

Impact of Ethanol Blending on Petroleum Prices and Crude Oil Import in India: A Longitudinal Analysis (1980–2025)

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ABSTRACT

Aims: To examine whether India's Ethanol Blending Programme (EBP) has influenced petrol prices and crude oil imports, and to project both at the 2030 target of 30% blending.

Methodology: Annual data on petrol price, ethanol blending percentage, inflation rate, exchange rate, balance of payments as a percentage of GDP, GDP growth rate and crude oil imports were collected. The sources were the Petroleum Planning and Analysis Cell, NITI Aayog, the World Bank and CEIC. The Shapiro–Wilk test showed the data were not normally distributed, so the Wilcoxon signed-rank test was used to compare petrol price and crude oil imports before and after the EBP. The Augmented Dickey–Fuller test showed the series were non-stationary. Multiple regression models were therefore estimated on first-differenced data, with the macroeconomic variables as controls. All analyses were carried out in JASP at the 5% significance level.

Results: Both petrol price and crude oil imports showed statistically significant median differences between the pre- and post-EBP periods ($p < 0.05$). In the regression models, ethanol blending had a significant positive association with changes in petrol price ($\beta = 1.53$, $p = 0.011$). It had no significant association with changes in crude oil imports ($\beta = 26.10$, $p = 0.316$), for which inflation was the only significant predictor. At 30% blending in 2030, the models project a petrol price of about Rs 125.75 per litre and crude oil imports of about 5,547 thousand barrels per day.

Conclusion: Ethanol blending supports energy diversification and environmental goals but, on its own, has not lowered fuel prices or India's dependence on crude oil imports. Complementary measures, such as passing cost savings on to consumers and investing in domestic energy sources, are needed alongside higher blending targets.

Keywords: ethanol blending, petrol price, crude oil imports, energy security, time-series analysis, inflation

Introduction

Economic stability with energy security and decarbonization policy is very challenging for a developing economy like India and at the same time very critical also. With increasing population and economic growth, the demand for transportation has been increasing and even dependence on crude oil (CEICdata.com, 2018), (ministryoftransport, n.d.)). In term of vehicle growth ,India has experienced a long-term growth in vehicle registration rising from 1417 vehicles in 1970 to nearly 2.93 crores in 2025 and growth was rapid during 1990 to 2000. Even India's crude oil import as per organization of petroleum exporting countries increased from 3935.5 thousand barrels per day in 2015 to 4985.5 thousand barrel per day in 2025 ((CEICdata.com, 2018)). Fluctuation in crude oil and petroleum price often affects the macro-economic condition of India (Kpodar & Liu, 2022). There has been numerous research that has analyzed petrol price change on economic welfare of developing economies (Gupta and Tiwary (2026), (Mwakabuli & Kaaya, 2026), (Habanabakize, 2021)). Vehicle growth and emission from crude oil also contribute towards greenhouse gas emission (GHG). Globally 25% of the ghg emission is through transportation and in India the transportation sector contributes almost 14%, with about 90% coming from road transportation (Scott & Scott, 2025). India is committed towards net zero emission by 2070, hence decarbonizing road and transportation which mainly runs of crude oil is urgent and essential ((Chaturvedi et al., 2024), (Ogungbemi & Dagbasi, 2025)). There are various steps taken globally to reduce emission reduction through transportation like electric vehicle for example in July 2025 the Ministry of Heavy Industries released the guidelines for electric truck under the PM e- DRIVE scheme with the aim of transitioning India's trucking sector towards cleaner and more self-reliant future. The Bureau of Energy Efficiency (BEE) has introduced corporate average fuel efficiency norms for passenger cars, and it is under finalization stage (Scott & Scott, 2025). Electric vehicle transition in India has a long way to go due to challenges like socio economic structures, governance dynamics, cultural natives, high cost, infrastructure barrier ((Hassani et al., 2026), (Kaur & Kumar, 2025)).

