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An Evaluation of the State of Iowa Revenue Forecasts, 1995 – 2017

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Abstract
A critical task in establishing the State of Iowa budget is to project available tax revenue. The 2017 fiscal year was characterized by tax revenues that did not live up to predictions, leading to midyear cuts in planned government expenditures and tapping into reserves. That experience raises the question of whether the Iowa state government revenue forecasts are faulty. Are revenue shortfalls avoidable through improved forecasts or are occasional shortfalls inevitable with even the best statistical predictions? I will show that the Iowa government revenue forecasts pass the standard tests of unbiasedness and rationality, meaning that they are not obviously flawed. However, policies that have increased the proportion of tax revenues that are refunded are making our tax system less efficient. Moreover, forecasts of net tax revenue have become less reliable, leading to increased likelihood of revenue shortfalls and midyear cuts in planned government services.

Keywords
Iowa, Revenue Estimating Conference, forecast, tax revenue, refunds, gross, net, bias, forecast error, efficiency, budgeting

Disciplines
Economic History | Economic Theory | Finance | Growth and Development | Income Distribution

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A critical task in establishing the State of Iowa budget is to project available tax revenue. The 2017 fiscal year was characterized by tax revenues that did not live up to predictions, leading to midyear cuts in planned government expenditures and tapping into reserves. That experience raises the question of whether the Iowa state government revenue forecasts are faulty. Are revenue shortfalls avoidable through improved forecasts or are occasional shortfalls inevitable with even the best statistical predictions? I will show that the Iowa government revenue forecasts pass the standard tests of unbiasedness and rationality, meaning that they are not obviously flawed. However, policies that have increased the proportion of tax revenues that are refunded are making our tax system less efficient. Moreover, forecasts of net tax revenue have become less reliable, leading to increased likelihood of revenue shortfalls and midyear cuts in planned government services.

I. Past research

All governments engage in revenue forecasts. This is particularly important for governments that are constitutionally obligated to balanced budgets such as state governments because the planned expenditures must lie within the constraints of expected revenues.[1] Because government budgets are, by nature, subject to political rather than economic interests, forecasts may deviate from the best statistical practices. The bias could go in either direction. Governments may err on the conservative side in revenue forecasts so that the budget surprises would typically be positive. Negative budget surprises would require cutbacks which may be viewed negatively by voters. On the other hand, forecasters may be under pressure to be overly optimistic in their revenue projections in order to allow larger planned government expenditures. This would be particularly true in election years as the benefit from government expansion is immediate and the cost of the budget shortfall will not be apparent until after the election.

Good economic times benefit incumbents in elections across all countries. Governments are punished for bad economic outcomes by being voted out (Lewis-Beck and Stegmaier, 2000). That means that there is a potential benefit to incumbents from manipulating fiscal or monetary policies during election years to generate short-term economic stimulation.

The theory that governments loosen the purse strings in election years to provide an economic surge that would gain voter support is called the theory of the political business cycle (Nordhaus, 1975). There is mixed evidence regarding the importance of politically motivated fiscal policies in election years. At the aggregate level, large complex economies are just not that sensitive to modest changes in government spending (Golden and Poterba, 1980). Voters are not as naïve as the theory requires, and so voters can see through opportunistic expansionary policies. Voters

[1] Iowa Code 8.54 of the Budget and Financial Control Act places the expenditure limitation as 99% of the initial net revenue estimate of the Revenue Estimating Conference. https://www.legis.iowa.gov/docs/code/8.54.pdf

anticipate having to pay for higher budget deficits (Chappell and Keech, 1985), and may even punish governments that are perceived to be making suboptimal budget decisions. The apparent correlation between government spending and elections actually appears to go in the opposite direction in parliamentary systems where the government can decide when to hold elections. Elections are called when economies are expanding and government revenues are strong (Heckelman and Berument, 1998; Cargill and Hutchinson, 1991). The empirical evidence suggests that there is only weak support for the existence of a political business cycle at the aggregate level in the U.S. (Nordhaus *et al*, 1989), but stronger evidence in Japan (Cargill and Hutchinson, 1991). Reischmann (2016) finds in a study of 27 OECD economies that governments are more likely to engage in creative accounting to disguise a surge in debt during election years.

There is much stronger evidence of a political business cycles in small economies and at the state and local levels, both in the U.S. and abroad. Schuknecht (2000) found that developing countries show consistent evidence of expenditure surges in election years. Reischmann (2016) found similar evidence in younger democracies which also tended to be developing economies. Expansionary fiscal policies related to the election cycle were found in Israel (Brender, 2003), municipalities in Portugal (Veiga and Veiga, 2007), and states of the United States (Poterba, 1994).

One way to administer expansionary fiscal policies in election years is to provide overly optimistic revenue forecasts which will allow larger planned government expenditures. In the United States, state revenue forecasts tend to be biased downward and so forecasted revenues tend to be lower than realized revenues (Cassidy *et al, 1989;* Feenberg, 1989). However, forecasts are more optimistic and often overly so in election years (Boylan, 2008; Feenberg, 1989). Brück and Stephan (2006) report similar findings of overly optimistic forecasts in Europe and Frankel (2011) finds a general pattern of overly optimistic revenues forecasts in his analysis of 33 governments.

