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Impact of a sudden fuel price hike on urban motorbike usage: Evidence from Barishal, Bangladesh

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ABSTRACT

Fuel price volatility has long been an important topic for understanding how consumers react to immediate price shocks. The sharp increase in petrol prices of approximately 52 percent in 2022 was a major economic concern for analyzing the consumption behavior of urban commuters in developing countries like Bangladesh. This study examines how motorbike users responded to the sudden fuel price increase in terms of short-run fuel consumption. Data were collected from 220 respondents through face-to-face surveys at petrol stations, parking areas, and major traffic junctions across Barishal city. Respondents were randomly selected motorbike owners who use their bikes for personal purposes only. Random effects regression results indicate a statistically significant decline in monthly fuel consumption by 2.5 liters, along with a substantial reduction in average monthly riding distance of 104.3 kilometers following the price shock. Additionally, the estimated arc price elasticity of fuel consumption is –0.213, with larger reductions observed among unemployed and middle-income riders. Demographic characteristics such as age, income, occupation, and riding experience are also included to examine their influence on fuel consumption. Overall, these findings inform energy policymakers on targeted fuel pricing or subsidy reforms affecting urban commuters.

Contribution/ Originality: This study contributes to the existing literature by analyzing immediate consumer responses to an unexpected fuel price shock in Bangladesh. It documents short-run household fuel consumption adjustments and heterogeneous behavioral responses across income, occupation, age, and riding experience, providing micro-level evidence on urban mobility and fuel demand elasticity.

1. INTRODUCTION

Sudden changes in the prices of essential goods often disrupt people's consumption behavior, forcing households to quickly adjust their budget allocation decisions (Buckwell, Davis, Balcombe, & Davidova, 1994). When the cost of a necessary item rises unexpectedly, individuals must immediately rethink their daily spending priorities (Srivastava, 2025). This dynamic became evident during Bangladesh's 2022 fuel price hike, when the government imposed an overnight increase of more than 52%, the largest fuel price shock in the country's history. The heavy crowds rushing to fuel stations in the final hour before the new prices took effect illustrate why it is essential to study how consumers respond to sudden price shocks. When the price of a normal good rises abruptly, consumers must immediately adjust their consumption decisions. Standard consumer theory explains this through the Hicksian decomposition of demand (Varian & Varian, 1992). As the price increases, consumers shift demand away from the now more expensive good

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toward cheaper substitutes. Simultaneously, the income effect reduces their real purchasing power, requiring them to reoptimize their overall budget allocation. These theoretical insights motivate the study's core questions. First, how do personal motorbike users adjust fuel consumption in the short run following a sudden fuel price increase? Second, do riders reduce their average riding distance in response to the price hike? Third, how do age, income, occupation, and riding experience influence these short-run adjustments?

In Bangladesh, motorbikes are the most common mode of public transport for short-distance travel, and in cities like Barishal, they are widely used for daily commuting. Due to limited public transport options, many residents rely on personal motorbikes to reach work, schools, markets, and other essential destinations. As a result, sudden increases in fuel prices can have immediate and significant effects on household budgets and commuting behavior, especially for low- and middle-income riders who have limited flexibility in their monthly expenditures. Accordingly, the study aims to quantify the short-run behavioral response to the price shock and examine how factors like income, age, riding experience, and occupation shape the response of riders to the price shock. Such an unanticipated shock provides a unique opportunity to observe the causal effect of abrupt price changes on individual consumption decisions. Using primary survey data from 220 motorbike users in Barishal, the study documents a clear response to the 2022 fuel price shock. To quantify riders' behavioral responses, the study first estimates the arc price elasticity of fuel consumption for different groups as well as overall. Examining differences across occupational and income groups allows for a more nuanced understanding of behavioral adjustments and helps identify which groups are most affected, providing insights for targeted policy interventions. Arc price elasticity measures the percentage change in fuel usage resulting from a given percentage change in price. It is particularly suitable for discrete changes between two points, such as before and after a sudden price hike, and is calculated using the midpoint formula.

