The usefulness of accounting earnings for state tax revenue forecasts

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Abstract: State tax revenue forecasts play a foundational role in states' fiscal planning, especially because states generally must balance their budgets and cannot freely borrow to fund deficits. We present three main findings about state tax revenue forecasts and aggregate public-company earnings. First, aggregate public-company earnings growth explains nearly as much variation in future state tax revenue growth as the state's own forecast and predicts state tax revenue growth incremental to the forecast. Second, earnings growth improves state tax revenue forecasts more than stock returns and analysts' forecasts of earnings growth. Third, earnings growth improves the forecasts of all major state tax types—personal income, sales, and corporate income. Further, our study develops a state-specific, industry-weighted measure of earnings growth. This measure and these findings should be useful to those who prepare, monitor, or study state tax revenue forecasts, budgets, and other state fiscal matters.

Keywords: revenue forecasts, state taxes and financial reporting, corporate tax, sales tax, revenue estimation.

JEL: H24, H25, H71, M41

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1. Introduction

This study examines whether and how publicly available firm-level financial information can improve macro-level tax forecasts. Specifically, we focus on the association between aggregate public-company earnings growth and future state tax revenue growth and pose several related questions. First, does earnings growth help predict future state tax revenue growth, and do current state tax revenue forecasts already impound this information? Second, how does the usefulness of earnings growth compare to that of stock returns and analysts' forecasts of earnings growth? Third, what types of taxes does earnings growth help forecast?

Forecasting tax revenues accurately is critical for U.S. states because most states require balanced budgets, which forces states to cut spending, raise taxes, or take other costly actions to avoid budget deficits.[1] Further, states cannot set their own monetary policy (e.g., manage central banking or print money) or freely issue debt to fund operating deficits.[2] Therefore, under-estimation prevents states from committing to needed projects, whereas over-estimation causes shortfalls and costly disruptions.[3] Exacerbating this issue, states' forecasting errors have increased since 2001 due to increased revenue volatility, especially for corporate and personal income taxes (Randall and Rueben 2017; Huh 2019). In an increasingly volatile forecasting environment, verifiable and timely public-company earnings data could provide meaningful information about future economic activity that forecasters may be missing.

We predict that state tax revenue forecasts do not fully impound information about future

[1] For example, see General Accountability Office 1993; Poterba 1994, 1995, 1996; Hou and Smith 2010; National Conference of State Legislatures 2010; Costello, Petacchi, and Weber 2017.
[2] States generally use bonds to fund long-term projects, and many states have limits on debt issuances. https://www.taxpolicycenter.org/briefing-book/what-are-municipal-bonds-and-how-are-they-used. https://www.taxpolicycenter.org/sites/default/files/publication/149161/debt-limits_1.pdf.
[3] We argue that forecasters have incentives to be accurate (i.e., there are costs to large forecast errors in either direction). However, we note and later discuss that in practice, there may be a modest conservative bias in state tax revenue forecasts. This bias would naturally result from the costs of overestimating future revenue being greater than the costs of underestimating future revenue.

economic activity that is publicly available in firm-level earnings. Tax revenue forecasts rely primarily on historical tax collections and economic forecasts. We expect that earnings growth, which is a leading indicator of GDP growth (Konchitchki and Patatoukas 2014), aggregate employment outcomes (Hann, Li, and Ogneva 2020), and aggregate investment (Kothari, Lewellen, and Warner 2014), contains incremental information for state tax bases. Further, disclosure processing costs may prevent state tax revenue forecasters from becoming aware of, acquiring, and integrating earnings information in their forecasts (Blankespoor, deHaan, and Marinovic 2020).

We test the prediction that aggregate earnings growth can improve state tax revenue forecasts using data from 1999 to 2018. We measure earnings growth by aggregating and value weighting firm-level pretax income from Compustat. Our annual measurement window is the four quarters ending on or before December 31 of each year, which represents the timeliest information available to forecasters when finalizing their forecast. We aggregate pretax income growth in three ways: (1) national earnings growth, (2) the earnings growth of firms with headquarters in a state, and (3) a state-specific, industry-weighted earnings growth rate based on an industry's contribution to state GDP.

We first regress future state tax revenue growth on each aggregate earnings growth measure to validate that earnings growth predicts tax revenues. Each measure predicts future tax revenue growth, but the industry-weighted measure has the highest partial correlation and explanatory power of the three measures.

Next, we test our hypothesis that earnings growth helps predict tax revenue growth *incremental to the state's forecast*, which is based on forecasters' expectations of GDP, unemployment, and other macroeconomic indicators. We find the predicted positive and

significant association between earnings growth and future tax revenue growth after controlling for forecasted tax revenue growth—even after including state fixed effects to control for state-specific time invariant factors such as a conservative forecast bias (Boyd and Dadayan 2014). The explanatory power of the model increases when we supplement the state's own forecast with each of our measures of earnings growth. Industry-weighted earnings growth explains more growth than the other two earnings measures and explains nearly as much variation in future state tax revenue growth as the state's own forecast.

We find similar evidence if we regress future state tax revenue forecast *errors* directly on earnings growth, as an alternative specification. Across both specifications, our industry-weighted measure adds more predictive power than the national or headquarter state earnings growth measures. Together, this evidence suggests that public-company earnings contain information not already captured in states' forecasting models (e.g., GDP forecasts, historical tax returns, estimated payments, etc.).

Next, we hypothesize that aggregate stock returns and analysts' forecasts of earnings growth improve state tax revenue growth forecasts, but not as much as earnings growth does. Although recent literature has focused heavily on aggregate earnings as a leading indicator of economic activity (Ball and Sadka 2015), aggregate stock returns and aggregate analysts' forecasts contain information about future firm performance (Ball, Sadka, and Sadka 2009; Howe, Unlu, and Yan 2009). However, stock returns reflect investors' perceptions of all future risk and cash flows, not just perceptions of next period's economic activity. Further, analysts forecast "core" earnings, which exclude special or non-recurring items that could affect state tax bases. Additionally, because there is a delay between earnings growth and subsequent changes in investment or consumption, analysts' forecasts of next year's earnings may not affect tax bases

until even further in the future.

We find that aggregate industry-weighted earnings growth, industry-weighted returns, and industry-weighted analysts' forecasts of earnings growth all improve tax revenue forecasts; however, earnings growth outperforms the two other measures. Further, in models that include the state's forecast and all three measures, the partial correlation with and explanatory power of earnings growth is the highest. These results provide evidence that earnings growth is the single aggregate firm performance measure that can provide the most improvement to forecasts made by resource-constrained state tax forecasters.

