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TECHNICAL MEMORANDUM #1

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Introduction

Oklahoma Policy Institute developed six revenue forecasts for the State General Revenue Fund (GRF) for the state fiscal years 2009-10 (FY '10) through 2012-13 (FY '13). This memorandum provides the technical background and detailed results for these forecasts. Readers are encouraged to first read the brief (available at <http://okpolicy.org/fy-10-budget-information>), which summarizes the forecast results in the context of the state's recent economic history and revenue performance and recommends improvements in forecasting and other aspects of state fiscal management and planning.

This memorandum describes each of the six forecasts, including assumptions, data used, and projected revenues. It then describes the impacts of tax cuts and revenue apportionment changes already in law, which will affect future state revenue under any forecasting assumptions. It then compares results of the various forecasts for both FY '10, the current fiscal year, and for future years. For FY '10 the forecast revenue shortfall for each forecast is calculated under various scenarios of how the Rainy Day Fund (RDF) is appropriated.

The Revenue Forecasts

This memorandum reports on the results of six revenue forecasts. Each estimates revenue for the General Revenue Fund only. The GRF comprises about 78 percent of state appropriations (excluding federal stimulus, or American Recovery and Reinvestment Act funding) for FY '10. Other state funds, such as the House Bill 1017 Education Reform Revolving Fund and the Transportation Fund, may respond differently to economic changes. Stimulus revenue is independent of state economic conditions.

Each of the forecasts estimates GRF revenue for each calendar quarter from the second quarter of FY '10 (October through December 2009) through the fourth quarter of FY '13 (April through June, 2013). It would be possible to forecast either monthly or annual revenue as well. Monthly revenue, however, is subject to extreme fluctuations that make it more difficult to see underlying patterns. Annual revenue does not provide sufficient data for analysis. Each forecast thus predicts four quarterly revenue amounts for each fiscal year.

Forecasting uses data from the past to predict what will happen in the future. All of the forecasts discussed below thus rely on historical quarterly revenue performance; in some cases historical revenue as far back as FY '01 is used to make the forecasts. In other cases, only a few quarters' data is used for forecasting. Recent quarterly change data are shown in the Table 1 below. Each quarter includes the actual revenue and the percentage change from the same quarter of the previous fiscal year. The \$1,105.80 million in revenue for the most recent quarter, the first quarter of FY '10, was 29.46 percent less than the revenue one year earlier, in the first quarter of FY '09. The table effectively

illustrates how quickly GRF revenue turned from healthy growth early in FY '09 to three quarters of increasingly large revenue declines.

Table 1

Quarter	Year	Revenue (Millions)	Annual % Change
1	FY '07	\$ 1,439.00	8.9%
2	FY '07	\$ 1,396.90	4.5%
3	FY '07	\$ 1,401.50	4.8%
4	FY '07	\$ 1,700.50	-0.4%
1	FY '08	\$ 1,466.20	2.1%
2	FY '08	\$ 1,377.60	-1.4%
3	FY '08	\$ 1,329.20	-5.2%
4	FY '08	\$ 1,780.00	4.7%
1	FY '09	\$ 1,567.70	6.9%
2	FY '09	\$ 1,513.30	9.85%
3	FY '09	\$ 1,298.10	-15.32%
4	FY '09	\$ 1,311.70	-26.31%
1	FY '10	\$ 1,105.80	-29.46%

The reader may benefit from a brief discussion of the three forecast methods used in the six forecasts before reviewing each forecast in detail. Forecasts 1 and 2 are based on *trend analysis*. Essentially, these study the recent trends in annual percentage revenue change as shown in Table 1, and then apply assumptions about the duration, length, and shape of the revenue pattern for future quarters. Forecasts 3 and 4 are *historically-based forecasts* that use data about previous Oklahoma revenue cycles and collections to predict future ones. Forecasts 5 and 6 use *multiple regression* to identify relationships between economic indicators and state revenue, then use predictions about future economic data to calculate future revenue.

The design, assumptions, and data for each of the six forecasts are described below. The strengths and weaknesses of each are briefly described as well. Actual quarterly and annual projections of all forecasts are compared in greater detail after all forecasts are described.

None of the forecasts are perfect and it will not be known for several years if any individual forecast is accurate. Forecasts require application of judgment and different analysts apply judgment differently to the same data. OK Policy's forecasting project attempts to compensate for these and other human problems inherent in forecasting by emphasizing the range of forecasting results that use a number of different methods instead of relying on just one method and one forecast.