$$E_{Arc} = \frac{(Q_2 - Q_1)/\left(\frac{Q_2+Q_1}{2}\right)}{(P_2 - P_1)/\left(\frac{P_2+P_1}{2}\right)}$$

In addition, a random-effects regression model is used to examine the factors influencing fuel consumption and average riding distance. This model takes into account rider-specific traits that do not change over time, as well as observable factors such as age, income, occupation, and riding experience, alongside the impact of the fuel price shock. It leverages both within-rider changes and differences across riders, making it well-suited for examining patterns in panel data. By comparing pre- and post-shock consumption within the same individuals, this study provides the first micro-level evidence on how individual motorbike users in Bangladesh adjust fuel use immediately after an abrupt, overnight price hike. This micro-level approach allows for a causal inference that is often obscured in aggregate or cross-sectional studies on developing economy transportation behavior. The rest of the paper is organized as follows. Section 2 reviews relevant literature. Section 3 presents the data, variables, and empirical strategy. Section 4 reports results, discussion, and robustness checks. Section 5 concludes with key insights and policy implications.

2. LITERATURE REVIEW

Price shocks significantly influence consumer demand, with varying effects depending on the nature of the price changes and consumer behavior. Essential goods like food and energy exhibit inelastic demand, meaning consumers are less responsive to price changes, while luxury goods show higher elasticity. Demand elasticity varies with income levels; higher income typically correlates with lower elasticity, indicating that wealthier consumers are less sensitive to price changes (Femenia, 2019). Essential goods are fundamental for survival, leading to a sharp indifference curve that indicates no substitutes can replace them (Beckman & Smith, 2016). Consumers continue to purchase these goods even as prices rise, reflecting their highly inelastic demand. In the case of gasoline, households tend to maintain consumption despite price increases, largely because they lack practical alternatives for transportation (Yanagisawa, 2008). For budget-constrained households, increases in gasoline costs are compensated by reducing and reallocating food spending, often through shifting to lower-cost food options (Gicheva, Hastings, & Villas-Boas, 2007). The price

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elasticity of fuel demand varies significantly between the short run and the long run. The short-run price elasticity of gasoline demand in Korea is estimated at -3.81, while the long-run price elasticity is -7.40, indicating that gasoline demand is more responsive to price changes in the long run than in the short run (Lim & Yoo, 2016). Lim, Kim, Kim, and Yoo (2012) investigate the demand function for diesel in Korea, focusing on the period from 1986 to 2011, and examine both short-run and long-run elasticities of diesel demand with respect to price and income. The short-run price elasticity of diesel demand in Korea is estimated at −0.357, while the long-run price elasticity is −0.547. Another key mechanism through which fuel price changes influence household behavior is the substitution effect. As gasoline prices rise, consumers tend to seek alternative modes of transportation. Higher gasoline prices correlate with increased demand for cycling, as evidenced by regression analyses, Conly (2022) showing a direct substitution effect between gasoline costs and bicycle usage. Belloc, Giménez-Nadal, and Molina (2023) indicates a negative relationship between gasoline prices and the proportion of commuting by private car, while showing a positive relationship for public transit, walking, and cycling they claim higher gasoline prices lead to a decrease in private car commuting by 0.844% and an increase in public transit, walking, and cycling by 0.418%, 0.664%, and 0.216%, respectively. Some studies indicate that higher gasoline prices lead households to substitute travel from inefficient vehicles to more fuel-efficient ones (Burke & Nishitateno, 2013; De Borger, Mulalic, & Rouwendal, 2016; Greene & Hu, 1985).