Next, we disaggregate total tax revenue forecasts and consider the relevance of earnings growth to personal income tax, sales tax, and corporate income tax. We find that earnings growth adds explanatory power to forecasted growth of all three tax revenue streams, suggesting public-company earnings growth serves as a broad signal of overall economic activity. The improvement is greatest for personal income and corporate income. Mediation analyses reveal the omitted earnings growth information is correlated with future growth in state GDP, employment, compensation, and personal consumption expenditures.

Finally, we perform several supplementary analyses. First, we compare state tax revenue forecasts to state economic forecasts made by third parties. We find that state tax revenue forecasts perform slightly better than the State Leading Index produced by the Federal Reserve Bank of Philadelphia, suggesting that state tax revenue forecasts are reasonably reliable and accurate. We also find earnings growth improves predictions of state tax revenue growth beyond the State Leading Index.

Second, we confirm our inferences using two different out-of-sample tests. Inferences from our primary analysis are robust to using randomly assigned training and test samples. If we

use observations before 2015 as our training sample (i.e., generally before the literature began exploring the predictive power of aggregate earnings for macroeconomic forecasting), our inference that aggregate earnings growth improves state tax revenue forecast holds, although the magnitude of the improvement decreases. This test helps alleviate concerns that state tax revenue forecasters and their suppliers of other macroeconomic forecasts have already made changes to their models to capture aggregate earnings growth.

Third, we consider sectoral shift theory and examine whether earnings dispersion further increases the explanatory power of our models. We find only modest improvements when we add earnings dispersion to our models.

This paper contributes to both practice and the academic literature. Because this study documents a publicly available information source that is not being included in forecasts, it should be of interest to those who prepare, review, approve, or monitor tax revenue forecasts and state governments' fiscal affairs. To the extent that earnings growth is an apolitical, public, and easily accessible predictor of future state tax revenues, it could be used as a benchmark to detect bias and other systematic manipulations of the forecast. Additionally, it could be useful to macroeconomic forecasters that prepare state forecasts.

We also extend the academic literature on how information in micro-level financial reports can improve macro-level forecasts. Our study is unique in several ways. We show that earnings growth is informative to a different forecast (i.e., state tax revenues) that is made over a different time horizon (i.e., annually), and whose forecasters have different incentives, information sets, and information processing costs than other forecasts examined in prior literature. Further, we newly demonstrate the informativeness of earnings to sub-national macro-

forecasts—specifically to multiple types of tax revenue.[4] Our new industry-weighted earnings growth measure should be useful to others interested in allocating financial statement information to make predictions at regional, state, or other sub-national levels.[5]

2. Institutional details and hypothesis development

2.1 Institutional details regarding state revenue forecasting

According to the National Association of State Budget Officers (NASBO), before the beginning of each budget cycle, states develop revenue estimates, which we refer to as forecasts. Forecasts project the amount of revenue that will be available based on current (or enacted) law to support operating costs and capital outlays in current and future years (NASBO's *Budget Processes in the States* 2015). Most states have annual budget periods, but 20 states have a biennial period because their legislatures only meet every other year. To make revenue forecasts, each state employs a budget agency, a board or commission, a revenue office, or a combination of various agencies and boards. This group typically estimates separate revenue prediction models for different tax types, industries, and/or geographic regions within their state. Estimates from these separate models are aggregated to generate a total budget forecast.

Figure 1 depicts the typical annual budget timeline for a state with a June 30 year-end. Only four states have a different fiscal year-end: Alabama (September 30), Michigan (September 30), New York (March 31), and Texas (August 31). The budget cycle usually begins in July or August with the state budget office sending instructions to state agencies. These agencies submit funding requests in the fall. The state budget office then reviews the requests and develops

[4] Khan and Ozel (2016) show that information in banks' loan portfolios (i.e., estimated credit losses, the risk premium on loans, and loan growth) aggregated at the state level is associated with current and future changes in statewide economic conditions.

[5] For example, as Cheng (2020) demonstrates, our findings can assist state bondholders in projecting states' fiscal health and revenue-generating capacity.

revenue projections. The governor finalizes the budget, usually in the late fall or early winter as determined by statute or the state constitution, and then submits the budget to the legislature. The legislature holds agency hearings before adopting the budget in late spring or early summer.

Importantly, states can revise the revenue estimates any time during the budgeting process to provide more up-to-date information and greater forecast accuracy. Thus, states could revise their spring forecasts to incorporate any earnings information from quarters ended on or before December 31, because most public companies are required to submit quarterly reports within 45 days after the quarter-end and annual reports within 90 days after the fiscal year-end.[6]

Although the forecasting process varies greatly by state, most states incorporate forecasts of the national and state economies into models that consider historical tax collections and tax policy changes (Boyd et al. 2011). A 2019 Volcker Alliance Project Paper conducted a survey of the budget and fiscal practices of all 50 states for fiscal years 2015, 2016, and 2017 (Bourdeaux, Franklin, and Hathaway 2019). Although states use general macroeconomic trends (e.g., GDP growth, housing starts, unemployment rates, inflation, etc.) in their revenue forecast calculations, the survey reported that few states disclose specific details of *how* they use such trends.[7]

Another potential source of information available to forecasters is estimated tax payments. Corporate income tax and personal income tax systems require annual income tax returns. In both cases, the annual return is typically due in the third or fourth month after year-end, although many taxpayers extend their due dates to the ninth or tenth month. Thus, states

[6] We acknowledge some firms have shorter filing requirements and must file annual reports within 75 days of the end of their reporting period. See topic 1, section 1330 (Exchange Act Report Due Dates): https://www.sec.gov/corpfin/cf-manual/topic-1#:~:text=The%20balance%20sheet%20date%20in,recent%20fiscal%20year%2Dend%20for

[7] Virginia is one exception that discloses their forecasting methodology. The November 2018 version of this document is available at: https://www.finance.virginia.gov/media/governorvirginiagov/secretary-of-finance/pdf/master-revenue-reports/GACRE-Nov-2018-notebook.pdf. Appendix B describes Virginia's forecasting methods and another state's methods, which are based on private conversations with the authors.

might not receive precise income tax information until nearly a year after the taxpayer's year ends. However, states could receive timelier data from quarterly estimated payment filings or employer payroll tax remittances.

Sales taxes follow a different compliance cycle. Large corporations generally file and remit sales taxes monthly or quarterly, while small taxpayers file and remit quarterly or annually. Thus, states could have timelier data for sales tax forecasts. On the other hand, retail spending is not only related to current personal income, but also to consumer sentiment (Garrett, Hernandez-Murillo and Owyang 2005). Because growth in public-company earnings should affect consumer sentiment, earnings growth should help forecast consumer spending and sales tax revenue.

