

**SALES TAX REVENUE IN THE CITY OF ARLINGTON, TEXAS:  
HISTORICAL REVIEW AND PROJECTIONS**

Prepared for the City of Arlington by

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## **Summary**

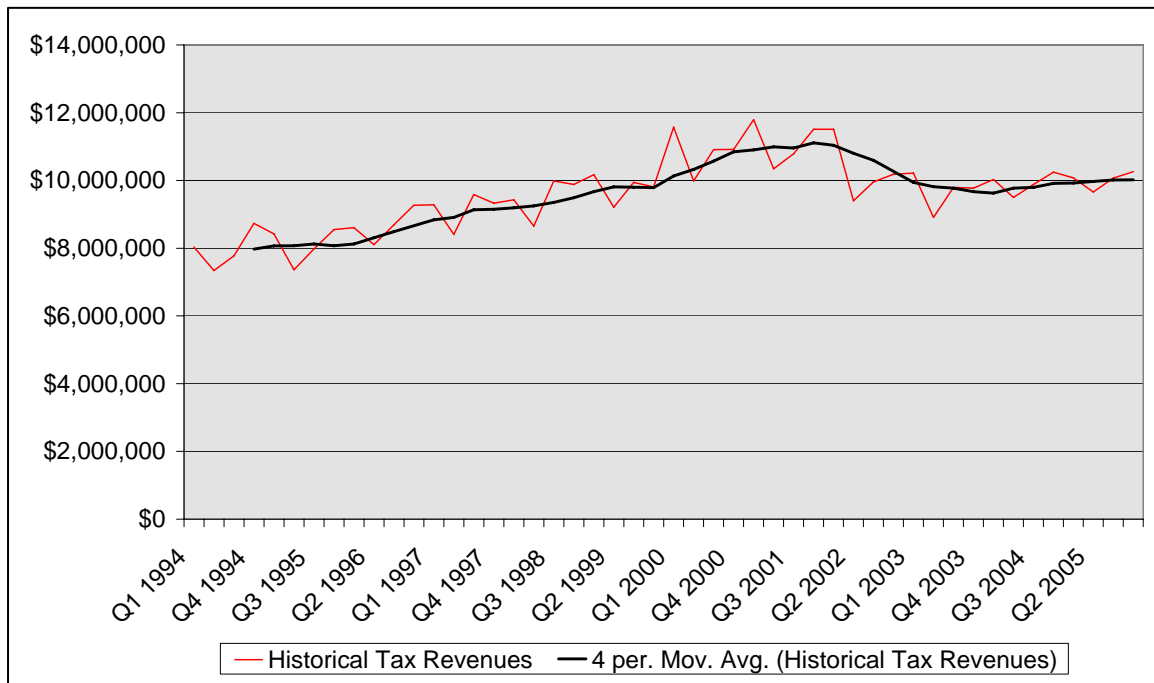
Sales tax revenues in Arlington rose more or less steadily from FY1994 to FY2000 (see Figure 1). But in the aftermath of a mild recession and the meltdown in the technology sector, sales tax revenues began falling in the first quarter of 2001. This decline lasted for two years, reaching a trough of \$8.9 million in second quarter of 2003 from a peak of about \$11.8 million in the first quarter of 2001. It was not until early 2004 that Arlington's sales tax revenues began to recover, in tandem with an improving local economy.

Taking a longer view, we find that Arlington's tax revenues in the first quarter of FY2005 were 14.53% lower than in the first quarter of 2001. But since early 2004, sales tax revenue growth has averaged about 0.68 per cent per quarter.

