Supermarket operating hours and distance to crime

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Household chores, particularly those related to food—such as meal preparation and grocery shopping—continue to reflect significant gender disparities. Supermarkets, by reducing the distance between consumers and food purchases while leveraging economies of scale to offer affordable and diverse options, are often associated with food security. However, it remains unclear how the establishment of these businesses impacts their surroundings, especially in comparison to other security measures, such as addressing crime.

This study examines how the operating hours and proximity of supermarkets affect local crime levels in Chicago, USA, over a one-year period (September 2023–August 2024). By combining three georeferenced datasets from the Chicago Police Department, Google Maps, and weather information to create a database and applying three negative binomial regression models.

Results indicate that open supermarkets are generally linked to slightly lower crime rates, though this effect fluctuates throughout the day—reducing crime in early hours but increasing it during peak periods. While proximity alone shows no strong correlation with crime, open supermarkets exhibit a localized deterrent effect.

Keywords**: Crime, operating hours, supermarket, supermarket proximity**

1. Introduction and objectives

Prior research has examined the relationship between commercial establishments and local safety from diverse perspectives. The literature on crime in urban environments identifies several key determinants. Criminal activity varies by time of day (Felson & Poulsen, 2003), and both natural and artificial lighting have been shown to affect crime incidence (Domínguez & Asahi, 2017). Certain land uses, such as entertainment districts, are consistently associated with higher crime rates (Boggs, 1965; Twinam, 2017), though the relationship between foot traffic and crime is context-dependent—it can either attract or deter crime (Lee, 2016). The consumption environment also matters; establishments that sell alcohol often correlate with elevated crime levels, especially when operating hours extend into the night (Gruenewald & Remer, 2006; Rossow & Norström, 2012). Similarly, fast-food outlets with high sales volumes and late hours have been linked to increased criminal activity (Askey et al., 2018).

Despite growing research on the relationship between commercial activity and crime, the specific role of supermarkets—retailers that often operate for extended hours, attract consistent foot traffic, and may sell alcohol—remains insufficiently examined. This study hypothesizes that longer supermarket operating hours could enhance local safety through increased lighting and surveillance, while proximity to a supermarket may further deter crime by improving environmental visibility. It analyzes both temporal (open vs. closed status) and spatial (distance) effects, as well as their interaction. These questions are especially pertinent given the gendered distribution of household food responsibilities and the increased exposure of women to crime in public spaces.

2. Methodology

This study analyzes the association between supermarkets and non-domestic crime recorded between September 3, 2023, to August 31, 2024, for 67 supermarket neighborhoods. The relationship was tested using three negative binomial regression models to account for the over-dispersion commonly observed in crime

count data. The study incorporated additional variables hypothesized to influence crime rates, including meteorological factors daylight duration.

2.1 Data

Crime data were obtained from the Chicago Data Portal. From an initial 257,876 incidents, domestic crimes, and cases with unspecified or irrelevant locations were excluded. Supermarket data—including geographic coordinates and operating hours—were sourced from Google Maps. The sample includes 67 locations, with opening hours ranging from 6 to 11 a.m. and closing hours between 6 p.m. and midnight. This yielded 469 supermarket-day observations. Distances between supermarkets and crimes were calculated using Vincenty's (1975) formula, and only incidents within one kilometer of a supermarket were retained, resulting in 77,082 crime records. Weather data were retrieved from the Visual Crossing platform, providing daily information on daylight duration and rainfall in Chicago throughout the study period.

Each supermarket-day pair was treated as a study neighborhood. For each, crimes were aggregated into 24 hourly time blocks, including blocks with zero reported crimes. The resulting panel dataset contains 4,097,184 observations (24 time blocks × 364 days × 483 areas).

2.2 Analysis

The first analysis employed a temporal intervention framework. The calculated model was as follows:

$$\log(\mathrm{E}[Y_{it}]) = \beta_0 + \beta_1 TimeBlock_{it} + \beta_2 Open_{it} + \beta_3 (TimeBlock_{it} * Open_{it}) + \beta_4 Neighbor_i + \beta_5 Rain_t + \beta_6 Daylight_t + \beta_7 Weekend_t \quad (1)$$

Y_{it} represents the crime count in neighborhood i during time block t. *TimeBlock* is a categorical variable ranging from 1 to 24, corresponding to the 24 hours of the day. Open is a dummy variable that equals 1 when the supermarket is open. *Neighbor* accounts for the unique effect of each neighborhood. *Rain* is a dummy variable that equals 1 if it rained on the day, while *Daylight* measures the total hours of sunlight on that day. Finally, *Weekend* is a dummy variable that equals 1 for Fridays, Saturdays, and Sundays, and 0 otherwise.

