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USING THE MIXED DATA SAMPLING (MIDAS) MODEL TO FORECAST VIETNAM'S COFFEE EXPORT GROWTH

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ABSTRACT

In recent years, mixed-frequency data analysis models have received much attention and application in the fields of economics and finance, especially in forecasting national macroeconomic indicators. However, in Vietnam, there are almost no studies applying these models. Vietnam is a country with a long-standing agricultural production background and the workforce mainly makes a living from farming. There are many types of Vietnamese agricultural products with high export value, bringing a significant source of foreign currency to the country. Coffee is Vietnam's main export product, a product that earns a lot of foreign currency, contributing to the country's socio-economic development. Therefore, applying models with mixed frequency data such as MIDAS to forecast coffee export growth is a promising new research direction.

KEYWORDS: Forecast; export growth; coffee; MIDAS model; Vietnam.

1 INTRODUCTION

In the context of the world economy in general and the Vietnamese economy in particular appearing more and more frequently unstable factors, accurately analyzing and forecasting the movements of economic indicators is essential.

Macroeconomics is extremely important in policy management and macroeconomic stability. A good analysis and forecast result will help the economy avoid disruptions, limit risks, and take advantage of development opportunities. Analyzing and forecasting macroeconomic indicators in general and forecasting export turnover in particular is always an urgent requirement, especially for a developing country like Vietnam, an open economy. Due to its small scale, it is vulnerable to adverse external fluctuations.

Therefore, researching and finding appropriate forecasting methods for Vietnam's export turnover is important. Over the past several decades, Vietnamese coffee production has developed as an export-oriented industry. Although coffee has gone through many ups and downs, fluctuations in output, turnover and export prices, it is always a key industrial crop, strategically linked to the lives of tens of thousands of producers, contributing to improve living standards and income for thousands of workers.

As the world's second largest coffee producer and exporter, our country's coffee products have been exported to more than 80 countries and territories, especially markets such as the United States and the EU, Japan, Korea, with the signing of free trade agreements, Vietnam's coffee export industry in recent years has increasingly improved in quality and output, enhancing competitiveness. Compete with other countries.

However, deep international integration will cause Vietnam's economy to suffer strong fluctuations due to shocks in the international market, typically the Covid-19 pandemic. When global supply chains break down, it will significantly affect the connection points of the chain (including Vietnam), thereby, there will be certain impacts and risks on export activities in General and coffee export activities in particular. The goal of manage macroeconomic policies in general and coffee export policies in particular in the new period of Vietnam.

MIDAS allows combining data from various sources with different time frequencies, enabling export data to be collected at multiple frequencies. Additionally, the coffee export market often experiences significant fluctuations influenced by various factors. MIDAS can model these fluctuations by utilizing both low-

frequency data (e.g., quarterly data) and high-frequency data (such as daily or monthly data). Moreover, the MIDAS model is suitable for integrating large amounts of data from diverse sources, therefore, in this study, the MIDAS model is applied to best exploit the collected data with different frequencies (weekly, monthly, quarterly, annually) and from various economic sectors to immediately forecast the growth rate of Vietnam's coffee exports. The study is evaluated with updated data from the 2021-2025 period.

2 LITERATURE REVIEW

2.1. Research on forecasting import and export growth

In 2018, a group of authors including Bui Thi Minh Nguyet, Nguyen Thi Quynh Nga, and Nguyen Thi Quynh Cham published a study titled "Using ARIMA Models to Forecast Export Values in Vietnam". The authors used the ARIMA (p,d,q) model and estimated parameters using Eviews 8 software. They tested the model using ACF correlation diagrams or Breusch-Godfrey tests, with a total of 102 observations. The results showed that ARIMA(1,1,16) was the most suitable model for data from 1/2010 to 6/2018, indicating that Vietnam's export situation in the last six months of 2018 was on an upward trend. According to the forecast results, the total export value in the last six months of 2018 was estimated to increase by USD 115 billion, up 1.3% compared to the first six months. The forecast results for the first six months were relatively close to the actual figures with the lowest error being 0.7%, an average error of 2%, and the export value for the last six months showed a higher increasing trend. The model provided valuable forecasts with relatively small errors compared to reality. However, the model is only applicable for short-term forecasts (up to 2 years) to maintain high accuracy, with accuracy decreasing rapidly over longer periods.

Overseas, there have been many studies on the ARIMA forecasting model. A notable example is the study "Forecasting China's Total Imports and Exports Based on ARIMA and Exponential Smoothing Models" by Yan Liu in 2024. The relative error value for the ARIMA model was 55.06%, and for the exponential smoothing model, it was 45.72%. Evaluating the research results of both models, both models showed good fit. Relatively speaking, the fit of China's export data in the exponential smoothing model was better than the ARIMA model. In the predictions of both models, the general trend of China's export data is upward and seasonal, which aligns with the actual situation. During the

pandemic, China's international trade faced significant challenges, and exports encountered considerable obstacles but also great opportunities. China needs to maintain a positive export level and adjust its export strategy accordingly to positively impact economic growth.

The study "Forecasting the Import and Export Volumes of the Kingdom of Saudi Arabia Based on ANN and ARIMA Models" in 2019. The author surveyed and concluded that: the ANN model and the ARIMA model are widely used in forecasting techniques. The ARIMA model is one of the best techniques for predicting the level of any time series data with any change model and is suitable for at least 50 observed variables. Through analysis, the ANN and ARIMA models were found to be the most suitable models for forecasting the total annual exports and imports of the Kingdom of Saudi Arabia. Previous research on export forecasting has proposed various methods, all of which rely on datasets where observed variables must be brought to the same frequency, potentially increasing estimation errors and omitting important factors affecting economic growth. Therefore, in recent years, the application of mixed data sampling (MIDAS) models to forecast economic growth has garnered significant attention from scientists worldwide.

Additionally, the study "Forecasting Chestnut Production and Export of Turkey Using ARIMA Model" by Baser et al., in 2018. Data was taken from the Food and Agriculture Organization (FAO) for the period 1961-2016. The Box and Jenkins linear time series model (also known as the ARIMA model) was used to forecast future production and export quantities. The study used the autocorrelation function (ACF) and the partial autocorrelation function (PACF) to investigate the stationarity of the data. Finally, to check if the residuals were white noise, the ACF of the residuals and the Ljung and Box (1978) statistic were used. The author concluded that the autocorrelation function is a useful tool for determining whether a time series is stationary. In this study, Turkey's chestnut production and export quantities were estimated for the period 2017-2021 using ARIMA(1,1,1) and ARIMA(1,2,1) models, respectively. For the chestnut production time series, the ARIMA (1,1,1) model was considered the most appropriate, while for the chestnut export time series, the ARIMA (1,2,1) model was considered the most appropriate. According to the model results, while chestnut production was almost stable, export quantities would fluctuate in the following years.