Figure 2 illustrates the timing and availability of these potential forecasting inputs. Specifically, it uses a calendar-year taxpayer as an example and plots the time period summarized by each information source, as well as each source's reporting lag.

2.2 Hypothesis development

Prior literature on aggregate earnings documents their ability to help predict a broad range of macroeconomic outcomes—many of which are correlated with tax bases. In general, firms do not simply retain earnings as cash. Rather, firms use retained earnings to pay employees, invest in capital, pay down debt, return value to shareholders, or otherwise spend excess profits (Konchitchki and Patatoukas 2014; Kothari, Lewellen, and Warner 2014; Ball and Sadka 2015; Hann, Li, and Ogneva 2020). Because firms partially base current investment and spending decisions on the funds they generated in prior periods, there is an association between earnings in one period and spending, investing, or otherwise using earnings in the next. To the extent firms' investment and spending decisions are taxable activities, then earnings growth in one period should help predict tax revenue growth in the next.

State tax revenues come primarily from three sources: personal income tax, sales tax, and corporate income tax. In 2019, personal income tax, sales tax, and corporate income tax made up 44.9%, 30.1%, and 6.5% of states' total general fund revenue (NASBO 2019).[8] We outline several mechanisms or channels by which earnings could inform forecasts of each tax.

Personal income tax. Earnings growth could affect personal income tax revenue via two major channels—employment and profit sharing. First, firms may use a portion of their earnings growth to hire more workers. Hann, Li, and Ogneva (2020) find that aggregate earnings news contains information about future labor market conditions that is not captured in other near-term macroeconomic measures. If aggregate earnings help predict future employment and employment correlates with the personal income tax base, aggregate earnings growth should help predict personal income tax revenue growth. Second, firms could share earnings growth with existing employees. Employees share in profits via increased wages, salaries, and bonuses. Blanchflower, Oswald, and Sanfey (1996) document that changes in firm-level profitability affect workers' future compensation. Finally, business profits that are not reinvested are returned to owners and included in the personal income tax base. To the extent that firms return earnings to investors via future dividends or investors reinvest dividends in the firm (which could increase share value and result in capital gains when sold), then aggregate earnings growth should be correlated with future personal income tax revenue growth.

Sales tax. Earnings growth could affect future sales tax revenue through several channels. First, to the extent companies pass on earnings growth to either workers or owners, individuals' disposable income will increase. Increases in disposable income should increase spending on

[8] The remainder comes from gaming/lottery (1.0%) and miscellaneous other sources (17.5%) such as tobacco taxes, alcoholic beverages, insurance premiums, severance taxes, franchise taxes, gaming taxes, interest income, licenses and fees for permits, inheritance taxes, and charges for state-provided services.

items that are subject to sales tax. Second, retail spending is partially dependent on consumer sentiment (Garrett, Hernandez-Murillo and Owyang 2005). Because growth in public-company earnings should positively affect consumer sentiment, earnings growth should help forecast consumer spending and sales tax revenue growth. Finally, Shivakumar and Urcan (2017) find that aggregate earnings are correlated with future aggregate investment. If firms invest in capital, machinery, or business equipment that is subject to sales or use taxes, then current aggregate earnings growth should be correlated with future sales tax revenue growth.

Corporate income tax. Aggregate earnings growth could affect future corporate income tax revenue via several channels. First, to the extent that aggregate earnings growth increases future business-to-business investment, then increases in aggregate earnings should also lead corporate profits. Second, Ball and Sadka (2015) argue that aggregate earnings growth provides information about the profitability of new investments, providing firms with better information about which projects to invest in. Earnings growth should thus lower capital costs—including newly issued deductible debt. If aggregate earnings growth lowers interest deductions, then aggregate earnings growth could be associated with future increases in corporate tax revenue.

For earnings growth to improve state tax forecasts, forecasters must not already be using earnings information. Based on a review of the available disclosures of states' forecasting methodologies and private conversations with several state forecasting agencies, current forecasting methodologies incorporate information from only two major sources.[9] First, state tax forecasters extrapolate from historical tax return data. Because taxable income is more cash-based than accrual-based, forecasting state tax revenues with historical tax revenue collections likely suffers from the same issues as forecasting with cash flows (i.e., high variability and/or

[9] In private conversations, the author team asked revenue forecasters from several states if they considered public financial statement data in their models. No state indicated they used this information in forecasts.

low persistence). Second, state tax forecasters purchase commercial nationwide and/or statewide economic forecasts (e.g., of GDP, unemployment, interest rates, financial market performance, foreign trade, consumer confidence levels, inflation, etc.), and incorporate this forward-looking information into their tax revenue prediction models (Boyd et al. 2011). Konchitchki and Patatoukas (2014) demonstrate that financial earnings growth is a leading indicator of GDP growth that appears to be omitted from GDP growth forecasts. To the extent that macroeconomic forecasts used in tax revenue forecasts do not reflect the incremental information about future economic activity contained in financial earnings growth, revenue forecasters likely omit useful and readily available information from their forecasts.

Although financial accounting information should predict state tax revenues, it may be costly for forecasters to process this information. Blankespoor, deHaan, and Marinovic (2020) propose several components of disclosure processing costs—awareness costs, acquisition costs, and integration costs—that could explain why forecasters do not incorporate the information.

First, many state tax forecasters have training in economics and statistics. Based on our research and informal discussions with several state tax revenue departments, forecasters generally do not have a formal accounting background which would introduce them to the beneficial properties of earnings for forecasting, and additional accounting training could be costly. Further, Konchitchki and Patatoukas (2014) note that macro forecasters at the Federal Reserve do not reference accounting information when discussing overall economic activity. Second, it may be costly for forecasters to acquire and aggregate public companies' financial statement information. Finally, it might be costly for forecasters to figure out what specific information from public financial statements to incorporate in their respective forecasts (e.g.,

Colorado corporate income tax, Texas sales tax, or New York personal income tax). [10]

Based on these arguments, we predict that aggregate earnings growth can improve existing state tax revenue forecasts. We state this hypothesis in alternate form as follows:

H1*: Aggregate earnings growth predicts state tax revenue growth incremental to the state's tax revenue growth forecast.*

There are several reasons why earnings growth might not provide information about future state tax revenue growth that is incremental to the information in the state's own revenue growth forecast. First, although our anecdotal evidence and literature review suggests otherwise, it is possible that states already explicitly include earnings growth in their forecasts. Second, prior literature generally focusses on the effect of earnings in quarters immediately after the earnings period. It is not clear that the information in earnings will still be useful given that the period being forecasted begins two quarters after the earnings period and covers a longer window (i.e., one year). Third, forecasters could already include some other signal of future economic activity that is correlated with earnings growth (e.g., estimated tax payments/mid-period payments). If these payments are based on timelier data than financial statement information, and if states incorporate estimated payments into their forecasts, then earnings growth might not contribute to revenue forecasts.

