

Original Article

Petrol-Retail Market Structure and Corridor Competition in Keffi, Nigeria: Evidence from a Geocoded Outlet Inventory

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Abstract

The spatial distribution of petrol retailing influences accessibility, rivalry, corridor extension, and cumulative urban motor road burden. This paper investigates the operational structure and corridor-level rivalry of filling stations in Keffi Local Government Area, Nigeria. It complements previous papers on the aggregated spatial pattern of stations, planning compliance and stakeholder-emergency management perceptions of market accessibility and public-safety risks. It builds upon the parent thesis' geocoded census of 43 active and inactive outlets in 2025 down to eight road corridors. Subsequently, operator names were cleaned and standardised, and outlet shares, CR4, HHI and corridor level operator diversity were derived. The parent census revealed 31 operator identities, of which 25 (80.6%) appeared once, with 58.1% of outlets (N=40) attributed. Abzat and NNPC each operated four stations, while MRS and Munsir each operated three. The four largest entities held 32.6% of outlets. The system-wide HHI of 449 (on a scale 0-10,000) indicated a fragmented pattern of ownership traditionally characterised as monopoly. Geographically, rivalry was highly concentrated: 60.5% of outlets were evenly distributed among the Abuja-Keffi, Keffi-Akwanga and Nasarawa Bypass corridors, with the remaining two minor corridors each hosting one outlet. Although between-corridor operator competition was average to high, corridor level operator diversity was generally high, implying that non-monopoly spatial clustering resulted from attraction to traffic and navigational exits. The paper concludes that relative low ownership concentration can coexist with extreme locational concentration; hence licensing decisions should measure both. A continuously updated store-locator register, verification of outlet state, corridor saturation indices, and integration of traffic, price, throughput, and service area data is recommended.

Keywords: Petrol Retailing, Market Concentration, Spatial Competition, Corridor Development, HHI, GIS.

INTRODUCTION

Petrol filling stations are a 'unique' retailing commodity within city landscapes. There is a degree of commoditisation in the product and the consumer is looking for convenience and autonomous outlets are heavily reliant on approaches to the road, directions of traffic, sighting, safe

access and location near the flow of travel. Competition is then spatial in nature: two filling stations can provide a very similar product on different corridors or different sides of a highway; however, many privately owned outlets can be forced to compete aggressively in the same location.

Research into the distribution of petrol stations in Nigerian cities has dealt with siting conformity, environmental hazard and aggregate spatial arrangement. Those issues are worthwhile, but do not explain whether a clustered petrol station system is dominated by a handful of firms or involves a large number operating independently in seeking the commercially best routes. The difference has implications. Concentration of owners can influence market power and the system's robustness to shocks; concentration of locations can generate redundant access points, congestion, and catchment gaps under multiple ownership.

The two current Keffi papers analyze the thesis data to assess spatial clustering and adherence, and to study location-choice characteristics, stakeholder-perceived hazards, and favored controls. This paper does not re-visit those analyses, but instead probes the data for a different set of questions: How varied is Keffi's petrol-retail operators group? What share of stations fall under the ownership of the big groups? How does operator diversity differ across corridors? Does the station system incorporate both ownership fragmentation and spatial agglomeration?

LITERATURE REVIEW

The Lymatical Basis of Spatial Competition

The location of a retail outlet involves both a production decision and a competitive strategy. Hotelling's (1929) linear-city model put forward the key idea that firms choose location relative to each other and the consumer in the same way; while Salop's (1979) circular-city setup demonstrated how distance-distance rivalry could be relaxed in this context (see also Brander and Southern (1981)). These models abstract from the complexity of real urban networks, but still provide an insight into the role of geography since travel costs, route amenities and search costs make outlets in different locations imperfect substitutes. Note that this reasoning could particularly well apply to petrol retailing: while the core product (petrol) is roughly homogeneous, the fact that station position affects journey time, perceived reliability, convenience, queuing time and the provision of other services differentiates each retail encounter.

Spatial competition in petrol is therefore multi-scalar. At the city scale, operators seek corridors with the greatest throughput and potential purchasing power. At the local scale, each outlet faces fewer competitors. At the trip level, consumers weigh the cost of deviation from an intended route against anticipated price and service level variation. On this multi-scalar playing field, administrative borders are rarely a valid market boundary. Outlets a few kilometers from one another may be considered potential rivals, when these are joined by a commuting corridor. Conversely, outlets so close as to be encounter-to-encounter rivals via a straight-line distance may bear very little relationship to actual competition, from road medians, directional turning restrictions or traffic congestion.

