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# Short-Term Household Economic Stress Effects on Retail Sales in El Paso: 2002-2019

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A revised version of this study is forthcoming in *Atlantic Economic Journal.*

THE UNIVERSITY OF TEXAS AT EL PASO

UTEP BORDER REGION MODELING PROJECT


TECHNICAL REPORT TX22-2

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Continued maintenance and expansion of the UTEP business modeling system requires ongoing financial support. For information on potential means for supporting this research effort, please contact Border Region Modeling Project - CBA 236, Department of Economics & Finance, 500 West University, El Paso, TX 79968-0543.

# SHORT-TERM HOUSEHOLD ECONOMIC STRESS EFFECTS ON RETAIL SALES IN EL PASO: 2002-2019*

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*A revised version of this study is forthcoming in ***Atlantic Economic Journal***.

**Abstract:** Economic stress indices are beginning to be developed as gauges of business cycle conditions for regional economies. Although the popularity of these metrics is increasing, there have been only a small number of studies that analyze the effectiveness of these tools for monitoring regional economic developments. This effort employs data for one such index that is maintained by The University of Texas at El Paso Border Region Modeling Project. The sample period covers December 2002 through March 2019. Specific components of the index include inflation, unemployment, and housing prices. Estimation results indicate that the effects of any changes in economic stress levels may take approximately 16 months to be fully experienced within the El Paso retail sector. Simulation results indicate that a one-time, 1-point increase in economic stress leads to a $2.987 million decrease in monthly retail sales.

**JEL Classifications:** R15 Regional Econometrics, M21 Business Economics, D12 Empirical Consumer Economics

**Keywords:** Economic Stress, Regional Economics, Commercial Activity, Time Series Models

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## INTRODUCTION

The Misery Index for the United States national economy is designed to provide a measure of household economic difficulty. The index is calculated by adding the annual percentage change in the consumer price index and the seasonally adjusted unemployment rate (Di Tella et al., 2001). Although there is widespread recognition that inflation and unemployment affect consumer sentiment, the original misery index overlooks financial conditions that are important to households (Lovell & Tien, 2000). Dye and Sutherland (2009) addresses that issue by introducing housing prices to the framework. The latter measure subtracts percentage changes in housing prices from the original misery index and is known as the Household Economic Stress Index *(HESI)*.

The intuition underlying *HESI* is straightforward. Inflation erodes consumer purchasing power, unemployment causes personal incomes to fall, but rising housing prices increase household wealth. As calculated, upward movements in *HESI* are associated with higher levels of household economic stress. Conversely, downward movements of *HESI* occur when national economic conditions improve (Fullerton & Gutiérrez-Zubiate, 2020). While there is no perfect or universal monthly regional wealth measure, more than 65 percent of households in the United States own residences (USCB, 2022). Of course, renter households that cannot purchase residences will likely not benefit from rising housing prices.

While there have been several studies that examine the performance of these types of measures for national economies (Tang & Lean, 2009; Sergi et al., 2021), comparatively little research of this nature has been conducted for regional economies. That is unfortunate because there are almost always more questions regarding regional and metropolitan economic conditions than there are for national economies. This effort attempts to partially fill that gap in the applied economics literature paper by analyzing variations in a household economic stress index for the El Paso, Texas, USA metropolitan economy *(HESI)* and how those fluctuations impact retail sales (RS) in this metropolitan economy. Updates for HESI are calculated by The University of Texas at El Paso (UTEP) Border Region Modeling Project (BRMP) and published every month (Fullerton et al., 2021). This is only the second study completed for this specific stress index and it covers a longer time span using a different methodology than Fullerton and Gutiérrez-Zubiate (2020).

Subsequent sections of the study are as follows. A review of prior research on related topics is provided in the second section. The short-run estimation methodology and hypotheses to be tested are then discussed. A description of the sample data collected is next. Empirical results are then summarized. A concluding section encapsulates the results obtained and offers suggestions for future research.

