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The Texas Construction Sector: The Tail That Wagged the Dog

In the first half of the 1980s, Texans joked that the construction crane should replace the mockingbird as the official state bird. Throughout the state, the construction boom made the steel-necked crane a more common sight than the state bird. In the mid-1980s, however, the construction crane virtually disappeared from the Texas landscape as building activity declined dramatically. While this boom and bust in the Texas construction sector is well-known, its causes and effects are less well understood.

In this article we examine the role construction played in the volatility of the Texas economy during the late 1970s and in the 1980s. While the roller coaster ride in oil prices was a widely acknowledged source of economic instability, the construction sector also may have played an important and independent role in the state's changing fortunes. While swings in the state's economy followed oil price movements fairly closely, the construction sector often moved differently from either oil prices or aggregate economic activity.

The volatility of the Texas construction sector in the 1980s may have originated from many different sources. One likely source was a series of tax law changes that made investing in real estate more lucrative in the first half of the decade. Another source of volatility in the real estate market may have been large swings in interest rates. In this article we attempt to sort out the different factors that may have led to the huge buildup and subsequent crash of the Texas construction industry.

We use an econometric model to analyze the roles residential and nonresidential construction played in the state's economic fluctuations in the 1980s.[1] Understanding the construction sector's role in the Texas economy, or in regional economies in general, is critical to understanding regional business cycles. Is the construction sector a source of regional fluctuations, or does it respond to other shocks in the economy? What causes boom and bust cycles in construction? How long after a shock to the construction sector will the regional economy feel its effects?

Our results suggest that while changes in oil prices and the U.S. economy generally had the largest effect on the volatility of the state's economy, movements in construction activity were also important. Our results also indicate that changes in oil prices, tax laws, and interest rates were major factors behind the volatility of the Texas construction sector.

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[1] *In this article, we do not examine nonbuilding construction, which includes roads, highways, and sewer systems. Data for this series were unavailable.*

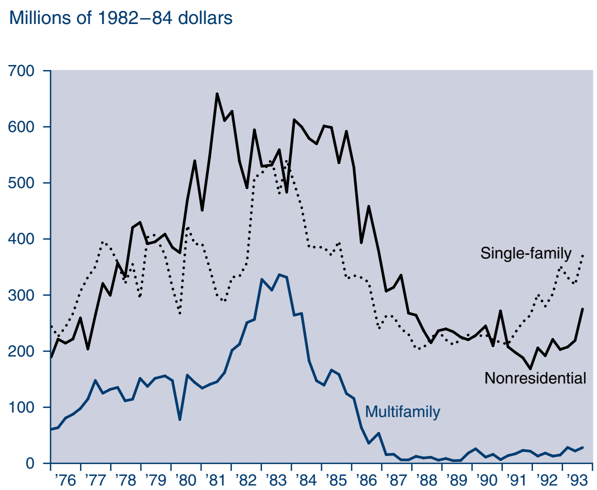
Construction in the 1980s: If you build it, they will come

During the 1980s, the construction sector's growth pattern often deviated from that of the overall Texas economy. The divergence was particularly noticeable in the early 1980s when the state's economy was in recession and the construction sector was still growing quite strongly. This strong expansion of the construction sector, combined with weak overall economic activity, eventually led to skyrocketing vacancy rates and a real estate bust. Although it may appear that construction grew without regard to demand, several other factors may have led to the unusual pattern of construction activity in the 1980s.

The Texas construction boom began in the mid-1970s and continued for almost ten years (*Figure 1*). At first, the strength in construction activity seemed motivated by strong gains in economic activity. Between early 1974 and early 1981, inflation-adjusted oil prices nearly tripled and the Texas economy expanded rapidly. The relationship between oil prices and the Texas economy is highlighted in Figure 2, which shows movements in the relative price of oil and detrended nonfarm employment.[2] During the same period, nonresidential construction activity more than quadrupled, while office vacancy rates fell from 15 percent to 7.6 percent in Dallas and from 7.8 percent to 5.7 percent in Houston.[3]

In 1982, however, the construction sector diverged from the rest of the economy. While oil prices fell and the Texas and U.S. economies turned downward, Texas construction activity surged (*Figure 3*). Throughout the mid-1980s, the high level of construction activity did not seem to be supported by the Texas economy's weak growth. Although declining interest rates may have motivated some construction activity, the amount of space added during this period far exceeded the demand, as shown by the rising vacancy rates in Table 1.

