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MIDWESTERN BUSINESS AND ECONOMIC REVIEW

MBER is the official journal of the Bureau of Business and Government Research within the Dillard College of Business Administration. It was founded in 1983 and worked towards publishing original empirical and theoretical research on business-related topics like economics, finance, management, accounting, marketing, and management information systems.

After a brief hiatus in its functionality from summer 2021 to summer 2023, the journal got redesigned in Fall 2023 to become an official outlet for **original undergraduate research** on any business-related topic. The journal also welcomes original faculty-led research, with the first author always being an undergraduate student. The manuscript review process follows the usual double-blind peer review procedure and aims to keep the total turnaround time of three months (from the first submission to final acceptance). The journal is indexed in Cabell's International and aspires to publish one issue every academic year, that is, during the summer months.

At the time of submission, the journal requires the original work not to be under consideration by any other journal or publication outlet. Papers published will present the points of view of the authors only and do not reflect those of the Bureau of Business and Government Research, the Dillard College of Business Administration, or Midwestern State University. The author assumes responsibility for the authenticity and accuracy of facts published in each article.

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ETHICS COMMITTEES AND CORRUPTION: DO ETHICS COMMITTEES REDUCE CORRUPTION CASES WITHIN STATE LEGISLATURES?

David Alexander Tooley
Mavuto Kalulu

ABSTRACT

In general, ethics committees are self-regulating, self-governing bodies that formulate and recommend legislative standards and conduct for senators, house members, and legislative employees. These committees are often formed in response to corruption scandals, which has led to the perception that legislators address corruption only when it becomes publicly exposed. Moreover, the self-policing structure of these committees has raised concerns about the ability of legislators to effectively oversee their own conduct. This study seeks to empirically assess the impact of ethics committees on corruption in state legislatures using a panel of all 50 U.S. states. The dependent variable, corruption, is measured as the percentage of convicted legislators in the legislature, while the independent variable, ethics committee, is a categorical variable indicating whether or not a state legislature has an ethics committee. The results indicate no significant evidence that the presence of ethics committees reduces corruption compared to states without such committees. These findings suggest that legislative ethics committees are not an effective mechanism for mitigating corruption in state legislatures.

Keywords: *Ethics committees, corruption, causes of corruption, effects of corruption, anti-corruption policies*

INTRODUCTION

A substantial amount of research reveals that public corruption is detrimental to economic development (Drury, Kreikhaus, and Lusztig, 2006; Kaufmann 2000; Mauro and Driscoll, 1997; Wei and Kaufman 1998). In light of the negative economic consequences associated with corruption, policymakers have grappled with the problem of corruption for centuries, seeking to understand what causes it and devising appropriate remedies to mitigate its existence (Bardhan, 2017).

While public corruption exists at all levels of government, research on corruption at lower levels of government is sparse (François, A., & Méon, P.

G., 2021). We argue that studying corruption within the legislative branch is just as important as studying corruption in the broader context. Dincer and Johnson (2018) conducted a survey of reporters covering state politics over a five-year period from 2014-2018 and found that state legislatures were perceived to be more corrupt than other branches of government. This branch of government is responsible for creating laws that directly impact the daily lives of residents. Therefore, addressing corruption within state legislatures is crucial for improving the quality of life for residents. However, there is a lack of empirical research on state-level legislative corruption, which may be attributed to the absence of specific corruption data related to state legislatures. The FBI's state-level corruption data is aggregated and does not provide information on the number of corrupt legislators by state. This paper aims to delve deeper into state-level legislative corruption and assess the effectiveness of mechanisms aimed at combating corruption within state legislatures. We compile our own data on the number of corrupt state legislators using various sources. Wikipedia serves as a sufficient starting point. Its lists on corruption scandals are by far the most organized and comprehensive. Due to the public nature and reputation of Wikipedia, we found it necessary to validate each list using newspaper articles and, in a few cases, email responses from state legislative officials.

We specifically focus on the effectiveness of ethics committees in state legislatures as a mechanism for curbing legislative corruption. State legislators, like other economic agents, seek to maximize their expected benefits. They are, therefore, prone to advancing bad laws if doing so maximizes their expected benefits. We define a bad law as one that, while enhancing the benefits for a targeted group, lowers societal wellbeing. Bad laws enacted by state legislatures can directly or indirectly impact the economic and socio-economic well-being of residents. Oversight of the legislature is, therefore, very important to ensure that the decision-making process is void of corruption. A corrupt legislature erodes public trust in the legislative process leading to diminished participation in residents and in certain extreme cases leading to political unrest (Morris & Klesner, 2010; Neshkova & Kalesnikaite, 2019). The creation of legislative ethics committees is viewed as a way of curbing corruption in the legislature. Unsurprisingly, these committees are the go-to response when legislative corruption scandals occur. For example, in 2018, Arkansas created a Senate ethics committee in response to the indictment of multiple lawmakers for their abuse of the General Improvement Fund (Wickline, 2018).

While large corruption scandals can be catalysts for ethics reforms, including the establishment of ethics committees, many are often skeptical about their effectiveness in curbing corruption for two reasons. First, the reactive nature of their formation fosters the perception that legislators

address corruption only when exposed by scandal. Second, the self-policing structure of these committees raises concerns about the ability of legislators to effectively monitor and discipline their behavior. (National Council of State Legislatures, 2024; Caputo and Quadri, 2025). This study aims to empirically assess the effectiveness of ethics committees in reducing corruption within state legislatures.

Crider and Milyo (2013) addressed a similar research question, but their focus was on the effect of ethics commissions on statewide corruption. These ethics commissions differ from ethics committees as they are often external, quasi-independent bodies that have greater oversight than legislative ethics committees. Our study focuses solely on legislative corruption within ethics committees rather than commissions. Crider and Milyo (2013) concluded that ethics commissions are not effective in curbing statewide corruption. An additional reason to focus on legislative corruption is that some of the state ethics commissions are limited in terms of their oversight of state legislatures.

Ethics committees vary from state to state, yet they are all consistent in the fact that they are bipartisan. They are self-regulating and self-appointing and apply either to the House, Senate, or both (National Conference of State Legislatures, 2023). Ethics committees can be standing, or ad hoc in nature. Ethics committees differ the most in their nomination process. For example, Alabama's Senate ethics committee nominates its members by allowing senators to submit a list of five senators they wish to see on the committee. The five senators that received the most votes serve on the committee. On the other hand, Delaware's House ethics committee allows the speaker to appoint three members while the minority leader appoints two. Appointees from all ethics committees serve for a specified term (usually lasting 2 to 4 years), for the entirety of their time in office, or for an unspecified amount of time. The responsibilities differ slightly from committee to committee, yet the overwhelming majority list receiving and investigating complaints as their primary responsibility. For our purposes, we only focus on the existence of legislative ethics committees and not the nature of the committees.

LITERATURE REVIEW

Corruption studies can be categorized in various ways. For our purposes, we discuss two broad categories. One category of research examines the effects of corruption, while the other explores its underlying causes. In terms of empirical studies, the former category considers corruption as an independent variable, while the latter considers it as a dependent variable. We provide brief literature reviews for both categories.

EFFECTS AND CAUSES OF CORRUPTION

Policymakers and society at large have grappled with corruption for centuries due to its profoundly detrimental impact on societal well-being. However, there is some research that suggests corruption may actually be beneficial. This is often referred to as the "grease the wheel hypothesis," which suggests that individuals and businesses pay bribes to public officials to expedite government processes. Researchers such as Acemoglu & Verdier (1998), Huntington (1968), and Leff (1994) argue that corruption can improve efficiencies by allowing individuals and businesses to bypass cumbersome bureaucratic processes. The "grease the wheel hypothesis" is supported by empirical evidence from studies by Dreher & Gassebner (2013), Meon & Weill (2010); Mendoza et al. (2015), and Bologna & Ross (2015), which point to underlying issues with failed institutions.

Despite research supporting the "grease the wheel" hypothesis, there is a larger body of evidence leaning towards the "sand the wheel hypothesis," which suggests a negative correlation between corruption and desirable economic indicators, disproportionately affecting economically disadvantaged groups (Mungiu-Pippidi, 2015; Rose -Ackerman & Palifka, 2016). Ugur (2014) conducted a meta-analysis on the direct effects of corruption on per-capita income growth and found a negative effect of corruption on per-capita GDP growth. Specific studies, such as Tanzi & Davoodi (2001), and Aidit (2009) have also found a negative relationship between corruption and economic growth.

In addition to its direct effect on economic growth, research has shown that corruption contributes to bureaucratic inefficiency (Kaufman & Wei, 1999; Ahlin & Bose, 2007), and income inequality and poverty (Gupta et al., 2002; Andres & Ramlogan-Dobson, 2011). Corruption also negatively affects the business and local investment climate (Tanzi & Davoodi, 1998; De la Croix & Delavallade, 2009) and undermines political legitimacy (Anderson & Tverdova, 2003; Gilley, 2006).

To mitigate the effects of corruption on society, understanding its causes is crucial. Research has explored various causes of corruption, including excessive government regulation (Goel & Nelson, 2010), lack of economic freedom (Paldam, 2002), illiteracy (Glaeser & Saks, 2006), and lack of transparency (Brunetti & Weder, 2003). Studies focusing on corruption treat it as response variable. For example, Castro & Lopez (2023) examined e-government as a tool for controlling public corruption and found a negative effect on corruption. Other factors studied include accountability (Laderman, Loayza & Soares, 2005); economic freedom (Shen & Williamson, 2005) and democracy (Bhattacharyya & Holder, 2010). Our study falls into this category of corruption research exploring whether the presence of legislative

ethics reduces corruption, akin to examining whether its absence causes corruption.

ANTI-CORRUPTION POLICY PRESCRIPTION

Hanna et al. (2011) conducted a systematic review of anti-corruption policies. The policies can be divided into two categories: "monitoring and incentive programs" and "programs that change the underlying rules." The former aims to impose a cost on perpetrators to discourage them from engaging in corrupt activities while the latter focuses on changing the rules of conducting business. Hanna et al. (2011) found that monitoring and incentive programs have varying levels of success. They are effective when voters can punish perpetrators through elections (Reinikka & Svensson, 2003; Ferraz & Finan, 2008). The establishment of legislative ethics committees fall in the monitoring and incentives category. The self-policing nature of legislative ethics committees causes some to doubt their effectiveness.

In a study similar to ours, Crider and Milyo (2013), examined the relationship between ethics commissions and corruption. These ethics commissions differ from ethics committees as they are often external, quasi-independent bodies, whereas ethics committees apply to the legislature only. The responsibilities of both ethics commissions and committees are very similar and include suggesting legislation, hearing complaints, and issuing advisory opinions, all in an effort to reduce corruption.

Crider and Milyo (2013) used a multivariate regression analysis in their study. They found that public corruption rates among state and local government officials are not highly correlated with the presence of a state ethics commission. They conclude that ethics commissions are not effective in reducing corruption. Our study acknowledges that in some states ethics commissions have limited or no jurisdiction over state legislators and their staff (National Conference of State Legislatures, 2024). Our study specifically focuses on legislative oversight within ethics committees. Studying these ethics committees adds value to the understanding of anti-corruption mechanisms. Additionally, the self-policing nature of ethics committees allows us to examine an entity that is structured differently from ethics commissions.

DATA AND METHODS

Our dependent variable is the percentage of convicted state legislators in both the House and the Senate. To compile this data, we relied on information obtained from Wikipedia and verified the accuracy using newspaper articles provided as sources. We acknowledge that the information provided may be incomplete, which can exacerbate an already

existing problem with corruption data. Corruption, by its nature, is secretive, so the absence of any corruption data in some states could be due to two different processes. Zeros in our data could indicate that the state legislature genuinely has no corrupt lawmakers or they may be generated from missing data due to non-reporting.

Another issue with corruption data is the lag between when corruption occurs and when culprits are convicted. Instead of examining annual data, our analysis focuses on decade-long cases. We anticipate that within a ten-year period, corruption cases may have been resolved. A 2024 Report to the Nations estimates that, on average, it takes about 13 months before perpetrators of corruption are caught (Association of Certified Fraud Examiners, 2024). The legal process itself can be lengthy, with corruption cases in 2023 requiring about 3 years to be completed (Transactional Records Access Clearinghouse, 2024). Additionally, charges may not be brought up immediately due to the statute of limitations, which allows prosecutors to bring charges at a later date before limitations expire. This does not completely eliminate the issue when a case spans two different decades, as corruption towards the end a decade can spill over into the next. However, examining decade-level corruption helps minimize the effects of zeros from the two different processes discussed above. From the descriptive statistics table (Table 1), we can see that the mean of legislative corruption is 0.011, ranging from 0 to 0.1. This means that the percentage of convicted lawmakers ranges from 0 to 10 percent.

