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Exploring the Structure and Performance of Petroleum Retail Outlets in Pakistan

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The petroleum retail industry is one of the least researched industries in Pakistan due to, perhaps, unavailability of the relevant data. This paper aims to fill this gap. Specifically, the present paper examines the structure and performance of petrol pumps in Pakistan, using primary survey data. Analysis of the data reveals that operating a petrol pump is a profitable venture and both location and non-locational variables are important in contributing to the profitability of a petrol pump. The exploratory analysis shows that the petrol pumps in urban areas and those on highways have higher sales, indicating that the geographical location of a petrol pump is important in explaining a petrol pump's performance. According to the regression results, as the size of a petrol pump increases, its profitability increases and there is a non-linear relation between the distance variable and profitability of a petrol pump. The non-linearity implies that there exists optimal distance between two petrol pumps that maximises profits. This optimal distance is shorter for urban and non-highway petrol pumps, compared with rural and highway petrol pumps.

JEL Classification: D24, L81, R3
Keywords: Cost, Retail Business, Firm Location, Petrol Pumps

1. INTRODUCTION

It is generally assumed that since petrol pumps sell homogenous products, differentiated only by the identity of Oil Marketing Companies (OMCs), there is not much petrol pumps owners could do to increase their sales and profitability other than setting up petrol pumps on strategic locations. Indeed, a petrol pump in a rural area, away from a highway, cannot be expected to outperform a petrol pump that is in an urban area or on a highway. However, the literature that analyses the performance of petrol pumps shows that there are other factors as well that affect the performance of petrol pumps. Keeping in view the unavailability of any study on the petroleum retail industry in Pakistan, the objective of this paper is to contribute a better understanding of the structure and factors that affect the performance of the petrol pumps in Pakistan. Thus far, the analysis of the petroleum retail sector in Pakistan has escaped the attention of the researchers. As far as we know, prior to this study neither has anyone collected information on any aspect of the petrol pump industry in Pakistan nor has anyone analysed this industry.

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In 2013, the year in which the data for this paper was collected, there were 7,198 petrol pumps in Pakistan, up from 6,377 in 2009, translating to 3.07 percent growth per annum [Oil Companies Advisory Council (OCAC); unpublished figures]. At the same time, the demand for petroleum products has also increased over the years. In 2008-09, the transport sector consumed 8.84 million tonnes of oil equivalent (toe), which increased to 10.3 million toe in 2012-13 (Pakistan Economic Survey, 2015-16). This amounts to 3.90 percent increase in consumption of petroleum products by the transport sector.

The reason for the increase in the number of petrol pumps can be linked with the increase in the demand for petroleum products, especially in the transport sector. In Pakistan, the number of registered vehicles was 6.56 million in 2009, which increased to 13.67 million in 2013. This amounts to annual average growth rate of 20.15 percent. In turn, the reason for growth in the number of vehicles is due to several factors, including rising household incomes, increase in the size of the middle class, ease of getting car financing at attractive rates, and the import of used vehicles. The concomitant increase in the number of petrol pumps and demand for the petroleum products by the transport sector could have important implications for the owners, both current and potential, of petrol pumps.

Petrol pumps have often been a subject of public debate in Pakistan, mainly because their margins are fixed and the petrol pump owners demand for increase in those margins from time to time. The margins they receive from selling a litre of petroleum products are fixed by the government and they cannot charge higher prices (margins are a part thereof) than those declared by the government, which are determined by a government-approved formula. The petroleum dealers claim that margins they receive from the sale of a litre of MoGas and HSD are quite low and, therefore, they cannot run the petrol pumps profitably. This was also highlighted by the petrol pump owners during data collection. Thus, one of the motivations of the present paper is to take the claim of the petrol pump owners that they make low profits, or even incur losses, to the data and see what the survey data tells us.

Using the data on the cost structure, sales volumes, number of workers, and secondary activities, which include tuck shops, car washes, and tyre shops, we contribute to the empirical analysis of petrol pumps in Pakistan in two ways. Firstly, we analyse the structure of petrol pumps in Pakistan, that is, we analyse how costs are spread over various activities, which fuels have higher sales, which petrol pump employs higher number of which categories of workers, and what are some of the activities, other than selling fuels, in which petrol pumps are involved. The structural analysis of the petrol pumps in Pakistan helps us gain insights into the characteristics of the pumps that are related with profitability and cost efficiency. It helps us understand what differentiates those petrol pumps that are profitable from those that incur losses. It also highlights the features of the petrol pumps that make them more cost efficient than the others. Secondly, we analyse performance of the petrol pumps through econometric investigation. Based on the regression analysis carried out in the paper, we also calculate optimal distance between two petrol pumps that is profit and sale maximising. This could help the entrepreneurs interested in setting up petrol pumps in different regions and locations and it could also serve as a guideline for licensing authorities.

Our analysis is confined to two petroleum products, namely Motor Gasoline (which is simply called petrol in Pakistan; MoGas henceforth) and High-Speed Diesel (HSD; HSD henceforth) because these are the two main products that are sold at the petrol pumps. The petrol pumps sell other products as well, such as High Octane Blending Component (HOBC). However, we do not include it in our analysis mainly for two reasons. Firstly, because this product is not sold at every petrol pump and secondly because the sale of HOBC is very little compared to two other main fuels—MoGas and HSD.

The organisation of the rest of the paper is as follows. The next section reviews the relevant literature. In Section 3, an overview of the retail petroleum industry in Pakistan is presented. Section 4 explains the methodology used for collecting the data, the empirical model, and the methods used to analyse the data. The description of the sample is also presented in this section. The findings and results are presented in Section 5. The discussion is summarised and concluded in Section 6.

2. REVIEW OF LITERATURE

The relevant literature on the retail petroleum industry is scant. Most of the literature on petrol pumps focuses on the effect of a petrol pump's location on its performance. The effect of location is an application of the location theory and although our paper is not concerned with the location theory, or its application to the petrol pump industry per se, a few words outlining the location theory are in order. Although our paper does not dig deeper into the geographical location decisions of the petrol pump owners, it is, nevertheless, one of the factors that we consider in our analysis. Simply put, location theory addresses the question of what businesses are set up where and why.

One of the predictions of the location theory is that when the product is homogenous and businesses face stiff competition, the firms tend to differentiate spatially. On the other hand, according to Netz and Taylor (2002), firms may also locate their businesses closer to their competitors to attract more consumers. Using an econometric model based on the location theory, they found that petrol pumps in Los Angeles, USA, tend to be located farther away from each other because of stiff competition. They also found a positive effect of the presence of convenience stores on the performance of petrol pumps. Reviewing the choices of retail firms regarding location, Schmidt (1983) argued that retail firms' location decisions are "[…] judgmental, combining 'objective' economic or geographic elements, as well as 'intangibles', tempered by experience" (p. 68; emphases in original).

Chan, Padmanabhan, and Seetharaman (2005) developed a model of locational choice and pricing decisions in the gasoline market, which they also tested empirically using Singaporean data. The results suggested that the proximity of a petrol pump to a highway has positive effect on its sales. Using the data from Montreal to test the sales performance of petrol pumps, Gagné, Nguimbus, and Zaccour (2004) showed that geographical zone does not affect the sales of a petrol pump. However, they argued that this could be due to the inclusion of the traffic variable in their analysis, which, according to them, also captures the effect of geographical zone (e.g. urban area) on the sales performance of a petrol pump. Among the non-location variables, they found that the most important variables contributing to the better sales performance of a petrol pump are the size (station service capacity) and identity of the marketing company. However, they did not include non-forecourt variables in their regression analysis.[1] This is surprising because non-forecourt activities could be an important determinant of the performance of a petrol pump, as suggested by other research on the topic. Therefore, in our analysis, we also include non-forecourt activities.