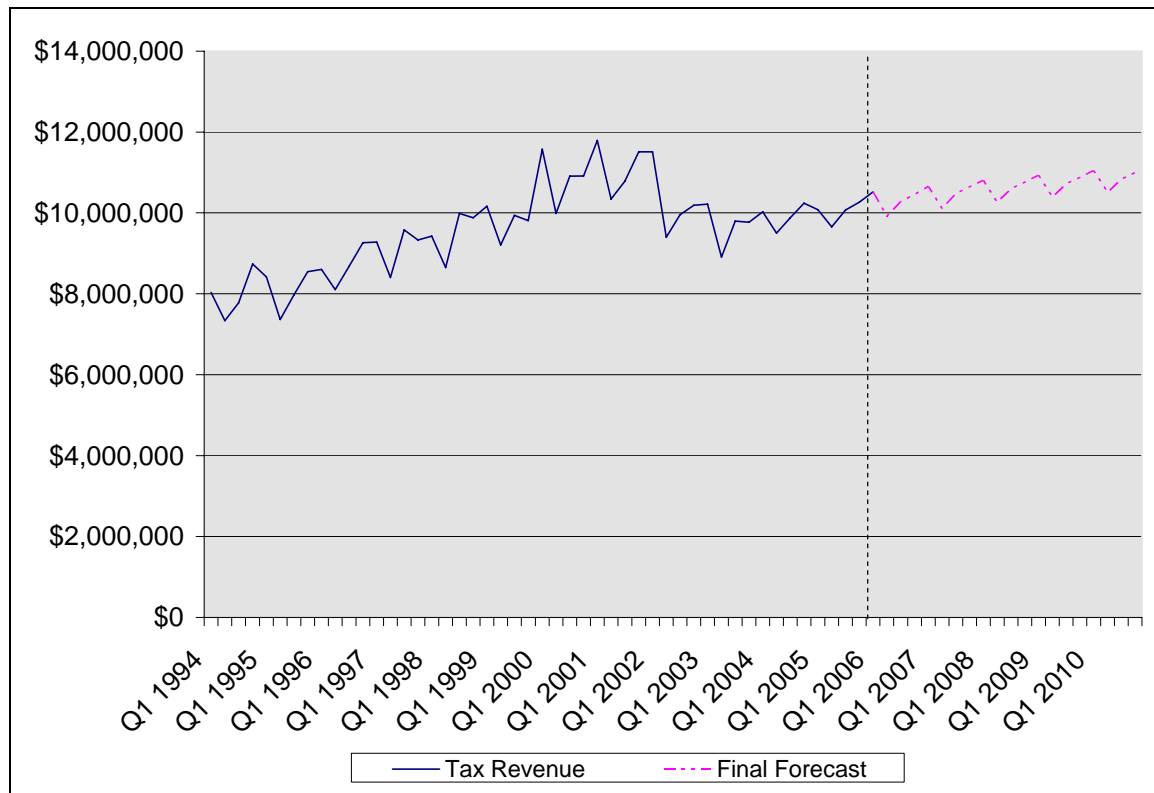
In predicting future sales growth, we have utilized several statistical approaches: autoregressive moving average (ARIMA) models, seasonal exponential smoothing, and ordinary least squares (OLS) regression analysis based on employment data. Each of these approaches is described briefly in the body of this report. Though not wildly different, each forecasting technique produces slightly different outcomes. These outcomes, along with adjustments we have made to account for new retail property development, form the basis of our quarter-by-quarter projections of sales tax revenue for the City of Arlington through 2010.

As indicated in Table 1 and Figure 2, we project sales tax revenue growth averaging 1.32 percent per year from the first quarter of 2006 through the fourth quarter of 2010.

**FIGURE 1: Quarterly Historical Tax Revenue Data**



**FIGURE 2: Arlington's Quarterly Actual and Forecasted Sales Tax Revenues**



## **Quarterly Sales Tax Revenue Forecasts: alternative approaches**

- Sales tax revenue can be forecasted with a variety of statistical techniques.
- Univariate time series forecasting techniques such as ARIMA and some exponential smoothing models incorporate subjective assumptions by the analyst regarding the relative emphasis placed on recent versus more historical trends. Multivariate methods and total error minimization approaches to exponential smoothing are more data driven. Therefore, we employ a multi-modal approach to take advantage of each method's strengths while mitigating methodological weaknesses. Of course, changing macro- and regional economic conditions could alter trends in taxable retail sales growth in unexpected ways.

