Comparative and Competitive Advantages in Coffee Exports: Examining the Role of FDI and Exchange Rates

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Abstract. This study examines the effects of foreign direct investment (FDI) inflows and real exchange rates on the quantity of coffee exports, while explicitly accounting for the roles of comparative and competitive advantages. Using annual data for Brazil, Vietnam, Colombia, Indonesia and India over the period 2009–2019, we estimate a panel path analysis model within a structural equation modelling framework. Comparative advantage is measured using the normalised revealed comparative advantage index, and competitive advantage is proxied by differences in export price indices. The empirical results show that FDI inflows have a positive and statistically significant direct effect on coffee export quantity, confirming their role in strengthening export capacity through technology, capital and market access. However, FDI exerts a significant negative indirect effect on exports through comparative advantage, while the indirect effect through competitive advantage is not significant. The real exchange rate has a negative and significant direct impact on coffee exports, indicating that exchange rate depreciation is associated with lower export volumes in the coffee sector, whereas its indirect effects through comparative and competitive advantages are not significant. Overall, the findings highlight the importance of jointly considering international capital flows, exchange rate movements and structural trade advantages when formulating policies to enhance coffee export performance in major producing countries.

Keywords: coffee exports, comparative advantage, competitive advantage, foreign direct investment (FDI), real exchange rate.

1 Introduction

Several studies have examined the impact of FDI inflows and exchange rates on trade. Some studies reveal a relationship between FDI inflows and exchange rates on trade with various impacts [1], [2]. From the perspective of coffee researchers, FDI is part of the input and can change the production cycle. From the perspective of coffee researchers, the exchange rate is considered a tool for maintaining the value of coffee farmers' profits [3].

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Since the dissolution of the International Coffee Agreement (ICA) in 1989, coffee commodities have transformed the production cycle to export sales. Free market prices have caused some countries to stop producing coffee and exit the international coffee market. Countries that can survive are those that maintain the profits and quality of their coffee farmers through various policies [3].

From a theoretical perspective, these two theories discuss trade competition. Comparative advantage and competitive advantage. Comparative advantage sees FDI as a production technology that can boost production to meet domestic and international demand [4]. From the perspective of the competitive advantage theory, FDI is a government effort to support the domestic business cycle to compete in the international business cycle [5].

From a comparative theory perspective, the exchange rate is seen as a government subsidy to increase exports [6]. From the perspective of competitive advantage, the exchange rate is a measure of a country's competitiveness [7]. These two trade theories have different perspectives, the comparative theory which sees advantages based on competition between countries, and the competitive theory which sees advantages based on domestic industry competition which will be adopted in this study.

In this study, we examine the effects of FDI inflows and real exchange rates on coffee exports directly or indirectly through comparative advantage and competitive advantage in the five largest coffee-exporting countries during the period 2009-2019. We use the comparative value of coffee exports as a measure of comparative advantage, and the difference in the coffee export price index as a measure of competitive advantage that can affect the quantity of coffee exports.

The next section in this article, Section II discusses the literature review as the basis for the formation of this article. Section III discusses the estimation model and Section IV discusses the estimation results and discussion. Section V concludes the paper by discussing the effect of FDI and the real exchange rate on coffee export quantity.

2 Literature Review

This section discusses the literature that supports the effects of FDI inflows and real exchange rates on exports and international trade.

Mundell, R.A. [8] initially investigated the relationship between foreign direct investment (FDI) and exports. Using the assumptions of the Heckscher-Ohlin-Samuelson theory. He emphasized that capital mobility drives exports. In product life cycle theory, Vernon, R. [9] saw the effect of FDI on trade that can change the phase of the production cycle. The presence of FDI is initially intended to fulfill domestic demand, and surplus domestic production is exported to foreign markets. With good quality, demand for products increases in foreign markets. Domestic firms start producing goods at a lower cost in response to foreign demand.

In addition, other theories such as Williamson's internalization theory Brainard, S.L. [10], Dunning, J.H. [11], Markusen, J. R., Venables, A. J. [12] state that factor mobility between countries is caused by high firm-fixed costs, transportation costs, and trade barriers. With FDI, trade barriers could be reduced.

On the other hand, Helpman, E. et al. [13] show a complementary relationship between exports and FDI depending on the type of FDI. FDI is divided into two types, horizontal FDI which has subsidies at each country's interest rate due to transport costs, or closest to the final consumer. Vertical FDI is seen from each stage of the production process in different countries according to its cost advantage. Horizontal FDI shows strong negative dominance over exports. Markusen, J. R., Venables, A. J. [12] developed a similar model based on countries with different capital and technological advantages, and found that trade and FDI have a substitution relationship.

