasingly fierce, with each country opening its markets to the other. The development of diverse processed coffee products holds a strategic position because they have the potential to become superior commodities with high competitiveness in the international market (Purwawangsa, Irfany and Haq, 2024). Indonesia, as a tropical country, has a significant opportunity to develop diversified processed coffee products and has the potential to build a speciality coffee processing industry. These products have distinctive flavours, such as Toraja Coffee and Kintamani Coffee, which can become a competitive advantage (Rahardjo et al., 2020). Previous studies found that Indonesian coffee has a comparative advantage in the global



Source: FAO Statistics & World Bank, 2024

Figure 1: Trends in coffee yield and price volatility in Indonesia from 1990 to 2023.

market, comparable to coffee from Brazil, Vietnam, and Colombia (Innayatuhibbah et al., 2024; Nasution et al., 2024; Suryana et al., 2024). However, research focusing on the downstream competitiveness remains limited, especially in major global coffee-producing countries like Indonesia. Changing global consumer preferences for convenient, ready-to-consume products create opportunities and a strategic position for processed coffee products to compete worldwide. Unfortunately, the contribution of downstream products to Indonesian coffee exports remains very limited. This is despite other producing countries, such as Brazil and Vietnam, having demonstrated success in making downstream products a significant source of foreign exchange. This indicates that Indonesia has not fully utilised its economic potential in the downstream processed coffee trade.

This study aims to determine the position and prospects of the Indonesian downstream coffee industry's competitiveness and identify its determinants. This study offers novelty by providing a more comprehensive perspective on determining the competitive position of the downstream sector, a relatively rare approach, using the Porter Diamond model. This study is expected to provide a more comprehensive and nuanced understanding of the position and evolving dynamics of the Indonesian downstream coffee industry's competitiveness in the international market, encompassing an analysis of its comparative standing against key global competitors, as well as the emerging opportunities and challenges that influence its long-term growth and sustainability.

Materials and methods

This research utilises two groups of data in accordance with the objectives to be achieved. The first objective is to estimate and forecast the competitive position of the Indonesian downstream coffee industry. The second objective is to analyse the factors influencing industry competitiveness based on the Porter Diamond Model. This study defines the downstream coffee industry as the segment of the coffee value chain engaged in post-harvest processing, value-added transformation, and product diversification beyond raw bean production, primarily encompassing processed and export-oriented coffee products. The first group of data analysed in this study is international trade data for downstream coffee in Indonesia obtained from UN Comtrade. The commodity group data analysed in this study is determined based on the aggregate value of the 6-digit HS code that represents processed coffee products as a representation of the downstream industry's capabilities. This study investigates the performance of Indonesia's downstream coffee industry by analysing export data corresponding to HS codes 210110, 210111, 210112, and 210130, which collectively encompass a broad spectrum of processed coffee products. Specifically, HS 210110 (coffee extracts, essences, concentrates, and preparations), HS 210111 (extracts, essences, and concentrates of coffee, and preparations based on these components), HS 210112 (preparations with a basis of coffee extracts, essences, or concentrates), and HS 210130 (roasted coffee substitutes such as chicory, including their extracts, essences, and concentrates) are included in the analysis. HS 210120 (tea or mate-based extracts, essences, and preparations) is excluded from this study, as it does not fall within the scope of coffee-related commodities. The export data, therefore, reflect the aggregate value of Indonesia's processed and value-added coffee products that constitute its downstream industry.

Furthermore, determinants of the downstream coffee industry were estimated using time series data from 1990 to 2023. The dependent variable of this study is the revealed symmetric comparative advantage of the Indonesian downstream coffee industry. The following independent variables are considered: coffee harvested area, GDP, manufacturing value-added, domestic consumption, FDI inflows, and price. The selection of independent variables in this study is based on the Porter Diamond model indicators developed by Tsai et al. (2021), by selecting several proxies that represent all aspects of the Porter Diamond model, including: factor conditions, demand conditions, firm strategy and rivalry, related and supporting industries, and government and chance. Table 1 presents the aspect, notation, definition, unit and source of variable used.

To estimate the competitive position of the downstream coffee industry, this study uses the Revealed Symmetric Comparative Advantage (RSCA). The RSCA is a symmetrical form of the RCA index developed by Balassa (1965) to measure a commodity relative comparative advantage compared to the global trade structure (Pascucci, 2018; Manalu et al., 2019; Jalata, 2021; Tandra et al., 2022; Wang et al., 2022; Suryana et al., 2024). The RSCA ranges from −1 to +1, where positive number shows comparative advantage, while negative number shows

Aspect	Notation	Definition	Unit	Source
Dependent Variable	$RSCA_t$	Revealed Symmetric Comparative Advantage (RSCA) Indonesia's downstream coffee industry at period *t*	Index	Author calculation
Factor Condition	$LAND_t$	Harvested area of coffee in period *t*	Hectare	FAO Statistics
Demand Condition	$CONS_t$	Domestic consumption of green coffee at period *t*	Bags (60 kg)	Indexmundi
	GDP_t	Gross domestic product at period *t*	US$	Worldbank
Related & Supporting Industries	$MANV_t$	Value added of the manufacturing sector at period *t*	US$	Worldbank
Strategy, Structure, and Rivalry	FDI_t	Foreign direct investment (FDI Inflows) at period *t*	US$	Worldbank
Government & Chance	$PRICE_t$	Average price of coffee in the international market at period *t*	US$	Worldbank

Source: Authors

Table 1: Variable description.

comparative disadvantage. The RCA formula and its transformation into RSCA are explained as follows:

$$\mathrm{RCA_{ij}} = \frac{X_{ij}/X_{it}}{X_{wj}/X_{wt}} \quad (1)$$

$$\mathrm{RSCA_{ij}} = \frac{RCA_{ij}-1}{RCA_{ij}+1} \quad (2)$$

Where X_{ij} is the value of exports of commodity *j* by Indonesia, X_{it} is the total export of all commodities by Indonesia, X_{wj} is the total world exports for commodity j, and X_{wt} is the total world exports for all commodities.

