Business Cycle Downturn Patterns across Texas

Aaron D. Nazarian[1] and Thomas M. Fullerton, Jr.[2]
[1]TFCU Market Research Department, 12020 Rojas Drive, El Paso, TX 79936
[2]UTEP Department of Economics & Finance, 500 University Avenue, El Paso, TX 79968-0543

Abstract
Yield spreads have been found to serve as valuable economic forecasting tools. This research employs dynamic autoregressive probit downturn models using the United States yield spread and other regional and macroeconomic variables. This study then inspects the predictive power of the United States yield spread on the five largest urban economies in Texas, the four largest metropolitan areas along the Texas-Mexico border, as well as the Texas state economy. The other regional and macroeconomic variables are included in model specifications based on characteristics of the economies being analyzed. Results indicate that a narrowing of the United States yield spread for either country tends to increase the probability of recessions in all the economies analyzed. Decreases in the real value of the peso are found to reduce the likelihood of a recession in border economies and Texas. However, results for west Texas intermediate oil price are mixed and suggest that for some economies when oil prices increase, the probability of a recession increases, which runs counter to conventional expectations.

Keywords
Regional Business Cycles; Texas; Applied Econometrics

JEL Classification
R15, Regional Econometrics; C53, Forecasting and Prediction; E32, Business Cycles

1. Introduction

Economic recession prediction is an area of interest for public and private decision makers. For national economies, the yield spread, the difference between long-term and short-term treasury bills, is a valuable recession forecasting tool (Estrella and Mishkin, 1996; Dueker, 1997; Estrella and Mishkin, 1998). Research by Nyberg (2010) and Kauppi and Saikkonen (2008) show that usage of the yield spread within dynamic binary response models outperforms standard static models in predicting future recessions.

Yield spreads have also been shown to effectively predict economic recessions for state economies (Gauger and Schunck, 2002; Shoesmith, 2003), but there is relatively little research on this topic for metropolitan economies. That gap in the literature is somewhat puzzling. Historically, there is much more information available regarding national and regional economies than there is for urban economies (Klein, 1969). This study takes advantage of previously published BCIs for nine urban economies located within the state of Texas. Those indices are compiled using a well-known methodology involving Kalman filtering and dynamic single-factor analysis (Stock and Watson, 1991). The indices are maintained and updated by the Federal Reserve Bank of Dallas. As coincident indicators, these BCIs provide gauges of current economic conditions for each of the geographic areas monitored (FRBD, 2018).

To examine metropolitan BCI downturn predictability, the study uses yield spreads plus some other economic indicators that are potentially related to business cycle developments across Texas. Subsequent sections of the paper are as follows. The next section provides a brief overview of related studies. Section three describes the methodological framework and data employed. Section four provides empirical analysis. Section five summarizes principal results and implications for future research.

2. Literature Review

Previous research examines what information the term structures for U.S. Treasury bill interest rates contain about future economic conditions in national economies. Research indicates that longer-term Treasury bill maturities have significant predictive power for future changes in inflation (Mishkin 1990). The yield spread, the difference between long-term and short-term treasury bills, has been found to serve as a valuable recession forecasting tool. While a substantial volume of recession predictability utilizing yield curves has been conducted for national economies, only a much smaller number of studies have been examined this topic for state and regional economies.

Forecasting economic conditions in U.S.-Mexico border regions is a unique challenge because cross-border economic relationships affect metropolitan business cycles (Fullerton 2001). Those commercial and industrial ties include retail sector "exports," health sector tourism, as well as supply chain linked manufacturing, transportation, and warehousing activities (Phillips and Cañas 2008). Similarly, energy sector fluctuations are likely to play outsized roles in the business cycle that characterizes urban economic conditions in places like Houston. Consequently, the inclusion of variables that reflect those types of considerations may augment the information provided by yield spreads.

When available, BCIs provide useful means for understanding prevailing states of national, regional, or metropolitan economies. Stock and Watson (1991) develops a widely used BCI methodology known as dynamic single-index factor modeling that employs Kalman filters. This methodology develops BCIs under the assumption that the co-movements of key economic indicators are influenced by a common underlying, unobservable factor. Regional BCIs provide fairly up to date gauges of whether the economies analyzed are expanding or contracting.