2.2. The research uses the Mixed Data Sampling (MIDAS) model to forecast import and export growth

A group of authors including Le Mai Trang, Hoang Anh Tuan, Nguyen Thi Hien, Dinh Thi Ha, and Tran Kim Anh published a study titled "Applying the MIDAS Model to Forecast Vietnam's Export Growth for the 2006-2020 Period". The group used data from various macroeconomic indicators collected at different frequencies (quarterly, monthly, weekly) from sources such as the General Statistics Office, IMF, WB, ADB, and Bloomberg during the period from 2006 to 2020. The dataset was divided into two periods: (i) 2006-2018 for parameter estimation in regression models; (ii) 2019-2020 for making forecasts. To forecast quarterly export growth, the research group used a dataset of 22 variables corresponding to 19 economic indicators (5 quarterly frequency variables, 14 monthly frequency variables) and 3 weekly frequency variables. They used 3 MIDAS models with 16 variables in each model, with 15 independent variables giving highly fitting results, accurately predicting the trends of Vietnam's export growth series. The forecast range of the three models was very narrow compared to actual values, with the mean absolute error of the three models ranging from 4% to 5%. Moreover, the forecast results closely tracked the peaks and troughs of the export cycle. Thus, the study further supported the feasibility of using the MIDAS model to forecast export growth. The MIDAS model is more effective for short-term forecasts, and with the same independent variables, higher frequency data yields better forecast results.

Conclusion: The studies mentioned hold significance not only in practical applications but also in subsequent research endeavors. They indicate that Vietnam's coffee exports have low value-added, significantly influenced by inflation and labor factors. Without a development strategy, Vietnam could quickly lose its position as the world's leading coffee exporter. However, the methods used in forecasting mainly rely on datasets with the same frequency (monthly, quarterly, yearly, etc.), while economic data is often published at varying frequencies. Furthermore, the use of mixed-frequency sampling models has not been widely adopted, mostly being used to forecast comprehensive economic indicators of a country rather than specific industries or sectors. To address these issues, the mixed-frequency data model is considered suitable for forecasting coffee export growth in Vietnam.

3 METHODOLOGY

3.1. Overview Of Mixed Frequency Data Analysis Models (MIDAS)

The mixed frequency data analysis model (MIDAS) was proposed by the author group Eric Ghysels, Arthur Sinko & Rossen Valkanov in 2002. The mixed frequency data analysis model is the regressions. The reduced-form parameterization involves sampling processes at different frequencies. In which, the explanatory variables have different frequencies, equal to or higher than the frequency of the dependent variable, and for explanatory variables with higher frequencies, lagged distribution polynomials are used to prevent the increase in frequency. Increase in the number of parameters as well as problems related to the choice of delay order. Basic mixed frequency data analysis model for one explanatory variable and the next step with $h_q = h_m/m$ is defined as follows:

$$y_{t_q} + mh_q = y_{t_m} + h_m = \beta_0 + \beta_1 b(L_m; \theta) x_{t_m+w}^{(m)} + \varepsilon_{t_m+h_m}$$

In there:

- y is the dependent variable with low frequency; x is an explanatory variable with high frequency.

- t_q is the time at which low-frequency data is available, t_m is the time when y has high frequency data available and h_q is the low frequency forecast time; h_m is the time of high frequency forecasting.

- m is an index that determines the higher frequency of the independent variable compared to the dependent variable.

For example, if y has a quarterly frequency and x has a monthly frequency, then $m = 3$, and if y has a quarterly frequency and x has a weekly frequency, then $m = 12$.

- $b(L_m; \theta) = \sum_{k=0}^k c(k; \theta) L_m^k$ is the lag polynomial with L_m is the delay operator defined by:

$L_m^k x_{t_m}^{(m)} = x_{t_m-k}^{(m)}$ sampled from high-frequency variables x_{t_m}

- $c(k; \theta)$ are the parameters of the model's lag coefficients that need to be estimated.

One of the main problems of the MIDAS method is to find a suitable parameterization for the lag coefficients $c(k; \theta)$. Because x_{t_m} has a higher frequency than y_{t_q} , full modeling often requires multiple lags in the regression equation, which can lead to over-parameterization. Some popular weighting schemes for parameterization such as Almon are also called "Exponential Almon Delay" corresponding to the Almon delay function. Specifically, the Almon diagram is represented as follows:

$$c(k; \theta) = \frac{\exp(\theta_1 k + \dots + \theta_Q k^Q)}{\sum_{k=1}^k \exp(\theta_1 k + \dots + \theta_Q k^Q)}$$

Where Q is the number of parameters of θ , or $\theta = (\theta_1, \theta_2, \dots, \theta_Q)$ are the parameters that need to be estimated. This function is quite flexible and can take many different shapes with just a few parameters. They can be ascending, descending or concave patterns. Ghysel, Santa-Clara, and Valkanov (2005) used this functional form with two parameters, which allows great flexibility and determines how many lags are included in the regression. Because the Almon lag scheme is the most commonly used and highly flexible, in this study the authors used the Almon lag scheme to determine appropriate parameterizations for the lag coefficients of the model.

Mixed frequency data analysis models are widely used in the financial sector; macroeconomics and was developed by Ghysels and a number of authors to produce extended models of unrestricted mixed frequency data analysis or U-MIDAS (a model for analyzing data with mixed frequency The mixture is supplemented with various restrictions on the influence of high-frequency variables by having each higher-frequency factor identified as an explanatory variable in a low-frequency regression, analyzing high-frequency data.

STEP weighted mixed probability or STEP-MIDAS (which is a U-MIDAS model where the coefficients for high-frequency data are constrained using the STEP function, augmented polynomial lag MIDAS model or ADL-MIDAS (where, for each high frequency up to k , the regression coefficients of the high-frequency components are modeled as a p -dimensional lag polynomial), the exponential Almon weighted MIDAS model or EAW-MIDAS (which is a MIDAS model using exponential weights Application of Composite Frequency Data Analysis Model to Forecast the Growth of Vietnam's Coffee Exports and second-order lag polynomials), β -weighted MIDAS model or BW-MIDAS (which is a MIDAS model using β -weighting function) (Andreou, Ghysels, and Kourtellos 2010; Ghysels, Kvedaras, and Zemlys 2016; Kvedaras et al. 2021). In particular, the U-MIDAS, STEP-MIDAS, and ADL-MIDAS models are estimated using the least squares (OLS) linear regression method, while the EAW-MIDAS and BW-MIDAS models are estimated. using the least squares nonlinear regression method. The advantage of the mixed frequency data analysis (MIDAS) model is that, in addition to overcoming the problem of mixed frequency data, it also reduces the number of estimated parameters and simplifies the regression model. simpler. The weighting function is used to reduce the number of parameters in MIDAS regression. According to published research results,

mixed-frequency data analysis models are often effective for immediate forecasting and short-term forecasting.