Another theoretical contribution showing that FDI and trade are complementary is the Helpman model. Helpman, E. [14] model states that, in the case of vertical FDI, there is a complementary relationship between the trade flows of final goods from foreign firms to domestic firms and inter-firm transfers of intermediate goods from domestic firms to foreign firms.

This model suggests that vertical FDI should be used in the relationship between developing and developed countries. Firms contribute to foreign markets with high demand for one product from the rest of the world [15]. Another reason for the complementary relationship between FDI and trade is that investment by firms increases the input of exported goods from domestic to foreign sources [16]. Chang, Y.-M., Gayle, P. G. [17] state that FDI can be a solution for exporting firms that face demand volatility.

From an exchange rate perspective, Mehare, A., Edriss, A. K. [1] reveal that domestic producers and consumers respond to world prices in domestic currency, and devaluing the currency increases the price of exported goods. Thus, for a certain world price, producers receive the price per unit of export using a higher national price. Therefore, the Real Exchange Rate (RER), according to Mehare, A., Edriss, A. K. [1], is a form of a country's competitiveness.

Similarly, Dang, T.T. et al. [6] confirmed the effect of exchange rates on international trade and exports on the price of agricultural goods with various impacts, as supported by Devadoss, S. [18], Doğanlar, M. [19], Wang, K. L., Barrett, C. B. [20]. Doğanlar, M. [19] found that exchange rate volatility reduces real exports, or that the exchange rate has a negative and significant effect. Xie, J. et al. [21] added that the exchange rate effect can be negative, but positive or insignificant if the exchange rate effect between countries is tested.

[22] also add that exchange rate volatility has no significant effect on exports in the long run. This argument has been tested in Turkey, although with a small magnitude of volatility effect. However, in the short run, there is a relationship between exchange rate volatility and export demand in Indonesia and Mexico [6], while in Nigeria, exchange rate volatility indirectly affects export demand.

Thuy, V.N.T., Thuy, D.T.T. [23] argued differently from Asteriou, D. [22], according to Thuy, V.N.T., Thuy, D.T.T. [23], who argued that exchange rate volatility harms export volumes even in the long run. In the case of developing countries, in the short term, trade payments are made in foreign currency, resulting in high dollarization in the country (always above 15% in the case of Vietnam). In developing countries such as Vietnam, in the long run, exchange rate volatility has a high risk, and a higher value

of risk will lead to an increase in the cost of maintaining future profits. This reduces the volume of the transactions in the market.

Furthermore, Asteriou, D. [22] reveal that the impact of exchange rate volatility on international trade activity can be both positive and negative, depending on the assumptions used and the characteristics of the goods tested in the market. However, more theoretical studies support the idea that increasing exchange rate volatility reduces international trade volume.

According to Lewin, B. et al. [24], in the coffee market, the exchange rate is considered a risk cost that must be borne by producers. In line with Lewin, Ahmad, I. [25] states that when experiencing devaluation or overvaluation, the country will gain a comparative advantage. Judging from the small risk that producers will lose profits when the country experiences devaluation or overvaluation.

Porter, M. E. [26] argues that the exchange rate is one of the factors that determine competitiveness. An appreciating or undervalued exchange rate will make the price of goods competitive in the international market because of the difference between domestic and international prices. Therefore, countries that appreciate or undervalue are competitively superior in the international market.

3 Methodology

This section describes the data and models used in this study. We used a sample of five coffee-producing countries, including Brazil, Vietnam, Colombia, Indonesia, and India during the period 2009-2019. We use a panel path analysis model to analyze the effect of FDI inflows and real exchange rates directly and indirectly through comparative and competitive advantages on coffee export quantity.

We use normalized revealed comparative advantage (NRCA), based on Yu, R. et al. [27], to measure comparative advantage.

$$\text{NRCA}_{ij} = \left(\frac{E_{ij}}{E}\right) - \left(\frac{E_i \cdot E_j}{E \cdot E}\right) \quad (1)$$

Where E_{ij} is the Domestic coffee export value, E_i is the Total export value of all domestic commodities, E_j is the average total export value of coffee commodities in coffee-producing countries, and E is the average total export value of all commodities in the coffee-producing countries.