Forecast 1, Immediate Recovery

This scenario assumes the just completed first quarter of FY '10 was the worst of the downturn. After this quarter, it assumes that revenue begins to recover and that the recovery is symmetrical to the

downturn in the short run. That would make second quarter revenue down 26.3% from the second quarter of FY '09 and the third quarter down 15.3% from Q3 '09. , The fourth quarter would see an increase of 9.9% over the fourth quarter of FY '09.

After FY '10, however, the forecast switches to an assumption of relatively rapid growth that has typified prior Oklahoma revenue recoveries. It assumes annual revenue growth of 5 percent for FY '11, 7.5 percent in FY '12, and 13.3% in FY '13. These are the average rates of growth Oklahoma has experienced in years 3-5 of three previous revenue downturns.

Strengths of this method are that it is simple and matches most discussion of the national economy. *Weaknesses* are that there is reason to believe revenue is not done falling, particularly in light of the continuing free fall in natural gas prices, and that the severity of this recession calls into question whether the assumption of fast recovery similar to previous, milder recessions is appropriate.

Scenario 2, Delayed Recovery

This forecast assumes that the downward trend in revenue is not yet finished and that the second quarter of FY '10, the current quarter, will be the worst. It then assumes a symmetrical recovery begins in the third quarter of FY' 10. This assumes second quarter revenue would be 32 percent below the second quarter of FY '09 and that the third and fourth quarters would be down 26 percent and 15 percent respectively. It assumes the same growth rates for FY '11 – FY '13 as Forecast 1, except it assumes the recovery continues to lag one quarter behind Forecast 1.

Strengths of this forecast are that it is conservative and leaves open room for the very real possibility that we have not bottomed out. *Weaknesses* are that it requires an unsupported assumption about how much worse the second quarter will be. Like Forecast 1, it assumes a fast recovery as Oklahoma has experienced in prior downturns.

Forecast 3, Repeat 2002

Forecast 3 looks to Oklahoma revenue experience to forecast future revenue. It assumes that this downturn will be proportional to the FY '02 revenue downturn. Revenue results are clearly worse in this recession, so this forecast uses the FY '02 experience not for the depth of the revenue drop, but for the path of the revenue trends.

Table2 shows it is possible to draw a rough parallel between the downturns. Revenue changes in two of the first three quarters of the FY '09 downturn were 3.4 to 3.5 times deeper than the same quarters of the FY '02 downturn. The second quarter was just 2.2 times more than the second quarter of the earlier recession. On average, the first three quarters of the current recession were 3.03 times deeper than the first three quarters of the FY '02 downturn.

Table 2
Comparison of FY '02 and FY '09 Revenue Downturns

Quarter of Downturn	FY '02 Rev. Change	FY '09 Rev. Change	FY '09/FY '02
1	-4.5%	-15.3%	3.39
2	-12.1%	-26.3%	2.17
3	-8.4%	-29.5%	3.52

This forecast assumes that the 3.03 ratio will continue for one quarter, and then slowly diminish so that the revenue declines become closer to the 2002 level over time. The last quarter with a revenue decline would be the seventh quarter of the downturn, which is the first quarter of FY '11. After that, the forecast assumes that annual revenue growth would be the same as it was after the FY '02 recession, averaging 11 percent over three years. As in the FY '02 recession, this forecast assumes the first and third years of recovery are the strongest.

Strengths of this scenario are that it uses all available information from our last significant recession and that the data do show some parallels. Further, the FY '02 experience reminds us that recovery can be uneven and there may be dips in the recovery for several more quarters. This is in marked contrast to the other scenarios, all of which assume more or less linear recovery. *Weaknesses* of this scenario are that it requires us to make judgments to fit quarters of this recession to quarters of the previous recession, that no two recessions are identical, and that this recession seems less likely to lead to as strong a rebound as the FY '02 experience.

