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Factors affecting card payment levels in Germany: Longitudinal research

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Abstract

This study aimed to examine the role of macroeconomic indicators on card payments in Germany. The study utilized the parameters of the data provided for Germany by the World Bank Country Reports between 2000 and 2023, as well as the total card payments data from the ECB Data portal. According to the results obtained in the study, both GDP, price index and GINI coefficients positively and significantly affected card payments. Bank loans and production value added, on the other hand, had a decreasing effect on payments. Multivariate analysis revealed a positive relationship between GDP and card payments only. Although many variables may influence these results, the reflection of economic activities is generally significant. According to the results obtained, although the effect of all macroeconomic indicators is statistically significant in the univariate dimension, only GDP was found to have a positive and substantial contribution to card payments in the multivariate analysis.

Keywords: Card payment, banking, Germany, cashless society.

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1. Introduction

The increasing prevalence of digital currencies and advancements in payment methods and opportunities are transforming many habits in today's economic landscape [1-4]. Payment methods, which are common topics of behavioral finance and classical finance, are also an essential issue in terms of communication between financial intermediaries and depositors or users of economic systems. For this reason, the preferences of individuals and companies for payment methods play a decisive role in many areas, from the flow of value in the economy to societal trends and the general tendencies of the banking system [1,5,6].

The preferences of individuals and institutions for payment methods are also a part of cashless society studies today, and the use of physical money is gradually decreasing to much lesser levels [7-9]. It is possible to replace this with cards, digitally, codes, phone applications, or other new methods [10,11]. Banks and financial intermediary institutions are continually developing new payment methods, integrating them into banking and financial payment systems, while also conducting new studies to ensure the security of these methods [10, 12]. Among all these payment methods, the one that can be associated with the cashless society, while also accommodating traditional depositors, is arguably more reliable than other digital methods [13-15].

Payment by card generally refers to the delivery of payments to the recipient via a card using the card information. However, payment by card is not just a physical withdrawal of that card using a POS device or a similar device. Payments by card can also be made digitally using the card number and other relevant details. Throughout this entire process, the card can be considered a vital information tool that contains details about the payment and account of both consumers and those sending money.

The most significant advantage of card payment over traditional payment methods is physical security, allowing for the integration of all the modern banking and financial intermediation benefits associated with a cashless society into the economic system. Physical payments with money both have technical obstacles and include serious criminal risks. Additionally, it is not possible for money to adapt to the movement within today's global financial systems. It also has global service quality with easy payment [16]. On the other hand, sufficient security has not yet been provided in payments through digital channels, and especially events occurring in virtual environments bring security problems related to digital channels to the forefront. For this reason, card payments are a significant payment type and alternative in the transition to a cashless society.

In every economic system, payments are also indicators of trade. For a value flow to occur, there must be a transaction that will cause that value flow [17-19]. In this respect, every payment shows an economic and commercial activity in a sense. Therefore, to understand and manage the trend and change of a payment method over time, analyzing the reflections of that method on macroeconomic indicators can provide meaningful and valuable insights.

The relationship between macroeconomic indicators and payments can also provide helpful insights into the transactions and activities of financial intermediaries. Germany is a significant country in terms of payment methods and trends towards the cashless society theory, as well as its strong economic ties with the rest of the world. Germany is one of the essential commercial and economic actors of both the European Union and the world. Germany also has a significant history in terms of card usage, financial intermediaries, and global trade, which will be subject to card payments. Germany can be analyzed as an important example in terms of the relationship between card payment and macroeconomic indicators for these reasons. Although there are various methods of card payment via POS devices, mail order, or virtual POS by entering card information, it is essential to reveal which economic and financial variables affect card payments, to encourage card payments, and manage macroeconomic variables. Although various studies have been conducted on card payments, there has been insufficient research on the macroeconomic variables in Germany that affect card payments and how, and in what direction, card payments have changed over time. Therefore, this study aimed to examine the role of macroeconomic indicators on card payments in Germany.

2. Methods

2.1 Research Model

The research was designed using a mixed-methods approach, incorporating both a descriptive screening model and a relational screening model. Accordingly, Germany's card payment and macroeconomic indicators were first selected and defined according to the descriptive screening model. Then, the effects of macroeconomic indicators on payment by bank card were analyzed with the relational screening model.

2.2 Data Set

The research utilized data from the World Bank Country Reports for Germany, covering the period from 2000 to 2023, and total card payments data provided by the ECB Data Portal. The dependent and independent variables of the research were as follows:

- *Independent Variable:*

Total Card Payment: TCP-ECB Data Portal
Total value of card payment, All, sent - SCA: , issuer location: Germany, POS location: world.