Furthermore, this study will also compare the competitiveness of Indonesia's downstream coffee industry with that of Brazil and Vietnam to enrich the findings and provide a global context for Indonesia's position in the processed coffee value chain. Brazil and Vietnam were chosen because they are both major global coffee producers and have significantly expanded downstream product exports. This comparison provides a strategic basis for assessing the potential and direction for strengthening the competitiveness of Indonesia's downstream coffee industry.

This study employs ARDL to analyse the factors that influence this competitiveness based on the Porter Diamond Model in the short-run and long-run. Furthermore, several steps are employed, namely the unit root test, cointegration test, diagnostic models, and stability test. The linear equation of this study is as follows:

$$RSCA_t = \beta_0 + \beta_1 LnLAND_t + \beta_2 LnCONS_t + \\ + \beta_3 LnGDP_t + \beta_4 LnMANV_t + \beta_5 LnFDI_t + \\ + \beta_6 LnPRICE_t + \mu_t \quad (3)$$

Where $RSCA_t$ = denotes the revealed symmetric comparative advantage of Indonesia's downstream coffee industry at period t. The independent variable includes $LAND_t$ represents the harvested area of coffee in hectares; $CONS_t$ Denotes the domestic consumption of green coffee in thousands of 60-kg bags; GDP_t refers to the gross domestic product, measured in US dollars; $MANV_t$ represents the value added of the manufacturing sector; FDI_t is the foreign direct investment inflows; *PRICE* denotes the average international market price of Robusta coffee; *Ln* is the natural logarithm, β_0 is the intercept, $\beta_1, \beta_2 \ldots \beta_6$ are the regression, and μ_t is the residual term.

A series of preliminary tests is required before ARDL model estimation to verify the data's appropriateness and the underlying assumptions to ensure model robustness. First step is unit root test, as non-stationary variables can produce unreliable results (Engle and Granger, 2012). The Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests are used in testing for the presence of a unit root (Dickey and Fuller, 1981; Phillips and Perron, 1988). The second stage is lag selection for the ARDL model criteria, carried out using LR, AIC, FPE, SC, and HQ criterion. Third, the Bound test stages to overcome the limitations of previous cointegration, which require variables to be at the same order of integration (I(1)) (Engle and Granger, 2012). Fourth, the bounds test to assess the cointegration. Values below the lower bound indicate no cointegration, above the upper bound confirm it, and values in between are inconclusive. Diagnostic checks were also run to validate the model and residuals. These included checks for residual autocorrelation, homoskedasticity, and normality (Wooldridge, 2004). Furthermore,

stability tests were conducted using CUSUM and CUSUMQ to ensure model consistency over time. To ensure the validity of an econometric model requires it to be free from violations of classical assumptions (Wooldridge, 2013). The normality, heterokedasticity, muticolonearity, and autocorrelation was used to evaluation of this model. There is a linear ARDL model can be written as follows:

$$RSCA_t = \beta_0 + \beta_1 \sum_{i=0}^{n} LnLAND_{t-i} + \beta_2 \sum_{i=0}^{n} LnCONS_{t-i} + \beta_3 \sum_{i=0}^{n} LnGDP_{t-i} + \beta_4 \sum_{i=0}^{n} LnMANV_{t-i} + \beta_5 \sum_{i=0}^{n} LnFDI_{t-i} + \beta_6 \sum_{i=0}^{n} LnPRICE_{t-i} + \mu_t \quad (4)$$

The decision to reject or accept the null hypothesis (H_0) is based on the following conditions. If the calculated F-statistic exceeds the upper critical limit, H_0 is rejected, indicating cointegration between the variables. Conversely, if the F-statistic is below the lower limit, H_0 is accepted, indicating no cointegration.. In short-run form, the framework of ARDL could be expanded by adding an error correction term (ECT_{t-1}). Hence, the short run of ARDL is specified as:

$$RSCA_t = \beta_0 + \beta_1 \sum_{i=0}^{n} \Delta LnLAND_{t-i} + \beta_2 \sum_{i=0}^{n} \Delta LnCONS_{t-i} + \beta_3 \sum_{i=0}^{n} \Delta LnGDP_{t-i} + \beta_4 \sum_{i=0}^{n} \Delta LnMANV_{t-i} + \Delta\beta_5 \sum_{i=0}^{n} LnFDI_{t-i} + \beta_6 \sum_{i=0}^{n} \Delta LnPRICE_{t-i} + \delta ECT_{t-1} + \mu_t \quad (5)$$

Where Δ is the difference organiser, ECT could be utilised to measure the cointegration. A negative and significant of ECT_{t-1} (δ) indicates short-run disequilibrium between the variables is gradually corrected, leading the system to converge toward its long-run equilibrium.