Forecasts for Arlington's sales tax revenues are made using the following methods:

- Univariate Techniques
  - Multiplicative Seasonal Exponential Smoothing
    - Subjective Exponential Smoothing
    - Total Error Minimization Exponential Smoothing
  - ARIMA
- Multivariate Techniques
  - OLS-based forecast using "employment" and "unemployment" as independent variables

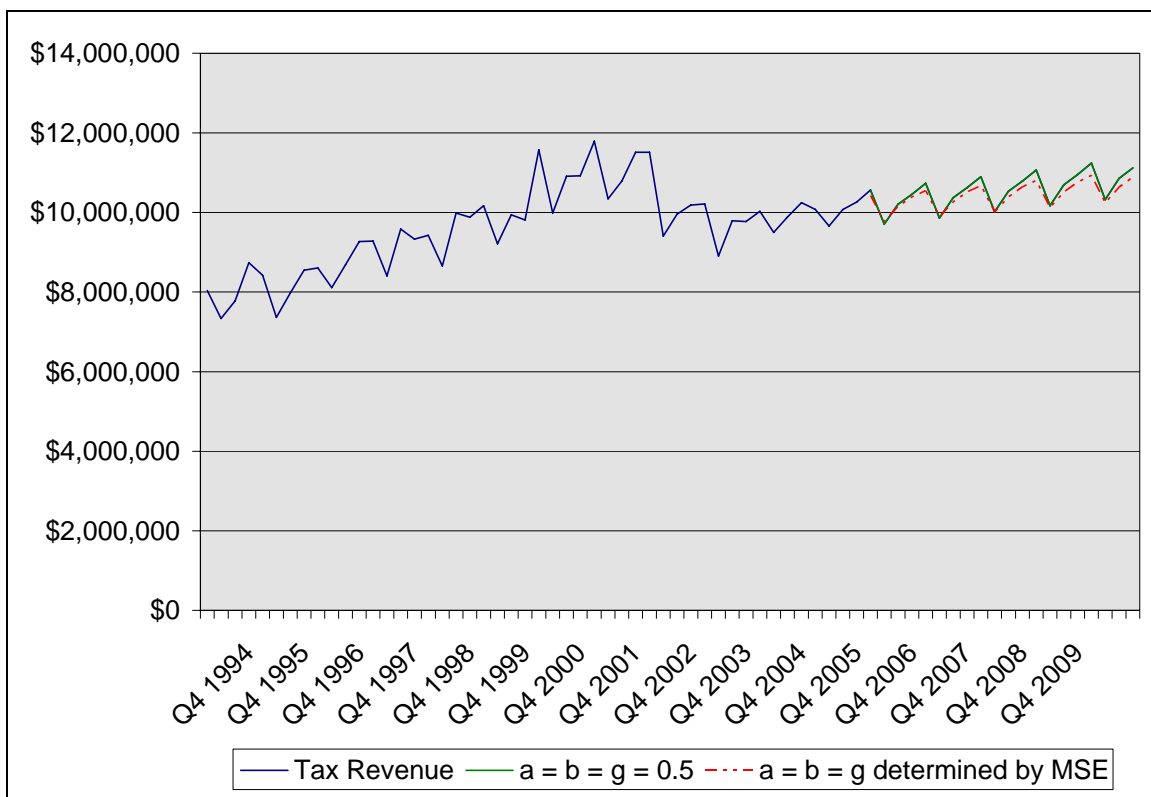
Since multivariate forecasting techniques require assumptions about the future development of independent variables, we will also provide the assumptions regarding those variables; "employment" and "unemployment."

## Univariate Quarterly Sales Tax Revenue Forecasts

### a. Multiplicative Seasonal Exponential Smoothing

- Figure 3 displays the results of two different forecasting techniques where the subjectivity of the forecast depends on the subjective weight assigned to the level ( $\alpha$ ), trend ( $\beta$ ), and seasonal factors ( $\gamma$ ), and one in which the weights are automatically determined based on the model generating the smallest total mean squared errors (MSE). The subjective model forecasts a slightly higher trend in revenues.