To measure competitive advantage, we used price differentials based on Durand, M., Giorno, C. [28].

$$\text{Comp}_{ij} = P_{xi} - PC_{xik} \quad (2)$$

Where P_{xi} is the coffee export price of country i and PC_{xik} is the average coffee export price of coffee-producing countries

We used data on the percentage of FDI inflows to Gross Domestic Product (GDP) obtained from the World Bank and real exchange rate data obtained from the International Monetary Fund (IMF). Data on coffee export quantity and price were

obtained from the International Coffee Organisation (ICO). Data on the value of coffee exports were obtained from the Trade Map for the period 2009–2019. The Structural Equation Model (SEM) equation in this study can be expressed as follows:

$$Y_{1it} = \alpha_0 + \alpha_1 X_{1it} + \alpha_2 X_{2it} + \mu_{1it} \quad (3)$$

$$Y_{2it} = \beta_0 + \beta_1 X_{1it} + \beta_2 X_{2it} + \mu_{2it} \quad (4)$$

$$Y_{3it} = \chi_0 + \chi_1 Y_{1it} + \chi_2 Y_{2it} + \chi_3 X_{1it} + \chi_4 X_{2it} + \mu_{3it} \quad (5)$$

where Y_3 is coffee exports, measured by the coffee export weight of 60 kg/bag; Y_1 is the comparative advantage measured by coffee export value comparison calculated using normalized revealed comparative advantage (NRCA); Y_2 is competitive advantage measured by coffee export price difference as a representation of competitive advantage; X_1 is FDI inflows measured through the percentage of FDI inflows to GDP; X_2 is the real exchange rate measured through the nominal exchange rate multiplied by the ratio of domestic and US prices; α_0, β_0, and χ_0 are constants; α_1, ..., α_n, β_1,... β_n and χ_1,..., χ_n are each parameter estimated; and μ_1, μ_2, and μ_3 are random errors.

The reduction form based on Equations 3, 4, and 5 can be presented as follows:

$$Y_{1it} = \alpha_0 + \alpha_1 X_{1it} + \alpha_2 X_{2it} + \mu_{1it} \quad (6)$$

$$Y_{2it} = \beta_0 + \beta_1 X_{1it} + \beta_2 X_{2it} + \mu_{2it} \quad (7)$$

$$Y_{3it} = A_0 + A_1 X_{1it} + A_2 \ln X_{2it} + \mu_{123it} \quad (8)$$

Where α_0, β_0, and A_0 ($\chi_0 + \chi_1\alpha_0 + \chi_2\beta_0$) are constants; α_1, ..., α_n and A_1 ($\chi_1 + \chi_1\alpha_1 + \chi_2\alpha_1\beta_2$), ... An are the total effects of variables X_1 , ..., X_n to variables Y_1, Y_2 , and Y_3 ; μ_{123} ($\mu_3 + \mu_1\beta_1 + \mu_2\chi_1$) is the composite random error.

4 Result

Table 1 presents the regression estimation results and related statistics. The reduced form of simple path analysis is used to measure coffee export behavior with two international policy variables: FDI inflows and the real exchange rate as exogenous variables. The comparative advantage and competitive advantage of five coffee-producing countries (Brazil, Vietnam, Colombia, Indonesia, and India) as endogenous variables intervene in the target variable of coffee exports. Directly, the coefficients of FDI inflows and the real exchange rate are significant at the 5 % significance level, and the direct relationship of the comparative advantage coefficient is also significant for coffee exports. The direct relationship between the coefficient of competitive advantage and coffee exports is insignificant.

Table 1. Estimate Result

Direction of Effect	Regression Coefficient	t-Statistic	Probability
x1 => y1	-0.401*	-3.3062	0.000
x1 => y2	-0.427*	-4.259	0.000
x1 => y3	0.824*	6.352	0.000
x2 => y1	. -0.087	-0.718	0.473
x2 => y2	-0.340*	-3.391	0.000
x2 => y3	-0.234*	-2.019	0.043
y1 => y3	0.2521*	2.147	0.032
y2 => y3	0.112	0.788	0.431

Note: *) significant at α = 5%

FDI inflows are not expected to be significant and have a negative effect on comparative advantage. However, FDI inflows have a significantly positive effect on coffee exports, as expected. Comparative advantage is significant with a positive effect on coffee exports, which makes the total effect of FDI inflows indirectly significant in negatively affecting coffee exports through comparative advantage.

This result is consistent with Chang Moon, H. [5] and Vernon, R. [9], who stated that FDI is directly part of input technology that can reduce input factors and is part of innovation. The presence of foreign capital provides capital exchange, as well as labor and technology. Foreign capital can also facilitate trade with marketing, transportation, communication, and financial services that can increase the production and interest of domestic producers to export [2].

Conversely, increasing FDI inflows reduces the quantity of coffee exports through comparative advantage. FDI gives domestic producers a comparative advantage over foreign competitors, with the presence of FDI providing advantages in terms of capital and export access. The superiority of export access reduces transaction costs when exporting compared with competing countries [2], [3], [4], [24], [29].