Our first hypothesis focuses on the predictive power of *earnings* growth because the theory and literature suggest that aggregate earnings predict aggregate economic activity. However, other publicly available performance measures might also improve state tax forecasts. Specifically, we consider stock returns and analysts' forecasts of earnings.[11] Stock returns might

[10] Some states also have specialists to help with specific sectors or tax types. For instance, we spoke with one state that had a chemical engineer who worked exclusively on forecasting sales taxes from oil exploration and production.
[11] We do not consider managerial earnings guidance because Hutton, Lee, and Shu (2012) find that analysts are better than managers at predicting how firms will be influenced by macroeconomic factors.

improve state tax forecasts because returns lead earnings (e.g., Beaver, Lambert, and Morse 1980; Beaver, Lambert, and Ryan 1987). Further, returns should reflect the market's expectations of how current period activity will affect future firm performance. Finally, stock returns often flow to personal income in the form of dividends or capital gains.

However, there are several reasons why returns might not improve forecasts as much as earnings do. First, stock returns are influenced by factors that would not necessarily affect the tax base in the forecast period. Specifically, stock returns reflect investors' perceptions of all future risk and cash flows, not just perceptions of next period's economic activity. Second, anecdotal evidence suggests some states may already include stock returns in their forecasts (e.g., see Virginia's forecasting model in Appendix B, Panel A). We therefore predict that earnings growth is more likely to improve forecasts than are stock returns.

H2a: *Aggregate stock returns improve state tax revenue forecasts, but not as much as aggregate earnings growth does.*

Analysts' forecasts of earnings growth might also improve state tax revenue forecasts. Financial analysts invest significant resources in forecasting and are compensated based on accuracy. Analysts' expectations of future firm performance should at least partially reflect their expectations of future aggregate economic activity. State forecasters might not include analysts' forecasts in their models due to disclosure processing costs or concerns about analysts' incentives and/or biased forecasts. For example, state forecasters might be concerned that analysts manipulate their forecasts to curry favor with managers (e.g., Ke and Yu 2006).

However, there are several reasons why analysts' forecasts might not improve state tax forecasts as much as earnings do. First, analysts generally focus on forecasting "core earnings," which excludes special and other nonrecurring items that can affect future economic activity

(Hann, Li, and Ogneva 2020). Second, analysts' forecasts do not perform better than simpler models based on cross-sectional data, persistence in earnings, or residual income at predicting future firm performance (Hou, van Dijk, and Zhang 2012; Li and Mohanram 2014). Third, because there is a delay between earnings growth and investment, analysts' forecasts of next year's earnings may not affect tax bases until even further in the future. Finally, although unlikely, it is possible that state forecasters already use analysts' forecasts in their models. We therefore expect that earnings growth is more relevant to economic activity in the forecast period than analysts' forecasts of future earnings.

> ***H2b****: Aggregate analysts' forecasts of earnings growth improve state tax revenue forecasts, but not as much as aggregate earnings growth does.*

3. Data, variable definitions, and descriptive statistics

3.1 Data sources: state tax forecasts, collections, and state GDP

Table 1, Panel A displays our sample selection of the state forecast and revenue data. NASBO collects data from each state on forecasts, preliminary collections, and actual collections. NASBO archives semi-annual reports from 1979 to spring 2019.[12] These reports include data on total revenues, corporate income tax revenues, personal income tax revenues, and sales tax revenues. We compile state data only for the years 1999 to 2018, due to limitations in other data sources.[13] Each state-year observation reflects revenue forecasted and collected during the state's fiscal year ended in that year. For example, 2001 reflects revenue for the fiscal year July 1, 2000-June 30, 2001.

[12] https://www.nasbo.org/mainsite/reports-data/fiscal-survey-of-states/fiscal-survey-archives

[13] Specifically, for our measure of industry-weighted earnings growth, we rely on the two-digit classifications listed on the NAICS Association's website https://www.naics.com/search-naics-codes-by-industry/. For periods prior to 1997, companies were assigned industry codes based on the Standard Industrial Classification (SIC). For periods after 1997, companies were assigned industry codes based on the NAICS. To ensure we use industry data that is consistent across years, we only rely on earnings data beginning in 1997 (which is used to predict state tax revenue growth for the fiscal year ending in 1999).

Overall, we have 20 years of data for 50 states, or 1,000 observations. We restrict the sample to 964 observations for which Scott Dyreng's 10-K header data shows a public company headquartered in the state that year and for which NASBO has non-missing data.[14]

3.2 Financial statement data – variable definitions

We use quarterly and annual financial statement data from Compustat North America starting in 1996 to measure firm-level earnings growth rates from 1997-2016, then estimate their effect on tax revenue growth for state fiscal years ending 1999-2018. Because state fiscal years are based on when the fiscal year *ends*, states must rely on financial information from two years prior to the fiscal year they are forecasting. For example, financial earnings growth from 2014 to 2015 (for a calendar year firm) would typically be available by April 1, 2016, and state forecasters could reasonably incorporate this data in their spring 2016 forecast revision for the state fiscal year beginning July 1, 2016 and ending June 30, 2017. Figure 2 illustrates this timing.

Key quarterly variables include pretax income (PIQ) and total sales (SALEQ). We multiply common shares outstanding (CSHOQ) by closing share price (PRCCQ) to arrive at the firm's market value of equity. We retrieve NAICS codes (NAICSH) from Compustat's annual database.

We use pretax income (PIQ) as our proxy for earnings. We sum pretax income and sales for the four quarters ending on or before December 31 of each year to represent the timeliest information that forecasters have a reasonable ability to incorporate prior to when they finalize their forecasts. We construct a "pseudo-calendar year" by adding four quarters of income ending

[14] The headquarter data, which have been used in prior studies (e.g., Dyreng, Lindsey, and Thornock 2013), are available at Scott Dyreng's website: https://sites.google.com/site/scottdyreng/Home/data-and-code. We rely on the 10-K header data instead of the zip code in Compustat (ADDZIP) because the Compustat data only reports the current principal executive location instead of the historic headquarter location. Heider and Ljungqvist (2015) find that Compustat's location data includes a significant number of errors because a nontrivial fraction of companies switch headquarter locations from 1989-2011.

on or before December 31. Thus, for a January 31 fiscal year end company, the pseudo-calendar year would be the four quarters ending January 31, April 30, July 31 and October 31.

