

12th IMF Statistical Forum

MEASURING THE IMPLICATIONS OF
**AI ON THE
ECONOMY**

NOVEMBER 20-21

Washington, DC



**Survey Data vs Digital Footprint:
The Impact of AI Adoption on
Firm's Performance**

NOVEMBER 21, 2024

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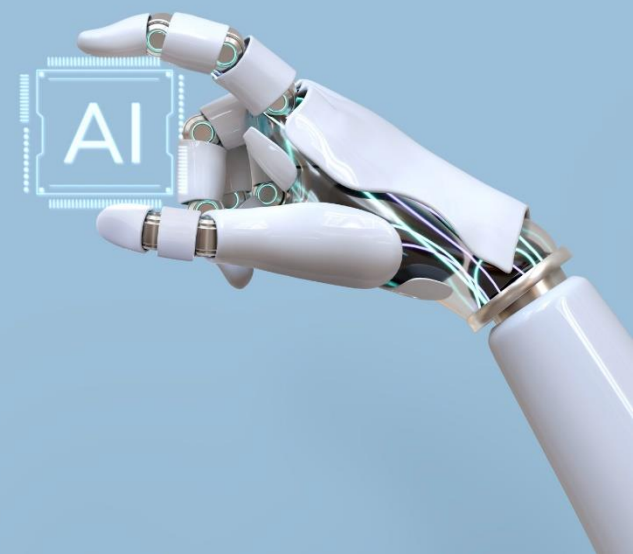
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OUTLINE

- 1 Introduction
- 2 Data
- 3 Methodology
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- 5 Conclusion



Introduction

Introduction

Background

- AI transforms a firm's business processes, demanding the quantification of its impact on firm performance
- Each sector has unique characteristics and AI's impact affects each sector differently
- National statistics needs to remain accurate and adaptable in the digital age, especially as big data becomes increasingly important

Contribution

- Provides a comprehensive analysis of AI's impact on firm-level outcomes and on the economy.
- Provides insight into which sectors experience the greatest impact of AI
- Demonstrates a new method that combines traditional and non-traditional data, as well as shows how alternative data sources can provide new insights into the implications of AI on the economy.

Data

Combining traditional and non-traditional data

Official Statistics Data

Digital Footprint

Business Characteristics Survey (BCS)

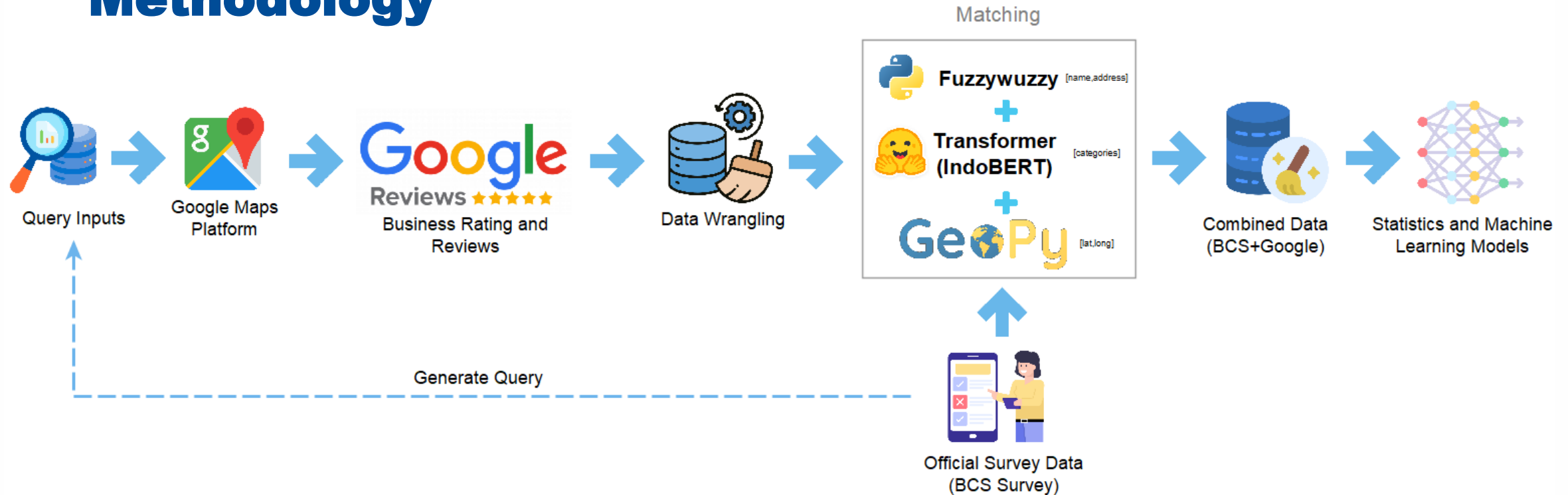
- ▶ Attributes:
 - Business characteristics and activities
 - AI adoption
 - Big Data, IoT, Advanced Robotic
 - Income

