To: The Revenue and Transportation Interim Committee and other interested parties
From: Sen. Dick Barrett
Re: Economic Activity and General Fund Revenue
Date: December 1, 2017

In the past few months (after it became apparent that FY 2016 revenue had fallen well below the HJ2 estimate), there has been considerable discussion about the relationship between the growth of state economic activity, one the one hand, and total general fund revenue on the other. The question is typically posed as follows: If indeed the state's economy is performing well (in terms of growth, unemployment, earnings, etc.), why is it that we are experiencing such lackluster growth in revenue?

In this note I offer a preliminary examination of this question. I examine the relationship between revenue growth and economic growth (measured in a couple of ways), how that relationship behaves in both the short and long run, how it has changed over roughly the past two decades, and how the behavior of different revenue streams have contributed, quantitatively, to that change. To be sure, there are observers who attribute the slowing of revenue collections not to an alteration in the revenue/economic activity relationship, but to the slowing of economic activity itself. That is certainly a possibility, but not the issue of concern here.

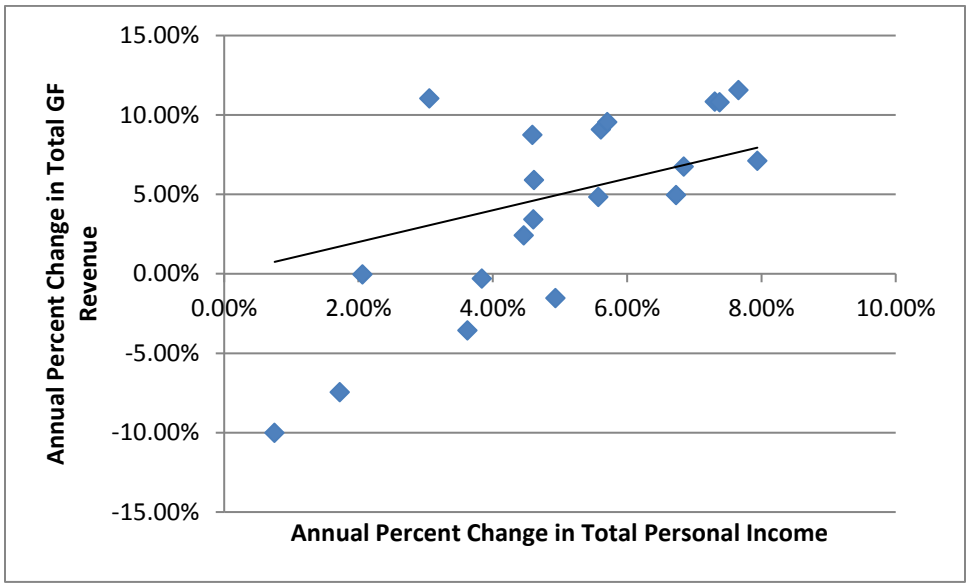
1. Economic Activity and Revenue

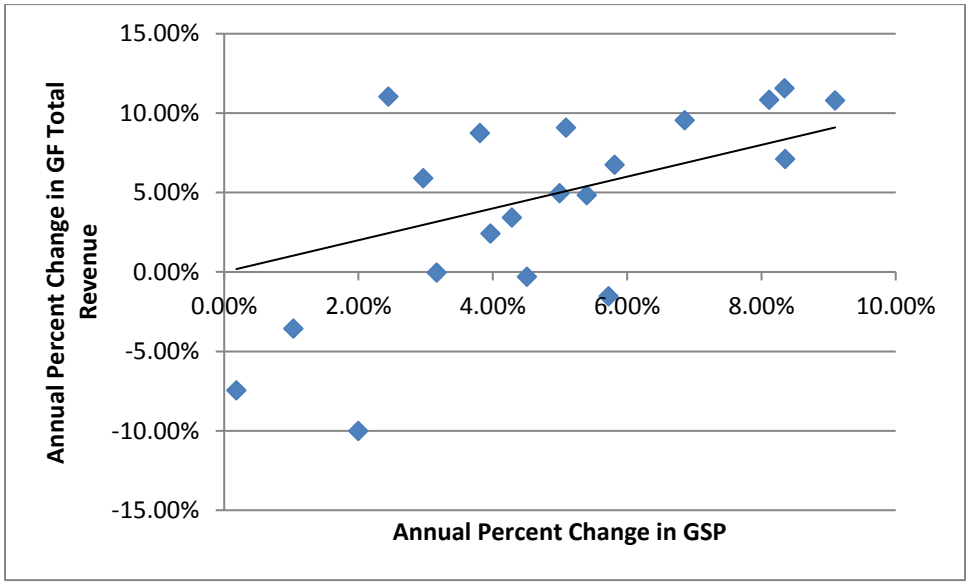
Consider the scatter diagrams on the next page. Each point in the first diagram represents a pair of annual growth rates of General Fund revenue and total personal income in Montana for the fiscal years 1997 to 2016; in this case, aggregate economic activity is measured by total personal income.[1] The second diagram, which is quite similar to the first, shows the same relationship, except that aggregate economic activity is measured by gross state product. (GSP represents, approximately, the total output of Montana's economy and the total income generated by producing that output, some of which is received by non-residents. Personal income includes all of the income of residents, some of which is derived from production occurring outside the state.)