To ease the political pressure that government forecasters face to generate optimistic revenue forecasts in election years, some governments rely on outside consultants to provide independent reactions to the predictions. There is evidence of reduced upward bias in revenue forecasts in election years in European countries that use private forecasters or advisers (Merola and Pérez, 2013; and Frankel and Schreger, 2016).

The Iowa Revenue Estimating Conference[2]

The Iowa Revenue Estimating Conference (REC) was established in 1986 as part of a state government reorganization. The REC is tasked with estimating tax revenues for the next two fiscal years. Since 1994, it also forecasts refunds to be paid out of tax revenues. The REC includes 3 members, the governor or the governor's designee, the director of the legislative fiscal bureau, and a third member agreed to by the other two. The third member has typically been someone outside the government. The group initially met quarterly but now meets at least three

[2] Information in this section is based on Section 8.22A, of the Department of Management — Budget and Financial Control Act.

times per year. For several years, the REC also received input for their forecasts from experts that included faculty from the University of Iowa and Iowa State University, but that practice has been discontinued. However, economists at the Iowa Department of Revenue continue to provide input about the economic outlook and the impact of tax credits on receipts and refunds.

The REC makes several projections of the tax revenue for a given fiscal year. Although the exact timing has changed over time, the main ones are the December before the fiscal year and March before the fiscal year. The December forecast establishes the baseline for the Governor and General Assembly budget at 99 percent of the net forecast. If the REC raises its estimate of tax revenue for the next fiscal year in March, the general assembly must use the original lower estimate in setting the budget. However, if the forecast decreases, the general assembly has to use the smaller amount. Consequently, downward revisions of the revenue forecasts are much more important for policy. Presuming that upward revisions cause less difficulty for elected officials, there may be a tendency for the REC to err on the side of more conservative initial estimates. Note that the REC also makes forecast of the current fiscal year that can result in budget cuts as was the case for FY 2017.

II. Methodology

The first binding forecasts are made in December of the year preceding the fiscal year.[3] In other words, the first forecast for revenues in fiscal year *t* will occur in December of fiscal year *t-1*. The relationship between the forecast and the realized value of the revenue can be written

(1) $R_t = \alpha_0 + \alpha_1 R_{t-1}^P + \varepsilon_{t-1}$,

where R_{t-1}^P is the forecasted revenue, R_t is the true value of the revenue, and ε_{t-1} is the error term. The parameters α_0 and α_1 represent the structural relationship between the forecast and the outcome. If the forecast is unbiased, $\alpha_1 = 1$ and $\alpha_0 = 0$. If the State of Iowa revenue forecasts are systematically biased for political reasons, the forecasts will violate these requirements. Hence, a test based on equation (1) is sufficient to evaluate whether Iowa revenue forecasts violate standard requirements for statistical forecasts.

We apply the test to three forecasts: the first December forecast, the forecast that occurs between August and October of the fiscal year but preceding the November elections, and the forecast that occurs in December of the fiscal year. The fall forecast predates the election and so it would be the forecast most likely to have a political payoff if there was a bias toward overly optimistic forecasts in election years.

The previous tests have been labeled weak-form tests of rationality. The alternative strong-form rationality test examines if the forecasts are making full use of available information at the time

[3] There are some earlier preliminary estimates made in October and as early as March, but these projections are not binding on the budget process.

the forecast is made. Define the forecast error as $E_{t-1}^{P} = R_t - R_{t-1}^{P}$. Let Z_{t-1} be information available at the time of the forecast. Then strong-form rationality can be tested using a regression of the form

(2) $E_{t-1}^{P} = \beta_0 + Z'_{t-1}\,\beta_Z + \epsilon_{t-1}$

The parameter vector associated with information available at time *t-1* is given by β_Z. Rationality requires that the error has a zero mean, which in turn requires that $\beta_0 = \beta_Z = 0$.

III. Data

The data for this analysis is provided by the Iowa Legislature on the Fiscal Analysis page.[4] Reasonably consistent data is provided on forecasts and eventual realized revenue amounts starting with the 1995 fiscal year.[5] Information on the final revenue amount is available by December of the following fiscal year, and so we have complete information on the 1995 through 2017 fiscal years. We will evaluate the gross and net revenue forecasts across all taxes and also the revenue forecasts for the three most important individual taxes, the income tax, sales tax and corporate tax.

The sample means for the forecast errors are presented in table 1. The first forecast for all the individual taxes and for the gross and net aggregate tax revenue all have positive average errors, indicating a bias toward under-forecasting tax revenues. The tendency toward conservative revenue forecasts is understandable because of the higher cost of downward revisions in revenue forecasts. The average errors for the first forecast are less than 1% for both the gross and net revenue estimates.