3.2. Methodology

3.2.1. General research method

- Qualitative research method: Conducted to synthesize, analyze, and compare to investigate studies in various research fields, including coffee export enhancement and growth forecasting models.
- Quantitative research method: Conducted to develop a model for forecasting the growth of Vietnamese coffee exports.

3.2.2. Project implementation process

3.2.2.1. Developing theoretical basis and gathering data variables

The authors engaged with theoretical frameworks concerning exports, export forecasting, and regression methods with mixed-frequency data. Additionally, the authors reviewed previous research to refine and enhance the theoretical framework regarding export forecasting, models with mixed-frequency data, identify issues raised, clarify unresolved aspects to determine new points and research scope in the topic. From a practical perspective, the research team examined the practicality of forecasting Vietnam's coffee exports, the process of data collection and publication of macroeconomic data. This aids in constructing an analytical forecasting model with mixed-frequency data, estimating the model, and proposing methods to forecast Vietnam's coffee exports in the near future.

Data was collected from secondary and primary sources regarding export volume, coffee cultivation area in Vietnam, as well as other macroeconomic data such as the consumer price index, balance of payments, spanning five years from 2021 to 2025. The reason for the authors to choose the period 2021 - 2025 is because the COVID-19 pandemic broke out strongly in 2021 the entire economy, economic indicators. The macroeconomic economy has strong fluctuations, which contributes to increasing the testability of the model. Data was sourced from official domestic and international channels such as the General Department of Customs, General Statistics Office, International Monetary Fund, etc. The authors based on analysis and synthesis methods to systematize general theoretical issues regarding exports, export forecasting, and MIDAS data models, based on inherited reference materials and research works domestically and internationally.

Subsequently, the team used comparative methods, testing on the basis of collected data to provide assessments and comments.

In this study, the authors forecast Vietnam's coffee export growth rate quarterly using the basic MIDAS model in which independent variables are selected at different frequencies. Analyses were performed on Excel and Eviews 12 software.

3.2.2.2. Variables included in the model

To forecast export growth rate by quarter, the research team based on a data set of 22 variables corresponding to 19 economic indicators (of which: 5 quarterly frequency variables, 14 monthly frequency variables) and 3 inverters. weekly rate, described in detail in Table 3.1, Table 3.2, Table 3.3.

Table 3.1: Quarterly frequency economic indicators

Variable	Unit	Economic Index
TTXK_Q	(%)	Export growth
TTGDP	(%)	GDP growth
CCTT	(%)	Balance of payments
DTTR	(%)	Net direct investment
TKV	(%)	Capital account

Source: Results of the authors' data analysis

Table 3.2: Monthly frequency indicators

Variable	Unit	Economic Index
TTDSBL	(%)	Retail sales growth
TDTQT	(%)	Total international reserves (excluding gold)
TTSXCN	(%)	Industrial production growth rate
TTNK	(%)	Growth of goods imports
TTCT_M	(%)	Money supply growth
CCTM	(%)	Balance of trade
TLDT_M	(%)	Reserve ratio
LP	(%)	Inflation rate
CSGCP		Index Composite stock price index
USD_M	USD/VND	exchange rate (1 month average)
LS	(%)	Interest rate
V_M	USD/OUNCE	Gold futures contract
CSTGHD		Index Exchange rate index
DT_M	USD/barrel	Crude oil futures contracts

Source: Results of the authors' data analysis

Table 3.3: Weekly frequency economic indicators

Variable	Unit	Economic Index
USD_W	USD/VND	exchange rate (1 week average)
V_W	USD/OUNCE	Gold futures contract
DT_W	USD/barrel	Crude oil futures contracts

Source: Results of the authors' data analysis

3.2.2.3. Building a forecasting model for the growth of Vietnam's coffee exports

Firstly, the authors employ a synthesis and statistical method to gather, analyze, and evaluate data. Next, before conducting regression, the research team utilizes the ARDL to test the long-term relationship between variables in the model. Then, the authors

used the hypothesis testing for stationarity to assess the stability of a time series variable and Pearson correlation coefficient to ascertain the relationship between independent and dependent variables in the model. Based on systematically organized theoretical foundations and secondary data collected, the study applies a regression model with MIDAS model and uses Eviews 12 software for computation, thereby forecasting the growth of Vietnamese coffee exports. The regression models obtained were analyzed to evaluate fitness and forecast errors, thereby selecting an appropriate model for forecasting Vietnamese coffee exports with mixed frequency data. The impact of independent variables on the dependent variable in the model will be demonstrated through their estimated coefficients and statistical significance.

4 RESULTS AND DISCUSSION

4.1. Results

4.1.1. Overview of Vietnam's coffee exports situation

4.1.1.1. Vietnam's coffee export growth situation in the period from 2021 - 2025

For many years, Vietnam has always been the second-largest coffee exporting country in the world, and the world leader in robusta coffee exports, present in more than 80 countries and territories, accounting for 14.2%. Global green coffee export market share (ranked 2nd, after Brazil). In particular, exported roasted, ground, and instant coffee has accounted for 9.1% of the market share (ranked 5th, after Brazil, Indonesia, Malaysia, and India). The EU is the largest consumer market for Vietnamese coffee, accounting for 40% of the total volume and 38% of the country's total export turnover; followed by Southeast Asia, accounting for 13% of total volume and total turnover. Coffee exports have grown strongly in the period 2021-2025, a period of crisis due to the Covid-19 pandemic and geopolitical conflicts.

Graph 4.1: Vietnam coffee export turnover in the period 2021 - 2025

Unit: US Dollar Billion



Source: Results of the data analysis by the Author

For the whole year 2021, coffee exports reached a total of 1,653,265 tons (about 27.55 million bags), a decrease of 223,702 tons, or a decrease of 11.92% compared to the export volume of 2020, accounting mainly for Robusta coffee. Germany and the US continue to be Vietnam's two largest coffee consumption markets. Vietnamese coffee products are exported to more than 80 countries and territories, accounting for 14.2% of the global coffee export market, ranking second after Brazil. In general, coffee export turnover tends to decrease quite significantly in 2021, the reason is said to be reduced coffee output due to bad weather and reduced cultivation area.

In 2022, the volume and value of coffee exports for the whole year 2022 reached 1.51 million tons and 2.66 billion USD, down 8.8% in volume and 7.2% in value compared to 2021. Germany, the US, and Italy continue to be Vietnam's three largest coffee consumption markets in the first 11 months of 2022 with market shares of 12.8%, 9.3%, and 8.4% respectively. In particular, robusta coffee exports to many main markets decreased, such as Germany, the US, Spain, Russia, Belgium, and Thailand. On the contrary, robusta coffee exports to other main markets increased, such as Italy, Japan, Algeria, and the Philippines. The reason is that large markets such as the EU, the US, and Russia increasingly prefer Arabica coffee varieties with a more delicious and delicate flavor.

