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MACROECONOMIC DETERMINANTS OF AUTOMOTIVE SALES VOLUME IN MALAYSIA: EVIDENCE FROM AN ARDL ANALYSIS

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Abstract:

Malaysian economic growth depends on the development of the automotive industry. The automotive industry is significant for employment, as well as industrial output and domestic consumption. This research examines the effects of a few macroeconomic variables (GDP, inflation rate and unemployment rate) on the volume of auto sales in Malaysia. The volume of auto sales is analyzed using annual time series data from 1994 to 2024, applying an Autoregressive Distributed Lag (ARDL) for the analysis of both a long-run and short-run relationship between the above-mentioned macroeconomic variables and the volume of auto sales. The research concludes that there is a long run cointegration relationship between the volume of auto sales and each of the macroeconomic variables described. Specifically, the study finds that while the level of GDP is positively correlated with the volume of auto sales, the levels of unemployment and inflation are negatively correlated with the volume of auto sales. In addition to the long-run effects described above, the research has also identified that macroeconomic shocks will affect the volume of auto sales in different ways over time, based on the dynamics of macroeconomic shocks. The results of this research present valuable information for policymakers and industry stakeholders in terms of developing strategies to stabilize and promote long-term growth in the Malaysian automotive industry.

Keyword:

ARDL, Automotive Sales, Gross Domestic Product, Inflation, Unemployment

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Introduction

Automotive manufacturing is one of the biggest industries in Malaysia, accounting for a significant portion of overall manufacturing output, employment growth and overall consumption. Automobiles are considered durable goods and therefore, demand for automobiles can be very sensitive to macroeconomic conditions. In fact, automobile volume sold is a key indicator of both economic performance and consumer confidence (Moe Sin et al., 2024).

For the past 30 years, there have been significant changes in automotive sales volume in Malaysia due to changes in the economy, specifically through economic expansions and contractions due to things like recessions and financial crises (Moe Sin et al., 2024). Economic expansion has always resulted in increased automobile sales, whereas recessions generally result in decreased sales of automobiles. Therefore, it is important to understand what macroeconomic elements drive the demand for automobile purchases.

Gross domestic product (GDP), inflation rates and unemployment rates are considered key macroeconomic indicators that influence consumers' ability to buy. GDP growth creates more disposable income and greater access to credit for consumers, while inflation reduces consumers' purchasing power and increases the cost of credit. Unemployment also affects consumers' income stability and consumer confidence, leading to less discretionary spending on items like automobiles.

While many international studies have identified how macroeconomic factors influence the demand for vehicles, few studies have focused on the specific case of Malaysia, and most have not taken into account the difference between short-term and long-term adjustments. The purpose of this research is to fill this gap by using an Autoregressive Distributed Lag (ARDL) method to analyse the short-term and long-term effects of GDP, inflation and unemployment on the volume of automotive sales in Malaysia.

Literature Review

There are three points will be discussed in literature review which are gross domestics product, inflation and unemployment impact on automotive sales in Malaysia.

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Gross Domestics Product and Automotive Sales

The purpose of Gross Domestic Product (GDP) is to measure the total worth of a country's output of goods & services. GDP represents the overall economic situation of a country (Saberi, 2018). GDP illustrates consumer's purchasing power and the level of consumer confidence which affect the purchase of luxury items such as automobiles (Muhammad et al. 2012). Therefore, as GDP increases individuals have more money to spend, thus prompting an increase in automobile purchases (Kasuga, 2021). The relationship between the increase in GDP and the growth in automobile sales has been substantiated by Malaysia (Rahman & Ismail 2022).

As indicated above, the automotive market in Malaysia is unlike any other because of the many branded Perodua and Proton automobiles that serve primarily Malaysian consumers (Nawi et al. 2013). Due to this dynamic, automobile sales are hence very responsive to national economic fluctuations. For example, in 2022, there was an 8.7% increase in the GDP of Malaysia, which resulted in an increase in automobile sales because of an increase in employment & consumer confidence (Lim & Chia 2022; Yusof et al. 2022). However, for the period of the COVID-19 Recession in 2020, the GDP declined by 5.6% and automobile sales declined by 12%, due to low income and high uncertainty (Rahman & Ismail 2022).