The quality of the overall forecast is closely tied to the quality of the income tax forecast which represents almost 50% of tax revenue. Initial forecasts for sales and corporate taxes are much noisier with initial percent errors of 1.6% and 6.4% respectively. The errors are still positive on average, suggesting that the members of the REC are more conservative on the forecasts that are more difficult. The forecasts of sales tax revenues, which represent 36% of the total, improve considerably in subsequent revisions. The corporate tax forecast remains quite noisy in subsequent revisions, but errors there are less critical because corporate tax represents only 6% of total receipts.

The other initial observation from Table 1 is that net revenues are substantially smaller than gross revenues. It is not efficient to collect taxes for the purpose of giving them back. However, net revenues are 88% of gross revenues, meaning that the cost of collecting state taxes in Iowa is no less than 12 cents per dollar of tax revenue.

Figure 1 shows another apparent cost of the Iowa State refund policies—they make it more difficult to forecast net revenues. Because the expenditure policies are based on net revenue and

[4] I am indebted to Jeff Robinson, Senior Fiscal Legislative Analyst at the Iowa Legislative Services Agency, for helping me locate the available data.

[5] Partial information on the 1995 fiscal year is also available, but it did not include the information we require for this study.

not gross revenue, the higher absolute value of the forecast errors attached to net revenues mean that the state's budget policies are tied to forecasts that are inherently less reliable.

If the State's refund policies were transparent, there should be no difference in the quality of the forecasts for gross and net revenues. Noisier forecasts for net revenues mean that the REC is having difficulty projecting who qualifies for refunds and how much those refunds will be. If the refund policy is more difficult to predict, it is likely that the recipients of refunds may also find it difficult to assess whether they will be getting refunds, and if so, how much they will get. If refunds are designed to incentivize behavior, the lack of transparency suggests that the incentives may be less effective.

IV. Results

Table 2 reports the results of the weak-form tests of rational forecasts. For both gross and net tax revenues, the REC forecasts pass easily. We cannot reject the null hypothesis that the expected value of the forecast is equal to the realized value, a result implied by our regression result that both $\alpha_1 = 1$ and $\alpha_0 = 0$. Moreover, the forecasts appear to be quite accurate. The first forecast made in the December before the fiscal year begins explains 96% of the variation in realized gross tax revenues and 90% of the net tax revenues. The poorer forecasting performance on net tax revenue suggests that the REC finds it more challenging to forecast refunds than initial revenues.

The apparent difficulty of predicting refunds reflects a growing cost to the Iowa tax structure that increasingly couples high marginal tax rates with tax refunds. As shown in Figure 2, refunds are a growing share of total tax receipts. Refunds have been growing more rapidly than gross tax receipts since 2008. One cost to the state is a more uncertain forecast of the revenues available for state programs. The other cost is that by 2014, the state is having to collect 18% more gross revenue than is available on net.

By the fall of the fiscal year, updated forecasts have removed most of the uncertainty regarding the final value of gross and net revenues. By October, 99% of the variation in gross revenue and 96% of the variation net revenue has been predicted by the REC.

Forecasts of the income tax and sales tax are nearly as accurate as the forecasts of gross revenues with 95% of the variation in revenues explained by the first forecast. We cannot reject that the forecasts are rational. The corporate tax receipts are the most difficult to predict. Only 78% of the variation is captured by the initial REC forecast and only 94% of the variation is explained by the December forecast halfway through the fiscal year. The corporate tax is more difficult to forecast because payment is more susceptible to legal tax avoidance or refund policies. Nevertheless, the corporate tax forecast also passes the weak-form test of rationality and unbiasedness.

Table 3 investigates several hypotheses based on past work on state revenue forecasts, using equation (2) as a guide. The first columns replicate a finding in table 1. The constant term will measure the simple average of the various forecast error series and the t-statistics will test whether the mean is significantly different from zero. In 13 of 15 cases, we cannot reject that the

errors have a zero mean, a requirement for rational forecasts. However, for the fall and December forecasts of corporate tax revenue, we reject the unbiasedness of the forecast. The REC significantly under-predicts the corporate tax revenue by around 5%, erring on the side of overly conservative projected corporate tax revenue.

Next, we test whether the mean error term changes in magnitude over time. The REC stopped using outside advisers on its forecasts. If these outside advisers were important, we might expect that the errors would increase in magnitude over time. That did not happen. In the column 2 estimates of table 3, the coefficient on the time trend is never significant. There is no systematic evidence of changing bias in the direction of forecast errors over time.

The third column examines whether there is evidence of differential bias in the forecast errors during election years. Past research has found evidence of overly optimistic revenue forecasts in election years. But that does not happen in Iowa. The coefficient on a dummy variable indicating the fiscal year is an election year is not statistically significant in 14 of 15 cases. In the one case where the fall sales tax forecast appears to vary in election years, the coefficient suggests that the REC under-forecasts revenues which means they are understating the strength of the economy. It does not appear that revenue forecasts are influenced by politics.