We compute each firm's earnings growth as follows: (pretax income$_t$ – pretax income$_{t-1}$) / sales$_{t-1}$. We scale by sales to avoid negative denominators (Konchitchki and Patatoukas 2014).

We aggregate earnings growth in three ways. First, *NATIONAL PI GROWTH*$_{t-2}$ measures nationwide pretax income growth during the pseudo-calendar year ending two years prior to the state's fiscal year, *t*. We compute, per firm, growth in earnings (scaled by sales) from pseudo-calendar year *t-3* to *t-2*, and value-weight the growth by market value of equity as of the end of the first quarter in pseudo-calendar year *t-2*.

Second, *HQ WEIGHTED PI GROWTH*$_{st-2}$ measures the pretax income growth for firms headquartered in state *s* during the pseudo-calendar year ending two years prior to the state's fiscal year, *t*.[15] We value-weight the growth rates by market value of equity within each state. We assign each firm to its headquarter state by year using Scott Dyreng's 10-K header data.

The headquarters assignment of earnings growth could inform tax revenue forecasts for two reasons. First, states only have jurisdiction to tax firms that have "nexus" in the state. Because companies headquartered in the state have nexus de facto, the earnings of firms headquartered in the state must affect the tax revenue base. Second, academic literature on investment spillovers suggest that the health of headquarters companies can have spillover effects on other economic actors in the headquarters' area (Dyreng and Hills 2018).[16]

[15] Because our design requires the second lag to predict actual revenue growth, we calculate financial earnings growth for the years 1997 to 2016 to predict actual tax revenue growth for the years 1999 to 2018. The 10-K header data covers 1994 to 2018 and the state GDP data by NAICS code (explained below) runs from 1997 to 2017. To ensure a consistent sample period, we only use headquarter data for the period 1997-2016.

[16] The literature on local bias may also be relevant, which suggests that investors rely on private information available within a local geography for investment decisions (Ivković and Weisbenner 2005). However, literature on the geographic comovement of company stock returns suggests this is due to local information (e.g., local trading patterns) rather than geographic comovement of fundamentals (Pirinsky and Wang 2006).

Third, *INDUSTRY WEIGHTED PI GROWTH*$_{st-2}$ measures the industry-weighted pretax income growth in state *s* during the pseudo-calendar year ending two years prior to the state's fiscal year, *t*. Specifically, we first compute earnings growth aggregated at the industry-level using the two-digit NAICS code for all Compustat firms. We value-weight the growth percentages by market value of equity within each industry. Then, for each state, we multiply the industry growth rates by each industry's proportional contribution to the state's total GDP in the concurrent year.[17] Finally, we sum these industry-weighted pretax income growth measures within the state to arrive at a state-specific industry-weighted pretax income growth measure.

Industry-weighted earnings growth could improve forecast accuracy because many companies not headquartered in a state still locate significant operations in the state. For example, Wal-Mart's headquarters are in Arkansas, but it is the largest employer in 22 states. Boeing remains the largest employer in WA even though it switched headquarters to IL in 2000.[18] A state-specific industry-weighted growth measure may therefore provide a more accurate depiction of a state's economic well-being than the growth of only headquarter companies. As a concrete example, consider the mining industry in Alaska. Because mining comprises 18.82% of Alaska's GDP in 2015, applying an 18.82% weight to earnings growth in the mining industry could strengthen the forecast of tax receipts in Alaska.

We use data from CRSP to calculate stock returns. We compound monthly returns to create annual buy-and-hold-returns that end on the first quarter of calendar year *t* (i.e., the annual return from April 1st to March 31st). We value weight returns based on the market value of equity across the nation, within a state, or within an industry.

[17] To determine the contribution of each industry to a state's economy, we rely on data from the Bureau of Economic Analysis' (BEA) Regional Economic Accounts. For each state, the BEA reports annual GDP and each industry's contribution to the state's GDP by North American Industry Classification System (NAICS) code.
[18] https://www.businessinsider.com/largest-employers-each-us-state-2017-6

We use the IBES Summary Statistics file to obtain analysts' forecasts of pretax income growth. We use the consensus forecast of firm *i*'s pretax income (IBES variable "PRE") made in March of year *t* for the firm's fiscal year ending on or after March 31st of year *t*. We compute the forecasted growth in earnings as: (consensus forecast of pretax $income_{it}$ – actual pretax $income_{it-1}$) / actual $sales_{it}$. We value-weight each firm's growth by market value of equity as above.

Table 1, Panel B describes our sample of quarterly and annual firm-level data from 1996 to 2016. We drop observations with less than four quarters of both pretax income and sales during the pseudo-calendar year or missing market value of equity. We require data in the immediate prior year to compute an annual growth rate. In the spirit of Konchitchki and Patatoukas (2014), we mitigate the effect of outliers by removing observations that fall in the top and bottom percentile of pretax income growth per year.[19]

3.3 Descriptive statistics

Table 2, Panel A describes the state tax revenue growth, forecasted growth, and macroeconomic growth variables. To reduce the effects of outliers, we winsorize actual revenue growth and forecasted revenue growth at the upper- and lower-one percent tails for total revenue and for each tax type.[20] Average growth in total revenues and by tax type are all in single digits over the twenty-year period. Corporate income tax growth is most variable, with decreases in collections for at least 25% of the state-year observations, and a large increase (38%) in the 90th percentile. Personal income and sales tax revenues are less volatile, but still show a decline in at least ten percent of the state-years. The macroeconomic growth variables are more stable.

On average, actual revenue growth significantly exceeds forecasted growth (untabulated

[19] We likewise remove observations that fall in the top and bottom percentile of returns, analysts' forecasts of pretax income growth, and return on assets (used for earnings dispersion) when we compute these aggregate measures.
[20] In robustness tests (described in Section 4.6), we show that our results are robust to other approaches to address concerns related to outliers.

p-value < 0.01) for total revenues, personal income tax, and corporate income tax. This observation is consistent with an overall conservative bias in forecasting suggested in prior studies (Joyce and Rodgers 1996; Boyd and Dadayan 2014). Sales tax actual growth and forecasted growth are not significantly different.

Panel B shows our financial accounting variables. Recall we scale the change in income by sales, so the earnings growth variables are not percentage changes. The difference between the national earnings growth measure and the industry-weighted measure is statistically significant (untabulated p-value < 0.01), and the difference between the national measure and the headquarters-weighted measure is weakly significant (untabulated p-value = 0.06). However, the difference between the industry-weighted measure and headquarters-weighted measure is not significant (untabulated p-value = 0.17).

