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# A Tale of Two Cities: A Business Cycle Index for Midland-Odessa

Elisabeth Downs

*University of Texas at El Paso*, [eccordero@miners.utep.edu](mailto:eccordero@miners.utep.edu)

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A TALE OF TWO CITIES: A BUSINESS CYCLE  
INDEX FOR MIDLAND-ODESSA

ELISABETH DOWNS

Master's Program in Economics and Finance

APPROVED:

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Thomas M. Fullerton Jr., Ph.D., Chair

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Timothy P. Roth, Ph.D.

---

Karl Putnam, Ph.D.

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Charles Ambler, Ph.D.  
Dean of the Graduate School

## **Dedication**

This thesis is dedicated to my husband, Joshua, who tolerated nearly three years of erratic schedules, emotional meltdowns, and being ignored, but showed nothing short of unconditional love and support. I love you, you mean the world to me.

To my sister, Jacquelin, the kindest person I know and my best friend. Thank you for always checking in on me, telling me I could do it, and showing me empathy even when I was just being whiny. You have always been there for me and I know we will always be there for each other.

To caffeine, in all of its glorious forms. Without it, none of this would have been possible.

A TALE OF TWO CITIES: A BUSINESS CYCLE  
INDEX FOR MIDLAND-ODESSA

by

ELISABETH DOWNS, B.B.A., A.A.

THESIS

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## **Abstract**

The purpose of this study is to estimate a coincident index for the Midland-Odessa region using the Stock and Watson (1988) methodology. The model assumes that the co-movements of indicators have a common element that can be summarized as a single underlying and unobservable variable, the “state of the economy” (Stock and Watson, 1988). The model utilizes the Kalman filter smoothing approach which smooths the index across time and across indicators and results in index movements that are less pronounced during expansions and recessions. Indicator series used to estimate the Midland-Odessa BCI are: employment, unemployment rate, real retail sales, and total real wages. The resulting index exhibits movements that are correlated with national contractions and expansions, movements in oil prices, and an existing Midland-Odessa business cycle index.

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## **Chapter 1: Introduction**

Knowledge regarding current conditions of the Midland-Odessa economy is difficult to acquire. Regional stakeholders, such as businesses that want to expand, local government agencies that need to create budgets, and individuals who want to buy houses will all benefit from more reliable local economic information. While there are many useful macroeconomic variables that can provide insight to national economic conditions, those data do not always reflect local business conditions (Phillips, 2004). One tool that can be used to gauge metropolitan economic health is a business cycle index (BCI). A BCI is a weighted combination of selected economic variables that can provide insights to the state of the economy (Cañas, Gilmer, and Phillips, 2003).

While Midland and Odessa are two separate metropolitan statistical areas (MSAs), strong economic ties and proximity intertwine the two MSAs as one economy. The Midland-Odessa metropolitan economy is part of the larger Texas Permian-Basin region that contains 20 counties. The Permian Basin economy is driven by the oil and gas industry which sustains over 44,000 jobs. It generates \$113.6 billion in economic output and contributes more than \$60.2 billion to the Texas Gross State Product (Ewing et al., 2014). Midland-Odessa holds roughly half of the Permian Basin population and is the most densely populated area of the region.

Not surprisingly, Midland-Odessa economic activity is strongly influenced by crude oil price movements. The region experienced rapid expansion in the 1970s and early 1980s due to high oil prices, but saw much of those gains lost when prices plummeted in 1986 (Osborne, 2013). The metropolitan area was not spared from the economic downturn of the recent recession. Its recovery, however, was far quicker than that of the rest of the state. Due largely to a 2009 increase in oil prices, employment increased by approximately 50 thousand jobs between

2010 and late 2014. During this same period, the unemployment rate declined rapidly, hitting a low of 2.8 percent in late 2014 (FRBD, 2015).

Retail sales for Midland-Odessa also did well during this period. Sales nearly doubled between 2010 and early 2014, reaching approximately \$2.0 billion. A significant decline in oil prices after July 2014 caused a slight downturn in employment and increases in unemployment. The unemployment rate of 3.3 percent in July 2015, however, was still noticeably lower than the Texas rate of 4.2 percent and the U.S. rate of 5.2 percent (FRBD, 2015).

Broad based measures of the Midland-Odessa economy are scarce. The objective of this study is to develop a business cycle index for this metropolitan economy. The Stock and Watson (1988) methodology is used to develop a BCI. This method is used by the Federal Reserve Bank of Dallas (FRBD) to estimate metropolitan and state business cycle indices for other regions in Texas.

Subsequent sections of the study are as follows. Section two is a brief review of the evolution of BCI estimation methodologies as well as the more recent Stock and Watson (1988) approach. The third section describes the data and methodology used in the study. Section four summarizes empirical results. Section five summarizes the study and offers concluding remarks.

## **Chapter 2: Literature Review**

Rudimentary business cycle indexes date from the early 1800s, but the first widely recognized effort is by Burns and Mitchell (1946). The two key elements of the Burns and Mitchell (1946) definition of a business cycle are the co-movements among the individual indicators and the differentiation between expansions and contractions (Diebold and Rudebusch, 1996). The index was maintained by the U.S. Department of Commerce (USDC) until 1995 (Phillips, 2005).

The Conference Board (CB) now maintains the U.S. coincident index which consists of four indicators: employees on nonagricultural payrolls, personal income less transfer payments, industrial production, and manufacturing trade sales (CB, 2012). The index is calculated by computing the month-to-month changes of each indicator and then adjusting these monthly contributions to equalize the volatility of each indicator. The “component factor,” used to equalize the volatility of the monthly contribution, is inversely related to the standard deviation of the month-to-month changes in each component (CB, 2012).

In order to take advantage of statistical advances and provide statistical rationalization for the estimation of indexes, Stock and Watson (1988) employ an econometric approach to index estimation and use the same indicators as the CB for initial estimates. The model developed is a parametric version of a single-index model used by Sargent and Sims (1977). The model assumes that the co-movements of indicators have a common element that can be summarized as a single underlying and unobservable variable, the “state of the economy” (Stock and Watson, 1988). The model utilizes the Kalman filter smoothing approach which smooths the index across time and across indicators which results in index movements that are less pronounced during

expansions and recessions (Phillips and Cañas, 2008). The single-factor model approach produces an index that is highly correlated with the USDC coincident index.

Clayton-Matthews and Stock (1998/1999) use the single-factor model to estimate coincident and leading indexes for Massachusetts. They compare the new indexes against indexes that were estimated using the CB methodology. Clayton-Matthews and Stock (1998/1999) use five criteria to select the specification for the coincident index model. The estimated index should reflect recent economic history as well as the cyclical history of the Massachusetts economy. The estimated filter should contain weights on the indicator series that concentrate around a zero lag and each indicator should have a significant contribution to the output index. The one-step ahead forecast error for each indicator should be uncorrelated with itself, forecast errors of other indicators, and each indicator. The output of the Kalman filter should be smooth to reflect the assumed smooth state of the economy. Characteristics of the index should be robust.

Phillips (2005) applies the Stock-Watson model to estimate a coincident index for Texas. The index is estimated using non-farm employment, quarterly real gross state product (RGSP), and unemployment. The growth rate for the index is equal to the weighted average change of the component series in order to make it comparable to the existing Texas coincident index which was estimated using the CB model (Phillips, 2005). One-step ahead forecast errors are tested to assess whether the white noise components of the error terms of each of the indicators is with itself, forecast errors of other indicators, and each indicator (Clayton-Matthews and Stock, 1998/1999). This test is used to evaluate the efficiency of the new index as well as the CB model Texas coincident index. The new coincident index passes the specification test for whiteness while the CB model Texas coincident index does not.

In addition to graphical comparisons, the Neftci (1982) technique which highlights recession and expansion signals given by an index is used to test the accuracy of the indexes (Phillips, 2005). The new coincident index has fewer false signals and better timing for predicting downturns (Phillips, 2005). The cyclical patterns of the new index are highly correlated with those of employment and RGSP.

Cañas, Gilmer, and Phillips (2003) use the Stock-Watson model to estimate a coincident index for the Houston metropolitan economy. Establishment employment, unemployment rate, real wage and real retail sales are used as indicators and the average growth rate of personal income is used to re-trend the series. The index correlates with the economic history of Houston including the double-dip oil recessions of the 1980s, stagnation in the early 1990s, expansion beginning in February 1992, and another stagnation period in the early 2000s. The same methodology, indicators, and re-trending procedure is used by Cañas, Gilmer, and Phillips (2003) to estimate a coincident index for the El Paso metropolitan economy. The coincident index follows movements in the U.S. industrial production manufacturing index and Ciudad Juarez maquiladora employment and correlates with major developments for this region.

### **Chapter 3: Theoretical Model**

Indicator series used to estimate the Midland-Odessa BCI are: employment, unemployment rate, real retail sales, and total real wages. Because the methodology produces a stationary index, the coincident index is re-trended using the growth rate of real metropolitan personal income. The average growth rate of the index is re-trended as equal to the average growth in real metropolitan personal income over the course of the sample (Phillips and Cañas, 2008). Metropolitan personal income is obtained from the Bureau of Economic Analysis (BEA), retail sales data are obtained from the Texas Comptroller of Public Accounts, wage data are obtained from the Texas Workforce Commission (TWC), and employment data are obtained from the Federal Reserve Bank of Dallas (FRBD). Data series used in this sample begin in 1990. Indicator series for the coincident index are chosen to represent broad components of the overall economy: consumption (retail sales), income (wages), and employment and unemployment (production) (Clayton-Matthews and Stock, 1998/1999). Comparability to indicator series used by the Conference Board for the national coincident index was also considered. Other selection criteria for indicator series includes: timeliness, relatively high frequency, and availability across MSAs.

Employment data produced by the Bureau of Labor Statistics (BLS) are early benchmarked with data from TWC. The data are seasonally adjusted with a two-step seasonal adjustment procedure proposed by Berger and Phillips (1993). Early benchmarking and two-step seasonal adjustments are done by the FRBD. The unemployment rate is produced by the BLS and seasonally adjusted using the X-12 procedure. Both employment series are reported monthly with a lag of about one month.

Wage data are seasonally adjusted using the X-12 procedure and adjusted for inflation to first quarter 2016 dollars. Retail sales data are obtained from the Texas Comptroller of Public Accounts. The Standard Industrial Classification (SIC) system was used to measure retail sales prior to 2002. Beginning in 2002, the North American Industry Classification System (NAICS) is used to measure retail sales. In order to avoid the bias that would occur from combining the two data sets, data prior to 2002 are converted into NAICS using the 2002 NAICS to 1987 SIC concordance provided by the U.S. Census Bureau (USCB, 2002). The data are then seasonally adjusted using the X-12 procedure and adjusted for inflation to first quarter 2016 dollars. Wage and retail sales data are reported quarterly with a lag of about three quarters. Metropolitan personal income is adjusted for inflation to first quarter 2016 dollars. Those data are reported yearly with a lag of two years.

The basic form of the Stock and Watson model is:

$$(1) \quad Y_t = \beta + \gamma(L)\Delta C_t + \mu_t$$

$$(2) \quad D(L)\mu_t = \varepsilon_t$$

$$(3) \quad \phi(L)\Delta C_t = \delta + \eta_t$$

To estimate the coincident index, the procedure of Stock and Watson (1991) is used. The series are logged and then first differenced (except for the unemployment rate which is just differenced). The series are then normalized by subtracting respective mean differences and dividing respective standard deviations of the differences. This results in  $\beta = 0$  in Equation (1) and  $\delta = 0$  in Equation (3).

Thus,  $Y_t = \Delta X_t$  are the stationary first difference in natural logs of the indicators,  $C_t$  is the log of the unobserved state of the economy, and  $\mu_t$  is the idiosyncratic component of each indicator.  $\phi(L)$  is a scalar lag polynomial and  $D(L)$  is a lag polynomial matrix,  $L$  denotes the lag



operator.  $\phi(L)$  and  $D(L)$  are assumed to have finite orders  $p$  and  $k$ , respectively. The disturbance terms  $\mu_t$  and  $\varepsilon_t$  are assumed to be serially uncorrelated and this assumption is tested as part of the analysis. It is assumed that all off-diagonal values of the  $D(L)$  matrix are equal to zero and that all diagonal values are non-zero numbers, assumptions that are also tested below. This allows the  $\mu_t$ 's in different equations to be mutually uncorrelated with each other at all leads and lags.

The scale of the  $\gamma(L)$  coefficients is fixed by setting the variance of  $\eta$  to unity, while the timing of the coincident index is fixed by setting all but one of the elements  $\gamma(L)$  to zero in one of the equations in Equation (1). One- and two-period lags are included for each indicator so that the variables are allowed to influence the index from zero to two lags (Phillips, 2005). Lags that are not significant at the 5% level are dropped. Significant error terms for each of the univariate equations are determined by examining correlograms and Q-statistics of the residuals estimated with the final lag structures. Autoregressive lags of the coincident index itself may also be added in order to correct for any autocorrelation in the index and reduce month-to-month noisiness.