Figure 1
Texas Real Building Permit Values



SOURCE: U.S. Department of Commerce.

Browne (1992) suggests that Texas construction sector's growth in the first half of the 1980s was much higher than what economic conditions would have predicted. According to Browne, the share of construction in the Texas economy was higher than expected given the existing interest rates, employment and population growth, and trend factors.

The passage of the Economic Recovery Tax Act of 1981 (ERTA) may have led to much of the growth in construction activity during the period 1982 to 1985. The act created significant tax breaks for investors in income-generating properties, such as apartments and office buildings. The most noteworthy element in the 1981 tax law was a major change in business depreciation allowances.

Under the new law, tax lifetimes of certain depreciable assets—such as real estate properties other than single-family housing—were significantly reduced. This change had the effect of reducing the effective tax rate on the lifetime income generated by the property and allowed for accelerated recovery of investments.[4] The tax law was espe-

[2] *Detrended employment is calculated as the residual of employment regressed on time and a constant term. If employment grows slower than trend growth, the detrended employment line in Figure 2 will show a decline.*

[3] *These vacancy rates for Houston and Dallas were supplied by CB Commercial, Torto Wheaton Research.*

[4] *For an explanation of how accelerated depreciation reduces the effective tax rate, see Musgrave and Musgrave (1989).*

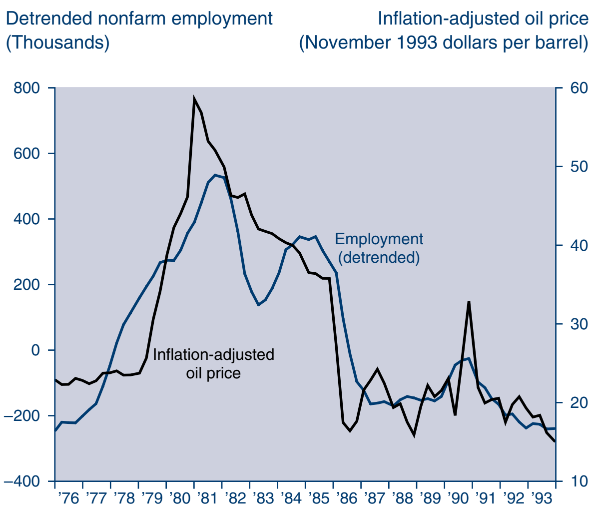
cially attractive to high-income investors who could invest in real estate through a limited partnership and use any losses to shelter taxes on other income.

Follain, Leavens, and Velz (1993) and others suggest that the buildup of real estate in the 1980s may have been exacerbated by what some have identified as a lending frenzy. In the early 1980s, when tax law changes made real estate investing more profitable, several events occurred that gave financial institutions a larger pool of available funds to lend to real estate investors. The Depository Institutions Deregulation and Monetary Control Act of 1980 accelerated the deregulation of deposit interest rates by providing an eventual phase-out of interest rate ceilings on time and savings deposits. In addition, the Garn–St Germain Depository Institution Act of 1982 created a new account, the money market deposit account, and as these accounts became available, a flood of money poured into them.[5] Meanwhile, a monetary easing initiated a decline in interest rates and added to banks' liquidity.

The increase of available funds and the pursuit of real estate lending by thrifts and commercial banks led to the financing of income-producing real estate to a point of extreme oversupply. The lending frenzy may have been even more pronounced in Texas than elsewhere in the country. Texas lending institutions that had been badly burned by energy loans were searching for new investments, and they chose real estate. As an example, apartment vacancy rates in Texas rose rapidly during the period 1981 to 1983, while Texas apartment construction more than tripled.