A common approach to predicting the onset of economic contractions is to use binary recession indicators as dependent variables. Various studies indicate that the slope of the yield curve is the most reliable recession predictor (Dueker 1997). To analyze metropolitan BCI downturn predictability, this study utilizes yield spreads from the U.S. and Mexico, plus other regionally relevant economic variables, with parameter estimation carried out using a dynamic probit methodology. Dynamic and dynamic autoregressive probit models have been found to perform well in this context (Ng 2012; Fullerton et al. 2017).

The objective of this study is to develop probit downturn models for nine urban economies in Texas, as well as the Texas state economy. The metropolitan economies included are the five largest urban economies in Texas plus the four largest metropolitan areas along the Texas-Mexico border.

3. Data and Methodology

Probit analysis is used to quantify the probability of recessions in a particular time period. This approach has been used to model business cycle contractions in multiple geographies. Both static and dynamic probit model variants have been deployed to analyze downturn predictability. Standard selection criteria such as pseudo-R^2 statistics can be used to identify which lags of candidate explanatory variables to include in an equation as well as what type of specification to employ (Nyberg 2010).

The modelling framework employed in this study analyzes probabilities of BCI downturns for selected urban economies located in Texas as functions of yield-spreads as well as other regional and macroeconomic variables. Oil prices can help predict business cycle fluctuations in economies with substantial energy activities (Lee 2015). Accordingly, West Texas Intermediate oil prices are included as part of the sample data collected for those five urban economies. Several studies have confirmed that the peso/dollar exchange rate strongly influences business activity along the border (Patrick and Renforth 1996; Coronado and Phillips 2007; Niño et al. 2015). Yield spreads for the United States and Mexico are also included in the specifications for each of these border economies.

The United States yield spread is calculated as the 10-year Treasury bond rate minus the 3-month Treasury bill rate. All United States interest rate data are from the Federal Reserve Bank of St. Louis (FRED 2018). The yield spread of Mexico is calculated as the 1-year Treasury bill rate minus the 28-day Treasury bill rate (CETES). All Mexican interest rate data are from the central bank of Mexico (BM 2018a). This study utilizes the above Mexican yield spread and a peso/dollar (MXN/USD) real exchange rate index because economic conditions in Mexico sometimes have pronounced impacts on the business cycles of the United States border cities (BM 2018b; Phillips and Cañas 2008).

Three different specifications employing the dynamic probit framework are proposed. Equation (1) is used for the five largest urban economies in Texas. Equation (2) is employed for the four border metropolitan economies. Equation (3) is utilized for the Texas state business cycle.

(1) $\Pr(Y_t = 1) = F(\beta_0 + \beta_1 USSP_{t-k} + \beta_2 WTI_{t-h} + \beta_3 Y_{t-m} + \varepsilon_t)$

(2) $\Pr(Y_t = 1) = F(\beta_0 + \beta_1 USSP_{t-k} + \beta_2 MXSP_{t-h} + \beta_3 REXR_{t-i} + \beta_4 Y_{t-m} + \varepsilon_t)$

(3) $\Pr(Y_t = 1) = F(\beta_0 + \beta_1 USSP_{t-k} + \beta_2 MXSP_{t-h} + \beta_3 REXR_{t-i} + \beta_4 WTI_{t-j} + \beta_5 Y_{t-m} + \varepsilon_t)$

Table 1

Variable Name	Description	Hypothesized Coeff. Sign
USSP	USA Yield Spread	(-)
WTI	West Texas Intermediate Oil Price, $/bbl	(-)
Y	Business Cycle Recession Indicator	(+)
MXSP	Mexico Yield Spread	(-)
REXR	Real Peso per Dollar Exchange Rate Index	(+ or -)

Table 1 summarizes the hypothesized relationships between the recession indicator, Y, and each of the explanatory variables. In Equations (1) through (3), *USSP* is the United States yield spread, *WTI* is the monthly West Texas Intermediate Crude Oil Spot Price in dollars per barrel, Y_{t-m} is the binary dependent variable with a lag of *m* months, *MXSP* is the yield spread for Mexico, and *REXR* is the inflation adjusted peso/dollar exchange rate index. The corresponding model is estimated for each of the metropolitan economies mentioned above in the previous section.

4. Empirical Results

Equations with varying specifications are estimated for each economy. In general, Equations (1) through (3) outlined in the previous section, deliver favorable estimation results. As hypothesized, all of the US yield spread parameter estimates are negative. Each of the USSP coefficients are also statistically significant at the 1-percent level.