Equations (1) - (3) form the dynamic single-factor, multiple indicator model (Sargent and Sims, 1977). If the  $Y_t$  indicators move in conjunction with the economy, then the common comovement  $C_t$  can be interpreted as the current state of the economy (Stock and Watson, 1991). Equation (1) shows how each of the indicator series contributes to the underlying growth process (Phillips and Cañas, 2008).  $\Delta C$  is the common comovements in the growth of the indicators,  $Y$ . Equation (2) models the idiosyncratic components of each on the indicator series.  $\mu$ , the idiosyncratic components, are stationary, mean zero, autoregressive stochastic processes (Clayton-Matthews and Stock, 1998/1999). Equation (3) models the growth of the underlying state of the economy (Phillips and Cañas, 2004). Growth in the state of the economy is modeled as a stationary autoregressive process.

Maximum likelihood estimations of the parameters of Equations (1) - (3) and estimation of the filtered state are obtained by representing Equations (1) - (3) in state space form and using the Kalman filter (Clayton-Matthews and Stock, 1998/1999). As shown in Stock and Watson (1991), the state space equation, also called the transition equation, is formed by combining Equations (2) and (3). One objective is to estimate the level of  $C_t$  using information up to time  $t$ , it is then convenient to augment these equations by the identity  $C_{t-1} = \Delta C_{t-1} + C_{t-2}$  (Stock and Watson, 1991). The Transition equation is given by,

$$(4) \quad \begin{pmatrix} C_t^* \\ \mu^* \\ C_{t-1} \end{pmatrix} = \begin{pmatrix} \phi^* & 0 & 0 \\ 0 & D^* & 0 \\ Z_c & 0 & 1 \end{pmatrix} \begin{pmatrix} C_{t-1}^* \\ \mu_{t-1}^* \\ C_{t-2} \end{pmatrix} + \begin{pmatrix} Z_c' & 0 \\ 0 & Z_\mu' \\ 0 & 0 \end{pmatrix} \begin{pmatrix} \eta_t \\ \varepsilon_t \end{pmatrix}$$

where:

$$C_t^* = [\Delta C_t \Delta C_{t-1} \dots \Delta C_{t-p+1}]'$$

$$\mu^* = [\mu_t' \mu_{t-1}' \dots \mu_{t-k+1}']'$$

$$\phi^* = \begin{pmatrix} \phi_1 \dots \phi_{p-1} & \phi_p \\ I_{p-1} & 0_{(p-1) \times 1} \end{pmatrix}$$

$$D^* = \begin{pmatrix} D_1 \dots D_{k-1} & D_k \\ I_{n(k-1)} & 0_{n(k-1) \times n} \end{pmatrix}$$

$$Z_c = \begin{pmatrix} 1 & 0_{1 \times (p-1)} \end{pmatrix}$$

$$Z_\mu = \begin{pmatrix} I_n & 0_{n \times n(k-1)} \end{pmatrix}$$

The asterisk indicates that the variable represents a vector or matrix of variables and is used for notational brevity.

The measurement equation is obtained by writing Equation (1) as a linear combination of the state vector:

$$(5) \quad Y_t = \beta + \begin{bmatrix} \gamma Z_c & Z_\mu & 0_{n+1} \end{bmatrix} \begin{bmatrix} C_t^* \\ \mu_t^* \\ C_{t-1} \end{bmatrix}$$

Equations (6) and (7) can be written as:

$$(6) \quad \alpha_t = \mu_\alpha + T_t \alpha_{t-1} + R \zeta_t$$

$$(7) \quad Y_t = \beta + Z \alpha_t + \xi_t$$

where:

$$\alpha_t = (C_t^* \quad \mu_t^* \quad C_{t-1})'$$

$$\xi_t = (\eta_t \quad \varepsilon_t)'$$

The Kalman filter is then applied to the state space representation of the model. Let  $\alpha_{t|\tau}$  denote the estimate of  $\alpha_t$  based on  $(y_1, \dots, y_\tau)$ , let  $E[\xi_t \xi_t'] = H$ ,  $E[\zeta_t \zeta_t'] = \Sigma$  and  $P_{t|\tau} = E[(\alpha_{t|\tau} - \alpha_t)(\alpha_{t|\tau} - \alpha_t)']$ . Given this notation, the prediction equations for the Kalman filter are

$$(8) \quad \alpha_{t|t-1} = \mu_\alpha + T_t \alpha_{t-1|t-1}$$

$$(9) \quad P_{t|t-1} = T_t P_{t-1|t-1} T_t' + R \Sigma R'$$

The forecast of  $Y_t$  at time  $t-1$  is  $Y_{t|t-1} = \beta + Z \alpha_{t|t-1}$  and the updating equations for the filters are:

$$(10) \quad \alpha_{t|t} = \alpha_{t|t-1} + P_{t|t-1} Z' F_t^{-1} v_t$$

$$(11) \quad P_{t|t} = P_{t|t-1} - P_{t|t-1} Z' F_t^{-1} Z P_{t|t-1}$$

where  $F_t = E[v_t v_t'] = Z P_{t|t-1} Z' + H$  and  $v_t = Y_t - Y_{t|t-1}$ .

This estimation procedure yields three versions of the state vector:  $\Delta C_{t|t-1}$ , the prediction estimates;  $\Delta C_{t|t}$ , the filtered estimates; and  $\Delta C_{t|T}$ , the smoothed estimates. The prediction estimates,  $\Delta C_{t|t-1}$ , use information from the prior period to estimate the state of each period (Clayton-Mathews and Stock, 1998/1999). These estimates are used to form the one-step ahead

prediction errors,  $\hat{\varepsilon}_{t|t-1} = \Delta X_t - \Delta X_{t|t-1}$  which are used to calculate the likelihood based on the initial parameter estimates (Clayton-Mathews and Stock, 1998/1999). These prediction errors are the fitted residuals from Equations (1) and (2), where the estimates for  $\Delta C_{t|t-1}$  are used in place of the unobserved  $\Delta C$ . The one-step ahead prediction errors are later used to test the validity of the assumption that the error terms of the component series are mutually uncorrelated with each other at all leads and lags (Clayton-Mathews and Stock, 1998/1999).

The filtered estimates,  $\Delta C_{t|t}$ , use information available through the current period to estimate the state in each period (Clayton-Mathews and Stock, 1998/1999). These estimates are referred to as the “Kalman filter” (Clayton-Mathews and Stock, 1998/1999). The smoothed estimates,  $\Delta C_{t|T}$ , use all information available in the sample to estimate the state in each period. These estimates are referred to as the “Kalman smoother” (Clayton-Mathews and Stock, 1998/1999). The weights of the Kalman smoother rapidly approach zero as they move away from the current period, estimates go to  $\Delta C_{t|t}$  as the data approach the end of the sample (Clayton-Mathews and Stock, 1998/1999).

As shown in Equation (3), the Kalman filter models each of the indicator series as left-hand-side variables with the unobserved coincident index on the right hand side. Given this structure, quarterly variables are modeled as a function of current and previous values of the monthly latent series. This allows quarterly data to enter the equations with monthly data. This can be demonstrated by:

$$(12) \Delta X_t = \gamma(L)\Omega(L)\Delta C_t + \mu_t$$

where  $\Omega(L) = 1 + 2L + 3L^2 + 2L^3 + L^4$  and  $\Delta X_t = X_t - X_{t-3}$ , with  $t$  representing months.

Because the methodology produces indexes that are stationary with unit variances, it is necessary to make two adjustments (Phillips and Cañas, 2008). First, the variance of the growth

rate of the index is scaled to the average variance of the growth rates in the component series (Phillips and Cañas, 2008). Second, the average growth rate of the index is re-trended to equal the average growth in real metropolitan personal income over the course of the sample (Phillips and Cañas, 2008).

The index is estimated using Dynamic Single-Factor Model Software (DSFM). The structure of the model, estimation, and transformation from estimated state of the economy to metropolitan coincident index allows extracting the relevant business cycle signal from potentially noisy data (Clayton-Matthews, 2005). The following section provides an analysis of the estimated coincident index for Midland–Odessa.

## Chapter 4: Empirical Analysis

Table 1 contains descriptions of the indicator series used to estimate the coincident index. Table 2 reports summary statistics for each indicator series during the sample period. The employment indicator reaches a maximum of approximately 179 thousand and has an average of about 120 thousand. The series follows an upward trend and exhibits cyclical movements. The unemployment indicator exhibits pronounced cyclical movements and a slight downward trend. It has a maximum of about 9.6 percent and an average of 5.35 percent. Real retail sales has a maximum of \$2,055 million and an average of \$1,260 million. It follows an upward trend and displays notable cyclical movements. Real total wages has an upward trend, but displays relatively muted cyclical movements in comparison to the other indicators.

Table 1: Variables, Definitions, and Units of Measure

Indicator Series	Definition	Units	Source
Employment	Monthly MSA total non-farm employment, early benchmarked using preliminary releases of the QWEC from the TWC, and two-step seasonally adjusted.	Thousands	Bureau of Labor Statistics; Federal Reserve Bank of Dallas
Unemployment	Monthly MSA total labor force currently unemployed and seeking employment, seasonally adjusted	Percent	Bureau of Labor Statistics; Federal Reserve Bank of Dallas
Real Retail Sales	Quarterly MSA retail sales as defined by NAICS, seasonally adjusted and in Q1 2016 dollars	Millions	Texas Comptroller of Public Accounts
Real Total Wages	Quarterly MSA total wages and salaries for all industries, seasonally adjusted and in Q1 2016 dollars. Included in wages are paid leave, bonuses, stock options, tips, and cash value of meals and lodging.	Millions	Texas Workforce Commission

All four indicator series are positively skewed. Real total wages, real retail sales, and employment have overall upward trends, while unemployment has a downward trend. All four series exhibit cyclical patterns caused by shocks to the regional economy. These shocks cause

rapid short term changes in the indicator series. The steady trends of the indicators are punctuated with small periods of high growth, resulting in positive skewness in each series.

Table 2: Indicator Series Summary Statistics

	Employment	Unemployment	Real Retail Sales	Real Total Wages
Mean	119.77	5.35	\$1,260.66	\$1,393.17
Median	109.61	5.17	\$1,145.42	\$1,107.07
Maximum	178.93	9.59	\$2,054.80	\$2,810.70
Minimum	88.78	2.67	\$905.66	\$894.61
Standard Deviation	24.76	1.61	\$299.91	\$542.41
Skewness	0.82	0.58	1.16	1.11
Kurtosis	2.48	2.67	3.28	2.96

Notes:

Values rounded to two decimal places.

Sample period: employment and unemployment 01:1990 – 08:2016.

Sample period: real retail sales and real total wages Q1:1990 – Q1:2016.

Table 3 reports the estimated values of the coefficients for the common state, the lags of the autoregressive error term equations, and autoregressive lags of the index. The coefficients of the common state exhibit the hypothesized signs and are all statistically significant at the 1% level. The common state enters the employment measurement equation contemporaneously and with lags of one and two months. The common state enters the measurement equations for unemployment and real total wages contemporaneously, only. The common state enters the real retail measurement equations contemporaneously and with a one-period lag.

One measure of smoothness of the coincident index is the sum of the autoregressive coefficients of the index itself (Phillips, 2005). Shocks are more persistent and the cycle is smoother when the sum is closer to one, while remaining less than one (Phillips, 2005). The index estimation includes a first-order autoregressive term which equals approximately 0.823. The autoregressive term of the index is statistically significant at the 1% level.

Table 3: Estimated Coefficients

Estimated coefficients of the common state $C_t$				
<u>Measurement Equation</u>	<u>Variable</u>	<u>Coefficient</u>	<u>Asymptotic std. error</u>	<u>t-statistic</u>
Employment	$C_t$	0.552239	0.063476	8.69997***
	$C_{t-1}$	-0.516197	0.0847395	-6.09157***
	$C_{t-2}$	0.359594	0.059548	6.03873***
Unemployment Rate	$C_t$	-0.315167	0.0463149	-6.80487***
Real Retail Sales	$C_t$	0.11235	0.02325	4.83219***
	$C_{t-1}$	-0.07458	0.022786	-3.27288***
Real Total Wages	$C_t$	0.058427	0.006716	8.6999***
Estimated Coefficients for lags in the autoregressive equations for the error terms				
<u>Measurement Equation</u>	<u>Lag</u>	<u>Coefficient</u>	<u>Asymptotic std. error</u>	<u>t-statistic</u>
Unemployment	-1	-0.05606	0.0632548	-0.886253
	-2	0.172828	0.0586011	2.94923***
	-3	0.221521	0.0626518	3.53576***
	-4	0.136343	0.0636094	2.14344**
Real Wages	-1	-0.65355	0.156051	-4.18809***
	-2	0.14357	0.198006	0.725079
	-3	0.346064	0.159406	2.17096**
Estimated Coefficients for the autoregressive equation for the common factor				
<u>Measurement Equation</u>	<u>Lag</u>	<u>Coefficient</u>	<u>Asymptotic std. error</u>	<u>t-statistic</u>
Lag	-1	0.82311	0.0442969	18.5818***

Notes:

Sample period: employment and unemployment 01:1990 – 08:2016.