Google Places

- ▶ Attributes:
 - Average rating
 - Number of reviews
 - Details user rating
 - Details user review

Methodology

Methodology



1

Generate Query

Using business names and addresses from the BCS data as query inputs to retrieve relevant data from Google Maps

2

Google Maps Platform

Business reviews and rating data are collected using generated query

Methodology

(Continued)

Data Wrangling

The collected Google Place data is cleaned, transformed and organized

3

Google Place Index

Calculate Google Place Index by combining Google Ratings and number of reviews

4

Matching Process

Automated Probabilistic Matching:

- Name (Fuzzy)
- Categories (Transformer-Indo BERT)
- Geolocation (GeoPy)

Similarity threshold > 0.8

Manual Matching

5

Statistics and Machine Learning Models

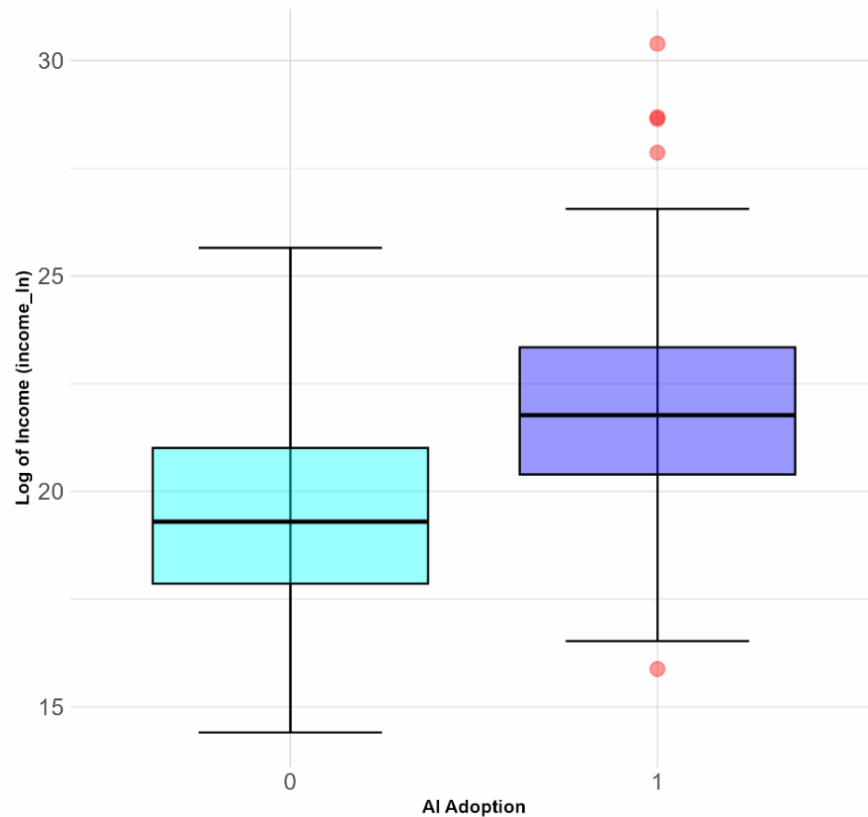
Analyzing the matched data using statistical models and machine learning techniques

