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Analysis of online presence of local food producers

Report

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1. Project Overview and Motivation

Local Food Systems (LFS) are gaining popularity worldwide, despite accounting for a relatively small share of total agricultural output. Research shows that LFS contribute to regional employment, diversify local food production, and promote healthier eating habits.

Despite these encouraging trends, local food producers face significant adaptation challenges when seeking new business opportunities. Therefore, improving the conditions for the development of local food production is crucial for the promotion of entrepreneurship in rural and peripheral areas.

As part of the research project "Enhancing Entrepreneurship in Rural Areas through Local Food Systems", one focus of the project is on digitalization and local food systems and in particular the assessment of the online presence of local food producers (LFP) in the Jämtland-Härjedalen region in Sweden.

To analyse the digitalization and online presence of LFPs, a dataset was compiled reflecting the digital footprint of 297 producers in Jämtland-Härjedalen. In addition to basic company information, the dataset includes variables such as website presence, engagement on platforms like Google Maps, Facebook, Instagram, and TripAdvisor, as well as participation in specialized regional platforms like REKO-rings. It also captures indicators of traffic and user feedback volume.

In this context, the aim is to investigate how local food producers use online platforms to promote their products and what factors influence their digital marketing success. The study further examines platform usage patterns, interdependencies, and distinct configurations of online presence among LFPs.

All data preparation and analysis have been executed using RapidMiner©, a data mining toolset.

The document is structured as follows. Chapter 2 presents the research questions and hypotheses. Chapter 3 outlines the dataset and preparation steps. Chapter 4 provides an exploratory data analysis. Chapter 5 investigates the core research questions using various analytical methods, and Chapter 6 summarizes the preliminary findings.

2. Research Questions and Hypotheses

The analysis focuses on answering the following four research questions (RQ):

1. **Which online platforms do LFPs use for the promotion of their products and to what extent?**
2. **What factors influence the use of online platforms and the success of their use?**
3. **How does the use of different platforms influence each other and what patterns of use can be identified?**
4. **Which distinct configurations of LFPs online presence can be identified?**

The following section provides a brief explanation of how these questions can be made measurable. Hypotheses were formulated for RQ2 and RQ3, with most of these being derived from the literature.

RQ1: Which online platforms do LFPs use for the promotion of their products and to what extent?

The RQ will be examined using descriptive statistics and exploratory data analysis (EDA) to identify which online platforms local food producers use and to quantify the extent of their usage.

RQ2: What factors influence the use of online platforms and the success of their use?

	Hypothesis	**verification/ measurement**	**Literature**
H2(a)	The product category has an impact on the online presence of the local food producer.	linear regression, Chi-Quadrat-Test, Kruskal-Wallis-Test	Cristobal-Fransi et al. (2023); O'Hara & Low (2020); Canavan et al. (2007)
H2(b)	The age of the company has a positive impact on the online presence of the local food producer.	linear regression, Kruskal-Willis-Test, T-Test	Szymański, G. (2021)
H2(c)	The company size, measured by the number of employees, has a positive impact on the online presence of the local food producer.	linear regression, Korrelationsmatrix, T-Test	

H2(d)	The turnover has an impact on the online presence of the local food producer.	linear regression, T-Test, Korrelationsmatrix	
H2(e)	An increasing number of online platforms used has a positive impact on online success, measured by metrics such as the number of followers, likes or engagement rates.	linear regression, T-Test, Korrelations-analyse	Checchinato et al. (2024)
H2(f)	The activity on online platforms, such as frequent posting, has a positive impact on online success, measured by metrics such as the number of followers, likes or engagement rates.	linear regression, Korrelationsanalyse, Anova/T-Test	Szymański (2021); Cui (2014)

Figure 1: Hypotheses for research question 2

RQ3: How does the use of different platforms influence each other and what patterns of use can be identified?

	Hypothesis	**verification/ measurement**	**Literature**
H3(a)	The use of a website has a positive impact on the use of social media platforms such as Facebook and Instagram.	Association rule learning	Szymański (2021); Pesci (2024); Checchinato et al. (2024)
H3(b)	Companies with a Facebook page are more likely to have an Instagram account, and vice versa, compared to companies without a presence on the platforms.	Association rule learning	Pesci (2024); Checchinato et al. (2024)
H3(c)	The use of REKOrings has a negative impact on the use of an own online shop.	Association rule learning, linear regression	

Figure 2: Hypotheses for research question 3

RQ4: Which distinct configurations of LFPs online presence can be identified?

RQ4 will be addressed by applying a cluster analysis, following the methodological approach outlined by Checchinato et al. (2024), to group local food producers into distinct

configurations of online presence based on similarities in their platform usage and digital engagement.

3. Data Exploration and Preparation

3.1 Data Understanding

The dataset consists of the following attributes, which were collected from 297 local food producers in the Jämtland-Härjedalen region of Sweden.

	Attribute	Description
1	company_name	Name of the local food producer
2	address	Physical address of the business
3	main_type_of_food_product	Primary food category offered
4	link_to_mathantverk.se	URL to company profile on Mathantverk.se
5	direct_sales_mathantverk.se	Whether company offers direct sales on Mathantverk.se
6	information_allabolag	Business registry information summary (link)
7	registered_company_name	Official registered name of the company
8	typ_of_company	Legal company type
9	turnover	Reported turnover
10	turnover_range	Categorized turnover range
11	company_founding_year	Year in which the company was founded
12	google_map_link	Direct link to company's location on Google Maps
13	number_of_reviews	Total customer reviews on Google Maps
14	customer_feedback_score	Average rating on Google Maps (e.g., 4.5 stars)
15	link_to_company_website_on_ googlemaps	Indicates if website is linked on Google Maps
16	link_from_website_to_googlemaps	If Google Maps is linked on company website
17	link_to_website	URL to the company website
18	website_or_own_platform	Whether company has its own website or platform
19	online_shop_on_own_website	Whether company has a webshop on its website
20	link_to_facebook_page	URL to company's Facebook profile
21	facebook_page	Indicates if a Facebook page exists