Forecast 4—Straight-line

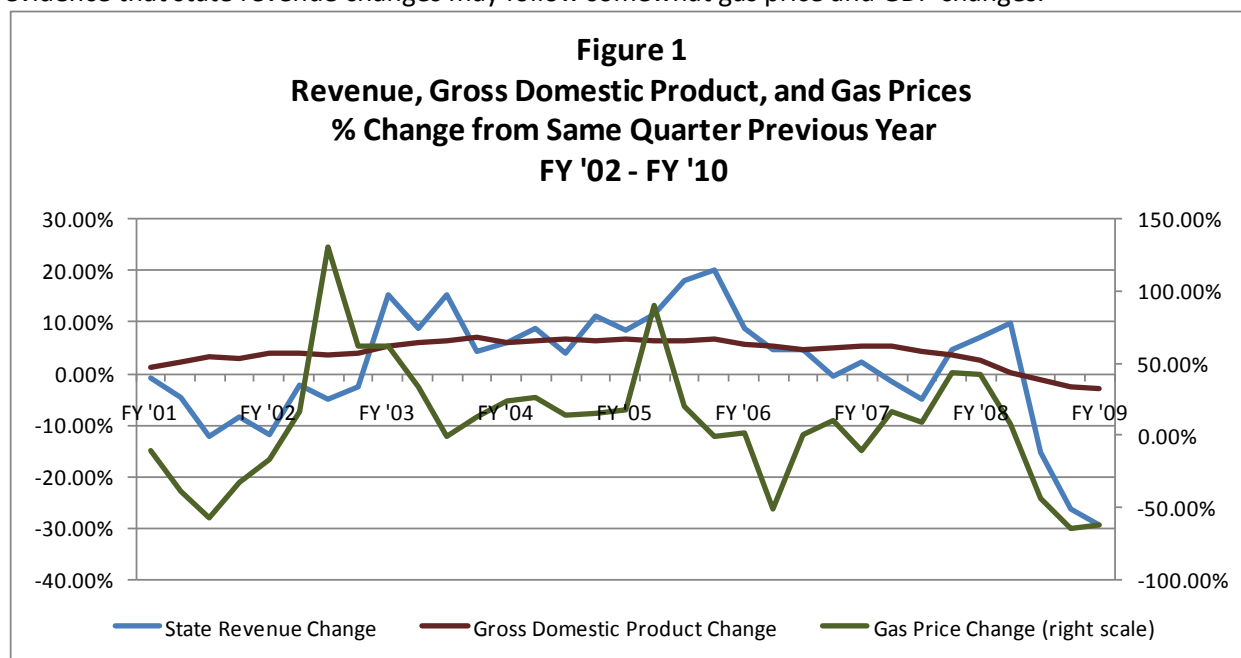
Revenue collections for the first quarter of FY '10 can be combined with the historical monthly revenue pattern to develop a straight-line forecast by extrapolating to the remaining three quarters of the fiscal year. From FY '01 through FY '09 the first quarter contributed an average of 24.7 percent of the revenue for the full year. Dividing the FY '10 first quarter revenue by 24.7 percent results in a revenue forecast of \$4.5 billion. This forecasting method does not, however, provide a basis on which to forecast future year revenues.

Strengths of this method are that it is simple and historically grounded. *Weaknesses* are that it assumes this year will be like all other years and it effectively assumes there will be no change in revenue performance for the entire fiscal year. The latter assumption is not supported by Oklahoma's revenue history.

Forecast 5—Regression on GDP and Gas Prices

Revenue watchers agree that the national economy and natural gas prices both have a significant effect on Oklahoma revenues. Indeed, these are blamed almost universally for our current downturn. Statistics bear out this interpretation. From FY '02 to FY '09, the correlation between quarterly state revenue and U.S. gross domestic product is 0.77 and the correlation between state revenue and wellhead gas prices is 0.69; both are very high correlations.

Figure 1 shows the quarterly changes in state revenue, gross domestic product (GDP) and natural gas prices at the wellhead. The figure suggests a reasonably close relationship among these three variables, though gas prices fluctuate much more severely than the other variables. The graph gives some evidence that state revenue changes may follow somewhat gas price and GDP changes.



Forecasts 5 and 6 are both regression models that seek to find relationships between quarterly values of state revenue and these other important variables. Forecast 5 is based on a regression model in which quarterly state revenue is the dependent variable (or the effect in a cause and effect relationship) and the independent variables (the causes) are quarterly nominal gross domestic product (GDP) in billions of dollars, as reported by the Bureau of Economic Analysis and the wellhead natural gas price reported for the middle month of each quarter by the Energy Information Administration, as well as a dummy variable for the fourth quarter of the fiscal year, which is typically the highest quarter of the year. This was the best fit of five different models using various combinations of these variables, some of which lag the independent variables.

The resulting regression model is:

$$\text{Revenue} = 0.072 \times \text{GDP} + 34.358 \times \text{gas price} + 193.834 \times \text{fourth quarter} + 168.150.$$

This regression model explains 80 percent of the variation in quarterly state revenues, indicating a very close relationship. There may, however, be some flaws in the modeling, since GDP and gas prices are highly correlated and each quarter's predicted value appears to be closely related to the previous quarter's prediction. While both of these weaknesses appear relatively minor, they could mean that this model does not offer the best prediction that is possible from regression analysis.