- *Independent variables:*

Inflation-CPI: Consumer price index (2010 = 100)
GDP: GDP per capita, PPP (current international $)
GINI: Gini index
Bank credits-BCR: Domestic credit to private sector by banks (% of GDP)
Production-MVA: Manufacturing, value added (% of GDP)
Unemployment-UNEMP: Unemployment, total (% of total labor force) (national estimate).

2.3 Statistical Methods

Mean, standard deviation, median, and change ranges were used to describe the data. A longitudinal time-based analysis was performed to examine the changes in data over time. The Kolmogorov-Smirnov test was performed to analyze the suitability of the data for a standard normal distribution. In relational screening analyses, Pearson's moment correlation analysis was performed to assess correlation. Generalized Linear Model (Logit) analysis was performed to minimize linearization deviations [20,21]. All analyses were performed using SPSS 25.0 for Windows, with a 95% confidence interval and a significance level of 0.05.

3. Results

The mean credit card payment value was 236.295,677 ± 117.314,453, with a range of 109.661,000 to 541.647,835. The GDP mean was 44,861,579 ± 12,743,393, the CPI mean was 103,130 ± 11,806, and the GINI mean was 30,881 ± 0.863 for Germany during the 2000-2023 time period. Bank credit rates ranged from 75,663% to 111,240% of GDP with 88,774±12,519 mean value. The MVA mean was 19,609±0.786 and the unemployment mean was 6,319±2,647 for Germany during the 2000-2023 time period (Table 1).

Table 1: Baseline characteristics of card payments and macroeconomic indicators

	Mean±SD	**Median (Min-Max)**
TCP (current international $)	236.295,677±117.314,453	192.579,000 (109.661,000-541.647,835)
GDP	44.861,579±12.743,393	43813,869 (27467,782-69205,883)
CPI (2010 = 100)	103,130±11,806	103,100 (85,699-131,892)
GINI (current international $)	30,881±0,863	31,000 (28,900-32,400)
BCR % of GDP	88,774±12,519	82,949 (75,663-111,240)
MVA % of GDP	19,609±0,786	19,779 (17,353-20,530)
UNEMP % of total labor force	6,319±2,647	5,669 (3,068-11,193)

TCP: Total value of card payment, GDP: Gross Domestic Product, CPI: Consumer Price Index, GINI: Gini coefficient, BCR: Bank credits, MVA: Manufacturing value added, UNEMP: Unemployment.

Although there were some changes in the trend in 2006, the general trend in card payments in Germany continued to show an increasing trend (Figure 1).

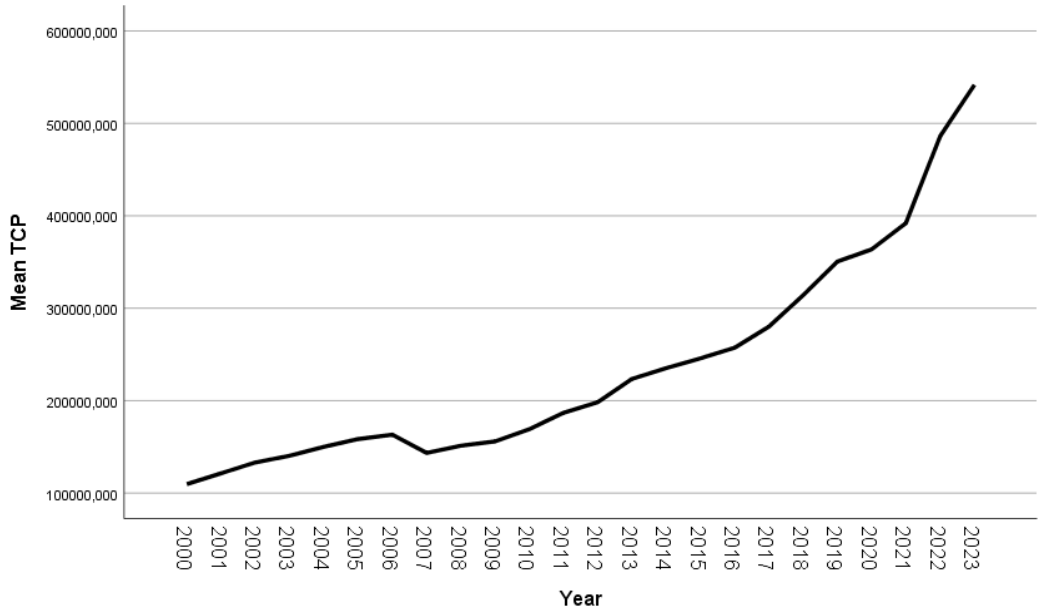

Figure 1: Card payment changes from 2000 to 2023 in Germany

Pearson's moments correlation analysis results showed that total card payments were significantly and positively correlated with GDP ($r = 0.958$; $p < 0.01$), the consumer price index ($r = 0.959$; $p < 0.01$), and the GINI coefficient ($r = 0.796$; $p < 0.01$). On the other hand, total card payments were significantly and negatively correlated with bank credits ($r = -0.677$; $p < 0.01$), manufacturing value added ($r = -0.490$; $p < 0.01$), and unemployment ($r = -0.797$; $p < 0.01$) (Table 2).