Sample period: real retail sales and real total wages Q1:1990 – Q1:2016.

The results of the diagnostics test on the one-step ahead prediction errors are shown in Table 4. Although both the unemployment and real wages series have statistically significant autoregressive coefficients, as shown in Table 3, the results of the diagnostics test generally indicate that the error terms of the component series are mutually uncorrelated at all leads and lags. One of the F-statistics is statistically significant at the 5% level and none of the other 31 coefficients are statistically significant. These results verify that idiosyncratic components of the indicators are modeled correctly and confirm the assumption that the co-movements of the component series stem from a single underlying variable.



Table 4: F-Statistics for 6-Lag Specification Test

	<u>Dependent Variables</u>			
	eEmployment	eUnemployment	eRetail	eWages
eEmployment	0.581723	1.17414	0.416397	0.314425
eUnemployment	0.882619	0.342936	0.181614	0.364564
eRetail	1.35291	1.5078	1.32864	0.56494
eWages	1.67954	0.880583	0.717112	0.810766
Employment	0.507108	1.6378	0.463671	0.1713
Unemployment	1.08328	0.629875	0.276541	0.340794
Real Retail Sales	1.05284	1.48507	1.3506	0.547973
Real Total Wages	0.649005	2.23785**	0.902707	0.59839

Notes:

Dependent Variable is One-Step Ahead forecast error. \*p<0.10; \*\*p<0.05; \*\*\*p<0.01.

Ho: Coefficients are jointly zero. Failure to reject the null hypothesis indicates that the idiosyncratic components of indicator series are uncorrelated and implies that the presence of only one single underlying factor is a reasonable assumption.

Sample period: employment and unemployment 01:1990 – 08:2016.

Sample period: real retail sales and real total wages Q1:1990 – Q1:2016.

Table 5 shows the cumulative dynamic multipliers and the weights of each of the indicators. The multipliers are the average growth rate of each of the indicator series and the weights are the share that each average growth rate contributes to the common co-movement growth rate,  $\Delta C$  (Murphy, 2005). Employment and real wages have the greatest weights, 53.24% and 20.64% respectively. Unemployment has a weight of 13.65% and real retail sales has the smallest weight of 12.46%.

Table 5: Cumulative Dynamic Multipliers

Indicator	Multiplier	Share*
Employment	1.12855	53.2439
Unemployment	-0.289347	13.6511
Real Retail Sales	0.26411	12.4605
Real Total Wages	0.437577	20.6445

Notes:

Values rounded to two decimal places.

Sample period: employment and unemployment 01:1990 – 08:2016.

Sample period: real retail sales and real total wages Q1:1990 – Q1:2016.

The average growth rate of the computed index is approximately 0.24% and has been adjusted to match the 0.21% average growth rate of the Midland-Odessa annual real total personal income for the 1990 to 2014 sample period. This adjustment is made because the methodology produces a stationary index which shows changes in the business cycle but not the trends and volatility of the region (Phillips and Cañas, 2008). Figure 1 plots the re-trended index of economic activity for the combined Midland-Odessa metropolitan economy. Although the data used to estimate the BCI begin in January or Q1 1990, the estimated BCI begins in January 1991 because employment and real retail sales include lags of the common state,  $C_t$ . This first available BCI value is used as the base period. The graph highlights six recessionary periods. Recessions for Midland-Odessa are defined as periods of at least a 0.5% decline in the coincident index with at least three months between the peak and trough (Crone, 2006). Three of the Midland-Odessa downturns coincide with national recessions, but with later start dates.

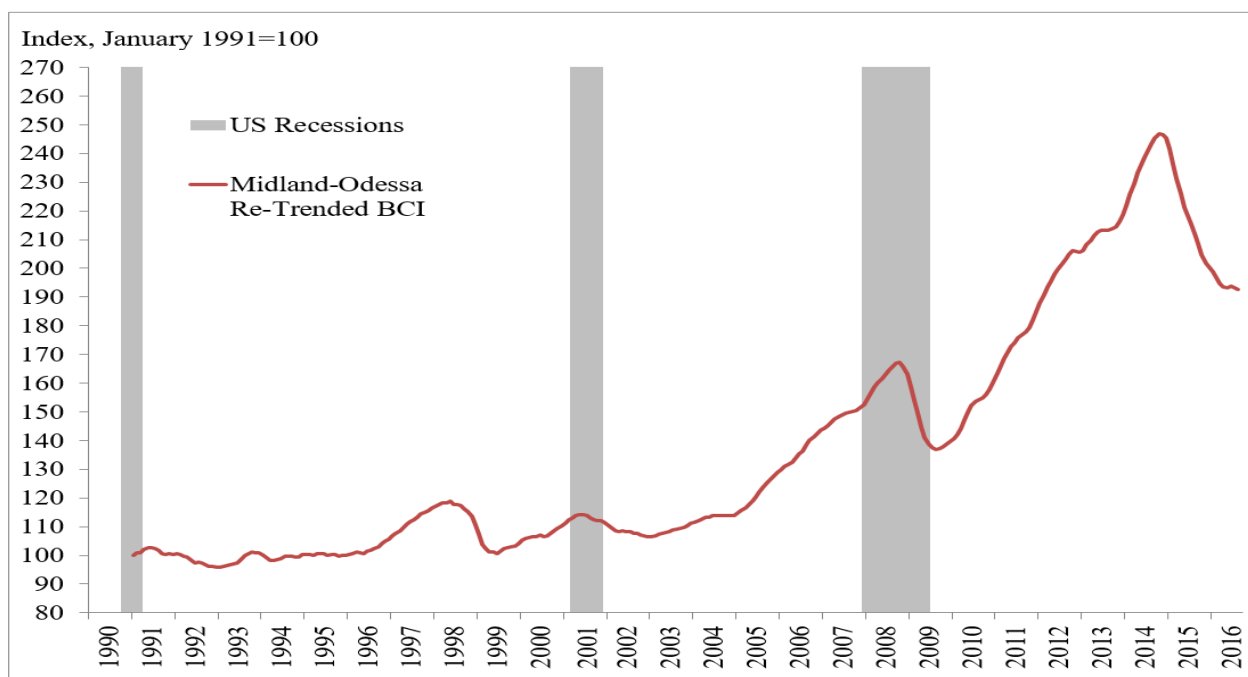


Figure 1: Midland-Odessa Re-Trended BCI

The first local recession that is independent of a national contraction occurred between October 1993 and March 1994. The second independent contraction occurred between May 1998 and June 1999. The third independent recession begins in October 2014 and because the index is still in decline for the current estimation period, a trough is not yet established. Figure 2 shows that all three local recessions are associated with sharp declines in oil prices. Prices declined 34% between June 1992 and March 1994, 56% between December 2006 and December 2008, and 59% between June of 2014 and July 2016.

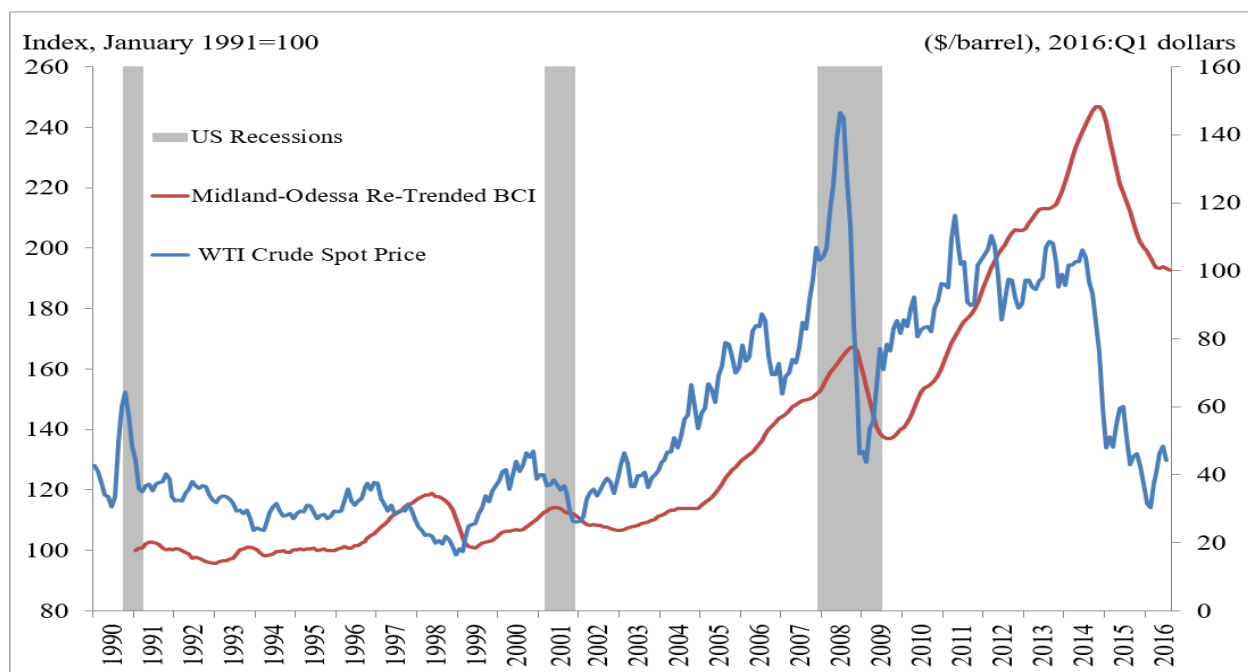


Figure 2: Midland-Odessa Re-Trended BCI and Oil Prices

Notable expansionary periods in the Permian Basin economy are also closely tied to increases in oil prices. The correlation coefficient between the contemporaneous lags of the re-trended BCI and the West Texas Intermediate oil price series during the sample period is approximately 0.668. When oil prices increased by 40% between July 1995 and December 1996, the coincident index increased by 13% between December 1996 and May 1998. Oil prices

more than doubled between March 1999 and January 2001 and the index increased by 14% between June 1999 and May 2001. When oil prices more than doubled between late 2003 and mid-2006, the BCI increased by 47% between November 2004 and October 2008. Oil prices also doubled between early 2007 and mid-2008. That development likely contributed to the delayed materialization of the 2008 to 2009 national recession in Midland-Odessa.

Figure 3 shows both the index estimated in this study as well as the Midland-Odessa Regional Economic index. The latter index is published monthly by the Midland Development Corporation (MDC) and is estimated by Ingham Economic Reporting (MDC, 2016). The MDC index tracks the business cycles of the combined Midland-Odessa metropolitan area using component series that include taxable retail sales, spending on automobiles, hotel/motel tax receipts, airline passenger volumes, value of all building permits, housing sales dollar volumes, average home sales prices, unemployment, and employment (Ingham, 2013). The methodology behind the estimation of the MDC index is not disclosed, but one observable difference between its estimation and the index estimated in this study is the greater number of indicators used in the estimation of the MDC index. As seen in Figure 3, the two indexes follow very similar patterns until November 2010 when the index estimated in this study begin to exhibit higher levels of growth. In general, the movements in the two indexes are closely correlated, but the estimated index tends to mark peaks and troughs earlier than the MDC series. The MDC appears to track as a lagging index relative to the coincident BCI developed in this study.