The regression model allows creation of a forecast for future revenue values from forecasts of future GDP and gas prices. GDP forecasts are available from a number of sources. Forecasts 5 and 6 use the median (middle) values of forecasts from the Office of Management and Budget, Congressional Budget Office, Federal Open Market Committee, Organization for Economic Cooperation and Development, National Association of Realtors, and the Blue Chip forecast. Natural gas prices are forecast by the U.S. Energy Information Administration.

Table 3 shows the forecast values for these variables through FY '13. It indicates that experts expect gross domestic product to stop falling by the third quarter of FY '10 and that growth could reach healthy levels over 5 percent by FY '12. Gas prices are expected to rebound relatively quickly to \$6.00 per MCF after one more quarter of significant declines from the prior year.

Table 3
Forecast Values for GDP and Gas Prices

Quarter	Year	GDP, current \$, billions	GDP annual chg from same qtr previous year	Gas/mcf, well-head, middle month of qtr (USDOE, EIA)	Gas price chg, annual change from same qtr previous year
2	FY '10	\$ 14,203.47	-1.00%	\$ 3.49	-45.13%
3	FY '10	\$ 14,206.36	0.20%	\$ 4.58	9.31%
4	FY '10	\$ 14,398.93	1.81%	\$ 4.25	23.19%
1	FY '11	\$ 14,625.45	3.41%	\$ 4.33	37.90%
2	FY '11	\$ 14,688.51	3.41%	\$ 5.03	44.13%
3	FY '11	\$ 14,731.99	3.70%	\$ 6.38	39.29%
4	FY '11	\$ 15,034.96	4.42%	\$ 5.92	39.29%
1	FY '12	\$ 15,376.38	5.13%	\$ 6.03	39.29%
2	FY '12	\$ 15,442.67	5.13%	\$ 7.01	39.29%
3	FY '12	\$ 15,461.22	4.95%	\$ 6.62	3.85%
4	FY '12	\$ 15,835.57	5.33%	\$ 6.15	3.85%
1	FY '13	\$ 16,252.83	5.70%	\$ 6.26	3.85%
2	FY '13	\$ 16,322.90	5.70%	\$ 7.28	3.85%
3	FY '13	\$ 16,342.51	5.70%	\$ 6.77	2.16%
4	FY '13	\$ 16,738.20	5.70%	\$ 6.28	2.16%

Strengths of this approach are that it is based on accepted economic relationships, helps us understand what to expect from revenue based on economic indicators, and uses a model that would have accurately predicted quarterly revenues in most previous quarters. One *weakness* is that the model would have predicted higher than actual revenue for the two most recent quarters, so it may not be up to the task of this deep a downturn. Another weakness is that it depends on outside forecasts of economic activity and gas prices. Even the experts cannot guarantee the right result.

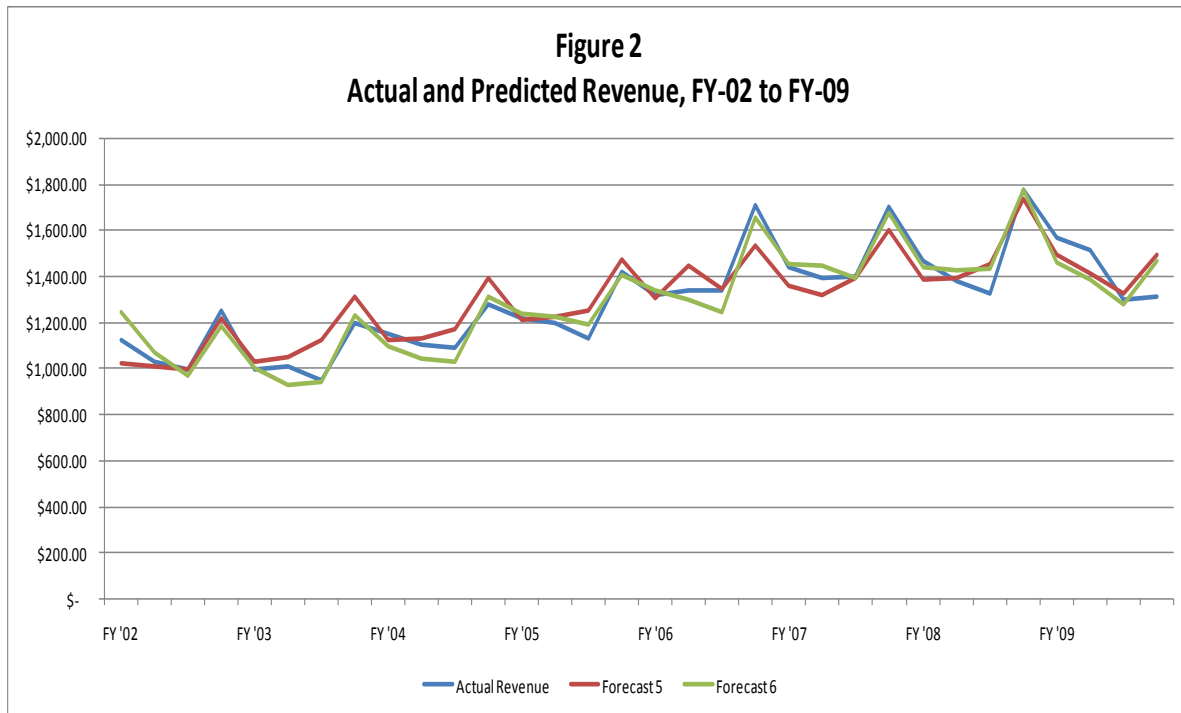
Forecast 6—Regression on Change in GDP and Gas Prices