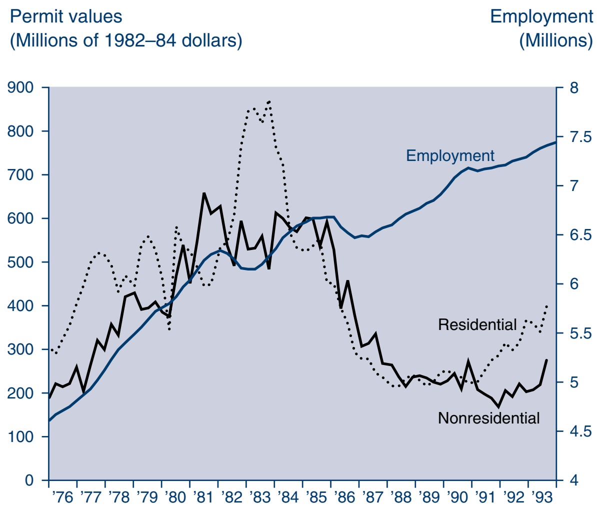
In 1986, the Texas construction sector entered a prolonged decline. Several factors may have initiated the decline, including a plunge in oil prices and a sharp recession in the Texas economy. Possibly the most important factor, however, was the 1986 Tax Reform Act (TRA). TRA removed the tax depreciation advantages given to real estate investors five years earlier by extending the tax depreciation lifetime for income-producing real estate and requiring straight-line depreciation. This method replaced the more accelerated 175 percent declining-balance method used under ERTA. These changes significantly reduced the tax savings generated by depreciation allowances to real estate investors.

Figure 2
Real Oil Prices and Texas Employment



SOURCE: Bureau of Labor Statistics and Federal Reserve Bank of Dallas.

Figure 3
Texas Real Building Permit Values and Nonagricultural Employment



SOURCE: Bureau of Labor Statistics, Federal Reserve Bank of Dallas, and U.S. Department of Commerce.

[5] Spong (1990).

Table 1
Vacancy Rates

Percent

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Rental Housing										
United States	5.0	5.3	5.7	5.9	6.5	7.3	7.7	7.7	7.4	7.2
Dallas	5.4	4.7	9.0	7.7	13.9	17.2	16.2	17.9	14.6	12.3
Houston	6.4	7.6	13.9	15.4	18.1	18.0	18.3	14.4	12.5	9.6
Homeowner										
United States	1.4	1.5	1.5	1.7	1.7	1.6	1.7	1.6	1.8	1.7
Dallas	2.2	1.4	2.0	2.2	1.6	2.1	3.7	3.9	4.1	2.1
Houston	2.2	4.1	3.4	5.4	3.6	3.7	3.4	2.3	2.4	2.1
Office - Downtown Areas										
United States	4.8	10.3	12.4	14.7	16.5	16.4	16.3	16.2	16.7	17.1
Dallas	4.8	10.0	14.6	17.2	17.5	21.6	24.5	23.5	22.4	24.7
Houston	1.3	5.8	14.6	20.9	20.2	20.0	21.9	19.4	18.5	17.7
Industrial										
United States	3.8	4.8	4.9	4.7	5.0	5.8	5.5	6.0	6.4	7.4
Dallas	8.1	7.3	6.9	4.6	6.1	7.0	6.9	8.4	7.2	8.8
Houston	5.7	4.6	5.6	7.7	14.1	14.9	12.7	9.6	9.8	9.3

SOURCE: Taken from Browne (1992, 37). Indirect sources: Housing–U.S. Bureau of the Census; office and industrial–Coldwell Banker.