22	number_of_followers_on_facebook_page	Total Facebook followers
23	number_of_likes_on_facebook_page	Total likes on Facebook page
24	link_to_instagram	URL to company's Instagram profile
25	instagram_account	Indicates if an Instagram account exists
26	number_of_followers_on_instagram_account	Total Instagram followers
27	number_of_posts_on_instagram	Number of Instagram posts published
28	link_to_TripAdvisor	URL to company's TripAdvisor profile
29	presence_on_trip_advisor	Indicates if company is listed on TripAdvisor
30	number_of_reviews_on_trip_advisor	Customer reviews on TripAdvisor
31	overall_score_on_trip_advisor	Average TripAdvisor rating
32	reko_rings	Indicates if the company sells via REKO-rings

Figure 3: Description of the attributes of the data set

3.2 Data Preprocessing

Data Cleansing Steps:

- Basic cleaning steps have been carried out (Removed redundant information, corrected spelling such as capitalisation, removed spaces, etc.)
- More specific steps were carried out prior to the analysis method used in each case

Data Extensions and Feature Engineering:

The following attributes have been added to the dataset:

- Keywords (Number of keywords worldwide for which the respective website is ranked in Google search)
- SISTRIX Visibility Index (https://www.sistrix.com/visibility-index/)
- Number of Backlinks
- Company size (number of employees)

The following main features were created:

- Online Presence Score (Counts the online platforms used by an LFP;
    1. Google Maps
    2. Website
    3. Online Shop
    4. Facebook
    5. Instagram
    6. TripAdvisor
    7. REKO-rings

8. mathantverk.se

- FoodType (The existing groups have been grouped into 7 super categories):
    - Meat, Bread Bakery, Diary, Sweets, Drinks, Plant based, Miscellaneous

4. Exploratory Data Analysis (EDA)

Figure 4 below illustrates how many of the 297 LFPs are active or not on the online platforms listed in the table, or whether information is missing from the dataset (NA).

	Google Map	**Website**	**Online Shop**	**Face-book**	**Insta-gram**	**Trip Advisor**	**REKO-rings**	**Link to Mathant-verk.se**
yes	**148**	**132**	**32**	**179**	**118**	**42**	**50**	**107**
yes in %	49,83%	44,44%	10,77%	60,27%	39,73%	14,14%	16,84%	36,03%
no	**149**	**159**	**215**	**111**	**172**	**249**	**241**	**190**
no in %	50,17%	53,54%	72,39%	37,37%	57,91%	83,84%	81,14%	63,97%
NA	**0**	**6**	**50**	**7**	**7**	**6**	**6**	**0**
NA in %	0,0%	2,02%	16,84%	2,36%	2,36%	2,02%	2,02%	0,00%

Figure 4: Online presence of LFP in Sweden's Jämtland-Härjedalen region

One of the target variables analysed is the Online Presence Score, which counts how many platforms (e.g. Google Maps, Facebook or Instagram) an LFP is active on. One point is awarded for each platform. As eight platforms were examined as part of the data collection, the maximum possible score is eight. The following chart shows how many companies have an Online Presence Score between one and eight.

OnlinePresenceScore AVG: 2,721 Median: 3	**No. of LFP**	**in %**
0 platforms	65	21,9%
1 platform	36	12,1%
2 platforms	47	15,8%
3 platforms	40	13,5%
4 platforms	35	11,8%
5 platforms	37	12,5%
6 platforms	27	9,1%
7 platforms	9	3,0%
8 platforms	1	0,3%
Total	**297**	**100%**

Figure 5: Distribution of online presence score among local food producers

The following table provides an overview of how many companies fall into specific follower, like, and post count ranges across Facebook and Instagram. The average and median values for the entire dataset are also included.

Category	**Facebook Follower**	**Facebook Likes**	**Instagram Follower**	**Instagram Posts**
AVG	**2342,58**	**2299,413**	**1664,174**	**571,293**
Median	**984**	**955**	**1114**	**195**
≤ 500	48	42	34	79
501 - 1.000	42	40	22	20
1.001 - 2.000	21	18	25	10
2.001 - 5.000	44	35	27	5
5.001 - 10.000	16	13	6	2
> 10.000	2	2	1	0

Figure 6: Distribution of companies by social media followers, likes and posts on Facebook and Instagram

Following the same pattern as before, the table below lists the number of companies that fall within a defined range of reviews on Google Maps and TripAdvisor. The average rating per category is also given, with ratings on both platforms ranging from one to five stars. The average and median values for the entire dataset are also included.

Category	Reviews on Google Maps	AVG Score Google Maps	Reviews on TripAdvisor	AVG Score TripAdvisor
AVG	**131,39**	**4,53**	**51,85**	**4,35**
Median	**16**	**4,7**	**27**	**4,5**
NA	158	-	258	-
< 10	52	4,416	12	4,600
10 - 20	26	4,635	4	4,375
21 - 50	8	4,625	4	4,125
50 - 70	8	4,688	3	4,333
> 70	39	4,582	11	4,273

Figure 7: Number and average values for Google Maps and Trip Advisor reviews

The same process is followed for the number of keywords and backlinks of the respective company website. Backlinks indicate how many links on the internet lead to the analysed page, while keywords show how many keywords the analysed page was ranked for in a Google search at the time of investigation.

Category	Keywords	in %	Backlinks	in %
AVG	**49,14**	**-**	**30,24**	**-**
Median	**16,5**	**-**	**14**	**-**
NA	165	55,56%	165	55,56%
0	20	6,73%	1	0,34%
1 - 10	32	10,77%	58	19,53%
11 - 20	23	7,74%	19	6,40%
21 - 30	15	5,05%	19	6,40%
31 - 50	9	3,03%	16	5,39%
51- 100	17	5,72%	8	2,69%
> 100	16	5,39%	11	3,70%
Total	297	100,00%	297	100,00%

Figure 8: Number of keywords and backlinks

The following table shows the data set's highest positive correlations.

