Incorporating Subjectivity into Economic Models: A Study on Consumption and Consumer Sentiment in The U.S.

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Abstract. This study examines the integration of consumer sentiment into economic models to elucidate consumption dynamics in the United States. Drawing on John Maynard Keynes's concept of 'Animal Spirits,' we analyze the relationship between consumer sentiment and consumption, alongside objective economic indicators. While consumer sentiment demonstrates a significant influence on spending behaviors, its significance diminishes when economic fundamentals are considered. This nuanced perspective underscores the multifaceted nature of consumer sentiment and highlights the need to integrate both subjective and objective factors into economic modeling.

Keywords: Consumer Sentiment, Animal Spirits, Economic Modeling, Consumer Price Index (CPI), Michigan Consumer Sentiment Index (MCSI).

1. Introduction

Consumption, is a central component of the economy, driving approximately 70% of economic activity in the United States. This critical role emphasizes the interconnectedness between consumer spending and economic growth and highlights the significance of consumer spending in fostering economic stability. This study delves into the complexities of consumption, drawing on John Maynard Keynes's concept of 'Animal Spirits' from "The General Theory of Employment, Interest, and Money" to explore the psychological underpinnings of economic decisions. This paper will extend the traditional Keynesian Consumption Function, which posits consumption as a function of income, to include additional variables such as inflation and in This paper also researches the integration of consumer sentiment into the consumption model, reflecting the impact of both measurable economic conditions and subjective future expectations on consumer behavior. Another extended model in this paper incorporates this subjectivity into economic models, especially with regard to consumption and consumer sentiment, aiming to bridge the gap between tangible economic indicators and the intangible influences of consumer perceptions. To sum up, this approach seeks to offer a more holistic view of how economic factors and subjective sentiments coalesce to shape consumption patterns, thereby enriching our understanding of economic dynamics.

2. Organization of the Text

2.1. Literature Review

Previous studies indicate that consumer sentiment can be studied from different viewpoints, especially from the perspective of consumer sentiment. El Alaoui et al. (2020) examine U.S. consumer sentiment using both linear and nonlinear models applied to monthly data from 2009 to 2019. They find significant deviations from Random Matrix Theory, indicating potential informational value in over 8.3% of eigenvalues. Linear models highlight the impact of stock market performance, confidence, personal income, and unemployment on consumer sentiment, while nonlinear models reveal shifts towards positivity in various factors (2020). Uhl (2011) introduces a novel dataset comprising a news sentiment index derived from 300,000 newspaper articles. Through ARMA models, he demonstrates that combining news and consumer sentiment with macroeconomic variables significantly explains changes in private consumption. In conclusion, these studies provide a comprehensive analysis of U.S. consumer sentiment through both linear and nonlinear models,

revealing the significance of various economic factors and deviations from Random Matrix Theory. Additionally, Uhl's introduction of a news sentiment index further underscores the importance of incorporating sentiment data into macroeconomic models for explaining changes in private consumption, highlighting the value of multidisciplinary approaches in studying consumer behavior.

In the realm of economic theory, John Maynard Keynes introduced the notion of "Animal Spirits" to describe the non-rational factors influencing economic decision-making. Embedded within his seminal work, "The General Theory of Employment, Interest, and Money," Animal Spirits encapsulate the psychological underpinnings of economic behavior, acknowledging the role of sentiment, confidence, and instinctual impulses in shaping economic outcomes. This concept suggests that individuals' perceptions, emotions, and expectations can significantly impact economic activity, particularly in contexts such as consumption and investment decisions. Within the framework of incorporating subjectivity into economic models, the concept of Animal Spirits provides a lens through which to understand the subjective elements driving consumer sentiment. By acknowledging the influence of psychological factors alongside traditional economic indicators, such as income and prices, economic models can better capture the complexities of consumer behavior and its implications for economic outcomes. As such, understanding and integrating Animal Spirits into economic models are crucial steps towards developing more comprehensive frameworks that accurately reflect the multifaceted nature of economic decision-making.