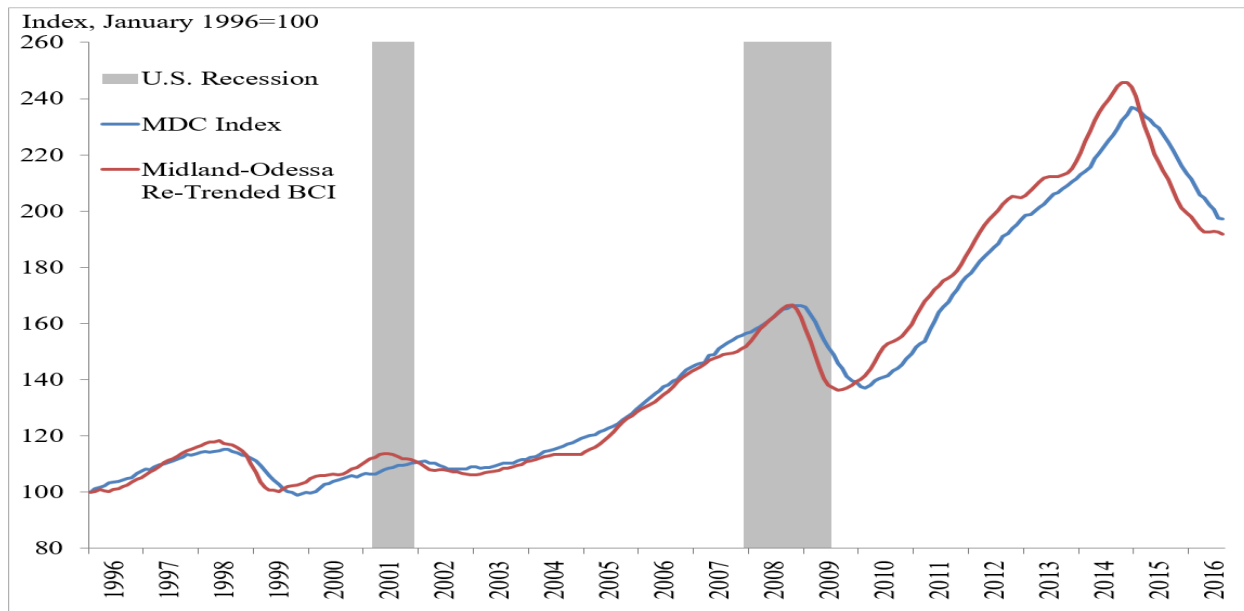


Figure 3: Midland-Odesa BCI and MDC BCI

The Midland-Odesa BCI offers a new tool for understanding the state of the regional economy. The timeliness and availability of the indicator series used to estimate the index allows for a more current estimation of economic conditions. It is clear that the dynamics of this economy often deviate from those of the national economy. The Midland-Odesa BCI provides a broad-based means for better tracking business conditions in this unique regional economy.

## **Chapter 5: Conclusion**

A dynamic single-factor modeling approach is used to estimate a coincident index for the Midland-Odessa metropolitan economy (Stock and Watson, 1991; Clayton-Matthews, 2005).

The methodology assumes that the co-movements of key economic indicators have a single underlying, unobservable factor. Through an econometric approach, this factor is extracted from indicator variables and used to calculate an index that represents current economic conditions.

The model also utilizes the Kalman filter smoothing approach, a recursive process that estimates mean square error estimates, facilitates the use of mixed-frequency data, and results in a smoother index with less pronounced recessions and expansions. Indicator series used in this study are: employment, unemployment, real retail sales, and real total wages. The data used in this study are from January 1990 through August 2016.

The calculated index for Midland-Odessa is generally smooth and its movements are consistent with historical economic conditions of the region. Three of the recessionary periods in Midland-Odessa are associated with national economic contractions. Two additional recessions for this metropolitan economy follow the movement of crude oil prices. Given that the petroleum industry is a well-known driver of the Midland-Odessa economy, the strong correlation between the coincident index and oil prices is to be expected.

The metropolitan business cycle index for Midland-Odessa is designed to reliably reflect current economic conditions. The approach employed is one that has been applied to other metropolitan economies in Texas (Phillips and Cañas, 2008). The new index thus provides an additional tool for monitoring Midland-Odessa economic conditions that is directly comparable to the BCI utilized for the other economic regions in Texas.

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## Appendix: Data

Table 6: Monthly Data

Date	Employment (Thousands)	Unemployment (Percent)	Nominal Total Personal Income	Real Total Personal Income Base Period (Q1:2016)	CPI-U: All Items (Monthly)	CPI-U: All Items (Monthly) Base Period (Q1:2016)
Jan-90	88.783	6.04	\$3,337,477,000	\$6,227,636,102	127.5	53.59
Feb-90	88.997	5.88	\$3,337,477,000	\$6,203,309,399	128	53.80
Mar-90	90.630	5.68	\$3,337,477,000	\$6,174,367,053	128.6	54.05
Apr-90	89.179	5.70	\$3,337,477,000	\$6,159,996,920	128.9	54.18
May-90	90.433	5.42	\$3,337,477,000	\$6,150,453,935	129.1	54.26
Jun-90	89.387	5.26	\$3,337,477,000	\$6,112,575,851	129.9	54.60
Jul-90	89.697	5.43	\$3,337,477,000	\$6,084,472,054	130.5	54.85
Aug-90	89.268	5.43	\$3,337,477,000	\$6,033,614,005	131.6	55.31
Sep-90	90.285	5.43	\$3,337,477,000	\$5,992,630,966	132.5	55.69
Oct-90	89.665	4.96	\$3,337,477,000	\$5,952,200,922	133.4	56.07
Nov-90	90.398	4.86	\$3,337,477,000	\$5,938,845,199	133.7	56.20
Dec-90	89.268	4.88	\$3,337,477,000	\$5,916,718,354	134.2	56.41
Jan-91	89.863	4.79	\$3,493,140,000	\$6,169,692,613	134.7	56.62
Feb-91	89.883	4.88	\$3,493,140,000	\$6,165,115,689	134.8	56.66
Mar-91	89.730	5.03	\$3,493,140,000	\$6,165,115,689	134.8	56.66
Apr-91	92.203	4.86	\$3,493,140,000	\$6,151,425,573	135.1	56.79
May-91	92.426	5.12	\$3,493,140,000	\$6,128,743,325	135.6	57.00
Jun-91	93.181	5.16	\$3,493,140,000	\$6,110,717,610	136	57.16
Jul-91	93.437	5.25	\$3,493,140,000	\$6,101,744,456	136.2	57.25
Aug-91	93.789	5.55	\$3,493,140,000	\$6,083,876,976	136.6	57.42
Sep-91	93.207	5.87	\$3,493,140,000	\$6,066,113,832	137	57.58
Oct-91	94.038	6.50	\$3,493,140,000	\$6,057,271,100	137.2	57.67
Nov-91	94.218	6.34	\$3,493,140,000	\$6,030,896,915	137.8	57.92
Dec-91	93.612	6.45	\$3,493,140,000	\$6,013,441,353	138.2	58.09
Jan-92	95.097	6.91	\$3,675,548,000	\$6,322,881,601	138.3	58.13
Feb-92	94.785	7.34	\$3,675,548,000	\$6,309,195,710	138.6	58.26
Mar-92	94.122	7.66	\$3,675,548,000	\$6,286,517,077	139.1	58.47
Apr-92	94.092	7.80	\$3,675,548,000	\$6,272,987,987	139.4	58.59
May-92	93.355	8.28	\$3,675,548,000	\$6,259,517,004	139.7	58.72
Jun-92	92.478	8.73	\$3,675,548,000	\$6,241,645,435	140.1	58.89
Jul-92	93.658	8.48	\$3,675,548,000	\$6,223,875,626	140.5	59.06
Aug-92	92.126	8.84	\$3,675,548,000	\$6,210,614,527	140.8	59.18

Sep-92	91.381	8.89	\$3,675,548,000	\$6,197,409,819	141.1	59.31
Oct-92	91.758	9.01	\$3,675,548,000	\$6,171,168,140	141.7	59.56
Nov-92	92.132	9.37	\$3,675,548,000	\$6,153,796,801	142.1	59.73
Dec-92	92.188	9.22	\$3,675,548,000	\$6,145,147,754	142.3	59.81
Jan-93	93.083	8.88	\$3,835,075,000	\$6,389,410,411	142.8	60.02
Feb-93	93.811	8.63	\$3,835,075,000	\$6,376,015,421	143.1	60.15
Mar-93	93.156	8.31	\$3,835,075,000	\$6,367,116,585	143.3	60.23
Apr-93	92.734	8.31	\$3,835,075,000	\$6,344,977,793	143.8	60.44
May-93	92.745	7.93	\$3,835,075,000	\$6,327,377,300	144.2	60.61
Jun-93	93.019	7.90	\$3,835,075,000	\$6,322,992,423	144.3	60.65
Jul-93	94.778	7.76	\$3,835,075,000	\$6,314,240,877	144.5	60.74
Aug-93	94.399	7.52	\$3,835,075,000	\$6,301,158,886	144.8	60.86
Sep-93	94.104	7.18	\$3,835,075,000	\$6,292,467,632	145	60.95
Oct-93	95.527	7.54	\$3,835,075,000	\$6,266,537,134	145.6	61.20
Nov-93	95.189	7.30	\$3,835,075,000	\$6,249,368,539	146	61.37
Dec-93	95.952	7.11	\$3,835,075,000	\$6,236,553,703	146.3	61.49
Jan-94	95.446	7.28	\$3,981,286,000	\$6,474,320,305	146.3	61.49
Feb-94	94.865	7.60	\$3,981,286,000	\$6,456,667,080	146.7	61.66
Mar-94	94.851	7.62	\$3,981,286,000	\$6,439,109,862	147.1	61.83
Apr-94	96.105	7.56	\$3,981,286,000	\$6,434,735,466	147.2	61.87
May-94	96.101	7.40	\$3,981,286,000	\$6,421,647,869	147.5	62.00
Jun-94	96.744	7.41	\$3,981,286,000	\$6,404,280,329	147.9	62.17
Jul-94	97.627	7.31	\$3,981,286,000	\$6,382,702,565	148.4	62.38
Aug-94	96.827	7.21	\$3,981,286,000	\$6,357,000,407	149	62.63
Sep-94	96.894	7.15	\$3,981,286,000	\$6,344,226,796	149.3	62.75
Oct-94	96.359	7.06	\$3,981,286,000	\$6,339,980,326	149.4	62.80
Nov-94	97.043	6.97	\$3,981,286,000	\$6,323,051,139	149.8	62.96
Dec-94	97.766	6.50	\$3,981,286,000	\$6,310,413,462	150.1	63.09
Jan-95	96.763	6.43	\$4,162,905,000	\$6,580,746,040	150.5	63.26
Feb-95	97.475	6.02	\$4,162,905,000	\$6,563,302,048	150.9	63.43
Mar-95	97.945	6.09	\$4,162,905,000	\$6,550,279,624	151.2	63.55
Apr-95	99.113	6.30	\$4,162,905,000	\$6,524,389,190	151.8	63.81
May-95	98.719	6.01	\$4,162,905,000	\$6,511,520,573	152.1	63.93
Jun-95	98.997	5.90	\$4,162,905,000	\$6,498,702,619	152.4	64.06
Jul-95	98.669	6.09	\$4,162,905,000	\$6,490,185,315	152.6	64.14
Aug-95	100.310	6.10	\$4,162,905,000	\$6,477,451,139	152.9	64.27
Sep-95	99.422	6.23	\$4,162,905,000	\$6,468,989,413	153.1	64.35
Oct-95	98.175	6.16	\$4,162,905,000	\$6,452,132,111	153.5	64.52
Nov-95	99.088	6.17	\$4,162,905,000	\$6,443,736,364	153.7	64.60
Dec-95	98.967	6.25	\$4,162,905,000	\$6,435,362,437	153.9	64.69

Jan-96	99.692	6.26	\$4,391,778,000	\$6,754,064,381	154.7	65.02
Feb-96	99.654	6.01	\$4,391,778,000	\$6,740,991,998	155	65.15
Mar-96	100.024	5.92	\$4,391,778,000	\$6,719,316,783	155.5	65.36
Apr-96	98.662	6.09	\$4,391,778,000	\$6,693,489,812	156.1	65.61
May-96	99.347	5.85	\$4,391,778,000	\$6,680,650,637	156.4	65.74
Jun-96	100.016	5.67	\$4,391,778,000	\$6,667,860,623	156.7	65.86
Jul-96	99.123	5.68	\$4,391,778,000	\$6,655,119,488	157	65.99
Aug-96	100.019	5.44	\$4,391,778,000	\$6,646,652,415	157.2	66.08
Sep-96	100.064	5.31	\$4,391,778,000	\$6,625,578,692	157.7	66.29
Oct-96	101.448	5.44	\$4,391,778,000	\$6,604,638,178	158.2	66.50
Nov-96	101.252	5.54	\$4,391,778,000	\$6,583,829,614	158.7	66.71
Dec-96	101.016	5.53	\$4,391,778,000	\$6,567,276,931	159.1	66.87
Jan-97	102.371	5.45	\$4,658,584,000	\$6,953,136,329	159.4	67.00
Feb-97	102.506	5.61	\$4,658,584,000	\$6,940,074,708	159.7	67.13
Mar-97	102.633	5.57	\$4,658,584,000	\$6,935,731,733	159.8	67.17
Apr-97	103.747	5.31	\$4,658,584,000	\$6,931,394,189	159.9	67.21
May-97	104.402	5.07	\$4,658,584,000	\$6,931,394,189	159.9	67.21
Jun-97	104.619	5.15	\$4,658,584,000	\$6,918,414,050	160.2	67.34
Jul-97	105.286	4.91	\$4,658,584,000	\$6,909,787,599	160.4	67.42
Aug-97	106.549	4.83	\$4,658,584,000	\$6,892,599,073	160.8	67.59
Sep-97	107.331	4.68	\$4,658,584,000	\$6,875,495,849	161.2	67.76
Oct-97	107.370	4.52	\$4,658,584,000	\$6,862,724,030	161.5	67.88
Nov-97	107.779	4.34	\$4,658,584,000	\$6,854,235,813	161.7	67.97
Dec-97	108.943	4.35	\$4,658,584,000	\$6,849,999,573	161.8	68.01
Jan-98	109.494	4.21	\$5,011,334,000	\$7,359,587,369	162	68.09
Feb-98	110.288	4.27	\$5,011,334,000	\$7,359,587,369	162	68.09
Mar-98	110.650	4.47	\$5,011,334,000	\$7,359,587,369	162	68.09
Apr-98	110.538	4.49	\$5,011,334,000	\$7,350,512,662	162.2	68.18
May-98	111.198	4.83	\$5,011,334,000	\$7,332,430,220	162.6	68.34
Jun-98	109.681	5.24	\$5,011,334,000	\$7,323,422,320	162.8	68.43
Jul-98	110.867	5.50	\$5,011,334,000	\$7,305,472,756	163.2	68.60
Aug-98	110.124	5.81	\$5,011,334,000	\$7,296,530,929	163.4	68.68
Sep-98	109.062	6.29	\$5,011,334,000	\$7,292,068,218	163.5	68.72
Oct-98	109.013	6.49	\$5,011,334,000	\$7,274,271,835	163.9	68.89
Nov-98	108.443	6.39	\$5,011,334,000	\$7,265,406,177	164.1	68.98
Dec-98	107.305	7.44	\$5,011,334,000	\$7,252,148,137	164.4	69.10
Jan-99	106.737	8.39	\$4,927,096,000	\$7,117,255,488	164.7	69.23
Feb-99	104.697	9.43	\$4,927,096,000	\$7,117,255,488	164.7	69.23
Mar-99	104.583	8.98	\$4,927,096,000	\$7,112,936,765	164.8	69.27
Apr-99	103.285	9.59	\$4,927,096,000	\$7,065,774,435	165.9	69.73