India initiated Ethanol Blending program (EBP) in January 2003 for sale of 5% ethanol blended petrol in 9 states and 4 Union Territories and this got extended till September 2006 to 24 states and 4 UTs, but blending remains low in te following year. From 2014 onwards, the government introduced several policy measures to increase ethanol production and blending. The government increased the blending percentage to 15% by 2023-24 and supported ethanol production capacity and feedstock availability ("Roadmap for Ethanol Blending in India: 2020-2025," 2021). By 2025 India achieved 20% blending target five years ahead the original plan which saved nearly 1.44 lakhs in foreign exchange and output of ethanol has increased from 38

crores litres in 2014 too 661 litres in June 2025 (G_Admin, 2026) and now India has an ambitious target of 30% by 2030. But ethanol production do comes with challenges like when sugarcane-based feedstock is heavily used it creates pressure on land, water, fertilizers and food security. It was suggested that sugarcane juice and second-generation feedstock along with better irrigation, fertilizer management and trade policies can reduce environmental burden and support ethanol production (Jha et al., 2026). It was also analyzed that second generation ethanol production from residual lignocellulosic biomass offers sustainable alternative fossil fuel while reducing competition with food production. It was suggested that agriculture residue such as corn straw, sugarcane bagasse and straw have stronger potential as feedstock for ethanol, but high pretreatment and enzyme cost remains a technological and economic challenge (Santos et al., 2026). For higher blending ratio and second-generation ethanol from rice can reduce CO₂ emission and can improve short term environmental and economic benefit, but long-term strategy suggests that sustainable ethanol expansion requires a balanced blending strategy, integrated multi feedstock production and effective policy (Kumar et al., 2024). Hence, this research aims to test the effectiveness of ethanol blending program in India and how it as impacted various macro-economic indicators on Indian economy.

Literature review

Ethanol blending can benefit environment and can benefit India's agricultural economy by using rice straw and bagasse which can help to reduce crop residue burning and CO₂ emission. It was found that higher blending ratios combined with 2G ethanol production can offer a good balance of environmental benefits and revenue generation (Kumar et al., 2024). Like in Turkey bioethanol is economically feasible without threatening the food security by additional supply of wheat and maize preferably by tariff reduction on imports rather than domestic production incentives. However, long-term sustainability may require supportive policies to create alternative rural employment opportunities and encourage farmers to shift towards alternative crops (Çağatay et al., 2017). In China corn base ethanol gasoline was compared with conventional gasoline using life cost analysis. The major internal cost arises from crude oil procurement and refinery/ethanol plant construction, while combustion emissions are key to external cost. It was found that ethanol E10 can reduce CO₂ emissions by more than 53 million tons, with a substantial reduction in wastewater emissions. The life cycle external cost of ethanol gasoline is 11.45% lower than conventional gasoline, which indicates significant environmental and economic benefits (Çağatay et al., 2017). A study also analyzed the environmental and resource impacts of India's 20% ethanol blending mandate, focusing on land, water, fertilizer use and GHG emission. It was analyzed that ethanol from molasses puts more pressure on land and water resources due to sugarcane high resource requirements, but at the same time sugarcane is relatively more sustainable. The study recommended diversified feedstock, improvised fertilizers