Consumer Mobility and Definition of the Local Market

Fuel-market research as characterized by the recent work of McCarthy (2009) and Houde (2012) sometimes uses trip paths tracking trip origins and destinations to proxy residence, rather than using location-specific data that captures the residential underlying. The results of Houde (2012) for instance suggest that trippaths significantly alter estimates of spatial competitiveness within the gasoline market. This is relevant for second tier cities like Keffi, where local trips are intersected with major inter-city movements. The Abuja-Keffi, Keffi-Akwanga, Keffi-Kaduna and Nasarawa corridors do not only convey residents between neighborhoods; these corridors also carry commuters, freight and heavy traffic, buses, and through travellers. Effective catchments depend not only on location within a circular buffer but also on position within network structure and destination-trip identity.

Proximity, however, still has economic significance. Cardoso et al. (2023) found that entry by a proximate competitor caused incumbent prices to fall for fuel, but that the effect diminished as proximity increased. Pennerstorfer (2009) also, by employing spatial econometrics, established that branded and independent outlets have different relations in the immediate local Austrian fuel markets. These all suggest that the number, type and accessibility of proximate operators are certainly important. They also warn us that having a high operator count for the entire city route does not necessarily mean the same level of competition exists on every corridor.

Agglomeration, Corridors and Locational Decisions

Agglomeration of retailing may also develop when multiple firms individually prioritize the same location benefits. High levels of traffic, frontage, visibility, junction access, public-transit flows

and cluster of shopping attractions collectively enhance demand. There may also be a cost saving to consumers in the form of lower search costs if a cluster enables motorists to minimize travel distance, by convening a number of potential outlets within a short drive. A commercial equilibrium of this sort could be possible even without consolidated control of land interests. It would be costly in terms of cumulative planning on measure of access points, turning movements, roadside friction, and uneven service.

While Central Place Theory can be used to determine the population threshold and range needed for a service (Christaller, 1966), the corridor-oriented retail trade demonstrates such principles in real terms because of the dynamic nature of the demand. In a secondary city, the most prominent corridors could serve as linear shopping centres and development could be focused around only a handful of busy motorways despite the fact that outer districts remain underserved. This differentiation is critical to planning analysis: mixability accounts for the clustering of malls, but it does not necessarily account for the optimises of clustering in terms of safety, efficiency, etc.

Ownership, Branding and Network Structure

Ownership concentration the distribution of outlets among firms is distinct from locational concentration the distribution of outlets across space. These two dimensions may work in favor of each other, but they do not have to. For example, a concentrated ownership structure may be characterized by a handful of networks with these stations located in different places, or a dispersed market with many independent operators with stations concentrated along the same highway corridors mixing these two can increase the apparent level of competition and planning pressure. Operator identity is also of concern since branded networks and independents may vary in procurement, inventory, product range, reputation, mix of services, and robustness to supply shocks. Evidence by Pennerstorfer (2009) suggests independents can increase price competition but also factors related to brand differentiation can influence consumer behavior. Houde (2012) further shows that ownership ties and spatial differentiation can interact. Therefore, inventories should keep confirmed data on ownership, brand identity, direction of operations, and throughput capacity and sales rather than classify every signboard as a wholly independent business.

Defining Market and Spatial Concentration

Market structure is often summarised using the single measures of the concentration ratio and the herfindahl-hirschman Index (HHI). The concentration ratio sums the market share of the leading firms (e.g. top 4 and 8) whereas the HHI assigns more weight to large shares by summing the squares of the individual shares. Such indicators can only be meaningfully interpreted if the numerator and market boundary can be justified. Where analysis of traditionally defined markets in terms of sales volume or revenues is not possible, outlet counts can be used to describe the presence of a network but should not be interpreted as product-market shares owing to differences in station storage capacity and throughput, operating hours, reliability of stock levels and customer visits. These measures, however, are addressing a different question. Corridor shares simply convey what fraction of outlets is situated on what fraction of routes, while within-corridor operator diversity summarizes the distribution of outlets over identities. Nearest-neighbour statistics can detect clustering, but not whether clustered stations belong to the same business. A comprehensive diagnosis combines the firm- and corridor- level concentration results described above with a local-market accessibility-based measure reflecting the distribution of outlets over identities. I take this multidimensional view and present its HHI as a descriptive measure of the entire outlet network, not as an antitrust measure.

Facts from Nigeria or Similarly Urban Surroundings

Most Nigerian research of filling-station activities have focused on spatial pattern, compliance and environmental or public-safety exposures. Mohammed and others (2014) employed GIS to analyze distribution of filling-stations in metropolitan Kano vis-a-vis physical-planning standards. Njoku and Alagbe (2015) integrated proximity analysis, planning norms and spatial analysis to embed a GIS-based suitability indicator for Oyo. These contributions confirm the use of geocoded inventories and regulatory buffers, but do not account for operator structure vis-a-vis spatial aggregation, nor quantify diversity of ownership across road corridors.