2.2. Data

To incorporate consumer sentiment into an economic model, there first needs to be a quantitative measure of the concept. The Michigan Consumer Sentiment Index (MCSI) has been the leading source of such measurements since 1952. This data serves as a pivotal tool in analyzing consumer sentiment, offering a deep understanding of consumers' perceptions towards their personal financial situations and the overall state of the economy. This index, compiled by researchers at the University of Michigan, provides valuable insights into consumer confidence levels, which in turn, can significantly impact consumer spending patterns and economic growth. The MCSI has been widely utilized in academic research, policymaking, and market analysis, as it offers a quantifiable measure of sentiment that can be tracked over time and correlated with various other economic indicators. Moreover, the index's methodology, which involves regular surveys of a representative sample of consumers, ensures its relevance and accuracy in reflecting changes in sentiment. In sum, the Michigan Consumer Sentiment Index is a crucial metric in the study of consumer behavior and its impact on the economy.

In the analysis of consumption patterns and economic behaviors, Consumer Sentiment data plays a pivotal role. The Bureau of Labor Statistics (BLS) provides invaluable insights into various aspects of the US economy, including employment, wages, and prices. However, these objective metrics often overlook the subjective component of economic decision-making, particularly consumer sentiment. To address this gap, our study incorporates the Michigan Consumer Sentiment Index (MCSI) into our economic models. The MCSI, a widely recognized measure of consumer sentiment, captures the subjective views of consumers regarding the current and future state of the economy. It provides insights into consumer confidence, expectations, and overall mood, which can significantly influence consumption decisions. Unlike other economic indicators, the MCSI directly reflects the subjective assessments of consumers, making it a crucial complement to objective data sources. By incorporating this subjective data, we were able to capture a more comprehensive picture of consumer behavior and its impact on the economy. It is important to note that the MCSI is not a widely understood metric. Therefore, a detailed discussion of its origins, construction, and interpretation is essential for readers to fully grasp its significance and implications. By explaining the concept and methodology behind the MCSI, we aim to enhance the understanding of our models and the role of subjectivity in economic decision-making. By doing so, we can gain a deeper understanding of consumption patterns and their impact on the overall economy.

Specifically, our study is focused on incorporating subjectivity into economic models, particularly regarding consumption and consumer sentiment within the United States, our analysis hinges on the annualized percentage growth rate as a key metric. The Bureau of Labor Statistics (BLS) provides a reliable source of data for consumption spending, GDP, and CPI. These quarterly releases of consumption and GDP offer a comprehensive overview of the nation's economic health. On the other hand, consumer sentiment data and monthly CPI figures require a different approach. To account for the monthly variations, we apply the annualized percentage growth rate formula to specific months (January, April, July, and October) to capture significant changes and seasonal patterns. The formula utilized for calculating this growth rate is expressed as:

Annualized Percentage Growth Rate = [(New Value - Old Value)/Old Value)^4.

This formula effectively captures the year-over-year growth, adjusting for the fact that our data is not uniformly collected on an annual basis. This approach allows us to compare and analyze the trends in consumption spending, GDP, and prices (CPI) with precision. Interest rates, another crucial determinant of consumer spending, are included in our analysis at their respective monthly levels, as we hypothesize that the absolute level of interest rates, rather than changes in them, has a more significant impact on spending decisions. An important hypothesis underpinning our study is that the interest rate itself serves as a more influential determinant of spending than fluctuations in that rate. Utilizing these variables, our regression model is structured as follows:

Consumer Spending = f(GDP,Inflation,Interest Rates, Consumer Sentiment)

This approach allows us to quantitatively assess the relative importance of objective economic indicators and subjective sentiment measures in shaping consumer behavior and, ultimately, the overall economic landscape.