The third objective of this study is to forecast the competitive position of the downstream industry. This study uses three time series forecasting approaches: HP-filter, ARDL forecasting, and ARIMA model to ensure comprehensive forecasting results. First, this study conducts a decomposition before regression analysis, using the Hodrick–Prescott (HP) filter. Second, this study employs the ARDL forecasting to capture forecasting value in the short-term and long-term dynamics based on its initial model in Equations (4) and (5). Third, this study also uses the ARIMA model popularised by Box and Jenkins (1970). This model is predicated on the construction of forecasts of future values as a linear combination of past values and lags of forecast errors. It does not involve independent variables in predicting future values; rather, it utilises trends, patterns, seasonal characteristics, and information within the data series itself to generate forecast values. The general ARIMA model is presented as follows:

$$Y_t = \mu + \alpha_1 Y_{t-1} + \ldots + \alpha_p Y_{t-p} - \theta_1 et\text{-}1 - \theta_q e_{t-q} \quad (6)$$

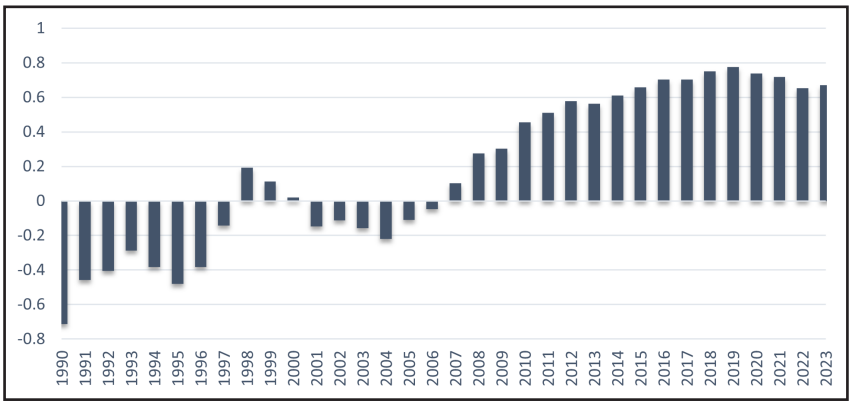
where Y_t is the differenced time series value, α and θ are unknown parameters, and e are independent, identically distributed error terms with zero mean. The lagged autoregressive (AR) processes are symbolised by p, and that of a moving average (MA) process are symbolised by q.

To provide a more comprehensive evaluation of model stability and to reduce potential over-optimism from trend-based forecasting, this study incorporates a simulation approach adopted from study by (Suroso et al., 2023). The analysis examines two key external risk channels, namely price shocks and consumption shocks, which are considered major pathways through which changes in global market conditions may influence the competitiveness of Indonesia's downstream coffee industry. Each type of shock is modeled through three alternative scenarios representing 5, 10, and 15 percent changes in the respective variables, while other factors are kept constant to isolate the effects. This scenario framework allows the model to simulate realistic global market disturbances and assess their potential impact on the Revealed Symmetric Comparative Advantage (RSCA) index, using 2023 as the baseline year for comparison.

Result and discussion

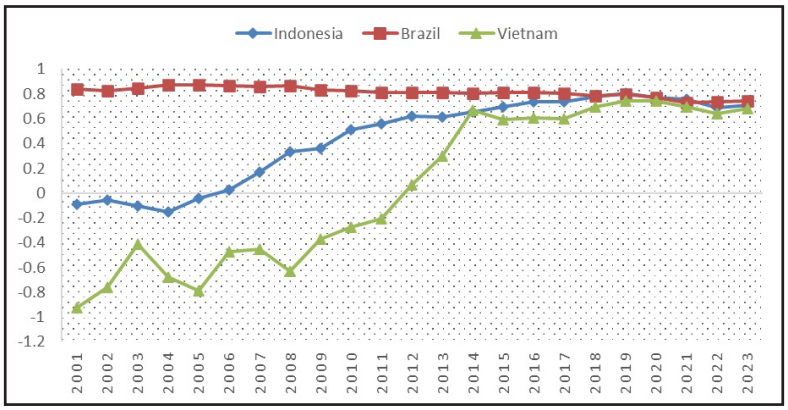
The Indonesia's downstream coffee industry competitiveness

Based on the RSCA calculation results for the period 1990 to 2023 in Figure 2, the competitiveness of Indonesia's downstream coffee industry shows a significant structural transformation in export performance. In the early 1990s, the RSCA value was in the negative range, as reflected in 1990 at -0.724, reflecting a weak comparative position due to a lack of product processing. Since the early 2000s, the RSCA value has shown a consistent upward trend and entered positive territory, with the highest value recorded in 2019 at 0.804. This finding indicates that the downstream coffee industry in Indonesia has a bright prospect and has the potential to become a country for global market expansion in the downstream coffee industry.



Source: Author analysis, 2025

Figure 2: Indonesia's downstream coffee industry competitiveness.



Source: Author analysis, 2025

Figure 3: Comparative trends of downstream coffee industry competitiveness in Indonesia, Brazil, and Vietnam.