The gap is significant in evolving secondary cities. A regulator might see many station names and conclude the system is competitive and widespread even if all outlets are concentrated on the same few transportation corridors, or a cluster of visible outlets may be confused for the result of a few network giants, when in reality hundreds of independent entrepreneurs react to the same signals of multimodal accessibility. Operator proof is necessary in either case.

Research Gaps

The extant literature develops four propositions. First, that petrol retail markets are route and space-prone. Second, that competition depends on provider location and competitor identity. Third, that corridor concentration can be compatible with franchised fragmentation. Fourth, that shop numbers are good indicators of network presence but do not provide a proxy measure of market share based on sales. Less developed in the Nigerian secondary city context is an internally consistent explanation of operator concentration and corridor household level diversity.

This study fills that void with Keffi's geocoded inventory of 43 stations. It examines whether heavy concentrations of operator identities relate to corridor intensities and whether congested corridors comprise a single network of or are scattered with firms of multiple types. Keep in mind that the study is highly exploratory; it does not measure prices, sales or market power. Instead its contribution lies in bridging retail-geography theory with real development-control issues of corridor carrying capacity, cumulative access-pressure, and under-service areas.

MATERIALS AND METHODS

Study Area and Data

Keffi. The town of Keffi is in Nasarawa State in North-Central Nigeria, approximately 57 km from Abuja. It stands along corridors connecting Abuja, Akwanga, Lafia, Kaduna, Nasarawa, and surrounding settlements and therefore attracts local and crossing traffic. The parent thesis took an inventory of 43 operational and non-operational filling stations, noting operator name, area, road corridor, latitude, longitude, and altitude.

Data Processing

The 43 records were transcribed from the thesis inventory. Quite obvious continuation errors caused by split Word tables were corrected, including the Kainuwa Petroleum record. Repetition of names was standardized conservatively: variations in spelling on the same named network were associated, but those with similar wording but more uncertain identity maintained as separate names. Two outlets with no names were combined with the tag "No Name" in the expanded view for sensitivity analysis only, not in the normalised block. Ibas Unique Universal Ventures and Ibas Petroleum Resources were combined as a single Ibas network for sensitivity analysis only, since they share the particular name (see above), but this should be checked with licensing records.

Indicators

Four indicators were calculated:

Operator outlet share: ($s_i = n_i/N$), where (n_i) is operator (i)'s outlet count and ($N=43$).

CR4: the combined outlet share of the four largest named operator groups.

HHI: ($HHI=10,000s_i^2$). The value is used descriptively because outlet counts are not sales shares.

Corridor diversity: the number of operator identities and Shannon diversity, ($H'=-\sum p_i(p_i)$), within each corridor.

The cell cannot rely on prices, volumes, tank capacities or consumer-choice data. Therefore, the author merely describes the structure of outlet-network, not the economic market power.

RESULTS

Operator Structure

There were 31 operator identities. Twenty five occurred once, representing 25 outlets (58.1%). Abzat and NNPC both had 4 outlets; MRS and Munsir each had 3; and the grouped Ibas identity had 2. Four named groups accounted for the 14 biggest (CR4 = 32.6%).

Table 1. Largest operator groups in the Keffi inventory

Operator group	Outlets	Share (%)
Abzat	4	9.3
NNPC	4	9.3
MRS	3	7.0
Munsir	3	7.0
Ibas	2	4.7
All other/unnamed identities	27	62.8
Total	43	100.0

The HHI index was around 449 at 0–10,000 scale. To its lower number, this is the result of

many identities having single outlets. Do not read these without the formal competition law thresholds in mind, however, because throughput and ownership verification does not exist.

Corridor Structures

In regard to Shop and Operator counts, they seem to be focused on the Highways and Ports. The site with the most shops was Keffi-Akwaga with 10 outlets. The Abuja-Keffi and Nasarawa Bypass had 8 outlets respectively, making the three corridors 26 outlets (60.5%).

Table 2. Outlet Concentration and Operator Diversity by Corridor

Corridor	Outlets	Operators	Shannon Diversity
Abuja-Keffi	8	8	2.079
Keffi-Akwanga	10	9	2.164
Keffi-Kaduna	5	5	1.609
Nasarawa Bypass	8	8	2.079
Old Nasarawa Road	3	3	1.099
Old Keffi-Akwanga Road	7	7	1.946
Emir's Palace Road	1	1	0.000
Market Road	1	1	0.000

Source: Field Survey, 2025

Of the ten outlets on Keffi-Akwanga, nine outlets identified only nine identities (NNPC appeared twice). On the six other multi-outlet corridors sampled, all the outlets belonged to separate recorded identities. Therefore, high-volume corridors showed a high level of inter-operator co-location rather than dominance of a network (see Figure 1).