## RELATED STUDIES

The well-known misery index is generated by adding the seasonally adjusted annualized rate of change in the consumer price index and the national unemployment rate. This easy to calculate variable is frequently used to compare and contrast the performance of the national economy under different presidential administrations. Beyond providing an informal report card regarding White House economic stewardship, Lean and Smyth (2011) uses it to design a novel test of macroeconomic stimulus package effectiveness. A reliable causal link from the misery index to the incidence of crime has also been documented for the United States (Tang & Lean, 2009). Hewing closer to the original political intent underlying the metric, it has also been shown to provide a useful tool for gauging presidential re-election prospects (Adrangi & Macri, 2019).

One of the more widely cited changes to the basic misery index is provided by Barro (1999). That modification adds the yield on 30-year Treasury bonds and the output gap for real gross domestic product (GDP) to the original misery index. Most recently, Sergi et al. (2021) employs this version of the variable to examine changes in equity market returns and volatility. The modified index is shown to perform well in this role, even after taking into account the impacts of Novel Coronavirus infections and deaths.

Another high profile study alters the original misery index by adding housing prices to the metric (Hufbauer et al., 2008). That step is taken in order to more accurately analyze presidential approval ratings. Because of the importance of housing to investor wealth portfolios, plus the prominence of residential real estate in business cycle developments, when home prices increase, consumer, and registered voter, confidence should strengthen. Conversely, declining housing prices often accompany worsening economic conditions. Accordingly, voter confidence will tend to suffer whenever residential real estate values erode.

Dye and Sutherland (2009) build upon that approach because of the likely connection between wealth and household economic stress. Housing is a major component of wealth (Grinstein-Weiss et al., 2013) and the amplified misery index will potentially capture fluctuations in household wealth. It is calculated by subtracting the change in housing prices from the sum of inflation and unemployment. Regional variants of the household economic stress index are also employed as barometers of regional and local economic conditions. Examples that are updated on fixed calendar schedules include CEDBR (2017) and Fullerton et al. (2021).

Preliminary research for the El Paso index indicates that variations in *HESI* are negatively correlated with fluctuations in *RS* (Fullerton & Gutiérrez-Zubiate, 2020). Results in that study indicate that a 1-point increase in HESI is associated with a $3.48 million reduction in monthly retail sales. Given the novelty of this category of stress indices, confirmation of that result by employing additional data and a different methodology would be useful.

To date, there are very few careful empirical analyses of potential links between regional household stress indices and prevailing commercial conditions. This effort builds upon the work of Fullerton and Gutiérrez-Zubiate (2020) by using a slightly larger sample and a different modeling procedure. The sample period is from December 2002 through March 2019. The estimation methodology is summarized in the next section

## DATA AND METHODOLOGY

A linear transfer function (LTF) autoregressive integrated moving average (ARIMA) procedure is used to analyze potential links between monthly data for El Paso *HESI* and retail sales (Diebold, 2007). The LTF methodology has previously been employed to examine short-term dynamics associated with a variety of economic issues in the Borderplex regional economy. Fairly recent examples include analyses of cross-border homicides and economic activity in El Paso (Niño et al., 2015), as well as empirical assessments of toll and wait time impacts on northbound international bridge traffic from Ciudad Juárez. (Fullerton & Solís, 2020). One advantage of this estimation method is that it is flexible enough to handle several different types of data generating processes (Pflaumer, 1992; Lorek & Willinger, 1996; Taneja et al., 2016).

*RS*, the local retail activity measure, is reported in millions of dollars at a quarterly frequency by the Federal Reserve Bank of Dallas (FRBD, 2020). Those data are converted into monthly estimates using a cubic spline procedure (CE, 2010). The historical data for HESI are from The University of Texas at El Paso Border Region Modeling Project (Fullerton et al., 2021).