However, an increase in domestic comparative advantage among competitors leads to a decrease in coffee exports. Coffee commodities have oligopoly market characteristics; a country's superiority in the comparative advantage of coffee export value will cause an increase in the transaction costs (tariff and non-tariff) of domestic exports. The large demand from domestic consumers causes policymakers to limit exports through policies such as export taxes to dampen foreign demand, so that domestic coffee commodity prices do not increase.

The importance of considering domestic demand for comparative advantage has been emphasized by the comparative product cycle hypothesis. This result is inconsistent with Widodo, T. [29] and the initial hypothesis that states the country's superiority in comparative advantage will increase the quantity of exports. This result is in line with that of [2], [3], [4], [24], [29]. These studies consider the pattern of domestic demand in an imperfectly competitive market. When domestic market demand is fulfilled, export demand from countries with similar demand patterns or tastes increases. Conversely, when domestic market demand is not met, the government issues policies to reduce exports.

On the contrary, the real exchange rate is directly significant and has a negative effect on coffee export quantity. The real exchange rate also has a significant negative effect on competitive advantage. However, the total effect of the real exchange rate on coffee export quantity was found to be insignificant through comparative advantage and competitive advantage. This result was consistent with that reported by Devadoss, S. [18], Doğanlar, M. [19], Wang, K. L., Barrett, C. B. [20]. Doğanlar, M. [19] states that exchange rate depreciation reduces real exports. This result is also reinforced by [21], who found that the exchange rate can have a negative impact.

Thuy, V.N.T., Thuy, D.T.T. [23] also argued that in the case of developing countries, trade payments are made using foreign currency, resulting in high dollarization in the country. Exchange rate depreciation has a high risk in the coffee commodity because of the long production process; the higher the risk, the higher the costs to maintain coffee farmers' future profits. This will reduce the volume of transactions in the market. Lewin, B. et al. [24] support this the exchange rate is considered a cost risk that producers must bear.

5 Discussion

This study set out to clarify how foreign direct investment (FDI) inflows and the real exchange rate shape coffee export performance in major producing countries, whilst explicitly considering whether comparative advantage and competitive advantage transmit these effects. The results provide a nuanced answer to the debates raised in the literature review, which have long documented that the direction of the FDI–trade nexus and the exchange rate–export relationship is theoretically and empirically contingent on underlying market structures, firm strategies, and macroeconomic conditions [8], [12], [13], [22].

5.1 FDI inflows and coffee export performance

The estimation indicates that FDI inflows exert a positive and statistically significant direct effect on coffee export quantity. This finding supports the view that international capital mobility can strengthen export capacity by relaxing financial constraints, improving technology, and expanding market access, thereby raising export supply [8]. It is also consistent with product cycle arguments that associate FDI with upgrading production processes and facilitating the transition from serving domestic markets towards exporting surpluses as production efficiency improves [9]. In the context of multinational activity, internalisation and related frameworks further suggest that FDI can mitigate trade frictions and reduce barriers to reaching foreign markets, which is compatible with the observed direct export-enhancing effect [10], [11], [12]. Moreover, the notion that FDI can help exporting firms manage volatility and sustain export participation also aligns with the positive direct relationship found here [17].

At the same time, FDI inflows are estimated to reduce coffee comparative advantage, measured by the normalised revealed comparative advantage (NRCA), and comparative advantage is positively related to coffee export quantity. This

configuration implies a statistically meaningful negative indirect effect of FDI via comparative advantage. This result refines the theoretical discussion on whether FDI and trade are complements or substitutes. Whilst some models predict complementarity, particularly under vertical FDI and fragmentation of production across borders [14], others predict substitution, especially when multinational production replaces exports from the home economy or when investment encourages reallocation towards alternative activities [12], [13]. Interpreted within this broader debate, the negative association between FDI and coffee NRCA suggests that higher FDI may coincide with a relative weakening of coffee specialisation in national export structures, even if FDI simultaneously expands coffee export volumes through capacity and market access channels. In other words, FDI can raise the level of exports while reducing the relative prominence of coffee within a country's export basket, which is precisely what a revealed comparative advantage measure is designed to capture [27]. This helps explain why the indirect pathway through comparative advantage is negative even though the direct pathway is positive.

By contrast, the indirect effect of FDI through competitive advantage is not supported. Although FDI inflows are associated with a reduction in the competitive advantage proxy, the price differential itself does not significantly explain export quantities in this sample. This suggests that price-based competitiveness, as proxied here, may not be the principal mechanism through which FDI translates into larger coffee shipments. One plausible interpretation is that the coffee market often features strong product differentiation and quality segmentation, limiting the extent to which relative export prices alone govern export volumes. Under such conditions, FDI may operate more through supply-side capacity, standards compliance, logistics, and contracting relationships than through the narrow channel of price undercutting.