and irrigation management, supportive trade policies and greater generation of second-generation ethanol (Jha et al., 2026b). A study also highlighted that biotechnology supports circular economy through valorization, biofuel, bioplastics, biofertilizers, renewable energy and bioremediation. Innovations like these reduce resource consumption, waste, and dependence on fossil fuels and contribute to sustainable economic development. However, the full potential of the full sector requires regulatory reforms, stronger public-private partnerships, and greater investment in innovation (Vandy et al., 2025). It was also analyzed and compared gasoline E6 and E12 blends in spark ignition engine to assess the performance emission and lubricant degradation. E12 improved torque by 7.82% and brake thermal efficiency by 14.69% compared with gasoline, while also reducing CO, CO₂, HC and NO_x emission. However, E12 caused greater deterioration of lubricant properties, particularly kinematic viscosity. It was suggested that lubricant formulation may need to be modified to suit higher ethanol blend fuels (Ahmed et al., 2022). A study also evaluated gasoline-cassava bioethanol mixing ratios (G100, G90E10, G80E20, and G70E30) on engine performance, including torque, brake specific fuel consumption, power, total hydrocarbons, nitrogen oxides, and carbon Monoxide emissions. It was found that they reduce CO and total hydrocarbon emissions. Response surface methodology identified an optimized blend of G70E30 at 2000 rpm achieving improved performance. The findings demonstrated that optimizing bioethanol blend ratios can support cleaner combustion, renewable energy use and sustainable transportation (Ye et al., 2023). Using Low Emission Analysis Platform (LEAP) model and transport sector model, it was found that refined petroleum demand is expected to peak around 2028-30, followed by significant decline in diesel and gasoline consumption. The study suggested three strategies core business development, business integration and business transformation and it recommends that consistent fuel policies, stronger infrastructure and diversification towards low carbon energy to ensure a resilient energy transition (Nakapreecha et al., 2026). A study also focused to examine the water food energy nexus of India's sugar industry, with a focus on Maharashtra's political economy. Maharashtra state government support for sugarcane has encouraged water intensive cultivation, reduced freshwater availability and limited production of nutritious crops. Improving sugarcane-based ethanol can improve energy security and create demand for sugar surplus. Ethanol production from sugarcane juice may help to reduce excess subsidized sugar consumption without necessarily increasing land and water use (Lee et al., 2020). A study also proposed a strategy to achieve 20% blending target by optimizing the use of sugarcane juice, B-molasses, and C-Molasses. Using life cycle greenhouse gas emission and stoichiometric analysis. It was suggested feedstock-mix strategies can substantially reduce carbon emissions while supporting India's biofuel goals (Azad et al., 2024). A study examined the long-term relationship between biofuels consumption, economic growth and carbon dioxide emission in Saudi Arabia using data from 1990 to 2023. By applying Engel-Granger method, dynamic ordinary least squares (DOLS) and fully

modified ordinary least squares (FMOLS) models for long term relationships between bionergy use, economic growth and environmental quality were analysed. Biofuel consumption is projected to grow from 2.40% (2010–2023) to 2.80% (2023–2035), alongside strong projected GDP growth. At the same time, CO₂ emissions growth is expected to decline from 1.90% to 0.95%, suggesting a potential decoupling of economic growth from environmental degradation (Ahmed et al., 2022). The study also found that the nested renewable fuel standards (RFS) and biodiesel tax incentives increase biodiesel production to reduce incentive ethanol particularly cellulosic ethanol. It was recommended that moving towards a non-nested RFS, removing biodiesel subsidies and reducing ethanol costs to encourage E85 and cellulosic ethanol production. This can help improve long term reductions, social welfare, and reduce dependence on gasoline (Zhong & Khanna, 2022). By examining the EU countries panel data for the year 2001 till 2022 biofuel production, consumption and green finance contribute to economic growth and result showed that biofuel consumption significantly promotes economic expansion and support circular economy. The effects of biofuel production and green finance are more pronounced in smaller EU countries than larger ones. The study recommends cost effective biofuel production and policies that stimulate consumption to support long term sustainable development (Hasan, 2026). Infact algae and algal biorefineries are sustainable components of blue and circular economy which supports sustainable development goals. Algae can capture CO₂, produce clean energy and food, treat wastewater, create employment, and stimulate economic growth. Using life cycle assessment (LCA) a systematic evaluation of the environmental performance of seaweed production and consumption was analyzed. Fisher Information Theory as a measure of sustainability taking into account equity in society, the environment, and the economy is highlighted. It was suggested that in Africa growing the production of algae along Egypt's coast could benefits vulnerable coastal communities' socioeconomic well-being in addition to aiding in the restoration of coastal ecosystems and related ecosystem services (Ismail & Zokm, 2025). Based on a literature review production of biofuel primarily relies on food crops and arable lands. There is a conflict with the need to produce more food for an increasing world population. It was suggested that the amount of land for growing plants can possibly sustain both food and biofuel production if marginal land are included. It becomes important to select biofuel crops with high productivity on marginal lands and pronounced resilience and adaptability traits. Underutilized crops such as *Carthamus tinctorius*, *Ricinus communis*, *Brassica carinata*, *Camelina sativa* etc. may fit the purpose and may represent a valuable alternative to first-generation feedstock because they require minimal agronomical input. Using underutilized crops on marginal lands can also provide important ecological services, including improving soil fertility and water regulation, increasing biodiversity, and reducing soil erosion. To fully exploit this option, it will be critical to calibrate plant growth models to estimate the potential biofuel production on marginal land from second-