No	First Attribute	Second Attribute	Correlation
1	number_employees	turnover_range	0,749313
2	turnover_range	number_of_reviews_on_trip_advisor	0,709150
3	number_of_followers_on_instagram	number_of_posts_on_instagram	0,643661
4	number_employees	number_of_reviews_on_trip_advisor	0,548326
5	number_of_likes_on_facebook_page	number_of_reviews_on_trip_advisor	0,537900
6	number_of_followers_on_instagram	number_of_reviews_on_trip_advisor	0,511163
7	number_of_followers_on_facebook	number_of_reviews_on_trip_advisor	0,503872
8	number_employees	number_of_followers_on_instagram	0,499418
9	facebook_page	instagram_account	0,491872
10	number_of_posts_on_instagram	number_of_reviews_on_trip_advisor	0,476416
11	turnover_range	number_of_likes_on_facebook	0,459787
12	turnover_range	number_of_followers_on_facebook	0,459154
13	website_or_own_platform	instagram_account	0,418856
14	number_employees	number_of_followers_on_facebook	0,410586
15	website_or_own_platform	facebook_page	0,401163

Figure 9: Highest positive correlations

The following table shows the data set's highest negative correlations.

No.	First Attribute	Second Attribute	Correlation
1	instagram_account	google_map_link	-0,5278
2	number_employees	overall_score_on_trip_advisor	-0,5261
3	facebook_page	google_map_link	-0,4808
4	website_or_own_platform	google_map_link	-0,4600
5	sistrix_visibility_index	link_to_mathantverk.se	-0,4213
6	turnover_range	overall_score_on_trip_advisor	-0,3437
7	website_or_own_platform	number_of_followers_on_instagram	-0,3118
8	facebook_page	reko_rings	-0,3031

Figure 10: Highest negative correlations

The following table shows aggregated data on the Online Presence Score (OPS) of companies, broken down by food category, company age, turnover range, and number of

employees. For each subgroup, the number of companies, as well as the average and median OPS, are reported.

Food Category	**Number of Companies**	**AVG OPS**	**Median OPS**
food_category_bakery	55	2,09	1
food_category_drinks	28	3,50	3
food_category_sweets	34	3,65	4
food_category_miscellaneous	38	2,26	2
food_category_plant_based	27	2,41	2
food_category_dairy	46	2,22	2
food_category_meat	67	3,09	3
Company Age	**Number of Companies**	**AVG OPS**	**Median OPS**
company_age_established	46	2,41	2
company_age_old	29	2,55	2
company_age_very young	97	2,57	3
company_age_young	71	2,93	3
Turnover Range	**Number of Companies**	**AVG OPS**	**Median OPS**
turnover_range_high(>4500)	65	3,14	3
turnover_range_medium(500-4499)	84	3,08	3
turnover_range_low(<=499)	77	1,74	1
Number of Employees	**Number of Companies**	**AVG OPS**	**Median OPS**
number_of_employees_NA	56	2,93	2
number_of_employees_zero	122	1,91	2
number_of_employees_low(<=3)	71	3,04	3
number_of_employees_high(>3)	48	4,06	5

Figure 11: Aggregations with the Online Presence Score

5. Investigation of Research Questions

5.1 RQ1: Online Platform Usage Among Local Food Producers

"Which online platforms do LFPs use for the promotion of their products and to what extent?"

The exploratory analysis of the data showed that the top five most used online platforms by local food producers are Facebook, Google Maps, the company websites, Instagram, and Mathantverk.se, with Facebook being the most frequently used.

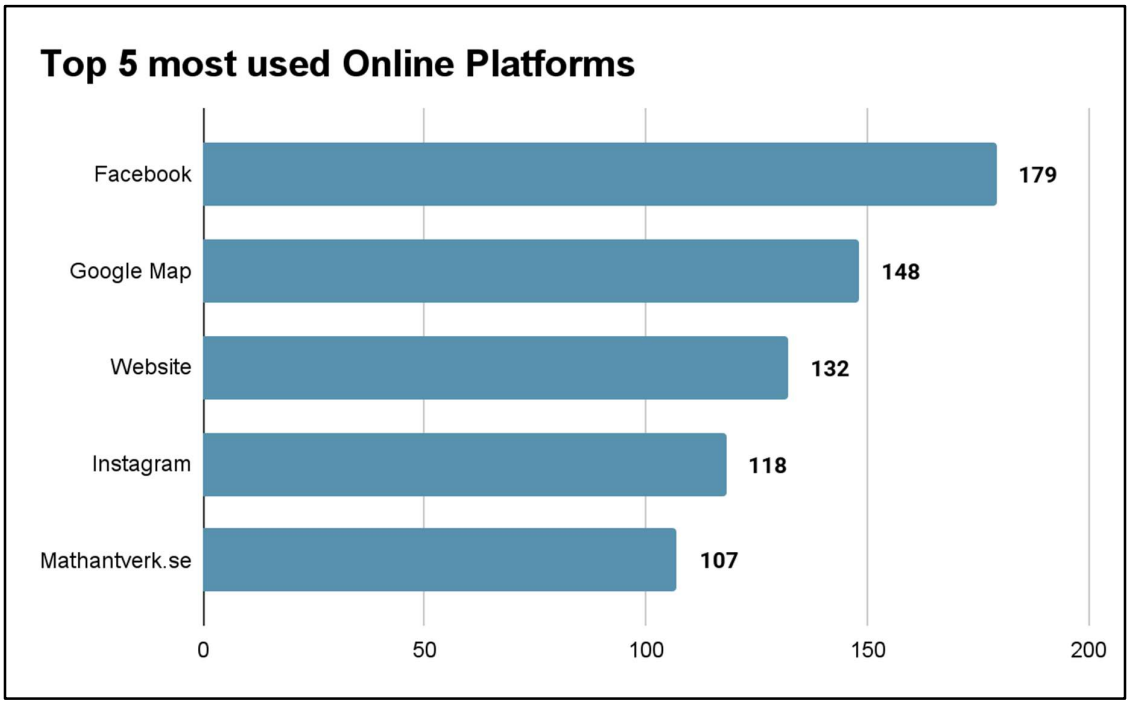

Figure 12: Top 5 most used online platform

5.2 RQ2: Factors Influencing Platform Use and Online Success

"What factors influence the use of online platforms and the success of their use?"