May-99	102.764	9.54	\$4,927,096,000	\$7,061,517,945	166	69.77
Jun-99	101.208	9.12	\$4,927,096,000	\$7,061,517,945	166	69.77
Jul-99	102.993	9.00	\$4,927,096,000	\$7,031,865,500	166.7	70.07
Aug-99	102.629	8.47	\$4,927,096,000	\$7,015,032,788	167.1	70.24
Sep-99	102.577	8.30	\$4,927,096,000	\$6,985,768,646	167.8	70.53
Oct-99	103.002	8.09	\$4,927,096,000	\$6,973,301,480	168.1	70.66
Nov-99	103.132	7.54	\$4,927,096,000	\$6,960,878,734	168.4	70.78
Dec-99	103.073	7.47	\$4,927,096,000	\$6,944,383,761	168.8	70.95
Jan-00	103.867	5.51	\$5,244,173,000	\$7,369,451,805	169.3	71.16
Feb-00	103.951	5.60	\$5,244,173,000	\$7,339,107,004	170	71.46
Mar-00	104.442	5.20	\$5,244,173,000	\$7,296,188,249	171	71.88
Apr-00	104.930	4.76	\$5,244,173,000	\$7,300,457,523	170.9	71.83
May-00	105.422	4.79	\$5,244,173,000	\$7,287,664,665	171.2	71.96
Jun-00	105.572	4.55	\$5,244,173,000	\$7,245,343,732	172.2	72.38
Jul-00	104.684	4.59	\$5,244,173,000	\$7,224,367,057	172.7	72.59
Aug-00	105.778	4.54	\$5,244,173,000	\$7,224,367,057	172.7	72.59
Sep-00	106.283	4.29	\$5,244,173,000	\$7,186,913,541	173.6	72.97
Oct-00	106.442	4.19	\$5,244,173,000	\$7,174,515,185	173.9	73.09
Nov-00	106.389	4.11	\$5,244,173,000	\$7,162,159,533	174.2	73.22
Dec-00	106.747	4.00	\$5,244,173,000	\$7,145,751,378	174.6	73.39
Jan-01	107.073	4.04	\$5,327,165,000	\$7,217,499,590	175.6	73.81
Feb-01	107.342	3.97	\$5,327,165,000	\$7,201,096,182	176	73.98
Mar-01	107.083	4.13	\$5,327,165,000	\$7,197,006,974	176.1	74.02
Apr-01	107.973	4.03	\$5,327,165,000	\$7,184,767,166	176.4	74.15
May-01	108.100	4.03	\$5,327,165,000	\$7,148,296,266	177.3	74.52
Jun-01	108.713	4.19	\$5,327,165,000	\$7,132,205,560	177.7	74.69
Jul-01	109.149	4.15	\$5,327,165,000	\$7,144,266,787	177.4	74.57
Aug-01	108.197	4.37	\$5,327,165,000	\$7,144,266,787	177.4	74.57
Sep-01	108.223	4.42	\$5,327,165,000	\$7,116,187,131	178.1	74.86
Oct-01	108.429	4.55	\$5,327,165,000	\$7,136,221,442	177.6	74.65
Nov-01	108.262	4.64	\$5,327,165,000	\$7,140,241,848	177.5	74.61
Dec-01	107.542	5.04	\$5,327,165,000	\$7,144,266,787	177.4	74.57
Jan-02	107.384	5.04	\$5,373,989,000	\$7,194,895,263	177.7	74.69
Feb-02	107.394	5.31	\$5,373,989,000	\$7,182,769,035	178	74.82
Mar-02	107.381	5.48	\$5,373,989,000	\$7,162,649,234	178.5	75.03
Apr-02	108.179	5.69	\$5,373,989,000	\$7,130,690,955	179.3	75.36
May-02	108.551	5.51	\$5,373,989,000	\$7,122,745,896	179.5	75.45
Jun-02	107.890	5.61	\$5,373,989,000	\$7,118,780,002	179.6	75.49
Jul-02	107.714	5.69	\$5,373,989,000	\$7,102,960,491	180	75.66
Aug-02	107.021	5.78	\$5,373,989,000	\$7,083,284,700	180.5	75.87

Sep-02	108.104	5.79	\$5,373,989,000	\$7,071,531,462	180.8	75.99
Oct-02	107.423	5.90	\$5,373,989,000	\$7,055,921,017	181.2	76.16
Nov-02	107.445	6.00	\$5,373,989,000	\$7,044,258,338	181.5	76.29
Dec-02	106.908	6.16	\$5,373,989,000	\$7,032,634,149	181.8	76.42
Jan-03	107.280	5.88	\$5,564,261,000	\$7,249,730,304	182.6	76.75
Feb-03	107.690	5.94	\$5,564,261,000	\$7,210,243,756	183.6	77.17
Mar-03	108.135	5.74	\$5,564,261,000	\$7,198,481,531	183.9	77.30
Apr-03	107.862	5.92	\$5,564,261,000	\$7,225,986,646	183.2	77.00
May-03	108.101	5.83	\$5,564,261,000	\$7,237,839,002	182.9	76.88
Jun-03	108.310	5.87	\$5,564,261,000	\$7,229,933,116	183.1	76.96
Jul-03	108.696	5.71	\$5,564,261,000	\$7,206,318,745	183.7	77.21
Aug-03	108.330	5.71	\$5,564,261,000	\$7,175,071,835	184.5	77.55
Sep-03	108.974	5.70	\$5,564,261,000	\$7,151,813,903	185.1	77.80
Oct-03	109.009	5.53	\$5,564,261,000	\$7,159,549,776	184.9	77.72
Nov-03	109.732	5.42	\$5,564,261,000	\$7,155,679,749	185	77.76
Dec-03	110.353	5.39	\$5,564,261,000	\$7,136,392,202	185.5	77.97
Jan-04	109.539	5.47	\$6,010,408,000	\$7,675,492,116	186.3	78.31
Feb-04	109.976	5.18	\$6,010,408,000	\$7,659,047,569	186.7	78.47
Mar-04	110.343	5.32	\$6,010,408,000	\$7,642,673,336	187.1	78.64
Apr-04	110.179	4.96	\$6,010,408,000	\$7,630,438,533	187.4	78.77
May-04	110.305	4.96	\$6,010,408,000	\$7,598,003,088	188.2	79.11
Jun-04	110.877	4.94	\$6,010,408,000	\$7,569,847,439	188.9	79.40
Jul-04	110.468	4.86	\$6,010,408,000	\$7,561,841,254	189.1	79.48
Aug-04	110.377	4.78	\$6,010,408,000	\$7,557,844,509	189.2	79.53
Sep-04	110.604	4.72	\$6,010,408,000	\$7,533,952,482	189.8	79.78
Oct-04	110.674	4.87	\$6,010,408,000	\$7,494,466,358	190.8	80.20
Nov-04	110.896	4.86	\$6,010,408,000	\$7,459,281,070	191.7	80.58
Dec-04	111.149	4.92	\$6,010,408,000	\$7,459,281,070	191.7	80.58
Jan-05	112.988	4.65	\$6,293,168,000	\$7,814,279,696	191.6	80.53
Feb-05	113.027	4.63	\$6,293,168,000	\$7,781,787,889	192.4	80.87
Mar-05	113.389	4.48	\$6,293,168,000	\$7,753,578,404	193.1	81.16
Apr-05	113.525	4.33	\$6,293,168,000	\$7,729,561,124	193.7	81.42
May-05	113.489	4.25	\$6,293,168,000	\$7,733,553,666	193.6	81.37
Jun-05	114.081	4.02	\$6,293,168,000	\$7,729,561,124	193.7	81.42
Jul-05	115.278	3.92	\$6,293,168,000	\$7,681,970,189	194.9	81.92
Aug-05	116.137	3.96	\$6,293,168,000	\$7,634,961,702	196.1	82.43
Sep-05	116.920	3.80	\$6,293,168,000	\$7,531,267,554	198.8	83.56
Oct-05	117.226	3.77	\$6,293,168,000	\$7,519,919,587	199.1	83.69
Nov-05	117.872	3.92	\$6,293,168,000	\$7,557,879,807	198.1	83.27
Dec-05	118.959	3.88	\$6,293,168,000	\$7,557,879,807	198.1	83.27

Jan-06	119.273	3.73	\$6,879,965,000	\$8,212,853,218	199.3	83.77
Feb-06	120.092	3.85	\$6,879,965,000	\$8,208,734,435	199.4	83.81
Mar-06	120.355	3.83	\$6,879,965,000	\$8,196,402,836	199.7	83.94
Apr-06	120.887	3.89	\$6,879,965,000	\$8,155,563,759	200.7	84.36
May-06	121.612	3.73	\$6,879,965,000	\$8,131,255,074	201.3	84.61
Jun-06	122.252	3.58	\$6,879,965,000	\$8,111,108,258	201.8	84.82
Jul-06	122.677	3.64	\$6,879,965,000	\$8,067,134,778	202.9	85.28
Aug-06	124.917	3.52	\$6,879,965,000	\$8,031,509,551	203.8	85.66
Sep-06	124.519	3.41	\$6,879,965,000	\$8,071,112,655	202.8	85.24
Oct-06	124.235	3.40	\$6,879,965,000	\$8,107,090,869	201.9	84.86
Nov-06	124.584	3.40	\$6,879,965,000	\$8,103,077,458	202	84.91
Dec-06	124.833	3.11	\$6,879,965,000	\$8,059,190,775	203.1	85.37
Jan-07	124.777	3.40	\$7,436,525,000	\$8,696,714,846	203.437	85.51
Feb-07	125.277	3.25	\$7,436,525,000	\$8,663,116,244	204.226	85.84
Mar-07	125.966	3.10	\$7,436,525,000	\$8,618,300,038	205.288	86.29
Apr-07	126.810	3.03	\$7,436,525,000	\$8,592,516,795	205.904	86.55
May-07	127.459	2.95	\$7,436,525,000	\$8,557,150,144	206.755	86.90
Jun-07	128.526	3.06	\$7,436,525,000	\$8,537,371,175	207.234	87.11
Jul-07	129.063	2.99	\$7,436,525,000	\$8,522,196,587	207.603	87.26
Aug-07	128.798	2.93	\$7,436,525,000	\$8,519,570,168	207.667	87.29
Sep-07	129.213	3.13	\$7,436,525,000	\$8,483,620,374	208.547	87.66
Oct-07	129.551	3.06	\$7,436,525,000	\$8,457,543,755	209.19	87.93
Nov-07	130.690	3.09	\$7,436,525,000	\$8,391,595,180	210.834	88.62
Dec-07	130.826	3.09	\$7,436,525,000	\$8,367,346,488	211.445	88.88
Jan-08	133.341	3.04	\$8,259,903,000	\$9,261,853,648	212.174	89.18
Feb-08	133.680	2.82	\$8,259,903,000	\$9,239,514,103	212.687	89.40
Mar-08	134.586	2.94	\$8,259,903,000	\$9,206,572,729	213.448	89.72
Apr-08	134.882	2.67	\$8,259,903,000	\$9,185,314,412	213.942	89.93
May-08	136.048	2.92	\$8,259,903,000	\$9,131,280,138	215.208	90.46
Jun-08	136.674	3.03	\$8,259,903,000	\$9,036,592,597	217.463	91.41
Jul-08	136.623	3.10	\$8,259,903,000	\$8,972,515,871	219.016	92.06
Aug-08	137.573	3.22	\$8,259,903,000	\$8,985,891,152	218.69	91.92
Sep-08	138.545	3.19	\$8,259,903,000	\$8,978,213,955	218.877	92.00
Oct-08	138.916	3.32	\$8,259,903,000	\$9,056,082,103	216.995	91.21
Nov-08	138.201	3.46	\$8,259,903,000	\$9,219,314,464	213.153	89.59
Dec-08	137.673	3.59	\$8,259,903,000	\$9,295,852,070	211.398	88.86
Jan-09	136.525	4.19	\$7,726,515,000	\$8,673,616,122	211.933	89.08
Feb-09	134.849	4.71	\$7,726,515,000	\$8,642,135,755	212.705	89.41
Mar-09	132.915	5.40	\$7,726,515,000	\$8,650,676,419	212.495	89.32
Apr-09	130.014	5.84	\$7,726,515,000	\$8,641,973,239	212.709	89.41