The results of the strong-form test of the rational forecast hypothesis are presented in table 4. For our vector of information Z_{t-1} available at the time of the first December forecast, we include the available information on Iowa real per capita income, the growth rate of Iowa's real gross state product, the rate of inflation and the Iowa population growth rate. Tax revenues should increase with population and production. The nominal value of the tax revenue should rise with inflation. And with progressive tax rates, higher average incomes should increase tax revenues as well. A good statistical model of tax revenue should already take this information into account, and so the forecast errors should be uncorrelated with Z_{t-1}. We report the F-tests of the joint hypothesis that these 4 variables have no effect on forecast errors. In all cases, we fail to reject the strong form of rationality in the REC revenue forecasts.

There is one clear violation of rationality in the Iowa revenue forecasts—the apparent persistence of positive or negative errors over successive fiscal. Returning to Figure 1, we can see that positive or negative errors come in succession rather than a pattern of random occurrence. For example, the revenue forecast errors were positive for 6 successive years between 2004-2009, something that should occur only 1.6% of the time. That was followed by 4 straight years of over-predicted revenues which should only happen 6.3% of the time. With relatively few years of data, we cannot do a detailed examination of these patterns of recurring positive or negative forecast errors to see if they are related to the makeup of the REC, but the finding suggests that while the REC forecasts are unbiased on average, they seem to have unexpected persistence within sample.

V. Refunds

Refunds have become an increasingly problematic issue for revenue forecasting and presumably for state economic policy as well. As Figure 2 shows, refunds are now 18% of gross revenue compared to 12% in the 2000s and 9% in the 1990s. It is not efficient for a state to collect taxes

for the purpose of returning them. Transaction costs alone would make that 18% refund inefficient. However, it seems that the rising error variance associated with forecasting net versus gross revenue is also a cost to rational government budgeting as the higher error variance will cause more frequent budget reversions and disruptions of planned government service. That begs the question of why there are more refunds now than 10 or 20 years ago.

One factor is the Iowa policy that allows Iowa tax payers to deduct their federal taxes from their Iowa tax returns. This complicates forecasting because Iowa does not control changes in federal tax liabilities. Uncertainty about changes in federal tax laws translates immediately to uncertainty regarding Iowa income tax revenues that make up 50% of the total.

A second factor is the increasing use of tax credits from a wide variety of Iowa tax incentive programs. The problem is that tax credits may not be exercised for up to 10 years from issuance. The forecaster has no way of predicting the year in which issued tax credits will be claimed. As the dollar amount of outstanding tax credits has increased, uncertainty about the value of net tax revenues has increased.

A third factor is that the State of Iowa tax withholding tables are not indexed to inflation. Over time, employers withhold more dollars because the tables are not adjusted to changes in income thresholds that define marginal tax rates. As income tax withheld rises, the amount of the refunds also increased.

The importance of refunds is illustrated in Figures 3-4. The amount of corporate tax refunds has more than tripled from $53 million to $165 million since 1994. The amount of income tax refunds has increased 2.5 times over that period, but income tax refunds are a much larger share of the total, amounting to $861 million by the end of the period. As shown in Figure 4, income tax refunds represent 80% of all refunds while corporate refunds are only 15% of the total. Therefore, it is the income tax refunds that are the most important drivers of the rising uncertainty about net revenue forecasts.

Most of the income tax refunds are not due to special tax credit programs but are the result of refunds paid to individual taxpayers who overpay. However, the large number of state tax deduction or tax refund programs do contribute to the rising dollar amount of refunds and they contribute to the inefficiency of the state tax collection process.

Conclusions

Over the 23 years for which we have comparable data on the Iowa Revenue Estimating Conference forecasts of tax revenue, we fail to find important deviations from rationality. As required of proper statistical forecasts, the error terms have a zero mean and the expected value of the forecasts is insignificantly different from the realized values. Only the corporate tax revenue forecasts show violations from rationality, but corporate taxes are only 6% of all revenue. The more important estimates of total gross tax revenue and net tax revenues are unbiased. Unlike other jurisdictions, it does not appear that the forecast errors are different in election years than other years.

The initial forecasts explain 96% of the variation in gross revenues and 90% of the variation in net revenues. Subsequent forecasts quickly converge to the final values. The greater error variance n estimating net revenues has become an increasing problem as refunds have increased as a share of gross revenues. Refunds are now 18% of gross revenues. The rising share of refunds means that the state has to collect more taxes in order to generate the same net revenue, a mark of rising inefficiency of the state tax policies. Moreover, the rising uncertainty of the refund amounts makes it more difficult to accurately forecast available revenues, complicating state budget planning and increasing the probability of midyear reversions and cuts in planned government services.