In general, the upward to the right drift of the points in these diagrams confirms what common sense tells us: the faster the economy is expanding, the faster revenue grows. But this relationship is not very tight. Indeed, in six of these 20 years, revenue fell while economic activity was expanding, albeit typically at a modest pace. For those years in which revenue growth was positive, if the point lies below the diagonal line in the diagram, revenue growth was less that the growth of personal income (or GSP, as the

[1] Personal income for any fiscal year is estimated as the mean of personal income in that and the preceding calendar year. Fiscal year GSP is estimated analogously. The annual growth rate for a variable in any year is calculated as the change in the variable from that year to the next, expressed as a percentage of that year's value.

case may be). Points lying above the diagonal line indicate years in which revenue growth was more rapid than economic growth. What these diagrams tell us then is that while revenue weakly tracks economic activity in the long run, it need not do so at all in the short run, and even in the long run it may track, but not match economic growth.





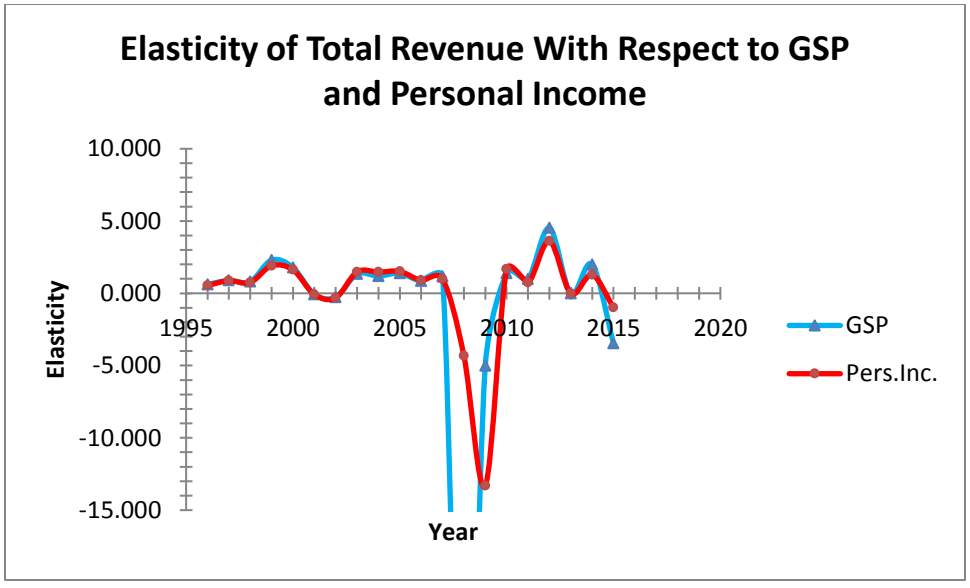
2. Revenue elasticity

In order to analyze the behavior of the relationship between changes revenues and changes in economic activity over time it is helpful to represent the relationship in the form of an *elasticity*. The elasticity of revenues with respect to personal income (or GSP) is simply the ratio of the percent change in revenues over some period of time to the percent change in personal income (of GSP) over that same period of time. Defined

in this way, elasticity can be thought of as measuring the responsiveness of revenues to changes in the level of economic activity.[2] Elasticities can be calculated for total revenue and for individual revenue streams such as the income tax, oil and gas tax, etc. These elasticities are expected to be positive, since revenue and economic activity are expected to move in the same direction, although as noted above, there were years in which that was not the case. If the value of a revenue elasticity is greater than 1, revenue is growing faster than economic activity; if elasticity is less than one, revenue is growing more slowly that economic activity.