Table 1: Descriptive statistics

	Mean	Std. dev.	Min	Max
Legislative corruption	0.011	0.016	0.000	0.100
Ethics Committee (dummy)	0.527	0.501	0.000	1.000
Log of median household income	11.192	0.165	10.814	11.417
Education (proportion with bachelors or higher)	0.303	0.059	0.171	0.470
Log of population	15.170	1.016	13.158	17.483
Term Limits	0.320	0.468	0.000	1.000
Minorities (proportion of population)	0.257	0.150	0.031	0.771
Full time legislature	0.200	0.401	0.000	1.000
Hybrid legislature	0.520	0.501	0.000	1.000
Part time legislature	0.280	0.451	0.000	1.000
Legislative democratic control	0360	0.482	0.000	1.000
Legislative republican control	0.490	0.502	0.000	1.000
Divided legislative control	0.150	0.358	0.000	1.000

N=150 expect for legislative control variables because Nebraska has a unicameral legislature.

The key explanatory variable for our analysis is the dummy variable "ethics committee," which indicates whether a state legislature has an ethics committee in the House and/or in the Senate. This variable was created using data from various sources including the 2007 OLR Research Report by Norman-Eady and Sullivan. The report compiles the names and nature of ethics committees that existed in state legislatures before 2007. We supplemented this information by searching state legislatures, making phone calls, and sending emails. In cases where we did not receive a response, we assumed that the status quo remained for subsequent years. Additionally, we used information from the National Conference of State Legislatures and Ballotpedia to fill in missing data. For our analysis, we do not differentiate corruption by chamber. So, our ethics committee variable indicates whether a committee exists in any chamber.

Our control variables include those typically included in corruption regressions, such as median household income, population, education level, median age, term limits (whether legislators are term-limited), percentage of minorities, and type of legislature (full-time, part-time, or hybrid).

DATA ANALYSIS

Ideally, we would analyze the effects of ethics committees before and after treatment. However, due to the lack of sufficient pre-treatment data, we cannot conduct the analysis using a pre-treatment comparison. Instead, we have three data points for each of the 50 states, representing the periods 2000-2009, 2010-2019, and 2020-2023, creating a panel dataset across these time periods. Our analysis leverages the panel structure of the data, providing more depth compared to cross-sectional data.

In addition to utilizing the panel structure of the data, there are a couple of issues that need to be considered when deciding on the estimation technique for our study. First, our dependent variable is a proportion ranging from 0 to 1. Researchers like Papke and Wooldridge (2008) argue that regular linear estimation techniques are not suitable when the dependent variable is restricted between 0 and 1. They suggest using fractional response models to estimate relationships where the dependent variable is restricted between 0 and 1. For example, in their study on spending and student performance, the dependent variable, student performance, is measured as a rate and bound between 0 and 1.

Our estimation technique incorporates the panel nature of our data and the 0-1 restriction of the dependent variable, corruption rate. We use a fractional response model and account for the unobservable effects by using the correlated random effects (CRE). According to Wooldridge (2008), this is achieved by including the means of the explanatory variables for each indi-

vidual. Specifically, we use the fractional probit model. We opt for the CRE over the fixed effects (FE) model because some variables are time-invariant and the CRE model provides the same benefits as the FE model without losing information about the time-invariant variables. The results of our estimation are presented in Table 2.

Recall that our dependent variable is measured by the percentage of corrupt legislators in the legislature. The zeros in our data do not necessarily indicate a lack of corruption in the legislature. It can also indicate that no corruption has been caught. Since we have no way of distinguishing the processes that generated the zeros, we estimate two equations. The first estimation (column 2) includes all the states with zero corruption regardless of the processes that generated the zeros. The second estimation (column 3) excludes observations with zero values for corruption. The results for both estimations (column 2 and column 3) in the table indicate a statistically insignificant negative relationship between legislative ethics committees and legislative corruption. This implies that the corruption rates in states with legislative ethics committees are not significantly different from those of states without legislative ethics committees.

For a robustness check, we matched the treated states (those with legislative ethics committees) with untreated states (those without ethics committees). Our propensity-matching process used the logit model to generate probabilities resulting in 68 matches. We then run the same regression as in column 2 using a smaller sample of 136 observations. The results of our estimation are shown in column 4 of Table 2. The results are similar to those in columns 2 and 3 as the independent variable of interest, ethics committees, remains insignificant, implying no significant difference in corruption rates between states with ethics committees and those without. Descriptive statistics for the treated and control groups are provided in Table 3 in the appendix. Additionally, density graphs in Figure 1 in the appendix show how closely matched the treated and control groups are before and after matching.

Table 2: Relationship between ethics committees and corruption
Dependent variable: Legislative corruption

	Fractional Probit with Correlated Random Effects	Fractional Probit with Correlated Random Effects (Corruption >0)	Fractional Probit with Correlated Random Effects: Propensity Score Matching	Lewbel Instrumental Variable
Ethics committee (categorical)	-0.330	-0.121	-0.340	-0.009
	(0.319)	(0.266)	(0.275)	(0.008)
Log of real median household income	1.791	4.064***	1.525	-0.012
	(1.594)	(1.208)	(1.694)	(0.016)
Education (proportion with bachelors or higher)	-1.208	-11.763**	-1.837	-0.020
	(14.295)	(6.014)	(14.695)	(0.050)
Log of population	1.685	1.078	1.082	0.001
	(1.468)	(1.180)	(1.536)	(0.003)
Median age	0.038**	0.0339	0.041	0.0001
	(0.019)	(0.021)	(0.026)	(0.0006)
Term limits (proportion of population)	-0.077	-0.027	-0.079	-0.0018
	(0.073)	(0.053)	(0.084)	(0.0027)
Minorities (proportion of population)	-2.323*	-1.001	-2.228	0.008
	(1.409)	(1.125)	(1.717)	(0.009)
Green full time (categorical)	0.530***	0.308	0.504**	0.0135*
	(0.201)	(0.195)	(0.208)	(0.0075)
Gray hybrid (categorical)	0.310*	0.025	0.295	0.0047
	(0.174)	(0.167)	(0.185)	(0.0047)
Democratic control (categorical)	-0.340*	-0.495***	-0.190	-0.0051
	(0.190)	(0.186)	(0.118)	(0.0047)
Republican control (categorical)	0.084	0.089	-0.035	-0.0030
	(0.267)	(0.150)	(0.133)	(0.0046)

Means of all explanatory variables	Yes	Yes	Yes	
State & year FE	Yes	Yes	Yes	
N	147	80	136	147
Wald chi-squared	107.41	129.40	89.06	
RkWald F Statistic				2.086

*Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1*

It is worth pointing out that the control variables median age, minorities, green full time, gray hybrid and democratic control are significant in the estimation in column 2. In column 3, the log of real median household income, education and democratic control are significant. In column 4, only green full time is significant. States with a full-time legislature (green full time) have more legislative corruption than those with a part time legislature. Similarly, states with a hybrid form of legislature (gray full time) have more legislative corruption than those with a part time legislature.[1]

To address the endogeneity issue that may arise due to various reasons, such as the potential establishment of legislative ethics committees in response to corruption scandals and endogeneity resulting from measurement error, we estimate an instrumental variable model. The estimation in column 5 indicates that the establishment of ethics committees in state legislatures does not have a significant impact on corruption within those legislatures.

DISCUSSION OF RESULTS AND CONCLUSION

Similar to Crider and Milyo (2013) our results do not support the claim that legislative ethics committees are effective in reducing legislative corruption. While Crider and Milyo (2013) focused on statewide corruption and investigated the effect of ethics commissions, our focus was on the legislature level. Since some state ethics commissions lack jurisdiction over the legislature, conducting investigations at the legislative level is warranted as this is where laws that directly impact the daily lives of residents are created.

Our results are not without limitations. One limitation is that our corruption variable contains a significant number of zeros. These zeros could be generated by two different processes. One possibility is that some of the zeros are generated due to missing or unreported corruption data, known as false zeros. The second possibility is that the zeros are generated from the absence of corruption in the state. The former can be mistakenly

[1] According to the National Conference of State Legislatures, states with green legislatures require 80 or more of a full-time job while gray legislatures require two thirds of a full-time job. A part-time legislature requires half of a full-time job.

interpreted as an absence of corruption in a state. This problem is not unique to our data. In a broader sense, this is a major issue when using the number of convictions to measure corruption. The measure usually underestimates corruption because by its very nature corruption is secretive. Undiscovered corruption is not accounted for in the analyses. Others have attempted to address this issue by using corruption perception measures. However, no such perception measures exist for state legislative corruption for the duration of our study period. We mitigated this problem by estimating two separate equations- one equation that included the zeros and another that excluded the zeros. We found no significant effect of ethics committees in corruption for both.

Another limitation is that there is a likelihood that the independent variable "ethics committees" is endogenous. As explained earlier, the formation of these committees may be a result of some corruption scandal. While an attempt was made to establish causality by employing a propensity score matching technique, the endogeneity problem still exists. We mitigated this problem by estimating an instrumental variable model following Lewbel (2012).

Despite the limitations, these results suggest that ethics committees may be established as a signaling mechanism to voters, demonstrating that legislative bodies are taking steps to address corruption among their members. Future studies should explore the possibility of delineating between the two state legislative chambers to investigate whether an ethics committee in one chamber is more effective than the other. Another potential area for investigation is whether the composition of ethics committees influences their effectiveness in curbing corruption.

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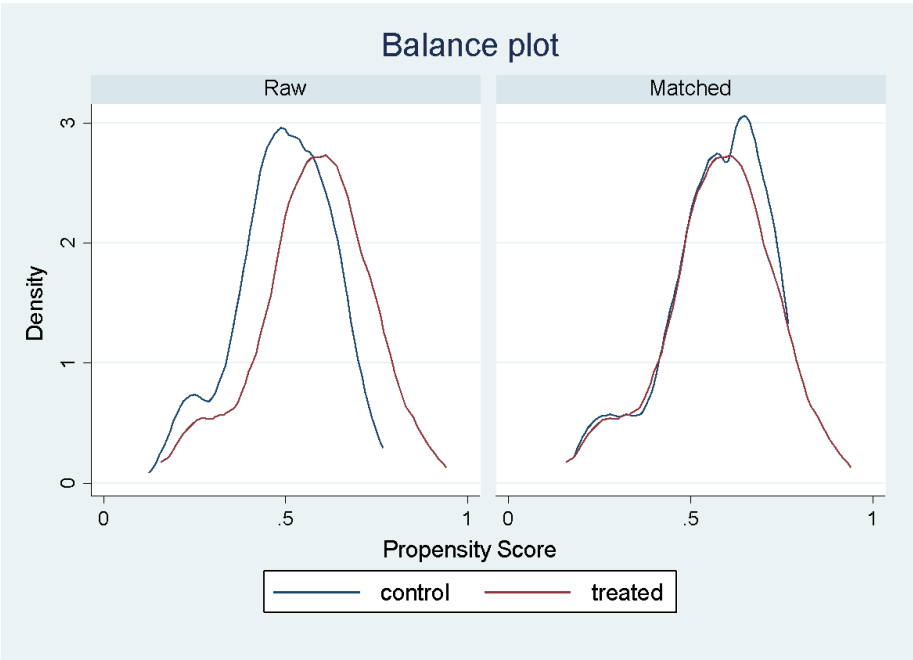
APPENDIX

TABLE 3: Descriptive statistics for treated and control groups

	Means		Variances	
Ethics committee (categorical)	Control	Treated	Control	Treated
Log of real median household income	11.217	11.168	0.030	0.024
Education (proportion with bachelors or higher)	0.313	0.295	0.004	0.003
Log of population	15.093	15.239	1.128	0.948
Median age	37.447	36.790	4.707	7.583
Term limits (categorical)	0.309	0.304	0.217	0.214
Minorities (proportion of population)	0.249	0.268	0.016	0.029
Green full time (categorical)	0.221	0.190	0.174	0.156
Gray hybrid (categorical)	0.515	0.506	0.254	0.253
Democratic Control (categorical)	0.441	0.291	0.250	0.209
Republican control (categorical)	0.426	0.544	0.248	0.251

Figure 1: Balance plot pre-treatment (raw) and post-treatment (matched)



THE IMPACT OF STATE TAX BURDENS ON THE MARGINAL PROPENSITY TO CONSUME

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ABSTRACT

Using data from 2009 to 2019, this study examines the impact of state tax burdens on the marginal propensity to consume. The study uses data from all 50 states plus the District of Columbia. Quantitative models are used to analyze the data. The results indicate that states with relatively low tax burdens have a lower marginal propensity to consume associated with income shocks, but a higher marginal propensity to consume associated with wealth effects. This implies that households in states with relatively low tax burdens tend to smooth consumption patterns more easily over time and tend to increase consumption as wealth increases.