TRA also included several provisions designed to restrict tax shelter investment. Passive-loss limitations were enacted that disallowed income tax deductions from active income for net losses of passive income, such as limited partnership investment. Passive-loss limitations likely had the largest impact on multifamily real estate, which had benefited greatly from limited partnership deals under ERTA.[6]

Also in 1986, a sharp decline in oil prices weakened the Texas economy, and it fell into a deep recession while the national economy continued to grow. Texas employment fell by approximately 250,000 that year, and people began leaving the state. Net out-migration and the impacts of TRA put increased pressure on already high apartment and office vacancy rates. The resulting decline in construction was severe. Although construction accounted for only 6.7 percent of Texas employment in 1985, it accounted for 40 percent of the job decline during 1986, or almost 100,000 jobs.

Despite a turnaround in the Texas economy in 1987, construction activity continued to decline throughout the late 1980s, and the sector remained out of sync with the state's economy. Activity in the single-family housing sector leveled out by 1988 but did not bottom out in the nonresidential sector until 1991. Apartment construction almost disappeared in the late 1980s and only began to show signs of resurgence in the early 1990s. The prolonged decline in construction activity, how-

[6] *Follain, Leavens, and Velz (1993) point out that the decline in multifamily construction in Dallas began before TRA's passage and may be attributed to unrealized expectations of high oil prices.*

ever, helped reduce some of the excess space built during the boom, and by the early 1990s, apartment and homeowner vacancy rates had fallen from the high levels of the mid-1980s. Nonresidential vacancy rates, however, remained elevated, especially in Dallas.

Since 1991, construction activity has become more in line with the Texas economy and has become an important part of the state's growth. Lean home inventories and falling interest rates contributed to a strong rebound in single-family construction beginning in 1991. In addition, multifamily and most nonresidential vacancy rates have tightened, and construction activity in these sectors has begun to pick up. Nevertheless, construction activity today is at much lower levels than in the heydays of the early 1980s.

Empirical analysis

The above summary of the Texas economy in the past twenty years illustrates that cycles in the construction industry have not necessarily been synchronized with the overall economy. Changes in tax laws and interest rates may have been important factors behind changes in the construction industry, while oil price changes were important for the overall Texas economy. In this study, our main interest is in determining whether the construction sector was an important factor behind business cycles in the Texas economy and whether it was the Texas economy or other factors such as oil prices, the U.S. economy, or changes in tax laws and interest rates that were the driving forces behind the swings in the Texas construction sector in the late 1970s and in the 1980s.

To examine the relationship between the construction sector and the Texas economy, we employ a VAR methodology.[7] We study the interrelationships between the regional construction sector, the overall regional economy, oil prices, and the national business cycle. To capture the different types of Texas construction activity, we use nonresidential, single-family, and multifamily permit values. We also allow for external factors such as interest rates and tax laws whose effect on construction is independent of changes in the state's economy.[8]

We test whether there is a long-term stable relationship between Texas personal income and the construction sector variables. We then measure the impact that shocks to the Texas economy have had on the construction sector. We also measure the impact of shocks to the construction sector on the Texas economy and trace the persistence of these shocks through time.

Our results suggest that the construction sector, particularly single-family building, was an important factor behind the volatility of the Texas economy in the late 1970s and in the 1980s. Oil prices played an important role in the dynamics of both the state economy and the construction sector. As expected, tax laws had at least a moderate effect on the volatility of the multifamily and nonresidential sectors. Interest rates played a key role in the volatility of the single-family sector.

What lies behind the boom–bust cycles Of the Texas construction sector?

Our results show that most of the volatility in the Texas construction sector resulted from changes in oil prices, tax laws, and interest rates rather than changes in the Texas economy (that is, changes in the Texas economy not explained by past changes in the other variables and itself). Shocks to the Texas economy had the most impact on multifamily residential construction.

Oil price shocks played an important role in the volatility of the two income-generating sectors of construction—nonresidential and multifamily. This result is consistent with the view that oil price shocks influenced investors' expectations about future growth in the Texas economy. These expectations likely led to decisions to build apartment complexes and industrial and commercial buildings.