Between 1996 and 2016, total general fund revenue, total personal income, and GSP grew by 120.2%, 161.8% and 154.4% respectively. For this very long period, the elasticity of total revenue with respect to personal income was .743 and with respect to GSP it was .779. Over this period, then, revenue growth failed to keep pace with economic growth, however measured.[3] That finding is certainly of interest and confirms what is generally believed about the revenue/economic activity relationship, but it leaves an important question unanswered, which is whether or not that relationship has been changing over time, and particularly whether or not the responsiveness of revenue growth to economic growth has been deteriorating.

One way to deal with that question is to track the behavior of short term, i.e. annual, elasticity over time. That is done in the diagram below.



[2] The calculated value of elasticity should not necessarily be taken to measure the strength of a causal link between changes in economic activity and revenue. The calculation is based on the observed association between changes in economic activity and revenue; that association may or may result from a causal linkage.

[3] Note that personal income grew more rapidly than GSP over the past two decades. This results from the fact that the share of personal income consisting of non-labor earnings generated by economic activity outside the state (e.g. many retirement earnings) has increased markedly.

What this chart tells us is that short term revenue elasticity is strikingly volatile. Such volatility helps explain why revenue estimation has proven to be so difficult. Revenue estimating models work by trying to identify reasonably stable relationships between revenue and one or more of its determinants (wages, interest rates, commodity prices, car sales, etc.); such determinants usually, but not always, correlate with economic activity. The volatility observed in the diagram suggests that the stability necessary for accurate estimation may simply not be there.[4] This lack of stability may be the result of a variety of factors, including the failure or inability to include in models determinants of revenue that do not correlate closely with the level of economic activity. For example, if personal income is rising and at the same time, taxpayers anticipate that tax rates will be reduced in the near future by legislative action, they may adjust their estimated tax payments downward to reflect that anticipation; income rises and at least of component of tax revenue falls.[5] Taxpayer behavior of this type is almost impossible to account for in modeling. In this hypothetical case, there is no reliable way of knowing what taxpayers anticipate, and no historical data that would allow us to predict how they would respond to such anticipations, even if they were known.

Although it is difficult to discern in the very volatile behavior of short term elasticity, there does appear to have been a decline in longer term elasticity over the past two decades. In the first decade, 1996 to 2006, for example, total general fund revenue, total personal income and GSP grew by 77.3%, 72.2% and 76.0% respectively; the elasticities of total revenue with respect to personal income and GSP were 1.071 and 1.017 respectively. Over these years, General Fund revenue growth more than kept up with economic growth, however measured. From 2006 to 2016, on the other hand, total general fund revenue, total personal income and GSP grew by 24.2%, 52.0% and 44.5% respectively; the elasticities of total revenue with respect to personal income and GSP were .456 and .543 respectively. Thus revenue growth fell far short of economic growth in the second decade. The very sharp slowing of economic growth in the second decade is obviously the result of the depth of, and slow recovery from, the recession beginning in 2008. Slower economic growth obviously implied slower revenue growth, but what is of interest here is the very large (approximately 50%) decline in revenue elasticity.

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[4] The volatility observed here means that even if we could predict what will happen to personal income and/or GSP two years into the future with 100% accuracy, our estimate of revenue for the period would still be subject to large errors. This kind of estimation error is to be distinguished from the error that arises from the fact that we can't predict with 100% accuracy where personal income, GSP or just about any other economic variable is going to be two years hence.

[5] This hypothetical needs to be distinguished from the idea of a "Trump bump," which involves taxpayers initially, in response to an anticipated tax cut, *not* realizing income and then, after the tax cut becomes effective, realizing it. This behavior would presumably not alter the relationship between income and tax payments, but it does make the behavior of taxable income difficult to predict and hence introduces a different type of error into the estimation of revenue. See the preceding note.

3. Decomposition of change in elasticity

A useful way of accounting for this rather large decline in revenue elasticity is to use a shift and share analysis to decompose the change in elasticity into three components. These are the change in total revenue elasticity that would have occurred if (1) the elasticities of each revenue stream (i.e. tax type, such as the personal income tax) had not changed but each stream's share of total revenue had changed as it actually did and (2) the shares of each revenue stream had not changed, but the elasticity of each stream had changed as it actually did and (3) the change attributable to the interactions between changes in revenue stream shares and revenue stream elasticities.