In the following section, the hypotheses are examined using non-parametric tests because the target variable (online presence score) does not show a normal distribution, and

transformation could not achieve this. Nevertheless, the hypotheses are examined with regressions at the end of the chapter.

The analyses were performed on the data with permuted NaN values. Depending on the column, appropriate methods were used (median, 0/1,...). For columns in which only very few values were missing (main_type_of_food_category), or where replacement was not reasonably possible (e.g. company_founding_year), no permutation was carried out.

Hypothesis H2(a): The product category has an impact on the online presence of the local food producer.

Kruskal-Wallis-Test (Online Presence Score as target attribute)
Group_Variable: main_type_of_food_product
Test_Statistic: 2.2821E+01
P_Value: 8.5873E-04
Result: Significant difference

The Kruskal-Wallis test showed significant differences in online presence across product categories ($p < 0.05$).

Anova (Online Presence Score)
Attribute: main_type_of_food
Online Presence Score: 1.24053449335193E-06
Result: Significant difference

Interpretation:
The product category influences the online visibility of local food producers. As Fig. 10 also shows, the product categories Meat, Sweets and Drinks have a particularly high online presence score.

Hypothesis H2(b): The age of the company has a positive impact on the online presence of the local food producer.

Kruskal-Wallis-Test (Online Presence Score as target attribute)
Group_Variable: company_founding_year
Test_Statistic: 4.4244E+00
P_Value: 3.5160E-01
Result: No significant difference
Mann-Whitney-U
Attribute: Company Age
Test_Statistic: 6.5890E+03
P_Value: 4.0500E-01

Result: No significant difference

T-Test: company_founding_year (group) & OPS
t-stat: 0.83576118006441
P_Value: 0.404687660164028
Result: No significant difference

Anova: company_founding_year & OPS
Online Presence Score: 0.699314406647461
Result: No significant difference

Results:
No significant positive effect of company age on online presence was found ($p > 0.05$).

Interpretation:
Company age does not appear to positively affect online presence in this dataset.

Hypothesis H2(c): The company size, measured by the number of employees, has a positive impact on the online presence of the local food producer.

Verification / Measurement:
Correlation matrix, T-test

Results:

- Positive correlation between company size and online presence ($p < 0.05$).
- T-test showed significant differences in online presence between small and larger companies.

Interpretation:
Larger companies tend to have stronger online presence.

Hypothesis H2(d): The turnover has an impact on the online presence of the local food producer.

Verification / Measurement:
T-test, Correlation matrix

T-Test: OPS (Group) & Turnover
T-Stat: -3.24797459727819
P-Value: 0.00138377568940833
Result: Significant difference

T-Test: Turnover (Group) & OPS
T-Stat: -3.40159434306663
P-Value: 0.000793822013566606
Result: Significant difference

Results:
Significant positive relationship between turnover and online presence ($p < 0.05$).

Interpretation:
Higher turnover is associated with stronger online presence.

Hypothesis H2(e): An increasing number of online platforms used has a positive impact on online success, measured by metrics such as the number of followers, likes, or engagement rates.

Verification / Measurement:
T-test, Correlation analysis

Results:

- Positive correlation between number of platforms used and online success metrics (followers, likes).
- T-tests indicate significant differences in online success based on platform usage.

Interpretation:
Using multiple online platforms enhances online success.

Hypothesis H2(f): The activity on online platforms, such as frequent posting, has a positive impact on online success, measured by metrics such as the number of followers, likes, or engagement rates.

Verification / Measurement:
Correlation analysis, ANOVA, T-test

Correlation matrix:

number_of_followers_on_facebook_page	number_of_likes_on_facebook_page	number_of_followers_on_instagram_account	number_of_posts_on_instagram	number_of_reviews_on_trip_advisor	overall_score_on_trip_advisor	Attributes
1.0000E+00	9.8432E-01	4.1374E-01	2.2255E-01	2.4494E-01	2.6074E-01	**number_of_followers_on_facebook_page**
9.8432E-01	1.0000E+00	3.7529E-01	2.0532E-01	2.3772E-01	1.9971E-01	**number_of_likes_on_facebook_page**
4.1374E-01	3.7529E-01	1.0000E+00	7.2238E-01	5.7716E-01	5.3666E-01	**number_of_followers_on_instagram_account**
2.2255E-01	2.0532E-01	7.2238E-01	1.0000E+00	5.4819E-01	4.7456E-01	**number_of_posts_on_instagram**
2.4494E-01	2.3772E-01	5.7716E-01	5.4819E-01	1.0000E+00	5.6955E-01	**number_of_reviews_on_trip_advisor**
2.6074E-01	1.9971E-01	5.3666E-01	4.7456E-01	5.6955E-01	1.0000E+00	**overall_score_on_trip_advisor**

Figure 13: Correlation Matrix

Results:

- Frequent posting is significantly associated with higher online success ($p < 0.05$).
- ANOVA shows activity level as a strong factor in explaining variance in followers and likes.

Interpretation:
Active management of social media accounts boosts online success.

Hypotheses independent results:

Kruskal-Wallis-Test (OPS)
Group_Variable: typ_of_company
Test_Statistic: 3.1585E+01
P_Value: 7.1781E-06
Result: Significant difference

Mann-Whitney-U
Attribute: type_of_company
Test_Statistic: 3.9220E+03
P_Value: 1.2171E-06
Result: Significant difference

Anova: type_of_company & OPS
Online Presence Score: 1.06116352371899E-08
Result: Significant difference

Note: Comparison for company type between the two most represented company groups

Results:
The tests showed significant differences in online presence across company types ($p < 0.05$).

Interpretation:
The company type influences the online visibility of local food producers.

H2(a)(b)(c)(d) simple- and -multiple linear regression

To examine the factors influencing the online presence of local food producers, a multiple linear regression analysis was conducted. The dependent variable was the Online Presence Score, which reflects the number of online platforms a company uses. The model included a set of company-level predictor variables, such as c*ompany_founding_year, main_type_of_food_product, number_employees, turnover_range*, and *typ_of_company*.