Generally, an increase in GDP correlates with an increase in car sales; however, during times of economic contraction, consumers have a tendency to postpone their purchases of cars and instead put their focus on basic necessities (Muhammad et al. 2012). In addition, government assistance in the form of tax incentives during the Covid-19 pandemic (Penjana, etc.) has helped to alleviate some of the negative effects that Covid-19 has had on the automotive industry (Yusof et al., 2022). Additionally, there is evidence that the relationship between GDP and car sales in Malaysia does not occur immediately and that GDP has a lagged relationship with car sales (Islam et al., 2016).

While researchers agree there is a positive relationship between GDP and auto sales in Malaysia, more research is needed to understand how employment stability, inflation rates, production capacity and government policies may also impact the correlation between these two economic variables (Islam et al., 2016; Rahman & Ismail, 2022). Understanding the unique local factors that impact automotive sales will aid in better forecasting and provide a clearer roadmap for policymakers in the car industry in Malaysia.

Inflation and Automotive Sales

The automotive industry has been impacted significantly due to inflation, which is defined as the persistent growth of retail prices of products and services. Because inflation makes the cost of producing these goods and makes them less affordable for consumers, manufacturers increase production costs while consumers have less money available to purchase cars (Wadud et al., 2020).

The correlation between inflation and the sale of vehicles is consistent across multiple studies showing a significant negative relationship between these variables, with increased borrowing costs delaying the purchase of vehicles during times of inflation. It has been shown through research that Keynesian economic theories also support the idea that inflation will lower a

consumer's disposable income and therefore decrease a consumer's ability to purchase durable goods, including vehicles (Keynes, 1936).

Some work, however, shows there are exceptions to the rule when it comes to this relationship. For instance, Namazi and Rezaei (2012) indicated that some automobile manufacturers may be able to pass some of their increased production costs onto consumers via higher vehicle prices, but at the same time manufacturers will experience a decline in sales immediately if this occurs. The outcome of these effects is influenced by both the region in which the company operates and the pricing strategy of the company (Cummins, & Tennyson, 1992).

The intervention through Penjana by the Government, which provided temporary sales tax exemptions, has alleviated the short-term negative effects of inflation on automotive demand (Rahman & Ismail, 2022). Nonetheless, continuous inflation continues to be a challenge on automotive demand, further highlighting the need for targeted government policy to address the issues that create supply-side pressure and restrictive consumer financing.

Unemployment and Automotive Sales

Unemployment plays as an important indicator of labor market conditions and economic stability. Higher unemployment reduces household income and increases uncertainty, discouraging expenditure on durable goods. Prior studies provide strong evidence of a negative relationship between unemployment and vehicle sales (Badkar, 2012; Muhammad et al., 2012). In Malaysia, where the automotive market is comprised primarily of local brands, namely Perodua and Proton, the levels of unemployment have a direct impact on the level of domestic demand for vehicles (Rahman & Ismail, 2022). Prior to Covid-19, Malaysia had an unemployment rate of approximately 3.3% and had sold over six hundred thousand cars per year. However, when unemployment increased to 4.8% in 2020, we saw that total sales had dropped by 12.4% (Lim & Chia, 2022; Yusof et al., 2022). Moreover, the prevalence of hire purchase financing, coupled with the stringent lending practices that are created primarily in times of high levels of unemployment, restrict access to loans for the general public (Lim & Chia 2022).

While some research has been conducted that investigates the interaction between unemployment, government policies and credit access within the special context of Malaysia, there is still a dearth of formal studies examining how these various factors interact with each other to impact the effect of unemployment on automotive sales. Improving the degree of diversification of the manufacturing sector and increasing access to credit and improving the support of exports will help to lessen the impact of unemployment and stabilize automobile sales in Malaysia.