**FIGURE 3: Multiplicative Seasonal Exponential Smoothing**

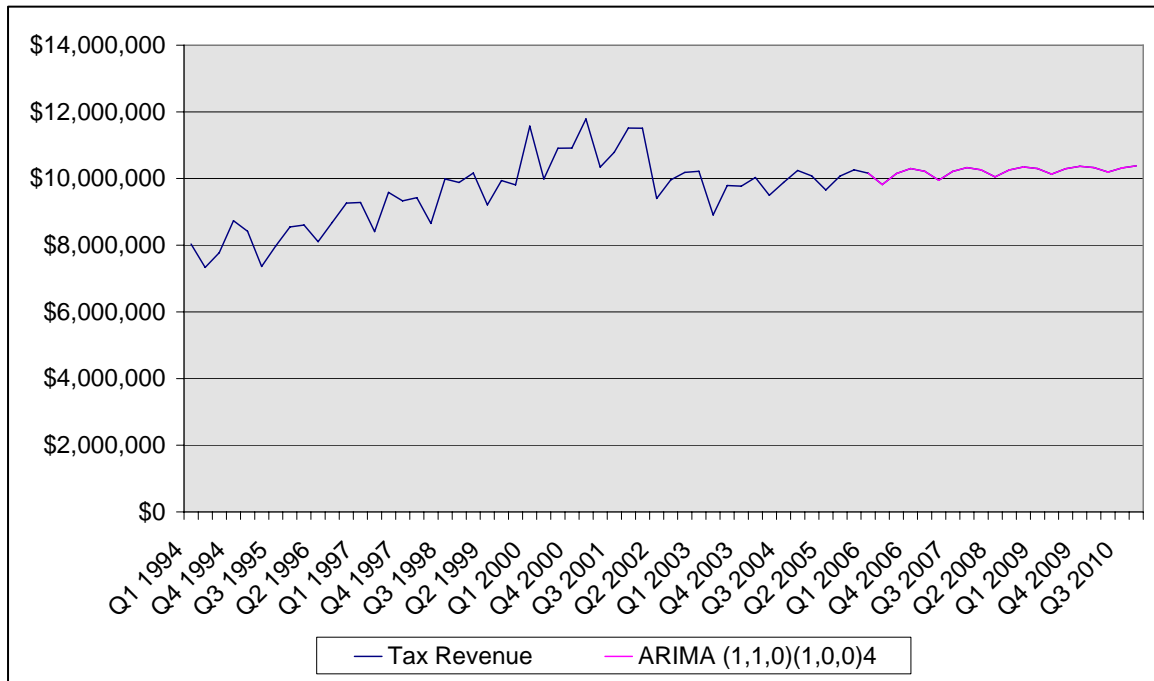


### b. ARIMA

Auto Regressive Integrated Moving Average (ARIMA) models use lags and shifts in historical data to uncover patterns (moving averages, seasonality, etc) and predict future observations. A lag is defined as the difference in time between an observation and a previous observation. ARIMA analysis is considered a more complex approach, yet it is useful in determining how much of the past observations should be used to predict future observations and the associated weightings.

- The quarterly sales tax revenue data from 1994Q1 to 2005Q4 was identified as an ARIMA (1,1,0)(1,0,0)<sub>4</sub> time series model.
- Figure 4 illustrates the results of the ARIMA analysis graphically. Obviously, this method is suggesting slower growth in total revenues. We judged this forecast to be at a lower bound for potential revenue growth.

