

The Cannibalization Effect of Food Delivery Platforms on Sales*

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Abstract Utilizing novel credit card transaction data from 2020 that encompass all Korean restaurants, we quantify the restaurant-level impact of platform sales on total restaurant sales and the degree of cannibalization of other sales channels, including on-premise dining and takeout orders. We observe a robust positive effect of platform sales on total sales, with limited cannibalization effects on other sales. For each additional Korean won earned from food delivery platforms, total sales revenue increases by 0.858 to 0.965 won, while the platforms cannibalize between 0.035 to 0.142 won from other sales. Notably, while the extent of cannibalization varies by restaurant type, substantial sales growth is observed across all restaurant types.

Keywords Food delivery platforms, sales cannibalization, online shopping, on-premise dining, COVID-19.

JEL Classification L81, L83, L10.

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1. INTRODUCTION

How much are offline sales cannibalized by online platform purchases? An increase in platform sales should be offset exactly by a reduction in brick-and-mortar store sales if customers simply switch from offline to online platform shopping. However, offline purchases might be unaffected if online platform and offline shopping channels are not substitutes. Thus, the degree to which online platform shopping cannibalizes offline sales is an empirical question of interest to various groups, including business owners contemplating online services and policymakers concerned about market and welfare implications. The answer is especially pertinent given rapid expansion of online platforms, such as food delivery, caused by Covid-19 (Ahuja *et al.*, 2021).

We quantify the impact of online platform shopping on total sales and brick-and-mortar sales in the restaurant market. In this sector, consumers can choose between online platform orders and other options such as on-premise dining. The key empirical challenge in determining platform sales' true influence is distinguishing it from firm- and market-level heterogeneity. Using novel credit card transaction data that cover the universe of South Korean restaurants in 2020, we control for both firm-level heterogeneity and market-level time-varying unobservable shocks by examining restaurant-level variations. We also apply an instrumental-variable regression, using lagged platform sales as an instrument, to ensure the robustness of our empirical results. Our findings indicate a robust positive effect of online delivery platforms on total sales, with limited cannibalization of other sales. For each additional Korean won earned from food delivery platforms, total sales revenue increases by 0.858 to 0.965 won, and the remaining 0.035 to 0.142 won from other sales is cannibalized by the platforms. Notably, the extent of cannibalization varies by restaurant type, substantial sales growth is observed across all restaurant types. Note that caution is advised in interpreting these results, as our analysis is confined to data from 2020, a year affected by the COVID-19 pandemic.

We contribute to the existing literature on the relationship between online and offline shopping (Goolsbee, 2001; Gentzkow, 2007; Prince, 2007; Pozzi, 2013; Duch-Brown *et al.*, 2017; Collison, 2020; Li and Wang, 2020; Relihan, 2022; Chun *et al.*, 2023; Kim and Lee, 2024). We offer empirical evidence of online platform sales' influence on total sales and the degree of cannibalization in the restaurant industry. Pozzi (2013) demonstrates limited cannibalization and an increase to total sales in the supermarket industry using data from a single retail chain. However, he does not observe store-level online sales revenue. Collison (2020) uses market-level data to estimate market-level influences of food

delivery platforms on sales. Our paper is first to quantify the firm-level influence of online platform sales on total sales and the degree of cannibalization of other sales, using restaurant-level transaction data that cover the universe of restaurants in a country.¹

Section 2 of this paper introduces the data. Section 3 describes the regression model and results, and Section 4 concludes.