The headquarters-weighted growth measure has a high standard deviation (0.24) and is negative at the 25th percentile. The variability in the headquarters measure could yield different effects on state revenue forecasts than the other two more similarly distributed measures.[21]

Panel C shows the correlations among our variables. All the tax revenue growth measures are positively correlated with each other and their forecasts. Our earnings growth measures are positively correlated with actual growth in tax revenues, consistent with H1. The national, headquarter state, and industry-weighted earnings growth measures are surprisingly negatively correlated with the states' forecasted total revenue growth measures, suggesting earnings growth could contribute information beyond the state's own forecast.

4. Empirical tests and results

[21] We note that the 10-K header data does not include a valid headquarters location for every firm in Compustat, which limits the power of our headquarters measure. For example, the data reflects three states (AK, MT, and WY) having three or fewer firms headquartered in the state throughout the sample period.

4.1. Validating that earnings growth alone predicts growth in total tax revenues

We first validate that earnings growth predicts tax revenue growth, ignoring forecasted tax revenue growth. We estimate the following OLS regression model:

$$ACTUAL\ TOTAL\ REVENUE\ GROWTH_{st} = \alpha + \beta[NATIONAL,\ HQ,\ or\ INDUSTRY\ WEIGHTED]\ PI\ GROWTH_{st-2} + \varepsilon_{st,} \quad (1)$$

where $ACTUAL\ TOTAL\ REVENUE\ GROWTH_{st}$ equals the year-over-year growth in general fund revenue for state *s* at the end of the state's fiscal year, *t.* We specifically focus on *general fund* revenue because it is the predominant fund for financing the state's operations. The general fund primarily includes revenues from corporate income tax, personal income tax, and sales tax, and excludes funds from the federal government.

$PI\ GROWTH_{st-2}$ measures earnings growth during the pseudo-calendar year ending two years prior to the state's fiscal year end. We use our three different measures of aggregate earnings: national, headquarter-state, and industry-weighted.

Table 3 presents the results of estimating equation (1). Column 1 shows that national earnings growth in year *t-2* predicts total tax revenue growth for the state fiscal year ending in year *t*. The coefficient of 0.4806 is significantly greater than zero. The adjusted R^2 of 8.2% suggests modest explanatory power. Columns 2 and 3 show that headquarters-weighted earnings growth and industry-weighted earnings growth also predict total tax revenue growth. The coefficients are economically meaningful. For example, the coefficient of 0.8400 on the industry-weighted growth measure implies a one-standard-deviation increase in earnings growth (0.0316) at time *t-2* is associated with a 2.65 (=0.84 * 0.0316) percentage point increase in total tax revenue growth at time *t*.

4.2. Does earnings growth predict growth in tax revenues, incremental to states' growth

forecasts?

To test H1, we examine whether earnings growth has *incremental* predictive power relative to a benchmark model with the states' own forecasts. We estimate the following OLS regression model:

$$ACTUAL\ TOTAL\ REVENUE\ GROWTH_{st} = \alpha + \beta_1 FORECASTED\ TOTAL\ REVENUE\ GROWTH_{st} + \beta_2\ [NATIONAL,\ HQ,\ or\ INDUSTRY\ WEIGHTED]\ PI\ GROWTH_{st-2} + \varepsilon_{st,} \quad (2)$$

where $FORECASTED\ TOTAL\ REVENUE\ GROWTH_{st}$ equals forecasted total general fund revenue growth for state *s* for the state's fiscal year, *t*:

$(FORECASTED\ TOTAL\ REVENUE_{st} - TOTAL\ REVENUE_{st-1}) / TOTAL\ REVENUE_{st-1.}$

Although most of our variables are constructed as changes, our forecast growth variable is not—it is benchmarked off prior year actuals rather than prior year forecasts to ensure that the measure is not contaminated by stale forecasts. We include state fixed effects in most specifications to control for state-specific time invariant factors such as a conservative bias in states' forecasts (Boyd and Dadayan 2014).

Because H1 only argues that earnings growth predicts tax revenue growth incremental to the state's own forecast, we do not include any other control variables theoretically correlated with future tax revenues.[22] A positive and significant coefficient estimate of β_2 would be consistent with our prediction that earnings growth helps improve forecasts of state tax revenues.

Table 4, Panel A, begins with a benchmark model (column 1) that associates growth in actual total tax revenue with forecasted total revenue growth. If forecasts were unbiased and

[22] Besides not directly addressing our research question, we do not control for state-specific forecasts of state GDP, unemployment, etc. because we do not have access to each state's unique forecast inputs. In supplemental analyses, however, we do examine how earnings growth supplements state revenue forecasts after controlling for other state-specific economic forecasts that are presumably based on comparable forecast inputs.

accurate, we would expect a coefficient of one and a high R^2. The coefficient of 0.5721, although significantly greater than zero, is significantly less than one (untabulated 95% confidence interval of 0.4278, 0.7164). The modest adjusted R^2 of 12.1% suggests opportunities for improvement, which H1 predicts aggregate earnings growth can provide. It also suggests that our industry-weighted earnings growth measure explains as much variation in future state tax revenue growth as the state's own forecast (the adjusted R^2 in Table 3, column 3 is also 12.1%).

The rest of Table 4, Panel A presents the results of estimating equation (2). Columns 2-4 present estimates using each earnings growth measure, and each estimate is positive and significant. The adjusted R^2 in column 2 is 21.9% and shows that including nationwide earnings growth provides an improvement over the benchmark model. Column 3 shows only modest explanatory power from including headquarters-weighted earnings growth (adjusted R^2 of 16.2%). Column 4 shows that including industry-weighted earnings growth offers the greatest explanatory power (adjusted R^2 of 25.5%). The adjusted R^2 *increase* of 13.4 percentage points for the industry-weighted model is a substantial improvement over the baseline forecast.

The minimal improvement using headquarters-weighted earnings growth suggests that headquarters location has limited ability to capture the influence of public-company earnings growth on state economies. This measure attributes all headquarters earnings growth to that state but excludes all earnings growth of other public corporations that are doing business in the state.

We re-estimate our models including state fixed effects in Table 4, columns 5-8. Our coefficient estimates are about the same, but the adjusted R^2 values increase by about 3 percentage points in each specification, suggesting some of the variation in state tax revenue growth is state-specific and time invariant. Thus, we include state fixed effects in our other tests.

As an alternative test of H1, we replace the dependent variable with forecast errors in tax

revenue growth, rather than estimating future tax revenue growth and controlling for forecasted growth. We measure the forecast error as actual revenue growth for fiscal year *t* minus forecasted revenue growth for fiscal year *t*. We present the results in Panel B of Table 4. These tests show that all three measures of aggregate earnings growth explain state tax revenue forecast errors; again, the industry-weighted measure provides the largest improvement.