generation feedstock and to create tools for a more rational management of this land (Russo et al., 2025). Several pre-treatment methods, biofuel synthesis, and the application of agricultural waste products as biofuel was examined and it was found that producing biofuel from agricultural waste offers promising potential for enhancing energy sustainability by providing renewable alternatives to fossil fuels. Advanced Conversion Technologies such as pyrolysis, gasification, and hydrothermal processing can be further developed and optimized. Utilizing Genetic engineering approach can also play a role in developing microbial strains with enhanced abilities for biofuel production. It is crucial to optimize biofuel production processes to increase productivity, reduce costs, and minimize environmental impacts (Tyagi et al., 2025).

Hence, making references from the previous studies, the significant studies has emerged from its focus on biofuel feedstocks, biofuel mixing with crude oils, but a smaller number of research has been recently found on to focus on long term trends of ethanol blending in India and how effectively ethanol blending in India has helped to stabilize petrol price and crude oil import. This research aims to analyze the long-term trend of ethanol blending program in India and its effectiveness and impact on crude oil import and petrol price.

Research Methodology

The study aims to analyze the effectiveness of ethanol blending primarily on petrol price in India and import of crude oil. The data for such variable has been taken as petrol price (Rs/litre in India). Ethanol blending percentage, inflation rate as change in crude oil price impacts the inflation, exchange rate (Rs/US\$) as exchange rate in one macroeconomic variable which can have affect on consumption expenditure with an economy, balance of payment ((Kumar et al., 2024), (Sarwal et al., 2021), (Habanabakize & Dickason-Koekemoer, 2022), (Hassan et al., 2020), (Chaiwat et al., 2014), (Okwu et al., 2025)). The data for these variables has been collected from the year 1980 to 2025 from sources like petrol planning and analysis cell (*Retail Selling Price (RSP) of Petrol, Diesel and Domestic LPG | Petroleum Planning & Analysis Cell | Government of India*, n.d.), ethanol blending rate from the report of Niti Aayog ("Roadmap for Ethanol Blending in India: 2020-2025," 2021), inflation data from the world bank website (*World Development Indicators | DataBank*, n.d.), exchange rate (Rs/US\$) from the database *indexmundi.com (India - Official Exchange Rate (LCU per US\$, Period Average)*, n.d.), inflation rate on consumer base from the website of world data (*Inflation Rates in India*, 2026), GDP growth rate from world bank database (*World Development Indicators | DataBank*, n.d.-b) , balance of payment data as percentage of GDP from world bank group database ((*World Bank Open Data*, n.d.)) and import of crude oil (Barrel/day) from the database (CEIC, 2025) . The data for the selected variable was arranged in time series format for the year 1980 till 2025 and descriptive analytics of the selected variables has been depicted in table 1 below.