Equation (1) illustrates how the original misery index for the United States national economy is calculated. *MI* stands for the index. *CPI12* is the 12-month change in the national consumer price index. *UR* is the seasonally adjusted national unemployment rate. The subscript t is a time period index for each month. When economic conditions worsen, *MI* (misery) tends to rise. When economic conditions improve, MI tends to decline.

$$MI_t = CPI12_t + UR_t \qquad (1)$$

$$HESI_t = CPI12_t + MA12(UR_t) - MA12(HP_t) \qquad (2)$$

Equation (2) shows how the El Paso household stress index is calculated. $HESI_t$ is the El Paso index value for month t. As in Equation (1), *CPI12* is the 12-month change in the national consumer price index. $MA12(UR_t)$ is a 12-month moving average of the local unemployment rate through month *t*. Because a 12-month moving average is utilized, it is not necessary to use seasonally adjusted values for this variable. $MA12(HP_t)$ is a 12-month moving average of the median price for existing single-family houses in El Paso up through month t. Historical data for *HESI* and the individual components are taken from Fullerton et al. (2021). The method for constructing the index is attractive due to computational ease and cost effectiveness.

Employing the median price for previously built single-family housing units price matches what is done at the national level in Dye and Sutherland (2009). For many metropolitan economies, including El Paso, the median housing price is the only broad-based measure of household wealth that is updated every month. Although it might be useful as a robustness check to construct an alternative *HESI* measure by adding the median rent for 2-bedroom apartments, monthly frequency apartment rent data are not available for El Paso for the December 2002 – March 2019 sample period. Other candidate variables along the same line might include monthly energy prices, crime incidence, and hospitalizations due to public health issues (Blake-Gonzalez et al., 2021).

Summary statistics for the sample data are provided in Table 1. The sample includes 196 observations. Rapidly escalating housing prices allow *HESI*, household economics stress, to decline to -10.16 in September 2006. Falling housing prices plus a 9.0 percent jobless rate causes *HESI* to reach a peak stress level of 15.41 in March 2010. The peak volume of $1.288 billion in retail sales occurred in November 2007, while the minimum sales amount was tallied in July 2003.

**Table 1. Stress Index and Retails Sales Summary Statistics**

| | ***HESI*** | ***RS*** |
|---|---|---|
| Number of Observation | 196 | 196 |
| Mean | 5.48 | $1,117.13 |
| Median | 5.96 | $1,182.75 |
| Standard Deviation | 5.01 | $63.64 |
| Maximum | 15.4 | $1,287.79 |
| Minimum | -10.16 | $1,023.42 |
| Skewness | -1.137 | -0.319 |
| Kurtosis | 1.691 | -0.943 |
| Coefficient of Variation | 0.914 | 0.057 |

***Notes:***
***The sample period is December 2002 to March 2019, N = 196.***
***RS is El Paso Retail Sales in $US Millions.***
***Quarterly RS are from the Federal Reserve Bank of Dallas (FRBD).***
***Monthly RS are UTEP BRMP cubic spline estimates from FRBD quarterly RS data.***
***HESI is the El Paso Household Economic Stress Index of the UTEP BRMP.***
***The monthly RS and HESI data employed for this table can be downloaded from: scholarworks.utep.edu/ef_data***

To identify potential lag structures, a cross correlation function (CCF) is estimated using the stationary components of *HESI* and *RS* (Trívez & Mur, 1999). Any systematic variation in RS that is not explained by lags of the dependent variable and *HESI* will be addressed using autoregressive and moving average coefficients to insure that the equation residuals are randomly distributed (Diebold, 2007). Equation (3) shows the basic equation form where y represents the stationary component of *RS*, *x* represents the stationary component of *HESI*, u is a potentially non-random error term, and v is a random disturbance term. As shown in Equation (3), when u is non-random, it may result from a data generating process that includes autoregressive and/or moving average components.

$$y_t = \alpha + \Sigma\beta_b y_{t-b} + \Sigma\gamma_c x_{t-c} + \Sigma\varphi_i u_{t-i} + \Sigma\theta_j v_{t-j} + v_t \qquad (3)$$

## EMPIRICAL RESULTS

The first step is to determine whether *RS* and *HESI* are non-stationary. Chi-squared statistical tests for autocorrelation (ACF) and partial autocorrelation (PACF) functions indicate that first differences are required to achieve stationarity (Enders, 2010). As shown in Table 2, Augmented Dickey-Fuller tests confirm that stationarity is attained after first differences are taken (Asteriou & Hall, 2016).