Furthermore, to provide a broader perspective on Indonesia's downstream coffee competitiveness, a comparative analysis was conducted with two major global coffee producers, Brazil and Vietnam. Due to data availability, the Revealed Symmetric Comparative Advantage (RSCA) index was calculated for the period 2001-2023 using the corresponding HS codes for processed coffee products. The results, presented in Figure 3 (above), reveal that Brazil consistently maintained a high and stable RSCA value (around 0.8), indicating a strong and sustained comparative advantage in downstream coffee exports throughout the period. In contrast, Indonesia and Vietnam exhibited dynamic improvement trends. Indonesia's RSCA moved from a negative value in the early 2000s to a strong positive advantage after 2010, peaking around 2019, which reflects a significant structural transformation in its value-added coffee industry. Vietnam showed a similar upward trajectory, transitioning from a deep negative RSCA in the early 2000s to a positive level after 2012, suggesting progressive industrial upgrading in downstream coffee exports. Collectively, the comparative trend highlights Indonesia's successful convergence toward the competitiveness level of traditional leaders such as Brazil and Vietnam, although sustaining this momentum will require continued investment in downstream capacity, innovation, and export sophistication. Accordingly, it is recommended that Indonesia prioritise continuous investment in processing capacity, quality enhancement, and market diversification to consolidate its competitive position in the global value chain.

The Determinants of Indonesia's downstream coffee industry competitiveness

This study also examines the determinants influencing the downstream coffee industry competitiveness, as proxied by the revealed symmetric comparative advantage value. This study uses only factors included in the Porter Diamond model as determinants of the competitive position of the downstream coffee industry in Indonesia. Table 2 shows descriptive statistics, including median, mean, max, min, and standard deviation. These tables are presented to determine

the range and scope of the data used in the study. No variables in this study deviate significantly from a balanced and normal variability (standard deviation, mean). The Mean and Std. Dev. are used to assess the variability of the data.

Table 3 shows the correlation matrix, indicating that all variables have correlation values below 0.8. This suggests that the variables are related but not excessively correlated, confirming the absence of multicollinearity problems in the model. These results further imply that the model specification is well constructed and robust, providing a reliable foundation for the ARDL model.

To examine the potential endogeneity among competitiveness, foreign direct investment (FDI), and economic growth (GDP), this study applied the Toda and Yamamoto, (1995) Granger causality test. The three variables are theoretically interrelated, as higher GDP growth may attract FDI inflows, while increased competitiveness can both result from and stimulate economic expansion and investment. The test results presented in Table 4 indicate no significant causal relationship among the variables at the 5 percent level. This absence of causality suggests that variations in competitiveness, FDI, and GDP move together in the long run through cointegration, but do not dynamically influence each other within the sample period. Consequently, the ARDL estimations are unlikely to suffer from endogeneity bias, supporting the robustness and consistency of the long- and short-run coefficients.

Variables	Mean	Median	Maximum	Minimum	Std. Dev.
$RSCA_t$	0.246	0.242	0.803	-0.467	0.434
$LnLAND_t$	13.922	14.034	14.138	13.523	0.211
Ln $CONS_t$	7.687	7.544	8.496	7.166	0.414
$LnGDP_t$	26.67	26.621	27.907	25.281	0.866
$LnMANV_t$	25.218	25.332	26.211	23.773	0.798
$LnFDI_t$	1.287	1.787	2.916	-2.757	1.338
$LnPRICE_t$	0.516	0.607	1.140	-0.232	0.329

Source: Author analysis, 2025

Table 2: Descriptive statistics.

	RSCA	LnLAND	LnCONS	LnGDP	LnMANV	LnFDI	LnPRICE
RSCA	1.0000						
LnLAND	0.6347	1.0000					
LnCONS	0.7589	0.3348	1.0000				
LnGDP	0.7165	0.7412	0.7746	1.0000			
LnMANV	0.3358	-0.2150	0.3764	0.3141	1.0000		
LnFDI	0.3838	-0.0110	0.4986	0.5043	0.4959	1.0000	
LnPRICE	0.7807	0.5472	0.7316	0.7701	0.2695	0.3848	1.0000

Source: Author analysis, 2025

Table 3: Correlation matrix.

Pairwise Granger Causality Tests			
Lags: 2			
Null Hypothesis:	**Obs**	**F-Statistic**	**Prob.**
LnFDI does not Granger Cause LnGDP	32	0.39693	0.6762
LnGDP does not Granger Cause LnFDI		0.86891	0.4308
RSCA does not Granger Cause LnGDP	32	0.93351	0.4055
LnGDP does not Granger Cause RSCA		2.88479	0.0732
RSCA does not Granger Cause LnFDI	32	1.12773	0.3385
LnFDI does not Granger Cause RSCA		0.86504	0.4324

Source: Author analysis, 2025

Table 4: Granger causality test.

The first assumption that must be met to avoid spurious regression is that all variables must be stationary at the first difference (Granger, Hyung and Jeon, 2001). Table 5 shows the results of the unit root test which shows that t the variable is stationary in the first difference and non-stationary at the level.

Table 6 shows the lag selection criteria determined using a sequentially modified LR test, FPE, AIC, SC, and HQ Criterion. The results indicate that lag 2 is the optimal lag for the ARDL model, as indicated by the atrerisk (*) value for each criterion. This criterion value indicates a higher level of robustness compared to other selection criteria.