Platform-specific variables (e.g., *facebook_page, instagram_account, google_map_link, website_or_own_platform*, etc.) were excluded from the model, as they directly contribute to the construction of the Online Presence Score and would therefore introduce circular reasoning into the analysis.

Forward selection was applied for model building, and cross-validation was used to ensure the reliability of the results. The analysis showed that none of the included company-level variables had a statistically significant effect on the Online Presence Score. This suggests that company age (H2b), product category (H2a), company size (H2c),

turnover (H2d), or legal form do not meaningfully explain variation in digital presence when considered together in a multivariate model.

To explore potential bivariate relationships, a set of simple linear regressions was also conducted. These revealed individual associations:

- number_employees (coefficient = 0.119, $t = 4.418$, $p < 0.001$)
- turnover_range (coefficient = 0.000, $t = 2.429$, $p = 0.016$)

These results could indicate that larger or higher-turnover companies are more likely to be active across multiple platforms, but only when these factors are considered in isolation. In the multivariate context, their effects are no longer statistically significant, suggesting that no single company characteristic independently explains online presence when accounting for others.

H2(e)(f) simple- and -multiple linear regression

To investigate how social media engagement influences the overall online presence of local food producers, both simple and multiple linear regression analyses were conducted. The dependent variable in each case was the Online Presence Score, which reflects the number of platforms a company actively uses.

The simple linear regressions revealed mostly positive relationships between various engagement metrics and online presence. Specifically:

- number_of_likes_on_facebook_page (coefficient = 0.000, $t = 4.792$, $p < 0.000$)
- number_of_followers_on_facebook_page (coefficient = 0.000, $t = 5.764$, $p < 0.000$)
- number_of_followers_on_instagram_account (coefficient = 0.001, $t = 11.646$, $p < 0.000$)
- number_of_posts_on_instagram (coefficient = 0.001, $t = 8.196$, $p < 0.000$)
- number_of_reviews (coefficient = 0.004, $t = 7.035$, $p < 0.000$)
- number_of_reviews_on_trip_advisor (coefficient = 0.022, $t = 5.893$, $p < 0.000$)
- overall_score_on_trip_advisor (coefficient = 0.751, $t = 10.191$, $p < 0.000$)

Each of these variables, when considered individually, was positively associated with broader digital presence, providing support to Hypothesis H2(f). These results may indicate that more active or visible engagement on individual platforms corresponds to a wider digital footprint.

To assess whether these relationships hold when controlling for overlap between variables, a multiple linear regression was conducted including the following predictors: *number_of_followers_on_facebook_page, number_of_likes_on_facebook_page, number_of_posts_on_instagram, number_of_followers_on_instagram_account, number_of_reviews, number_of_reviews_on_trip_advisor*, and *overall_score_on_trip_advisor.*

After applying forward selection and cross- validation, only three variables remained statistically significant:

- Number of followers on Facebook (coefficient = 0.001, $t = 5.284$, $p < 0.001$)
- Number of Instagram posts (coefficient = 0.001, $t = 7.096$, $p < 0.001$)
- Number of Facebook likes (coefficient = –0.001, $t = -4.527$, $p < 0.001$)

The multiple regression refines the findings from the simple models by showing that when considered together, active posting and a larger follower base remain predictors of broader online activity. Interestingly, the number of Facebook likes shows a negative coefficient in the multivariate context, possibly due to multicollinearity or indicating that likes alone, without engagement or growth in followers, are a weaker signal of strategic digital presence.

Other metrics, such as TripAdvisor reviews, average scores, and Instagram followers, did not contribute significantly when the above variables were already included. This suggests that not all engagement indicators are equally predictive when viewed in combination.

Together, these results emphasize H2(f) and show that visible, ongoing activity like posting frequency and follower growth is more associated with overall digital engagement than static popularity metrics like likes or rating.

5.3 RQ3: Interrelationships and Usage Patterns Across Platforms

"How does the use of different platforms influence each other and what patterns of use can be identified?"

In the first step, association rules were used to investigate this question. For this purpose, the FP-Growth and Apriori algorithms were used. The advantage of the Apriori algorithm is that it provides a significance test. All subsequent results of the Apriori algorithm are therefore statistically significant, as a significance filter was applied.

Despite the lack of a normal distribution, regressions are used to examine the hypotheses at the end of this chapter.
Before examining the hypotheses of research question 3, all online platforms are investigated using association rule mining. First, the FP-Growth algorithm is used to gain an initial overview of the relationships between all platforms, followed by the Apriori algorithm.

Association rules (FP-Growth) based on Lift descending order (focus on online platforms only; min confidence 0,2; min support 0,1):

	Premises	Conclusion	Support	Confidence	Lift
1	instagram_account_true	presence_on_trip_advisor_true	0,1246	0,3136	2,2173
2	presence_on_trip_advisor_true	instagram_account_true	0,1246	0,8810	2,2173
3	online_shop_on_own_website_true	website_or_own_platform_true	0,1044	0,9688	2,1797
4	presence_on_trip_advisor_true	website_or_own_platform_true	0,1212	0,8571	1,9286
5	presence_on_trip_advisor_true	google_map_link_true	0,1347	0,9524	1,9112
6	online_shop_on_own_website_true	google_map_link_true	0,0976	0,9063	1,8186
7	online_shop_on_own_website_true	facebook_page_true	0,1077	1,0000	1,6592
8	google_map_link_true	instagram_account_true	0,3266	0,6554	1,6496
9	instagram_account_true	google_map_link_true	0,3266	0,8220	1,6496
10	reko_rings_true	google_map_link_true	0,1347	0,8000	1,6054
11	google_map_link_false	facebook_page_false	0,3165	0,6309	1,5879
12	facebook_page_false	google_map_link_false	0,3165	0,7966	1,5879
13	website_or_own_platform_true	instagram_account_true	0,2795	0,6288	1,5826
14	instagram_account_true	website_or_own_platform_true	0,2795	0,7034	1,5826
15	presence_on_trip_advisor_true	facebook_page_true	0,1347	0,9524	1,5802
16	reko_rings_true	instagram_account_true	0,1044	0,6200	1,5605
17	reko_rings_true	facebook_page_true	0,1582	0,9400	1,5597
18	reko_rings_true	link_to_mathantverk.se_true	0,0943	0,5600	1,5544
19	google_map_link_true	website_or_own_platform_true	0,3367	0,6757	1,5203
20	website_or_own_platform_true	google_map_link_true	0,3367	0,7576	1,5203