2. DATA

We utilize credit card transaction data provided by Shinhan Card, the largest credit card company in South Korea, holding a 21% market share in 2020 (Financial Supervisory Service, 2022). The data encompass all credit card transactions in Korean restaurants processed by Shinhan Card in 2020. The data are weighted to ensure national representativeness of all credit card transactions.² For each restaurant-month, we observe a unique restaurant identifier, total sales, platform prepaid sales, and the number of total and platform prepaid orders. These platform sales and orders are those processed through *Baemin* and *Yogiyo*, South Korea’s top online delivery platforms with a combined market share of 98.6% as of December 2020 (Wise App Retailer, 2021). We calculate estimated total platform sales, which include both prepaid and collect-on-delivery (COD) orders where payment is made on delivery, by dividing the platform prepaid sales by the share of prepaid orders. The province-month level prepaid share data were provided by *Baemin*, the largest online delivery platform in South Korea. Additionally, we observe characteristics of each restaurant, such as county-level location (*si-gun-gu* in Korea; 250 counties) and the main type of food served (11 types). Certain types of restaurants, such as cafeterias, catering services, and drinking places, are not included in the analysis. Furthermore, we categorize restaurants into four groups for further analysis in section 3: Korean food, fast food, Chinese food, and other. In this paper, “fast food” refers to the restaurants that serve pizza, hamburgers, sandwiches, and chicken. Note that only sales and number of orders variables are firm-level time-varying variables; other restaurant-level characteristics are not. Table 1 presents summary statistics.

¹Kim and Lee (2024), our companion paper, assess the heterogeneous influence of adoption of food delivery platforms in the restaurant market but does not quantify potential cannibalization by platforms.

²Shinhan Card caters to a wide range of customer segments, from high-end to basic credit cards, ensuring a broad and unbiased representation of spending patterns. Monthly spending on Shinhan Card aligns closely with overall credit card transactions and the retail sales index, showing correlation coefficients of 0.97 and 0.92, respectively.

	Total sales		Platform sales		1{Platform sales > 0}		Number of Observations
	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std. Dev.	
A. Korean food	9,895.149	16,811.837	636.162	2,664.200	0.172	0.377	5,285,113
B. Fast food	11,845.817	17,003.854	3,171.724	5,758.993	0.561	0.496	756,687
<i>Pizza, hamburgers, sandwiches</i>	14,239.041	22,109.475	2,843.656	5,553.961	0.503	0.500	326,327
<i>Chicken</i>	10,031.119	11,404.902	3,420.486	5,897.575	0.605	0.489	430,360
C. Chinese food	15,456.365	20,038.375	2,401.547	6,214.587	0.343	0.475	268,002
D. Other	11,601.968	17,927.044	866.281	2,884.026	0.271	0.445	1,316,421
<i>Japanese food</i>	18,125.006	22,180.871	1,357.423	3,894.456	0.325	0.468	178,726
<i>Western-style food</i>	16,095.558	27,800.847	828.569	2,745.431	0.230	0.421	149,440
<i>Other international food</i>	17,190.083	18,004.330	2,836.194	4,537.137	0.604	0.489	14,895
<i>Confectionery stores</i>	15,848.129	21,459.857	370.605	1,117.016	0.272	0.445	199,982
<i>Snack food ("bunsik")</i>	8,152.379	10,585.570	1,642.903	4,250.199	0.343	0.475	275,921
<i>Non-alcoholic beverages</i>	7,736.038	11,557.106	334.316	1,349.144	0.199	0.399	474,075
<i>Other</i>	12,235.162	12,067.941	1,958.836	3,138.783	0.513	0.500	23,382
Total	10,578.758	17,194.409	989.507	3,410.939	0.234	0.423	7,626,223

Table 1: SUMMARY STATISTICS. The unit of observation is a restaurant-month. Total and platform sales were measured in 1,000 Korean won (approximately 0.8 USD). Platform sales are those processed through two major delivery platforms in Korea—Baemin and Yogiyo—adjusted to include both prepaid and collect-on-delivery (COD) orders where payment is made on delivery, by dividing the platform prepaid sales by the share of prepaid orders.