INTRODUCTION

State and local tax policies play a vital role in shaping household and business decisions, particularly in the context of geographic mobility and economic behavior. In recent years, internal migration within the United States has intensified, with many individuals and firms relocating from high-tax, highly regulated states such as California and New York to lower-tax states including Texas, Tennessee, and Florida (Vranich & Ohanian, 2021; Toukabri et al., 2022). These movements have been accelerated by the COVID-19 pandemic, which prompted many Americans to reevaluate their residential and lifestyle preferences.

Such demographic changes have broad implications. States experiencing net outmigration often face declining tax bases, workforce shortages, and slower economic growth, while states with rapid population growth must grapple with increased demands on housing, infrastructure, and public services (Schneider & Riccardi, 2021). At the same time, migration patterns are influencing both regional economies and fiscal policy planning. Given the central role of consumption in driving economic activity and the effectiveness of fiscal policy (Fazzari et al., 2021), it is essential to understand how state tax burdens shape household spending behavior. Foundational economic

models—from Keynes' early work on the consumption function to more contemporary income and wealth-based models—underscore the importance of disposable income and perceived wealth in determining consumption patterns (Duesenberry, 1949; Friedman, 1957; Hall, 1978; Modigliani, 1988).

This paper investigates whether state tax burdens influence the marginal propensity to consume (MPC), particularly in response to income and wealth shocks. By examining panel data from all 50 U.S. states between 2009 and 2019, this study explores how tax structures moderate the relationship between disposable income, housing wealth, and consumption behavior. The findings offer new insights into the interplay between fiscal conditions and economic decision-making with implications for tax policy, regional development, and long-term economic planning.

LITERATURE REVIEW

The link between household consumption and both income and wealth has been a cornerstone of macroeconomic theory for decades. Keynes (1936) introduced the consumption function, which posited that current income is the primary determinant of consumption. Building on this, subsequent models emphasized expectations, life-cycle patterns, and relative income effects (Duesenberry, 1949; Friedman, 1957; Hall, 1978; Modigliani, 1988). In modern consumption theory, wealth—particularly housing wealth—has been identified as a major determinant of spending behavior. Since wealth is not directly observable, economists have relied on proxies such as stock and housing price changes. Case et al. (2001) found that housing wealth impacts a broader range of households and has more persistent effects than stock market wealth. Campbell and Cocco (2007) and Slacalek (2009) further confirmed that positive changes in housing prices significantly increase consumption expenditures.

Attanasio et al. (2011) found that housing price shocks have a particularly strong impact on consumption decisions among older households. Berger et al. (2018) extended this line of inquiry, showing that housing price increases produce an "endowment effect," acting as a liquidity boost and encouraging spending. Their business cycle simulations revealed that housing-driven borrowing during expansions may contribute to declines in consumption during downturns. Despite this growing literature, relatively few studies have examined how state-level tax policies influence consumption responses to income and wealth changes. Tax burdens affect disposable income and can shape household perceptions of financial well-being. Yet, most existing models treat fiscal variables as background conditions rather than central explanatory factors.

This study addresses this gap by integrating state tax burden measures into a standard consumption framework. By assessing whether tax burdens

moderate the MPC from income and housing wealth shocks, it adds a new dimension to the literature on fiscal influences on consumer behavior. The findings contribute to understanding how fiscal structure affects economic resilience and consumption volatility at the state level.

The remainder of the study is divided into four additional sections. Section 3 describes the data and explains the methodology. Section 4 reports the regression results and implications. Section 5 provides the conclusion on the study. Section 6 lists the study references.

DATA AND METHODOLOGY

3.1 Data

When estimating consumption functions, many studies have used microdata, but the problem with microdata is that they are limited. In the case of this study, identifying a tax burden variable that is consistently measured across all United States counties and across time prohibited using microdata. A limitation of using microdata is the possibility of endogeneity. A Durbin-Wu-Hausman test for endogeneity found that the coefficients failed to reject the null hypothesis that the coefficients were inconsistent for the microdata used in this study.

Given the Durbin-Wu-Hausman test results and data availability, this study used a short-panel dataset of annual microdata observations for the 50 United States from 2008-2019 to estimate the consumption function equations. Although data from 2020 to the present were available, Covid-19 pandemic policies, such as the shutdown of non-essential businesses and the Coronavirus Tax Relief and Economic Impact Payments, distorted 2020 behaviors. Therefore, data beyond 2019 were excluded from this study. The source of the real personal consumption expenditures per capita and the real disposable income per capita data is the United States Bureau of Economic Analysis, regional GDP and personal income data. The source of the housing price index data is the United States Federal Housing Finance Agency, FHFA House Price Index. Since the FHFA House Price Index is quarterly data, the fourth quarter observations were used in the study. A unit root test for each variable found non-stationarity, so the first difference of each variable was calculated and stationarity verified. Multicollinearity between the independent variables was tested and rejected.

After reviewing several measures of state and local tax rate burdens for the United States, the Cato Institute State Tax Burden Score was selected for this study (Ruger and Sorens, 2021). The State Tax Burden Score was selected over other options because TaxBurden captures the relative variability of the state tax rates relative to the mean tax rates for all 50 states. Specifically, the

State Tax Burden Score is the number of standard deviations a state's state-plus-local tax rate is from the 2000-2019 fifty-state (national) mean state-plus-local tax rate. The 2000-2019 national mean state-plus-local tax rate was 9.5%. Twenty-five states were within one-half standard deviation of the national mean state-plus-local tax rate. Fifteen states were more than one-half standard deviation below the national mean of state-plus-local tax rate while ten states were more than one-half standard deviations above the national mean state-plus-local tax rate. Figure 1 noted below shows the state burden tax score for the fifty states. This measure was chosen because it offers a consistent, longitudinally comparable metric that accounts for both state and local tax rates across all states, making it well-suited for panel data analysis and comparative research over time.

Figure 1: State Tax Burden Scores by State

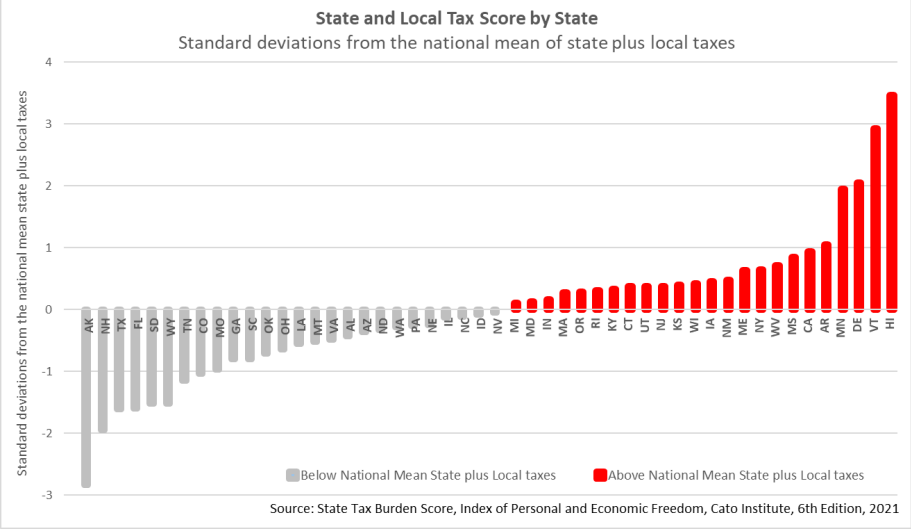

Table 1 lists the division of the states into three groups with the groups ranging from the lowest relative state tax burden in Group 1 to the highest relative state tax burden in Group 3.

Table 1: State Tax Burden group classifications by standard deviation (σ)

Group 1 σ < -0.5		Group 2 -0.5 < σ < 0.5		Group 3 0.5 < σ
Alaska	Ohio	Alabama	Nevada	Arkansas
Colorado	Oklahoma	Arizona	New Jersey	California
Florida	South Carolina	Connecticut	New Mexico	Delaware
Georgia	South Dakota	Idaho	North Carolina	Hawaii
Louisiana	Tennessee	Illinois	North Dakota	Maine
Missouri	Texas	Indiana	Oregon	Minnesota
Montana	Wyoming	Iowa	Pennsylvania	Mississippi
New Hampshire		Kansas	Rhode Island	New York
		Kentucky	Utah	Vermont
		Maryland	Virginia	West Virginia
		Massachusetts	Washington	
		Michigan	Wisconsin	
		Nebraska		

The panel data consists of a cross-section of 50 entities and a time series of 11 years from 2009 through 2019. Table 2 provides the summary statistics for each variable.

Table 2: Variable Summary Statistics

	All	Group 1	Group 2	Group 3
Obs	549	165	275	109
Δc				
Mean	414.206	410.327	381.484	502.633
Std Dev	653.201	630.489	689.247	587.742
Min	-2536	-2083	-2536	-1576
Max	2337	2337	2232	2067
Δy				
Mean	612.889	577.473	606.178	683.431
Std Dev	1273.4	1405.913	1298.098	971.727
Min	-6059	-6059	-3578	-3182
Max	5108	4228	5108	2666
Δh				
Mean	2.6858	3.0727	2.6463	2.1999
Std Dev	4.6616	3.9387	5.1939	4.2182
Min	-18.3052	-10.2512	-18.305	-12.2311
Max	19.9149	11.4793	19.9149	16.5948

3.2 Model

The model used to explore the influence income shocks and wealth effects have on consumption expenditures is:

$$\Delta c_{i,t} = a + b_1 \Delta y_{i,t} + b_2 \Delta y_{i,t} \text{TaxBurden}_{it} + b_3 \Delta h_{i,t} + b_4 \Delta h_{it} \text{TaxBurden}_{it} + \alpha_i + e_{i,t} \quad (1)$$

where i indicates the entity (i.e. state), t denotes the time period, and Δ is the first difference operator associated with observations for time period t minus

the observations for the previous time period, t-1. The equation indicates that the change in real personal consumption expenditures per capita ($\Delta c_{i,t}$) is determined by the change of real disposable income per capita ($\Delta y_{i,t}$) and the housing price index change ($\Delta h_{i,t}$), which is a proxy for wealth changes. The equation coefficients are a, which is the constant, b_1, which is the marginal consumption response associated with income shocks, and b_3, which is the marginal consumption response associated with wealth changes. Coefficients b_2 and b_4 captures the additional effect the state tax rate burden (TaxBurden) has on the marginal propensity to consume associated with an income shock and the marginal propensity to consume associated with a wealth effect, respectively. For the remaining terms, α_i is the entity intercept for each entity and controls for the entity fixed effects, and $e_{i,t}$ is the error term that is independent and identically distributed. Table 3 identifies the variable descriptions and units.

Table 3: Variable Descriptions and Units

Variable	Description	Units
Δc_{it}	Change in real personal consumption expenditures per capita	US dollars per capita
Δy_{it}	Change in real disposable income per capita	US dollars per capita
$\textbf{TaxBurden}_{it}$	Standardized state tax burden score (relative deviation from national mean)	Standard deviations
Δh_{it}	Change in housing price index (proxy for wealth)	Percent (%)
$\Delta y_{it} \times \textbf{TaxBurden}_{it}$	Interaction term for income change and tax burden	Composite (USD × Std. Dev.)
$\Delta h_{it} \times \textbf{TaxBurden}_{it}$	Interaction term for housing price change and tax burden	Composite (% × Std. Dev.)
α_i	Entity (state) fixed effects intercept	Unitless (state-specific constant)
ε_{it}	Error term (residual)	Unitless (random error)

3.3 Methodology

After considering and testing three regression approaches, a pooled OLS model, a fixed effects model, and a random effects model, the fixed effect model approach was selected to estimate the consumption function. The fixed effects model recognizes that the entities may have unique characteristics that may or may not influence the real personal consumption expenditures per capita. A fixed effects model estimates the relationship between the real personal consumption expenditures per capita change and the independent variables by controlling for the time-invariant characteristics that may be unique to the entities. A fixed effects model assumes that any entity and/or time differences are captured in the entity intercepts and that an entity's error term and constant are not correlated with the other entities. This means the entity intercept for each entity is not zero ($\alpha_i \neq 0$), but the between-entity error is zero ($u_{i,t} = 0$). Since heteroscedasticity was present, a robust estimation was used to estimate the fixed effects model.