Figure 14: Association rules related to online platform usage among local food producers (FP-Growth, Sorted by Lift)

Association rules (W-Apriori) based on Lift descending order (focus on online platforms only)

Minimum support: 0.1 (30 instances)
Minimum metric <lift>: 0.6
Significance level: 0.05
Number of cycles performed: 18

Generated sets of large itemsets:

- Size of set of large itemsets L(1): 8
- Size of set of large itemsets L(2): 13
- Size of set of large itemsets L(3): 7
- Size of set of large itemsets L(4): 2

1	presence_on_trip_advisor=true 42 ==> google_map_link=true instagram_account=true website_or_own_platform=true 30	conf:(0.71) < lift:(2.91)> lev:(0.07) [19] conv:(2.44)
2	presence_on_trip_advisor=true 42 ==> instagram_account=true website_or_own_platform=true 32	conf:(0.76) < lift:(2.73)> lev:(0.07) [20] conv:(2.75)
3	google_map_link=true presence_on_trip_advisor=true 40 ==> instagram_account=true website_or_own_platform=true 30	conf:(0.75) < lift:(2.68)> lev:(0.06) [18] conv:(2.62)
4	instagram_account=true website_or_own_platform=true 83 ==> google_map_link=true presence_on_trip_advisor=true 30	conf:(0.36) < lift:(2.68)> lev:(0.06) [18] conv:(1.33)
5	presence_on_trip_advisor=true 42 ==> google_map_link=true instagram_account=true 35	conf:(0.83) < lift:(2.55)> lev:(0.07) [21] conv:(3.54)
6	presence_on_trip_advisor=true website_or_own_platform=true 36 ==> google_map_link=true instagram_account=true 30	conf:(0.83) < lift:(2.55)> lev:(0.06) [18] conv:(3.46)
7	instagram_account=true presence_on_trip_advisor=true 37 ==> google_map_link=true website_or_own_platform=true 30	conf:(0.81) < lift:(2.41)> lev:(0.06) [17] conv:(3.07)
8	presence_on_trip_advisor=true 42 ==> google_map_link=true website_or_own_platform=true 34	conf:(0.81) < lift:(2.4)> lev:(0.07) [19] conv:(3.1)
9	link_to_mathantverk.se=true instagram_account=true 43 ==> google_map_link=true website_or_own_platform=true 33	conf:(0.77) < lift:(2.28)> lev:(0.06) [18] conv:(2.59)
10	instagram_account=true 118 ==> presence_on_trip_advisor=true website_or_own_platform=true 32	conf:(0.27) < lift:(2.24)> lev:(0.06) [17] conv:(1.19)

Figure 15: Association rules related to online platform usage among local food producers (W-Apriori, sorted by lift)

Hypothesis H3(a): The use of a website has a positive impact on the use of social media platforms.

Association rules (FP-Growth)

Premises	Conclusion	Support	Confidence	Lift
presence_on_trip_advisor_true	website_or_own_platform_true	0,1212	0,8571	1,9286
website_or_own_platform_true	instagram_account_true	0,2795	0,6288	1,5826
instagram_account_true	website_or_own_platform_true	0,2795	0,7034	1,5826
google_map_link_true	website_or_own_platform_true	0,3367	0,6757	1,5203
website_or_own_platform_true	google_map_link_true	0,3367	0,7576	1,5203
reko_rings_true	website_or_own_platform_true	0,1044	0,6200	1,3950
facebook_page_true	website_or_own_platform_true	0,3670	0,6089	1,3701
website_or_own_platform_true	facebook_page_true	0,3670	0,8258	1,3701
website_or_own_platform_true	link_to_mathantverk.se_true	0,2054	0,4621	1,2827
link_to_mathantverk.se_true	website_or_own_platform_true	0,2054	0,5701	1,2827

Figure 16: Association rules related to website use and its relationship to other online platforms(FP-Growth)

Association rules (W-Apriori)

website_or_own_platform=true 132 ==> link_to_mathantverk.se=true google_map_link=true instagram_account=true 33 conf:(0.25) < lift:(1.95)> lev:(0.05) [16] conv:(1.15)
website_or_own_platform=true 132 ==> instagram_account=true presence_on_trip_advisor=true 32 conf:(0.24) < lift:(1.95)> lev:(0.05) [15] conv:(1.14)
website_or_own_platform=true 132 ==> google_map_link=true presence_on_trip_advisor=true 34 conf:(0.26) < lift:(1.91)> lev:(0.05) [16] conv:(1.15)
website_or_own_platform=true 132 ==> link_to_mathantverk.se=true instagram_account=true 36 conf:(0.27) < lift:(1.88)> lev:(0.06) [16] conv:(1.16)
website_or_own_platform=true 132 ==> link_to_mathantverk.se=true google_map_link=true 44 conf:(0.33) < lift:(1.74)> lev:(0.06) [18] conv:(1.2)
website_or_own_platform=true 132 ==> google_map_link=true instagram_account=true 73 conf:(0.55) < lift:(1.69)> lev:(0.1) [29] conv:(1.48)
website_or_own_platform=true 132 ==> instagram_account=true 83 conf:(0.63) < lift:(1.58)> lev:(0.1) [30] conv:(1.59)
website_or_own_platform=true 132 ==> reko_rings=true 31 conf:(0.23) < lift:(1.4)> lev:(0.03) [8] conv:(1.08)

Figure 17: Association rules related to website use and its relationship to other online platforms (W-Apriori)

Interpretation:

Based on the results of the Apriori algorithm, Hypothesis H3(a) can be verified. The analysis shows that local food producers with their own website are significantly more likely to use social media platforms.