Table 1. Descriptive Analytics

Variable	Mean	Median	Standard Deviation	Minimum	Maximum
Petrol Price (Rs/Litre)	40.8	32.7	30.96	5.1	105.01
Ethanol Blending (%)	2.1	0.1	4.5	0	19.89
Inflation rate (%)	7.47	7.07	3.01	3.33	13.87
Exchange Rate (Rs/US\$)	42.9	44	23.36	7.86	88.72
Balance Of Payment as % of GDP	-1.31	-1.31	1.17	-.5	1.4
GDP Growth Rate (%)	6.11	6.4	2.6	-5.2	9.8
Import of Crude Oil (Barrel/day)	2195.45	1935.1	1739.69	278.1	4985.5

As per table 1 petrol price ranges significantly increased from Rs 5.10 per liter to 105.01 per liter and ethanol blending has also shown some recent expansion. Inflation and GDP growth rate significantly fluctuated during the period (Nafisa, 2026). As per research also oil prices have played a crucial role in linking external shocks to domestic macro-economic outcomes, however during short-run dynamics indicated that shocks in oil price send through inflation and exchange rate channels before hampering industrial activity (Bueno et al., 2025). Even balance of payment as a percentage of gdp had a considerable variation in India's external balance over time, making it relevant for examining its relationship with crude-oil imports and ethanol blending. The descriptive statistics clearly shows that significant change in India's fuel price, ethanol blending, macroeconomic condition, exchange rate and crude oil import. One of the main objectives of Ethanol Blending Programme in India was to reduce the import of crude oil and reduce the petrol price and this study aims to test this by comparing the after and before the quantity of crude oil imported and petrol price in India (Rs.litre). To test this, following hypothesis has been framed:-

Hypothesis 1

Ha:- There is a significant median difference in petrol price (Rs/Litre) in India before and after ethanol blending programme

Ho:- There is no significant median difference in petrol price (Rs/Litre) in India before and after ethanol blending programme

Hypothesis 2

Ha:- There is a significant median difference in crude oil (Barrel/day) in India before and after ethanol blending programme (EBP)

Ho:- There is no significant median difference in crude oil (Barrel/day) in India before and after ethanol blending programme (EBP)

To test the hypothesis (hypothesis 1) the normality of the data was tested Shapiro wilk test and data highly deviated from normality, hence Wilcoxon signed rank test was applied to test the hypothesis 1 using JASP software at 5% significance level. The p value was less than 0.05, hence we rejected the null hypothesis and concluded that the median difference between Pre-ethanol Blending and Post-Ethanol Blending for petrol price was significantly different from 0. Similarly, we tested for import of crude oil (hypothesis 2) and p value is less than 0.05, hence we reject the null hypothesis and median difference between Pre-ethanol Blending and Post-Ethanol Blending for crude oil import significantly differs from 0.

From the above hypothesis testing, it is quite evident that the pre and post median difference in import of crude oil (Barrel /day) and petrol price (Rs/ltrs) is significantly different from 0. It is evident that there has been a significant change in import of crude oil and petrol prices since 1980, but it can also be due to other macroeconomic factors. Hence, it is also important to analyze the most significant factor which has impacted the import of crude oil (barrel/day) and petrol price (Rs/ltrs) over a period in India.

Data Analysis

India has undergone various macro-economic changes due COVID 19, global crisis of 2008, oil price shock, changes in foreign direct investment, interest rates etc... (Bhardwaj et al., 2026), (Jain et al., 2025). Changes in petrol price (Rs/ltrs) and import of crude oil (barrel/day) get impacted due to inflation rate, exchange rate (Rs/US\$), balance of payment as % of GDP, GDP growth rate (%). To analyze further the significance of other macro-economic variables on petrol price and import of crude oil the data has been arranged in time series format and using Augmented Dickey Fuller (ADF) test the stationarity was test. The results showed that the series are integrated of mixed order: exchange rate, balance of payment (% of GDP), and import of crude oil became stationary after first-differencing, while petrol price, inflation rate, and GDP growth rate required further differencing, and ethanol blending (%) remained non-stationary even after differencing which reflected a structural shift in the series, as blending percentages stayed at 0% for over two decades before rising sharply after 2013. Given this, the regression models were estimated on the first-differenced series (i.e., year-on-year changes) rather than on

the raw levels, to avoid the risk of spurious regression that non-stationary level data can produce. To further analyze the data following hypothesis were tested