3. RESULTS

3.1. REGRESSION MODEL

We investigate the relationship between platform and total sales using the following empirical model:

$$\text{total}_{it} = \alpha_i + \beta \text{platform}_{it} + \gamma_{j(i),k(i),t} + \varepsilon_{it}, \quad (1)$$

where platform_{it} and total_{it} represent platform sales and total sales of restaurant i during month t . α_i and γ_{jkt} are restaurant and county-type-month fixed effects, with $j(i)$ denoting the county of restaurant i and $k(i)$ mapping restaurant i with its main type of food served k . When $0 < \beta < 1$, incremental platform sales increase total sales but cannibalize other sales, such as on-premise dining and takeout orders. For each additional Korean won earned from online delivery platforms, β and $1 - \beta$ represent total extra revenue and the degree of cannibalization. When $\beta > 1$, extra platform sales increase not only total, but also other sales.³ Identification of the influence of online sales on total sales β comes from restaurant-month-level variations, after controlling for firm-level heterogeneity α_i and market-type-level time-varying unobservable shocks γ_{jkt} . Note that these county-type-month fixed effects account for any market-level time-varying shocks unless such shocks impact restaurants differentially.

We utilize two estimation strategies. Firstly, we focus on certain subsamples to mitigate potential bias. This includes examining restaurants that observed all months in 2020—neither entering nor exiting during the year, thus eliminating bias linked to a restaurant’s decision to start or discontinue business. Additionally, we examine restaurants that adopted platforms in 2020 to isolate the impact on both platform-specific and overall sales due to the adoption of food delivery platforms.

Secondly, we also employ an instrumental-variable regression to address any remaining endogeneity concerns. Endogeneity might occur if an increase in a restaurant’s platform sales correlates with the error term ε_{it} , which represents restaurant-level, time-varying, unobserved factors that affect other sales channels. The direction of the bias is ambiguous. If a restaurant-month level shock simultaneously increases both platform sales platform_{it} and other sales ε_{it} , it would result in a positive bias in β . Conversely, if the shock—such as Covid-19 impacts—has opposite effects on platform and other sales, it would cause an underestimation of β . We consider the lagged platform sales variable, $\text{platform}_{i,t-1}$

³Our specification is similar to Pozzi (2013)’s household-level analysis, in which he regresses the total amount spent by a household on online purchases.

as an instrument. The instrument is relevant because a restaurant with high platform sales in the previous month is more likely to maintain high platform sales in the current month, possibly due to a loyal customer base; the first-stage results confirm its relevance. The exogeneity of the instrument would hold if error terms are not serially correlated; however, they may exhibit serial correlation if a restaurant with a significant volume of other sales in one month tends to experience similar sales the following month. While it is impossible to completely rule out the possibility of serial correlation in other sales, particularly given our reliance on the serial correlation of platform sales, any potential correlation between the instrument and the error term, if it exists, would be lower unless the error term is perfectly serially correlated over time. The extent of bias reduction achieved through instrumental-variable regression can indicate the potential magnitude and direction of any existing bias, as well as the robustness of our fixed-effect regression results.

3.2. EFFECT OF PLATFORM SALES ON TOTAL SALES

Table 2 reports restaurant-level regressions of total sales on platform sales. Results represent robust evidence of the increase in total sales revenue and limited cannibalization. Column (1) reports ordinary least-squares (OLS) result, which suggest a positive correlation between platform and total sales. With the coefficient significantly different from one at the 0.01% significance level, it suggests that additional platform sales appear to increase not only total but also other sales channels. This implies complementarity between platform sales and other sales. Specifically, for every additional Korean won generated through platforms, an increase of 0.236 won is observed in sales from other channels.

Column (2) reports a limited cannibalization effect from platform sales. The positive effect on other sales disappears upon controlling for restaurant and county-type-month fixed effects. The within-restaurant effect of platform sales on total sales is 0.964; for each Korean won earned from online food delivery platforms, 0.964 won contributes to increased total revenue, with a marginal 0.036 won lost from other sales.