Several studies document the consequences of these unexpected price shocks. The impact of fuel price hikes is multifaceted, affecting various sectors of the economy, microenterprises, consumer goods, and overall economic stability. A study conducted in the Philippines shows that fuel price hikes significantly affect microenterprises, particularly in terms of consumer expenditure (Plaza, 2023). The fuel price hike leads to decreased community income, increased public transport fares, reduced purchasing power, and widespread dissatisfaction, particularly among lower-middle-class citizens. It also triggers protests and affects various sectors, causing economic and social challenges across the community (Nadhifah, Mardiah, Lubis, & Lingga, 2022). In most cases, fuel price hikes are unanticipated, leaving households and firms with little time to adjust their behavior. Goel and Morey (1995) investigate how sudden gasoline price changes, particularly due to supply shocks, affect gasoline consumption. It highlights the price elasticity of demand, indicating that unanticipated fuel price shocks can significantly alter consumer fuel demand patterns. The 2014-2015 unanticipated negative oil price shock significantly influenced U.S. consumer spending. The findings indicate that consumer spending increased post-oil price shock, particularly among vehicle owners and high gasoline spenders, suggesting a significant response to the decline in oil prices (Alexander & Poirier, 2020). Not all consumers adjust their behavior in the same way when fuel prices change; rather, responses vary widely depending on socioeconomic characteristics and mobility needs. In this context, Wadud, Graham, and Noland (2010) indicate that consumer fuel demand responds heterogeneously to price shocks, with variations based on household characteristics such as income, number of vehicles, and location, affecting both price and income elasticities significantly across different socio-economic groups. Peersman and Wauters (2024) reveal that low-income families and those planning major renovations exhibit higher price elasticity of energy demand during fuel price shocks, while households with a greater appetite to consume show lower elasticity, indicating significant heterogeneity in consumer responses. There are significant differences in price elasticity for gasoline and diesel between OECD and non-OECD countries. OECD countries exhibit a price elasticity for gasoline around -0.7, significantly higher than the non-OECD elasticity of about -0.2, indicating heterogeneous impacts of fuel price shocks on consumer fuel demand across different country classifications (Liddle & Huntington, 2020).

Despite these important contributions, a significant research gap remains in Bangladesh, where almost no study has captured the immediate consumer response to the unprecedented fuel price shock. One study on Sylhet City shows that fuel price increases significantly reduced recreational trips and trip lengths. Motorcycle users shifted toward shared CNG auto-rickshaws, and the impacts of fuel price hikes and travel patterns differed depending on key socioeconomic attributes, including gender, age, income, education, and vehicle ownership (Mily, Haque, & Islam, 2024). However, this study does not capture how households adjust fuel consumption itself, how riding distance

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changes in the short run, or how price elasticity differs across key socioeconomic groups such as income levels and occupations. By analyzing these immediate behavioral responses in a developing-country urban setting, our study contributes to the literature in two key ways. First, it provides micro-level short-run evidence on consumer fuel consumption adjustments in Bangladesh. Second, it documents heterogeneous behavioral responses across socioeconomic groups, including variations by income, occupation, age, and riding experience, thereby enriching the global literature on fuel demand elasticity and short-run consumer adjustments to energy price volatility.

3. DATA AND METHODS

3.1. Data Source and Sampling Framework

The data for this study were collected through face-to-face surveys conducted at several strategic locations across Barishal city, including petrol stations, major traffic junctions, and parking areas. Respondents were randomly selected motorbike owners who use their motorcycles solely for personal purposes. This study excludes buses, private cars, and motorbikes used for income-generating activities for specific reasons. Bus drivers do not personally bear fuel expenses the cost is passed on to passengers through higher fares, so their behavior does not reflect individual fuel-cost adjustments. Private car owners tend to be relatively high-income and are therefore less sensitive to short-term fuel price changes, which could distort results by introducing income-related bias. Finally, individuals who ride motorbikes for income-generating purposes (such as ride-sharing or job-related travel) are not directly affected by fuel shocks, as they can compensate by increasing fares or receive higher transport allowances from employers.

A total of 220 male motorbike users were surveyed, reflecting the local context where female riders are rare. The survey was conducted in October 2022 and collected retrospective information on fuel usage before and after the fuel price adjustment. Specifically, "before" refers to typical fuel consumption in July 2022, prior to the fuel price increase implemented in August 2022, while "after" refers to consumption in September 2022. Because respondents were generally unable to recall exact fuel quantities, the survey elicited information on typical monthly fuel expenditures for both periods. Monthly fuel consumption was then derived by dividing reported fuel expenditures by the corresponding period-specific fuel prices. This approach ensured consistent measurement of fuel usage across respondents and periods.