Incorporating subjectivity into economic models has become an increasingly important area of research, particularly in the context of studying consumption and consumer sentiment in the United States. Models that capture the subjective element of consumer behavior, such as sentiment indices and psychological factors, have gained significant attention in recent years. Linear regression models have traditionally been employed to examine the relationship between objective economic indicators and consumer behavior, offering insights into how variables such as GDP, inflation, and unemployment impact consumption patterns (Batrancea, 2021). However, to capture the nuanced interplay between subjective factors and economic outcomes, researchers have also increasingly turned to nonlinear models. Nonlinear models, such as switching regime models, allow for the identification of shifts in consumer sentiment and behavior over time, providing a more nuanced understanding of how individuals respond to changes in economic conditions (El Alaoui et al., 2020). Moreover, psychological measures have also been incorporated into economic models to capture individual differences in consumer behavior. Overall, the integration of subjectivity into economic models, as demonstrated by these citations and other studies, has emerged as a promising avenue for enhancing our understanding of consumption and consumer sentiment in the US. This approach offers a more holistic view of consumer behavior, considering both rational and emotional factors that influence decision-making.

In addition to the data on consumer sentiment, we also include variables that are more traditionally included in consumption models. The Bureau of Economic Analysis (BEA) provides quarterly data on the gross domestic product (GDP). In addition, the Bureau of Labor Statistics (BLS) reports monthly on a variety of measures of prices and inflation.

The Department of the Treasury publishes daily information on a range of interest rates. To integrate these various reports, these variables (except for interest rates) are constructed by creating annualized percentage changes. Since we believe that consumers respond more directly to the level of interest rather than changes, we did not annualize this variable.

2.3. Data Analysis

As described above, the measure of the consumer sentiment we applied is the Michigan Consumer Sentiment Index (MCSI) [1], which is primarily based on telephone surveys [2] of the consumers'

feelings about their finances, buying conditions, and the economy at the societal level [3], etc. In Fig. 1 we plot this consumer sentiment index and GDP data for every quarter from April 1971 through October 2023. These are shown by the blue curve and light orange shadow, respectively in Figure 1.

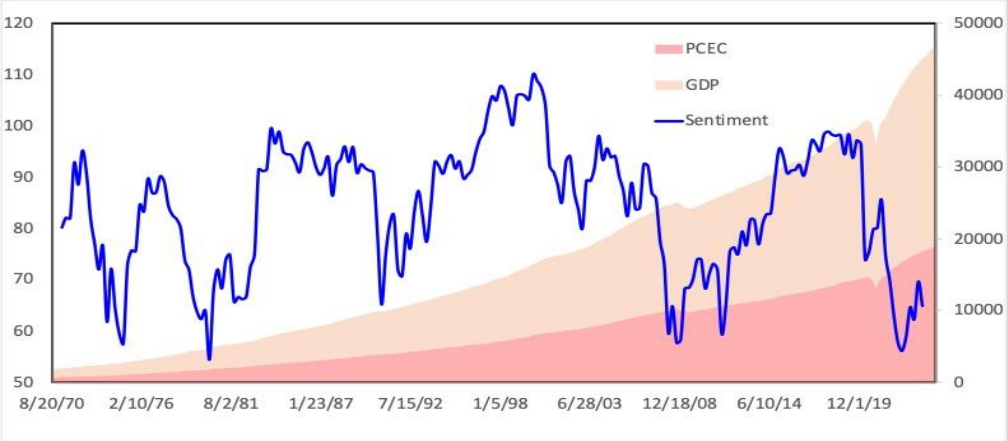

Fig. 1 Quarterly data of the consumer sentiment, GDP, and the predicted values of consumption (PCEC).

The first estimates we considered were based on a regression with the annualized percentage change of consumer sentiment as the dependent variable with the mortgage interest rate and annualized changes in GDP and the CPI as explanatory variables. The results of this are reported in Appendix Table A1. As expected, increases in GDP are associated with increased consumer sentiment. A one percent increase in GDP causes an estimated 1.4% increase in consumer sentiment. In addition, a one percent increase in the CPI causes a 1.8% decrease in consumer sentiment. Both are significant at a 1% level of significance. However, changes in the mortgage interest rate do not have a significant effect on consumer sentiment.