The second model analyze the effect of the distance to a supermarket and crime count as follow:

$$\log(\mathrm{E}[Y_{it}]) = \beta_0 + \beta_1 TimeBlock_{it} + \beta_2 Distance_{it} + \beta_3 Neighbor_i + \beta_4 Rain_t + \beta_5 Daylight_t + \beta_6 Weekend_t \quad (2)$$

Where *Distance* is a measurement in kilometers of the distance from each supermarket to each crime. After studying the effect of the openness and distances of the supermarket, a third negative binomial regression model it was calculated to assess the combine effect:

$$\log(\mathrm{E}[Y_{it}]) = \beta_0 + \beta_1 TimeBlock_{it} + \beta_2 Distance_{it} + \beta_3 Open_{it} + \beta_4 TimeBlock_{it} * Open_{it} + \beta_5 Neighbor_i + \beta_6 Rain_t + \beta_7 Daylight_t + \beta_8 Weekend_t \quad (3)$$

3. Results

Descriptive statistics shows that crime counts per neighborhood and time block, have an overall mean of 0.02 crimes (SD = 0.15), with values ranging from 0 to 10 incidents. However, when conditioning on instances where crimes occurred, the mean crime count rose to 1.15 (SD = 0.44). The highest average crime counts tend to occur during the early morning hours (00:00 to 02:00 a.m.), as well as in the afternoon between 12:00 p.m. and 8:00 p.m. Regarding climatological variables, 45.1% of the days had rained, and on average, there were 12.2 hours of sunlight per day during the study period, with a minimum of 9.1 hours and a maximum of 15.2

hours. The geospatial analysis revealed that criminal incidents occurred at an average distance of 0.54 km (SD = 0.27) from the nearest supermarket, with observed distances spanning from immediate proximity (minimum = 0.01 km) to the maximum threshold of 1 km.

Table 1 presents the results of model (1). Indicating that the number of crimes is significantly influenced by several factors. *Time Block* has a small but positive effect on crime counts, suggesting that as time progresses during the day, crime rates tend to increase. In terms of percentage, crime rate decreases by 5.80% compared to when the supermarket is closed, holding other factors constant. As the hour progresses, the impact of supermarkets being open on crime shifts from reducing crime in the early hours to increasing crime later in the day. Early in the day (00:01 to 01:00 a.m.), the supermarkets being open results in a 2.86% decrease in the crime rate. Midday (11:01 am to 12:00 pm), the supermarket being open leads to a 36.17% increase in the crime rate. Late in the day (23:01 to 00:00), the supermarket being open results in a 96.82% increase in the crime rate.

Table 1: *Results Negative Binomial Model (1)*

Variable	Coef.	Std. Err.	z	P>|z|	95% CI (Lower)	95% CI (Upper)
Time Block	**0.0046*** **	**0.0009**	**4.89**	**0.000**	**0.0028**	**0.0065**
Open	**-0.0597*** **	**0.0205**	**-2.91**	**0.004**	**-0.0998**	**-0.0195**
Open* Time Block	**0.0307*** **	**0.0014**	**21.67**	**0.000**	**0.0279**	**0.0335**
Rain	**-0.0155***	**0.0082**	**-1.89**	**0.059**	**-0.0316**	**0.0006**
Daylight Hours	**0.0147*** **	**0.0019**	**7.54**	**0.000**	**0.0109**	**0.0185**
Weekend	**0.0369*** **	**0.0082**	**4.51**	**0.000**	**0.0209**	**0.0530**
Constant	**-3.9950*** **	**0.0369**	**-108.16**	**0.000**	**-40.674**	**-39.226**

The results for the second negative binomial model are presented below. This time, only weather and temporal variables play an important role.

Table 2: *Results Negative Binomial Model (2)*

Variable	Coef.	Std. Err.	z	P>|z|	95% CI (Lower)	95% Cl (Upper)
Time Block	-0.0003	0.0006	0.56	0.577	-0.0001	0.0014
Distance	-0.0087	0.0137	-0.63	0.526	-0.0354	0.0181
Distance * Time Block	0.0005	0.0009	0.55	0.582	-0.0012	0.0022
Rain	-0.0034	0.0029	-1.32	0.185	-0.0096	0.0019
Daylight Hours	0.0023***	0.0007	3.26	0.001	0.0009	0.0036
Weekend	0.019***	0.0029	6.48	0.000	0.0132	0.0247
Constant	0.1129***	0.0152	7.41	0.000	0.0831	0.1427

Finally, the results of the third model are presented in Table 3. The number of crimes is influenced by several factors. *Time Block* has a small but statistically significant negative effect on crime, suggesting that crime slightly decreases over the day. The distance to the nearest supermarket is not statistically significant on its own, but its interaction with supermarket opening status is positive and significant, indicating that crime increases with distance when supermarkets are open. *Open* has a strong impact: when a supermarket is open, crime decreases significantly, but the interaction term with Time Block is positive and significant, suggesting that the crime-reducing effect diminishes over the day.