3.2. Variables

This study uses two main outcome variables to capture individual-level behavioral responses to the fuel price shock. Monthly fuel consumption, reported by each respondent, is the first dependent variable. The second outcome variable is the average riding distance per month. However, individuals are generally unable to recall exact monthly travel distances; this measure is constructed indirectly by their reported mileage (kilometers per liters). The key explanatory variable, shock, equals 1 for the period after the fuel price increase and 0 otherwise. In addition to this treatment indicator, several individual-level characteristics are included as controls. These consist of the respondent's age, monthly personal income, and years of riding experience, each of which may influence fuel consumption patterns and sensitivity to price changes.

3.3. Empirical Strategy

To examine the impact of the 2022 fuel price shock on motorbike usage, we employ a random-effects panel regression model. The random-effects estimator allows the use of within-individual variation over time while maintaining time-invariant factors such as age, income, riding experience, and occupation in the analysis. Since the shock is exogenous and unrelated to any individual-specific unobserved traits, the assumption that individual effects are uncorrelated with the regressors is reasonable. This makes the random-effects specification an appropriate and efficient estimation strategy for the main analysis. The basic specification is as follows:

$$Consumption_{it} = \beta_0 + \beta_1\, shock_t + \beta_2 X_i + u_i + \varepsilon_{it} \quad (1)$$

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$$Distance_{it} = \beta_0 + \beta_1 shock_t + \beta_2 X_i + u_i + \varepsilon_{it} \quad (2)$$

In our empirical analysis, we estimate two separate panel regression models to capture the short-run behavioral responses. Model (1) uses monthly fuel consumption in liters as the dependent variable, while Model (2) considers average monthly riding distance in km. In both models, the main explanatory variable is the shock dummy, which takes the value 1 in the post–price-hike period and 0 otherwise, and the coefficient β_1 captures the average short-run effect of the fuel price shock on consumption/distance. The vector X_i includes a set of individual-level covariates such as age, monthly income, years of riding experience, and occupation. The term u_i captures unobserved individual-specific heterogeneity, assumed to be uncorrelated with the regressors under the random-effects assumption, and ε_{it} is the idiosyncratic error term.

4. RESULTS

4.1. Descriptive Statistics

Table 1 reports the descriptive statistics for the pooled sample of 440 individual-period observations, derived from 220 respondents surveyed before and after the 2022 fuel price increase. Monthly fuel consumption averages 28.77 liters, with values ranging from 4 to 120 liters. Riders travel an average of 1,278 km per month, though distances vary widely across individuals. The mean monthly income of respondents is 28,074 BDT, and riders have, on average, 6.3 years of riding experience. The average age in the sample is 32 years, with a range from 18 to 52.

Table 1. Pooled summary statistics of key variables.

Variables	Obs.	Mean	Std. Dev.	Min.	Max.
Consumption	440	28.769	15.868	4.01	120
Distance	440	1278.436	748.763	41.54	5400
Income	440	28073.832	23533.344	3000	280000
Experience	440	6.256	4.273	1	30
Age	440	31.832	8.221	18	52

Source: Sample survey.

4.2. Price Elasticity of Fuel Consumption

Recent studies provide a range of elasticity estimates varies significantly across different contexts and regions. The elasticity of gasoline demand was found to be stable around –0.3 until 2014, with a slight increase to –0.2 in 2015-16, remaining stable thereafter. Demand is more elastic in states with lower income and higher unemployment (Kilian & Zhou, 2024). Table 2 summarizes the arc price elasticities of fuel consumption across occupation groups, income groups, and for the overall sample. For simplicity, several detailed occupation categories were collapsed into three broad groups (employed, unemployed, and students), and household income was divided into low, middle, and high groups using terciles.

Table 2. Arc Price elasticity of fuel consumption across different groups.