Table 2. Retail Sales and Stress Index Unit Root Test Results

| Variable | Computed ADF Test Statistic | Probability |
|---|---|---|
| *RS* | 0.3578 | 0.7871 |
| *d(RS)* | -2.1518 | 0.0306 |
| *HESI* | -1.4339 | 0.1411 |
| *d(HESI)* | -9.2429 | 0.0000 |

***Notes:***

***The sample period is December 2002 to March 2019, but the adjusted sample size is N = 195.***

***d is a first difference operator.***

***Null hypothesis tested is that the variable has a unit root.***

***The monthly RS and HESI data employed for this table can be downloaded from: scholarworks.utep.edu/ef_data/3***

Cross-correlation functions (CCFs) indicate a fairly interesting lag structure between the stationary components of the independent variable, d$(HESI_t)$ and those of the dependent variable, d$(RS_t)$. Table 3 summarizes the estimation output for the resulting equation. The presence of serial correlation among the residuals necessitated the inclusion of both autoregressive and moving average terms at a one-month lag.

The basic assumption tested is that an inverse relationship exists between *HESI* and *RS*. In other words, if household economic stress increases, retail sales should decline. That hypothesis is confirmed by the results shown in Table 3, but the lag structure is fairly complicated. The coefficient estimate for a 3-month lag of the dependent variable indicates that any large increase in retail activity is later followed by a decline in overall sales. Given the budget constraints under which most consumers operate, that pattern is understandable.

Table 3. Retail Sales and Stress Index LTF ARIMA Estimation Results

| Variable | Coefficient | Standard Deviation | Computed t-statistic | Prob. |
|---|---|---|---|---|
| Constant | -0.3894 | 4.1118 | -0.0947 | 0.9247 |
| d(RS(-3)) | -0.7730 | 0.0442 | -17.4867 | 0.0000 |
| d(HESI(-4)) | 0.4790 | 0.3178 | 1.5073 | 0.1336 |
| d(HESI(-5)) | 0.5233 | 0.2898 | 1.8054 | 0.0728 |
| d(HESI(-13)) | -0.4824 | 0.2894 | -1.6668 | 0.0974 |
| d(HESI(-14)) | -0.9550 | 0.4502 | -2.1212 | 0.0354 |
| d(HESI(-15)) | -1.2076 | 0.5495 | -2.1975 | 0.0294 |
| d(HESI(-16)) | -0.6020 | 0.3745 | -1.6074 | 0.1098 |
| AR(-1) | 0.8956 | 0.0305 | 29.4051 | 0.0000 |
| MA(-1) | 0.8830 | 0.0416 | 21.2135 | 0.0000 |

| | | | |
|---|---|---|---|
| R-Squared | 0.9312 | Dep. Variable Mean | 0.2761 |
| Adj. R-Squared | 0.9271 | Std. Dev. Dep. Var. | 11.385 |
| Std. Err. of Reg. | 3.0740 | Akaike Info. Criterion | 5.1673 |
| Sum Sq. Residuals | 1587.5 | Schwarz Info. Criterion | 5.3632 |
| Log Likelihood | -451.48 | Hannan-Quinn Criterion | 5.2468 |
| Computed F-stat. | 227.36 | Prob.(F-statistic) | 0.0000 |