May-09	128.141	7.20	\$7,726,515,000	\$8,629,275,313	213.022	89.54
Jun-09	127.050	7.29	\$7,726,515,000	\$8,558,245,196	214.79	90.28
Jul-09	126.608	7.63	\$7,726,515,000	\$8,560,796,018	214.726	90.25
Aug-09	125.587	7.67	\$7,726,515,000	\$8,532,226,256	215.445	90.56
Sep-09	125.892	7.88	\$7,726,515,000	\$8,515,783,239	215.861	90.73
Oct-09	125.929	7.94	\$7,726,515,000	\$8,490,295,949	216.509	91.00
Nov-09	126.200	7.77	\$7,726,515,000	\$8,461,960,309	217.234	91.31
Dec-09	126.693	7.66	\$7,726,515,000	\$8,457,560,885	217.347	91.36
Jan-10	126.234	8.20	\$8,110,984,000	\$8,872,650,528	217.488	91.42
Feb-10	127.331	7.96	\$8,110,984,000	\$8,881,103,355	217.281	91.33
Mar-10	128.251	7.85	\$8,110,984,000	\$8,878,161,415	217.353	91.36
Apr-10	129.437	7.59	\$8,110,984,000	\$8,876,119,548	217.403	91.38
May-10	130.259	7.08	\$8,110,984,000	\$8,880,735,506	217.29	91.33
Jun-10	131.209	6.54	\$8,110,984,000	\$8,884,456,273	217.199	91.29
Jul-10	131.560	6.52	\$8,110,984,000	\$8,867,879,957	217.605	91.46
Aug-10	132.176	6.61	\$8,110,984,000	\$8,854,939,672	217.923	91.60
Sep-10	132.927	6.45	\$8,110,984,000	\$8,840,659,801	218.275	91.75
Oct-10	134.073	6.63	\$8,110,984,000	\$8,809,984,788	219.035	92.07
Nov-10	134.680	6.91	\$8,110,984,000	\$8,787,718,102	219.59	92.30
Dec-10	135.456	6.52	\$8,110,984,000	\$8,752,562,766	220.472	92.67
Jan-11	137.036	6.25	\$9,197,098,000	\$9,892,506,558	221.187	92.97
Feb-11	137.979	6.00	\$9,197,098,000	\$9,860,809,237	221.898	93.27
Mar-11	139.985	5.81	\$9,197,098,000	\$9,810,056,437	223.046	93.75
Apr-11	141.093	5.72	\$9,197,098,000	\$9,764,222,211	224.093	94.19
May-11	142.532	5.43	\$9,197,098,000	\$9,733,253,774	224.806	94.49
Jun-11	143.503	5.35	\$9,197,098,000	\$9,733,253,774	224.806	94.49
Jul-11	145.402	5.25	\$9,197,098,000	\$9,707,818,931	225.395	94.74
Aug-11	145.713	5.23	\$9,197,098,000	\$9,677,292,279	226.106	95.04
Sep-11	145.837	5.35	\$9,197,098,000	\$9,656,323,111	226.597	95.24
Oct-11	146.476	5.12	\$9,197,098,000	\$9,649,807,488	226.75	95.31
Nov-11	147.322	4.95	\$9,197,098,000	\$9,632,008,980	227.169	95.48
Dec-11	148.357	4.80	\$9,197,098,000	\$9,629,719,914	227.223	95.51
Jan-12	149.521	4.64	\$10,034,173,000	\$10,476,799,251	227.86	95.78
Feb-12	150.876	4.60	\$10,034,173,000	\$10,453,081,866	228.377	95.99
Mar-12	151.995	4.45	\$10,034,173,000	\$10,429,471,621	228.894	96.21
Apr-12	153.353	4.25	\$10,034,173,000	\$10,411,640,821	229.286	96.37
May-12	154.934	4.28	\$10,034,173,000	\$10,437,314,632	228.722	96.14
Jun-12	155.190	4.21	\$10,034,173,000	\$10,447,180,719	228.506	96.05
Jul-12	156.341	4.31	\$10,034,173,000	\$10,448,598,216	228.475	96.03
Aug-12	157.723	4.16	\$10,034,173,000	\$10,386,364,131	229.844	96.61

Sep-12	158.471	3.90	\$10,034,173,000	\$10,334,968,969	230.987	97.09
Oct-12	158.719	3.94	\$10,034,173,000	\$10,305,167,069	231.655	97.37
Nov-12	158.141	4.02	\$10,034,173,000	\$10,321,965,242	231.278	97.21
Dec-12	158.512	4.01	\$10,034,173,000	\$10,322,233,030	231.272	97.21
Jan-13	159.379	4.33	\$10,204,921,000	\$10,481,159,906	231.641	97.36
Feb-13	160.257	4.08	\$10,204,921,000	\$10,419,803,702	233.005	97.94
Mar-13	160.382	3.97	\$10,204,921,000	\$10,450,841,587	232.313	97.65
Apr-13	161.546	3.94	\$10,204,921,000	\$10,471,440,729	231.856	97.45
May-13	162.254	3.98	\$10,204,921,000	\$10,469,679,647	231.895	97.47
Jun-13	162.218	4.04	\$10,204,921,000	\$10,448,862,576	232.357	97.67
Jul-13	162.321	3.92	\$10,204,921,000	\$10,431,264,416	232.749	97.83
Aug-13	162.823	3.87	\$10,204,921,000	\$10,408,903,625	233.249	98.04
Sep-13	163.431	3.91	\$10,204,921,000	\$10,391,395,219	233.642	98.21
Oct-13	163.152	3.88	\$10,204,921,000	\$10,384,417,220	233.799	98.27
Nov-13	164.064	3.85	\$10,204,921,000	\$10,366,194,277	234.21	98.44
Dec-13	164.783	3.72	\$10,204,921,000	\$10,338,076,968	234.847	98.71
Jan-14	166.132	3.62	\$11,094,369,000	\$11,211,013,274	235.436	98.96
Feb-14	167.606	3.60	\$11,094,369,000	\$11,202,210,844	235.621	99.04
Mar-14	168.956	3.46	\$11,094,369,000	\$11,189,104,233	235.897	99.15
Apr-14	170.293	3.11	\$11,094,369,000	\$11,160,811,524	236.495	99.40
May-14	171.446	3.15	\$11,094,369,000	\$11,146,295,111	236.803	99.53
Jun-14	173.172	3.07	\$11,094,369,000	\$11,136,278,231	237.016	99.62
Jul-14	174.627	3.16	\$11,094,369,000	\$11,124,872,487	237.259	99.73
Aug-14	175.798	3.09	\$11,094,369,000	\$11,129,375,667	237.163	99.69
Sep-14	176.989	2.97	\$11,094,369,000	\$11,113,115,748	237.51	99.83
Oct-14	177.951	2.90	\$11,094,369,000	\$11,106,522,259	237.651	99.89
Nov-14	178.444	2.85	\$11,094,369,000	\$11,124,778,709	237.261	99.73
Dec-14	178.925	2.80	\$11,094,369,000	\$11,162,274,686	236.464	99.39
Jan-15	177.329	3.15			234.954	98.76
Feb-15	174.941	3.36			235.415	98.95
Mar-15	173.094	3.61			235.859	99.14
Apr-15	170.169	3.82			236.197	99.28
May-15	168.090	3.96			236.876	99.56
Jun-15	168.026	3.92			237.423	99.79
Jul-15	166.230	3.96			237.734	99.93
Aug-15	165.427	4.04			237.703	99.91
Sep-15	164.355	4.31			237.489	99.82
Oct-15	163.685	4.55			237.949	100.02
Nov-15	163.259	4.77			238.302	100.16
Dec-15	163.028	4.77			238.041	100.05



Jan-16	161.736	4.58			238.107	100.08
Feb-16	160.478	4.67			237.707	99.91
Mar-16	159.321	5.06			237.92	100.00
Apr-16	159.369	5.30			238.89	100.41
May-16	159.063	4.96			239.41	100.63
Jun-16	159.481	4.78			239.927	100.85
Jul-16	159.244	5.11			239.828	100.81
Aug-16	159.317	5.29				

Table 7: Quarterly Data

Date	CPI-U: All Items	CPI-U: All Items Index, Q1:2016=100	Nominal Retail Sales	Real Retail Sales Base Period (Q1:2016)	Nominal Total Wages	Real Total Wages Base Period (Q1:2016)
Q1-90	128.03	53.81	\$501,622,333	\$1,017,774,844	\$502,640,108	\$935,952,643
Q2-90	129.30	54.35	\$554,380,237	\$1,049,396,267	\$555,429,633	\$936,994,408
Q3-90	131.53	55.29	\$587,281,354	\$1,079,811,816	\$588,361,166	\$933,331,625
Q4-90	133.77	56.23	\$678,630,180	\$1,070,091,334	\$679,700,271	\$942,057,302
Q1-91	134.77	56.65	\$544,564,640	\$1,049,400,443	\$545,614,040	\$962,939,918
Q2-91	135.57	56.98	\$569,092,814	\$1,026,539,621	\$570,119,354	\$972,618,943
Q3-91	136.60	57.42	\$557,981,803	\$987,681,422	\$558,969,484	\$958,895,990
Q4-91	137.73	57.89	\$636,812,061	\$977,450,669	\$637,789,512	\$932,222,060
Q1-92	138.67	58.29	\$512,931,632	\$959,652,020	\$513,891,284	\$949,717,596
Q2-92	139.73	58.73	\$529,125,264	\$923,264,833	\$530,048,529	\$926,510,444
Q3-92	140.80	59.18	\$557,846,735	\$958,681,117	\$558,805,416	\$921,937,577
Q4-92	142.03	59.70	\$659,569,048	\$985,677,560	\$660,554,726	\$917,281,954
Q1-93	143.07	60.14	\$546,515,171	\$989,047,802	\$547,504,219	\$894,611,705
Q2-93	144.10	60.57	\$597,696,042	\$1,006,778,761	\$598,702,821	\$924,046,453
Q3-93	144.77	60.85	\$613,894,663	\$1,027,277,969	\$614,921,941	\$930,200,158
Q4-93	145.97	61.36	\$707,443,268	\$1,033,935,647	\$708,477,204	\$965,737,946
Q1-94	146.70	61.66	\$586,374,512	\$1,033,331,828	\$587,407,844	\$922,858,928
Q2-94	147.53	62.01	\$625,046,115	\$1,021,971,351	\$626,068,086	\$915,159,246