Category	Sub-category	Mean Fuel Consumption (Liters) - Before	Mean Fuel Consumption (Liters) - After	Arc Elasticity
Employment	Employed	31.56	28.88	− 0.218
	Unemployed	28.09	20.00	− 0.826
	Student	26.16	24.43	− 0.168
Income	Low	26.87	13.44	− 0.145
	Middle	30.11	17.63	− 0.308
	High	34.02	17.56	− 0.210
Overall		31.56	28.28	–0.213

Note: "Before" refers to July 2022 (pre-price adjustment), and "After" refers to September 2022. Monthly fuel consumption was derived from reported fuel expenditures using period-specific fuel prices.

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Across all groups, fuel demand is inelastic, meaning that consumption falls by a smaller percentage than the percentage increase in price. The overall elasticity is –0.213, indicating that a 1% increase in fuel price reduces consumption by only 0.21%.

Elasticity varies across groups. Among occupations, the unemployed are the most price-responsive (–0.826), suggesting they reduce consumption sharply when prices rise, while students (–0.168) respond the least. Employed individuals fall in between (–0.218). Income differences also matter: middle-income households are the most sensitive to price changes (–0.308), followed by high-income (–0.210), whereas low-income households are the least responsive (–0.145).

4.3. Regression Results

Table 3 presents the random-effects regression estimates for the impact of the 2022 fuel price increase on monthly fuel consumption (Model 1) and average riding distance (Model 2). In both models, the coefficient on shock is negative and highly significant, indicating a substantial behavioral adjustment following the price hike. Monthly fuel consumption decreases by approximately 2.5 liters, while average riding distance declines by about 104 km after the shock.

Table 3. Random-effects regression estimates for monthly fuel consumption and riding distance.

Variables	(Model-1)	(Model-2)
	Consumption	Distance
Shock	–2.492***	–104.3***
	(0.520)	(22.56)
Income	0.000102*	0.00426*
	(5.23e-05)	(0.00248)
Experience	0.380	11.49
	(0.278)	(13.20)
Age	– 0.310*	– 11.54
	(0.166)	(7.880)
Occupation (unemployed)	– 6.018	– 394.3
	(8.975)	(426.0)
Occupation (student)	– 4.394	– 258.5*
	(2.854)	(135.5)
Constant	35.92***	1,583***
	(5.322)	(252.6)
Observations	440	440
Number of ID	220	220

Note: Standard errors in parentheses
*** p<0.01, * p<0.1

Among the control variables, income is positively associated with both outcomes, although the magnitude is small, suggesting that higher-income riders reduce consumption and travel less sharply. Age shows a modest negative effect, indicating that older riders tend to consume slightly less fuel and travel shorter distances. Riding experience is positively signed but statistically insignificant in both models. Occupational differences are generally weak, although students appear to reduce distance traveled more than employed riders.

Overall, the results clearly indicate that the fuel price hike led to a meaningful contraction in fuel use and mobility among motorcycle users, consistent with hypotheses about short-run behavioral responses to higher fuel costs.

4.4. Discussion

The findings of this study provide clear evidence that the 2022 fuel price hike led to a significant behavioral adjustment among private motorbike users in Barishal. The negative and highly significant coefficient on the shock variable in both models indicates that individuals responded to higher fuel costs by reducing their monthly fuel

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consumption as well as their average riding distance. A decline of about 2.5 liters of monthly fuel use and more than 100 km of riding distance demonstrates that this adjustment is substantial, reflecting a meaningful behavioral response to the shock. This is consistent with established theoretical expectations: when fuel prices rise sharply, individuals tend to cut discretionary trips, combine errands, or temporarily shift to alternative transportation options. The results further indicate that the response to the fuel price shock varies meaningfully across different demographic groups. The positive income coefficient suggests that riders with higher earnings are less responsive to the fuel price shock. The negative association with age implies that younger riders, who tend to be more mobile, reduce their travel more noticeably in response to higher costs. Meanwhile, occupational categories, although largely insignificant, indicate that students reduce mobility relatively more than employed individuals, likely due to stricter budget constraints and fewer alternatives for coping with higher fuel prices.