While the hierarchy principle typically recommends including lower-order terms when interaction terms are present, this study omits the direct effect of the tax burden variable due to the specific structure and interpretation of the model. In this context, the state tax burden is a standardized, time-invariant measure that does not independently vary over time within each state during the study period. As such, its main effect is fully absorbed by the fixed effects estimator, which controls for all time-invariant heterogeneity across states. Including the direct effect of tax burden would therefore introduce perfect multicollinearity or provide no additional explanatory power in the fixed effects framework. Instead, the interaction terms (e.g., $\Delta y_{it} \times \text{TaxBurden}_{it}$) capture the differential impact of income and wealth shocks depending on a state's relative tax burden, which aligns with the study's objective to examine how the marginal propensity to consume varies across tax regimes. Thus, in this setting, omitting the main tax burden variable is methodologically appropriate and avoids redundancy in the model specification.

4. Results and Implications

A fixed effects model approach with robust estimators was used to estimate the consumption function equations. Table 4 reports the regression results overall and by the three state tax burden groups.

Table 4: Regression Results

		Groups		
Variables	**All States**	**1: σ < -0.5**	**2: -0.5 < σ < 0.5**	**3: 0.5 < σ**
$\Delta y_{i,t}$	0.3695***	0.2972***	0.3712***	0.4455***
	(0.01512)	(0.02395)	(0.0212)	(0.0384)
$\Delta y_{i,t}$ * TaxBurden	-0.0518***			
	(0.01352)			
$\Delta h_{i,t}$	31.6790***	43.2694***	29.8293***	23.5595***
	(4.0577)	(8.7796)	(5.4203)	(8.8807)
$\Delta h_{i,t}$ * TaxBurden	4.7615			
	(3.7498)			
Constant	102.216***	105.7271**	77.5425**	146.3696***
	(21.299)	(41.4967)	(30.2305)	(46.2622)
Number of States	50	15	25	10
Observations	549	165	275	109
Rho	0.0623	0.0406	0.0534	0.0750
F-test	p=0.000	p=0.000	p=0.000	p=0.000
R^2 Overall	0.6204	0.6038	0.6315	0.6137

*Note: standard errors are reported in parenthesis. ***, ** and * denote estimates that are significant at the 99%, 95%, and 90% confidence level, respectively.*

The regression results find that for the United States the real consumption response from an income shock is 0.3695. Holding everything else constant, as the real personal income change (Δy) increases across time by $1, real consumption expenditure changes (Δc) increase by $0.3695. While this value may appear low for a marginal propensity to consume associated with an

income shock, it is consistent with other estimates of the marginal propensity to consume found in the literature and captures the smaller income effect when the income change is temporary as opposed to a permanent income change.

The results also reveal that the marginal propensity to consume arising from an income shock differs across state tax burden groups. An income shock, for states with relatively lower state tax burdens, leads to a smaller marginal consumption change when compared to states with relatively higher state tax burdens. This is supported by the significance of the interactive income effect-Tax Burden ($\Delta y_{i,t}$ * TaxBurden) coefficient using the aggregate data and when comparing the income effect coefficient ($\Delta y_{i,t}$) for the three groups. This indicates that households living in states with relatively high state tax burdens respond more to income shocks when compared to households living in states with relatively low state tax burdens. This suggests that households living in states with a high tax burden cannot smooth consumption over time as easily as households living in states with a low tax burden when income shocks arise. From a fiscal policy perspective, this result indicates that households living in states with relatively high tax rates will be more responsive to fiscal policy changes than those in states with relatively lower state tax burdens, albeit at the cost of greater consumption variability and uncertainty.

The wealth effect results reveal that for the United States the real marginal consumption response to a wealth effect change is 31.679. Holding everything else constant, as housing prices increase across time by 1%, real consumption expenditure changes increase by $31.679. The positive relationship is consistent with other studies that have investigated the relationship between wealth effect changes and marginal consumption behavior.

Although the interactive wealth effect -Tax Burden ($\Delta hi,t$ * TaxBurden) - coefficient reveals a positive but insignificant relationship, comparing the results for the three groups suggest a positive wealth shock for households living in states with the lowest state tax burdens; this tended to increase marginal consumption expenditures more than for households who lived in states with relatively higher state tax burdens. This may be because households anticipate the net-tax wealth gains will be relatively higher in lowest tax burden states than in higher tax burden states. This has the effect of increasing aggregate consumption for the lowest tax burden states, leading to higher economic growth in lowest tax burden states relative to higher tax burden states. The conflicting significance of the wealth effect between the aggregate and group data offers an opportunity for future investigation.

The primary challenge involved in this study's model is this: If tax burden is endogenous, then dividing the sample based on sub-samples by total state tax burden (state + local) can potentially result in sample selection bias. Unlike most other studies, every unit of analysis in the population (in this

case, states in the union) is included in the analysis. A single state, depending on its group, weighs differently towards the total tax burden of the group. The endogeneity lies in the fact that states on the far right (or left) of the curve pull the mean (and standard deviation) more than states that are closer to the center. This is because the normal distribution curve contains the mean (not the median) at its center. Typically, that is not a problem. Dividing states into groups alone fails to allay endogeneity concerns; fortunately, our fixed effects model does. Despite the use of robustness estimators, however, a small amount of endogeneity potentially persists. Although our model explains 62% of the variance in household consumption change, 38% variance remains outstanding due to a plethora of correlates contained in the error term: Inflation, seasonality surrounding holidays, work bonuses, tax refunds, interest rate changes, and more.

Although the fixed effects model and robustness estimators mitigate many concerns, the potential for endogeneity remains, particularly regarding the influence of unobserved variables and reverse causality between tax burdens and consumption behavior; future research could explore instrumental variable approaches or dynamic panel models to further address this limitation.

An interesting note is that the fraction of the error term variance attributable to the fixed effects, rho, increases as the state tax burden increases. Using the data for all states, 6.23% of the unexplained error term variance was attributed to the state-fixed effects. When comparing the group results, rho increased as the tax burden increased suggesting that the observed differences in real consumption expenditures per capita that occur between states rather than within states increases as the tax burden increases.

CONCLUSION

This study explored the impacts state and local tax burdens have on consumption expenditure decisions. The results revealed that households in states with relatively lower state tax burdens have a smaller marginal propensity to consume associated with income shocks but a relatively higher marginal propensity to consume associated with wealth effect shocks. Households in states with relatively lower state tax burdens more easily smooth consumption expenditures over time and increase consumption more as wealth increases. Both of these results imply higher aggregate consumption and therefore higher economic growth for states with low state and local tax burdens. While households living in states with relatively high tax rates are likely more responsive to fiscal policy changes than those in states with relatively lower state tax burdens, the cost of the higher spending multiplier is greater consumption variability and uncertainty and likely lower economic growth.

There are several avenues for future research projects based on the results of this study. The current study is primarily an inter-state analysis that examined this issue concerning state tax rates in terms of low tax rate states vs. high tax rate states. However, it is worth mentioning that tax rates vary within states based on income. In other words, many if not most states have tax brackets based on household income. For example, in the state of Virginia where one of the authors of this manuscript resides, tax brackets are 2%, 3%, 5%, and 5.75% depending on household income. Hence, an intra-state study that examines this issue within individual states would be an interesting extension of this study. Also, this study examined this issue with respect to changes in fiscal policy. Another extension to the current study would be to examine this issue for changes in monetary policy and the effect on the marginal propensity to consume.

While this study employed state fixed effects to control for time-invariant heterogeneity across states, it did not incorporate year fixed effects, which could capture common macroeconomic shocks or national policy changes that affect all states uniformly over time. Future research could extend this analysis by incorporating both state and year fixed effects, to assess whether unobserved temporal influences meaningfully alter the estimated effects of tax burdens on consumption behavior.

The authors would like to conclude this study by emphasizing that marginal propensity to consume is an important economic concept that deserves research investigation. This study has contributed to the academic literature by highlighting some of the factors that could potentially impact it. This study has implications for fiscal and monetary policy decisions.

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An Empirical Study on Customer Satisfaction in Amazon's Shopping Experience

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Yudan Zheng

ABSTRACT

This study explores the key factors influencing customer satisfaction on Amazon, focusing on cart abandonment, personalized recommendations, product reviews, rating accuracy, competitive pricing, and service appreciation. Based on 602 survey responses from the Amazon Consumer Behavior Dataset, multiple linear regression analysis identifies six key drivers: cart abandonment due to better prices or indecision, reliance on product reviews, frequency of personalized recommendations, accuracy of product ratings, and appreciation for competitive pricing.

The results indicate that cart abandonment due to better prices and indecision significantly reduces satisfaction, underscoring the need for more competitive pricing strategies and decision-support mechanisms. Additionally, heavy reliance on product reviews and concerns about competitive pricing negatively impact satisfaction, likely due to conflicting or misleading information, price fluctuations, or hidden fees.

Conversely, personalized recommendation frequency and rating accuracy emerge as the strongest positive predictors, reinforcing the importance of relevant recommendations and reliable ratings in enhancing the shopping experience. These findings offer actionable insights for optimizing Amazon's customer experience, fostering brand loyalty, and sustaining a competitive edge in e-commerce. This study highlights the value of data-driven methodologies in improving customer service and underscores their significance in navigating the evolving e-commerce landscape.

INTRODUCTION

E-commerce is a dynamic and rapidly evolving industry that continually shapes how consumers shop and how businesses operate. The emergence of digital technologies has transformed business models across sectors, enabling firms to collect and analyze massive volumes of data to personalize experiences, predict consumer behavior, and improve operational efficiency (Kareska, 2024). These changes have blurred traditional industry boundaries and given

rise to digital ecosystems, where agility, innovation, and customer-centricity are essential for survival (Kareska, 2024). In this context, customer satisfaction has become one of the most vital non-financial indicators of business success, influencing customer loyalty, brand reputation, and long-term profitability. Satisfied customers are more likely to pay premium prices, remain loyal, and generate positive word-of-mouth, all of which are essential in the highly competitive digital marketplace (Wattoo et. al., 2025).

Among e-commerce giants, Amazon stands as a global leader in digital innovation and consumer engagement, leveraging artificial intelligence, big data, and user-generated content to deliver seamless and personalized shopping experiences (Ologunebi et al., 2025). Its success stems from a highly developed technological ecosystem that supports fast delivery, easy returns, personalized recommendations, and transparent customer service, all of which reinforce trust and satisfaction (Ahmar et al., 2023). However, even with its extensive capabilities, Amazon faces ongoing challenges in consistently meeting the diverse expectations of its vast customer base. Understanding the complex relationship between digital features, service quality, and consumer satisfaction is crucial for improving customer service and sustaining competitive advantage. This study aims to investigate these dynamics through the research question: "How can Amazon improve its customer service through the analysis of shopping satisfaction?"

Customer satisfaction is fundamental to e-commerce success, directly influencing customer loyalty, word-of-mouth referrals, and long-term profitability. Key drivers of satisfaction in online retail include ease of use, personalized product recommendations, and efficient checkout processes. For instance, a study by Al-Debei et al. (2015) found that perceived usefulness and ease of use significantly impact customer satisfaction in e-commerce settings. Additionally, the Baymard Institute (2023) reports that the average cart abandonment rate is 70.19%, highlighting the negative impact of cart abandonment on sales and customer retention. Addressing these issues is essential for enhancing customer satisfaction and optimizing revenue.

While existing literature has explored individual aspects of online customer satisfaction—such as trust (Khan et al., 2023), usability (Ahmar et al., 2023, Ologunebi et. al., 2025), and personalization (Moodley et. al., 2025) - there is a lack of comprehensive empirical studies that analyze how these features interact collectively within a single analytical framework. Specifically, few studies examine how key digital experience elements like personalized recommendations, cart abandonment behavior, and search functionality simultaneously influence satisfaction on major platforms like Amazon. This study fills that gap by using a survey-based dataset and multiple regression analysis to assess the relative importance of these variables, providing a more holistic understanding of what drives customer satisfaction in today's data-rich e-commerce environment.