According to the Import-Export Department (Ministry of Industry and Trade), for the whole year 2023, Vietnam's coffee exports reached 1.52 million tons, worth approximately 3 billion USD, down 2.7% in volume, but increased 9.4% in value compared to 2022. Notably, in December 2023, export coffee prices reached their highest level since June 2017. According to the Import-Export Department (Ministry of Industry and Trade), easing social distancing, more favorable customs clearance activities, and increased world demand are factors helping Vietnam's coffee exports recover at the end of 2023. According to estimates, Vietnam's coffee exports in December 2023 reached 130 thousand tons, worth 305 million USD, an increase of 21% in volume and an increase of 26.2% in value compared to November 2023, compared to January 2023. December 2022 decreased by 6.5% in volume but increased by 20.3% in value.

By 2024, the global coffee market will face many difficulties when global inflation increases rapidly and consumers tend to "tighten their belts", causing demand for coffee to decrease. Despite this,

Vietnam's coffee industry still achieved remarkable results when exports grew at double digits compared to 2023. In 2024, Vietnam's coffee exports reached 1.72 million tons, reached 3.94 billion USD, an increase of 10.1% in volume and an increase of 28.3% in value compared to 2023. In the first months of 2024 Vietnam's coffee exports grew strongly thanks to recovering demand. returned after the COVID-19 pandemic and rising coffee prices in the context of tight global supply due to crop failures and supply chain congestion in some major producing countries. In addition, the increase in exports was also supported by improved container and ship supply. According to the Report at the conference "Summary of the 2024-2025 coffee crop year, and mission directions for 2024- 2025", at the end of the 2024-2025 crop year (from October 2024 to September 2025), coffee exports coffee reached 1.66 million tons, down 4.5% compared to the 2023-2024 crop year, but turnover reached 4.08 billion USD, up 3.4% thanks to high selling prices. This is the highest turnover level in any crop year to date. The average coffee export price reached 2,451 USD/ton, an increase of 5.5% compared to the previous crop year.

Although coffee exports decreased in the first half of 2025, over the past several months, world Robusta coffee prices have recorded a continuous upward trend, contributing to Vietnam's coffee export turnover still growing positively. In particular, in June 2025 alone, Vietnam exported 150,00 tons of coffee with a value of 342.94 million USD, an increase of 9.1% in volume and 24.3% in value compared to the same period in 2024.

Accumulated in the first 9 months of 2025, Vietnam's coffee exports reached 1.27 million tons, down 7.3% over the same period last year; Turnover reached 3.16 billion USD, up 1.9%. Citing data from the General Department of Customs, in October 2025, the whole country exported over 43,000 tons, down 14.2% over the previous month and down 48.8% over the same period last year. This is the lowest export volume every month in the past 12 years. Coffee export turnover in October 2025 reached 157.55 million USD, down 6.6% compared to September 2024 and down 28.0% compared to January 2023. Specify the reason why the amount of coffee exported decreased sharply, accordingly, there were no more goods left for export in the country.

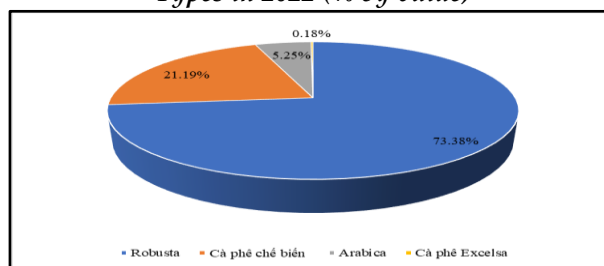
Overall, in 2025, Vietnam's coffee exports will reach 1.62 million tons, down 8.7% compared to 2024; but turnover reached a record high of more than 4.24 billion USD, an increase of 4.6% compared to 2024. Output decreased but turnover increased because export prices in 12 consecutive months increased

sharply, on average reaching 2,613, 8 USD/ton, up to 14.5% over the same period in 2023.

4.1.1.2. Structure of Coffee Export Types

Regarding types, in addition to exporting green coffee, Vietnam has also been boosting the production and export of processed coffee in recent years. Robusta coffee is the largest export, accounting for 85.4% of the total coffee exports in 2022, reaching 1.337 million tons, valued at 2.011 billion USD, a decrease of 5.6% in volume and 6.4% in value compared to 2021. The average export price of Robusta coffee reached 1,504 USD/ton, down 0.9% from 2021. Processed coffee exports reached 580.8 million USD, down 0.4% from 2021. In contrast, Arabica coffee exports increased by 5.0% in volume and 18.7% in value compared to 2021, reaching 62.3 thousand tons, valued at 143.8 million USD. The average export price of Arabica coffee reached 2,310 USD/ton, up 13% from 2021.

Graph 4.2: Structure of Vietnam's Coffee Export Types in 2022 (% by value)



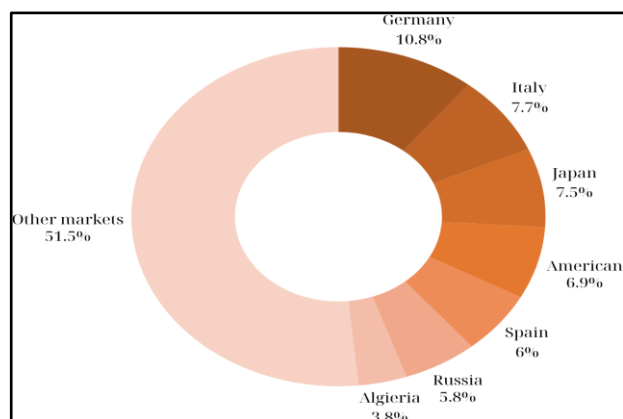
Source: Calculations from General Department of Vietnam Customs data

4.1.1.3. Structure of Coffee Export Markets

Vietnam's top coffee export markets in 2025 remain the EU, Japan, the US, Russia, etc. Among them, the EU continues to be the largest export market with a volume of 600,548 tons, valued at nearly \$1.5 billion, accounting for 37% in volume and 35% in value of Vietnam's total coffee exports. However, compared to 2023, coffee exports to this market decreased by 12.8% in volume and 0.7% in value.

In the EU, the volume of coffee exported to Germany reached 196,090 tons, down 12.7%; Italy reached 142,191 tons, up 2.1%; Spain and Belgium decreased by 20% and 50.5% respectively.

Graph 4.3: Vietnam's Coffee Export Market Structure in 2025 (% by turnover)



Source: Compiled data from the General Department of Customs

Exports to other major markets like the US decreased by 4.1% this year, reaching \$293 million. Additionally, exports to Russia, the Philippines, etc, also declined. Meanwhile, growth was recorded in Japan (+14.9%), Algeria (+88.4%), South Korea (+27.1%); especially Indonesia, which increased by 122.4%.