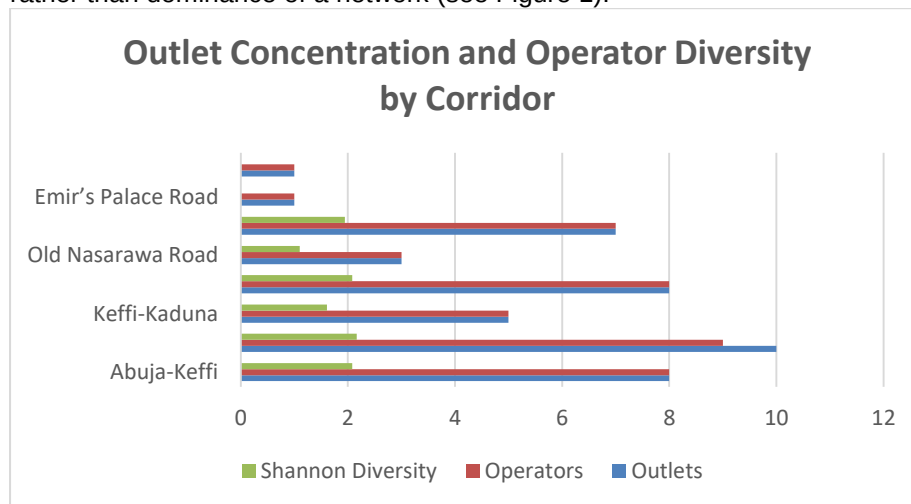


Figure 1: Outlet Concentration and Operation Diversity by Corridor

Fragmentation of Ownership along with Focus of Location

The joint outcomes display a dual pattern. Holdings were dispersed over a large number of identities, but outlets were located on a very limited number of corridors. Thus, a higher number of operators do not necessarily imply better geographic balance. Operators, facing the same traffic, looking and exit-route benefits reproduced a dominant spatial pattern.

DISCUSSION

Our findings validate the distinction between market concentration and location concentration. While a low outlet-count HHI may be regarded as a positive indicator from a competition viewpoint it does little to alleviate the urban-planning challenges associated with numerous independent operators deploying along the same transport corridors. Common attraction to the road links boosts driveway density, roadside manoeuvres and duplication of service areas, whilst massing too many operators along minor links has the counter effect of depriving them of provision altogether.

The fact there are so many retailers on major corridors is consistent with the spatial-competition framework. Retail operators are competing over consumers who are already preceding in their direction of travel, and some facility characteristics, like road coverage or trip-objective times, might be just as important as Euclidean distance. The 2 NNPC stations at Keffi-Akwanga and their competitors in adjacent locations exemplify why we should in future try to analyze the choice of outlet through direction of travel, accessibility, observed prices, and consumer trips.

Regulatory consequences of the results are also worth considering. A licensing regime which treats each application in isolation might authorise a run of individually acceptable locations that fails to recognise cumulative corridor saturation. Planning judgment should therefore balance station specific safety within the planning assessment with network indicators for potential off take saturation: rate of existing outlet consumption, access point gap, queue storage volume, class of road, junction proximity, volume of traffic, and service gaps elsewhere.

Therefore, this analysis does not confirm a price competition or market power. An outlet count is not a reflected sales share and some inventoried facilities were not working. The two unbranded outlets may not be owned by one group, and Ibas records may or may not use one group. For this reason, check with the NMDPRA licensing and corporate records.

CONCLUSION AND RECOMMENDATIONS

The petrol-retail system in Keffi has a complex operator composition and high corridor concentration. 31 identities out of 43 outlets appeared in the sample, the four largest groups had only 32.6% of outlets in the sample, and the descriptive index of HHI was 449. Nonetheless, 60.5% of outlets were located along three main corridors. These findings demonstrate that a low ownership structure is not a sufficient indicator of balanced service provision.

It is suggested that a geocoded operator register be created which differentiates owner, brand, licence holder, in use, storage capacity and average throughput. Licensing should examine owner concentration and corridor saturation. The field in future should incorporate pump prices, daily sales, traffic flows, direction of travel, catchment areas and consumer- choice surveys to allow spatial econometric analysis of the market. The inventory needs to be updated as this study reflects the 2025 field period.

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