Columns (3) and (4) show that results are robust to market entry/exit decisions and other factors that potentially affect both online platform and other sales. Column (3) reports that the result is robust to a restaurant's decision to enter or exit the market, since we include only restaurants that continued businesses during the entire sample period. In Column (4), we focus only on variations due to use of a food delivery platform; we exclude restaurants which never used online platforms, used them all months, or have ever stopped using platforms in

	(1)	(2)	(3)	(4)	(5)
platform _{it}	1.236*** (0.006)	0.964*** (0.006)	0.951*** (0.008)	0.858*** (0.034)	0.965*** (0.019)
Restaurant FE		Yes	Yes	Yes	Yes
County-type-month FE		Yes	Yes	Yes	Yes
Observed all months?			Yes	Yes	Yes
Adopted platforms in 2020?				Yes	Yes
IV regression?					Yes
<i>First stage</i>					
platform _{it-1}					0.674*** (0.021) [1015.454]
Observations	7,626,223	7,626,223	5,501,232	577,956	529,793

Table 2: THE RELATIONSHIP BETWEEN PLATFORM AND TOTAL SALES. The dependent variable is total sales $total_{it}$. Total sales and platform sales $platform_{it}$ were measured in 1,000 Korean won (approximately 0.8 USD). The unit of observation is a restaurant-month. “Type” represents the Korean Standard Industry Classification (KSIC) codes that indicate the main types of food served in the restaurant. “Observed all months?” indicates restaurants observed across all months in the sample period. “Adopted platforms in 2020?” indicates, with abuse of terminology, the establishments that adopted food delivery platforms during February 2020 or later; their platform sales were initially zero but later became consistently positive. Restaurant type represents the main type of food served in each restaurant. Standard errors in parentheses are clustered at the restaurant level. First-stage Kleibergen-Paap F-statistics are reported in square brackets. Significance levels are *5%, **1%, and ***0.1%.

2020. We likely excluded variations to platform and total sales due to other factors, such as common shocks to platform and other sales. Column (4) shows that the result is also robust, though effects on total sales are slightly smaller.

Column (5) indicates that our results remain robust when employing an instrumental-variable regression. In this column, our preferred specification, the estimated impact on total sales is 0.965. This estimate is similar to the 0.951 found in Column (3) and is slightly higher than the 0.858 in Column (4); however, the differences between these estimates are small. The first-stage result confirms the relevance of our instrument. This suggests that our estimates in Columns (3) and (4) are unlikely to be highly biased. Nonetheless, these results should be interpreted with caution for two reasons: First, the estimate significantly differs from one only at the 10% significance level, providing only weak evidence of the cannibalization effect. This is largely due to the exclusion of most restaurants in Column (5) to ensure the robustness of our empirical find-

	(1)	(2)	(3)	(4)	(5)
platform_orders _{it}	1.446*** (0.010)	0.942*** (0.010)	0.921*** (0.015)	0.829*** (0.052)	0.915*** (0.021)
Restaurant FE		Yes	Yes	Yes	Yes
County-type-month FE		Yes	Yes	Yes	Yes
Observed all months?			Yes	Yes	Yes
Adopted platforms in 2020?				Yes	Yes
IV regression?					Yes
<i>First stage</i>					
platform_orders _{i,t-1}					0.634*** (0.040) [245.295]
Observations	7,626,223	7,626,223	5,501,232	577,956	529,793

Table 3: THE RELATIONSHIP BETWEEN NUMBER OF PLATFORM AND TOTAL ORDERS. The dependent variable is the number of total orders $total_orders_{it}$. The unit of observation is a restaurant-month. “Type” represents the Korean Standard Industry Classification (KSIC) codes that indicate the main types of food served in the restaurant. “Observed all months?” indicates restaurants observed across all months in the sample period. “Adopted platforms in 2020?” indicates, with abuse of terminology, the establishments that adopted food delivery platforms during February 2020 or later; their platform sales were initially zero but later became consistently positive. Restaurant type represents the main type of food served in each restaurant. Standard errors in parentheses are clustered at the restaurant level. First-stage Kleibergen-Paap F-statistics are reported in square brackets. Significance levels are * 5%, ** 1%, and *** 0.1%.

ings, although this approach reduces the statistical power. Second, while our findings are robust, the complete exogeneity of the instrument may not be fully guaranteed.