Using survey data and case study approach, Sartorious, Eitzen, and Hart (2007) analysed the variables influencing the retail fuel industry in South Africa. They found that the size of petrol pumps, measured by the number of bays, did not have a significant positive effect on their profitability. They used sales volume as a proxy for gross profits. This is problematic because higher sales do not necessarily translate into higher profits. Inefficient cost structure may lead to lower, or even negative profits, even if the sales are relatively high. Considering this fact, we use both sales volumes and profitability in separate models. Sartorious, Eitzen, and Hart (Ibid.) found that location is an important variable for the gross profitability of a petrol pump. However, they did not include convenience store in their econometric analysis to test its effect on the profitability of petrol pumps. Rather, employing the case study methodology, they asked the petrol pump owners about the impact of convenience stores on their businesses. The owners felt that the effect of having a convenience store was positive. In a study on the petrol pumps in the United Kingdom, the effect of non-fuel sales was also found to be positive [Deloitte (2012)].

3. OVERVIEW OF THE PETROLEUM RETAIL INDUSTRY IN PAKISTAN

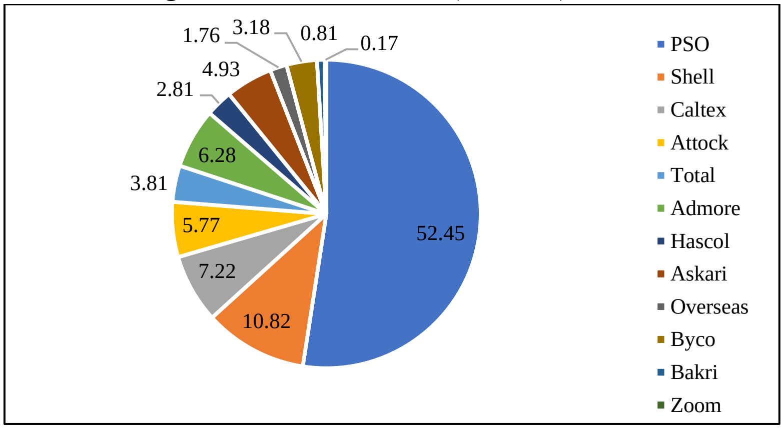
This section presents an overview of the petroleum retail outlet industry in Pakistan. In 2013, there were 12 OMCs that supplied fuel to 7,198 fuel stations, as per the data provided by the OCAC, Karachi (OCAC; unpublished figures). The petrol pumps in Pakistan do not operate in a competitive environment, as such. The prices of petroleum products, though deregulated over the years, are determined by a government approved formula and the petrol pumps are bound to sell different petroleum products at the declared prices. The petrol pump owners receive a fixed amount per litre as their margin. The margins, however, are not all profits. Since the petrol pumps must incur costs and bear overheads to sell their products, it leaves only a part of the margin as their profits. This contrasts with how petrol pumps operate in more developed countries where the petroleum industry is deregulated and petrol pumps are largely free to sell fuel at different prices, keeping in view the market conditions and the extent of competition in their respective areas.

3.1. OMC-Wise and Geographical Distribution

The biggest player in the petroleum industry is the Pakistan State Oil (PSO), which had 3,775 petrol pumps situated all over Pakistan in 2013. The second highest number of petrol pumps, 779, were those of Shell Pakistan Limited. Caltex and Admore operated 520 and 452 petrol pumps, respectively. The others were even smaller players in the petroleum retail industry. Figure 1 gives the petrol pumps operating under the banner of each OMC, as a percentage of total outlets, operated by all the OMCs.

[1]Activities at petrol pumps are typically divided into forecourt and non-forecourt activities. The forecourt activities refer to the selling of fuels and other related products, such as motor oil and non-forecourt activities refer to tuck shop, car wash, and tyre shops.

Fig. 1. OMC's in Pakistan (% Share) - 2013

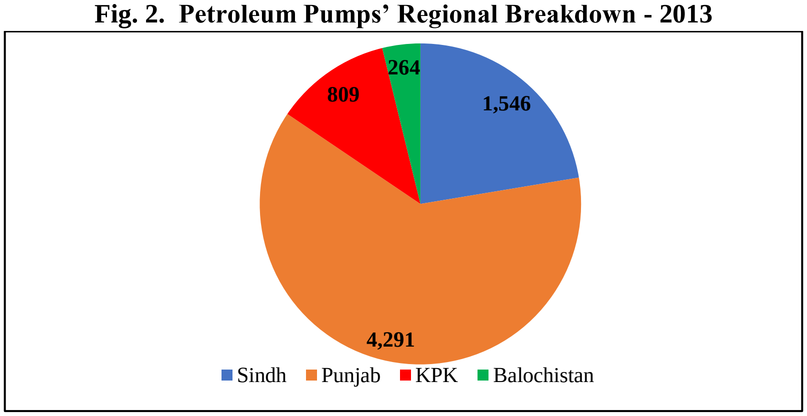


Source: Oil Companies Advisory Council (OCAC).

With the increase in demand and consumption of petroleum products, the number of petrol pumps has also increased. In 2009, the earliest year for which the data was available from the OCAC (unpublished figures), the number of petrol pumps was 6,377. The number increased to 7,198 in 2013. This amounts to an increase of 3.07 percent per annum, from 2009 to 2013. The number of registered vehicles in Pakistan in 2013 was 13.67 million, which increased from 6.56 million in 2009 (Pakistan Economic Survey, 2015-16). This translates to an increase from 1,029 vehicles per petrol pump in 2009 to 1,899 vehicles per petrol pump outlet in 2013. With the increase in vehicles on the roads due to different factors already discussed (see Section 1), the number of vehicles per petrol pump would probably increase over the years, given the modest growth in the petrol pumps. What these numbers imply is that the petrol pumps have become a lucrative business and with increase in vehicles, their sales and earnings are also expected to have increased over time.

As far as the regional distribution of petrol pumps in Pakistan is concerned, unsurprisingly, the highest number of petrol pumps in 2013 were in the province of the Punjab (4,291), followed by Sindh (1,546), KPK (809), and Balochistan (264). The regional breakdown of the petrol pumps is given in Figure 2 below.

Fig. 2. Petroleum Pumps' Regional Breakdown - 2013



Source: Oil Companies Advisory Council (OCAC).

3.2. Operations of Petrol Pumps

The activities of the petrol pumps are typically divided into forecourt (primary) and non-forecourt (secondary) activities. The forecourt activities include selling of fuels, which is the basic function of a petrol pump. Besides selling fuel, the petrol pumps also engage in other activities, which are known as non-forecourt activities. These activities include tuck shops, carwashes, and tyre shops. In more advanced countries, petrol pumps also have facilities such as auto teller machines (ATMs) but in Pakistan such an activity has only begun to appear and has not gathered pace. Moreover, in Pakistan, some of the pumps also sell compressed natural gas (CNG) but our analysis does not include this segment of the market because the operation of CNG stations is governed by entirely different procedures, and rules and regulations.

4. METHODOLOGY

This section contains discussion on the methodology employed to select sample and collect data, and methods used to explore the data to analyse the structure and determinants of the performance of petrol pumps.