4.3. Does earnings growth outperform stock returns and analysts' forecasts in improving states' tax revenue growth forecasts?

To test H2a and H2b, we re-estimate equation (2), but compare the explanatory power of the models that use earnings, returns, and analysts' forecasts. Because our initial analysis of aggregate earnings growth suggests that industry-weighting is the most informative basis of aggregation, we aggregate all performance measures by industry and then weight by each industry's contribution to state GDP. Specifically, we replace *PI GROWTH* with *RETURNS* and *ANLST FCST,* respectively.

Table 5, Panel A presents our tests of H2a. Estimates suggest that earnings growth provides more explanatory power to predict future revenue growth than does returns (column 2 versus 3), ignoring the state's own growth forecast. When we include the states' own forecasts of growth, earnings growth still improves the model more than does stock returns (column 4 versus 5). Column 6 includes the state's forecast, earnings growth, and returns. The adjusted R^2 of 29.9% is only modestly greater than the R^2 of 28.5% for the model in column 4 that only includes the state's forecast and earnings growth. These results are consistent with H2a.

Table 5, Panel B presents our tests of H2b. The number of observations drops to 698, because analysts' pretax income forecasts were not widely available until around 2003. The estimates suggest earnings growth provides more explanatory power than analysts' forecasts

(column 2 versus 3) and improves state tax forecasts more than analysts' forecasts do (column 4 versus 5). Column 6 includes the state's forecast, earnings growth, and analysts' forecasts. Column 7 adds returns. Although analysts' forecasts provide more information than returns, earnings growth outperforms both returns and analysts' forecasts. These results are consistent with H2b and suggest earnings growth is the firm-level performance measure that a resource-constrained state tax forecaster should add to their model if they could only add one.[23]

4.4. Additional analyses – Tax types and mediation

We next examine whether earnings growth improves forecasts of different types of tax revenue. Table 6 replicates elements of Table 4 with separate dependent variables for personal income tax, sales tax, and corporate income tax. The number of observations differs from the main analysis and differs by tax type because some states do not impose all tax types.

In Table 6, Panel A, we tabulate benchmark models that include only the forecast in the odd-numbered columns and models that include both forecasts and industry-weighted earnings growth in the even-numbered columns. We see from columns 1, 3, and 5 that the states' own forecasts have low explanatory power for personal income tax (R^2=14.8%), and moderate for sales tax (33.4%) and corporate income tax (24.1%).

In columns 2, 4 and 6 we add industry-weighted earnings growth. For personal income tax, earnings growth improves the adjusted R^2 to 42.2% (column 2), an increase of 27.4 percentage points. For sales tax, earnings growth improves the adjusted R^2 to 38.9% (column 4), an increase of only 5.5 percentage points. For corporate income tax, earnings growth improves the adjusted R^2 to 34.4% (column 6), an increase of 10.3 percentage points.

Earnings growth improves state revenue forecasts more for personal income tax than

[23] In untabulated analyses, we also consider aggregate market value of equity growth, sales growth, and operating cash flow growth and do not find that these measures outperform earnings growth.

corporate income tax. This is consistent with corporate earnings growth positively affecting employment rates, employee bonuses, stock option exercises, salaries, and hourly wages.[24] All these factors should affect personal income tax revenues. Given that earnings growth predicts personal income tax revenue growth and that taxpayers adjust consumption based on changes in income (Davis and Palumbo 2001; Lettau, Ludvigson, and Barczi 2001), it follows that corporate earnings growth should also predict growth in sales tax revenue. However, we are not surprised that the sales tax prediction obtains the least improvement, because states have timelier forecast information arising from more frequent quarterly or monthly sales tax filings.

Table 6, Panel B presents results from replacing the dependent variable with forecast errors in tax revenue growth. The results are similar to the results in Panel A.

We use the results in Table 6, Panel B to conduct mediation analyses that explore what macroeconomic information associated with aggregate earnings growth is being omitted from state tax forecasts. Our theory suggests that earnings growth is a leading indicator of various macroeconomic activities that affect state tax bases and that state forecasts may be omitting.

To conduct our mediation analyses, we first obtain various state-specific macroeconomic indicators (gross state product, unemployment rate, population, total number of employees, total compensation, and personal consumption expenditures) and compute year-over-year growth rates for each variable. We then conduct a mediation analysis as illustrated in Figure 3. For each tax type, we first test and confirm that earnings growth at time *t-2* predicts the forecast error at time *t* (tabulated as Table 6, Panel B). We next test and confirm that earnings growth at time *t-2* predicts growth in each macroeconomic indicator at time *t-1* (untabulated for parsimony). We

[24] For example, Nallareddy and Ogneva (2017) show that changes in firm-level earnings are positively associated with future firm-level employment growth. Blanchflower, Oswald, and Sanfey (1996) show that a rise in the manufacturing sector's profitability leads to an increase in the long-run level of wages in that sector.

then test that the growth in each macroeconomic indicator at time *t-1* predicts the forecast error at time *t* after controlling for earnings growth at time *t-2* (untabulated for parsimony).

In the final step, we show that the effect of earnings growth on the forecast error decreases after controlling for growth in each macroeconomic indicator. Table 7, Panels A-C present these results for personal income, sales, and corporate income. Table 7 reveals that the omitted earnings growth information is correlated with future growth in state GDP, employment, total number of employees, total compensation of employees, and personal consumption expenditures for both personal income and sales taxes. The omitted earnings growth information is only correlated with future growth in state GDP for corporate income taxes.

4.5. Supplementary analyses

4.5.1. State Leading Index

We next explore the informativeness of a third-party economic forecast to benchmark the accuracy of state tax forecasts. The We use the Federal Reserve Bank of Philadelphia's State Leading Index, which predicts the six-month growth rate in each state's coincident index. Inputs to models of the State Leading Index include the state coincident index, state-level housing permits (1 to 4 units), state initial unemployment insurance claims, delivery times from the Institute for Supply Management manufacturing survey, and the interest rate spread between the 10-year Treasury bond and the 3-month Treasury bill. We do not include the State Leading Index in our main tests because it is generally not available to forecasters when they finalize their forecasts due to a reporting lag.[25] The State Leading Index is, however, constructed with the

[25] The Federal Reserve Bank first published the leading index in 2010. It uses a time-series model (vector autoregression) to construct the leading index. Revisions occur when the underlying data are updated (e.g., the release of the actual coincident indexes normally cause the revisions). Therefore, the revised amounts available on https://www.philadelphiafed.org/surveys-and-data/regional-economic-analysis/state-leading-indexes would not have been available to state tax forecasters.

same type of macroeconomic leading indicators and forecasts that state tax revenue forecasters would include in their models of future tax revenue growth.