Table 7 present the Bound test, which was used to confirm the long-run cointegration in the ARDL model. The bound test results indicate an F-Stat value of 5.205, significant at the 1%, 2.5%, 5%, and 10% levels. Therefore, this model exhibits a long-run cointegration.

Table 8 presented the long-run and short-run estimation. In the long-term estimates, GDP ($LnGDP_t$), manufacturing sector value added (LnMANVt), and foreign direct investment ($LnFDI_t$) show a significant positive effect on the competitiveness of the downstream coffee industry in Indonesia. This result indicates that improved macroeconomic performance, a strengthening of the manufacturing industrial base, and the influx of foreign investment significantly strengthen the comparative advantage of the processed coffee sector. Meanwhile, the variables for land area ($LnLAND_t$) and domestic consumption ($LnCONS_t$) show a negative but insignificant effect, indicating that they do not yet play a dominant role in influencing long-term competitiveness. The export price variable ($LnPRICE_t$) also shows a significant negative effect, reflecting that rising product prices can negatively impact of the downstream competitiveness of the coffee industry.

In the short-term estimation, the $LnGDP_t$ and LnMANVt variables continue to show a significant positive effect, reinforcing the role of economic growth and strengthening the manufacturing sector as key drivers of downstream industry competitiveness.

Variables	Augmented Dickey Fuller		Philip-Perron	
	Level I(0)	First Difference I(1)	Level I(0)	First Difference I(1)
$RSCA_t$	-1.926	-4.261***	-1.954	-4.549***
$LnLAND_t$	-1.910	-4.397***	-1.909	-4.397***
Ln $CONS_t$	-0.289	-5.598***	-0.378	-5.597***
$LnGDP_t$	-0.733	-5.829***	-0.720	-5.829***
$LnMANV_t$	-1.202	-3.923***	-1.392	-6.379***
$LnFDI_t$	-2.256	-5.447***	-2.396	-5.447***
$LnPRICE_t$	-1.959	-4.628***	-2.077	-4.522***

Source: Author analysis, 2025

Table 5: Unit root test.

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-850.292	NA	2.47e+15	55.309	55.633	55.415
1	-667.103	271.829	4.67e+11	46.652	49.242	47.496
2	-571.458	98.730*	3.93e+10*	43.642*	48.500*	45.226*

Source: Author analysis, 2025

Table 6: Lag selection criteria.

K	F-Statistics	Significant	Lower bound I(0)	Upper bound I(1)
5	5.205	10%	2.12	3.23
		5%	2.45	3.61
		2.5%	2.75	3.99
		1%	3.15	4.43

Source: Author analysis, 2025

Table 7: Bound test.

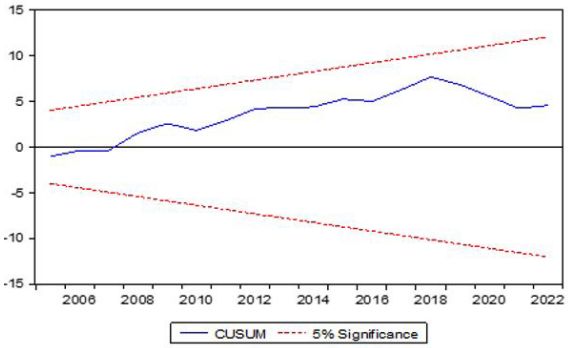
The export price variable (LnPRICEt) shows a significantly negative effect, which means that excessive price pressure can reduce the industry's competitiveness. In addition, the lag domestic consumption variable (D(LnCONS$_t$(-1))) has a significant negative effect, while FDI (D(LnFDIt(-1))) also shows positive significant effect. The value of (CointEq(-1)) is −0.341 and significant at the 1% level, indicating that approximately 34.1% of the short-term imbalance will be corrected towards long-term equilibrium each period. The adjusted R-squared value of 0.977 means that the model can explain 97.7% of the variability in industry competitiveness, and the Durbin-Watson value of 1.997 indicates the absence of autocorrelation. Therefore, our model is fit and robust for the estimation.

Variables	Coefficient	Std. error	Probability
Longrun Estimation			
LnLANDt	-1.131	0.816	0.184
LnCONSt	-0.247	0.195	0.222
LnGDPt	0.830	0.398	0.053*
LnMANVt	1.737	0.600	0.010**
LnFDIt	0.151	0.056	0.015**
LnPRICEt	-0.407	0.203	0.061*
CointEq(-1)	-0.341	0.071	0.000***
Constant	-3.629	5.795	0.539
Shortrun Estimation			
RSCA (-1)	0.659	0.071	0.000***
LnLAND	-0.385	0.260	0.157
LnCONS	-0.166	0.129	0.214
LnCONS(-1)	-0.113	0.112	0.328
LnCONS(-2)	0.195	0.095	0.056*
LnGDP	0.416	0.096	0.001***
LnGDP(-1)	0.133	0.053	0.022**
LnMANV	0.592	0.155	0.001***
LnFDI	0.010	0.014	0.506
LnFDI(-1)	0.014	0.015	0.355
LnFDI(-2)	0.028	0.014	0.070*
LnPRICE	-0.296	0.059	0.000***
LnPRICE(-1)	0.158	0.049	0.005***
Constant	-1.236	2.072	0.559
R-squared	0.987		
Adjusted R-squared	0.977		
Durbin-Watson stat	1.9974		