Consider the specific example of the individual income tax. Because in the first period its elasticity with respect to income was high relative to other revenue streams and because its share in total revenue grew between the two periods, there was a positive impact (.09) on the elasticity of total revenue . On the other hand, the elasticity of the income tax declined between the two periods and given its initial share in total revenue, this implied an negative impact (-.135) on the elasticity of total revenue. Finally, there was an additional negative impact (-.018) due to the fact that this revenue stream with declining elasticity was providing a higher share of total revenue.[6]

The table on the next page shows the details of this decomposition of the change in the elasticity of total revenue with respect to personal income.[7] For the purposes of this calculation, I grouped some smaller revenue streams together and excluded all revenue streams that either began after 1996 or ended before 2016; the remaining revenue streams included in the analysis account for more than 90% of total General Fund revenue. The elasticities of total revenue from these sources with respect to personal income were 1.305 and .595 in the first and second decades respectively, so elasticity changed by -.710 from one decade to the next; it is this change that is decomposed in the table.

The figures in the table suggest the following:

1. The change in the composition by tax type of total revenue that occurred between the first and second decades tended to increase the income elasticity of total revenue. This is not surprising. As the economy grows, the revenue streams that grow most rapidly along with it are going to become more important. That is, given the elasticities of the

[6] Let e and e* be the elasticities of total revenue in the first and second periods respectively, e_i and e^*_i be the analogous elasticities of revenue stream i, and s_i and s^*_i be the shares of revenue stream i in total revenue. $\Delta e = e^* - e$ and Δe_i and Δs_i are defined analogously, then, summing over I, $\Delta e = \Sigma e_i \Delta s_i + \Sigma \Delta e_i s_i + \Sigma \Delta e_i \Delta s_i$.

[7] The decomposition of the change in elasticity with respect to GSP would be quite similar.

different revenue streams, total revenue generation will evolve in the direction of greater responsiveness to economic growth.

Tax Type	Change in Elasticity of Total Revenue from:			
	Change in Shares	Change in Elasticity	Interaction	Total
Individual Income Tax	0.088	-0.135	-0.018	-0.065
Property Tax	0.024	0.303	-0.167	0.159
Corporation Income Tax	0.051	-0.191	-0.064	-0.204
Vehicle Taxes & Fees	0.477	-0.161	-0.482	-0.166
Oil & Natural Gas Production Tax	0.458	-0.150	-0.519	-0.211
Insurance Tax & License Fees	0.008	-0.039	-0.006	-0.037
Video Gambling Tax	0.133	-0.073	-0.130	-0.070
Other Business Taxes	-0.001	-0.008	0.000	-0.008
Other Natural Resource Taxes	-0.005	-0.039	0.015	-0.029
Other Interest Earnings	0.007	-0.070	0.039	-0.024
Other Consumption Taxes	0.006	-0.045	-0.004	-0.044
Other Sources	-0.007	-0.005	0.001	-0.011
Total	1.239	-0.614	-1.334	-0.710

2. All of the increase in total revenue elasticity that might have occurred because high elasticity revenue streams were becoming more important were essentially more than offset by the fact that the elasticities of all of these streams, except the property tax, were declining. It's somewhat like switching from a slow to a fast elevator in order to get to the second floor more quickly. It should work, but it turns out that any advantage that you might have expected from the switch is nullified by your new elevator slowing down.

3. Only one tax type, property taxes, experienced an increase in income elasticity, and that had a significant positive impact on the income elasticity of total revenue.

4. The three largest sources of the decline in total revenue elasticity were declines in elasticities of the corporate license, vehicle and oil and natural gas production taxes.

It is important to emphasize that these conclusions do not constitute explanations for why the elasticity of total revenue fell so sharply. Rather, they provide a quantitative accounting for the decline and suggest where explanations are called for. So, for example, they indicate that the behavior of property tax revenue had a positive effect on elasticity and invite an explanation for why the elasticity of property tax revenue grew between the two decades. Was there a change in state mills? Did something happen to the market value of properties and/or the way they were appariased? Did legislative mitigation and phase-in have an impact? Did the property tax base shift towards classes with higher tax rates? And so forth.

There have been a number of explanations offered for why revenue is not growing along with the growth of the economy, including the putative effects of changes in the structure of the economy and the industrial and occupational composition of employment, the emergence of the "new economy" and on-line commerce, restructuring of income tax brackets and the extension of income tax credits, the decline of natural resource industries, etc. The purpose of this note is to provide information that might be helpful in focusing the discussions of those alternative explanations.[8]

[8] I am grateful to Stephanie Morrison in the Legislative Fiscal Division for providing detailed data on General Fund revenue, by tax type, for the period 1996 to 2017. Data on gross state product and total personal income was downloaded from the US Census Bureau of Economic Analysis Regional Economic Information System.