7 *The details of the econometric model and empirical analysis are in the Appendix.*

8 *Browne (1992) and Moscovitch (1990) use a regional base approach to determine the importance of construction to the regional economy. The regional economic base approach assumes that construction, over longer periods of time, moves in response to growth in regional export or "base" industries such as manufacturing and mining. We do not use the regional base approach. As discussed in Krikelas (1992), the regional base approach has several problems, such as difficulty in defining export industries and focusing solely on external demand.*

Table 2
Sources of Long-Run Forecast Error Variance In Construction Variables, 1976–90

	Value of Building Permits (Percent)		
	Nonresidential	Multifamily	Single-family
Oil prices	56.9	31.1	7.2
Tax laws	7.1	12.2	1.1
Interest rates	7.2	10.3	34.4
U.S. personal income	6.9	4.3	.7
Texas personal income	.3	14.8	2.4
Construction measure	21.5	27.2	54.2

NOTE: Each column shows the source of variance for the respective construction variable used in the model. The construction measure listed in the table refers to the construction sector listed at the top of the column. For example, the first column shows that 21.5 percent of the forecast error variance in nonresidential construction was due to shocks in itself.

While shocks to long-term real interest rates generally were important for all construction sectors, they had the largest impact on single-family construction. For example, Table 2 shows that shocks to interest rates were responsible for 34.4 percent of the unexpected changes in single-family construction. This is likely because residential borrowers have limited sources of financing (such as savings and loans, mortgage companies, and banks), and swings in real interest rates can have a large impact on the number of individuals qualified to borrow.

Our results also suggest that the change in tax laws in the 1980s had an important impact on multifamily construction and, to a lesser degree, on nonresidential construction. Shocks to the Texas economy appear to have had an important impact on the multifamily sector but showed little impact on the two other sectors.

Finally, much of the source of volatility in the three different construction sectors is explained by shocks to the sectors themselves. This implies that much of the movements in these sectors is unexplained by the other variables included in the models. Other factors such as the lending frenzy may have had an important impact on construction during this period.

Construction's role in the Texas economy

While changes in oil prices and the U.S. economy generally had the largest impact on the Texas economy in the 1970s and 1980s, the construction sector, particularly single-family housing, also played an important role.

Our results show that shocks to oil prices and the U.S. economy were major sources of volatility for the Texas economy, regardless of the construction variable used (*Table 3*). These shocks accounted for at least one-third of the variation in the Texas economy with single-family permit values as the construction variable, and up to 75 percent with nonresidential permit values. For example, Table 3 shows that, in the model with multifamily permit values, oil price shocks accounted for 28.9 percent of the unexpected changes in Texas personal income and shocks to the U.S. economy explained 21.7 percent.

Unexpected shocks to residential construction, especially single-family construction, had a much greater impact on the Texas economy than shocks to nonresidential construction. For instance, shocks to single-family construction explain 54 percent of the changes in the Texas economy during the period in question. In the multifamily housing

Table 3
Sources of Long-Run Forecast Error Variance In the Texas Economy, 1976–90

	Measure of Construction Used (Percent)		
	Nonresidential	Multifamily	Single-family
Oil prices	40.9	28.9	16.0
Tax laws	4.6	10.4	9.0
Interest rates	13.9	9.7	.8
U.S. personal income	34.4	21.7	19.4
Texas personal income	1.8	17.9	.8
Construction measure	4.3	11.5	54.0

NOTE: Each column shows the source of variance for Texas personal income for the three different construction variables used in the model. For example, the first column shows that 40.9 percent of the forecast error variance in Texas personal income was due to shocks to oil prices when nonresidential permit values are used as the construction variable. The variable construction measure refers to the construction sector listed at the top of the column.

model, the construction measure had a smaller effect, but was still two and one-half times greater than the effect of nonresidential construction.

Our finding that shocks to the residential sector have a larger impact on the Texas economy than the nonresidential sector is consistent with conventional wisdom. Residential construction is much more closely tied to the regional economy than the nonresidential sector. Moreover, the residential sector represents more than 50 percent of total construction, and shocks to the residential sector in the period under study have been quite large, as illustrated by Figure 3.[9]

How long do shocks last?