***Notes:***

***The sample period is December 2002 to March 2019, but the adjusted sample size is N = 179.***

***d is a first difference operator.***

***Parenthetic negative numbers represent the number of months lagged.***

***d(RS(-3)) is the acronym for a 3-month lag of differenced retail sales.***

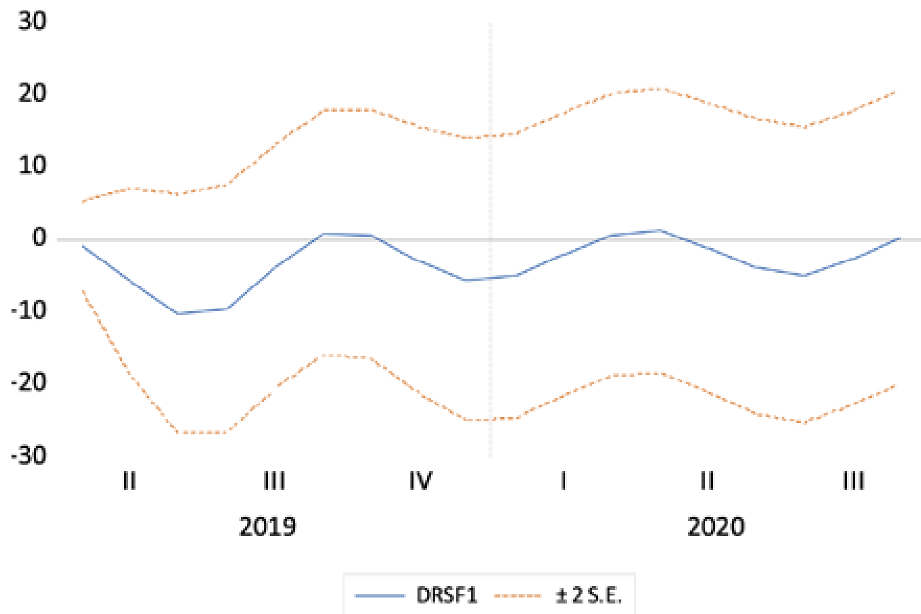
***d(HESI(-4)) is the acronym for a 4-month lag of differenced household economic stress estimates.***

***AR(-1) is the acronym for a residual autoregressive parameter at lag 1.***

***MA(-1) is the acronym for a residual moving average parameter at lag 1.***

Multiple lags of the stress index are included in Table 3. Surprisingly, the parameters at lags 4 and 5 have positive signs and imply that *RS* may have a rather strong inertial component that partially delays responses to increases in *HESI*. Those slope coefficients are more than offset by parameter estimates at lags 13 through 16 that are all negative. The effects of economic difficulties seem to require more than a year to be fully experienced in El Paso.

Figure 1: Retail Impact of a Permanent 1-Point Increase in Economic Stress




***Notes:***

***The graph summarizes an 18-month out-of-sample simulation.***

***DRSF1 is the monthly change in RS measured in US$ millions.***

An 18-month out-of-sample simulation of the impacts resulting from a permanent 1-point increase in *HESI* is used to provide a final empirical assessment of the model. Figure 1 illustrates what happens to *RS* as a consequence of the permanent 1-point increase in *HESI*. Although the monthly changes in commercial activity oscillate, the overall impact of increased economic stress is to reduce *RS* in a fairly pronounced manner over the course of the entire 18-month simulation period. The simulation results indicate that the negative impact of the 1-point permanent increase in *HESI* lowers *RS* by approximately $2.987 million per month. That largely corroborates what is reported in Fullerton and Gutiérrez-Zubiate (2020). What is different, however, is that more of the impact occurs within 6 months of the increase in *HESI* in this study than in the original study.

## CONCLUSION

Misery indices have been employed, for several decades, as devices for measuring national economic health. Similar efforts to devise regional counterparts to those indices have emerged in recent years. To date, there has been much less empirical testing of the reliability of the regional stress indices as gauges of local business cycle conditions.

This study attempts to shed light on this topic by employing historical data for one such household economic stress index that is maintained by The University of Texas at El Paso Border Region Modeling Project. The specific hypothesis examined is that an inverse relationship should exist between household economic stress and retail sales activity. Because prior research indicates that the linkages between economic stress and regional commercial activity may be short-term in nature, a linear transfer function ARIMA procedure is employed for parameter estimation.