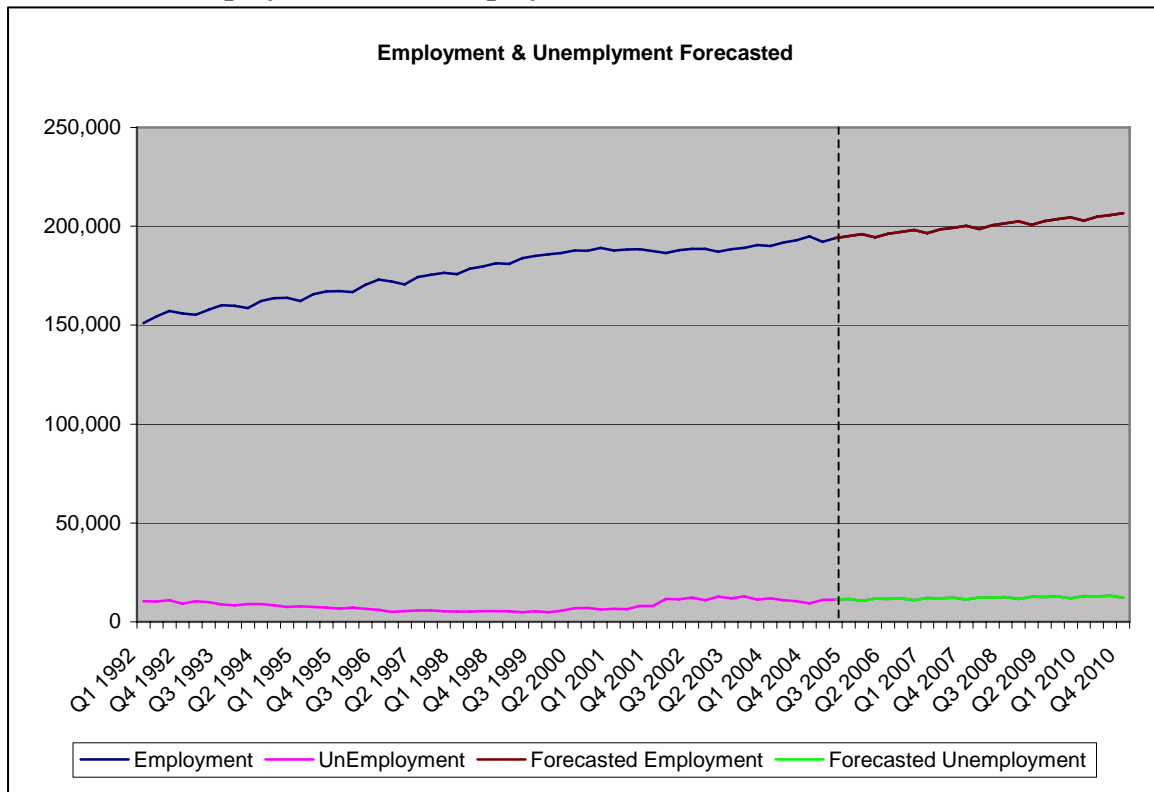
**FIGURE 4: ARIMA Forecast**



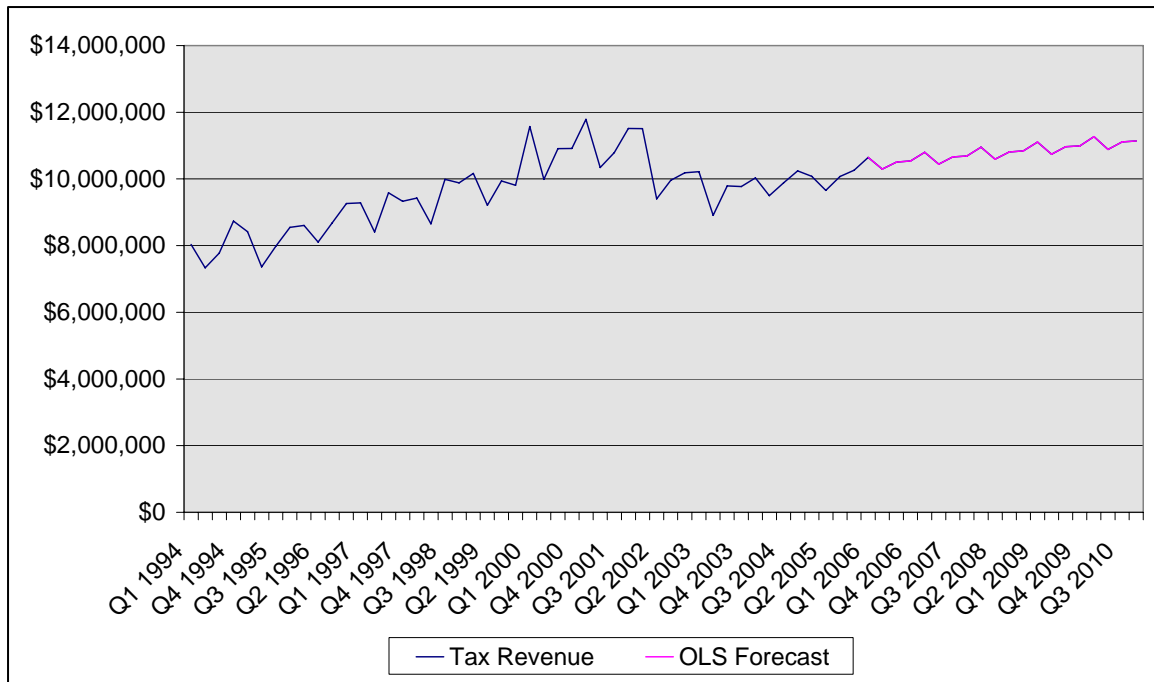
## Multivariate Quarterly Sales Tax Revenue Forecasts