6

Discussion

Firm Performance : Income

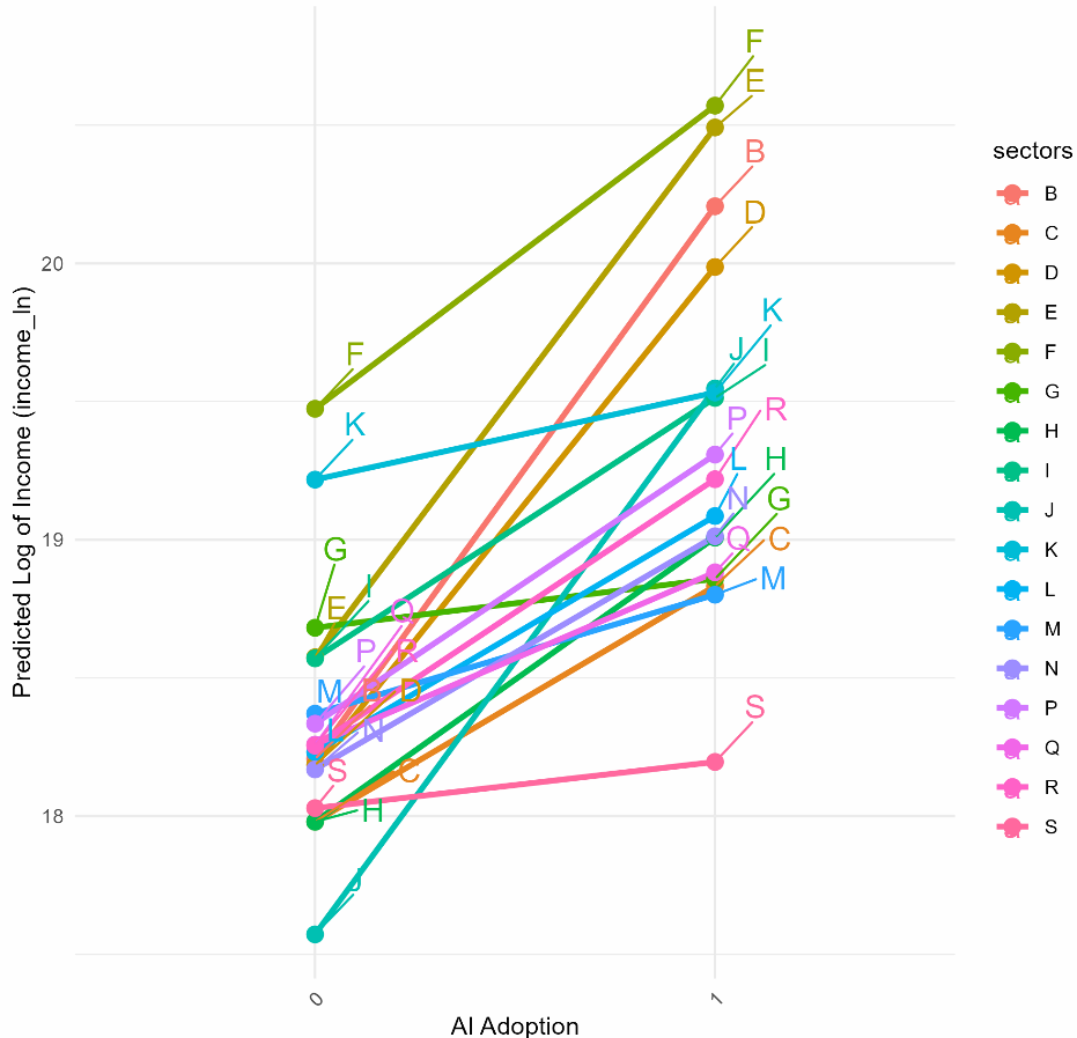
Boxplot of Income based on AI Adoption



- The adoption of AI is associated with higher income
- The implementation of IoT has a positive significant impact to income
- Firms could significantly boost sales and engage more customers by utilizing AI and maximizing its potential
- AI can streamline tasks and improve efficiency, helping to reduce costs while driving increased income

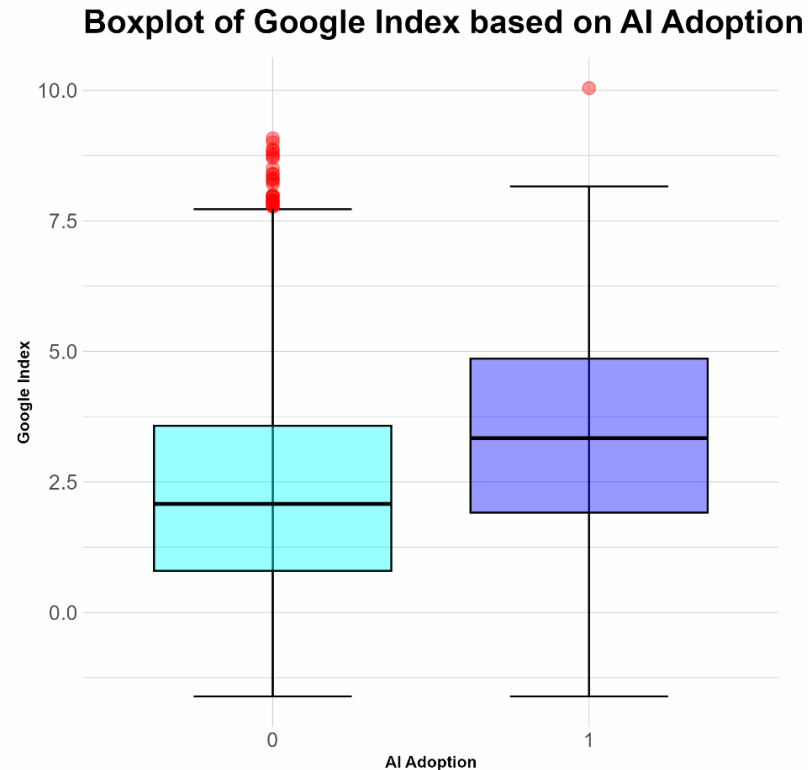
Firm Performance : Income *(Sectors Analysis)*