Empirical results confirm the basic hypothesis regarding an inverse relationship between economic stress and regional retail sales volumes. The lag structure is somewhat complicated in nature. Model simulation outcomes corroborate prior evidence regarding the magnitudes of the downward impacts on commercial activity in dollar terms. The evidence also indicates that the distribution of those effects tends to be more heavily concentrated during the first six months of an 18-month simulation period. Although the results obtained are fairly encouraging, experimentation with more advanced latent index calculation methods should also be considered. Those approaches are fairly expensive and may not be feasible for regions with limited budgets.

From a regional economics perspective, three additional steps in the research progression are worth considering. First, similar metrics should be assembled for other metropolitan economies. In cases where data constraints prevent full replication of the index used in this research, modifications may be necessary. The linkages, or lack thereof, between the indices and regional business cycle conditions, will help expand applied economic insights with respect to regional economic measurement and performance. Second, once the pandemic subsides, the sample for this study should be updated and the analysis replicated to examine whether the results obtained in this study are upheld. Third, alternative and/or additional stress measures such as energy prices, crime incidence, or hospitalization data can be considered as additional index components. That will be a mandatory step for regional or metropolitan economies where monthly housing price data are not available.

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The authors of this publication are UTEP Professor & Trade in the Americas Chair Tom Fullerton and UTEP Border Region Modeling Project Associate Director & Economist Steven Fullerton. Dr. Fullerton holds degrees from UTEP, Iowa State University, Wharton School of Finance at the University of Pennsylvania, and University of Florida. Prior experience includes positions as Economist in the Executive Office of the Governor of Idaho, International Economist in the Latin America Service of Wharton Econometrics, and Senior Economist at the Bureau of Economic and Business Research at the University of Florida. Steven Fullerton has published research on Major League Baseball, the National Football League, and housing price fluctuations in Las Cruces.

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# The UTEP Border Region Modeling Project and UACJ Press

### Announce the Availability of

## Basic Border Econometrics

The University of Texas at El Paso Border Region Modeling Project is pleased to announce **Basic Border Econometrics**, a publication from Universidad Autónoma de Ciudad Juárez. Editors of this new collection are Martha Patricia Barraza de Anda of the Department of Economics at Universidad Autónoma de Ciudad Juárez and Tom Fullerton of the Department of Economics and Finance at The University of Texas at El Paso.

Professor Barraza is an award winning economist who has taught at several universities in Mexico and has published in academic research journals in Mexico, Europe, and the United States. Dr. Barraza currently serves as Research Provost at UACJ. Professor Fullerton has authored econometric studies published in academic research journals of North America, Europe, South America, Asia, Africa, and Australia. Dr. Fullerton has delivered economics lectures in Canada, Colombia, Ecuador, Finland, Germany, Japan, Korea, Mexico, the United Kingdom, the United States, and Venezuela.

Border economics is a field in which many contradictory claims are often voiced, but careful empirical documentation is rarely attempted. **Basic Border Econometrics** is a unique collection of ten separate studies that empirically assess carefully assembled data and econometric evidence for a variety of different topics. Among the latter are peso fluctuations and cross-border retail impacts, border crime and boundary enforcement, educational attainment and border income performance, pre- and post-NAFTA retail patterns, self-employed Mexican-American earnings, maquiladora employment patterns, merchandise trade flows, and Texas border business cycles.

Contributors to the book include economic researchers from The University of Texas at El Paso, New Mexico State University, The University of Texas Pan American, Texas A&M International University, El Colegio de la Frontera Norte, and the Federal Reserve Bank of Dallas. Their research interests cover a wide range of fields and provide multi-faceted angles from which to examine border economic trends and issues.

A limited number of **Basic Border Econometrics** can be purchased for $15 per copy. Please contact Professor Servando Pineda of Universidad Autónoma de Ciudad Juárez at spineda@uacj.mx to order copies of the book. Additional information for placing orders is also available from Professor Martha Patricia Barraza de Anda at mbarraza@uacj.mx.

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