Table 2: Correlation analysis between credit card payment and macroeconomic indicators

TCP	r	p
GDP	0.958**	0.000
CPI	0.959**	0.000
GINI	0.796**	0.000
BCR	-0.677**	0.000
MVA	-0.490**	0.015
UNEMP	-0.797**	0.000

**p<0.01, TCP: Total value of card payment, GDP: Gross Domestic Product, CPI: Consumer Price Index, GINI: Gini coefficient, BCR: Bank credits, MVA: Manufacturing value added, UNEMP: Unemployment.

Since all parameters showed a significant correlation with card payments, they were all included in the regression model. Due to minimizing deviations [20,21], the Logit model was used for regression. The research model is given below:

$$TCP = \beta 0 + \beta 1.CPI + \beta 2.GDP + \beta 3.GINI + \beta 4.BCR + \beta 5.MVA + \beta 6.UNEMP$$

According to the logit model, only the effect of GDP on card payment was significant at the multivariate level (B=14,513; $p<0.01$), the impact of other macroeconomic indicators was statistically insignificant ($p>0.05$) (Table 3).

Table 3: Generalized Linear Model (Logit) for effects of macroeconomic indicators on card payment in Germany

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test		
			Lower	Upper	Wald X2	df	p
(Intercept)	65553,908	605743,0893	-1121680,731	1252788,547	0,012	1	0,914
GDP	14,513	2,6831	9,254	19,772	29,256	1	0,000
CPI	-7457,606	5579,9360	-18394,079	3478,868	1,786	1	0,181
GINI	9020,614	8265,5075	-7179,483	25220,711	1,191	1	0,275
BCR	1151,217	1613,5211	-2011,226	4313,661	0,509	1	0,476
MVA	-5996,432	7726,7877	-21140,658	9147,793	0,602	1	0,438
UNEMP	1781,060	3082,1593	-4259,861	7821,981	0,334	1	0,563
(Scale)	114932950,593	36344990,2079	61840215,416	213608297,503			

TCP: Total value of card payment, GDP: Gross Domestic Product, CPI: Consumer Price Index, GINI: Gini coefficient, BCR: Bank credits, MVA: Manufacturing value added, UNEMP: Unemployment.

In general, the positive effect of GDP on card payments was observed in Germany for the 2000-2023 period. Only three breaking points with insignificant changes were found at 34.748, 754, 37554, 443, and 59270, 728 GDP points (Figure 2).

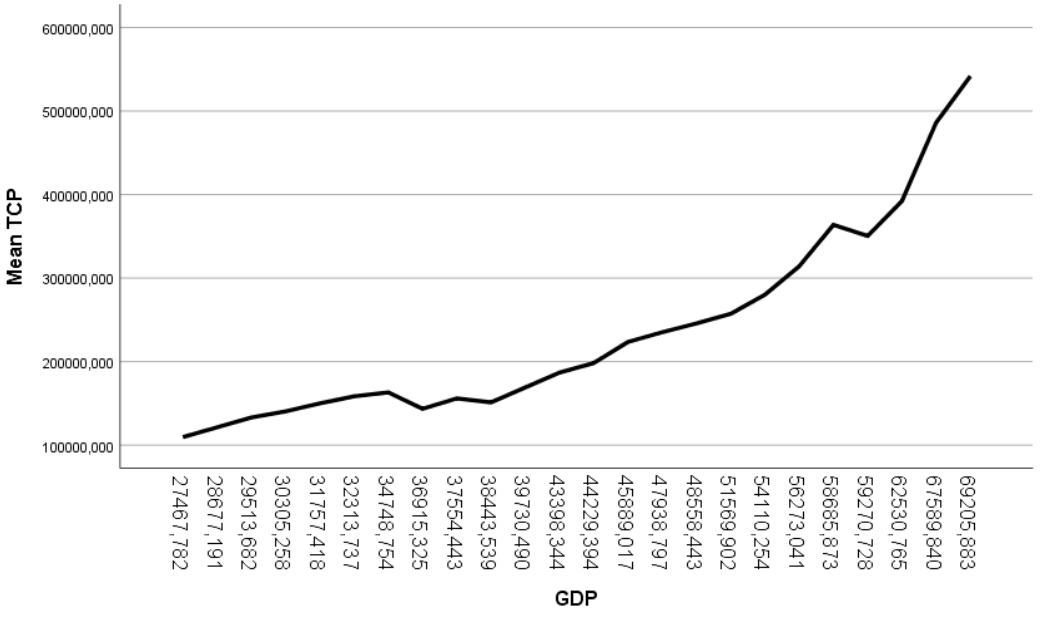

Figure 2: Change in GDP and card payments for Germany for the 2000-2023 time period

4. Discussion

In this study, the relationship between card payment values and macroeconomic indicators in Germany was examined, and data from 2000 to 2023 were analyzed in this context. According to the results obtained, although the effect of all macroeconomic indicators in the univariate dimension was statistically significant, only GDP made a positive and significant contribution to card payments in the multivariate analysis.