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Table 1: Sample Statistics of Revenue Forecast Errors, FY1995 - 2017

		Forecast Errors		
	Average Value[a]	December$_{t-1}$	Aug - Oct$_t$	December$_t$
Gross Revenues$_t$	5754.3	0.82%	0.55%	0.52%
	(1721)	(0.046)	(0.024)	(0.020)
Net Revenues$_t$	5066.2	0.23%	0.60%	0.56%
	(1129)	(0.060)	(0.035)	(0.030)
Income Tax$_t$	2870	0.81%	0.47%	0.37%
	(873)	(0.055)	(0.034)	(0.030)
Sales Tax$_t$	1820.8	1.64%	0.60%	0.50%
	(626)	(0.076)	(0.045)	(0.048)
Corporate Tax$_t$	364.4	6.52%	5.22%	5.86%
	(122)	(0.185)	(0.098)	(0.101)

[a]Average revenue level in millions

Standard errors are reported in parentheses under the means

Table 2: Tests of the Means, Trends and Election Bias in State of Iowa Revenue Forecast Errors, 1995-2017

$$R_t = \alpha_0 + \alpha_1 R_{t-1}^P + \varepsilon_{t-1}$$

	Gross Revenues$_t$			Net Revenues$_t$		
	December$_{t-1}$	Aug - Oct$_t$	December$_t$	December$_{t-1}$	Aug - Oct$_t$	December$_t$
α_0	331.9	201	93	468.9	282.4	169.3
	(1.14)	(1.4)	(.76)	(1.24)	(1.33)	(.90)
α_1	0.952**	0.971**	0.989**	0.912**	0.951**	0.973**
	(20.7)	(42.3)	(50.2)	(13.2)	(23.9)	(27.7)
R^2	0.96	0.99	0.99	0.9	0.96	0.97
N	22	22	23	22	22	23
Test: α_1=1	1.06[a]	1.58	0.29	1.6	1.54	0.61
Rational?	**Accept**	**Accept**	**Accept**	**Accept**	**Accept**	**Accept**

	Income Tax$_t$			Sales Tax$_t$			Corporate Tax$_t$		
	December$_{t-1}$	Aug - Oct$_t$	December$_t$	December$_{t-1}$	Aug - Oct$_t$	December$_t$	December$_{t-1}$	Aug - Oct$_t$	December$_t$
α_0	126.1	1.23	59.1	121.7	55.8	52.8	74.4*	39.6*	40.1**
	(0.83)	(1.41)	(0.76)	(1.21)	(0.99)	(1.01)	(1.90)	(1.75)	(2.02)
α_1	0.965**	0.962**	0.983**	.95**	0.974**	0.977**	0.843**	0.935**	0.936**
	(20.0)	(34.2)	(39.2)	(19.1)	(34.6)	(37.4)	(8.39)	(15.9)	(18.6)
R^2	0.95	0.98	0.99	0.95	0.98	0.99	0.78	0.92	0.94
N	22	22	23	22	23	23	22	22	22
Test: α_1=1	0.53	1.87	0.045	1.02	0.87	0.81	2.43	1.23	1.53
Rational?	**Accept**	**Accept**	**Accept**	**Accept**	**Accept**	**Accept**	**Accept**	**Accept**	**Accept**

[a] Numbers represent the probability that the null hypothesis that the coefficient equals 1 is true. Values below 0.05 would be viewed as strongly rejecting the null, while values between 0.05 and .1 would weakly reject the null.

Notes.: t-statistics reported in parentheses. * implies the hypothesis is rejected at 90% confidence level. ** implies the hypothesis is rejected at 95% confidence level.

Table 3: Tests of the Means, Trends and Election Bias in State of Iowa Revenue Forecast Errors, 1996-2016

$$E_{t-1}^{P} = \beta_0 + Z'_{t-1}\beta_Z + \epsilon_{t-1}$$

	Gross Revenues$_t$									Net Revenues$_t$								
	December$_{t-1}$			Aug - Oct$_t$			December$_t$			December$_{t-1}$			Aug - Oct$_t$			December$_t$		
	1	2	3	1	2	3	1	2	3	0.001	0.42	0.008	1	2	3	1	2	3
β_0	0.007	0.625	0.017	0.005	-1.05	19.4	0.005	0.112	0.002	(0.05)	(.10)	(.45)	0.005	0.855	0.001	0.005	-0.037	0
	(0.72)	(.20)	(1.24)	(1.06)	(.69)	(.33)	(1.21)	(.09)	(.40)		-0.0002		(.73)	(.38)	(.06)	(0.79)	(.02)	(.01)
Trend		-0.0003			-0.001			0			(.10)			0			0	
		(.19)			(.69)			(.08)				-0.015		(.37)			(.02)	
Election			-0.015			0.005			0.006			(.59)			0.01			0.011
			(1.03)			(.53)			(.67)	0	0	0.02			(.66)			(.81)
R^2	0	0	0.05	0	0	0.01	0	0	0.02	22	22	22	0	0.01	0.02	0	0	0.03
N	22	22	22	22	22	22	23	23	23	22	22	22	22	22	22	23	23	23
Bias?	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**