Hypothesis 3

Ha:- Ethanol blending (%) significantly impacts the petrol price (Rs/litre) in India

Ho:- Ethanol blending (%) does not significantly impacts the petrol price (Rs/litre) in India

Hypothesis 4

Ha:- Ethanol blending (%) significantly impacts the import of crude oil (Barrel/day) in India

Ho:- Ethanol blending (%) does not significantly impacts the import of crude oil (Barrel/day) in India

To test the hypothesis the other macro-economic control variables were taken into consideration like inflation rate (%), exchange rate (Rs/US\$), balance of payment as % of GDP and GDP growth rate (%). For hypothesis 3 and 4 to check the autocorrelation and it was found to be 2.15 and 1.84 respectively, both within the acceptable range and even multicollinearity was tested variance inflation factor (VIF) and all were close to acceptable range of 1, but and high collinearity was found between exchange rate and import of crude oil (Jain et al., 2025), hence import of crude oil was dropped off for hypothesis 3 and petrol price(Rs/litre) was dropped for hypothesis 4. The equation derived for hypothesis 3 are as follows, which was tested at 5% significance level using JASP software:-

Equation 1

Petrol Price (Rs/Ltrs) = 1.424 + 1.53 Ethanol Blending (%) + 0.063 Inflation Rate (%) + 0.122 exchange rate (Rs/US \$) – 1.45 Balance of payment as % of GDP – 0.152 GDP Growth Rate (%)

As per equation 1. ethanol blending positively and significant affect on change in petrol (coefficient =1.53, p=0.011) supporting hypothesis 3. It was also observed that change in balance of payment as % of GDP has a negative affect with a border line significance value (p=0.05), whereas inflation, exchange rate and GDP growth rate were not statistically significant predictors at 5%. Similarly, hypothesis 4 was tested as 5% significance level using JASP software and following equations were derived: -

Equation 2

Import of crude (Barrel/Day) = $81.8 + 26.10 \text{ Ethanol Blending (\%)} - 24.03 \text{ Inflation Rate (\%)} + 5.59 \text{ exchange rate (Rs/US \$)} - 62.84 \text{ Balance of payment as \% of GDP} + 13.6 \text{ GDP Growth Rate (\%)}$

As per equation 2, the change in ethanol blending (%) does not significantly influence the change in import of crude oil (coefficient =26.1, $p=0.316$), so hypothesis 4 fails to be rejected. Infact inflation rate is a significant negative predictor (coefficient = -24.03, $p = 0.025$) (Panigrahi et al., 2025).

Below table 2 depicts the proposed hypothesis, interpretation and equation formed

S.No	Hypothesis	P Value (<0.05)	Equation
1	Hypothesis 3. Ha:- Ethanol blending (%) significantly impacts the petrol price (Rs/litre) in India Ho:- Ethanol blending (%) does not significantly impacts the petrol price (Rs/litre) in India	0.011 Reject Ho	Petrol Price (Rs/Ltrs) = $1.424 + 1.53 \text{ Ethanol Blending (\%)} + 0.063 \text{ Inflation Rate (\%)} + 0.122 \text{ exchange rate (Rs/US \\$)} - 1.45 \text{ Balance of payment as \% of GDP} - 0.152 \text{ GDP Growth Rate (\%)}$
	Hypothesis 4. Ha:- Ethanol blending (%) significantly impacts the import of crude oil (Barrel/day) in India Ho:- Ethanol blending (%) does not significantly impacts the import of crude oil (Barrel/day) in India	0.316 Failed to reject Ho	Import of crude (Barrel/Day) = $81.8 + 26.10 \text{ Ethanol Blending (\%)} - 24.03 \text{ Inflation Rate (\%)} + 5.59 \text{ exchange rate (Rs/US \\$)} - 62.84 \text{ Balance of payment as \% of GDP} + 13.6 \text{ GDP Growth Rate (\%)}$