The decrease in export turnover in major markets, alongside the significant global demand for coffee, highlights that most of Vietnam's coffee is still primarily exported in raw form, with low added value and a very low proportion of deep processing. Thus, the Ministry, the Government, and businesses are still struggling with the puzzle of deep processing to enhance the brand of Vietnamese coffee. Additionally, the Vietnamese coffee industry needs to innovate to meet the increasingly stringent requirements of importing markets.

4.1.1.4. Prices

The 2021-2022 season is considered the most challenging year for the global coffee market in the past decade, including Vietnam. The prices on both the Robusta London and Arabica New York futures exchanges hit their lowest levels in over ten years. From a supply and demand perspective, this year saw a bumper coffee crop worldwide, and pressure mounted as Brazilian coffee growers increased their sales. The average export price of Robusta coffee in the first 11 months of 2021 was 1,512 USD/ton, down 12.5% from the same period in 2020. The average export price of processed coffee in the first 11 months of 2021 was 5,019 USD/ton, down 1.2% from the same period in 2020.

In 2021, the coffee market faced a double hardship as coffee prices had not yet recovered from a four-year crisis when the COVID-19 pandemic spread globally, freezing many economies and reducing coffee demand. In 2021, the average export price of coffee

was estimated at 1,759 USD/ton, up 1.8% from 2020. When coffee prices dropped, farmers tended to switch to pepper cultivation. According to preliminary statistics from the General Department of Vietnam Customs, in 2021, the country exported 1.57 million tons of coffee, valued at 2.74 billion USD, with an average price of 1,751.2 USD/ton, down 5.6% in volume, down 4.2% in value, but up slightly by 1.4% in price compared to 2020.

The year 2023 continuously witnessed coffee prices hitting new peaks. It also marked the end of four consecutive years of low coffee prices due to an oversupply crisis. During this year, global coffee prices surged to their highest level in a decade. Domestic coffee prices also increased, with the highest reaching nearly 43,000 VND/kg. Despite high prices, the COVID-19 pandemic led to nationwide social distancing, increased transportation costs, container shortages, labor shortages, and high pandemic prevention costs, causing difficulties for businesses and reducing revenues. For the whole of 2023, the average export price of Vietnamese coffee was estimated at 1,934 USD/ton. In December 2023, the world coffee price monitored by the ICO continued to rise to the highest level in a decade, exceeding 200 US cents/pound, reaching an average of 203.06 US cents/pound. The upward trend from the start of the 2023-2024 season until early 2024 showed that coffee prices were returning to the peak period of 2013 after many consecutive years of low levels.

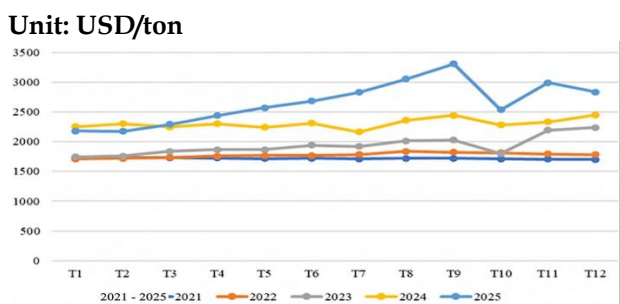
In 2024, the average export price of Vietnamese coffee recorded the highest level in many years, averaging 2,266 USD/ton, up 16% from 2023. The domestic coffee market also experienced significant fluctuations in 2024, with the price of raw coffee beans in the Central Highlands provinces maintaining around 40,000 - 44,000 VND/kg for the first seven months of the year. In August, prices surged to nearly 51,000 VND/kg, then fluctuated downward in the following months. As of December 31, the price of raw coffee beans in Lam Dong province was only 38,600 VND/kg, while in Dak Lak, Dak Nong, and Gia Lai provinces, prices ranged from 39,200 to 39,300 VND/kg, down over 22% from the peak at the end of August and down 5.3% from the same period in 2023. The coffee supply supplemented from the 2024-2025 harvest and the bleak outlook of the global economy were the main factors exerting downward pressure on the market in the final months of 2024.

When calculated by the crop year, the coffee price in the 2023-2024 season increased significantly compared to the average of the previous five years.

Accordingly, the average domestic coffee price in the 2023-2024 season was about 43,500 VND/kg, up 25% from the previous season and up 17% from the average of the previous five years.

In May 2025, global coffee prices fluctuated sharply due to the low supply of Robusta in leading producing countries. The price of Robusta for July 2025 delivery on the London market (UK) increased by 148 USD/ton, reaching 2,557 USD/ton. Similarly, the average export price of Vietnamese coffee in 2025 reached 2,657 USD/ton, up 17.25% from the same period. The high export coffee price was the main reason helping coffee exports reach a new record in turnover, despite a decrease in export volume. The continuous increase in coffee prices was due to the supply not meeting demand.

Graph 4.4: Average Coffee Export Price Trends Over the Period 2021-2025



Source: General Department of Vietnam Customs

From 2023 to 2025, the average export price of Vietnamese coffee generally showed an upward trend. Along with this, the export volume of Vietnamese coffee also tended to increase. In 2024, the export volume reached 3.61 billion USD, marking an impressive growth of 31.27% compared to 2023. By 2025, the export volume of coffee reached 4.24 billion USD.

4.1.2. Results of forecasting growth of Vietnamese coffee exports using the MIDAS model

In the forecast study on Vietnam's coffee export growth, the team applied the basic MIDAS model with the parameters in the model selected as presented. The team reviewed and selected a model with 22 variables, including 21 independent variables.

MIDAS model: The 21 independent variables include 4 quarterly frequency variables, 14 monthly frequency variables and 3 weekly frequency variables.

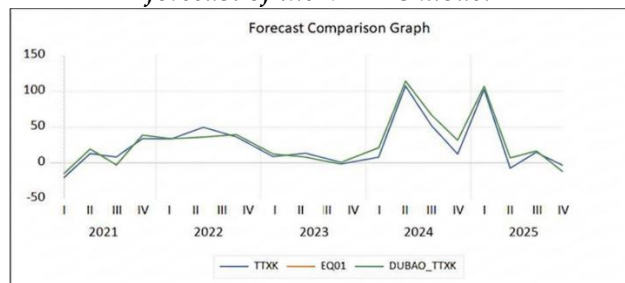
The peculiarity of the MIDAS model is to quickly forecast export growth in the period when the data has not been published based on the information

collected up to the most recent time. Therefore, the research team applied to forecast Vietnam's coffee export growth in the first quarter of 2026 and the second quarter of 2026 with high-frequency data collected until December 2025. The way the forecast is conducted is as follows: The authors will forecast the next quarter based on the previous quarter's data and compare it with the actual data value of that quarter when announced.

Application of Composite Frequency Data Analysis Model to Forecast the Growth of Vietnam's Coffee Exports. For example, the results of the fourth quarter of 2022 will be used to forecast the results of the first quarter of 2023 and compare the results with the actual published data of the first quarter of 2023; Then continue to use the announced results of the first quarter of 2023 to forecast the second quarter of 2023 and compare the results with the actual published data of the second quarter of 2023, the forecasting process continues similarly. same for the following quarters.