	Income Tax$_t$									Sales Tax$_t$								
	December$_{t-1}$			Aug - Oct$_t$			December$_t$			December$_{t-1}$			Aug - Oct$_t$			December$_t$		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
β_0	0.007	-0.152	0.013	0.004	1.41	0.001	0.003	0.333	0	0.014	-0.087	0.024	0.004	0.41	-0.011	0.005	0.123	-0.007
	(.55)	(.04)	(.78)	(.58)	(0.64)	(.09)	(.52)	(0.17)	(.03)	(.90)	(.02)	(1.08)	(.42)	(.14)	(.89)	(.57)	(.05)	(.58)
Trend		0			-0.001			0			0			-0.0002			0	
		(.04)			(0.64)			(0.17)			(.02)			(.14)			(.04)	
Election			-0.014			0.007			0.006			-0.02			0.031*			0.025
			(.56)			(.47)			(.50)			(.64)			(1.75)			(1.45)
R^2	0	0	0.02	0	0.02	0.01	0	0	0.01	0	0	0.02	0	0	0.07	0	0	0.09
N	22	22	22	23	22	22	23	23	23	22	22	22	23	23	23	23	23	23
Bias?	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**Weak**	**No**	**No**	**No**

Notes.: t-statistics reported in parentheses. * implies the hypothesis is rejected at 90% confidence level. ** implies the hypothesis is rejected at 95% confidence level.

Table 3: Tests of the Means, Trends and Election Bias in State of Iowa Revenue Forecast Errors, 1995-2016 (Continued)

$$E_{t-1}^{P} = \beta_0 + Z'_{t-1}\beta_Z + \epsilon_{t-1}$$

	Corporate Tax_t								
	$December_{t-1}$			$Aug - Oct_t$			$December_t$		
	1	2	3	1	2	3	1	2	3
β_0	0.049	0.565	0.093*	0.047**	1.74	0.054**	0.053**	1.59	0.043
	(1.30)	(.05)	(1.76)	(2.40)	(.29)	(1.97)	(2.67)	(.26)	(1.55)
Trend		-0.0003			-0.001			-0.001	
		(.04)			(.28)			(.25)	
Election			-0.088			-0.016			0.02
			(1.18)			(.39)			(.51)
R^2	0	0	0.07	0	0.01	0.01	0	0	0.01
N	21	21	21	23	23	23	23	23	23
Bias?	**No**	**No**	**Weak**	**Yes**	**No**	**Yes**	**Yes**	**No**	**No**

Notes.: t-statistics reported in parentheses. * implies the hypothesis is rejected at 90% confidence level. ** implies the hypothesis is rejected at 95% confidence level.

Table 4: Strong-Form Test of the Rationality of State of Iowa Revenue Forecasts 1995-2017[a]

$$E_{t-1}^{P} = \beta_0 + Z'_{t-1}\beta_Z + \epsilon_{t-1}$$

	Gross Revenues$_t$			Net Revenues$_t$					
	December$_{t-1}$	Aug - Oct$_t$	December$_t$	December$_{t-1}$	Aug - Oct$_t$	December$_t$			
Test that β_Z =0	0.33	0.6	0.38	0.13	0.2	0.15			
	(.86)	(.67)	(.82)	(.97)	(.93)	(.96)			
N	22	23	23	22	23	23			
Rational?	**Accept**	**Accept**	**Accept**	**Accept**	**Accept**	**Accept**			
	Income Tax$_t$			Sales Tax$_t$			Corporate Tax$_t$		
	December$_{t-1}$	Aug - Oct$_t$	December$_t$	December$_{t-1}$	Aug - Oct$_t$	December$_t$	December$_{t-1}$	Aug - Oct$_t$	December$_t$
Test that β_Z =0	0.26	0.32	0.12	0.88	1.58	1.71	0.13	1.23	0.35
	(.90)	(.86)	(.97)	(.50)	(.22)	(.19)	(.97)	(.33)	(.84)
N	22	23	23	22	23	23	22	23	23
Rational?	**Accept**	**Accept**	**Accept**	**Accept**	**Accept**	**Accept**	**Accept**	**Accept**	**Accept**

[a] The Z vector includes information available at the time of the first December forecast including the most recent available information on real per capita income in Iowa, the growth rate of real gross state product, the rate of inflation and the Iowa population growth rate

[b] Numbers represent the F test of the joint hypothesis that all 4 variables included in the information vector have no impact on the magnitude of the forecast error. Strong rationality would require that we cannot reject the null hypothesis that the information vector has no effect on the size of the error terms. The value in parentheses is the probability that the null hypothesis is true.

Figure 1: Percent deviation from the initial revenue forecast to the actual outcome for Iowa State government forecasts of gross and net revenue, FY1996 – FY2017