Our analysis identifies several critical areas for improvement. First, the frequency and relevance of personalized recommendations can significantly affect the customer experience. While tailored suggestions often enhance convenience and satisfaction, irrelevant or repetitive recommendations may frustrate users and undermine trust. Second, cart abandonment - a prevalent issue in e-commerce - requires a deeper understanding of why customers leave their purchases incomplete. Addressing this issue is crucial for improving satisfaction and maximizing revenue. Lastly, product search functionality plays a pivotal role in customer satisfaction. An intuitive and efficient search experience significantly enhances the likelihood of purchase and reduces frustration. For example, Tarute et al. (2017) emphasize the importance of user-friendly website design in enhancing customer satisfaction and loyalty.

This study aims to uncover new insights into these challenges by employing multiple linear regression analysis on key variables, such as personalized recommendations, cart behavior, and search functionality. By identifying actionable strategies, we provide Amazon with a roadmap to refine its customer experience, maintain its competitive edge, and strengthen its position as an industry leader. When customers are satisfied, they are more likely to return, recommend the platform to others, and contribute to sustained growth and profitability for Amazon.

LITERATURE REVIEW

Amazon has emerged as a leader in the digital business landscape, setting industry standards through its customer-centric model, advanced recommendation systems, and seamless shopping experience (Ologunebi et al., 2025). Its strategy is rooted in data-driven decision-making, offering features like one-click purchases, personalized suggestions, and reliable delivery, all of which strengthen consumer trust and satisfaction (Ahmar et. al., 2023 and Ologunebi et al., 2025). This model reflects the broader evolution of digital business, where companies use data and technology to understand customer behavior and deliver personalized experiences, ultimately transforming traditional operations into agile, tech-driven ecosystems (Kareska, 2024). Platforms like Amazon illustrate how digital transformation has enabled new business models and value creation by integrating buyers, sellers, and logistics within one system (Kareska, 2024). The digital era has also pushed firms to reimagine customer engagement, focusing not just on transactions but on long-term relationships built on trust, usability, and responsiveness (Wattoo et al., 2025).

In e-commerce, customer satisfaction remains a critical performance indicator linked to loyalty and financial success. Elements such as personalization, clear return policies, and dependable delivery have been shown to significantly

improve satisfaction (Wattoo et al., 2025). Amazon's approach, offering consistent service quality, intuitive navigation, and transparent pricing, contributes to trust and encourages repeat purchases (Khan et al., 2023). Trust plays a central role in shaping consumer behavior in e-commerce, particularly in environments where physical interaction with products or sellers is absent. The Trust-Based Model of E-Commerce emphasizes that elements such as website design, clear return policies, transparent pricing, and secure transactions are foundational in fostering consumer trust (Mansouri et al., 2022). On platforms like Amazon, trust is reinforced through consistent user experience, customer reviews, and prompt customer service, all of which reduce perceived risk and enhance satisfaction. Research shows that higher levels of trust not only influence initial purchase decisions but also lead to long-term customer loyalty and repeat buying behavior (Khan et al., 2023).

Recent developments highlight the growing role of artificial intelligence in delivering personalized shopping experiences through real-time recommendations and predictive analytics. The COVID-19 pandemic accelerated digital transformation, solidifying e-commerce as a vital channel for consumers and businesses alike (Moodley et al., 2025). As customer expectations continue to rise, personalization, trust, and usability have become central to satisfaction. Platforms like Amazon must continuously innovate their digital services to meet these evolving expectations. While existing studies emphasize the importance of trust (Khan et al., 2023), usability (Ahmar et al., 2023; Ologunebi et al., 2025), and personalization (Moodley et al., 2025), few have examined how specific digital features—such as recommendation relevance, cart behavior, and search functionality—interact to influence customer satisfaction within a data-driven framework.

This study addresses that gap by offering a comprehensive empirical analysis of how multiple aspects of the online shopping experience affect customer satisfaction on platforms like Amazon. While prior research has focused on individual drivers, limited attention has been given to how these factors jointly impact satisfaction in an integrated model. Using survey-based data and multiple regression analysis, this study evaluates the combined effects of personalized recommendations, cart abandonment behavior, and search efficiency. The findings provide actionable insights to improve user experience and inform strategic decisions in customer service and platform design.

SAMPLE, VARIABLES, AND RESEARCH QUESTION

3.1. Data and Sample

The dataset used in this study, titled "Amazon Consumer Behavior Dataset," was published in July 2023. The data was collected through a survey

conducted over a two-week period in June 2023. The survey was randomly distributed to Amazon customers using Google Forms shared across various social media platforms. Its primary goal was to evaluate customer experiences with the Amazon platform and identify areas for improvement. The survey began with basic demographic questions, such as age and gender, to help contextualize the respondents' profiles.

The main section of the survey consisted of multiple-choice questions, covering topics such as customer satisfaction with the shopping experience, frequency of purchases, preferred product categories, browsing habits, reliance on customer reviews, search methods, and factors influencing cart abandonment.

In addition, the survey included yes/no questions addressing behaviors like purchasing based on recommendations, cart usage, and leaving reviews. Respondents were also invited to provide free-text responses, sharing what they appreciate about Amazon's services and suggesting areas for improvement.

The survey received 602 responses across 24 questions, forming the dataset's rows (responses) and columns (questions).

3.2. Variables and Descriptive Statistics

Table 1 presents the descriptive statistics for the variables used in our final regression model. Abbreviations for each variable are explained in parentheses. The table is organized into two panels to differentiate between numeric and categorical variables.

Panel 1 summarizes the descriptive statistics for the numeric variables: Personalized Recommendation Frequency (PRF) and Rating Accuracy (RA). For both variables, key statistics such as the 25th percentile (P25), mean, median, 75th percentile (P75), and standard deviation (Std) are provided. Notably, both variables have a mean and median of 3, suggesting a central tendency around this value, with PRF exhibiting slightly greater variability (Std = 1.0420) compared to RA (Std = 0.8997).

Panel 2 focuses on categorical variables, presenting the counts of observations for each category (e.g., "Yes" or "No") and the total number of observations per variable. For instance, D_PF_LTOM (Purchase Frequency - Less than a month) shows 124 "Yes" responses and 478 "No" responses out of 602 total observations, highlighting that most respondents fall outside this frequency category. Similarly, variables such as D_CAF_FBPE (Cart Abandonment Factors - Found a better price elsewhere) and D_RR_M (Review Reliability - Moderately) show relatively balanced distributions, with 255 and 199 "Yes" responses, respectively.

3.3. Research Question

We had 24 different data variables available to formulate our research question, covering a broad range of topics such as consumer behavior, influences on purchase decisions, browsing frequency, and shopping satisfaction. After careful consideration, we chose to focus on Amazon's customer service, posing the question: How can Amazon improve its customer service by analyzing shopping satisfaction?

This question is particularly significant because customer satisfaction is foundational to e-commerce success. Satisfied customers are more likely to return for future purchases, recommend the platform to others, and contribute to long-term profitability. As highlighted in the introduction, customer satisfaction is directly influenced by key factors such as ease of use, personalized recommendations, efficient checkout processes, and effective search functionality. For example, research by Al-Debei et al. (2015) underscores that perceived usefulness and ease of use are critical drivers of satisfaction in online retail settings. Additionally, the Baymard Institute (2023) reports an alarmingly high average cart abandonment rate of 70.19%, emphasizing the urgency of addressing this issue to retain customers and maximize revenue.

Our research question addresses these crucial areas by investigating how improving elements like cart behavior, personalized recommendations, and user-friendly design can enhance the overall customer experience on Amazon. For instance, irrelevant product recommendations can frustrate users, undermining their trust in the platform, while high cart abandonment rates directly impact sales and retention. By focusing on these pain points, our study aims to provide actionable strategies to strengthen customer satisfaction.

Figure 1 presents a conceptual framework grounded in consumer behavior theory, illustrating how personalized recommendations and user feedback interact to influence customer satisfaction and loyalty (Khan et al., 2023). The model begins with personalized recommendations, which are assumed to enhance trust - an essential construct in relationship marketing. Trust, in turn, is expected to contribute to customer satisfaction, a well-documented predictor of loyalty (Hallencreutz et al., 2019). We further posit that satisfaction influences post-purchase behaviors, including repeat purchases and engagement activities such as leaving product reviews. These feedback mechanisms, in turn, inform and refine future personalized recommendations. Our a priori assumption is that personalized, responsive systems cultivate trust and satisfaction, which subsequently promote loyalty and generate valuable data that reinforces the personalized recommendation cycle.

This framework highlights the dynamic and cyclical nature of consumer interactions with personalized digital systems, emphasizing the central role of

trust and satisfaction in sustaining customer loyalty. By incorporating feedback into the recommendation process, firms can improve the relevance of their offerings and enhance the overall customer experience. The proposed "Customer Experience Feedback Loop" provides a theoretically grounded model for understanding how data-driven personalization and consumer behavior mutually reinforce one another, driving long-term value for both customers and organizations.

We deemed our research question critical because shopping satisfaction encapsulates many of the challenges and opportunities in e-commerce. By understanding what drives satisfaction, Amazon can optimize customer experiences, reduce pain points, and bolster loyalty. Ultimately, a satisfied customer is not only more likely to return but also to advocate for Amazon, amplifying its competitive edge and reinforcing its market leadership.

Empirical Analysis

4.1. Regression Models and Outputs

We estimate the following multiple linear regression model to examine the relationship between several independent variables and a single dependent variable:

$$Y=\beta_0+\beta_1X_1+\beta_2X_2+\ldots+\beta_kX_k+\varepsilon$$

In this equation, Y represents the dependent variable, $X_1, X_2,\ldots,X_k$ denote the independent variables, β_0 is the intercept, $\beta_1,\beta_2,\ldots,\beta_k$ are the coefficients associated with the independent variables, and ε is the error term.

In this study, shopping satisfaction was used as the dependent variable to evaluate how Amazon can improve customer service. Because Microsoft Excel supports only 16 independent variables per regression, the data was split into two sets: one focusing on purchasing behavior and customer reviews, and another on browsing patterns, search interactions, and service feedback. A third dataset then combined the most significant variables from both. While purchasing-related factors were less influential than expected, browsing and service-related variables emerged as more important. The combined analysis highlighted complex interactions among variables, providing meaningful insights into how Amazon can refine its strategies to enhance customer satisfaction.

The final model from the regression analyses is as follows:

Shopping Satisfaction = 1.1251 – 0.1531 * D_PF_LTOM + 0.1315 *D_BF_FTM + 0.1657 *D_BF_R - 0.2777 * D_CAF_FBPE - 0.3247 * D_CAF_CM - 0.3508 * D_RR_H -0.1259 *D_RR_M + 0.2433 * PRF + 0.4167 * RA - 0.1817 * D_SA_CP -0.1387 D_SA_WPS

The regression analysis results on shopping satisfaction in Table 2 highlights the key factors influencing customer experiences. The model includes 602 observations and explains approximately 36.67% of the variance in shopping satisfaction, as indicated by the R-squared value of 0.3667. The adjusted R-squared value of 0.355 further confirms the model's robustness, showing a strong explanatory fit without significant overfitting.

While this level of explanatory power is generally acceptable in behavioral and consumer research - where outcomes are influenced by a wide range of psychological, contextual, and situational factors - it is particularly notable given the scope of variables included in the final model. Our final regression model incorporates diverse predictors from the broader set of behavioral, demographic, and attitudinal measures in Datasets 1 and 2, including browsing and purchase behaviors, cart abandonment reasons, review reliability, personalization, and service appreciation. The 36.67% R-squared thus reflects meaningful explanatory power. However, the remaining unexplained variance suggests that other influential factors, such as emotional responses, brand loyalty, or post-purchase service experiences, may not have been fully captured and could be explored in future research. These findings should be interpreted with an understanding of both their practical relevance and the inherent complexity of consumer satisfaction.

Several variables exhibit statistically significant relationships with shopping satisfaction. Cart Abandonment Factors - Found a Better Price Elsewhere (D_CAF_FBPE) and Cart Abandonment Factors - Changed My Mind (D_CAF_CM) are both negative and highly significant at the 1% level, with coefficients of -0.278 and -0.325, respectively. The coefficient, -.278, indicates that every 1% increase of customers finding a better price elsewhere would decrease 27.8% of their satisfaction. A 1% increase in customers abandoning carts due to indecision corresponds to a 32.5% decrease in shopping satisfaction. This underscores the importance of decision reinforcement tools to reduce uncertainty. These patterns highlight the need for competitive pricing strategies and stronger decision reinforcement tools to minimize uncertainty and improve overall customer satisfaction.