Research Gap

While macroeconomic variables have generally been associated with car sales, the effects that GDP, inflation and unemployment collectively have on car sales in Malaysia have not yet been studied using modern time series methods. This research adds to the existing body of knowledge by using the Auto-Regressive Distributed Lag (ARDL) approach to examine both short-run and long-run relationships.

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Data and Methodology

Data Description

This study uses annual time-series data from 1994 to 2024. Automotive sales volume (ASV), measured by total vehicle registrations, is employed as the dependent variable. The independent variables include gross domestic product (GDP), inflation rate (IR) and unemployment rate (UR). Data are obtained from the Department of Statistics Malaysia and the Malaysian Automotive Association.

Table 1: Data Description

Variables	Data Description	Unit of Analysis
Dependent Variable		
Automotive Sales Volume	Total industry volume in Malaysia	Unit
Independent Variables		
Gross Domestic Product	GDP growth rate of %	Percent (%)
Inflation Rate	Inflation rate of %	Percent (%)
Unemployment Rate	% of total labor force	Percent (%)

Model Specification

The relationship between automotive sales and macroeconomic variables is specified using the ARDL model as follows:

Estimation Results: ARDL Model

$$ASV_t = -0.0897ASV_{t-1} - 1549.91GDP_t + 9434.68GDP_{t-1} + 2014.62IR_t - 12952.10IR_{t-1} + 9106.79IR_{t-2} - 49246.40UR_t + 89446.29UR_{t-1} + \varepsilon_t$$

Long-run ARDL Relationship:

$$ASV_t = 7235.69GDP_t - 1679.99IR_t + 36890.62UR_t - 110461.86$$

Short-run ARDL (Error Correction Representation):

$$\Delta ASV_t = -1549.91\Delta GDP_t + 9434.68\Delta GDP_{t-1} + 2014.62\Delta IR_t - 12952.10\Delta IR_{t-1} + 9106.79\Delta IR_{t-2} - 49246.40\Delta UR_t + 89446.29\Delta UR_{t-1} - 1.0897ECT_{t-1} + \varepsilon_t$$

Where the Error Correction Term (ECT) is:

$$ECT_{t-1} = ASV_{t-1} - (7235.69\, GDP_{t-1} - 1679.99\, IR_{t-1} + 36890.62\, UR_{t-1} - 110461.86)$$

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Estimation Procedure

A long run cointegration analysis of the relationship between the independent and dependent variables was conducted using the ARDL technique. The ARDL approach is valid for variables that have mixed orders of integration (i.e., I(0) and I(1)). In addition, diagnostic tests were performed on the estimated model to validate that it was appropriate. Specifically, tests for serial correlation, heteroskedasticity, and stability of the estimated coefficients were performed.

Table 2: Statistical Output for Bounds Test

F-Statistics	Significance Level	Bound Critical Values (Unrestricted constant and no trend)	
		I[0] (Lower Bound Value)	I[1] (Upper Bound Value)
7.7394	10%	2.75	3.79
	5%	3.12	4.25
	2.5%	3.49	4.67
	1%	3.93	5.23

Critical value bounds are computed by surface response procedure developed by Pesaran, Shin & Smith (2001).

Table 3: Long-Run Models

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-120370.8	1114783.1	-1.079723	0.2973
ASV(-1)*	-1.089705**	0.167383	-6.510259	0.0000
GDP(-1)	7884.768	4539.420	1.736955	0.1029
IR(-1)	-1830.690	10209.91	-0.179305	0.8601
UR(-1)	40199.89	25367.41	1.584706	0.1339

Notes: (**) means that the significance level is less than 5% and the rejection of the null hypothesis.

Table 4: Short-Run Models

Variable	Coefficient	Prob.	Interpretation
Δ (GDP)	-1549.910	0.3590	No statistically significant short-run effect of GDP on sales volume.
Δ (IR)	2014.617	0.6049	Current inflation rate does not significantly affect sales in the short term.
Δ (IR(-1))	-9106.790	0.0168**	Lagged inflation rate has a significant negative effect, indicating past inflation dampens current automotive sales.
Δ (UR)	-49246.40	0.0208**	Unemployment rate negatively impacts sales volume in the short run, consistent with reduced consumer spending power.