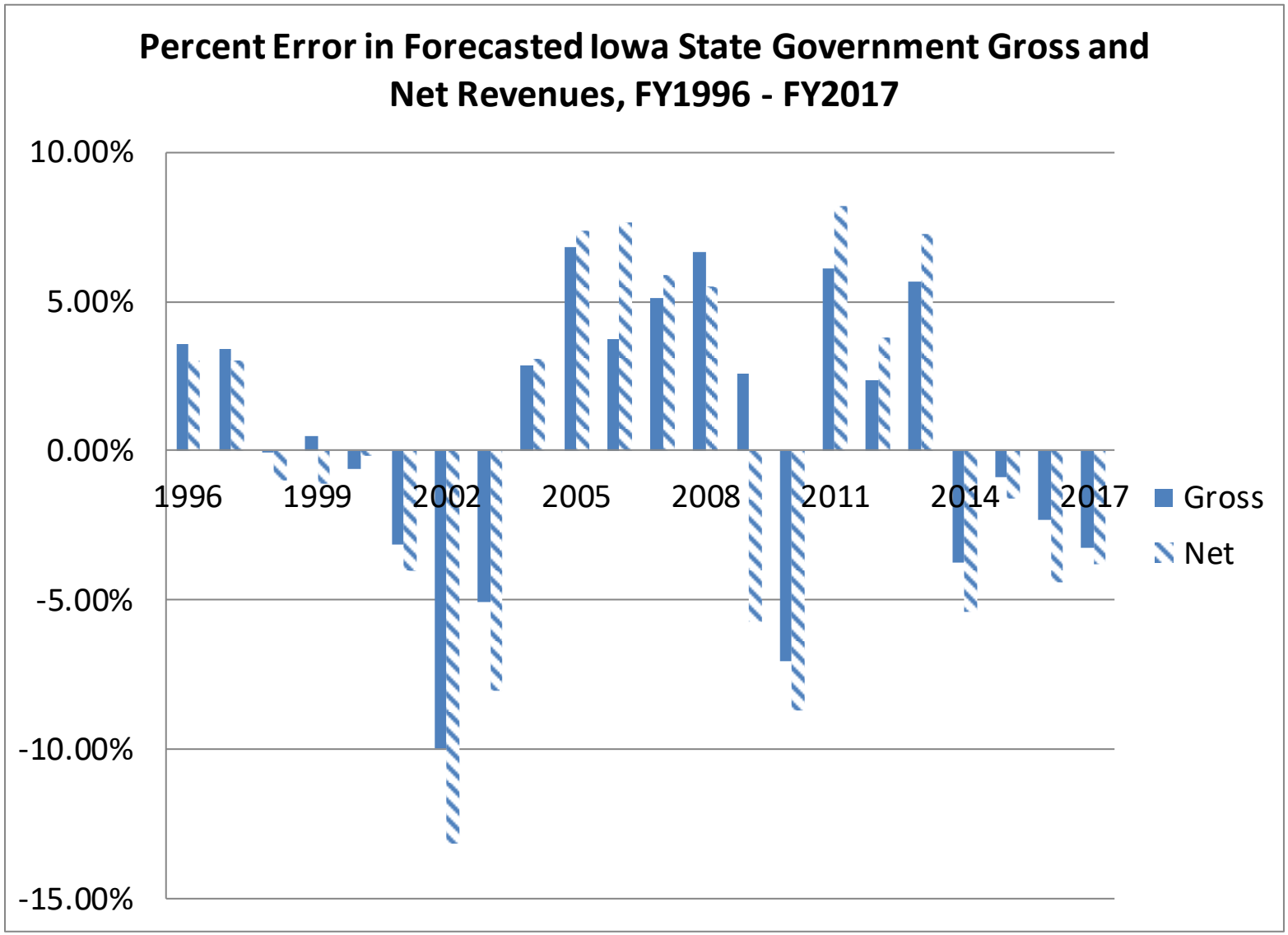

Figure 2: Trends for Iowa State Tax Receipts and Refunds, 1992 – 2016.