Looking at the Analysis of Variance, we see that the F-statistic of 4.31 is significant at 1%, indicating that as a group, GDP, inflation, and mortgage rates provide a statistically significant effect on consumer sentiment. However, the R2 of .059 tells us that only 5.9% of the variation in consumer sentiment is explained by these three variables. The remainder could be due to other factors that were not included, or random variation in consumer sentiment. It is also possible that some of the remaining variation is due to the Keynesian concept of 'Animal Spirits'.

We next turned our attention to the relationship between consumer sentiment and consumption expenditures. Results from a regression of the annualized change in consumer sentiment on consumption are reported in Appendix Table A2. Although the coefficient of .03 is quite small, it is statistically significant at the 5% level of significance. However, it is not clear from this simple regression whether the changes in consumption are due to economic variables, or to changes in consumer sentiment that are independent of these measurable effects.

To help separate these effects, we then considered a model that included only our three observable economic variables, without the inclusion of consumer sentiment as an explanatory variable. The results of this regression are reported in Appendix Table A3. In this case, only annualized changes in GDP have a statistically significant effect on the annualized changes in consumption spending. Neither changes in the CPI nor the level of the mortgage interest rate are statistically significant. However, the R2 of .78 indicates that 78% of the variation in consumer spending is explained by these variables.

Finally, to test our hypothesis of whether 'Animal Spirits' have an independent effect on consumer spending, we regressed the annualized percentage change in consumer spending on the mortgage interest rate and the annualized percentage changes in GDP, prices and consumer sentiment. These results are reported in Table A4. Once again, only changes in GDP have statistically significant effects on consumer spending. While the estimated effect of an increase in consumer sentiment is positive, it is not statistically significant. In addition, the R2 only increases from .77 to .78 with the addition

of consumer sentiment to the model, which emphasizes the insignificance of consumer sentiment as an explanatory variable.

Such findings prompt a reconsideration of the conventional wisdom surrounding consumer sentiment. It suggests that the tangible aspects of the economy significantly mediate the relationship between sentiment and spending, relegating the intangible 'Animal Spirits' to a secondary role. This pivotal insight advances our understanding of economic behavior, emphasizing the need to consider both measurable economic factors and the psychological elements they inspire in shaping consumer expenditure patterns.

2.4. Findings & Discussion

The regression analysis conducted revealed a robust positive linear relationship between consumer sentiment and consumption patterns. This finding is strongly supported by a high correlation coefficient (Multiple R = 0.879) and a substantial coefficient of determination (R Square = 0.774), indicating that fluctuations in consumer sentiment have a significant impact on consumption behaviors.

Furthermore, the model's predictive accuracy and robustness are confirmed by an Adjusted R Square of 0.772 and a low Standard Error, reflecting a precise fit to the available data. ANOVA analysis adds further credibility to the model's statistical significance, with a notably high F-statistic and a near-zero p-value, underscoring its reliable predictive capabilities.

However, when the model was expanded to incorporate additional variables such as GDP, prices, and mortgage rates, the significance of consumer sentiment diminished. This observation highlights the mediating role of economic fundamentals in shaping consumer behavior. Specifically, while GDP and price elasticity demonstrated considerable effects on spending patterns, consumer sentiment lost its statistical significance. This finding suggests that consumer sentiment plays a secondary role in the presence of direct economic indicators, emphasizing the multifaceted nature of consumer sentiment, which appears to be heavily influenced by tangible economic factors rather than acting independently.

Taken together, these results present a nuanced understanding of the complex interplay between economic indicators, consumer sentiment, and consumption behavior. This analysis underscores the importance of considering both objective and subjective factors in economic modeling to accurately capture the dynamics of consumer behavior. The findings of this study contribute to a deeper understanding of the role of sentiment in economic decision-making and highlight the need for a holistic approach in analyzing consumer behavior.

2.5. Conclusion

The results of our analysis provide profound insights into the intricate relationship between consumer sentiment, economic indicators, and consumption behavior. Initially, leveraging the Michigan Consumer Sentiment Index (MCSI) as a metric to assess consumer sentiment, our study plotted this sentiment alongside GDP data spanning several decades.