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ECT	-1.089705	0.0000	The error correction term is negative and highly significant, indicating a rapid adjustment process towards long-run equilibrium.

Notes: (**) means that the significance level is less than 5% and the rejection of the null hypothesis.

Table 5: Results Of Diagnostic Testing

Types of tests	F-statistics	Prob.	Conclusion (at 5% significance)
Serial Correlation LM	1.3866	0.2845	**Fail to reject null**: No evidence of serial correlation
Heteroskedasticity (BPG)	0.4996	0.8920	**Fail to reject null**: Homoskedasticity holds (constant variance of errors)
Heteroskedasticity (ARCH)	1.4360	0.2416	**Fail to reject null**: No ARCH effect (no conditional heteroskedasticity)
Normality test (JB-statistics)	0.0798	0.9609	**Fail to reject null**: Residuals are normally distributed
Ramsey RESET Test	0.0307	0.8634	**Fail to reject null**: No model misspecification detected

Empirical Results and Discussion

As demonstrated by the ARDL bounds test, there exists a long-term cointegration between automotive sales volume and selected macroeconomic variables, hence there is a relationship between automotive sales in Malaysia and macroeconomic conditions over a time horizon. However, when examining the estimated coefficients, it is clear that the impacts of each of the macroeconomic variables on automotive sales volumes differ between the short-term and the long-term. Consequently, automotive sales have a high-value, durable goods interpretation.

The short and long-term significance of the GDP growth variable with respect to automotive sales is due to both consumer expectations and adjustment dynamics. Although there is currently no evidence to support the claim that GDP has an immediate positive impact on automotive sales. This implies that consumers do not immediately translate short-term fluctuations in income into a decision to purchase a car rather, households tend to hold off on making large irreversible purchases, such as automobiles until they believe the economic improvements are going to last into the future. The same pattern is observed for the relationship between inflation and automotive sales. While contemporaneous inflation is unimportant to the automotive sales for the short run, the negative impact of lagged inflation is statistically significant. This finding suggests that consumers will gradually adjust their buying behaviour in response to rising lagged inflation as it reduces their purchasing capabilities and raises their financing costs. Unemployment has a negative impact on automotive sales for the short-term, however, this is due to the negative impact of unemployment on consumer perceptions regarding income security and job stability, which strongly discourages discretionary spending. The second finding, which also differs from those traditionally accepted, is that while some of the coefficients were statistically insignificant, they were still economically meaningful rather than indicating that those shocks had no effect on automotive sales. Statistically insignificant coefficients over the short-term indicate that shocks occurring in one period will not be reflected as noticeable changes in automotive sales until later. This lack of response to macroeconomic shocks can be attributed to many reasons including behavioural, institutional and policy factors. For example, individual consumers may smooth their consumption over

time by saving money or using credit to purchase a vehicle, while temporary government policy interventions such as tax incentives or income support may mitigate the impact of macroeconomic fluctuations on automotive sales. Additionally, the automotive market is characterized by multiple steps to acquire a new vehicle, beginning with planning and ending with financing approval and transitional delays before the consumer receives their vehicle. It follows that short-term statistically insignificant coefficients may reflect longer-term impacts by way of indirect or delayed channels, rather than the complete absence of any economic impact over time. Thus, an understanding of the disparate nature of short-term statistical insignificance compared to long-term economic significance is vital.