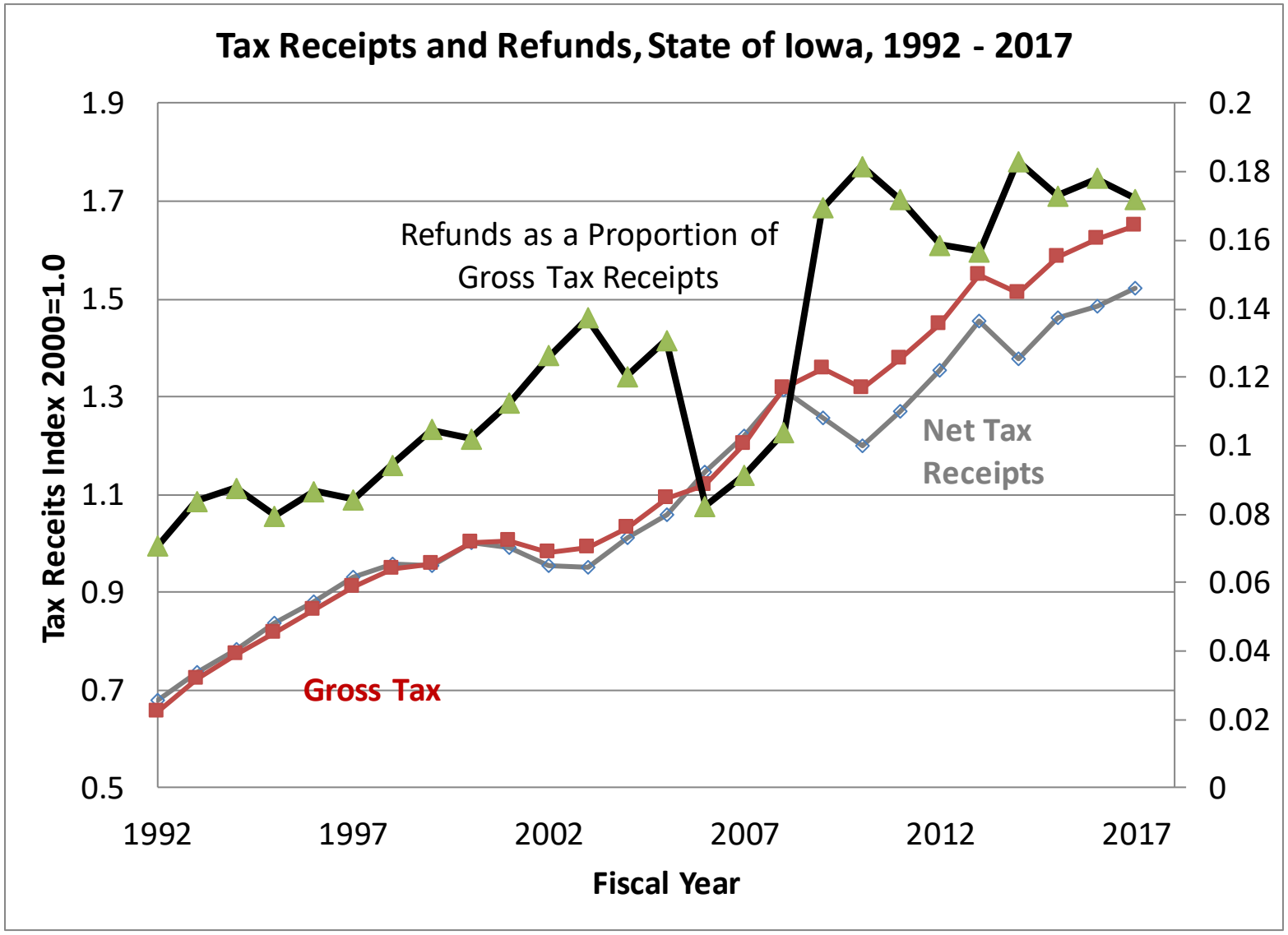

Figure 3: Dollar Amounts of Tax Refunds by Tax Type, Iowa State Government, FY1994 – FY2017

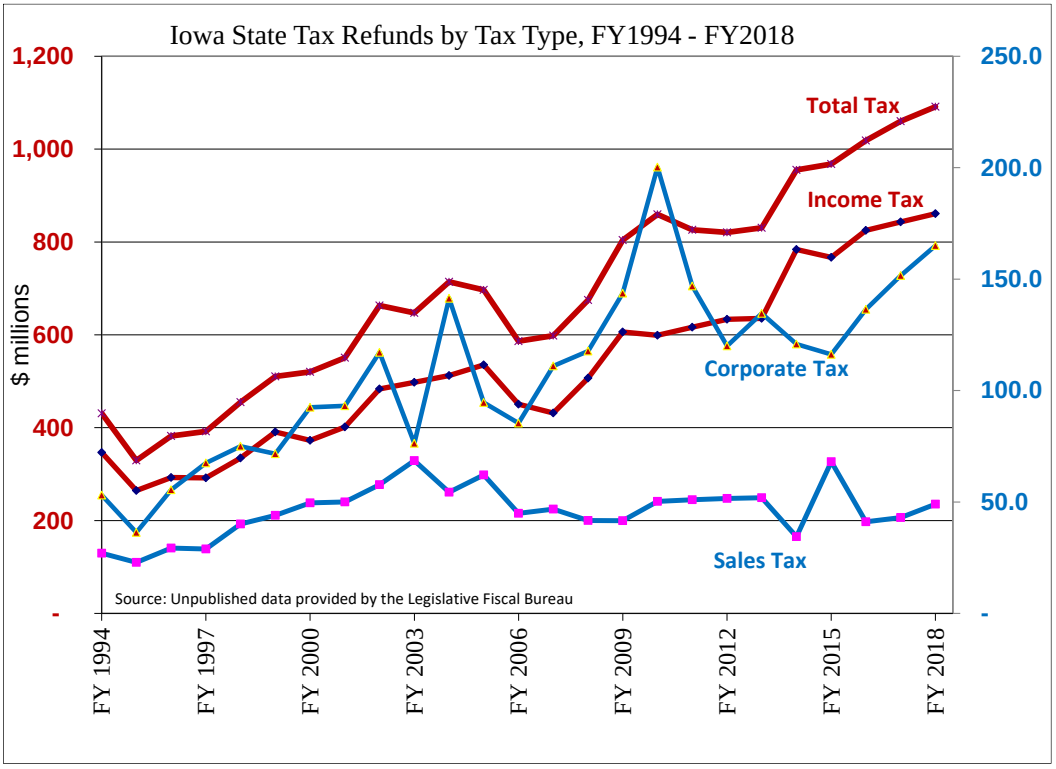

Figure 4: Share of Refunds by Tax Type, Iowa State Government, FY1994 – FY2018