Consumer spending is a pivotal driver of the U.S. economy, this study explores the intricate relationship between consumer behavior and economic health, emphasizing the role of subjective factors in shaping consumption patterns. Drawing from Keynes's 'Animal Spirits' concept, it extends economic models to include variables like inflation, interest rates, and unemployment. By integrating consumer sentiment, we clarify the interplay between economic conditions and subjective perceptions, enhancing our understanding of consumption dynamics. Analysis reveals a positive relationship between sentiment and consumption, yet the significance of sentiment diminishes when considering economic fundamentals. This nuanced perspective underscores the need to integrate both economic factors and subjective perceptions to accurately capture consumption behavior. This study enriches our understanding of economic dynamics, informing more effective policymaking and forecasting.

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Appendix

Table A1: Dependent Variable: Consumer Sentiment (Annualized Percentage Change)

SUMMARY OUTPUT							
Regression Statistics							
Multiple R	0.24296						
R Square	0.05903						
Adjusted R Square	0.04532						
Standard Error	0.29698						
Observations	210						
ANOVA							
	df	SS	MS	F	Significance		
Regression	3.00000	1.13972	0.37991	4.30746	0.00568		
Residual	206.00000	18.16865	0.08820				
Total	209.00000	19.30837					
	Coefficients	Standard Error	t Stat	P-value			Upper 95%
Intercept	1.86511	0.69288	2.69181	0.00769			3.23116
GDP	1.35669	0.43201	3.14040	0.00194			2.20842
CPI	-1.89179	0.69457	-2.72369	0.00701			-0.52241
Mort Rate	0.00671	0.00703	0.95445	0.34098		0715	0.02057

Table A2: Dependent Variable: Consumer Spending (Annualized Percentage Change)

SUMMARY OUTPUT		A2	Spending				
Regression Statistics							
Multiple R	0.17382						
R Square	0.03022						
Adjusted R Square	0.02555						
Standard Error	0.05255						
Observations	210.00000						
ANOVA							
	df	SS	MS	F	Significance		
Regression	1.00000	0.01789	0.01789	6.48055	0.01163		
Residual	208.00000	0.57431	0.00276				
Total	209.00000	0.59220					
	Coefficients	Standard Error	t Stat	P-value			Upper 95%
Intercept	0.06524	0.00365	17.86814	0.00000			0.07244
Sentiment	0.03044	0.01196	2.54569	0.01163		687	0.05402

Table A3: Dependent Variable: Consumer Spending (Annualized Percentage Change)

SUMMARY OUTPUT		A3	Spending					
Regression Statistics								
Multiple R	0.881642							
R Square	0.777293							
Adjusted R Square	0.774049							
Standard Error	0.025303							
Observations	210							
ANOVA								
	df	SS	MS	F	Significance F			
Regression	3	0.460312	0.153437	239.6602	0.00			
Residual	206	0.131887	0.00064					
Total	209	0.5922						
	Coefficients	Standard Error	t Stat	P-value				
Intercept	-0.08053	0.059034	-1.36413	0.174016				
GDP	0.86057	0.036807	23.38033	7.13E-60				
CPI	0.084938	0.059177	1.435306	0.152717				
Mort	0.00046	0.000599	0.767828	0.443468			0.00164	

Table A 4: Dependent Variable: Consumer Spending (Annualized Percentage Change)

SUMMARY OUTPUT		A4	Spending		
Regression Statistics					
Multiple R	0.88280				
R Square	0.77934				
Adjusted R Square	0.77503				
Standard Error	0.02525				
Observations	210.00000				
ANOVA					
	df	SS	MS	F	Significance F
Regression	4.00000	0.46152	0.11538	181.00442	0.00000
Residual	205.00000	0.13068	0.00064		
Total	209.00000	0.59220			
	Coefficients	Standard Error	t Stat	P-value	
Intercept	-0.09575	0.05993	-1.59770	0.11165	
GDP	0.84950	0.03760	22.59523	0.00000	
CPI	0.10038	0.06010	1.67014	0.09642	
Mort Rate	0.00041	0.00060	0.67637	0.49957	
Sentiment	0.00816	0.00592	1.37808	0.16968	