4.1. Survey Design and Sample Selection

This study uses primary survey data collected in 2013. The survey was conducted for a larger study carried out for the Ministry of Petroleum and Natural Resources (MP&NR) on the margins of the OMCs and petroleum dealers in Pakistan. To the best of our knowledge, no other data on the retail petroleum industry in Pakistan was available at the time this paper was written. Until a newer dataset becomes available, the data used in our study is the best source that can be used for the analysis of retail petroleum industry in Pakistan. Also, the inferences drawn from a cross-section data are valid unless there are significant changes in the population from which the sample is drawn. In Pakistan, there have not been any significant changes in the market structure of the retail petroleum industry. Although a couple of new marketing companies have entered the market but those are very small players and their operations are geographically limited. Furthermore, it is pertinent to mention that the businesses in Pakistan are reluctant to share information, especially on the workforce and financial aspects, even for research and academic purposes. Collecting data, used in the present study, was made possible because of the involvement and financial assistance of a government agency. Without the involvement of an authority, collecting newer data is quite difficult due to reluctance of business entities to share information. Besides, collecting more recent data is not only time consuming but it also requires significant resources, financial and otherwise. Moreover, collecting data when the reference population is scattered geographically makes the task even harder. In the given scenario, it is safe to assume that the results of the present study are tenable.

The data on petrol pumps was collected through purposive sampling, using a structured questionnaire. The questionnaires were filled from the owners of the petrol pumps in most of the cases and in some cases from the managers of the pumps. Before proceeding to the data collection stage, we held numerous discussions with various stakeholders (OCAC, Pakistan Petroleum Dealers’ Association, individual petrol pump owners, and the MP&NR. During the discussions, it was inferred that due to spatial diversity of the petrol pump population that is scattered all over the country and due to security situation in some of the regions (especially Karachi and Balochistan), the most practicable sampling method would be purposive sampling**.** Handcock and Gile (2011) argue that in the cases when probability sampling is not possible, non-probability sampling is an effective mean to collect data.

Given the nature and scope of the study, petrol pumps were selected with certain cautions. Firstly, it was ensured that the sample covers major mix of petroleum products. Secondly, representation from highways and non-highways was also ensured as the nature and quantity of fuel sale (consumption), as well as structure and scale of pumps, vary by region (rural and urban) and location (highway and non-highway). For example, HSD is major fuel for long route transportation. Likewise, sale of MoGas in cities is higher as compared to the sale of MoGas at petrol pumps located on highways. Thirdly, to ensure proportional representation of population, petrol pumps in this case, 64 percent pumps were selected from urban areas. National urban to rural ratio is 57 percent to 43 percent. According to the data on the number of petrol pumps in Pakistan, there were 4,125 petrol pumps with modern facilities in 2013. This is almost 57 percent of the total pumps in Pakistan. It can be safely assumed that most of the pumps with modern facilities are in urban areas.

All these cautions, along with the disclosure of financial information involved in the process, forced us to follow purposive sampling. Petrol pumps were selected from the regions/areas in which authors have direct or indirect access so that petrol pump owners were ready to share financial information. Random sampling in this case would have resulted in a very high non-response rate, incurring monetary and time losses. Guided by lower intra-population variation, coupled with time and resource constraints, data were collected from 81 petrol pumps. Furthermore, the preference to probability sampling is emphasised because the non-probability sampling may lead to heteroscedasticity. To overcome this concern, we have used the heteroskedasticity-consistent estimation techniques.

4.2. Empirical Investigation

The data collected from the survey is analysed in two ways. Firstly, we use exploratory data analysis, which is carried out by disaggregating data on the bases of region (rural and urban) and location (highway and non-highway) of the petrol pumps. This is done because, as discussed above, the sales vary according to the region and location of the petrol pumps. The performance indicators we have used in our analysis are total costs, sales volumes, and profitability of the petrol pumps.

Secondly, regression analysis is done to understand the determinants of sales and profitability of the petrol pumps. We use profits per litre as a measure of profitability in our analysis, which are derived by dividing gross profits with total sales volume in litres. The gross profits, in turn, are defined as total revenues minus total variable costs, i.e.,

$$\Pi_i = TR_i - TVC_i \qquad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

where Π_i,TR_i, and TVC_i stand respectively for total profits, total revenues, and total variable costs, for the ith fuel station. Dividing Equation 1 with total sales volumes gives us profits in per litre terms, i.e.,

$$\pi_i = tr_i - tvc_i \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

Lowercase letters are used for per unit (per litre) variables.

The profitability of a petrol pump may depend on several things. The literature review shows that the performance of petrol pumps is affected by the location of the petrol pump, size, and price of petroleum products. In the case of Pakistan, however, price is irrelevant because prices of MoGas and HSD are determined by the government approved formula and are the same across all petrol pumps. Including the price variable in the regression analysis, therefore, would give singular matrix and for this reason we do not include prices in our analysis. Moreover, since price is the same across all petrol pumps of different OMCs[2], consumers would not be concerned about the price of MoGas or HSD. Therefore, it would not be incorrect to assume that price does not directly affect the sales and profitability of a petrol pump.

Apart from the price of the petroleum products, other factors that might affect the profitability of a fuel stations are numerous. Below, we discuss the variables included in the econometric analysis and present the rationale for including them in the analysis, based on the literature explored.

4.2.1. *Identity of the OMC*

One of the important factors is the identity of the OMC. Although MoGas and HSD are homogenous products, consumers are sometimes partial to some brands and are loyal to one brand rather than the other. For this reason, we include OMC as one of the determinants of profitability and sales in econometric investigation.

4.2.2. *Size of the Petrol Pump*

The size of a petrol pump is measured by the number of fuel dispensers, or bays, installed on the premises. Higher number of bays allows petrol pumps to take advantage of the economies of scale as per-unit costs do not increase proportionately with the number of bays, thereby contributing to higher per-litre profitability. Additionally, a higher number of bays installed on a petrol pumps means that the customers do not have to wait long for their turn to get the fuel. In this way, throughput increases and may have a positive effect on the profitability of the business.

4.2.3. *Region and Location*

The literature that explores that petroleum retail business suggests that an important factor that affects the performance of a petrol pump is where it is situated. The survey data reveals that petrol pumps that are in urban areas have higher throughput as compared to the petrol pumps in rural areas (see Section 5 below). In addition, petrol pumps situated on highways sell more HSD as compared to MoGas. However, it could be that the petrol pumps that are in rural areas are situated on highways. To take care of

[2]The prices do vary between citied due to difference in freight but the prices are the same within a city.

these factors, we include three dummy variables in our analysis that control for the geography of the petrol pumps. Specifically, we include one dummy for the region (urban or rural), another for the location (highway or non-highway), and an interaction dummy for region and location. The literature suggests that these geographical divisions strongly influence the performance of petrol pumps [see, for example, Netz and Taylor (2002) and Chan, Padmanabhan, and Seetharaman (2005)].

4.2.4. *Distance*

According to the available literature on the retail petroleum industry, the performance of petrol pumps may be affected by their proximity to the next nearest petrol pump. For one thing, the competition among the petrol pumps may spur the owners to improve their services. Furthermore, closely situated petrol pumps may lead to increase in the sales of petrol pumps as the consumers will have more options to get fuel if there are long queues at a petrol pump during the rush hours. The flip side is that the presence of more petrol pumps in close vicinity can also affect the sale performance negatively. Since the prices MoGas and HSD do not vary within a city, presence of too many petrol pumps within a touching distance of each other may affect the sale performance of petrol pumps negatively. We also include the squared term of the distance variable to capture any possible non-linear relationship between the distance and dependent variables.

4.2.5. *Product Mix*

We have included the share of MoGas in total sales volume as one of the determinants of profitability of petrol pumps. In Pakistan, the margins petroleum dealers receive on each litre of MoGas and HSD are different. Since the margins they received in 2013 on each litre of MoGas (2.78 rupees per litre) wass higher than on each litre of HSD (2.30 rupees per litre), it implies that pumping an extra litre of MoGas is more profitable for the petrol pump businesses.