In summary, the results reported in Table 2 suggest that online platforms have a positive effect on total sales, with limited cannibalization of other sales. Table 3 shows that these results are robust when alternative measures—number of platform and total orders—are employed.⁴

⁴The results remain robust when using log variables, which show positive effects on total sales but negative impacts on other sales. Results are also robust to inclusion of an indicator of positive online sales. Robustness-check results are available on request.

3.3. HETEROGENEOUS EFFECT OF PLATFORM SALES ON TOTAL SALES

To examine whether the results are heterogeneous in restaurant type, we include interaction terms between the platform sales variable and indicators for different types of restaurants: “Korean food,” “Fast food,” “Chinese food,” and “Other.” Table 4 presents the regression results with these indicators. The results show no cannibalization effects exclusively for Korean and Chinese restaurants. In Column (5), our preferred model, the estimated effects are 1.038 for Korean food and 0.977 for Chinese food. Notably, the null hypothesis that each parameter equals 1 cannot be rejected at the 5% significance level for Korean and Chinese restaurants, with corresponding p-values of 0.1301 and 0.7152. However, the estimated effects for fast food and other types of restaurants are significantly different from 1; we reject the null hypothesis that each parameter equals 1 at the 0.01% significance level. Moreover, the effects for these latter two types are estimated to be lower than for Korean and Chinese restaurants. These results suggest that the limited, yet noticeable, cannibalization effect found in Table 2 is primarily associated with fast food restaurants, as well as other restaurants, such as Japanese, Western-style, and other international cuisines.

Although a comprehensive explanation of why cannibalization effects are observed only in certain restaurant types is beyond the scope of this paper, we hypothesize that these effects are more pronounced in types where primary consumers frequently utilize food delivery platforms. If this hypothesis holds, consumers may simply switch to platform orders once a restaurant adopts these platforms, leaving total sales unchanged. According to *Restaurant Business Survey 2020* (Lee *et al.*, 2021), the primary customer age groups for Korean and Chinese food restaurants are the 50s and 40s, respectively. In contrast, the predominant age groups for fast food restaurants are the 20s and 30s—specifically, the 20s for pizza, hamburger, and sandwich restaurants, and the 30s for chicken restaurants, all categorized under fast food. For Japanese, Western-style, and other international cuisines—grouped as other restaurant types—the primary customer age group consistently remains in the 30s. Notably, a 2020 survey by Opensurvey (2020) indicates that 39.0% of individuals in their 20s and 41.4% in their 30s use food delivery services as their primary means of accessing cuisine, compared to only 32.9% of those in their 40s and 30.4% in their 50s. For restaurants whose primary customers are not frequent platform users, adopting these services may enhance accessibility for other customer segments. Conversely, for restaurants where the majority of customers are frequent platform users, platform adoption may simply provide an alternative ordering method, thereby potentially canni-

	(1)	(2)	(3)	(4)	(5)
platform _{it} × Korean food	1.128*** (0.009)	0.970*** (0.005)	0.960*** (0.006)	0.910*** (0.019)	1.038*** (0.025)
platform _{it} × Fast food	1.202*** (0.010)	0.957*** (0.018)	0.959*** (0.028)	0.692*** (0.174)	0.832*** (0.035)
platform _{it} × Chinese food	1.537*** (0.020)	0.999*** (0.012)	0.974*** (0.017)	0.939*** (0.050)	0.977*** (0.064)
platform _{it} × Other	1.385*** (0.021)	0.930*** (0.011)	0.893*** (0.014)	0.773*** (0.039)	0.826*** (0.042)
Restaurant FE		Yes	Yes	Yes	Yes
County-type-month FE		Yes	Yes	Yes	Yes
Observed all months?			Yes	Yes	Yes
Adopted platforms in 2020?				Yes	Yes
IV regression?					Yes
Observations	7,626,223	7,626,223	5,501,232	577,956	529,793