Websites appear to be part of a broader, multi-channel trend. If a website exists, it is highly probable that several platforms will be used simultaneously.

Hypothesis H3(b): Companies with a Facebook page are more likely to have an Instagram account, and vice versa, compared to companies without a presence on the platforms.

Association rules (FP-Growth)

Premises	Conclusion	Support	Confidence	Lift
instagram_account_true	facebook_page_true	0,3569	0,8983	1,4905
facebook_page_false	instagram_account_false	0,3569	0,8983	1,4905
facebook_page_true	instagram_account_true	0,3569	0,5922	1,4905
instagram_account_false	facebook_page_false	0,3569	0,5922	1,4905

Figure 18: Association rules between Facebook and Instagram usage among local food producers (FP-Growth)

Association rules (W-Apriori): no results

Interpretation:
While the FP-Growth algorithm indicates a positive relationship between Facebook and Instagram usage, Hypothesis H3(b) cannot be considered verified due to the lack of significant results from the Apriori algorithm.

Hypothesis H3(c): The use of REKOrings has a negative impact on the use of an own online shop.

Association rules (FP-Growth):
Premises: reko_rings_true
Conclusion: online_shop_on_own_website_false
Support: 0,1380
Confidence: 0,8200
Lift: 0,9190

Association rules (W-Apriori): no results
Interpretation:

Although 82% of REKO users do not operate their own online shop, which supports the hypothesis based on the FP-Growth results, the lift value is below 1 and the W-Apriori algorithm produced no significant rules. This means that the hypothesis cannot be statistically verified.

H3(a)(b)(c) simple- and multiple -linear regression:

To analyze the relationship between platform-specific digital presence and the use of a Facebook page by local food producers, a multiple linear regression was conducted. The dependent variable was the presence of a Facebook page. The predictor variables included indicators of presence on various online platforms, such a*s google_map_link, instagram_account, link_to_mathantverk.se, website_or_own_platform, online_shop_on_own_website, presence_on_trip_advisor,* and *reko_rings.*

The results of the multiple linear regression show:

- Instagram Account had a positive effect (coefficient = 0.336, $t = 6.059$, $p < 0.001$). This suggests that companies with an Instagram presence are more likely to also operate a Facebook page, highlighting the complementary use of major social media platforms. This finding supports Hypothesis H3(b), which concludes that companies using one social media platform are more likely to use others as well.

- Google Map Link also showed a positive effect (coefficient = 0.286, t = 5.264, p < 0.001), indicating that companies visible on Google Maps are more likely to maintain a Facebook page.

- Link to mathantverk.se was another predictor (coefficient = 0.209, t = 4.343, p < 0.001), suggesting that businesses integrated into regional food networks are also more active on mainstream social media platforms like Facebook.

Additionally, engagement-based metrics, such as *number_of_reviews, number_of_followers_on_instagram_account, number_of_posts_on_instagram, number_of_followers_on_facebook_page,* and *number_of_likes_on_facebook_page* were intentionally excluded. These variables directly depend on already having a presence on the respective platforms (e.g., you can only gain followers or reviews if you have an account)

These results reflect independent explanatory effects, meaning each predictor contributed uniquely to explaining Facebook usage, after adjusting for the influence of the others.

Notably, these findings align closely with the simple linear regression results, which explored bivariate associations. That analysis also found positive relationships between Facebook presence and several platform-related variables:

- website_or_own_platform (coefficient = 0.424, t = 7.669, p < 0.001)
- online_shop_on_own_website (coefficient = 0.445, t = 5.051, p < 0.001)
- instagram_account (coefficient = 0.490, t = 9.667, p < 0.001)
- google_map_link (coefficient = 0.469, t = 9.370, p < 0.001)
- link_to_mathantverk.se (coefficient=0.227, t= 3.917, p < 0.001)
- presence_on_trip_advisor (coefficient = 0.407, t = 5.205, p < 0.001)
- reko_rings (coefficient = 0.406, t = 5.603, p < 0.001)

The simple regression results support hypotheses H3(a) and H3(b), showing that individual platform usage is positively related to Facebook presence. The multiple regression model confirms the robustness of these associations for Instagram, Google Maps, and mathantverk.se.

5.4 RQ4: Configurations of Online Presence Among Local Food Producers

"Which distinct configurations of LFPs online presence can be identified?"

K-means clustering was used to investigate this question.

The objective of clustering is to combine similar elements into homogeneous groups. The elements within each group should be as similar as possible, and the elements in different groups should be as different as possible.

Preprocessing:

- Create binominal food categories
- Replaced missing values of binominal attributes (e.g. Instagram account: yes/no) with 0/no.

Process:

- Replaced missing values with average
- Removed 20 Outliers (number of neighbours 10)
- Normalization of binomial Attributes: Range Transformation
- Normalization of numerical Attributes: Z-Transformation
- K-Means Measure Type: Numerical measures

Cluster Model:

- Cluster 0: 49 items
- Cluster 1: 114 items
- Cluster 2: 114 items
- Total number of items: 277

Performance Vector:

- Avg. within centroid distance: 7.065
- Avg. within centroid distance_cluster_0: 13.448
- Avg. within centroid distance_cluster_1: 7.201
- Avg. within centroid distance_cluster_2: 4.186
- **Davies Bouldin: 1.619**