Another regression approach is to use the *change in revenue* as the dependent variable or effect and change in GDP and gas prices as the independent variables or causes. This is the best of three models with this approach. It lags the independent variables by two quarters, suggesting that Oklahoma revenue change depends on economic and gas price conditions of six months earlier. The graph above suggests that is an appropriate model and the three models themselves indicate the same thing. The resulting model is:

Change in revenue = 4.12 X change in GDP two quarters earlier + 0.11 X change in gas prices two quarters earlier – 0.19.

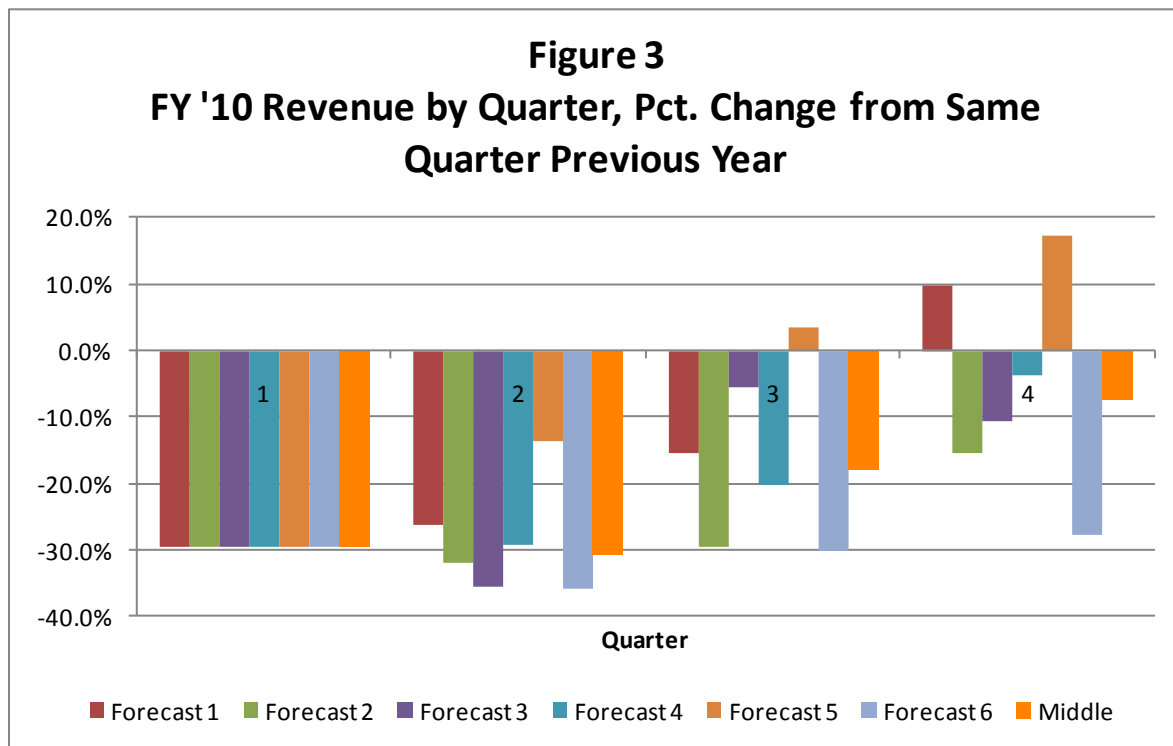
All variables are percentage change from the same quarter of the previous year. This model explains 70 percent of the variation in quarterly revenue changes and does not have any significant modeling errors. Using the same GDP and gas prices (though for a period two quarters earlier than Forecast 5) and applying the formula from the model allows prediction of revenue for future quarters.