Our results indicate that shocks to the construction industry take a long time to work their way through the Texas economy. In addition, we find that the three construction sectors responded differently to shocks in the Texas economy during the period under study.

Our results show that shocks to the construction sector have long-lasting effects on the Texas economy of five years or more. Within the construction sector, shocks from nonresidential and single-family housing were shorter lived than those from multifamily housing. The Texas economy adjusted to a shock in the nonresidential and single-family sectors in about five years, while it took more than ten years to adjust to a shock in the multifamily sector.

The adjustment time of the construction industry to changes in the Texas economy varies with the type of construction. The single-family residential and the nonresidential sectors adjusted relatively quickly to changes in the Texas economy. Both sectors adjusted to shocks within four years. Adjustment to oil price and depreciation rate shocks took just as long. However, all shocks to the multifamily sector were very persistent, lasting more than ten years. This finding is consistent with the prolonged weakness seen in the multifamily sector since 1986 (*Figure 1*).

[9] *Although Figure 3 shows the actual changes in the series and not the shocks, a separate analysis of the error terms from the VARs shows that the variance of the shocks to the single-family and multifamily sectors were larger than that of the nonresidential sector.*

Conclusion

While the oil industry played the major role in the volatility of the Texas economy over the past twenty years, the construction industry also played an important role. Our results suggest that different sectors of the construction industry played differing roles in the region's economy. We find that over the past twenty years, unexpected shocks to single-family construction had a larger impact on the Texas economy than shocks to multifamily or nonresidential construction.

Our results also indicate that changes in oil prices, tax laws, and interest rates affected the income-generating construction sectors (nonresidential and multifamily) independently of changes in the regional economy. Changes in interest rates were the most important factor for the single-family housing sector. We also find, however, that between 20 percent and 50 percent of the shocks to the construction sectors were not explained by shocks to the interest rate, tax laws, oil prices, Texas personal income, or U.S. personal income. This finding leaves room for other explanations for the large swings in construction, such as the lending frenzy theory proposed by some economists.

The adjustment of the Texas economy to shocks in the construction sector takes many years. Shocks from the nonresidential and single-family housing sector are shorter lived, lasting five years, while shocks to multifamily housing are more persistent, lasting more than ten years. Similarly, nonresidential construction and single-family housing adjust more quickly to shocks to the Texas economy, while multifamily housing does not show much adjustment even after ten years.

Our results have implications not only for Texas but for other states as well. The residential construction expansion Texas has experienced in the past few years will likely have positive effects on the state for years to come. For states that experienced negative construction shocks in the late 1980s, our results suggest that the effects of these shocks are still being felt.

Appendix

Empirical Analysis

To examine the relationship between the construction sector and the Texas economy, we employ a VAR methodology. A VAR is a system of equations in which lagged values of the dependent variables are used as explanatory variables. We study the interrelationships between the regional construction sector, the overall regional economy, oil prices, the national business cycle, interest rates, and tax law changes. We allow for external factors such as interest rates and tax laws to affect construction independently of changes in the state's economy.

In our analysis, the oil price variable (*OIL*) is the refiner's acquisition cost, adjusted for inflation. The interest rate (*INT*) is a ten-year utility bond rate, minus expected inflation.[1] The tax policy variable (*DEPR*) is the present value of the tax savings generated by depreciation allowances and is from Follain, Leavens, and Velz (1993). U.S. personal income minus Texas personal income is used as the measure of U.S. economic activity (*US*), and the measure of Texas economic activity (*TX*) is Texas personal income.[2] The data used in our analysis are quarterly and span the years 1976–90. All variables except *INT* and *DEPR* are expressed in dollars and are deflated by the U.S. consumer price index.

To capture the different types of Texas construction activity, we use single-family (*SFPV*), multifamily (*MFPV*), and nonresidential (*NRESPV*), permit values, as this data is the most consistent across the different types of residential and nonresidential construction activity. A separate system of equations is estimated for each of the three different measures of Texas construction activity.