Regression results

Graph 4.5: Results of quarterly coffee export growth forecast of the MIDAS model



Source: Results of the research team

Through the process of building a model on Eviews 12, the researchers have produced a model to test the quarterly growth forecast of Vietnamese coffee exports. With test data for the period 2021-2025, the graph is represented by two growth lines including the forecast growth line for Vietnamese coffee exports through the MIDAS model (DUBAO_TTXK) and the growth line for Vietnamese coffee exports in reality (TTXK). The researchers provided a comparison graph between the two growth paths to test the reliability and accuracy of the model compared to reality.

The results in the graph show that the two growth lines have almost the same development trends at each stage and are almost asymptotic to each other. Thereby, it partly shows that the model has relative accuracy, reflecting the actual situation of Vietnam's coffee export growth in the period 2021-2025 despite

many objective fluctuations in the economy. To test in more detail the reliability and accuracy of the forecast model, the research team continues to evaluate the indicators of the forecast model.

Evaluate the forecast error of the MIDAS model

Table 4.1: Evaluate the forecast error of the MIDAS model

Time	TTXK (Actual)	MIDAS (Forecast)	e
2021Q1	-8,2900	-10,5229	2,2329
2021Q2	6,3800	10,8310	4,4510
2021Q3	-6,1800	-3,5095	2,6705
2021Q4	-25,0700	-18,9890	6,0810
2022Q1	-4,3200	-14,4955	10,1755
2022Q2	3,0900	8,6381	5,5481
2022Q3	-10,9400	-13,3115	2,3715
2022Q4	-1,9300	-6,3790	4,4490
2023Q1	-20,9000	-14,8937	6,0063
2023Q2	13,0000	19,3000	6,3000
2023Q3	7,5900	-2,0040	9,5940
2023Q4	33,5400	38,2200	4,6800
2024Q1	33,2100	34,1846	0,9746
2024Q2	49,8800	35,3966	14,4834
2024Q3	35,7200	38,9932	3,2732
2024Q4	8,7400	12,5101	3,7701
2025Q1	13,0100	7,9505	5,0595
2025Q2	1,0200	-1,5871	2,6071
2025Q3	0,3600	3,68	3,3200
2025Q4	-34,8800	-31,14	3,7400
R2			0,915228
RMSE			1,349254688
MAE			0,3373136719

Source: Results of the research team

Using the forecast results (Table 4.1), assess the error magnitude $|e|$, where $|e|$ represents the absolute difference between the actual and predicted values at each forecast point. The results indicate that the forecast values for the coffee export growth value chain exhibit a relatively small error, with most quarterly forecasts showing an error rate below 6%. The period with the highest error was 2023-2024, when socio-economic fluctuations impacted the accuracy of economic indicators. However, the forecast error has been steadily decreasing since Q32024, demonstrating improved forecast accuracy and the stabilization of variables.

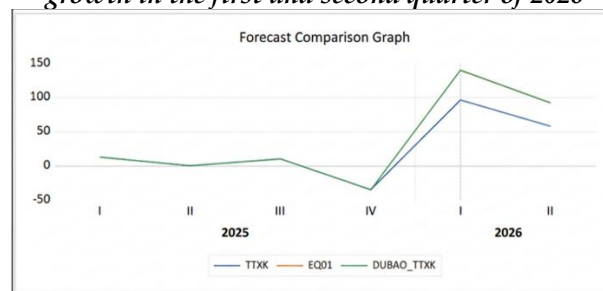
Graph of the forecast line obtained from the MIDAS model in the chart and measurement indicators such as R-squared index, average error measurement index (RMSE), average absolute value measurement index of error (MAE) of the regression model in the table shows that in general, the basic MIDAS model gives quite good forecasting results for Vietnam's quarterly coffee export growth with high indexes close to 1 (The closer the value is to 1, the better the model). The authors chose a large sample size from the first quarter of 2021 to the fourth quarter of 2025

to provide the smallest standard error. The smaller the standard error, the more accurately the model shows the ability to predict and explain secondary variables well.

The graph shows that the model can almost predict periods of major changes in Vietnam's coffee export growth rate, specifically in the period 2022-2023 when the COVID-19 pandemic caused export growth to increase. Vietnam's coffee exports fluctuate abnormally or in 2025 export growth will decrease sharply, mainly due to the decline in aggregate demand, supply chain disruption, and tightening monetary policy. This method proves to be superior to traditional models that are limited by using balanced data (for example, models that only use monthly data or models that only use quarterly data). The flexibility will not be as high as the MIDAS model.

This result proves that the development of these forecasting models is on the right track and the input data are selected appropriately. Furthermore, adding high-frequency financial data to the MIDAS regression model also improves prediction accuracy, demonstrating that financial data plays an important role in predicting commodity export growth. This finding implies that to fully utilize the predictive power of financial indicators, they must be combined with macroeconomic data.

Graph 4.6: Forecast results of Vietnam coffee export growth in the first and second quarter of 2026



Source: Results of the authors' data analysis

By analyzing the error assessment presented in Table 4.1, it is evident that the MIDAS model demonstrates sufficient reliability and high accuracy in predicting the growth of Vietnam's coffee exports. Consequently, the authors will proceed to utilize this model to forecast the export growth of Vietnamese coffee for the period from the first quarter of 2026 to the end of the second quarter of 2026, using actual data from the third quarter of 2026.

Graph 4.6 shows that the forecast results for Vietnam's coffee exports growth in the first two quarters of 2026 tend to increase, specifically by 140.3% in Q1 2026 and by 92.97% in Q2 2026

compared to the same period last year. Accordingly, the research team collected and analyzed secondary data on Vietnam's coffee export growth in the first two quarters of 2026 from official sources such as the General Statistics Office, the Ministry of Industry and Trade, IMF, and the Vietnam Coffee-Cocoa Association. From this analysis, the researchers projected that Vietnam's coffee export growth during this period would be approximately 96.87% for Q1 2026 and around 58.34% for Q2 2026.

This perspective is based on the rising demand for imported coffee from major markets such as Europe, Germany, Italy, and Spain. Concurrently, coffee prices are expected to continue their upward trend, leading to an increase in the export value of coffee. As of the research period, coffee harvesting activities for the 2025-2026 crop year had concluded. According to the Mercantile Exchange of VietNam (MXV), there may be a supply shortage in the coffee market, although this is not due to factors within Vietnam. This implies that other countries and regions are importing large quantities of coffee to meet their market demands, positioning Vietnam as a key supplier.

However, global organizations like Rabobank and the Foreign Agricultural Service (FAS) of USDA predict a slight surplus rather than a shortage for the 2025-2026 crop year. Despite the fact that coffee prices have not been adjusted lower in the first three months of the year, export value is likely to grow significantly even though export volumes have decreased.