In today's world, where various payment methods are continually evolving and new alternatives are emerging, the banking sector must understand both the behavior of payments and the factors related to them [22-28]. In this context, card payments can be described as a prominent payment method, as they involve relatively fewer trust issues in digital payment channels and are less prone to difficulties in physical payments. Since every payment is also an economic value flow, payment methods can serve as a good indicator for understanding economic activities, financial systems, and the economic cycle [29,30]. For this reason, macroeconomic indicators affecting card payment values, which are relatively more preferable than alternative payment methods, were selected as the subject of this research.

Studies in the literature on the effects of macroeconomic indicators on payments are quite limited [31-33]. It is both an economic and a border issue of countries [34]. In general, studies on card payments primarily base consumers' payment habits on behavioral finance, aiming to establish a relationship between consumer preferences and their behavior. On the other hand, although card payment preference is a subject of behavioral finance, behavioral reasons for preference only include internal factors, and external factors should also be considered in addition to these variables. In addition, it is possible to state that macroeconomic indicators have an effect on behavioral finance and consumer behavior, as well as external factors.

Selecting macroeconomic indicators that are likely to affect purchasing and payment balances and are most emphasized in the literature was chosen. These were also selected as indicators that are related to consumption, marketing, and purchasing, in other words, as indicators that determine activities that may result in payment. Therefore, GDP, which represents the general income level, CPI, an indicator of purchasing power, unemployment, loans, and production values were selected as fundamental indicators in the research. However, more comprehensive research can be designed with more specific values and indicators.

According to the results obtained in the study, both GDP, the price index, and the GINI coefficient positively and significantly affected card payments. Bank loans and production value added, on the other hand, affected payments in a decreasing way. Multivariate analysis revealed a positive relationship between GDP and card payments. Although many variables may influence these results, the reflection of economic activities in general is significant. Although this is the expected result, the negative relationship with high value added that emerged in univariate analyses may also indicate a change in the direction of cash flows originating from investments or savings. Further research is needed to respond more effectively to all these possibilities.

- *Limitations of the Study*

The most significant limitation of the study is that comprehensive and detailed data on other payment methods were not available. Although Germany's domestic banking and data systems share data on this issue, studies conducted on general, proven, and independently audited data providers such as the World Bank or the Central Bank are pretty limited. This situation also emerges as a significant limitation in the study.

Another significant limitation of the study is that it does not include variables related to internal preference reasons related to behavioral finance and preferences. The study only focuses on external factors, and there is not enough information about which payment method is preferred to what extent and for what reason. Therefore, it would be beneficial to conduct further research on both internal and external preference reasons.

- *Contributions of the research to literature and field applications*

The most significant contribution of the research to the literature is that it is among the pioneering studies in its field, examining card shopping through a macroeconomic model. In this respect, the research provides a perspective on behavioral finance and payment methods about external variables. Additionally, it offers an opportunity to analyze payment methods and the transition to a cashless society from a different perspective.

The contribution of the research to field applications is that financial intermediaries can have a limited ability to predict how much non-card payments will be in which periods by using single-variable analysis methods. Especially in the banking sector, it is possible to evaluate and manage macroeconomic indicators to determine payment methods and present them to consumers.

5. Conclusion

According to the research results, payments made by card are generally correlated with GDP and exhibit a positive relationship. This situation demonstrates that the dynamics of economic activities and their impact on the field have a similar effect on consumers' card payment habits. The results of the univariate correlation analysis show that value-added production and credits have a decreasing effect on card payment rates. This situation shows the impact of cash flow and liquidity problems on card payments. However, when all the results are evaluated in general, card payment comes to the forefront as an essential payment alternative and preference in successful economic systems.

More comprehensive and cross-sectional studies can be conducted that incorporate both internal data and external data used in the study to gain a better understanding of preferences in payment methods. The research results can be expanded to Germany by considering other payment methods and macroeconomic indicators. The research model can be replicated for different countries outside Germany, and the results from various countries can be compared in future studies. With the results obtained, new strategies can be developed for financial intermediaries, particularly banks, in terms of payment method planning and use in the context of competition.

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