Projection for the Year 2030

As India has aimed for ethanol blending of 30% by 2030 (<https://www.team-bhp.com/>, 2025), this study has also analysed that based on the above equation 1 and equation 2 what be the project petrol price and import of crude oil. For this the project inflation rate of India has been considered 4% (Statista, 2026), exchange rate (Rs/US\$) has been considered as Rs 105/US\$ (*DOLLAR TO RUPEE FORECAST 2026, 2027, 2028 - 2030*, n.d.), GDP growth rate has been considered as 10% (*India 2030: GDP & Public Debt Outlook | India Debt Clock*, n.d.) and balance of payment as percentage of GDP has been considered as -1.9 (Federal Bank of

St.Louis, 2026) and 2025 observed values has been observed as ethanol blending 19.89%, inflation 3.9%, exchange rate Rs 88.72, BoP -0.4% of GDP, GDP growth 7.6%. Hence the implied changes are

Change in ethanol blending – 10.11 points, change in inflation = 0.1 points, change in exchange rate = Rs 16.26, change in balance of payment as % gdp = -1.5 points and change in GDP growth rate = 2.4 points

The projected petrol price (Rs/litre) is found to be $-1.42 + (1.52 \times 10.11) + (0.063 \times 0.1) + (0.122 \times 16.28) - (1.45 \times -1.5) - (0.152 \times 2.4) = \text{Rs } 20.74/\text{litres}$

Hence projected petrol price in 2030 = 2025 level (105.01) + Rs 20.74 = Rs 125.75 / ltrs

Similarly the import of crude oil is

Change in crude import = $81.837 + (26.106 \times 10.11) - (24.038 \times 0.1) + (5.592 \times 16.28) - (62.840 \times -1.5) + (13.623 \times 2.4) = 561.35$ thousands barrel/day

Hence projected crude oil import in 2030 = 2025 level (4985.5) + 561.35 = 5546.85 thousand barrels/day

This estimation treats cumulative 2025 to 2030 changes in each predictor as a single input and estimated relationship remains linear and stable over the five years.

Findings and Conclusion

This study aims to analyze how much EBP has achieved reducing petrol price and reducing import of crude oil in India using 46 years macroeconomic data from 1980 till 2025. The pre – post comparison using paired test confirmed a statistically significant median shift in both petrol price and crude oil import volumes after the introduction of blending ($p < 0.05$ in both cases), though this alone could not attribute the shift specifically to ethanol blending given the many other forces driving both variables upward over four decades. The regression analysis, estimated on first-differenced data to correct for non-stationarity and avoid spurious regression, offered a more precise and somewhat counter-intuitive picture: ethanol blending (%) showed a statistically significant *positive* relationship with the change in petrol price (coefficient = 1.53, $p = 0.011$), suggesting that any cost savings from blending have not been passed through to consumers or have been outweighed by other cost pressures since blending accelerated post-2013, while it showed no significant relationship with the change in crude oil import volumes (coefficient = 26.10, $p = 0.316$), with inflation instead emerging as a significant negative predictor of import changes (coefficient = -24.03, $p = 0.025$). Projecting these relationships to India's targeted 30% blending rate by 2030 suggests petrol price rising to approximately Rs 125.75/litre and crude oil

imports rising to approximately 5,546.85 thousand barrels/day, driven more by exchange rate depreciation and GDP growth than by blending itself — implying that continuing to raise blending targets may support energy diversification and environmental goals, but should not be assumed, on this evidence, to independently lower fuel prices or import dependence without complementary policy measures such as subsidy pass-through or parallel investment in domestic energy sources. These conclusions should be read alongside some limitations: the annual data yields fewer than 50 observations, constraining statistical power; ethanol blending's own series reflects a structural break (near-zero for two decades before a sharp post-2013 rise) that even differencing could not fully resolve into stationarity; and the 2030 projections assume the estimated relationships stay linear and stable over a five-year horizon, which may not hold as blending approaches higher, potentially diminishing-return percentages — future work using higher-frequency data and a formal cointegration/error-correction framework would help address these constraints.

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