4.2.6. *Non-forecourt Activities*

To control for the non-forecourt activities of a petrol pump, we include dummies for tyre shop, car wash, and tuck shop. Availability of these services is postulated to affect sales and profitability of petrol pumps positively. Automobile owners may prefer those fuel stations to get fuel that also have services such as a tyre shop, a car wash, and a convenience store. The literature also shows a positive effect of non-forecourt activities, particularly a tuck shop, on the performance of petrol pumps.

4.3. Empirical Model

Based on the discussion above, analysis we use the following model to analyse the determinants of profitability of petrol pumps in Pakistan in the econometric analysis.

$$Profits = f\,(distance, distance^2, size, amenities, location, region, location * region, share) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

According to Equation 3, petrol pumps' profitability is postulated to depend on the traveling distance (of the petrol pump from the nearest petrol pump), distance squared, size of the petrol pump (bays), MoGas share, non-forecourt activities (tuck shop, tyre shop, and car wash), region (rural or urban), location (highway or non-highway), and an interaction of region and location.

Thus, our econometric specification is as following:

$$\pi_i = \alpha + \beta_1 S_i + \beta_2 D_i + \beta_3 D_i^2 + \sum_{i=1}^{3} \gamma_i A_i + \emptyset_1 R_i + \delta_1 L_i + \beta_5 M_i + \epsilon_i \quad \ldots \quad (4)$$

In Equation 2 above, α is the constant term, D_i and D_i^2 are distance and distance-squared, respectively, S_i is the size, and M_i is the share of MoGas in total sales of the *i*th firm. D_i, D_i^2, S_i, and M_i are continuous variables. A_is are dummy variables for tuck shop, tyre shop, and car wash, which are defined as $A_i = 1$ if the petrol pump does not have a tuck shop, tyre shop or a car wash, and 0 otherwise. R_i and L_i are region and location dummies, which are defined, respectively, as $R_{\mathrm{i}} = 1$ if rural, 0 otherwise, and $L_{\mathrm{i}} = 1$ if non-highway, 0 otherwise. I is interaction of R_{i} and L_{i}, which is defined as $I = 1$ if petrol pump is urban and highway, 0 otherwise. ϵ_i is the error term.

Similarly, to check the determinants of sales volumes of the petrol pumps the specification is as following.

$$Z_i = \alpha + \beta_1 S_i + \beta_2 D_i + \beta_3 D_i^2 + \sum_{i=1}^{3} \gamma_i A_i + \emptyset_1 R_i + \delta_1 L_i + \epsilon_i \quad \ldots \quad \ldots \quad (5)$$

Z_i is the sales volume of the *i*th petrol pump. The description of the rest of the variables is the same as in Equation (4). It is plausible to assume the determinants of the sales volumes are the same as that of the profitability of the petrol pumps. However, in the total sales volume equation, we have not included the share of MoGas as an independent variable because total sales volume is sum of MoGas and HSD volumes.

We have used OLS technique to estimate the models, with robust standard errors. Robust standard errors are used to tackle the problem of heteroskedasticity. There could also be the problem of endogeneity. For example, as pointed out by Chan, Padmanabhan, and Seetharaman (2005), an unobserved advantage due to a station's location may impact its profit per litre (and sales) at the same time leading the station owner to install more bays. They have termed such endogeneity as "characteristic endogeneity" (pp. 15-16). However, they pointed out that they could not find valid instruments to take care of this problem. Other relevant literature also does not point to any instruments, guided by the theory, that could be used in such a case. Furthermore, Gagné, Nguimbus, and Zaccour (2004), who estimated a model similar to the one we have estimated, also used the OLS estimation method. In view of unavailability of instruments and the use of OLS in the existing literature on the topic, we also use the same estimation technique.

4.4. Description of the Sample

In the survey, information was collected from 81 petrol pumps. Out of these 81 petrol pumps surveyed, 52 were situated in the urban region and the rest of 29 pumps were in rural areas. The location-wise breakdown shows that out of 81 petrol pumps, 39 were on the highways and 22 were on non-highways. Since most of the petrol pumps are in the Punjab, therefore, our sample also included more petrol pumps from the Punjab, which were 57 in number. The breakdown of the sample according to region (urban and rural), location (highway and non-highway), and provinces is summarised in Table 1. The data collected and reported below pertains to monthly figures.

Table 1

Sample Breakdown—Regional, Locational, and Provincial

	Numbers
Region	
Rural	29
Urban	52
Total	*81*
Location	
Highway	42
Non-Highway	39
Region and Location	
Rural and Non-Highway	14
Rural and Highway	15
Urban and Non-Highway	25
Urban and Highway	27
Total	*81*
Province	
Punjab	57
Khyber Pakhtunkhwa	9
Sindh	10
Islamabad Capital Territory	5
Total	**81**

The sample also included most petrol pumps of PSO, amounting to 25, because most of petrol pumps in Pakistan are operated by PSO, as per national figures (OCAC; unpublished figures). PSO is followed by Shell Pakistan in terms of the number of petrol pumps linked with each OMC. Our sample included 17 petrol pumps operated by Shell Pakistan. The OMC-wise breakdown is given in Table 2.

Table 2

Sample Breakdown—OMCs

Oil Marketing Company (OMC)	Numbers
Attock	5
Admore	9
Byco	1
Caltex	9
Hascol	1
PSO	25
Shell	17
Total	14
Total	**81**

5. FINDINGS AND RESULTS

5.1. Sales Volumes

Table 3 provides a snapshot of sales volumes of MoGas and HSD. MoGas is used mainly in Light Transport Vehicles (LTV), such as cars and motorcycles. HSD, on the other hand, is used as a fuel in trucks, tractors, and other Heavy Transport Vehicles (HTV). Table 3 shows that the sale of MoGas was higher in urban areas because most of the vehicles that consume MoGas are in urban areas. On the other hand, the sale of HSD was higher on highways because most of the HTVs, which use HSD, travel on the highways. On average, a petrol pump sold 284,915.60 litres of fuel (MoGas and HSD) per month. The mean was higher for the urban areas (367,017.3 litres) and for the highway petrol pumps (361,364.2 litres) as compared to rural (137,798.7 litres) and non-highway petrol pumps (202,586.3 litres). The sale of HSD was also higher in urban areas (200,479.5 litres) because urban petrol pumps also included those petrol pumps that were situated on highways. The petrol pumps on highways sold lower volume of MoGas (118,147.9 litres) as compared to non-highway pumps (140,901.3 litres). On the other hand, the highway petrol pumps sold significantly higher volume of HSD (243,216.3 litres) as compared to the non-highway petrol pumps (61,684.98 litres).

Table 3

Sales Volumes (Per Month; Thousand Litres)

Variable	Mean	Std. Dev.	Minimum	Maximum
Total Volume (MoGas+HSD)	**284.92**	**331.64**	**33.46**	**2,129.40**
Region				
Rural	137.70	80.45	48.67	380.25
Urban	367.02	387.01	33.46	2,129.40
Location				
Non-Highway	202.59	158.05	33.46	882.18
Highway	361.36	423.10	39.55	2,129.40
MoGas (Overall)	**129.10**	**137.48**	**0.00**	**760.50**
Region				
Rural	61.98	43.50	0.00	162.15
Urban	166.54	156.90	6.08	760.50
Location				
Non-Highway	140.90	137.16	9.13	760.50
Highway	118.15	138.52	0.00	608.40
HSD (Overall)	**155.81**	**260.05**	**0.00**	**1,673.10**
Region				
Rural	75.72	59.27	6.08	243.36
Urban	200.48	313.80	0.00	1,673.10
Location				
Non-Highway	61.68	44.44	0.00	182.520
Highway	243.22	337.44	6.08	1,673.10

The survey data also included a petrol pumps that had zero sale volume of MoGas. The petrol pump was in a rural area, on a highway. Even though, as discussed above, MoGas sales were lower in rural areas, zero sale of MoGas is surprising since there must be some vehicles that use MoGas at a pump in rural area. On the other hand, zero sales volume of HSD at a petrol pump in urban area, which was not situated on highway, is not surprising. Diesel engine cars are becoming rarer in Pakistan and mostly the vehicles that need HSD, get fuel at the pumps that are on highways.