All of the Mexico yield spread parameter estimates are also negative as hypothesized. Most are statistically significant at the 1-percent level. For the economies where this variable is included (Texas and the border economies), the lead times for MXSP are shorter than those for USSP. MXSP is included with contemporaneous lags or with 6-month lags. These shorter lead times may be attributed to the fact that the Mexico yield spread is calculated as the 1-year Treasury bill rate minus the 28-day Treasury bill rate (CETES). That varies substantially from the USSP measure calculated as the difference between the 10-year Treasury bond rate and the 3-month Treasury bill rate.

The results further indicate that real depreciation of the peso against the dollar decreases the probability of a recession in all four of the border economies. Peso depreciations tend to stimulate export-processing activity in northern border municipalities in Mexico (Coronado et al. 2004; Canas et al. 2007; Niño et al. 2015). That generally leads to increased economic activity in the adjacent metropolitan areas on the northern side of the international boundary (Hanson 1996; Varella-Mollick et al. 2006; Canas et al. 2013). The negative REX coefficients provide additional evidence along those same lines.

Nearly all of the West Texas intermediate spot oil price parameter estimates for the metropolitan economies are negative. The exception is the WTI coefficient estimated for Laredo. Oil prices are included in the specification of this border economy because of its presence on the Eagle Ford Shale formation. The positive parameter is puzzling. However, Laredo has a very high concentration of employment in transportation and warehousing. Across the border, and closely linked to that segment of the Laredo metropolitan economy, are large manufacturing sectors in both Monterrey and Nuevo Laredo. Transportation and manufacturing are energy intensive sectors and that may be what leads to the positive correlation between oil price hikes and recessions in the former Rio Grande Republic. As more data become available, additional research appears warranted.

In-sample simulations are employed order to examine how well each of the models can predict business cycle downturns. When the predicted probabilities exceed 0.5 (50 percent), recessions almost always occur. In contrast, the predicted probabilities tend to stay below 0.5 when the economies are growing. The recession forecasts do have some missteps. In 2000, two of the equation simulations generated false signals for slumps that never materialized. Those false signals are for the Brownsville border economy and the Dallas metropolitan economy.

5. Conclusion

Regional and metropolitan business cycle indices are not widely available, but several of these indices variables are estimated for Texas and nine of the largest urban economies in that state. Modeling and predicting recessions in Texas, however, offers a special challenge. The state is so large that the various urban economies located in Texas exhibit unique business cycle idiosyncrasies. Given the importance of international trade in Texas, many urban economies in the state are affected by domestic and international factors. This study attempts to allow for these factors using domestic and foreign yield spreads, a real peso per dollar exchange rate, West Texas Intermediate oil prices, and a dynamic lag variable.

The United States yield spread is found to predict slumps in all of the economies analyzed in this study. Confirming relatively important cross-border industrial and commercial linkages, the Mexico yield spread is found to help anticipate economic contractions for all four border economies as well as for the Texas state economy. The real peso per dollar exchange rate index also helps anticipate business cycle downturns for the four border economies. Somewhat surprisingly, West Texas Intermediate oil price declines help predict economic slumps for four of the large urban economies, but not for the state as a whole. In-sample simulations indicate that the estimated models exhibit good predictive behavior with only minimal false signal emissions.

Metropolitan business cycle index estimation has fairly minimal data requirements. These indices provide useful information to policymakers and business analysts. As the procedure is extended to analyze more regions, further research on business cycle predictability will become feasible. That will help determine whether regional economic recession predictions can provide informative tools to decision makers for sub-national economic markets.

Acknowledgements

Partial financial support for this research was provided by El Paso Water, City of El Paso Office of Management & Budget, National Science Foundation Grant DRL-1740695, UTEP Center for the Study of Western Hemispheric Trade, Hunt Institute for Global Competitiveness at UTEP, and TFCU. Econometric research assistance was provided by Sergio Olivas.

References

BM (2018a). *Securities Prices and Interest Rates*. México, DF: Banco de México.

BM (2018b). *Peso Real Exchange Rate Index*. México, DF: Banco de México.

Coronado, R., T.M. Fullerton, Jr., and D.P. Clark (2004). Short-Run Maquiladora Employment Dynamics in Tijuana. *Annals of Regional Science* 38 (4): 751–763. doi:10.1007/s00168-004-0215-8.