Review Helpfulness - Heavily (D_RR_H) also has a significant negative impact on shopping satisfaction, with a coefficient of -0.351 (significant at the 1% level). The coefficient indicates that a 1% increase in customers heavily relying on reviews leads to a 35.1% decrease in satisfaction. This suggests that heavy reliance on reviews can expose customers to conflicting or misleading information, increasing uncertainty and dissatisfaction. It may also reflect gaps in product descriptions or seller credibility, forcing greater dependence on external opinions.

Similarly, Service Appreciation - Competitive Prices (D_SA_CP) is signif-

icant at the 5% level with a negative coefficient of -0.182. This indicates that a 1% increase in customers emphasizing competitive pricing reduces satisfaction by 18.2%. While competitive pricing is a key factor in purchase decisions, dissatisfaction may arise when customers perceive price fluctuations, hidden fees, or unclear discount structures. Frequent changes in pricing or the perception that lower prices come at the expense of service quality (such as slow shipping or poor customer support) may contribute to lower shopping satisfaction.

On the positive side, Personalized Recommendation Frequency (PRF) and Rating Accuracy (RA) stand out as the strongest predictors of shopping satisfaction. Both variables are significant at the 1% level, with coefficients of 0.243 and 0.417, respectively. Thus a 1% increase in customers valuing personalized recommendations raises satisfaction by 24.3%, while a 1% increase in perceived rating accuracy boosts satisfaction by 41.7%**.** PRF highlights the value of delivering relevant and tailored product recommendations to customers, which can enhance convenience and engagement. Meanwhile, RA, as the strongest positive predictor, reflects the importance of providing reliable and trustworthy product information to foster customer trust and satisfaction.

In contrast, several variables were found to be insignificant. For example, Browsing Frequency - Few Times a Month (D_BF_FTM) and Browsing Frequency - Rarely (D_BF_R) both have positive coefficients but fail to reach statistical significance, suggesting that browsing frequency alone does not strongly influence satisfaction. Similarly, Review Reliability - Moderately (D_RR_M) and Service Appreciation - Wide Product Selection (D_SA_WPS), though included in the model, did not significantly contribute to explaining shopping satisfaction.

In summary, among the significant predictors, cart abandonment due to price concerns (D_CAF_FBPE) and indecision (D_CAF_CM) negatively impact satisfaction, emphasizing the need for better pricing strategies and decision support. Heavy reliance on reviews (D_RR_H) also reduces satisfaction, likely due to conflicting or misleading information, while concerns about competitive pricing (D_SA_CP) suggest that price fluctuations or hidden fees contribute to dissatisfaction. Conversely, Personalized Recommendation Frequency (PRF) and Rating Accuracy (RA) emerge as the strongest positive predictors, underscoring the importance of relevant product recommendations and trustworthy ratings in enhancing customer experience. Several variables, such as browsing frequency (D_BF_FTM, D_BF_R) and certain service appreciation factors (D_SA_WPS), were found to be insignificant, indicating that these aspects do not strongly influence shopping satisfaction. These insights provide actionable strategies for platforms like Amazon to prioritize efforts that enhance customer satisfaction, reduce dissatisfaction points, and ultimately increase customer loyalty.

STRATEGIC RECOMMENDATIONS

After completing our research, we identified the most significant factors influencing customer satisfaction: cart abandonment, rating accuracy, review reliability, personalized recommendation frequency, and service appreciation. Building on these findings, the following strategic recommendations aim to leverage these insights to enhance customer satisfaction and optimize Amazon's operations.

5.1. Cart Abandonment

Cart abandonment remains a significant challenge for all e-commerce platforms, including Amazon. It occurs when customers add items to their cart but fail to complete the purchase.

Table 3 provides a detailed breakdown of the counts for various factors contributing to cart abandonment, based on a total of 602 responses. Each factor represents a specific reason cited by respondents for not completing their purchases.

To address this issue, we recommend several strategies. First, optimizing the checkout process by simplifying the number of steps and offering more payment options can enhance the user experience. Research suggests that providing diverse payment methods can significantly reduce cart abandonment rates (Wattoo et al., 2025). Second, introducing incentives such as discounts, free shipping, or time-limited promotions can motivate hesitant shoppers to complete their purchases. Finally, utilizing remarketing tactics, including personalized email reminders or targeted product recommendations based on abandoned cart items, can effectively re-engage customers and prompt them to return and finalize their orders. By implementing these strategies, Amazon can meaningfully reduce cart abandonment and capture otherwise missed sales opportunities.

5.2. Reviews & Ratings

Customer reviews are critical for building trust and credibility. They provide potential buyers with real-life perspectives on products that are unavailable in the company's official descriptions (Ologunebi et al., 2025)

Table 4 summarizes the extent to which customers rely on product reviews when making purchase decisions on Amazon, based on a total of 602 responses.

Out of 602 surveyed customers, nearly all reported some degree of reliance on product reviews. Positive reviews boost confidence and influence purchasing decisions, while negative reviews can deter potential buyers. Stud-

ies show that customers focus more on negative reviews than positive ones, amplifying their impact (Chen et al., 2022).

To mitigate the adverse effects of negative reviews, we recommend that sellers actively address these reviews rather than ignore them. One effective approach is responding directly to negative feedback by engaging with dissatisfied customers and acknowledging their concerns, which demonstrates accountability and professionalism. In addition, offering resolutions, such as providing a replacement product or issuing a full refund when appropriate, can help resolve customer dissatisfaction and show a commitment to service quality. While negative reviews cannot be removed, visible efforts to resolve issues can enhance trust and credibility with prospective buyers. When customers see that Amazon or its sellers are proactive in addressing concerns, it fosters greater confidence in the platform.

5.3. Personalized Recommendations & Service Appreciation

5.3.1. Personalized Recommendations

Personalized recommendations play a crucial role in improving customer satisfaction. By analyzing customers' browsing and purchase behaviors, Amazon provides tailored product suggestions, effectively guiding customers toward items they are likely to purchase (Jiang, 2024).

Table 5 presents the distribution of customers based on how frequently they utilize personalized recommendations when making purchases, out of a total of 602 responses.

To maximize the effectiveness of personalized recommendations, Amazon should strategically position these suggestions throughout its website. For instance, placing recommendations under shopping carts, on product pages, and on the homepage can encourage customers to explore and add more items to their carts. Optimizing these placements will not only enhance the shopping experience but also increase sales opportunities.

5.3.2. Service Appreciation

Customers highly value key aspects of Amazon's service, including competitive pricing, a diverse product selection, and user-friendly interface. Notably, the company's ongoing enhancements and optimizations in shipping have significantly improved convenience, further increasing customer satisfaction and appreciation (Ologunebi et al., 2025).

Figure 2 displays the counts for various factors contributing to customer appreciation of Amazon's services. Each category represents a specific reason for which customers value the service, such as product recommendations,

competitive prices, wide product selection, and a user-friendly website/app interface. The chart highlights the most frequently cited factors driving customer satisfaction.

To enhance service appreciation, Amazon could invest in customer service training by equipping representatives with empathy, problem-solving skills, and in-depth knowledge of the company's offerings to effectively address customer inquiries. Additionally, implementing proactive communication can help keep customers informed throughout the purchase process and address potential concerns before they escalate. By improving both personalized recommendations and overall service quality, Amazon can further strengthen its position as a leader in e-commerce, enhancing customer satisfaction and loyalty.

These recommendations provide actionable insights for Amazon to address critical customer satisfaction factors, reduce cart abandonment rates, leverage reviews and ratings, and optimize personalized recommendations and service appreciation. Implementing these strategies will not only improve customer experiences but also strengthen Amazon's competitive advantage in the market.

CONCLUSION

This study examined key factors influencing customer satisfaction on Amazon, leveraging data from the *Amazon Consumer Behavior Dataset* and applying multiple linear regression analysis. Our findings highlight several critical elements that significantly impact customer experiences, including cart abandonment, rating accuracy, review reliability, personalized recommendation frequency, and service appreciation. These insights provide a data-driven foundation for improving Amazon's customer service and optimizing user satisfaction.

One of the most significant findings of our analysis is the role of cart abandonment in shaping customer satisfaction. High rates of cart abandonment, particularly due to price concerns and indecision, suggest that Amazon could benefit from strategies such as streamlining the checkout process, expanding payment options, and using targeted remarketing tactics. Addressing these issues effectively can help minimize lost sales and enhance the overall shopping experience.

Our results also emphasize the importance of product reviews and ratings in influencing customer trust and purchase decisions. A majority of Amazon customers rely on product reviews, and negative feedback disproportionately impacts consumer behavior. Implementing strategies to actively manage and respond to customer feedback, such as improving seller engagement with negative reviews and ensuring the reliability of ratings, can enhance trust and credibility within the marketplace.

Furthermore, personalized recommendations play a crucial role in shaping user satisfaction. Our analysis indicates that customers who frequently engage with personalized recommendations report higher levels of satisfaction. By refining recommendation algorithms and strategically placing suggested products in key locations throughout the shopping journey, Amazon can further improve user engagement and drive higher conversion rates.

Lastly, service appreciation, particularly regarding competitive pricing and user-friendly website design, emerged as another essential factor influencing customer experiences. While Amazon already excels in these areas, further improvements in customer service training and proactive communication can reinforce customer loyalty and satisfaction.

In conclusion, our study provides actionable insights into optimizing Amazon's customer service by focusing on key pain points and leveraging data-driven strategies. By implementing improvements in checkout processes, review management, personalized recommendations, and overall service quality, Amazon can continue to enhance customer satisfaction, retain a loyal consumer base, and maintain its competitive edge in the e-commerce industry. Future research could explore additional dimensions of customer satisfaction, such as brand loyalty, delivery efficiency and post-purchase support, to provide an even more comprehensive understanding of consumer preferences.

While this study offers valuable insights into factors influencing customer satisfaction on Amazon, it is not without limitations. The use of convenience sampling through social media platforms may introduce selection bias, as participants are more likely to be digitally engaged and familiar with e-commerce, potentially limiting the generalizability of our findings to the broader consumer population. Additionally, while Microsoft Excel provided a practical and accessible tool for data modeling and analysis, it may not support the same level of robustness or scalability as more specialized statistical software. Acknowledging these methodological constraints helps contextualize the scope of our conclusions and suggests avenues for future research using more diverse samples and advanced analytical tools.

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APPENDIX

Table 1. Descriptive Statistics

This table presents the descriptive statistics for the variables used in the final model in this study. Abbreviations for each variable are explained in parentheses. The table is divided into two panels: Panel 1 reports descriptive statistics for the numeric variables, including the first and third quartiles, mean, median, and standard deviation. Panel 2 shows the frequency counts and total number of observations for the categorical variables.

Panel 1

Numeric Variables	P25	Mean	Median	P75	Std
PRF (Personalized Recommendation Frequency)	2	2.6993	3	3	1.0420
RA (Rating Accuracy)	2	2.6728	3	3	0.8997

Panel 2

Categorical Variables	Yes	No	Total Observations
D_PF_LTOM (Purchase Frequency - Less than a month)	124	478	602
D_BF_FTM (Browsing Frequency - Few times a month)	249	353	602
D_BF_R (Browsing Frequency – Rarely)	77	525	602
D_CCF_R (Cart Completion Frequency – Rarely)	72	520	602
D_CCF_N (Cart Completion Frequency – Never)	21	581	602
D_CAF_FBPE (Cart Abandonment Factors - Found a better price elsewhere)	255	347	602
D_CAF_HSC (Cart Abandonment Factors - High shipping costs)	70	532	602
D_CAF_CM (Cart Abandonment Factors - Changed my mind)	241	361	602
D_RR_H (Review Reliability – Heavily)	149	453	602
D_RR_M (Review Reliability – Moderately)	199	403	602
D_SA_CP (Service Appreciation - Competitive prices)	182	420	602
D_SA_WPS (Service Appreciation - Wide product selection)	150	452	602

Table 2. Regression on Shopping Satisfaction

This table presents the results of the regression analysis on shopping satisfaction. The coefficients for each variable are listed along with their standard errors (in parentheses). Statistical significance is denoted by ***, **, and * for the 1%, 5%, and 10% significance levels, respectively.