Figure 2 shows how the models used in Forecast 5 and Forecast 6 would have forecast revenues since FY '01 and compares these forecasts to the actual revenue results. Both models show very good fits throughout the historical revenue period. Forecast 6 in particular seems to predict downturns very closely. Neither forecast would have predicted the severe downturn in the fourth quarter of FY '09.



FY '10 Revenue Forecasts

Figure 3 shows the expected quarterly revenue changes for FY '10 under the six forecasts and the middle scenario. The figure indicates that all six forecasts anticipate continued revenue declines in the current, second quarter. Three of the forecasts and the middle scenario expect the revenue decline to be greater in the second quarter than the first, while three suggest a moderating revenue decline. For the third quarter, one forecast indicates revenue will begin growing again, while the remainder show varying levels of revenue decrease. By the fourth quarter, two of the forecasts indicate revenue growth will return. The middle scenario and four forecasts indicate lower revenue growth. Forecast 6, the most conservative of the six, shows continued sharp revenue declines throughout FY '10.



The forecasts establish a range of possible revenue outcomes, but also establish that the state faces a high degree of uncertainty at this time. All of the scenarios are quite possible, with the possible exception of Forecast 5, the most optimistic. This suggests the state should be prepared for a revenue range of \$3.9 to \$4.8 billion, with a middle scenario of \$4.5 billion.

Table 4 summarizes the FY '10 total revenue estimates for the six forecasts and the middle scenario. Each forecast appears on a single row of the table. Data for the forecast include the forecast revenue, the forecast shortfall from the original appropriation (which is \$5.143 billion for all scenarios), both in millions of dollars and percentage. Three separate columns show the forecast shortfall as a percentage of appropriations:

- without using any money from the Rainy Day Fund (RDF),
- after appropriating the “shortfall” portion (3/8ths) of the Rainy Day Fund which is up to \$225 million, and
- after appropriating both the shortfall portion and the “emergency” portion (1/4th) of the RDF, which is up to an additional \$150 million for a total RDF appropriation of \$375 million.

Table 4							
FY '10 Revenue Forecasts and Shortfall Amounts							
Forecast	Forecast Revenue	Shortfall	Shortfall with no RDF (%)	Needed from RDF shortfall (3/8ths)	Shortfall with 3/8ths of RDF (%)	Needed from RDF emergency (1/4 th)	Shortfall with 5/8 th of Rainy Day Fund (%)
1	\$ 4,761	\$ 382	7.4 %	\$ 225	3.1 %	\$ 150	0.1 %
2	4,161	982	19.1	225	14.7	150	11.8
3	4,480	663	12.9	225	8.5	150	5.6
4	4,473	670	13.0	225	8.7	150	6.3
5	5,293	-0 -	-0-	-0-	-0-	-0-	-0-
6	3,933	1,210	23.5	225	19.1	150	16.2
Middle	\$ 4,439	\$ 704	13.4 %	\$ 225	9.3	\$ 150	6.4 %
All dollar amounts are in millions.							

The table indicates a wide range of potential shortfalls which range as low as \$1.2 billion or 23.5 percent of the budget. Of the six forecasts, only two would allow the budget to be balanced without using the maximum possible amount from the RDF. Only forecast 5 would allow the budget to be balanced without using RDF monies, cutting budgets, or identifying other new revenues.