Q3-94	148.90	62.59	\$633,684,389	\$1,032,579,843	\$634,716,969	\$936,112,439
Q4-94	149.77	62.95	\$715,938,250	\$1,025,088,748	\$716,963,339	\$927,595,386
Q1-95	150.87	63.41	\$608,631,364	\$1,041,753,729	\$609,673,118	\$926,763,808
Q2-95	152.10	63.93	\$659,298,759	\$1,040,035,969	\$660,338,795	\$933,746,675
Q3-95	152.87	64.26	\$644,507,521	\$1,023,412,598	\$645,530,934	\$922,702,369
Q4-95	153.70	64.60	\$723,704,211	\$1,013,825,145	\$724,718,036	\$928,077,840
Q1-96	155.07	65.18	\$643,620,958	\$1,072,203,088	\$644,693,161	\$936,857,460
Q2-96	156.40	65.74	\$705,938,593	\$1,078,466,826	\$707,017,060	\$938,851,076
Q3-96	157.30	66.12	\$697,718,981	\$1,076,666,722	\$698,795,648	\$956,032,588
Q4-96	158.67	66.69	\$816,549,465	\$1,110,752,630	\$817,660,218	\$976,167,456
Q1-97	159.63	67.10	\$706,086,787	\$1,142,930,834	\$707,229,718	\$1,022,043,923
Q2-97	160.00	67.25	\$809,800,409	\$1,207,632,392	\$811,008,041	\$1,036,885,119
Q3-97	160.80	67.59	\$792,926,828	\$1,196,474,587	\$794,123,303	\$1,064,814,286
Q4-97	161.67	67.95	\$885,024,307	\$1,181,636,021	\$886,205,943	\$1,089,533,442
Q1-98	162.00	68.09	\$731,669,255	\$1,168,019,919	\$732,837,275	\$1,098,250,153
Q2-98	162.53	68.32	\$778,934,450	\$1,144,709,903	\$780,079,160	\$1,119,611,782
Q3-98	163.37	68.67	\$743,739,731	\$1,103,192,097	\$744,842,923	\$1,108,665,406
Q4-98	164.13	68.99	\$788,617,773	\$1,035,931,152	\$789,653,704	\$1,091,780,298
Q1-99	164.73	69.24	\$626,704,087	\$983,678,172	\$627,687,765	\$991,186,619
Q2-99	165.97	69.76	\$688,455,015	\$994,834,924	\$689,449,850	\$976,663,354
Q3-99	167.20	70.28	\$723,406,367	\$1,046,079,157	\$724,452,446	\$981,941,537
Q4-99	168.43	70.80	\$858,576,851	\$1,097,323,263	\$859,674,174	\$1,005,072,075
Q1-00	170.10	71.50	\$752,996,600	\$1,144,365,259	\$754,140,965	\$1,009,242,092
Q2-00	171.43	72.06	\$815,870,590	\$1,145,421,572	\$817,016,012	\$1,019,810,355
Q3-00	173.00	72.72	\$815,041,836	\$1,137,246,229	\$816,179,082	\$1,034,338,706
Q4-00	174.23	73.23	\$962,463,362	\$1,188,821,372	\$963,652,183	\$1,044,326,702
Q1-01	175.90	73.94	\$848,878,350	\$1,244,669,874	\$850,123,020	\$1,089,082,854
Q2-01	177.13	74.45	\$937,490,731	\$1,277,284,348	\$938,768,015	\$1,115,893,869
Q3-01	177.63	74.66	\$901,379,582	\$1,225,029,894	\$902,604,612	\$1,094,389,228
Q4-01	177.50	74.61	\$1,017,388,542	\$1,234,000,457	\$1,018,622,542	\$1,091,069,338

Q1-02	178.07	74.85	\$652,370,307	\$942,182,496	\$653,312,489	\$1,083,212,564
Q2-02	179.47	75.44	\$672,922,013	\$905,660,585	\$673,827,674	\$1,061,168,344
Q3-02	180.43	75.84	\$693,183,503	\$928,822,813	\$694,112,326	\$1,081,837,116
Q4-02	181.50	76.29	\$805,755,536	\$956,332,156	\$806,711,868	\$1,054,301,494
Q1-03	183.37	77.08	\$700,118,581	\$978,914,079	\$701,097,495	\$1,068,012,257
Q2-03	183.07	76.95	\$778,570,632	\$1,028,082,967	\$779,598,715	\$1,073,954,819
Q3-03	184.43	77.52	\$774,070,068	\$1,015,956,507	\$775,086,025	\$1,090,864,710
Q4-03	185.13	77.82	\$880,683,276	\$1,025,033,383	\$881,708,309	\$1,107,072,584
Q1-04	186.70	78.48	\$790,020,164	\$1,083,795,602	\$791,103,960	\$1,125,565,403
Q2-04	188.17	79.09	\$867,382,101	\$1,112,867,016	\$868,494,968	\$1,148,895,077
Q3-04	189.37	79.60	\$888,793,583	\$1,137,533,561	\$889,931,117	\$1,145,273,921
Q4-04	191.40	80.45	\$1,032,855,816	\$1,163,879,209	\$1,034,019,695	\$1,153,302,151
Q1-05	192.37	80.86	\$914,006,498	\$1,216,288,340	\$915,222,786	\$1,169,497,292
Q2-05	193.67	81.40	\$981,458,161	\$1,222,425,671	\$982,680,587	\$1,184,780,186
Q3-05	196.60	82.64	\$1,003,487,462	\$1,236,431,507	\$1,004,723,894	\$1,286,450,276
Q4-05	198.43	83.41	\$1,198,380,255	\$1,303,426,678	\$1,199,683,682	\$1,284,874,131
Q1-06	199.47	83.84	\$1,033,011,101	\$1,327,934,848	\$1,034,339,036	\$1,350,422,682
Q2-06	201.27	84.60	\$1,139,780,828	\$1,364,096,002	\$1,141,144,924	\$1,385,100,605
Q3-06	203.17	85.40	\$1,184,944,038	\$1,411,113,747	\$1,186,355,152	\$1,405,556,097
Q4-06	202.33	85.04	\$1,343,958,296	\$1,434,030,603	\$1,345,392,327	\$1,510,449,712
Q1-07	204.32	85.88	\$1,100,277,011	\$1,384,218,285	\$1,101,661,229	\$1,507,761,265
Q2-07	206.63	86.85	\$1,152,409,878	\$1,342,481,971	\$1,153,752,360	\$1,572,715,982
Q3-07	207.94	87.40	\$1,108,929,276	\$1,287,589,435	\$1,110,216,865	\$1,574,151,358
Q4-07	210.49	88.47	\$1,259,052,452	\$1,292,107,645	\$1,260,344,560	\$1,613,236,549
Q1-08	212.77	89.43	\$1,181,822,282	\$1,430,994,762	\$1,183,253,277	\$1,655,483,015
Q2-08	215.54	90.60	\$1,275,879,904	\$1,421,910,504	\$1,277,301,815	\$1,707,132,820
Q3-08	218.86	91.99	\$1,333,446,173	\$1,470,789,389	\$1,334,916,962	\$1,784,020,156
Q4-08	213.85	89.89	\$1,359,988,136	\$1,376,248,102	\$1,361,364,384	\$1,771,333,239
Q1-09	212.38	89.27	\$953,184,920	\$1,154,880,666	\$954,339,801	\$1,658,263,037
Q2-09	213.51	89.74	\$999,672,506	\$1,124,208,820	\$1,000,796,715	\$1,540,106,721

Q3-09	215.34	90.51	\$984,535,344	\$1,102,541,457	\$985,637,885	\$1,499,388,884
Q4-09	217.03	91.22	\$1,139,721,955	\$1,140,537,449	\$1,140,862,492	\$1,534,048,988
Q1-10	217.37	91.37	\$1,010,354,800	\$1,191,764,440	\$1,011,546,564	\$1,562,971,220
Q2-10	217.30	91.34	\$1,130,904,494	\$1,248,726,550	\$1,132,153,221	\$1,691,696,186
Q3-10	217.93	91.60	\$1,145,321,553	\$1,268,091,058	\$1,146,589,644	\$1,702,137,810
Q4-10	219.70	92.35	\$1,359,633,286	\$1,349,716,232	\$1,360,983,002	\$1,759,222,522
Q1-11	222.04	93.33	\$1,245,924,483	\$1,430,330,273	\$1,247,354,813	\$1,875,830,067
Q2-11	224.57	94.39	\$1,403,346,903	\$1,501,879,928	\$1,404,848,783	\$1,876,701,015
Q3-11	226.03	95.01	\$1,467,740,427	\$1,563,791,160	\$1,469,304,218	\$2,004,810,312
Q4-11	227.05	95.44	\$1,737,265,063	\$1,676,595,250	\$1,738,941,658	\$1,967,108,248
Q1-12	228.38	95.99	\$1,562,849,619	\$1,736,756,290	\$1,564,586,375	\$2,153,793,354
Q2-12	228.84	96.19	\$1,723,351,206	\$1,812,742,349	\$1,725,163,948	\$2,182,137,894
Q3-12	229.77	96.58	\$1,872,118,528	\$1,955,275,038	\$1,874,073,803	\$2,238,697,510
Q4-12	231.40	97.26	\$2,012,462,755	\$1,916,000,007	\$2,014,378,755	\$2,311,911,886
Q1-13	232.32	97.65	\$1,815,387,819	\$1,975,156,025	\$1,817,362,975	\$2,288,745,749
Q2-13	232.04	97.53	\$1,867,177,929	\$1,943,547,676	\$1,869,121,477	\$2,378,601,147
Q3-13	233.21	98.02	\$1,733,122,215	\$1,771,462,385	\$1,734,893,677	\$2,406,134,887
Q4-13	234.29	98.48	\$1,908,888,164	\$1,804,646,239	\$1,910,692,810	\$2,407,188,615
Q1-14	235.65	99.05	\$1,783,012,189	\$1,909,975,596	\$1,784,922,165	\$2,566,620,619
Q2-14	236.77	99.52	\$1,907,470,266	\$1,948,351,557	\$1,909,418,618	\$2,676,518,300
Q3-14	237.31	99.75	\$2,055,229,181	\$2,054,797,439	\$2,057,283,978	\$2,736,840,036
Q4-14	237.13	99.67	\$2,134,607,193	\$2,001,850,573	\$2,136,609,044	\$2,810,702,269
Q1-15	235.41	98.95	\$1,700,398,853	\$1,822,563,443	\$1,702,221,416	\$2,681,948,028
Q2-15	236.83	99.55	\$1,710,253,935	\$1,747,762,092	\$1,712,001,697	\$2,536,407,160
Q3-15	237.64	99.89	\$1,689,492,427	\$1,683,696,084	\$1,691,176,123	\$2,418,959,362
Q4-15	238.10	100.08	\$1,664,407,272	\$1,568,990,667	\$1,665,976,263	\$2,294,995,029
Q1-16	237.91	100.00	\$1,462,190,639	\$1,549,594,897	\$1,463,740,234	\$2,253,686,891

Table 8: Supplemental Data

Date	Raw BCI	Re-trended BCI	Re-trended BCI Base Period (January:1991)
Jan-91	101.83	101.83	100
Feb-91	102.73	102.71	100.8627091
Mar-91	102.77	102.72	100.8750786
Apr-91	103.96	103.88	102.0116576
May-91	104.54	104.43	102.5587421
Jun-91	104.75	104.61	102.7322948
Jul-91	104.40	104.23	102.3625734
Aug-91	103.91	103.72	101.8599999
Sep-91	102.75	102.53	100.6910255
Oct-91	102.30	102.06	100.2259614
Nov-91	102.68	102.41	100.5750821
Dec-91	102.39	102.09	100.2609924
Jan-92	102.66	102.34	100.4981709
Feb-92	102.62	102.27	100.4325545
Mar-92	101.99	101.62	99.79229624
Apr-92	101.53	101.14	99.32010244
May-92	100.90	100.48	98.67688009
Jun-92	99.72	99.27	97.49072266
Jul-92	100.00	99.53	97.74263583
Aug-92	99.77	99.27	97.49216784
Sep-92	99.03	98.52	96.74803981
Oct-92	98.55	98.01	96.24739412
Nov-92	98.38	97.81	96.05551748
Dec-92	98.14	97.55	95.80139795
Jan-93	98.18	97.56	95.81138884
Feb-93	98.70	98.06	96.29726635
Mar-93	98.97	98.30	96.53078826
Apr-93	99.14	98.44	96.67653358
May-93	99.60	98.87	97.09619183
Jun-93	99.98	99.23	97.44613958
Jul-93	101.52	100.73	98.92131715
Aug-93	102.81	101.98	100.1516511
Sep-93	103.16	102.30	100.4587317

Oct-93	103.85	102.96	101.1066631
Nov-93	103.76	102.84	100.9976162
Dec-93	103.64	102.69	100.8475167
Jan-94	102.94	101.97	100.1406821
Feb-94	101.87	100.89	99.07492118
Mar-94	100.94	99.94	98.14467517
Apr-94	101.19	100.16	98.36235662
May-94	101.49	100.43	98.62602251
Jun-94	101.77	100.69	98.87741926
Jul-94	102.56	101.44	99.61741974
Aug-94	102.69	101.54	99.71474134
Sep-94	102.79	101.61	99.78774141
Oct-94	102.44	101.24	99.4233314
Nov-94	102.44	101.21	99.39526765
Dec-94	103.29	102.03	100.1965211
Jan-95	103.36	102.06	100.2318491
Feb-95	103.49	102.17	100.3336379
Mar-95	103.32	101.98	100.1439567
Apr-95	103.69	102.31	100.4736939
May-95	103.84	102.43	100.5953519
Jun-95	104.00	102.57	100.7268849
Jul-95	103.30	101.85	100.0255777
Aug-95	103.58	102.10	100.2648371
Sep-95	103.73	102.22	100.3855393
Oct-95	103.13	101.60	99.77479024
Nov-95	103.26	101.70	99.87844932
Dec-95	103.37	101.79	99.95994494
Jan-96	103.89	102.27	100.433423
Feb-96	104.23	102.57	100.732216
Mar-96	104.83	103.14	101.285428
Apr-96	104.36	102.65	100.8087916
May-96	104.29	102.56	100.7135573
Jun-96	105.09	103.31	101.4577196
Jul-96	105.33	103.53	101.6675175
Aug-96	106.16	104.31	102.4378224
Sep-96	106.69	104.81	102.9268712