Coronado, R., and K.R. Phillips (2007). Exported Retail Sales along the Texas-Mexico Border. *Journal of Borderlands Studies* 22 (1): 19–38. doi:10.1080/08865655.2007.9695667.

Dueker, M.J. (1997). Strengthening the Case for the Yield Curve as a Predictor of U.S. Recessions. *Federal Reserve Bank of St. Louis Review* 79 (2): 41–51.

Estrella, A., and F.S. Mishkin (1996). The Yield Curve as a Predictor of U.S. Recessions. *Current Issues in Economic and Finance* 2 (7): 1–6.

Estrella, A., and F.S. Mishkin (1998). Predicting U.S. Recessions: Financial Variables as Leading Indicators. *Review of Economics and Statistics* 80 (1): 45–61.

FRBD (2018). *Regional Economic Data*. Dallas, TX: Federal Reserve Bank of Dallas.

FRED (2018). *Economic Data*. St. Louis, MO: Federal Reserve Bank of St. Louis.

Fullerton, T. M., Jr. (2001). Specification of a Borderplex Econometric Forecasting Model. *International Regional Science Review* 24 (2): 245–260. doi:10.1177/016001701761013141.

Fullerton, T.M., Jr., E.D. Saenz-Rojo, and A.G. Walke. (2017). Yield Spreads, Currency Movements, and Recession Predictability for Southern Border Economies in the United States. *Applied Economics* 49 (30): 2910-2921, doi: 10.1080/00036846.2016.1251556.

Gauger, J., and D. Schunk (2002). Predicting Regional Recessions via the Yield Spread. *Review of Regional Studies* 32 (2): 151–170.

Hanson, G.H. (1996). Economic Integration, Intraindustry Trade, and Frontier Regions. *European Economic Review* 40 (3–5): 941–949. doi:10.1016/0014-2921(95)00103-4.

Kauppi, H., and P. Saikkonen (2008). Predicting U.S. Recessions with Dynamic Binary Response Models. *Review of Economics and Statistics* 90 (4): 777–791.

Klein, L.R. (1969). The Specification of Regional Econometric Models. *Papers of the Regional Science Association* 23 (1): 105–115.

Lee, J. (2015). The Regional Economic Impact of Oil and Gas Extraction in Texas. *Energy Policy* 87 (SI): 60-71, doi: 10.1016/j.enpol.2015.08.032.

Mishkin, F.S. (1990). The Information in the Longer Maturity Term Structure about Future Inflation. *Quarterly Journal of Economics* 105 (3): 815–828. doi:10.2307/2937901.

Niño, P., R. Coronado, T.M. Fullerton, Jr., and A.G. Walke. (2015). Cross-Border Homicide Impacts on Economic Activity in El Paso. *Empirical Economics* 49 (4): 1543–1559. doi: 10.1007/s00181-015-0924-0.

Nyberg, H. (2010). Dynamic Probit Models and Financial Variables in Recession Forecasting. *Journal of Forecasting* 29 (1–2): 215–230.

Patrick, J.M., and W. Renforth (1996). The Effects of the Peso Devaluation on Cross-Border Retailing. *Journal of Borderlands Studies* 11 (1): 25–41. doi:10.1080/08865655.1996.9695481.

Phillips, K.R., and J. Cañas (2008). Regional Business Cycle Integration along the US-Mexico Border. *Annals of Regional Science* 42 (1): 153–168. doi:10.1007/s00168-007-0124-8.

Shoesmith, G.L. (2003). Predicting National and Regional Recessions Using Probit Modeling and Interest-Rate Spreads. *Journal of Regional Science* 43 (2): 373–392.

Stock, J.H., and M.W. Watson. (1991). A Probability Model of the Coincident Economic Indicators. Chapter 4 in *Leading Economic Indicators: New Approaches and Forecasting Records,* K. Lahiri & G. Moore (eds.), Cambridge, UK: Cambridge University Press.

Varella-Mollick, A., A. Cortez-Rayas, and R.A. Olivas-Moncisvais (2006). Local Labor Markets in U.S.-Mexican Border Cities and the Impact of Maquiladora Production. *Annals of Regional Science* 40 (1): 95–116. doi:10.1007/s00168-005-0031-9.