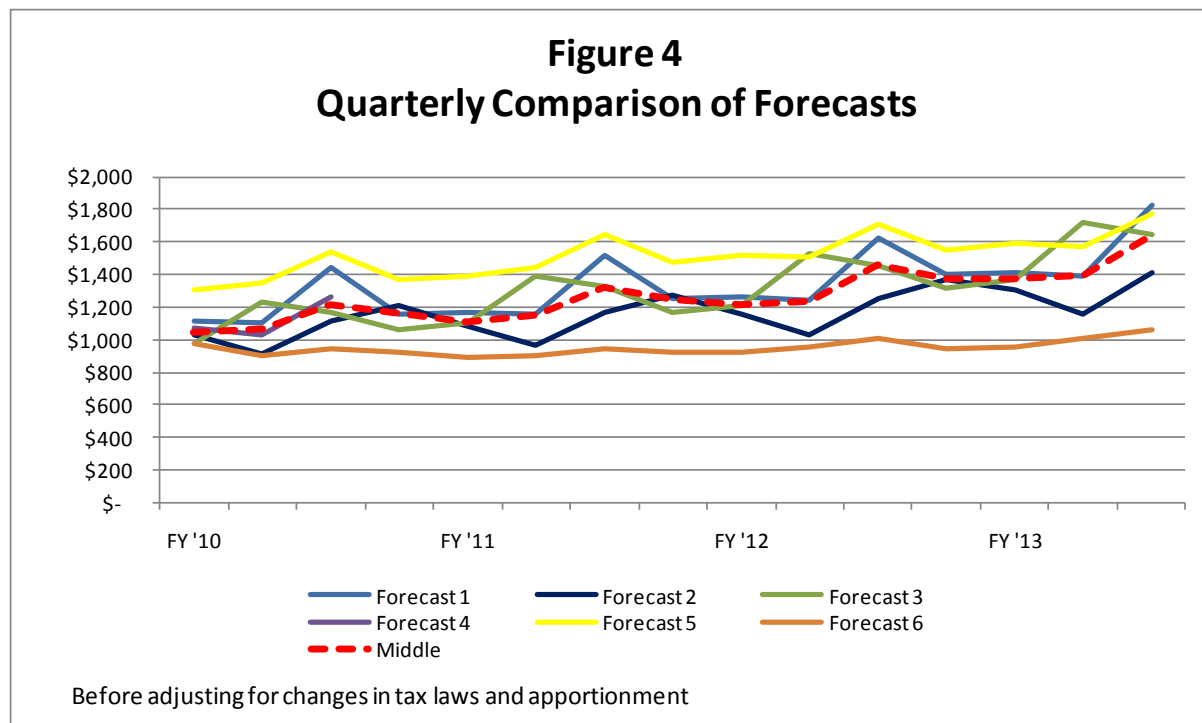
Under the middle scenario, the state would need to use the full allowable amount of the RDF and still cut agency budgets 6.4 percent to stay in balance.

Comparing Long-term Forecast Results

Comparing the estimates of the six forecasts from now through FY '13 can give a picture of the likely shape of the recovery. Figure 4 summarizes the quarterly revenue projects from the six forecasts and a middle scenario, which is the middle value of the six forecasts for each quarter.¹ The figure indicates significant variation among the forecasts. Forecast 5, a regression model, consistently estimates revenues the highest. Forecast 6, also a regression model, forecasts lowest. This is an interesting anomaly, given that they use the same data. However, Forecast 6 assumes it takes six months for changes in the economy or gas prices to effect revenue. The most of the other scenarios, using trend analysis or other historical approaches, forecast more moderate values. The middle scenario, shown in

¹ Forecast 4 estimates revenue only for FY '10, so there are five forecasts and the middle scenario for FY '11 – FY '13.

a dashed red line, represents the best information from all of the forecasts and is recommended by Oklahoma Policy Institute for use in planning state responses to the recession and the recovery. That scenario suggests a very slow recovery beginning late in FY '10.



Adjusting Revenues for Changes in Tax Laws

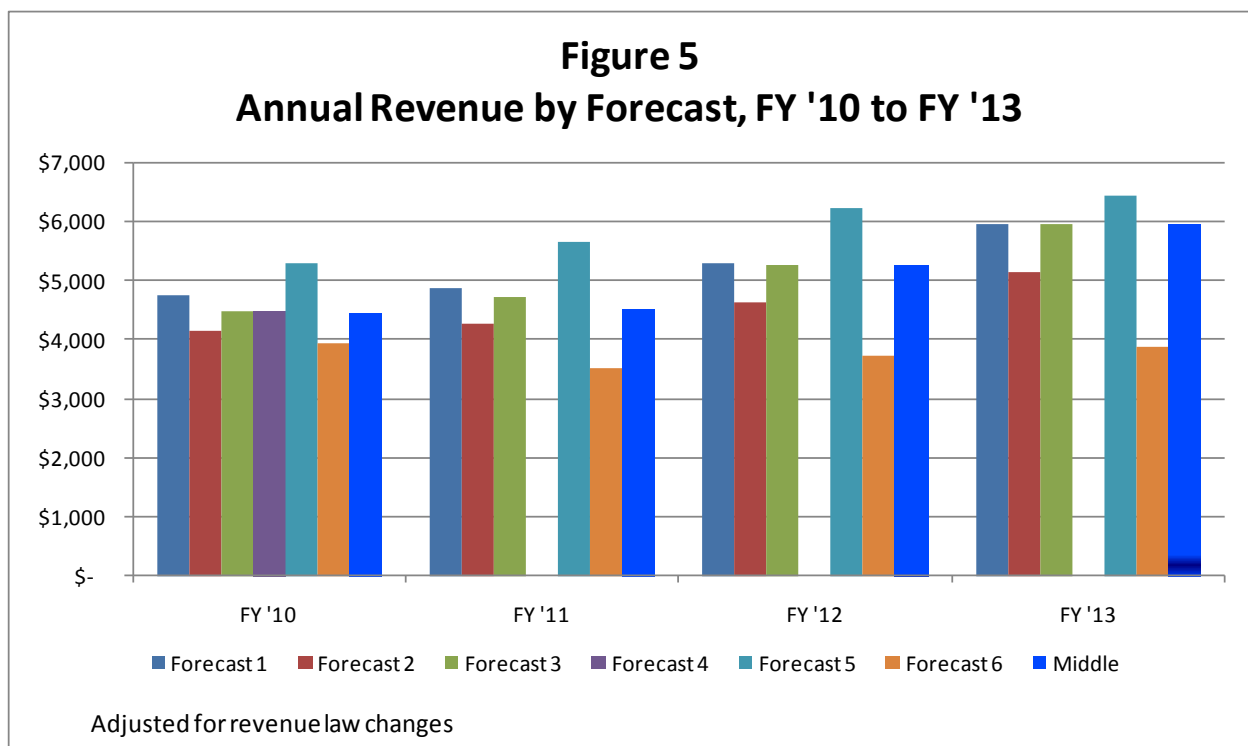
Forecasts must be adjusted for future revenue changes that have already been incorporated into law. The forecasts shown in Figure 4 all assume that FY '10 revenue allocations will remain in place through FY '13. That is not the case, because tax cuts and changes in revenue allocations that were adopted prior to the downturn will continue to be phased in through FY '13. The forecasts thus make the adjustments described below.