5.2. Workforce

The workforce at a petrol pump typically consists of managers, supervisors, cashiers, and attendants, commonly referred to as fillers in Pakistan. Some of the petrol pumps did not employ all the categories of workers as in some cases one category of worker performed multiple tasks. Table 4 shows the number of workers, employed, on average, at petrol pumps. For the sake of brevity, we have lumped all the categories together and have given statistics for total workers. The breakdown of the workers' categories is discussed below without tabulation. Table 4 shows that the urban petrol pumps employed higher number of workers as did the highway petrol pumps.

Table 4

Total Workers (Numbers)

	Mean	Std. Dev.	Minimum	Maximum
Total Workers (Overall)	**13.79**	**8.75**	**2**	**48**
Region				
Rural	9.90	5.74	2	26
Urban	15.96	9.42	2	48
Location				
Non-Highway	12.54	7.37	4	43
Highway	14.95	9.82	2	48

In one case, petrol pump employed as many as 48 workers in an urban petrol pump, on a highway. In total, there were 2 petrol pumps that employed 40 or more workers, both of which were in urban areas. This shows that the variation is quite large, given the fact that some petrol pumps only operated with 2 workers. There were 3 petrol pumps that employed only 2 workers. All these 3 petrol pumps were in rural areas.

As far as categorical breakdown is concerned, overall there were 12 petrol pumps that did not employ a manager and 40 pumps operated without a supervisor. Most of the petrol pumps that employed more than 2 managers and supervisors were in urban areas and/or were situated on highways.

According to the data, there were 29 pumps that did not employ any cashier, whereas, as expected, there was no petrol pump that was without a filler. This means that the filler is the only category of the workforce that is indispensable. In one case, a petrol pump, which was located on a highway, had as many as 38 fillers at the site. There were also several pumps that employed 10 or more fillers, most of which were either in urban areas or were on highways. The absence of a manager, cashier, or a supervisor is not surprising as during the survey it was revealed that in some cases it is the fillers, or even the owners themselves in some cases, that perform the job of managing, supervising, and collecting cash from the customers. But that is true mostly of the petrol pumps that do not have very high throughput.

5.3. Costs

To analyse the structure of costs and expenses incurred in running a petrol pump, we have bifurcated the costs into labour and non-labour costs. The labour costs comprise the wage bill of the workforce. Added together, labour costs formed the largest chunk of total costs of running a petrol pump. The other substantial cost was the expense on electricity. Some petrol pumps also spent a sizeable amount on running a generator to be able to keep on operating during power outages that were prevalent across the country during the time the survey was conducted.

5.3.1. *Labour Costs*

Table 5 below reports salaries of the different categories of workers involved in running a petrol pump. As it can be seen from the table, managers commanded the highest remuneration among all the categories of workers. Unsurprisingly, the maximum salary was also paid to a manager working in a petrol pump in urban area. The trend is the same for all other categories as the highest salary in each of the other three categories of workers went to those who worked in a petrol pumps located in urban areas. It is interesting to note that in quite a few cases, the workers at petrol pumps were given salaries that was below the legal minimum wage prevailing in 2013, which was rupees 10,000. In 34 out of 81 cases, the fillers were given salary which was below the minimum wage. As it can be seen from the table, the minimum salary for fillers was rupees 4,000.

To present the overall picture of the labour costs incurred in running a petrol pump, average total labour costs are presented in Table 6. On average, total labour costs stood at rupees 124,083.30, with the highest being rupees 454,000 and the lowest rupees 15,800, which is surprisingly quite low. However, on closer observation, it turns out that such a small wage bill was for the petrol pump which employed only two workers. The petrol pump was in a rural area.

Table 5

Employees' Salaries (Per Month; Thousand Rupees)

Variable	Mean	Std. Dev.	Minimum	Maximum
Managers (Overall)	**15.54**	**6.58**	**6.50**	**50.00**
Region				
Rural	12.83	4.32	6.50	25.00
Urban	17.18	7.18	7.00	50.00
Location				
Non-Highway	16.10	8.19	6.50	50.00
Highway	14.96	4.40	7.00	30.00
Supervisors (Overall)	**10.44**	**4.44**	**6.00**	**34.00**
Region				
Rural	8.88	2.37	6.00	15.00
Urban	11.50	5.20	7.00	34.00
Location				
Non-Highway	10.52	5.65	6.00	34.00
Highway	10.35	2.70	6.00	16.00
Cashier (Overall)	**9.03**	**1.96**	**5.00**	**15.00**
Region				
Rural	9.06	2.29	5.00	15.00
Urban	9.01	1.80	6.00	15.00
Location				
Non-Highway	8.63	1.66	5.00	13.00
Highway	9.50	2.21	6.00	15.00
Fillers (Overall)	**7.88**	**1.73**	**4.00**	**15.00**
Region				
Rural	7.38	1.60	4.00	10.00
Urban	8.16	1.74	5.00	15.00
Location				
Non-Highway	8.05	1.83	4.00	15.00
Highway	7.72	1.63	4.00	10.00

Table 6

Total Labour Costs (Per Month; Thousand Rupees)

Variable	Mean	Std. Dev.	Minimum	Maximum
Total Labour Costs (Overall)	**124.08**	**85.64**	**15.80**	**454.00**
Region				
Rural	82.11	47.46	15.80	212.00
Urban	147.49	93.32	15.80	454.00
Location				
Non-Highway	113.62	76.26	30.00	454.00
Highway	133.80	93.38	15.80	380.00

5.3.2. *Other Costs*

In our analysis, the "other costs" comprise electricity expenses, generator expenses (i.e. fuel for running generator), product loss, and sub-costs. The sub-costs, in turn, comprise telephone, water, uniform, stationery, and maintenance expenses. We have lumped these costs into a single sub-cost category because these costs alone are miniscule. Before moving further, a few words on explaining the product loss category are in order. MoGas is a volatile product and tends to evaporate easily. HSD, on the other hand, is less volatile than MoGas and does not evaporate as much as MoGas does, while stored. International practices also allow for 0.5 percent product loss for MoGas whereas, normally, no allowance is given for the loss of HSD. The respondents of the survey also told that they only factored in the loss of MoGas due to evaporation. Such losses are called normal loss and are a part of the cost of goods sold.

The breakdown of the other costs is given in Table 7. The table shows that the mean of the generator expenses (rupees 81,746) was higher than the mean of electricity expenses (rupees 48,866.81). The data shows that the highest expenditure on generator was for the petrol pump that also had the highest throughput. Similarly, the petrol pump that had the lowest electricity expense also was the pump that did not have generator installed at their site. Expenditure on electricity was higher in urban areas and for the petrol pumps on highways. The sub-costs were also higher in urban areas and highway petrol pumps because this is where most of the petrol pumps that had the highest throughputs in our sample were situated.