Interaction Effect of AI Adoption and Sectors on Log of Income



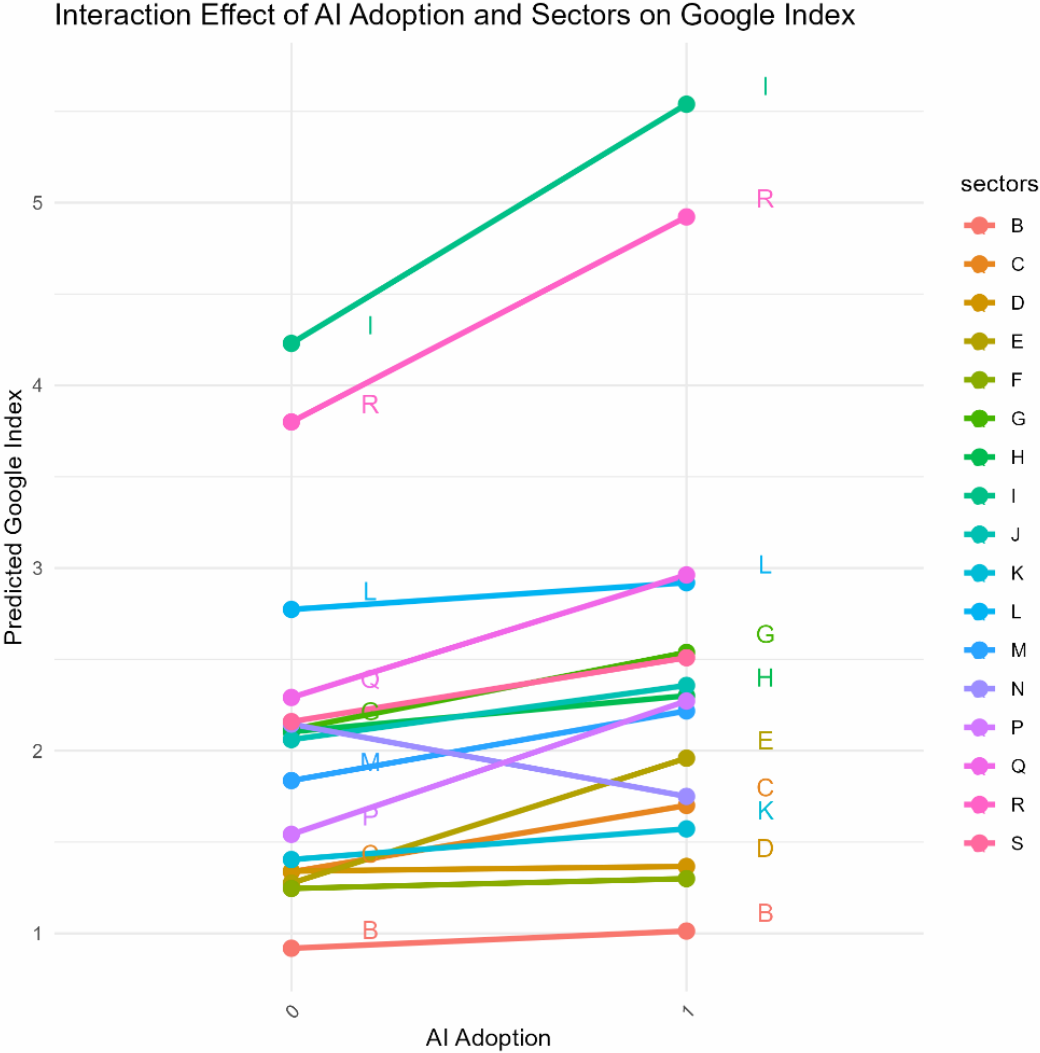
- The adoption of AI in Mining and quarrying (B) has the highest impact on income among other sectors, followed by ICT (J), Water and waste management (E), and Electricity, gas, and steam (D)
- AI enables Sector Mining and quarrying to increase efficient productivity (e.g. process automation, optimize the extraction process, and enhanced resource management)
- AI enables ICT firms to innovate faster, optimize networks, and deliver personalized services, directly enhancing productivity and revenue.