- In 2006 the Legislature adopted a measure to significantly increase (from \$3,000 to \$11,200 for a married couple filing jointly) the standard deduction from the state personal income tax over four years. The last and largest of the phased increases takes effect in tax year 2010 and will affect income tax revenue in FY '11 and after. Oklahoma Policy Institute projects that this will reduce revenue by \$98 million in FY '11 under all of the forecasts.
- The same 2006 tax cut law also phased in reductions in the top income tax rate. The rate has fallen from 6.75 percent to 5.50 percent. It is scheduled to be reduced to 5.25 percent in the first year in which revenues are forecast to increase by four percent or more. This will take place in FY '11 under the highest forecast, Forecast 5, and in FY '12 under the remaining forecasts. The revenue impact of this reduction is forecast at \$43 million in the first fiscal year of the cut and \$60 million more in the second year.

- In 2006, the Legislature also voted to phase out the estate tax. The tax ends for deaths after December 31, 2009. Because estate taxes may be paid for some time after the death, the revenue loss will be felt through FY '11 and FY '12, for a total reduction of \$27 million from FY '10 revenue levels.
- Also in FY '06, the Legislature created the Rebuilding Oklahoma Access and Driver Safety (ROADS) program. It was funded by reapportioning a growing amount of tax revenue from the General Revenue Fund to the ROADS fund. This will reduce GRF revenues by an additional \$30 million each year from FY '11 through FY '13 and in later years.
- The Legislature created a permanent funding source for the Oklahoma's Promise scholarship program in the 2007 session. Each year the Regents for Higher Education are required to estimate the cost of this program and the Board of Equalization is required to set aside funding before any other state function is funded. Each dollar of increased scholarship cost thus reduces GRF revenue. To date, there has been no need to increase the \$56 million annual apportionment to this fund. The forecasts do not set aside any funds for this purpose due to the uncertainty of the amount and timing. It is highly likely however, that by FY '13 more funding will have to shift from GRF to Oklahoma's Promise.

Cumulatively, these already-adopted revenue changes are estimated to cost at least \$318 million in FY '11 through FY '13. These costs will reduce the speed at which revenues recover as the economy turns back up.

Figure 5 shows annual revenue estimates through FY '13 for the five multi-year forecasts and the middle scenario. Each of these estimates is adjusted for the revenue law changes described above.



This graph shows the high degree of uncertainty that will face those who estimate revenues in each of the coming years. It also suggests the wide variation in possible impacts of the continuing economic downturn on state spending and public services. While the forecasts agree that revenues will begin climbing again in FY '11, they also agree that recovery will be slow and will take until FY '12 or longer. The variation and the likely slow recovery are important considerations in Oklahoma Policy Institute's recommendations to improve state fiscal forecasting, planning, and communication efforts in the very near future.

Oklahoma Policy Institute (OK Policy) is committed to advancing policies aimed at alleviating poverty, expanding economic opportunity and promoting fiscal responsibility.

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