The comparison of significant and insignificant results reveals a great deal about consumer behaviour related to the automotive sector in Malaysia. The significance of the results demonstrates that Malaysian consumers appear to be future looking, risk averse and driven by expectations when they make their vehicle purchasing decisions. Moreover, the evidence shows that consumers will not react instantly to short-term or immediate changes in GDP or prices. Rather, the results indicate that consumers will react to consistent changes in employment and prolonged inflationary pressures that result in a change in their perception of income and consequently their perception of the affordability of vehicles. In addition, the negative value (statistically significant at the 0.000 level) assigned to the error correction term supports this view by indicating that the adjustment to the long run equilibrium occurs rapidly following a deviation in the short run. Thus, while the automotive market may experience varying sales levels for short durations as a result of macroeconomic influences, ultimately those short-term fluctuations will return to a long-run trend defined by the underlying conditions of the economy.

Thus, the consumers are cautious consumers and that the behaviour of consumers is adaptive to changes in the macroeconomic environment. Short-term fluctuations in the market will occur gradually while consumers adapt to changes in the long-term economic environment, ultimately resulting in sustained growth in the market based upon long-term economic fundamentals. As a result, the data reflects the importance of a stable macroeconomic environment in order to support the continued growth of the automotive market. Therefore, developing a comprehensive understanding of how consumers respond to fluctuations in demand over short time horizons and longer time frames will help identify potential growth areas within Malaysia's automotive industry.

Conclusion and Policy Implications

Malaysia has demonstrated an ongoing long-term association between the volume of automotive sales and macroeconomic trends, which highlights the major impact that the broader economic climate has on vehicle demand in Malaysia. The results of this research indicate that consumers buying automobiles consider the value of vehicles as durable goods, so they will be cautious when making decisions therefore, they will look to sustained economic growth rather than short-lived fluctuations in the economy as the basis for buying decisions. The data indicate that while the day-to-day changes in GDP (Gross Domestic Product) and inflation have a negligible effect on consumers' purchase habits, the longer-term effects of GDP and inflation, as economic trends, have a considerable effect. Consumers that expect income stability, inflation pressures and job stability will adjust their purchasing decisions to match sustained economic trends. When consumers are not secure in their income or job, unemployment has a negative short-term impact on automotive sales due to the decrease in

consumer confidence associated with becoming unemployed. Therefore, consumers become less willing to spend money on discretionary items during this time.

Although some macroeconomic variables may show short-term statistical insignificance, that does not indicate that those variables are of minor economic importance. It is indicated by the statistical insignificance of some variables that consumers have developed a pattern of adapting their purchasing behaviors (adaptive purchasing behavior), which is affected by the institutional mechanisms and government policies that may intervene in the immediate response to short-term events. The concept of adaptive purchasing behavior supports this rapid move to long-run economic equilibrium following the immediate deviation from the long-run growth trend. Therefore, the macroeconomic principles of stability and growth as applied to the automotive market are extremely important in maintaining that same level of stability and long-term growth in the automotive sector.

The automotive industry can use digital technology and data-driven insights of consumers to increase its agility and responsiveness to shifting consumer purchasing patterns in Malaysia while simultaneously enhancing the traditional measures employed by the government to stabilize Malaysia's economy. By creating an automotive data centre that captures current data on consumers' purchasing behaviour and financing trends, as well as macroeconomic data in real-time, policymakers and participants in the auto industry will be able to identify and develop dynamic solutions such as customized incentives and flexible credit programs that will be able to quickly adjust to rapidly changing conditions and consumer sentiment about future economic outlooks. In addition, partnerships will be established among governments, financial institutions and manufacturers to accelerate the adoption of alternative fuel vehicles, thus furthering the country's efforts to align with the United Nations sustainable development goals, while also creating new markets for the vehicles in the foreseeable future. By leveraging technology and sustainable development for greater consumer interaction, reducing volatility and future-proofing the Malaysian automotive market through a fast-changing economic climate.

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Author Contribution Statement:

All authors contributed significantly to the development of this manuscript. Nur Afizah Muhamad Arifin was responsible for the conceptualization, methodology and overall supervision of the study. Nurfatehah Nazwa Mohd Zakaria handled data collection, analysis and interpretation of results. Nurfatehah Nazwa Mohd Zakaria contributed to the literature review, drafting and critical revision of the manuscript. All authors read and approved the final version of the manuscript prior to submission.

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