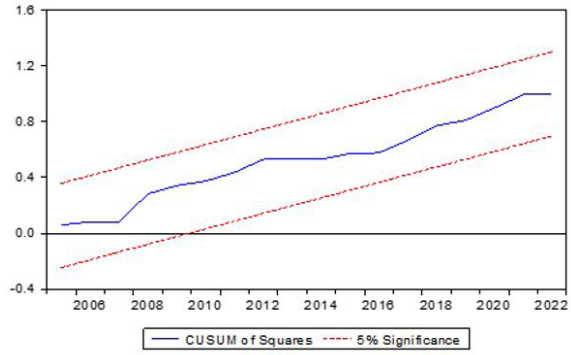
Notes: *, **, and *** are significant at 10%, 5%, and 1%, respectively.
Source: Author analysis, 2025

Table 8: Long-run and short-run estimations.

Furthermore, we also conducted stability tests to verify the model consistency over time, to ensure the validity of the estimates and the consistency of the economic inferences. Figure 4 shows the stability tests, indicating that the model is stable through the CUSUM and CUSUMQ tests. The graph plot shows that the blue line does not cross the red line at the upper and lower limits, which are the critical value line indicating the estimation technique's stability. Furthermore, the CUSUM and CUSUMSQ plots do not support parameter instability. These results indicate that the downstream competitive positioning model used in this study has been correctly determined, confirming its stability over the sample period.



CUSUM



CUSUM of Squares

Source: Author analysis, 2025

Figure 4: CUSUM and CUSUM of squares.

Table 9 presents various diagnostic test results for the classical model assumptions. The probability value of the Breusch–Godfrey is 0.798, as well as the heteroscedasticity test value with several tests, including Breusch–Godfrey, Glesjer, and Harvey, showing probability values of 0.995, 0.851, and 0.310 > α (0.05) respectively, so there are no heteroscedasticity and autocorrelation problems in this model. We also ran a data normality test to ensure the data used in this research model was normally distributed. The probability value was found to be 0.626 > α (0.05), so it can be stated that all data in this model was normally distributed.

	Obs*R-square	F-Statistics	Probability
Serial correlation: Breusch-Godfrey Serial Correlation LM Test	0.449	0.11	0.798
Heteroskedasticity Test: Breusch-Pagan-Godfrey	12.585	0.894	0.995
Heteroskedasticity Test: Glesjer	13.597	1.021	0.851
Heteroskedasticity Test: Harvey	19.181	2.122	0.31
Jarque-Bera and Probability			
	Jarque-bera		Probability
Normality: Jarque-Bera (Probability)	0.935		0.626

Source: Author analysis, 2025

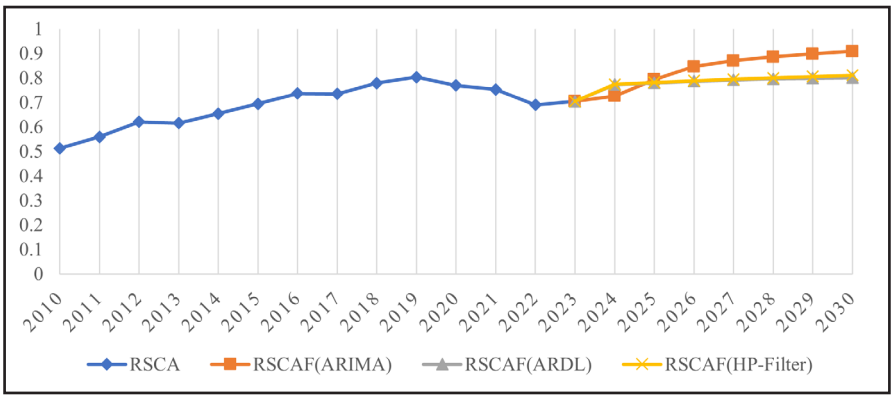
Table 9. Diagnostic test.

Forecasting of Indonesia's downstream coffee industry competitiveness

Figure 5 and Table 10 presents the forecasted results of the RSCA value, representing Indonesia's downstream coffee industry's competitiveness for 2024–2030, based on three forecasting approaches: ARIMA, ARDL, and HP-Filter. The HP-Filter model produces a conservative and stable projection, with the RSCA value gradually increasing from 0.774 in 2024 to 0.811 in 2030. This projection reflects a linear trend based on historical patterns, assuming minimal structural changes in processed coffee export dynamics. In contrast, the ARIMA approach produces the most optimistic projection, with the RSCA value estimated to increase from 0.727 to 0.909 over the same period. This sharp increase indicates the potential for significant acceleration in competitiveness, which aligns with expectations of industrial reforms and improvements in downstream capabilities. The ARDL model, on the other hand, produces more moderate but realistic results, with the RSCA value increasing from 0.773 to 0.800. This projection reflects a balance between short and long-term dynamics, without exhibiting the extremes of ARIMA. Collectively, these three models reveal a consistent upward direction, suggesting that Indonesia's downstream coffee industry is beginning to show encouraging signs of improvement in its competitive performance.