- In order to forecast sales tax revenue through the use of a multivariate model, assumptions are made regarding the independent variables “employment” and “unemployment.”
- Employment and Unemployment appear to be good predictors of sales tax revenue. As such, future employment and unemployment are forecasted first using a multiplicative exponential seasonal smoothing technique that minimizes total mean squared error in the model (see Figure 5).
- The resulting revenue forecast, which uses an AR1 error correction model to account for serial correlations in the regression error term, offers a more positive assessment of revenue growth (see Figure 6).

**FIGURE 5: Employment vs. Unemployment**



**FIGURE 6: Quarterly Tax Revenue based on Employment & Unemployment**



Sales Tax Revenue vs. Employment & Unemployment

**OLS Model:**

$$\text{TaxRev} = A + (b_1 * \text{EMP}) + (b_2 * \text{Uemp})$$

	<u>Coeff.</u>	<u>t-stat</u>	<u>Prob. Level</u>
A	-6,768,217.717	-4.007	< 0.01
b <sub>1</sub>	98.773644	9.894	< 0.01
b <sub>2</sub>	-180.65848	-4.094	< 0.01
		Durbin.	2.045
		Watson.	



## **Findings**

- The initial review of additional statistical methods showed variations in forecasted projections. Some of these forecasts showed substantial gains in revenue, while others displayed flat-lined or very little increase in sales tax revenue. Decisions as to which methods to utilize were based on the stabilization of Arlington's retail market over the past two years.
- Recent closings of retail businesses are expected to have a minimal impact on total sales tax revenue. The Festival Marketplace Mall contributed very little to city revenues during its last years of operation. Foley's, previously located at Six Flags Mall, had been experiencing declining sales for several years prior to closing.
- The retail closing mentioned above will be more than offset by the addition of new retail outlets soon to be under construction. Undoubtedly, a new Wal-Mart Super Center at US-287 and Little Road will have a positive influence on Arlington's sales tax revenue. In addition, the new Arlington Highlands retail center will provide a boost to tax revenues once completed. The 75-acre development on the northeast corner of I-20 and Matlock Rd is expected to contain around 900,000 square feet of retail space. Two-thirds (Phase One) of this project should be completed by the first quarter of 2007. However, it must be remembered that some of the sales at new retailers are simply shifted from existing Arlington stores. We also assume that the new Cowboys stadium will have a modest impact on total retail sales in the city during our forecast period.
- Table 1 shows the results of each of our statistical methods as well as our "final forecast" that accounts for new opportunities through the expansion of Arlington's retail property base.