4.5. Robustness and Endogeneity Concerns

Table 4 presents the results of the household fixed-effects (FE) model used to assess the robustness of the baseline RE estimates. Although time-invariant covariates necessarily drop out, the coefficient on the fuel price shock remains almost unchanged in both magnitude and significance. This consistency suggests that the core results are not driven by unobserved, time-invariant household characteristics and remain stable across alternative model specifications. Potential endogeneity concerns, such as reverse causality or anticipatory behavioral adjustments, are unlikely to affect the estimated relationship. The fuel price increase was announced and implemented by the government overnight, without advance notice or gradual adjustment. Because riders had no opportunity to respond ahead of the policy change, the shock can be treated as plausibly exogenous to individual mobility decisions. This minimizes the risk that changes in fuel use or riding distance influenced the timing or magnitude of the price increase, supporting a causal interpretation of the results.

Table 4. Random and fixed effects estimates.

Variables	Consumption (RE Model)	Consumption (FE Model)	Distance (RE Model)	Distance (FE Model)
Shock	−2.492***	−2.492***	−104.3***	− 104.3***
	(0.520)	(0.520)	(22.56)	(22.56)
Income	0.000102*	-	0.00426*	
	(5.23e-05)		(0.00248)	-
Experience	0.380	-	11.49	
	(0.278)		(13.20)	-
Age	− 0.310*	-	− 11.54	
	(0.166)		(7.880)	-
Occupation(unemployed)	− 6.018	-	− 394.3	
	(8.975)		(426.0)	-
Occupation (student)	− 4.394	-	− 258.5*	
	(2.854)		(135.5)	-
Constant	35.92***	30.01***	1,583***	1,331***
	(5.322)	(0.367)	(252.6)	(15.95)
Observations	440	440	440	440
R-squared	0.057	0.095	0.056	0.089
Number of ID	220	220	220	220

Notes: Standard errors are reported in parentheses. * and *** denote statistical significance at the 10% and 1% levels, respectively.
Source: Sample Survey.

5. CONCLUSION

This study set out to examine how the abrupt 2022 fuel price hike shaped the immediate travel behavior of private motorbike users in Barishal city. The results consistently show that the price shock led to a significant reduction in both monthly fuel consumption and average riding distance, indicating that riders responded quickly and

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meaningfully to the sudden increase in fuel costs. A key contribution of this paper is its focus on behavioral adjustments following an unexpected price shock an area rarely explored in the existing transport or fuel-demand literature, particularly within a developing-country urban context. The findings offer practical insights for policymakers: sudden fuel price changes can impose immediate burdens on everyday mobility, especially for lower-income and younger riders and may even generate a net welfare loss, where the government's additional revenue from higher fuel prices is outweighed by the broader social and economic costs borne by the public. This aligns with broader evidence that any increase in fuel prices disproportionately exacerbates the vulnerability of lower-income households (Grimal, 2016; Oluwatayo & Alagbe, 2015). Evidence from other developing economies also supports the welfare concern. For example, a 53% fuel price hike in Nigeria led to an average 3.8% decline in household welfare, with the middle 40% income group experiencing the largest losses due to higher fuel expenditures (Umar & Umar, 2013). While in Indonesia, the net welfare impact of the fuel price hike is negative, as it forces households to allocate more income to oil, reducing spending on food and leading to decreased general welfare (Adam & Lestari, 2008). This underscores the need for more predictable pricing policies and accessible transport alternatives. While the study is based on a relatively small sample and a short pre–post window, the results remain valuable because they provide rare empirical evidence on short-term behavioral responses to an unanticipated policy shock. Future research could extend this work by analyzing longer-term behavioral adjustments. Additionally, evaluating the net welfare effects of abrupt fuel price shocks by comparing government revenue gains with the economic and social costs borne by consumers would provide a more complete understanding of the policy's overall impact.

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Transparency: The authors state that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.
Competing Interests: The authors declare that they have no competing interests.
Authors' Contributions: All authors contributed equally to the conception and design of the study. All authors have read and agreed to the published version of the manuscript.
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