Prior to estimating the VARs, we perform several diagnostic checks to assess the correct specification for the various series. We test for stationarity using Dickey–Fuller tests, and find that all of the series are integrated of order of one. Thus, the first differences of the series are stationary and any shock to the series is permanent.

In addition, we test the models for cointegration. Time series are cointegrated if they move together in the long run; in other words, there is a stationary, long-run relationship between the series. Estimating a VAR in first differences when cointegration is present can result in overdifferencing and a loss of information about the long-term relationship between series.

We check for cointegration in the three systems of equations in which each system is distinguished by a different construction variable, and find cointegration in all three systems. We account for cointegration by specifying an error-correction model in which changes in the dependent variable are expressed as past changes in both the independent and dependent variables plus an error-correction term.[3] The error-correction

[1] The expected inflation rate is a ten-year expected inflation series based on a survey of economists prepared by the Federal Reserve Bank of Philadelphia.

[2] We also use total nonagricultural employment as a measure of U.S. and Texas economic activity to analyze the sensitivity of results to the measure of economic activity employed. The results are not qualitatively different.

[3] Engle and Granger (1987).

(Continued on the next page)

Appendix

Empirical Analysis—*Continued*

term specifies the adjustment to deviations from the long-run equilibrium relationship.

We use variance decomposition to measure the impact that shocks to the Texas economy have had on the construction sector and vice versa. Variance decomposition apportions the variance of forecast errors in a given variable to shocks to itself and shocks to the other variables. The method we use to calculate the variance decomposition is the Choleski decomposition. This method decomposes the residuals (μ) into sets of impulses that are orthogonal to each other (ν). Orthogonalization takes the covariance between the residuals into account. If the covariance between the residuals is sufficiently high, the ordering of the dependent variables can affect the results. The structure we employ for the variables is specified such that it allows a one-way contemporaneous relationship between the construction variables and Texas economic activity variables. The structure is as follows:

(1) $$\mu_{OIL} = \nu_{OIL}$$

(2) $$\mu_{DEP} = c_{21}\mu_{OIL} + \nu_{DEP}$$

(3) $$\mu_{INT} = c_{31}\mu_{OIL} + c_{32}\mu_{DEP} + \nu_{INT}$$

(4) $$\mu_{US} = c_{41}\mu_{OIL} + c_{42}\mu_{DEP} + c_{43}\mu_{INT} + \nu_{US}$$

(5) $$\mu_{TX} = c_{51}\mu_{OIL} + c_{52}\mu_{DEP} + c_{53}\mu_{INT} + c_{54}\mu_{US} + \nu_{TX}$$

(6) $$\mu_{CONS} = c_{61}\mu_{OIL} + c_{62}\mu_{DEP} + c_{63}\mu_{INT} + c_{64}\mu_{US} + c_{65}\mu_{TX} + \nu_{CONS}.$$

In equations 1 through 6, μ_i represents the current innovation in variable *i* and the innovation process, ν, is assumed to be orthogonal. An innovation is a shock, or a change in a given variable that is not anticipated by the model. The above structure implies that unexpected changes in oil prices do not contemporaneously arise from any of our specified variables. Innovations in oil prices, depreciation rates, and interest rates affect the innovations in the U.S. economy contemporaneously, but the U.S. economy does not affect these variables contemporaneously. Current innovations in the Texas economy variables are affected by current innovations in oil prices, depreciation rates, interest rates, and the U.S. economy variables but not the construction variables. Although innovations in the construction variables affect the Texas economy variables, they are not contemporaneous—they work their effects through the system over time.

Finally, to examine the long-run dynamics of the shocks to construction and the Texas economy, we calculate impulse response functions. The impulse response function traces over time the effects on a variable of a given shock to another variable. The persistence of a shock tells us how fast the system adjusts back to equilibrium. The faster a shock dampens, the faster the adjustment. The Choleski decomposition is used to calculate the impulse response functions. We analyze the effects of a one-time, one standard-deviation shock to the first difference of each variable. We then trace the effects of this shock on each of the variables.

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