The forecast results show early indications of improvement and underlying growth potential within Indonesia's downstream coffee industry. Rather than signalling immediate expansion, the projections point to gradual structural strengthening supported by improvements in processing capability, product innovation, and export diversification. These patterns suggest that Indonesia is progressively moving toward a more competitive and resilient value-added coffee sector. However, the realisation of this potential will depend on consistent policy implementation and responsiveness to global market dynamics. From a policy perspective, the findings emphasise the importance of maintaining strategic support for industrial upgrading, technological advancement, and market development to translate this potential into tangible competitiveness gains. Encouraging greater participation from both domestic and international investors in processing, branding, and quality improvement will also be essential for consolidating Indonesia's position within the global processed coffee value chain. Overall, the forecasting results provide meaningful signals of emerging competitiveness, reflecting a gradual transition toward higher value creation and sustainable downstream development.

Furthermore, this study incorporates the potential impact of global demand shocks to capture how external market dynamics may shape the future performance of Indonesia's downstream coffee industry. The simulation framework focuses on two key scenarios that represent the primary channels of global demand fluctuation. The first is the consumption-shock scenario, which captures the impact of declining global coffee consumption on export performance. The second is the price-shock scenario, which reflects the effects of rising international coffee prices on competitiveness. Figure 6 presents the results of the simulation analysis, showing a consistent decline in competitiveness under both consumption and price shock scenarios as the magnitude of the shocks increases. Under the consumption-shock scenario, the baseline value of 0.7403 decreases slightly to 0.7306 when consumption falls by 5 percent, and continues to decline to 0.6963 and 0.6624 at 10 and 15 percent reductions, respectively. This pattern indicates that a contraction in global coffee consumption moderately weakens Indonesia's



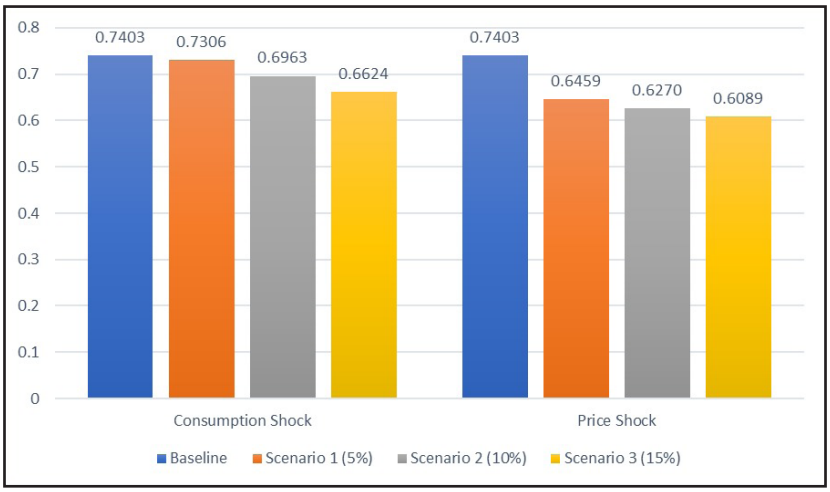
Source: Author analysis, 2025

Figure 5: Forecasting of Indonesian downstream coffee industry competitiveness.

Year	HP-Filter	ARDL	ARIMA
2024	0.774322018	0.773399179	0.726954439
2025	0.782046522	0.78048254	0.793637138
2026	0.788792255	0.786782517	0.846184877
2027	0.794817133	0.792100257	0.870719061
2028	0.800358973	0.796220719	0.886370239
2029	0.805628422	0.799014356	0.898496871
2030	0.810794746	0.800482256	0.908817676

Source: Author analysis, 2025

Table 10: Forecasting of Indonesian downstream coffee industry competitiveness.



Source: Author analysis, 2025

Figure 6: The Simulation of RSCA under shock scenario, value from actual data 2023.

downstream industry performance. Under the price-shock scenario, the impact is more substantial, with competitiveness declining from 0.7403 to 0.6459, 0.6270, and 0.6089 under 5, 10, and 15 percent price increases. The sharper decrease under the price-shock simulation demonstrates that fluctuations in export prices have a more substantial and more immediate effect on Indonesia's downstream coffee competitiveness compared to consumption shocks. The observed pattern suggests that the global demand shift driven by price dynamics poses a greater challenge to Indonesia's downstream coffee industry than changes in aggregate consumption. Price instability directly affects export margins, production costs, and value-added returns, which in turn influence the competitive structure of the industry. The results imply that the resilience of Indonesia's

downstream coffee sector is closely tied to the stability of international coffee prices, reflecting its dependence on global market valuation and cost transmission mechanisms within the value chain.

The competitive position of the downstream coffee industry in Indonesia has exhibited significant potential, as evidenced by a consistent growth trend and an enhancement in competitiveness over the past two decades. This growth in industrial competitiveness is inseparable from the government's strategic role in encouraging downstream processing through fiscal incentives, strengthening logistics infrastructure, and expanding access to foreign markets through bilateral and regional trade agreements. Furthermore, industrial transformation is also driven by improved product quality and connectivity within a more complex and digital global value chain system, including the integration of technology into production and distribution processes (Suzianti et al., 2024). Nevertheless, challenges in adopting global quality standards and sustainability issues remain crucial factors that must be considered in maintaining competitiveness (Wang et al., 2024). The success of commodity-based industries depends on adapting to evolving market expectations, including supply chain sustainability and transparency (Gardner et al., 2019). However, in reality, for emerging markets like Indonesia, adopting sustainable certification strengthens the legitimacy of Indonesian downstream coffee products in premium export markets. However, this certification process is often more accessible to large-scale players than to small businesses (Donovan, Blare and Poole, 2017). The main obstacles to certification adoption by smallholder farmers in Indonesia include high costs, low direct economic incentives, and weak local institutional support, reflecting a disconnect between compliance with standards and the tangible benefits experienced by upstream actors (Glasbergen, 2018).