Variable	Statistics
D_PF_LTOM (Purchase Frequency - Less than a month)	-0.1531 (0.0940)
D_BF_FTM (Browsing Frequency - Few times a month)	0.1315 (0.0745)
D_BF_R (Browsing Frequency – Rarely)	0.1657 (0.1165)
D_CAF_FBPE (Cart Abandonment Factors - Found a better price elsewhere)	-0.2778*** (0.0957)
D_CAF_CM (Cart Abandonment Factors - Changed my mind)	-0.3247*** (0.0963)
D_RR_H (Review Reliability – Heavily)	-0.3508*** (0.0887)
D_RR_M (Review Reliability – Moderately)	-0.1259 (0.0793)
PRF (Personalized Recommendation Frequency)	0.2433*** (0.0359)
RA (Rating Accuracy)	0.4168*** (0.0417)
D_SA_CP (Service Appreciation - Competitive prices)	-0.1817** (0.0789)
D_SA_WPS (Service Appreciation - Wide product selection)	-0.1387 (0.0872)
Observations R-Square Adjusted R-Square	602 0.3667 0.3549

Table 3. Reasons for Cart Abandonment Factors

Car Abandonment Factors	Frequency	Percentage
Found a better price elsewhere	255	42%
Changed my mind or no longer need the item	241	40%
High Shipping Costs	70	12%
Others	36	6%
Total	602	100%

Table 4. Reliance on Product Reviews before Making Purchases on Amazon

Options	Frequency	Percentage
Heavily	231	38%
Moderately	199	33%
Occasionally	149	25%
Never	23	4%
Total	602	100%

Table 5. Frequency of Using Personalized Recommendations for Purchases

Categories	Frequency	Percentage
No	251	42%
Sometimes	229	38%
Yes	122	20%
Total	602	100%

Figure 1. Conceptual Framework

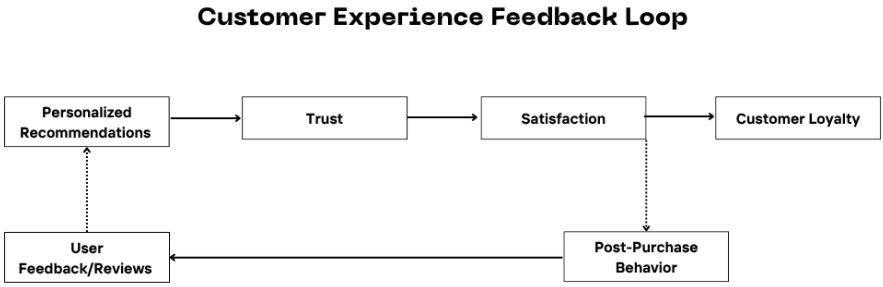
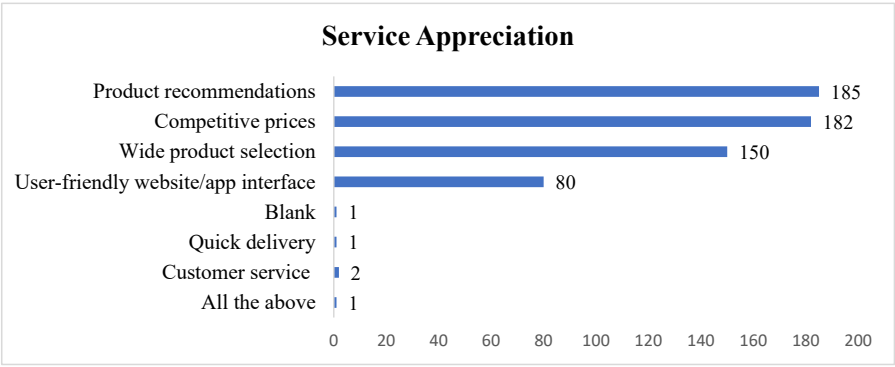


Figure 2. Factors Contributing to Service Appreciation



CONSUMER PERCEPTIONS OF THE APPLE'S SOLAR-POWERED WATCH

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ABSTRACT

Apple Inc. is an American technology company that produces computers, laptops, smartphones, tablets, earphones, watches, and many other products. In recent years, there has been increased demand for technology companies to become more eco-friendly due to sustainability and growing environmental concerns. With increasing pressure on technology companies to adopt sustainable practices, understanding the appeal of eco-friendly product features has become essential. This study investigates consumer perceptions of a proposed solar-powered Apple Watch featuring biodegradable band materials. A survey was conducted in November 2024 using Google Forms and yield 196 respondents. Accordingly, this study empirically examined how attributes such as watch face size, band material, and band color, and consumer demographics like age, gender, income, and education influence purchase decisions. Correlation analysis and a multiple regression model were employed to evaluate which variables significantly predicted willingness to pay. The results indicated that prior Apple Watch ownership and specific product features (battery and color) were the most significant predictors. These findings suggest that Apple has evenly eco-friendly with brand loyalty and high performing to achieve in the sustainable product innovation.

INTRODUCTION

The Apple Watch was first introduced in 2015, extending iPhone functionality and promoting an active and health-conscious lifestyle. Its features, such as heart rate monitoring, step tracking, and workout recording, help promote wellness with convenience. Beyond basic smartphone mirroring, the device also allows messaging, phone calls, and app interactions from the wrist. Apple has collaborated with Nike since 2016, and the intent behind this partnership was to focus on runners and fitness enthusiasts. Since starting their collaboration, the Apple Watch Nike series has improved technology by finding innovative ways to help users better understand and monitor their bodies and health. Examples include cellular connectivity, blood oxygen monitoring, temperature sensors, and the S9 chip. Cellular technology in an

Apple Watch allows Nike models to have long-term evolution in the watch. Blood oxygen monitoring measures blood oxygen saturation, helping users monitor lung function. With that information, runners can improve their blood oxygen levels and running ability. The temperature sensor feature in the Nike Watch allows users to better understand how their bodies regulate temperatures regarding activities such as ovulation and sleep. The S9 chip powers the Apple Watch, and it has technology that makes the watch faster and more efficient. All these upgrades that Apple and Nike have made over the years result in a great watch for active people by making it easier for them to understand their bodies and know where to improve their lifestyles.

The Nike Apple Watch Solar gives a good example for inspecting consumer insight of solar-powered hand wearable technology. It is eco-friendly, offering customers the benefit of a long-lasting battery life through solar power. This helps reduce the environmental impact without imposing strict rules, allowing customers to make positive choices for the planet. Each consumer who buys the Nike Apple Watch contributes to a cleaner environment. Beyond the solar charging feature, the watch also supports various activities, making it useful for trips or vacations far from a charger. For instance, the watch can still assist if lost in a park without phone service.

The product also saves money by reducing battery waste with its solar power feature. It is highly competitive with other, less environmentally friendly watches, helping Nike drive in more revenue. Apple is a globally recognized company that appeals to a wide range of consumers, from adults to children, making it one of the most fashionable brands in the world. Their products cater to all ages, allowing them to benefit from a broad consumer base. Specifically, the comfort Apple designs in the Apple Watch enhances its daily use, making it a luxury item and an affordable option for those with different budgets. Additionally, Apple's commitment to listening to customer feedback and understanding their likes and dislikes helps them continually improve their products. This attention to consumer interests fosters loyalty, which is essential for any company. The pricing strategy of Apple products is value-based, and the product prices align with the target consumers' expectations and perceived value (Cehn, 2024).

This study supports the development of a new solar-powered Apple Watch, designed to reduce the necessity of charging through integrated solar battery technology. Although the watch does not rely solely on solar power, the technology provides users with added comfort during activities, especially outdoors, that do not have easy access to charging stations or electrical outlets. Some drawbacks of this technology are that it is not entirely reliant on solar charging and is dependent on the actual sunlight. When the watch is in an area with limited sunlight, it may not charge as effectively. Currently,

only a few smartwatches on the market have solar technology. With continued research and development, these drawbacks could be reduced or eliminated, making it easier to use sustainable technology while maintaining a healthy lifestyle.

The reason behind using biodegradable material for the Apple Watch band is to contribute to a more environmentally friendly future. Even though many people try to reduce harmful products and increase sustainability, lasting change won't happen unless the root causes are addressed. As one of the most innovative companies, Apple is taking the lead in minimizing waste products. They are planning a new initiative starting in 2025, where they will offer free packaging to customers purchasing their products. One reason the Apple Watch band is so popular is its functionality. It caters to the average person's daily needs, making life a little easier ("Apple unveils its first carbon-neutral products"). The Apple Watch offers many features, standing out as one of the best products in today's society, particularly regarding health-related features. Apple is challenging other companies to keep up in the competitive space by pushing for more environmentally friendly business practices, such as reducing the carbon footprint in shipping and packaging. They significantly impact the environmental landscape, surpassing many other companies' commitment to sustainability.

In this study, we investigate the consumers' view of a solar-powered Apple Watch with the biodegradable band. Those who appreciate how the features can make a big change, and the items such as watch materials, size of the watch, style, alongside the population growth, have an impact on what is bought. And just doing this study points to the awareness of how comfortable technology has become, wearing them for style and becoming such a regular thing to see someone wearing it on. This study examines how eco-friendly features, such as solar charging and biodegradable bands, influence consumer perceptions of the Apple Watch, while also considering the roles of brand loyalty and product performance in shaping purchase intentions.

LITERATURE REVIEW

Prior studies have shown that consumer perceptions of sustainability help shape attitudes towards new and innovative technological products. However, cost, quality, and brand reputation often remain key drivers when it comes to purchase behavior. Although consumers express interest in buying solar-powered products, they hesitate to fully commit because they are held back by their skepticism about how reliable the product is. In addition to practical factors such as cost and reliability, researchers have also highlighted the importance of emotional and psychological benefits in consumer adoption.

For example, Hartmann and Apaolaza-Ibanez (2012) found that purchase decisions are often represented by perceptions of performance and value. The concept of warm glow (feeling good about acting sustainability) significantly boosted purchase intentions and consumer attitudes. Their findings demonstrate that the consumer's ability to express their identity through purchasing the environmentally sustainable product has an even greater impact on their purchase intentions. For wearable technologies like a solar-powered Apple Watch, the consumer will be more attracted to the item and go through with their purchase when it is positioned as part of their lifestyle and self-image rather than a functional add-on.

Other research points to potential drawbacks when companies position items as "sustainable". Luchs *et al*. (2010) describe this as "sustainability liability", meaning that consumers sometimes assume eco-friendly products are weaker, less durable, or less effective compared to the regular version. Consumers may hesitate to purchase the product if they think performance or reliability has been sacrificed, even though they are intrigued by the idea of sustainable features. This trade-off is important for high-involvement purchases, such as a smartwatch that consumers depend on daily, because consumers won't trade off reliability or performance for just reliability. Apple can't simply rely on "green marketing" to persuade consumers unless Apple convinces them that it works just as well or better than the standard models. For these types of devices, functionality and reliability are often more important than sustainability alone.

The way companies communicate eco-friendly features also plays a critical role in shaping consumer perceptions. Magnier and Crie (2015) demonstrate that when brands clearly explain the sustainability in their packaging, consumers reported greater trust and more positive evaluations. The packaging explains why, how, and what it means for the consumer and the planet in a transparent way. These explanations help reinforce the claims. On the contrary, if the communication is vague, consumers get skeptical and might not believe the eco-friendly claims. These findings suggest that companies such as Apple can't solely rely on adding sustainable features like solar power and biodegradable bands. They must also communicate these features in a transparent way to build consumer trust and highlight their value.

Apple not too long-ago sustainability showed how knowledgeable the problems are for the Apple watch. Although Apple watch series 9 now has the recycle type cobalt battery in the device, it is reusable and has a type of gold materials in it, and has different types of bands that are built from biodegradable materials or reusable parts. Studies on the Apple watch activity have shown that consumers were more focused on specific features, like the charge life of the device, ability the things it can do overall than renewable (Jung *et*

al., 2016). This shows how important solar power and how the biodegradable bands help improve Apple watches like the other products that work great or even better like the other models. For the faithful consumers, Apple's strong image is strong and may have less worries for the sustainability features. The Apple watch was coming off as more than just a regular device. It is known as a lifestyle device to have and with that the younger generation can be influenced to buy the watches which will match their lifestyle.