Table 7

Other Costs (Per Month; Thousand Rupees)

Variable	Mean	Std. Dev.	Minimum	Maximum
Electricity (Overall)	**48.87**	**48.58**	**4.00**	**300.00**
Region				
Rural	28.45	14.35	4.00	80.00
Urban	60.25	56.74	6.69	300.00
Location				
NHW	35.28	24.65	4.00	110.00
HW	61.48	60.85	12.00	300.00
Generator (Overall)	**81.75**	**68.38**	**10.00**	**350.00**
Region				
Rural	58.52	40.50	13.21	150.00
Urban	91.50	75.39	10.00	350.00
Location				
NHW	60.48	33.60	10.00	125.00
HW	99.19	83.67	13.21	350.00
Product Loss (Overall)	**17.61**	**18.20**	**0.85**	**105.71**
Region				
Rural	8.92	5.92	1.27	22.54
Urban	22.28	20.76	0.85	105.71
Location				
NHW	19.59	19.06	1.27	105.71
HW	15.72	17.37	0.85	84.57
Sub Costs (Overall)	**17.53**	**21.17**	**1.25**	**109.00**
Region				
Rural	11.10	16.05	1.70	87.50
Urban	21.11	22.92	1.25	109.00
Location				
Non-Highway	16.36	15.53	1.70	58.33
Highway	18.61	25.47	1.25	109.00

The product loss, which is calculated at 0.5 percent of the total volume sold, would rise as sales volume increases. The calculation of product loss can be explained with the help of the following hypothetical example, for the sake of exposition. Let us assume that the price of 1 litre of petrol is rupees 100 and a petrol pump gets a 100 litre of MoGas from an OMC. The total cost of MoGas, thus, would be rupees 10,000 and the product loss would be 10,000 x 0.5 percent = 50, i.e. rupees 50.

Table 8 below combines electricity, generator, product loss, and sub-costs. Summary statistics of "Total Other Costs" are obtained by simply adding together the costs reported in Table 7.

Table 8

Total Other Costs (Per Month; Thousand Rupees)

Variable	Mean	Std. Dev.	Minimum	Maximum
Other Costs (Overall)	**155.44**	**128.20**	**10.77**	**722.43**
Region				
Rural	90.55	61.92	10.77	247.93
Urban	191.62	141.23	46.02	722.43
Location				
Non-Highway	120.85	71.83	10.77	287.16
Highway	187.55	158.41	22.70	722.43

To give an overall picture of how much total costs petrol pumps bear in running a petrol pump, Table 9 reports total costs. These total costs are the sum of total labour costs and total other costs. Table 10 shows that the highest cost was associated with the petrol pump in urban area, on a highway. On average, the lowest costs were borne by the petrol pumps located in rural areas. Similarly, average costs of running a petrol pump were lower for petrol pumps situated in non-highway areas. Costs would naturally be lower in rural areas because not only the workers employed at these petrol pumps were lower, total sales volumes were also lower in rural areas as compared to urban areas.

Table 9

Total Costs (Per Month; Thousand Rupees)

Variable	Mean	Std. Dev.	Minimum	Maximum
Total Costs (Overall)	**279.52**	**199.85**	**38.70**	**1,102.43**
Region				
Rural	172.66	91.83	38.70	425.36
Urban	339.11	218.88	102.27	1,102.43
Location				
Non-Highway	234.47	135.03	50.77	741.16
Highway	321.35	239.39	38.70	1,102.43

Presenting costs in per unit (i.e. in rupees per litre) terms would be more illuminating of the cost structure besides showing which petrol pumps are cost efficient. Thus, we have presented per-unit total costs in Table 10. We have only reported total per-unit costs because some of the per-unit costs were very small. The table clearly shows that the per-unit costs were higher in rural areas as compared to those in the urban areas. Further, the total per-unit costs were the lowest for the highway petrol pumps. One of the reasons is higher throughput, which results in economies of scale. Another reason could be that the petrol pumps that had lower per-unit costs were more efficient.

Table 10

Per-Unit Costs (Per Month; Rupees Per Litre)

Variable	Mean	Std. Dev.	Minimum	Maximum
Total Costs (Overall)	**1.35**	**0.82**	**0.34**	**4.70**
Region				
Rural	1.41	0.73	0.44	3.59
Urban	1.32	0.87	0.34	4.70
Location				
Non-Highway	1.43	0.74	0.44	3.74
Highway	1.28	0.89	0.34	4.70

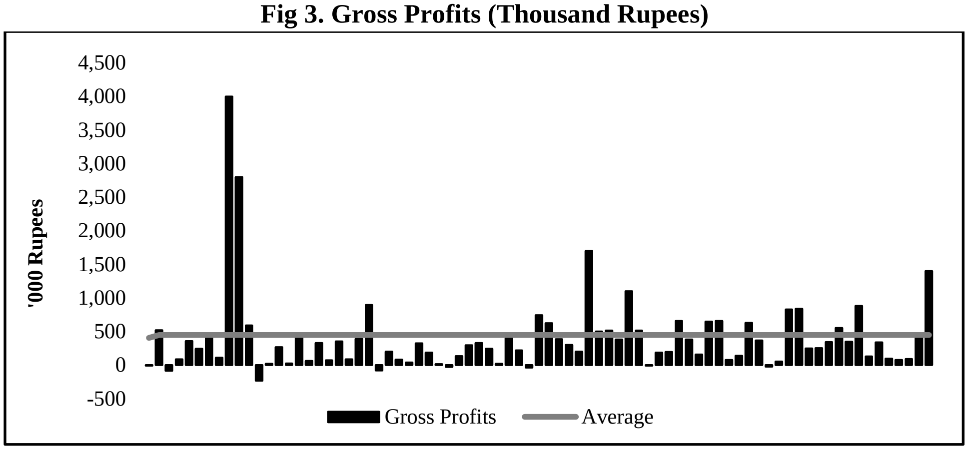
5.4. Profitability

The profitability of petrol pumps is analysed in two ways. Firstly, we have calculated gross profits, which are total revenues minus total costs. Secondly, we have calculated profits per litre, which are obtained by dividing gross profits with total sales.

5.4.1. *Gross Profits*

Gross profits for the entire sample are presented in Figure 3. The figure clearly shows that most of the petrol pumps were profitable. Some petrol pumps had profits that were substantially higher than the sample average, and quite a few were near the average. Thus, the data from the survey sample clearly shows that most of the petrol pumps had positive profits and the claim of the petrol pump owners that they make incur losses is not corroborated, at least by the data of this study. There were only 8 petrol pumps that incurred losses.

Fig 3. Gross Profits (Thousand Rupees)



5.4.2. *Profits Per-Litre*

The gross profits do not necessarily reflect the efficiency with which a company operates, so to take this factor into account, in Table 11 below, we have given the summary statistics of profits per litre. As it can be seen from the table, profits per litre, on average, were the highest in the urban areas. Although the total costs were also highest in the urban areas, these were more than offset by higher sales volumes, which in turn result in higher total revenues.

Table 11

Profits Per Litre (Rupees Per Litre)

Variable	Mean	Std. Dev.	Minimum	Maximum
Profit Per-Litre (Overall)	1.19	.82	-2.37	2.14
Region				
Rural	1.11	.75	-1.12	2.14
Urban	1.23	.86	-2.37	2.14
Location				
Non-Highway	1.18	.73	-1.13	2.14
Highway	1.19	.90	-2.37	2.14

Similarly, profits per litre were also higher for highway petrol pumps as compared to non-highway petrol pumps for the same reason as they were higher in urban areas as compared to the rural areas. Some of the petrol pumps also incurred losses on each litre of fuel sold. The highest loss incurred was rupees 2.37 per litre and the lowest was rupees 0.11 per litre. Out of the 8 petrol pumps that incurred losses, 3 were in the rural areas and 5 were in urban areas.