Table 3: *Results Negative Binomial Model (3)*

Variable	Coef.	Std. Err.	z	P>|z|	95% Cl (Lower)	95% Cl (Upper)
Time Block	-0.0014**	0.001	-2.29	0.022	-0.0026	-0.0002
Open	-0.0735***	0.0103	-7.12	0.000	-0.0937	-0.0533
Distance	-0.021	0.0146	-1.44	0.150	-0.05	0.008
Open * Distance	0.0295**	0.0129	2.29	0.022	0.0042	0.0547
Distance * Time Block	-0.0001	0.001	-0.15	0.881	-0.0019	0.0016
Open * Time Block	0.0051***	0.0005	10.39	0.000	0.0042	0.0061
Rain	-0.0038	0.0029	-1.31	0.189	-0.0096	0.0019
Daylight Hours	0.0023***	0.0007	3.33	0.001	0.001	0.0037
Weekend	0.0189***	0.0029	6.51	0.000	0.0132	0.0247
Constant	0.1309***	0.0158	8.31	0.000	0.1000	0.1617

4. Conclusions

Proximity to supermarkets alone does not significantly correlate with crime levels. However, when supermarkets are open, greater distance from them is associated with increased crime, suggesting a localized deterrent effect, likely linked to enhanced lighting and foot traffic. Additionally, crime levels are significantly influenced by broader temporal and environmental conditions, including daylight hours and weekends. This approach adds new perspectives to the traditional methodological analysis of consumption (Molina, 1994, 1995, 1996, 1997).

These results underscore the dual role of supermarkets as both potential crime deterrents and attractors, depending on time and context. They contribute to a broader understanding of how commercial infrastructure intersects with urban safety and highlight the importance of incorporating time-sensitive and gender-aware perspectives into urban planning and food access policy.

Bibliography

Askey, A. P., Taylor, R., Groff, E., & Fingerhut, A. (2018). "Fast food restaurants and convenience stores: Using sales volume to explain crime patterns in Seattle". Crime & Delinquency, 64(14), 1836–1857.

Boggs, S. L. (1965). "Urban crime patterns". American Sociological Review, 30(6), 899–908.

Day, P., Breetzke, G., Kingham, S., & Campbell, M. (2012). "Close proximity to alcohol outlets is associated with increased serious violent crime in New Zealand". Australian and New Zealand Journal of Public Health, 36(1), 48–54.

Domínguez, P., & Asahi, K. (2017). "Crime time: How ambient light affect criminal activity". SSRN Working Paper.

Felson, M., & Poulsen, E. (2003). "Simple indicators of crime by time of day". International Journal of Forecasting, 19(4), 595–601.

Gruenewald, P. J., & Remer, L. (2006). "Changes in outlet densities affect violence rates". Alcoholism: Clinical and Experimental Research, 30(7), 1184–1193.

Lee, Y. (2016). "Crime and land use in Pittsburgh: A micro-size grid-cell analysis of the influence of land-uses on area crime". Crime Prevention and Community Safety, 18(3), 204–227.

Molina, J.A. (1994). “Food demand in Spain: an application of the Almost Ideal System”. *Journal of Agricultural Economics*, 45, 252-258.

Molina, J.A. (1995). “The intertemporal behavior of French consumers”. *Economie Appliquée*, 48, 175-191.

Molina, J.A. (1996). “Testing for the utility maximization hypothesis of consumers using the revealed preference theory”. *International Journal of Consumer Studies*, 20, 131-143.

Molina, J.A. (1996). “Is Spanish consumer behaviour consistent with the utility maximization? A non-parametric response”. *Applied Economics Letters*, 3, 237-241.

Molina, J.A. (1997). “Two-stage budgeting as an economic decision making process for Spanish consumers”. *Managerial and Decision Economics*, 18, 27-32.

Rossow, I., & Norström, T. (2012). "The impact of small changes in bar closing hours on violence: The Norwegian experience from 18 cities". Addiction, 107(3), 530–537.

Twinam, T. (2017). "Danger zone: Land use and the geography of neighborhood crime". Journal of Urban Economics, 100, 104–119.

Vincenty, T. (1975). "Geodetic inverse solution between antipodal points". Geodetic Science Report, Ohio State University.