The results of the ARDL estimation based on the Porter Diamond model indicate that land area has no significant effect on industry competitiveness. This finding differs from Yadav and Chattopadhyay (2024), who found that yield positively contributes to the export competitiveness of agricultural products, and Long (2021) emphasised the importance of land availability in supporting large-scale production in the upstream sector. However, because this study focuses on the downstream industry, the role of land becomes less dominant, as competitiveness is determined more by processing efficiency, post-harvest technology utilisation, supply chain integration, product quality standards, and the ability to create differentiation and added value that aligns with market preferences. In the demand condition component, GDP has a positive effect in both the short and long term. Exporting countries with high GDP are linked to greater export competition, especially among regions with similar economic profiles (Li et al., 2022). Higher GDP can intensify competition for export markets, particularly in regions with many similar exporters. Furthermore, GDP can also significantly enhance the competitiveness and growth of a country's manufacturing sector, thereby creating greater added value (Hotsawadi and Gea, 2024).

Interestingly, this study reveals that in the short term, domestic consumption can reduce the competitiveness of downstream industries. Domestic consumption and competitiveness are closely linked, particularly in the context of global disruption and supply chain changes (Willer and Aldridge, 2023). Increasing domestic consumption can strengthen food security and resilience and drive stable demand for industries, including downstream sectors such as coffee processing. However, excessive reliance on the domestic market or high domestic market concentration can reduce international competitiveness and limit productivity gains from participation in global trade (Fambeu and Yomi, 2025). Therefore, encouraging domestic consumption needs to be balanced with active involvement in international trade and avoiding excessive domestic market concentration to maintain sustainable competitiveness and productivity growth. A country's industrialisation capacity represents related and Supporting Industries. This study shows that manufacturing value-added has a positive and significant impact on short- and long-term competitiveness. Investing in advanced technology and innovation can increase product added value, directly strengthening competitiveness (Huo, 2014; Chikán et al., 2022). Downstream industries with dynamic production capabilities and strong innovation management tend to outperform those that rely solely on basic production capabilities.

Furthermore, FDI, as a proxy for Firm Strategy and Rivalry, has a significant positive effect in both the short and long term, as it enables technology transfer, the adoption of international quality standards, and the expansion of export market networks (Skare and Cvek, 2020). Simionescu

et al. (2021) stated that FDI is a driver for integration in global value chains, especially when directed to the downstream sector and supported by facilitative policies. This study also revealed that price, as a component of government and change in the Porter Diamond model, has a negative effect on competitiveness. These results indicate that increasing commodity prices do not automatically contribute to improved competitiveness, especially if downstream products do not yet have a strong brand position or cannot meet premium market preferences (Yu et al., 2024). The increase in commodity prices does not necessarily strengthen the competitiveness of downstream industries, considering that Indonesian exports are still dominated by raw material-based products that produce low added value, and the export structure is not yet optimally diversified, limiting the industry's capacity to respond to demands for innovation and quality in the global market. Therefore, policies to increase competitiveness are insufficient to rely solely on production expansion or macroeconomic growth, but must also be directed at creating an innovative, vertically integrated downstream ecosystem capable of producing high-value processed coffee products.

Conclusion

This study reveals that the competitiveness of the downstream coffee industry in Indonesia has exhibited significant potential, as evidenced by a consistent growth trend and an enhancement in competitiveness over the past two decades. The Porter Diamond model developed in this study reveals that GDP, value-added in the manufacturing sector, and foreign direct investment play significant roles in driving competitiveness, both in the short and long term. Conversely, variables such as land area and domestic consumption have not significantly contributed to the downstream industry's competitiveness. The forecasting results developed in this study using ARIMA, HP Filter, and ARDL forecasting also indicate that the competitiveness of the downstream coffee industry in Indonesia is projected to continue growing between 2024 and 2030.

These findings carry important implications for both policymakers and industry stakeholders, indicating that strategies to enhance the downstream coffee industry competitiveness should prioritise strengthening manufacturing capabilities, improving product quality, and optimising the flow of foreign investment. Furthermore, government policy must be directed to developing pricing strategies oriented toward premium markets and product differentiation, rather than simply focusing on raw commodity volume or price. This study is limited in the scope of variables analysed, as it does not explicitly include institutional factors, regulations, technology, and the dynamics of the global crisis. The omission of these dimensions may reduce the model's ability to capture structural transformations and external disruptions, such as technological adoption, climate-related risks, or policy and market shocks that could influence long-term competitiveness. Future studies are recommended to incorporate these factors through more complex and comprehensive scenario-based or simulation analyses, enabling the assessment of alternative policy, technological, and environmental pathways. In addition, future research may employ a longer dataset in forecasting analysis to improve the robustness and accuracy of the results, and replication of this study in other major coffee-producing countries is encouraged to strengthen the empirical findings and enhance generalizability.

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