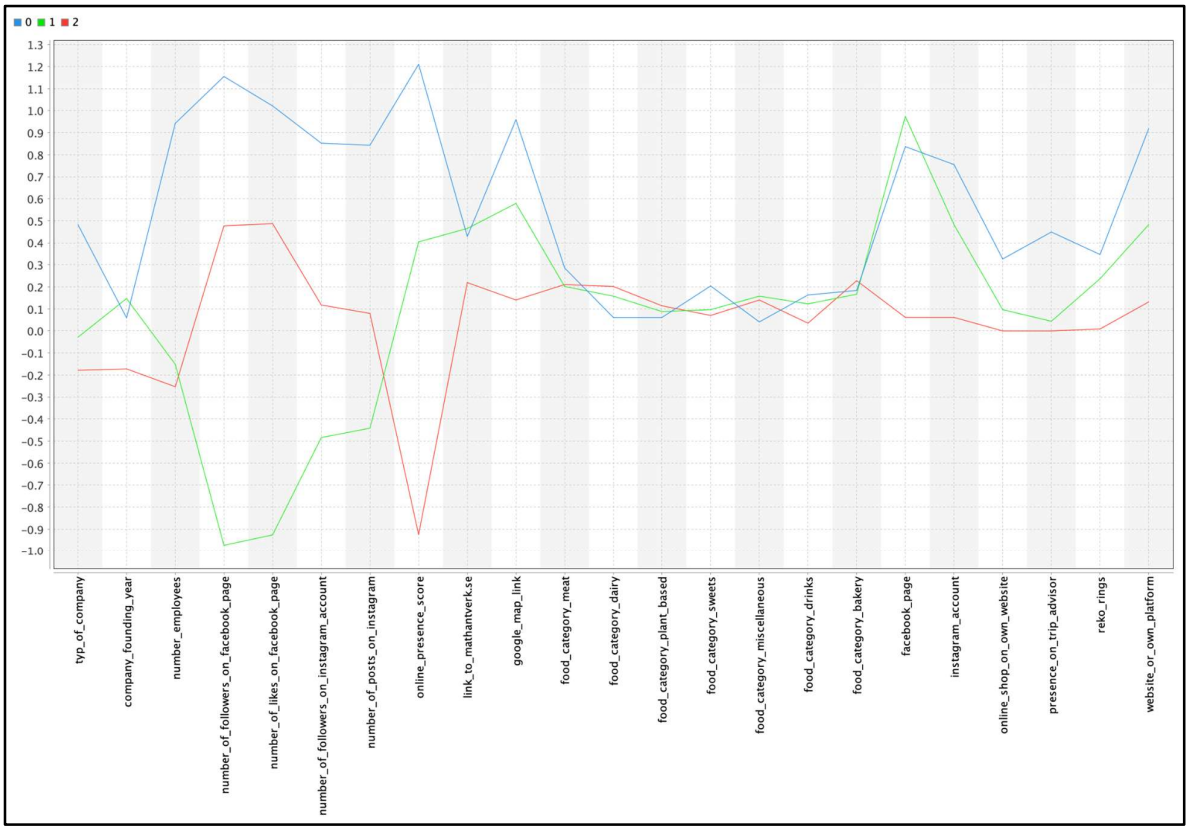

Figure 19: Visual K-means clustering results

Interpretation:

- **Cluster 0: "Digital High Performers"** - High-performing online presence with strong use of multiple platforms and high follower engagement. Typical producers: sweets, drinks, meat
- **Cluster 1: "Steady Connectors"** - Moderate online presence with acceptable platform use, but low social media engagement (few likes and followers)
- **Cluster 2: "Offline Traditionals"** - Weak online presence overall. Mostly producers of bakery and dairy goods with the lowest digital visibility

6. Preliminary Conclusion

The exploratory analysis revealed that the five most commonly used online platforms by local food producers in the Jämtland-Härjedalen region in Sweden are Facebook, Google Maps, company websites, Instagram, and Mathantverk.se, with Facebook being the most frequently adopted tool for online visibility.

Statistical tests, including the Kruskal-Wallis test and ANOVA, showed that the main product category significantly influences online presence. Producers of meat, sweets, and drinks exhibited the highest Online Presence Scores (OPS), as highlighted in the aggregated OPS visualization (Fig. 11) and confirmed by the cluster analysis (Fig. 19).

Furthermore, a positive correlation was found between company size and online presence ($p < 0.05$). T-tests and simple linear regression models consistently demonstrated that larger companies tend to have a stronger online presence. Similarly, a significant positive relationship between turnover and OPS ($p < 0.05$) was identified, suggesting that higher-performing firms in terms of revenue are also more active and visible online.

The analysis also confirmed that using multiple online platforms is positively associated with online success metrics such as followers and likes. T-tests revealed significant differences in online success between producers using only one or two platforms and those with a more diversified presence. Moreover, posting frequency was found to be a strong predictor of social media performance. ANOVA results showed that higher activity levels lead to significantly higher follower counts and engagement, emphasizing the importance of active management of social media channels.

Lastly, results from the Apriori algorithm confirmed that local food producers with their own website are significantly more likely to use additional online platforms such as Facebook and Instagram. This indicates that websites often form part of a broader multi-channel strategy, and their presence strongly correlates with a more extensive and diversified digital footprint.

The table below summarizes the verification or falsification of the proposed hypotheses based on the empirical findings.

	Hypothesis	verification/ falsification
H2(a)	The product category has an impact on the online presence of the local food producer.	✅ verified
H2(b)	The age of the company has a positive impact on the online presence of the local food producer.	❌ falsified
H2(c)	The company size, measured by the number of employees, has a positive impact on the online presence of the local food producer.	✅ verified
H2(d)	The turnover has an impact on the online presence of the local food producer.	✅ verified
H2(e)	An increasing number of online platforms used has a positive impact on online success, measured by metrics such as the number of followers, likes or engagement rates.	✅ verified
H2(f)	The activity on online platforms, such as frequent posting, has a positive impact on online success, measured by metrics such as the number of followers, likes or engagement rates.	✅ verified
H3(a)	The use of a website has a positive impact on the use of social media platforms such as Facebook and Instagram.	✅ verified
H3(b)	Companies with a Facebook page are more likely to have an Instagram account, and vice versa, compared to companies without a presence on the platforms.	❌ Falsified using association rules ✅ Verified with regressions
H3(c)	The use of REKOrings has a negative impact on the use of an own online shop.	❌ falsified

Figure 20: Overview of hypotheses with their status of empirical verification

In addition, the cluster analysis using the K-means algorithm identified three distinct groups of local food producers: “Digital High Performers,” characterized by a strong presence across multiple platforms and high engagement, typically involved in sweets, drinks, and meat; “Steady Connectors,” with moderate platform use but low follower interaction; and “Offline Traditionals,” representing producers with minimal online activity, mainly from the bakery and dairy sectors.

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