**Table 1: Summary of techniques and forecasts**

FY	Seasonal Exponential Smoothing			OLS Based on Employment	Average	Refined Average
	ARIMA (1,1,0)(1,0,0)4	$\alpha = \beta = \gamma = 0.5$	$\alpha = \beta = \gamma$ determined by MSE			
2006.1	\$10,160,215	\$10,560,546	\$10,423,021	\$10,643,363	\$10,446,786	\$10,518,429
2006.2	9,819,946	9,704,198	9,770,056	10,296,347	9,897,637	9,917,059
2006.3	10,148,929	10,206,093	10,143,433	10,509,610	10,252,016	10,277,788
2006.4	<u>10,298,343</u>	<u>10,457,054</u>	<u>10,387,173</u>	<u>10,541,859</u>	<u>10,421,107</u>	<u>10,451,798</u>
Total	\$40,427,433	\$40,927,891	\$40,723,683	\$41,991,179	\$41,017,546	<b>\$41,165,075</b>
2007.1	\$10,217,877	\$10,730,032	\$10,549,286	\$10,799,132	\$10,574,082	\$10,652,112
2007.2	9,949,324	9,859,318	9,888,054	10,444,506	10,035,300	10,105,270
2007.3	10,208,925	10,368,586	10,265,571	10,660,335	10,375,854	10,479,629
2007.4	<u>10,326,813</u>	<u>10,622,885</u>	<u>10,511,871</u>	<u>10,691,895</u>	<u>10,538,366</u>	<u>10,644,858</u>
Total	\$40,702,939	\$41,580,820	\$41,214,781	\$42,595,869	\$41,523,602	<b>\$41,881,869</b>
2008.1	\$10,263,324	\$10,899,517	\$10,675,551	\$10,954,721	\$10,698,278	\$10,806,220
2008.2	10,051,424	10,014,438	10,006,051	10,592,747	10,166,165	10,262,956
2008.3	10,256,260	10,531,079	10,387,709	10,811,241	10,496,572	10,600,348
2008.4	<u>10,349,279</u>	<u>10,788,714</u>	<u>10,636,569</u>	<u>10,842,112</u>	<u>10,654,168</u>	<u>10,760,661</u>
Total	\$40,920,287	\$42,233,748	\$41,705,879	\$43,200,821	\$42,015,184	<b>\$42,430,184</b>
2009.1	\$10,299,183	\$11,069,003	\$10,801,816	\$11,110,211	\$10,820,053	\$10,927,995
2009.2	10,131,985	10,169,558	10,124,049	10,740,907	10,291,624	10,388,415
2009.3	10,293,610	10,693,572	10,509,847	10,962,146	10,614,794	10,718,569
2009.4	<u>10,367,006</u>	<u>10,954,542</u>	<u>10,761,266</u>	<u>10,992,148</u>	<u>10,768,741</u>	<u>10,875,233</u>
Total	\$41,091,783	\$42,886,675	\$42,196,977	\$43,805,412	\$42,495,212	<b>\$42,910,212</b>
2010.1	\$10,327,478	\$11,238,489	\$10,928,081	\$11,265,799	\$10,939,962	\$11,047,903
2010.2	10,195,551	10,324,678	10,242,046	10,889,247	10,412,880	10,509,671
2010.3	10,323,080	10,856,065	10,631,985	11,113,052	10,731,046	10,834,821
2010.4	<u>10,380,993</u>	<u>11,120,371</u>	<u>10,885,964</u>	<u>11,142,085</u>	<u>10,882,353</u>	<u>10,988,846</u>
Total	\$41,227,101	\$43,539,603	\$42,688,076	\$44,410,184	\$42,966,241	<b>\$43,381,241</b>
Average annual percentage change	0.49%	1.56%	1.18%	1.41%	1.17%	<b>1.32%</b>

Note: "Refined Average" includes estimates of tax revenue for new retail projects: Wal Mart Supercenter and Arlington Highlands (FY2007)

### **Data sources**

- Sales tax data from 1994Q1 to 2005Q4 were obtained from the City of Arlington, Texas staff.
- Local unemployment statistics were obtained from the Bureau of Labor Statistics website at <http://data.bls.gov/PDQ/outside.jsp?survey=la>