Interestingly, all the 8 petrol pumps that incurred losses, did not have amenities (tuck shop, car wash, or a tyre shop) at their sites. Further, the share of MoGas in their total sales was less than 50 percent. Since the petroleum dealers get higher margin on selling a litre of MoGas than selling a litre of HSD, it is more profitable for them to pump a litre of MoGas as compared to pumping a litre of HSD. Further exploration of the data reveals that the pumps with negative profits had high per-unit total costs. Their per-unit labour costs were also higher than the average for the whole data. The average labour cost per unit for the entire sample was 0.64 rupees per litre, whereas for the petrol pumps making losses, it was 1.61 rupees per litre. Although it may be difficult to bring down other costs, it is possible for these pumps to curtail labour costs since their throughput is also lower and they might not be needing as many workers as they currently employ. As far as the total number workers employed at the petrol pumps is concerned, the average for the whole sample was 13.79 workers. The loss-making petrol pumps, on the other hand, employed 12.88 workers, on average, which is close to the sample mean. Given the fact that their average throughput was significantly lower than the sample mean (284,915.6 litres versus 75,289.5 litres), the number of workers employed at these pumps was quite high.

Analysing the petrol pumps whose per-unit total costs were lower than the sample mean, which is 1.35 rupees per litre, shows that there were 52 such petrol pumps in our sample. Most of these petrol pumps, which were 37 in number, were in urban areas. Similarly, on highways, there were 31 petrol pumps, which had per-unit total costs lower than the sample mean. Moreover, the sale of MoGas was higher at these petrol pumps as compared to the sample average. The sample average MoGas sale is 129,103.3 litres; compared to this, the average sale of MoGas at the petrol pumps, which had per-unit total costs lower than the sample average, was 161,124.6 litres. The data also shows that 65 percent of the petrol pumps that had tuck shops are those that had per-unit total costs lower than the sample mean.

5.5. Non-Forecourt Activities

Table 12 reports the breakdown of non-forecourt activities.

Table 12

Petrol Pumps with Amenities (Numbers)

	Tuck Shop	Tyre Shop	Car Wash
Overall	**17**	**22**	**17**
Region			
Rural	6	6	5
Urban	11	16	12
Location			
Non-Highway	11	16	12
Highway	6	6	5

There were 17 petrol pumps that also operated a tuck shop, 6 of them were in a rural area while the rest were in urban areas. Similarly, 11 of the petrol pumps that had a tuck shop were non-highway petrol pumps. It can be seen from the table that most of the petrol pumps that had different amenities were in the urban region.

5.6. Size of the Petrol Pump

Table 13 summarises the size of the petrol pumps, measured by the number of bays installed. The table shows that the petrol pumps in urban areas and those on highways had a higher number of bays. The minimum number of bays at any petrol pump was 2 and the highest number was 14.

Table 13

Size (Number of Bays Installed)

Variable	Mean	Std. Dev.	Minimum	Maximum
Bays (Overall)	**4.05**	**1.96**	**2.00**	**14.00**
Region				
Rural	3.55	0.99	2.00	6.00
Urban	4.33	2.29	2.00	14.00
Location				
Non-Highway	3.74	1.93	2.00	13.00
Highway	4.33	1.96	3.00	14.00

5.7. Distance

We calculated the distance variable using the Google Maps. We had the addresses of the fuel stations we surveyed and names and addresses of all the fuel stations in Pakistan, accessed at the Oil and Gas Regulatory Authority (OGRA) website. We calculated the shortest traveling distance between the surveyed fuel station and the closest fuel station by entering the addresses of the two fuel stations into the Google Maps utility, giving us the required distance in kilometres between the two fuel stations. Table 14 below summarises the distance variable. According to the table, the mean traveling distance of the petrol pumps, included in the sample, from the nearest petrol pump was 6.25 kilometres. The distance between two petrol pumps increased in the rural areas by about 2.25 kilometres, on average, as compared to the petrol pumps in the urban areas. The average distance was also higher for highway petrol pumps as compared to the non-highway petrol pumps.

Table 14

Distance from the Nearest Petrol Pump (Kilometres)

Variable	Mean	Std. Dev.	Minimum	Maximum
Distance (Overall)	**6.25**	**4.38**	**0.70**	**22.00**
Region				
Rural	7.70	5.11	1.20	22.00
Urban	5.44	3.74	0.70	18.00
Location				
Non-Highway	5.74	4.34	1.50	21.10
Highway	6.72	4.42	0.70	22.00

5.8. Regression Results

The regression results are given in Tables 15 and 16 below. We have presented results of the determinants of profits per litre and sales in Tables 15 and 16, respectively. Equation 1 in both the tables is the base equation in which neither the quadratic term of the distance variable nor the interaction term of the region and location variables are included. Equation 2, on the other hand, includes the quadratic term of the distance variable but does not include the interaction term of the region and location variables. The interaction term is included in Equation 3. As it can be seen from the results, the predictive power of the models increases with the inclusion of quadratic term of the distance variable and the interaction term. To see if there was a problem of heteroskedasticity, we used Breusch-Pagan test. The test results show that the null hypothesis of homoskedastic variance is rejected and therefore we use robust standard errors to correct for the problem of heteroscedasticity. In the regression analysis, we excluded the Byco and Hascol petrol pumps from the estimation because there was only one petrol pump each of these OMCs. Including these observations in the analysis would have resulted in the covariance matrix to be of lower rank than the number of covariates, which would have made it impossible to calculate the overall model F-statistic in robust regression.

Most of the results are in accordance with the expectations, both in terms of signs and significance. The linear term of the distance variable is significant and its sign is positive. It means that the profitability of a petrol pump increases as its distance from the nearest petrol pump increases. This could be an evidence that petrol pumps that are spatially differentiated are more profitable. Furthermore, it also implies that since the prices of the petroleum products are the same across all petrol pumps, the consumers are distributed among petrol pumps located close by. This results in reduced sales and possibly hurts a petrol pump's profitability. The sign of the squared term of distance is negative, as expected, and significant. This indicates that the profits per litre and sales volumes have a non-linear relation with the distance variable. An implication of this result is that as this distance increases beyond a certain optimal level (discussed below), it starts to impact profitability and sales negatively. The size of the petrol pump is also positive and significant. It is highly significant in the sales volume model. The explanation for this is straightforward. The consumers prefer those petrol pumps where waiting time is lesser owing to higher number of bays installed.

Table 15

Regression Results—Profitability Determinants

Independent Variables	Equation 1 Coefficient	Equation 2 Coefficient	Equation 3 Coefficient
Distance	.03	0.13	0.13
	(1.48)	(1.90*)	(1.88*)
Distance-squared	–	–0.005	–0.005
		(–1.67*)	(–1.66*)
Size	0.04	0.04	0.04
	(1.87*)	(1.75*)	(1.68*)
MoGas Share	.61	0.63	0.72
	(1.39)	(1.44)	(1.53)
Admore+	–0.13	–0.15	–0.12
	(–0.31)	(–0.37)	(–0.31)
Attock	0.06	0.17	0.17
	(0.12)	(0.33)	(0.33)
Caltex	0.30	0.45	0.46
	(0.70)	(1.00)	(1.02)
PSO	0.64	0.65	0.64
	(2.03**)	(2.14**)	(2.06**)
Shell	0.29	0.34	0.35
	(0.89)	(1.02)	(1.03)
Tuck Shop	–0.26	–0.22	–0.22
(=1 if no Tuck Shop)	(–1.35)	(–1.22)	(–1.17)
Region (=1 if Rural)	–0.13	–0.14	–0.01
	(–0.60)	(–0.73)	(0.28)
Location	–0.13	–0.08	–0.08
(=1 if Non-Highway)	(–0.73)	(–0.41)	(0.03)
Region*Location (=1 if Urban & Highway)	–	–	0.28
			(0.76)
Constant	0.57	0.14	–0.14
	(1.14)	(0.20)	(–0.18)
Number of Observations	79	79	79
F Value	1.82*	1.97**	1.99**
Prob>F	0.067	0.04	0.04
R^2	0.19	0.22	0.23
Breusch-Pagan Test [$\chi^2(12)$]	17.94***	21.55***	21.19***

Note: ***, **, * denote significance level at 1 percent, 5 percent, and 10 percent, respectively. Figures in parentheses are t-values. +Total (OMC) is the base category.