If the first quarter of 2026 achieves the growth forecasted by the MIDAS model, coffee export turnover could reach its highest level among all quarters, potentially making coffee one of the fastest-growing agricultural exports during this period.

In the second quarter of 2026, coffee prices might come under pressure as supply is bolstered by countries like Brazil and Indonesia. Additionally, organizations are adjusting their supply and demand forecasts for the 2025-2026 crop year from a shortage to a surplus. Consequently, the quantity of coffee exported in the following months is predicted to gradually decrease as supply diminishes. Therefore, combined with the MIDAS model forecast, the research team believes that Vietnam's coffee export value in the second quarter of 2026 will significantly decline compared to the first quarter but will still be much higher than in the same period last year. To recover coffee output, export businesses will need to wait until October 2026, when the new coffee harvest begins, allowing Vietnam's coffee supply to increase again.

Overall, without the rising coffee prices, Vietnam's dominant position on the world coffee map would gradually fade. Since the 2023-2024 crop year, Vietnam's coffee market share has continuously decreased from 40% of total global production to 36% in the current crop year. This decline is attributed to difficulties in the production process faced by farming households. Currently, Vietnam faces strong competition from Brazil, and the government needs to implement changes in development policies to more effectively promote Vietnam's coffee exports.

5 DISCUSSION

Summary of Research Results

The study has developed a high-frequency forecasting model to forecast Vietnam's coffee export growth and evaluate its accuracy. The authors built a research model through analyzing multi-frequency data sets, which were collected from official sources during the period 2021-2025. Then, the researchers compared the analyzed results with the actual data to draw conclusions about the accuracy of the model. The results show that this is a reliable model, as indicated by the low error indices and its consistency with secondary data. Both the forecasting model and secondary data indicate significant growth in Vietnam's coffee exports during the first half of 2026. Specifically, the increase in coffee export growth in Q1 2026 is driven by concerns about supply shortages, particularly for Robusta coffee, along with Red Sea tensions pushing up global coffee prices, leading enterprises to boost exports. This trend may continue for a while. By Q2 2026, as global tensions ease, the growth rate of coffee exports is expected to gradually decline.

Through this study, it can be confirmed that the MIDAS model is suitable for forecasting studies. For the coffee industry, the forecasting model that the authors have built can be applied to forecast important indicators in export activities and can be expanded to a larger scale. Forecasting market trends enables businesses and policymakers to implement and refine more effective strategies.

Comparison with Previous Studies

To achieve high-accuracy forecasts of Vietnam's coffee exports, forecasting models need to address three main issues:

1. Selecting appropriate factors (variables) to include in the forecasting model.
2. Effectively utilizing data on economic indicators published by statistical agencies.
3. Constructing a suitable validation model.

Vietnam's export indices have been subject to many economic forecasts by reputable organizations such as the World Bank (WB), the International Monetary Fund (IMF), and the Asian Development Bank (ADB). However, these forecasts often lack consistency as each organization uses its own distinct forecasting model, typically applying them universally across countries without considering the specific economic characteristics of each country.

Additionally, traditional export forecasting models in previous domestic studies have only analyzed variables with the same frequency within a single research period, meaning they have not fully exploited datasets published at different frequencies and times. This can result in significantly inaccurate outcomes, particularly during major market fluctuations like those experienced during the Covid-19 pandemic. This study applied a mixed-frequency data analysis model to forecast Vietnam's coffee exports, thus overcoming these limitations.

As of now, research on Vietnam's coffee exports remains limited, particularly in terms of forecasting using mixed-frequency data regression models. At present, no official source offers specific forecasts for the growth of Vietnam's coffee exports on a monthly or quarterly basis. Additionally, the MIDAS model has neither been extensively developed nor widely implemented. Both theoretically and empirically, the results of this study will make a positive contribution, with significant implications for macroeconomic management in general and coffee industry research in particular.

6 EXPLANATION OF RESEARCH RESULTS

After constructing the MIDAS model for testing, the results on Eviews 12 provided a data series on coffee export growth from 2021 to 2025. This period is sufficiently long to offer a comprehensive view of the growth trend of the dependent variables. Moreover, economic indicator variables during this period were fully published by reputable organizations with multiple frequencies such as monthly, quarterly, and yearly. Compared to studies using the same frequency, the model proposed by the researchers employs multiple frequencies to analyze in detail potential high-frequency fluctuations. To test the reliability and accuracy of the model against reality, the forecast results were compared with the quarterly frequency data on coffee export growth published for the 2021-2025 period, resulting in small errors.

Based on the validated model, the research team continued to forecast Vietnam's coffee export growth for the first two quarters of 2026. The forecasting

process was carried out as follows: The authors forecast the next quarter based on the previous quarter's data and compare it with the actual published data for that quarter.

For example, the results from Q4 2022 were used to forecast Q1 2023, and these results were compared with the actual published data for Q1 2023. Then, the actual published data for Q1 2023 were used to forecast Q2 2023, and the results were compared with the actual published data for Q2 2023. This forecasting process continues similarly for subsequent quarters.

Since the model forecasts future trends in Vietnam's coffee export growth, data for this period have not yet been published. Therefore, the research team relied on secondary data collected from analyses by reputable large organizations such as the Vietnam Coffee - Cocoa Association (VICOFA), the General Statistics Office, and the General Department of Customs to compare and evaluate the similarity between forecasts. The results showed a high degree of similarity between the model's forecasts and the secondary data collected for the first two quarters of 2024. This further confirms the reliability of the forecasting model.

Significance of Research Results

Theoretically, the model for forecasting Vietnam's coffee export growth based on mixed-frequency data analysis is an advanced method for forecasting research. Future forecasting studies can utilize the same method to produce more accurate results by effectively using published economic indices. Moreover, the model demonstrates its updateability since future growth indices will continue to be forecast based on previously updated data. This means that researchers only need to continuously update current data for the forecasts to be carried out. For Vietnam's coffee industry, the forecast results are essential for authorities to formulate timely policies, avoid fluctuations, and mitigate risks in export activities. This also serves as a crucial reference for enterprises to consider the value and volume of coffee exports to better adapt to the market.

However, the model still lacks sufficient capability to forecast on a larger scale as the growth rate only supports part of the solution for authorities and enterprises. Furthermore, economic indices published at high frequencies are not consistent across organizations, leading to minor discrepancies in research results. These issues can be addressed in the future with better investment in the process of collecting variable data.