Table 4: THE HETEROGENEOUS RELATIONSHIP BETWEEN PLATFORM AND TOTAL SALES, BY RESTAURANT TYPE. The dependent variable is total sales total_{it}. Total sales and platform sales platform_{it} were measured in 1,000 Korean won (approximately 0.8 USD). The unit of observation is a restaurant-month. “Fast food” is classified according to the Korean Standard Industry Classification (KSIC) codes, which identify pizza, hamburgers, sandwiches, chicken, and other international foods as the main types of food served in each restaurant. Similarly, “Korean food,” “Chinese food,” and “Other” categorizations for restaurants are defined. “Observed all months?” indicates restaurants observed across all months in the sample period. “Adopted platforms in 2020?” indicates, with abuse of terminology, the establishments that adopted food delivery platforms during February 2020 or later; their platform sales were initially zero but later became consistently positive. Restaurant type represents the main type of food served in each restaurant. Standard errors in parentheses are clustered at the restaurant level. Significance levels are *5%, **1%, and ***0.1%.

balizing other sales.

These heterogeneous effects have implications for both business owners and policymakers. Business owners might consider adopting platforms given their favorable impact on restaurant sales. However, they should assess whether their primary consumers frequently use food delivery platforms before deciding to adopt them. If not, adopting these platforms may allow other consumer segments to access their restaurants, potentially expanding their customer base. Their adoption decisions, along with their marketing strategies, may hinge on

the cannibalization effect or, conversely, the impact on expanding their customer base.

Policymakers should consider the positive impacts of platforms on sales growth and avoid formulating platform policies based solely on the assumption that consumers will simply switch from offline to platform orders—a view that presumes substantial cannibalization effects. The introduction of new technologies and services often triggers controversies over cannibalization, sometimes delaying their adoption. Our research has implications for the restaurant industry's adoption of new services by examining the cannibalization effects of food delivery platforms. For restaurants, particularly those affected by the COVID-19 pandemic, increasing sales via platforms offers a way to improve total sales without substantially affecting other sales. Our results also have implications for competition policy. If consumers do not view offline and platform orders as highly substitutable, it may be prudent to consider the markets for offline and platform services separately. Our results suggest that although such a switch is generally minimal, the degree of cannibalization varies depending on the characteristics of the restaurants and their primary consumers.

4. CONCLUSIONS

We examine the influence of food delivery platforms on total sales and potential cannibalization of other sales. For each additional Korean won earned from the platforms, total sales revenue increases by 0.858 to 0.965 won, and the remaining 0.035 to 0.142 won from other sales is cannibalized by online delivery. Notably, the extent of cannibalization varies by restaurant type, substantial sales growth is observed across all restaurant types. Contrary to the perception that the emergence of new services could hinder the sales of existing services, these findings suggest that services such as food delivery platforms can have a net positive effect on sales.

The estimated cannibalization effects in this paper are total effects, encompassing both direct cannibalization—switching from other sales to platform sales—and potential complementary effects, such as increased consumer awareness that could boost dine-in sales. The direct cannibalization would be larger than our estimated effects, as these complementary effects are not accounted for. Precisely disentangling these two effects is beyond the scope of the paper, yet both business owners and policymakers are primarily interested in the total effects, specifically in determining to what extent other sales are cannibalized by platform sales. Future research might explore this aspect more deeply to identify the

mechanisms behind limited cannibalization effects. Additionally, market-level analysis could help distinguish between cannibalization resulting from business stealing and that from market expansion, which could have wide-ranging implications for the restaurant industry and other sectors undergoing digital transformation. Incorporating data that include time periods before or after the COVID-19 pandemic would also help determine the extent to which our estimates are affected by the pandemic.

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