Table 16

Regression Results—Determinants of Sales

Independent Variables	Equation 1 Coefficient	Equation 2 Coefficient	Equation 3 Coefficient
Distance	12874.27	43104.53	43201.29
	(2.25**)	(2.59***)	(2.57***)
Distance-squared	–	–1577.77	–1571.73
		(–2.12**)	(–2.11**)
Size	102976.10	103302.3	103212.7
	(3.89***)	(4.06***)	(4.22***)
Admore+	–14119.42	–17844.12	3476.43
	(–0.17)	(–0.21)	(0.04)
Attock	–104285.6	–73461.94	–82049.46
	(–1.63)	(–1.07)	(–1.20)
Caltex	–94893.69	–52282.32	–47958.02
	(–1.32)	(–0.71)	(–0.66)
PSO	136404.3	137511.7	130257.4
	(1.94**)	(2.02**)	(1.99**)
Shell	40338.00	54717.8	59533.3
	(0.54)	(0.76)	(0.82)
Tuck Shop	23288.1	35753.54	40003.75
(=1 if no Tuck Shop)	(0.38)	(0.57)	(0.63)
Region (=1 if Rural)	–160726	–166745.2	–84948.51
	(–4.08***)	(–4.23***)	(–1.68*)
Location	–86269.19	69585.02	31802.16
(=1 if Non-Highway)	(–1.79*)	(–1.39)	(0.57)
Region*Location (=1 if Urban & Highway)	–	–	159463.1
			(1.91*)
Constant	–156798.9	–281376.8	–415879.1
	(–1.10)	(–1.64*)	(–2.15**)
Number of Observations	79	79	79
F Value	3.69***	3.64***	3.72***
Prob>F	.0006	0.0005	.0003
R^2	0.63	0.65	0.66
Breusch-Pagan Test [$\chi^2(12)$]	54.08***	53.54***	52.36***

Note: ***, **, * denote significance level at 1 percent, 5 percent, and 10 percent, respectively. Figures in parentheses are t-values. +Total (OMC) is the base category.

As far as the identity of the OMC is concerned, only PSO's dummy is significant, which is also positive. This means that the petrol pumps working under the PSO banner are more profitable. One of the explanations for this result could be the higher labour productivity of PSO. Total sales per unit of labour is the second highest for PSO, which is 27,095.42 litres per unit of labour.[3]

Results regarding the region and location of the petrol pumps are also interesting. The region and location dummies are negative, implying that the performance of the

[3]To calculate labour productivity, we divided total sales volumes (MoGas *plus* HSD sales volumes) with the total number of workers (sum of all categories of workers, i.e. managers, supervisors, cashiers, and fillers).

urban and highway petrol pumps is better than the performance of the rural and non-highway petrol pumps. The coefficient of the interaction dummy of region and location variables is positive, in both the models (profitability and sales volume). It is significant in the case of sales volume model. It shows that petrol pumps that are in urban areas and are on highways are more profitable as compared to those located in rural areas and are non-highway petrol pumps.

From the equations that include the quadratic terms of the distance variable, we have calculated optimal distance between two petrol pumps that maximises profits and sales. The results of these calculations are reported in Table 17 below.

Table 17

Optimal Distance (Kilometres)

Region	Optimal Distance
Rural	11.8
Urban	8.4
Non-Highway	10.6
Highway	12.8

Authors' calculations.

The table shows that the optimal distance that maximises per-litre profits (and total sales) is greater for the rural and highway petrol pumps, whereas it is shorter for the urban and highway petrol pumps. Since in rural areas there is less traffic compared to traffic in urban areas, it would be beneficial for the potential petrol pumps owners to set up petrol pumps further apart in rural areas than in the urban areas. On the other hand, the optimal distance that maximises profits (and sales) is shorter for non-highway petrol pumps than for the highway petrol pumps. The traffic on the highways usually travels long distance, making fewer stops for refuelling and other needs. Therefore, the optimal distance that maximises per-litre profits should be longer for highway petrol pumps.

6. SUMMARY AND CONCLUSIONS

The results of the present paper are in line with the existing literature on the topic, which suggests that both geographical and non-geographical factors are important in affecting the sales and performance of petrol pumps. The results show that throughput and profits per litre are higher and per-unit costs are lower for the petrol pumps in urban areas and on highways. An important finding of the present study is that petrol pumps, in general, are profitable. The petrol pumps that incur losses are the ones that do not have non-forecourt activities on their sites. These petrol pumps also have high per-unit labour costs. An implication of this result is that petrol pump businesses need to employ workforce that is commensurate with their throughput since loss-making petrol pumps have lower sales.

Our results also show that the size is an important determinant of a petrol pump's performance and sales. The distance variable is positive and significant whereas its non-linear term is negative and significant. The result that there is a non-linear and statistically significant association between distance and performance of petrol pumps could have important implications for potential entrepreneurs who wish to set up a petrol pump as strategically locating a petrol pump could help boost the petrol pumps sales and profitability. In this connection, an important contribution of this study is the calculation of profit-maximising distance between two petrol pumps. This threshold distance could serve as a guideline for the entrepreneurs wishing to set up petrol pump business and a guideline for the licensing authorities. Our results also show that although, petrol is a homogeneous product, identity of the marketing company is important, which is also the evidence found by Gagné, Nguimbus, and Zaccour (2004).

There are some limitations that must be kept in mind while interpreting the results. Although, most of the petrol pumps in our sample make positive profits, it must be borne in mind that we could not get data on some of the financial aspects of the petrol pumps. Land is an expensive factor of production and the land on which petrol pumps are set up could have huge opportunity cost. Therefore, taking fixed costs into account could potentially change the picture. Similarly, the start-up cost of a petrol pump is high, which must be dug deeper into in future research.

As we discussed in the description of the sample, our ability to collect more in-depth data and larger sample was hampered by numerous considerations. Although, our results are in line with the existing literature but to have a better understanding of the petrol pump business, future research should be based on a larger sample. The theoretical literature shows that why and where a retail business is placed is very important, therefore, the process of finding a location for petrol pump should be one of the focal points of the future research. The caveats notwithstanding, our results show that a petrol pump is a lucrative business. This finding is contrary to what the normal perception is about the viability of opening and running a petrol pump, under the current rules and regulations.

REFERENCES

Chan, T. Y., V. Padmanabhan, and P. B. Seetharaman (2005) Modelling Locations and Pricing Decisions in the Gasoline Market: A Structural Approach. Olin Business School, Washington University in St. Louis. (Working Paper).

Deloitte (2012) *Study of the UK Petroleum Retail Market—A Final Report for DECC.* London, UK: Deloitte LLP.

Gagné, Robert, Raphaël Nguimbus, and Georges Zaccour (2004) The Effects of Location and Non-Location Factors on Gasoline Station Performance. *Energy Studies Review* 12:2, 153 – 169.

Handcock, Mark S. and Krista J. Gile (2011) On the Concept of Snowball Sampling. *Sociological Methodology* 41, 367 – 371.

Netz, Janet S. and Beck A. Taylor (2002) Maximum or Minimum Differentiation? Location Patterns of Retail Outlets. *The Review of Economics and Statistics* 84:1, 162–175.

Pakistan, Government of (2015-16) *Pakistan Economic Survey, 2015-16.* Economic Advisor’s Wing, Finance Division, Islamabad.

Sartorious, K., C. Eitzen and J. Hart (2007) An Examination of the Variables Influencing Retail Fuel Industry. *Acta Commercii* 7:1, 218 – 235.

Schmidt, Charles G. (1983) Location Decision-Making within a Retail Corporation. *The Journal of Regional Analysis and Policy* 13:1, 60 – 71.