7 CONCLUSION

The study uses the MIDAS model to predict Vietnam's coffee export growth based on a data set of macroeconomic indicators collected in the period 2021 - 2025. Analysis results show that, with the same independent variables, and data taken at Application of Composite Frequency Data Analysis Model to Forecast the Growth of Vietnam's Coffee Exports a higher frequency, the MIDAS model will give better forecasting results. Like some previously published research results, the forecast results show that the MIDAS model is effective for short-term forecasting. The research results also show that high-frequency financial variables can be used to forecast Vietnam's coffee export growth. This may be related to the recent development of Vietnam's financial market. From a policy perspective, our findings imply that financial variables need to be closely monitored to

predict fluctuations in the commodity export cycle. On the model side, the results point to the importance of linking financial sectors and economic reality in macroeconomic models. The role of financial variables in predicting export growth is due not only to their forward-looking nature but also to the close linkage between financial markets and a country's import and export activities.

Short-term forecasts of macroeconomic indicators will have important implications in policy planning and devising each country's economic development strategy. Therefore, with the goal of providing timely and appropriate forecasts in the future, the research team will continue to build and deploy models with different frequency data to forecast economic indicators.

REFERENCES

1. BAŞER, U., BOZOĞLU, M., EROĞLU, N. A., & TOPUZ, B. K. (2018). Forecasting chestnut production and export of Turkey using ARIMA model. *Turkish Journal of Forecasting*, 2(2), 27-33.
2. Bin, J., & Tianli, X. (2020). Forecast of export demand based on artificial neural network and fuzzy system theory. *Journal of Intelligent & Fuzzy Systems*, (Preprint), 1 - 9.
3. Bui, T. M. N., Nguyen, T. Q. N., & Nguyen, T. Q. C. (2019). Using Arima model in forecasting the value of Vietnam's exports. *Journal of finance & accounting research*, Vol. 186, No. 1, p. 58.
4. Bussière, M., Fidrmuc, J., Schnatz, B. (2005), Trade integration of Central and Eastern European countries: Lessons from a gravity model. *ECB Working Article*, No. 545;
5. Dung, T. T. M., Tuan, V. T., Huong, D. T. M., & Luan, N. M. (2014). Applying quantitative methods in forecasting pangasius exports. *Scientific Journal of Can Tho University*, p. 123 - 132.
6. Eckert, F., Hyndman, R. J., & Panagiotelis, A. (2019). Forecasting Swiss exports using Bayesian forecast reconciliation (No. 457). *KOF Working Papers*.
7. Feenstra, R. C. (2015). *Advanced international trade: theory and evidence*. Princeton university press.
8. Foroni, C., & Marcellino, M. G. (2013). A survey of econometric methods for mixed-frequency data. Available at SSRN 2268912.
9. Ghysels, Eric, Pedro Santa-Clara, and Rossen Valkanov (2004). "The MIDAS Touch: Mixed Data Sampling Regression Models". Powered by the California Digital Library University of California, 34p. <https://escholarship.org/uc/item/9mf223rs>.
10. Hai, N. M., Dung, N. D., Thanh, D. V., & Lam, P. N (2020). Building Export Value Forecast Model Using Dimensional Reduction Method Based on Kernel Technique. *The XXIII National Conference: Some Selected Issues of Information and Communication Technology*.
11. Kuzin, V., Marcellino, M., & Schumacher, C. (2011). MIDAS vs. mixed-frequency VAR: Nowcasting GDP in the euro area. *International Journal of Forecasting*, 27(2), 529-542.
12. Le, N. B. N., T. A., & Le, L. Q. T. (2018). Forecast model for shrimp export prices of Vietnam. *Scientific Journal of Can Tho University*, p. 188-195.
13. Lehmann, R. (2015). Survey-based indicators vs. hard data: What improves export forecasts in Europe? (No. 196). *ifo Working Paper*.
14. Mariano, R., and Y. Murasawa (2010): "A coincident index, common factors, and monthly real GDP", *Oxford Bulletin of Economics and Statistics*, 72(1), 27 - 46.
15. Pyo, H. K., & Oh, S. H. (2016). A Short-term Export Forecasting Model using Input-Output Tables.
16. Qu, Q., Li, Z., Tang, J., Wu, S., & Wang, R. (2019). A Trend Forecast of Import and Export Trade Total Volume based on LSTM. In *IOP Conference Series: Materials Science and Engineering* (Vol. 646, No. 1, p. 012002). IOP Publishing.
17. Schorfheide, F., and D. Song (2011): "Real-time forecasting with a mixed frequency VAR", mimeo.

18. Siggel, E. (2006). International competitiveness and comparative advantage: a survey and a proposal for measurement. *Journal of Industry, competition and trade*, 6(2), 137-159.
19. Stoevsky, G. (2009). Econometric Forecasting of Bulgaria's Export and Import Flows. Bulgarian National Bank Discussion Articles DP/77/2009.
20. Urrutia, J. D., Abdul, A. M., & Atienza, J. B. E. (2019). Forecasting Philippines imports and exports using Bayesian artificial neural network and autoregressive integrated moving average. In *AIP Conference Proceedings* (Vol. 2192, No. 1, p. 090015). AIP Publishing LLC.
21. Xie, Q., & Xie, Y. (2009). Forecast of the total volume of import-export trade based on grey modelling optimized by genetic algorithm. In *2009 Third International Symposium on Intelligent Information Technology Application* (Vol. 1, pp. 545-547). IEEE.
22. Dao, H. T. (2024). A study to investigate possible advantages of Vietnam in exporting Agricultural products to the European Union. University of Applied Sciences.
23. Trang, L. M., Tuan, H. A., Ha, D. T., Hien, N. T., & Anh, T. K. (2022). Application of Mixed-Frequency Data Models in Forecasting Vietnam's Economic Growth. *Journal of Economics and Development*.
24. Trang, L. M., Tuan, H. A., Hien, N. T., Ha, D. T., & Anh, T. K. (2021). Application of MIDAS Model to Forecast Vietnam's Export Growth. *Vietnam Banking Journal*.
25. Nguyet, B. T. M., Cham, N. T. Q., & Nga, N. T. Q. (2019). Using the ARIMA Model to Forecast Vietnam's Export Value. *Journal of Finance & Accounting Research*.
26. Nhien, N. T. H. (2016). THE COMPETITIVENESS OF VIETNAMESE COFFEE INTO THE EU MARKET. University of Applied Sciences.
27. Yan, L. (2024). Prediction of China's Total Import and Export of Goods Based on ARIMA Model and Exponential Smoothing Model. *Hanspub Journal*.
28. Alam, T. (2019). Forecasting exports and imports through artificial neural network and autoregressive integrated moving average. ResearchGate.
29. Thuy, P. T. T. (2021). Analysis of Factors Affecting Coffee Exports in Vietnam from 2008 to 2019. University of Economics Ho Chi Minh City.
30. Stationarity. University of Economics and Law.
31. Phong, L. H., & Van, D. T. B. (2015). Verifying the Impact of Macroeconomic Factors on Vietnam's Stock Index Using the ARDL Model. Ho Chi Minh City University of Economics and Finance.
32. Nkoro, E., & Uko, A. K. (2016). Autoregressive Distributed Lag (ARDL) cointegration technique: application and interpretation. *Journal of Statistical and Econometric Methods*.