Oct-96	107.89	105.96	104.0592713
Nov-96	108.95	106.98	105.0544092
Dec-96	109.48	107.46	105.532537
Jan-97	110.68	108.62	106.6673796
Feb-97	111.82	109.71	107.737341
Mar-97	112.64	110.48	108.4966022
Apr-97	113.92	111.70	109.6977049
May-97	115.33	113.06	111.0260571
Jun-97	116.25	113.93	111.8809934
Jul-97	116.86	114.50	112.4453253
Aug-97	117.74	115.33	113.26123
Sep-97	118.88	116.42	114.327855
Oct-97	119.74	117.22	115.1183143
Nov-97	120.32	117.76	115.6480602
Dec-97	121.18	118.58	116.4463836
Jan-98	121.88	119.23	117.0850124
Feb-98	122.55	119.86	117.7045622
Mar-98	123.11	120.37	118.2122423
Apr-98	123.22	120.44	118.2814258
May-98	123.74	120.92	118.745796
Jun-98	122.82	119.99	117.833838
Jul-98	122.63	119.78	117.6246893
Aug-98	122.29	119.41	117.2646753
Sep-98	121.26	118.37	116.2478765
Oct-98	120.25	117.35	115.2470556
Nov-98	118.57	115.69	113.613178
Dec-98	115.33	112.50	110.4775247
Jan-99	112.04	109.26	107.2983485
Feb-99	108.58	105.86	103.9591073
Mar-99	106.88	104.17	102.3020897
Apr-99	105.75	103.05	101.1965659
May-99	105.71	102.98	101.13197
Jun-99	105.29	102.54	100.6965019
Jul-99	106.29	103.48	101.6264896
Aug-99	107.17	104.32	102.4473377
Sep-99	107.44	104.55	102.6725341

Oct-99	107.70	104.78	102.9003758
Nov-99	108.25	105.28	103.3923852
Dec-99	108.91	105.90	103.9957816
Jan-00	110.34	107.27	105.3418934
Feb-00	111.09	107.96	106.0257887
Mar-00	111.44	108.27	106.3306479
Apr-00	111.59	108.40	106.4506076
May-00	111.74	108.52	106.5668419
Jun-00	112.18	108.91	106.9506948
Jul-00	111.85	108.56	106.6084681
Aug-00	112.18	108.85	106.8976197
Sep-00	113.03	109.65	107.676578
Oct-00	114.00	110.56	108.5708375
Nov-00	114.83	111.34	109.335888
Dec-00	115.79	112.24	110.2217742
Jan-01	116.86	113.25	111.2151725
Feb-01	118.07	114.39	112.3346419
Mar-01	118.75	115.01	112.9482962
Apr-01	119.71	115.91	113.8310872
May-01	120.10	116.26	114.1733118
Jun-01	120.02	116.16	114.0709027
Jul-01	119.92	116.02	113.9406391
Aug-01	119.06	115.17	113.098482
Sep-01	118.35	114.45	112.3951246
Oct-01	118.18	114.26	112.2054281
Nov-01	118.12	114.17	112.1185388
Dec-01	117.41	113.45	111.4169066
Jan-02	116.38	112.42	110.4034372
Feb-02	115.38	111.43	109.4331409
Mar-02	114.43	110.48	108.4977302
Apr-02	114.13	110.16	108.1845735
May-02	114.41	110.41	108.4252159
Jun-02	114.36	110.33	108.350082
Jul-02	114.33	110.28	108.295643
Aug-02	113.65	109.59	107.6213584
Sep-02	113.65	109.56	107.5928683



Oct-02	113.24	109.13	107.1737584
Nov-02	113.00	108.87	106.9166691
Dec-02	112.66	108.52	106.5712905
Jan-03	112.76	108.59	106.6376745
Feb-03	113.09	108.88	106.9249517
Mar-03	113.71	109.44	107.4786207
Apr-03	113.98	109.68	107.711506
May-03	114.30	109.96	107.980753
Jun-03	114.64	110.26	108.2770296
Jul-03	115.26	110.82	108.8332197
Aug-03	115.48	111.01	109.0149249
Sep-03	116.04	111.52	109.5141816
Oct-03	116.46	111.88	109.8749099
Nov-03	117.00	112.38	110.3583103
Dec-03	117.95	113.26	111.2256045
Jan-04	118.29	113.56	111.5201891
Feb-04	118.84	114.05	112.0054036
Mar-04	119.62	114.78	112.7161475
Apr-04	120.21	115.30	113.2343495
May-04	120.42	115.48	113.4079883
Jun-04	120.88	115.89	113.805185
Jul-04	121.05	116.02	113.9388864
Aug-04	121.02	115.97	113.8843023
Sep-04	121.04	115.96	113.8744281
Oct-04	121.04	115.92	113.8400068
Nov-04	121.20	116.04	113.9605516
Dec-04	121.18	115.99	113.9113295
Jan-05	122.26	116.99	114.8935924
Feb-05	123.14	117.81	115.6934551
Mar-05	124.06	118.66	116.5300497
Apr-05	125.22	119.74	117.5869995
May-05	126.51	120.94	118.7660882
Jun-05	128.09	122.42	120.217583
Jul-05	130.05	124.26	122.0243813
Aug-05	131.92	126.01	123.7449869
Sep-05	133.71	127.69	125.3924067

Oct-05	135.06	128.94	126.6262286
Nov-05	136.14	129.94	127.6037756
Dec-05	137.58	131.28	128.9204182
Jan-06	138.69	132.30	129.9277142
Feb-06	139.76	133.30	130.9022871
Mar-06	140.64	134.09	131.6830679
Apr-06	141.61	134.98	132.5607329
May-06	143.03	136.31	133.8581743
Jun-06	144.65	137.81	135.3356364
Jul-06	145.61	138.69	136.1982909
Aug-06	147.83	140.76	138.2346831
Sep-06	149.73	142.54	139.9790306
Oct-06	151.09	143.80	141.2172932
Nov-06	152.41	145.01	142.4082763
Dec-06	153.70	146.21	143.5807802
Jan-07	154.48	146.91	144.270668
Feb-07	155.46	147.80	145.1441232
Mar-07	156.71	148.95	146.2733275
Apr-07	158.03	150.16	147.4655661
May-07	158.89	150.94	148.2289206
Jun-07	159.64	151.61	148.8895292
Jul-07	160.41	152.31	149.5714009
Aug-07	160.67	152.51	149.7722926
Sep-07	161.02	152.80	150.0605409
Oct-07	161.54	153.26	150.5054455
Nov-07	162.89	154.50	151.7286241
Dec-07	163.73	155.26	152.4695303
Jan-08	166.13	157.49	154.6641177
Feb-08	168.41	159.61	156.7474135
Mar-08	170.62	161.66	158.7556237
Apr-08	172.12	163.04	160.1151849
May-08	173.68	164.47	161.5213454
Jun-08	175.56	166.21	163.229256
Jul-08	177.09	167.61	164.6026731
Aug-08	178.51	168.91	165.8818946
Sep-08	179.70	170.00	166.9432001

Oct-08	180.05	170.29	167.2283572
Nov-08	178.59	168.86	165.8281047
Dec-08	175.60	165.99	163.0083096
Jan-09	171.13	161.72	158.8156674
Feb-09	165.96	156.79	153.9793056
Mar-09	161.11	152.17	149.4411265
Apr-09	156.31	147.60	144.9456874
May-09	152.10	143.59	141.0067516
Jun-09	149.47	141.07	138.5370424
Jul-09	148.43	140.05	137.5324295
Aug-09	147.78	139.40	136.8944441
Sep-09	147.95	139.53	137.0218152
Oct-09	148.64	140.14	137.6213992
Nov-09	149.72	141.12	138.5824323
Dec-09	151.21	142.48	139.9230531
Jan-10	152.03	143.22	140.6482523
Feb-10	153.70	144.76	142.1569707
Mar-10	156.07	146.95	144.3120867
Apr-10	159.11	149.78	147.0867029
May-10	162.13	152.58	149.8357123
Jun-10	164.77	155.02	152.2324377
Jul-10	166.25	156.37	153.5664095
Aug-10	167.11	157.14	154.3189779
Sep-10	167.88	157.82	154.9894364
Oct-10	169.20	159.02	156.1643072
Nov-10	171.05	160.71	157.8271543
Dec-10	173.63	163.09	160.1651166
Jan-11	177.09	166.30	163.3152748
Feb-11	180.01	169.00	165.9676631
Mar-11	182.93	171.70	168.6148653
Apr-11	185.26	173.84	170.7229008
May-11	187.55	175.94	172.7822271
Jun-11	189.08	177.33	174.1466639
Jul-11	190.92	179.01	175.7967037
Aug-11	192.25	180.21	176.9734921
Sep-11	193.28	181.13	177.8753124

Oct-11	195.08	182.77	179.4850646
Nov-11	197.76	185.23	181.9039757
Dec-11	201.01	188.23	184.8480854
Jan-12	204.37	191.32	187.8894157
Feb-12	207.68	194.37	190.8776818
Mar-12	210.57	197.02	193.4849229
Apr-12	213.02	199.26	195.6826211
May-12	215.60	201.63	198.0054315
Jun-12	217.39	203.24	199.5934942
Jul-12	219.17	204.86	201.1777597
Aug-12	221.44	206.92	203.2090593
Sep-12	223.48	208.77	205.0243998
Oct-12	224.69	209.84	206.0760467
Nov-12	224.58	209.69	205.9239249
Dec-12	224.40	209.47	205.7101378
Jan-13	225.14	210.10	206.3279784
Feb-13	227.25	212.02	208.2132609
Mar-13	229.07	213.66	209.8250136
Apr-13	230.85	215.26	211.397353
May-13	232.29	216.55	212.6633747
Jun-13	232.92	217.08	213.1773335
Jul-13	232.95	217.05	213.1549657
Aug-13	233.00	217.04	213.1438166
Sep-13	233.72	217.65	213.7432284
Oct-13	234.48	218.30	214.3848133
Nov-13	236.43	220.07	216.1145478
Dec-13	239.23	222.61	218.6160369
Jan-14	242.85	225.92	221.8615249
Feb-14	246.98	229.70	225.5767734
Mar-14	251.33	233.69	229.4893178
Apr-14	255.51	237.51	233.241712
May-14	258.65	240.37	236.0517396
Jun-14	261.44	242.89	238.5308698
Jul-14	264.10	245.30	240.8993121
Aug-14	266.71	247.66	243.2115154
Sep-14	269.17	249.88	245.3952173

Oct-14	270.83	251.35	246.8389617
Nov-14	270.73	251.20	246.6912368
Dec-14	269.30	249.81	245.3241167
Jan-15	265.39	246.12	241.696967
Feb-15	259.51	240.60	236.2815539
Mar-15	253.92	235.36	231.1294045
Apr-15	248.44	230.21	226.0770682
May-15	243.23	225.33	221.279412
Jun-15	240.13	222.40	218.4071239
Jul-15	236.79	219.25	215.3108433
Aug-15	233.34	215.99	212.1156073
Sep-15	229.37	212.27	208.4537142
Oct-15	225.42	208.56	204.8139905
Nov-15	222.22	205.54	201.8478503
Dec-15	220.45	203.85	200.1890245
Jan-16	218.92	202.39	198.7517074
Feb-16	216.91	200.47	196.8738171
Mar-16	214.43	198.13	194.5684814
Apr-16	213.29	197.02	193.4868874
May-16	213.19	196.88	193.3465398
Jun-16	213.65	197.25	193.7127746
Jul-16	213.28	196.86	193.3264885
Aug-16	212.60	196.18	192.6606094

## **Vita**

Elisabeth Downs was born in Pirmasens, Germany and grew up in El Paso, Texas. She graduated from W.H. Burges High School in 2008 and enrolled at El Paso Community College in 2009 where she received an Associate of Arts in Economics. She began attending the University of Texas at El Paso (UTEP) in 2011 and received a Bachelor of Business Administration with a major in Finance in 2012 with magna cum laude honors. While pursuing her undergraduate degree, she worked for the City of El Paso Parks and Recreation Department.

Elisabeth was admitted to the Master of Science in Economics program at UTEP in June 2014. While in graduate school, she worked as a research intern at the Federal Reserve Bank of Dallas El Paso Branch. She also worked as a graduate research assistant for the UTEP College of Education Department of Educational Leadership and Foundations. She is currently a Research Coordinator for CBRE in El Paso, Texas.

Contact Information: [downs.edc@gmail.com](mailto:downs.edc@gmail.com)

This thesis/dissertation was typed by Elisabeth Downs.