Firm Performance: Google Place Index



- The adoption of AI has a positive significant impact on Google Place Index
- The implementation of IoT also has positive significant impact to Google Place Index
- Other users' experiences which are reflected in ratings and reviews often impact potential customers to decide whether they want to use/purchase the business product or not.

Firm Performance: Google Place Index (Sectors Analysis)



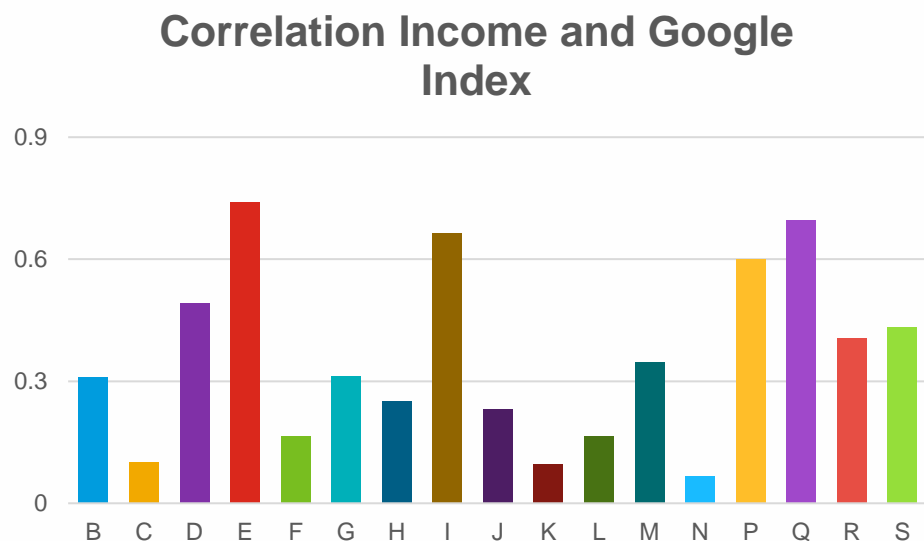
- Not all sectors' performance are represented by Google rating and review
- Firms that depend on customer trust and satisfaction are particularly considerate of the impact of Google ratings and reviews representing other consumer opinions.
- (I) Accommodation and food service businesses and (R) Arts, entertainment, and recreation are heavily influenced by customer feedback and AI adoption has a higher impact among other sectors

Statistics Methods and Machine Learning Methods

Method	Income			Google Review Index		
	RMSE	R-Square	MAE	RMSE	R-Square	MAE
<u>Statistical Methods</u>						
Parametric Regression	1.61	0.50	1.29	1.553	0.378	1.236
<u>Machine Learning</u>						
KNN Regression	1.56	0.53	1.23	1.595	0.384	1.285
Random Forest Regression	1.53	0.54	1.20	1.565	0.407	1.251
XGBoost Regression	1.53	0.54	1.20	1.561	0.410	1.256
SVR	1.52	0.55	1.19	1.559	0.411	1.245

- To check the robustness of the result
- The output of Bayesian Linear Regression is in line with that of Frequentist Linear Regression
- Output of SVR shows the highest accuracy than other methods

Income and Google Place Index



- Google Place Index can be an alternative data source for measuring firm performance in some sectors. It offers timely data and is robust to shocks.
- Sectors (I) Accommodation and food service activities (e.g. hotel and restaurant), (Q) Human health, and social work activities (e.g. hospital and clinic) are highly correlated with Google Rating and Review to income.
- A company with higher ratings and reviews on Google Place is more likely to draw in more clients, which potentially leads to higher revenue

Conclusion

- The adoption of AI technologies significantly affects business performance through higher income, rating, and review.
- Each sector has its opportunities, risks, and challenges for adopting AI.
- Rating and review from Google Place is proposed for a proxy as firm performance which offers timely data and robustness to shocks although it does not apply to all sectors
- Future research:
 - ▶ Collect and compare various platforms, not only Google Places
 - ▶ Analyze user reviews using sentiment analysis or LLMs

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Thank You

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