Scholars observed that brand reputation and consumer trust are at the core of embracing green technology. While environmental qualities are in their beginning stages, consumers will be compelled to bet on the reputation of reputable and established brands before agreeing to purchase. Iglesias *et al.* (2019) noted that strong brand attachment increases the desire of consumers to embrace innovations in the form of sustainability. Chen and Chang (2013) argue that if companies exaggerate "greenwashing", consumers may feel skeptical. However, if the brand already has a strong reputation for quality and ethics, it builds green trust, which makes consumers more likely to purchase the eco-friendly product. Loyal customers want to support Apple's innovations, and Apple's strong reputation makes consumers trust the genuineness of the eco-friendly features. Wearable technology is increasingly viewed as functional and a fashion accessory that communicates a consumer's identity and their social values. Sustainable products are more likely to be accepted by the consumer and their communities when they remain visually appealing and align with style trends (Joy *et al*., 2012). Consumers find fissionability a more attractive attribute than sustainability when making purchases, which highlights the importance of eco-friendly products having both fashion and sustainability to be more desirable (Becker-Leifhold & Iran, 2018). In the wearable technology market, adoption is influenced by how seamlessly devices integrate into daily lives while also enhancing personal style (Lunardo *et al*., 2016). A solar-powered Apple Watch with biodegradable bands is most likely to succeed in this market if it balances environmental benefits with sleek and fashionable designs that consumers already associate with the aesthetic of Apple.

RESEARCH DESIGN

When it comes to Apple's dominance in the smartwatch space, it all boils down to the accessibility and innovation they provide to complete the tasks their users need. Apple constantly competes by improving functionality and making things work more seamlessly. First, the various Apple Watch attributes offer multiple styles and designs. The most popular models come in both extended and regular sizes, maximizing comfort and a style that ac-

commodates individual preferences. Additionally, Apple has introduced new biodegradable materials, which have been very successful. This change reflects Apple's commitment to reducing its environmental impact and creating cleaner products to reduce carbon emissions. Apple is adjusting its devices and materials to contribute to a less carbon-intensive environment. The shift to biodegradable materials is part of Apple's larger plan to become carbon neutral by 2024 and in the future.

This study proposes a solar-powered Apple Watch with a biodegradable band to address both technological and environmental weaknesses in current smartwatch designs. The initial concept came from evaluating current Apple Watch limitations, especially considering short battery life. While the traditional Apple Watch users appreciate the fitness and health tracking features, many users, including the authors of this study, noted frequent and inconvenient charging interruptions that reduce usability during the day. This sparked the desire to focus on solar-powered alternatives that could optimize battery life and usability between charges. Although current solar-powered watches are not fully reliant on sunlight, introducing this feature into the Apple company represents a step toward sustainable innovation.

To complement the solar battery concept, a biodegradable watch band was also proposed. While some Apple Watch bands already use partially recycled materials, this product would better support environmental goals by using fully biodegradable materials derived from plant-based plastics or vegan leather. These brands aim to reduce waste and make recycling materials simpler at the end of product life. Combining solar power with biodegradable bands positions the product as a leader in sustainable wearable technology.

To assess consumer response to this concept, three key features were selected to analyze preference: watch face size, band material, and band color. The watch face sizes included 40mm and 44mm, aligning with Apple's standard offerings. Larger watch faces naturally accommodate more solar surface area, enhancing charge capacity. Band material options were vegan leather and plant-based plastic, selected based on trends in sustainable fashion. Color options were white, brown, and black, which were chosen because they are neutral and compatible with daily wear.

The selection of this feature was strategic, aiming to see and understand the variety of responses to different Apple Watch models being released. It ensures that Apple supports the quality and variety consumers expect without releasing unnecessary products that give negative thoughts about the brand. By focusing on high-quality offerings, Apple can gather valuable customer feedback, which will be crucial for adjusting to keep its products competitive. This approach will help Apple remain a leader in the tech industry by staying aligned with customer needs. The different watch sizes and the

unique features included play a significant role in the decision-making process when customers consider buying an Apple Watch.

SURVEY DATA

A survey was designed to better understand what attributes consumers were looking for when buying a solar-powered watch. Following the development of the solar-powered Apple Watch concept with biodegradable bands, a survey was conducted to evaluate consumer preferences. The survey aimed to figure out how key attributes such as band color, battery life, and price point influence decision-making. Respondents were asked about their preferences across different watch features that varied by watch face size (40mm or 44mm), band material (vegan leather or plant-based plastic), and band color (black, white, or brown). For instance, "What color band would you prefer?"

A survey was conducted in November 2024 using Google Forms and yielded 196 respondents. Table 1 below shows the details of all the variables. To ensure a diverse respondent base, the survey included demographic questions covering age, gender, education level, income, employment status, ethnicity, and type of residence. Gender representation showed a slight majority of female participants (64.6), which may reflect sampling channels or social sharing patterns. Most respondents were students or young professionals between 18 and 24 years old with annual incomes below $25,000. The majority (51%) are identified as White/Caucasian and live in rental housing (45.4%). The demographic data shows that the survey sample skewed toward young adults, most of whom were college-aged, single, and either employed part-time or full-time.

Table 1 Summary of all variables

Variables	Percentage	Variables	Percentage
Gender		**Age**	
Male	32.8	18-24	68.4
Female	64.6	25-34	14.8
Prefer not to say	2.6	35 and above	16.8
Ethnicity		**Residence**	
White/Caucasian	51.0	Rental property	45.4
Hispanic/Latino	19.4	Self-owned apartment	11.2
Black/African American	10.7	Self-owned house	19.9
Asian	14.3	Other	23.5

Prefer not to say	4.6	**Previous ownership**	
Marital status		No	31.6
Single	78.6	Yes, but no longer use it	29.6
Married, no child	8.7	Yes, and currently use it	38.8
Married, with underage children	8.6	**Preferred color**	
Married, with adult children	4.1	White	35.9
Employment status		Black	42.1
Student	39.8	Brown	22.0
Employed part-time	21.9	**Preferred battery**	
Employed full-time	34.2	≤ 12 hours	3.6
Others (housewife, retired, etc.)	4.1	13-18 hours	10.4
Annual income		19-24 hours	28.1
<US$25,000	48.0	25-30 hours	25.5
US$25,000-US$49,999	14.8	≥30	26.0
US$50,000-US$99,999	12.2	**Willingness to pay (WTP)**	
US$100,000-US$150,000	12.2	≤ US$250	24.0
>US$150,000	12.8	US$251-- US$350	28.6
Education		US$351-- US$450	24.0
High school or equivalent	14.3	US$451-- US$550	16.3
Community college or associate's degree	47.5	≥ US$551	7.1
Bachelor's degree	25.0		
Graduate and above	13.2		

Most respondents (38.8%) currently use an Apple Watch, 31.6% had never owned one, and 29.6% had previously used one but no longer do. This indicates that the majority of the sample participants are familiar with Apple Watch products, which strengthens the relevance of the study's product-based survey. It was also found that black is the most popular choice, favored by over 40% of respondents, followed by white and brown. These colors are associated with professionalism, sophistication, and versatility. They also

pair well with various outfits, making the watch a psychological appeal. When asked about battery life expectations, most participants preferred a solar-powered Apple Watch that could last between 19 to 24 hours on a full charge. Interestingly, the second most common response was a preference for a duration of over 30 hours, indicating a desire for extended performance. Regarding the dependent variable of willingness to pay (WTP), the $251–$350 range was most selected, aligning with the expectation of Apple watch pricing (So, 2023). Overall, the survey data offers useful insight into how younger, eco-aware, cost-conscious consumers evaluate wearable tech products and which attributes are most influential in their purchasing decisions.

CORRELATION ANALYSIS

The correlation matrix of all variables was plotted (see Table 2). As the correlation coefficients of the dependent variable (WTP) and the exploratory variables are lower than 0.30, the dependent variable has very weak correlation with the exploratory variables. All those variables failed to achieve statistical significance ($p<0.05$). In order to further determine how these factors influence respondents' WTP, the regression model was adopted in the next section.

Table 2 Correlation matrix of all the variables

Variables	WTP	gender	age	marriage	income	education	employ	ethnic	residence	own	color
Gender	-0.01	1									
Age	-0.03	-0.08	1								
Marriage	-0.02	0.24	-0.22	1							
Income	0.05	0.35	0.20	0.26	1						
Education	0.10	0.28	-0.31	0.14	-0.03	1					
Employ	0.07	0.56	0.51	0.47	0.11	0.44	1				
Ethnic	-0.01	0.16	0.15	0.43	-0.05	-0.20	0.21	1			
Residence	-0.11	-0.06	0.22	0.42	0.42	-0.20	0.01	0.23	1		
Own	0.26	-0.07	0.14	-0.10	0.01	-0.01	-0.07	-0.04	-0.01	1	
Color	0.14	-0.15	0.11	0.17	0.16	0.03	-0.21	-0.01	0.15	0.01	1
Battery	0.15	-0.50	0.54	-0.48	-0.19	0.36	-0.77	-0.24	-0.11	0.18	0.08

REGRESSION ANALYSIS

The regression model presented the influence of a range of factors on consumers' willingness to pay for the solar-powered Apple Watch. One key takeaway from the regression output is the significance of prior Apple Watch ownership as a predictor of buying intention. This finding aligns with the observed relationships in the correlation matrix, particularly the strong association between past ownership and willingness to pay. This variable has a strong positive coefficient of 0.664 ($p<0.01$), showing that it strongly predicts the likelihood of buying future Apple products. This suggests that customers who have owned an Apple Watch are more likely to continue buying new products from the brand. This information brings the power of brand loyalty and shows how Apple can use this awareness to its advantage. By highlighting the benefits of upgrading to their latest products, Apple can strengthen its marketing strategy and maintain customer retention. The insight into previous ownership is pretty valuable. The regression analysis points out that prior ownership is a strong predictor of purchase intention and WTP, which is interesting, especially given that 48% of the sample makes under $25K and 31.6% have never owned an Apple Watch. Table 3 shows the detailed regression results.

Table 3 Regression results of consumers' willingness to pay

Variables	Coefficients	Standard error	p-value
Gender	0.28	0.30	0.35
Age	-0.06	0.15	0.69
Marriage	-0.03	0.12	0.78
Income	-0.11	0.08	0.16
Education	0.08	0.08	0.33
Employment	-0.03	0.17	0.85
Ethnicity	-0.03	0.08	0.75
Residence	0.07	0.07	0.32
Ownership before	0.66**	0.20	<0.01
Color	0.27*	0.13	0.04
Battery	0.29**	0.10	<0.01

Notes: * $p < 0.05$; ** $p < 0.01$

The model further examined the variables related to color and battery features to assess their statistical influence on consumer decisions. While their coefficients and P-values suggest they have statistically significant impacts on consumers' willingness to pay. For example, the color feature has a coefficient of 0.27 ($p<0.05$) and the battery with 0.29 ($p<0.01$), showing they are major factors in consumer decision-making. Interestingly, factors like age, annual income, and type of residence appear to have statistically insignificant impacts on consumer purchasing. It suggests that Apple focuses less on demographic factors and more on embracing the features and benefits of their products to improve customer satisfaction and involvement. This approach aligns with Apple's reputation for prioritizing product innovation over targeting specific demographics.

CONCLUSION

Managerial implications

This study shows consumers' perceptions of the Apple watch's unique features, such as solar charging and biodegradable bands. It is worth noting that having these environmentally friendly features was not influential. In fact, the battery life, watch size, and the things that make the band material had a huge effect on consumers' willingness to pay. Customers who were already intended to have an Apple Watch would always keep getting the upgrades, showing brand loyalty to the company. These findings emphasize the way of balancing the unique features with high performance for Apple, and still having the brand image attached to it. It is worth noting that the solar-powered battery and the band colors will bring better recognition and higher willingness to pay.

Limitation and future research

This study has some restrictions. The sample was mostly young adults, and some had lower incomes than others. The survey also has self-responses and can sometimes not match the real-life buying actions. In future studies, more diverse respondents should be interviewed. Studies could look at how things are being promoted with product testing or real-world experience can influence customer attraction in the friendly environmental features. Seeking out several types of ways of technology that consumers wear on their wrist would add such worth to the debate about the ongoing technology and its eco-friendliness.

The empirical findings indicate a chance for Apple to highlight the long-term benefits of solar charging and biodegradable materials in future marketing and consumer education. By embracing the positive environmental

influence and practical advantages of solar-powered technology, Apple could enhance consumer awareness and potentially boost interest in these upgrades. It also highlights a younger, budget-conscious, and environmentally aware audience, which may be a key segment for future marketing of solar-powered wearable technologies. More importantly, the regression analysis highlights the significant influence of brand loyalty and product style on consumer choices. Apple should use these strategies to carry the positive features of their products and address potential customer needs. As a well-known company, Apple is very established to attract the attention of both loyal customers and new consumers who may be unfamiliar with the solar-powered Apple Watch.

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