5.2 Real exchange rate effects on exports and competitiveness

The real exchange rate exhibits a negative and statistically significant direct effect on coffee export quantity. This finding speaks directly to the mixed evidence in the literature. Some contributions argue that exchange rate movements can act as a competitiveness instrument, where depreciation improves export incentives by raising domestic currency returns, thereby supporting exports [1]. However, a substantial body of empirical work finds that exchange rate volatility and adverse currency movements can depress export volumes, particularly for agricultural commodities, through heightened uncertainty, risk premia, and reduced trade participation [18], [19], [20], [22]. The present results are consistent with the strand documenting negative export responses, including evidence that depreciation or volatility can reduce real exports [19] and that the sign may vary across country pairs and settings [21].

The negative export response is also consistent with arguments emphasising risk and currency mismatch in developing economies. When trade payments and input costs are heavily foreign-currency denominated, exchange rate depreciation can increase effective production and financing costs, raise hedging expenses, and compress margins, particularly in sectors with long production cycles such as coffee [23]. This mechanism resonates with the view that exchange rate movements constitute a risk cost

borne by coffee producers, which may lead to more cautious export behaviour and lower realised export volumes [24]. In short, the evidence suggests that, for coffee, exchange rate depreciation is not automatically export-expanding; instead, it can be export-reducing when risk, dollarisation, and cost pass-through dominate incentive effects.

The real exchange rate is also found to reduce the competitive advantage proxy, yet competitive advantage does not translate into statistically significant changes in export quantity. This pattern implies that the exchange rate affects price positioning relative to competitors, but that such price positioning is not sufficient to explain export volumes in this sample. Whilst competitiveness frameworks highlight the exchange rate as a determinant of international price competitiveness [26], the absence of a volume response through the price differential suggests that quantity adjustments may be constrained by supply rigidities, contractual arrangements, or quality segmentation that decouples volume from small relative price movements. This is consistent with the broader literature noting that exchange rate effects on trade can be heterogeneous across commodities and market structures [22].

5.3 Comparative advantage versus competitive advantage as mediating mechanisms

A central motivation of the study was to jointly consider structural trade advantages in assessing policy effects. The estimates indicate that comparative advantage, as captured by NRCA, is a significant and positive determinant of export quantity. This supports the theoretical expectation that stronger revealed specialisation in coffee is associated with larger export volumes, reflecting deeper productive capability and sustained international demand [27]. In contrast, the price-differential proxy for competitive advantage does not significantly affect export quantity. This suggests that, in the coffee sector and within this sample, export performance is more strongly aligned with structural specialisation than with short-run price competitiveness. Such a result is not inconsistent with competitiveness theory; rather, it may imply that the selected proxy captures only one dimension of competitive advantage, whereas broader competitiveness, including productivity, branding, and value-chain positioning, may be more relevant than price gaps alone [26], [28].

5.4 Policy implications and interpretation

Taken together, the findings indicate that policies designed to improve coffee export performance should not treat FDI inflows and exchange rate movements as independent levers. FDI can support export expansion directly through capacity and market access channels [8], [9], [10], [11], [12], [17], yet it may simultaneously weaken coffee's relative specialisation, as reflected in NRCA, consistent with theories highlighting substitution or reallocation effects under certain forms of multinational activity [12], [13], [14]. Accordingly, policy frameworks that attract FDI should also consider how investment is allocated across sectors and within the coffee value chain so that gains in export capacity are not accompanied by an erosion of sectoral comparative strength.

For the exchange rate, the negative direct effect on export volume reinforces the need for macroeconomic stability and risk management mechanisms in commodity-exporting economies. Where depreciation increases uncertainty and costs, especially under foreign-currency exposure and long production horizons, export performance can deteriorate despite theoretical competitiveness arguments [1], [19], [22], [23], [24]. Policies that reduce currency mismatch, expand hedging access, and stabilise export financing conditions may therefore be as important as exchange rate level adjustments in supporting coffee exports

6 Conclusion

There is room for further research in this area. The insignificant positive coefficient of competitive advantage may require more research to analyze coffee export performance. International policies play an important role in determining coffee exports through comparative advantages. FDI inflows positively and significantly affect coffee exports directly but negatively and significantly through comparative advantage. The real exchange rate negatively and significantly affects coffee exports but insignificantly through comparative and competitive advantage.

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