We compare the explanatory power of state tax revenue forecasts, the State Leading Index, and aggregate earnings growth and show results in Table 8, columns 1, 2, and 3. *STATE LEADING INDEX*$_{st-1}$ is the leading index for state *s* in April of year *t-1*. We find that state forecasts explain more of the variation in tax revenue growth than the state leading index or industry-weighted earnings growth (adjusted R^2 of 15.0% versus 12.9% and 12.2%) alone. However, earnings growth adds explanatory power to models that include both the state's forecast and the State Leading Index (Table 8, column 5 versus 4).

These tests provide two major insights. First, they confirm that state tax revenue forecasters' incentives are adequate to produce forecasts that are as good as other macroeconomic forecasts.[26] Second, they confirm that the information in earnings growth is incremental to other forecasts of economic activity correlated with state tax bases.

4.5.2. Out-of-sample testing

To see how well our models perform using out-of-sample data, we perform two different holdout tests wherein we split the data into a training and test sample. Our first holdout test randomly assigns each observation a number between 0 and 1 from a uniform distribution and assign observations with values above 0.5 to the training sample. Our second holdout test assigns observations before 2015 to the training sample. We obtain predicted parameters from estimating equation (2) using the training sample, use those parameters to calculate predicted values for the test sample, then test whether the predicted values outperform states' forecasts in the test sample.

[26] Tax revenue forecasters are generally public servants who do not have the same financial incentives as analysts to make bold predictions and outperform the competition. However, our private conversations with several state tax forecasters suggest they have an interest in improving their models.

Table 9 presents the results. The odd columns present the state's forecast and the even columns present predicted values.

Table 9, Panel A presents the results of each tax type when we randomly assign observations to the training set. The improvement in the adjusted R^2 from the odd columns to the even columns is consistent with our main results.

Table 9, Panel B shows the results of using observations before 2015 (after 2014) as the training (test) sample. Our inference that aggregate earnings growth improves state tax revenue forecast continues to hold, although the magnitude of the improvement decreases. Post 2014, there was an increase in the number of papers exploring the predictive power of aggregate earnings for macroeconomic forecasting. Results from our test help alleviate concerns that state tax revenue forecasters and their suppliers of macroeconomic forecasts have already changed their models to fully capture aggregate earnings growth.

4.5.3. Sectoral shift theory

We also consider the possibility that earnings dispersion could provide incremental information to state tax revenue forecasters. Sectoral shift theory predicts that high performance dispersion within or across sectors is a prelude to costly resource re-allocation wherein workers at less profitable firms in an industry migrate to either (1) more profitability firms within the same industry or (2) firms in a more profitable industry; hence, earnings dispersion is a leading indicator of unemployment (Lilien 1982; Ball and Sadka 2015). Kalay, Nallareddy, and Sadka (2018) further find that high dispersion coupled with low performance predicts unemployment. We therefore explore whether earnings dispersion improves forecasts of total revenue and personal income tax revenue.

Table 10, column 1 tabulates the results of regressing total revenue growth on the state's

forecast and earnings growth. Column 2 adds a measure of earnings dispersion (defined in Appendix A), and the interaction of earnings growth and earnings dispersion. Columns 3 and 4 repeat the analysis using personal income tax. We find only modest improvements in the adjusted R^2. This reinforces the notion that earnings growth is the primary firm-level performance measure that state tax forecasters should consider adding to their model.

4.6. Robustness tests

Our results are robust to numerous untabulated tests. First, our primary analyses use worldwide pretax income (*PI*) for U.S. corporations, because the overall health of U.S. firms affects both income sources directly and sentiment (consumer optimism or pessimism) indirectly. However, states have limited and varying jurisdiction to tax foreign source income. Thus, as an alternative specification, we repeat the analyses using growth in domestic pretax income (PIDOM) rather than PI.[27] We find results consistent with our main analyses.[28] Inferences from the study are also robust to using income before extraordinary items (after-tax income).

Next, we drop the interim year for the 20 states that have biennial budget periods, because those years' budgets may not be timely. Our inferences are unchanged.[29] Our results are also robust to dropping the four states without June 30 year-ends.

Our main tests winsorize earnings growth, which we think is appropriate given our small

[27] This analysis is similar to the analysis in Green, Henry, Parsons, and Plesko (2020).

[28] Specifically, the adjusted R^2 in the PIDOM model is greater than the adjusted R^2 in the PI model by about one percentage point across all tax types except corporate income tax. For corporate income tax, the adjusted R^2 is the same in each model. This suggests that PIDOM growth is at least as informative as PI growth. However, states have become increasingly aggressive in taxing foreign source income through tax haven legislation and the inclusion of Global Intangible Low-Taxed Income - a provision in the 2017 federal tax reform legislation (the Tax Cuts & Jobs Act). Therefore, PI, which includes foreign source income, may be more informative than PIDOM for tax years after 2017.

[29] A 2014 survey by the Rockefeller Institute asks state forecasters how many weeks the forecast is finalized prior to the start of the fiscal year (Boyd and Dadayan 2014). In only four biennial budget states do the number of weeks exceed 52, suggesting that the other 16 states update their second year forecast rather than anchoring on the initial forecast. Thus, it is less surprising that dropping the second year of biennial budgets does not substantially improve the benefit of incorporating financial earnings growth.

sample size and that the NASBO data contained at least one entry error.[30] However, we evaluate several alternatives. First, we re-estimate equation (2) *without* winsorizing or otherwise adjusting the data for outliers. The coefficient on earnings growth remains positive and significant at the 0.01 level across all types of tax revenue. Our inferences also remain unchanged after estimating robust regression or removing influential observations using Cook's D or DFBETA.[31]

5. Conclusion

Can public-company financial accounting information assist states with their critical task of forecasting tax revenues? Konchitchki and Patatoukas (2014) demonstrate that aggregate earnings growth helps explain GDP growth beyond the Federal Reserve Bank's own forecast based on surveys of economists. We apply similar reasoning to other critical government forecasts: state tax revenue forecasts, in total and by type of tax.

We find that including aggregate earnings growth substantially improves the explanatory power of total revenue forecasts. Our method of assigning earnings growth to states using the proportionate share of each industry's contribution to state GDP is an innovation that other researchers could adopt. This measure outperforms either national or headquarters earnings growth in improving tax revenue forecasts, both in total and for each tax type. In fact, it has nearly as much explanatory power as actual forecasts do for predicting future tax revenue. We

[30] Specifically, we found that the estimated PIT in Iowa went from $3,150 million in 2008 to $351 million in 2009, and then back up to $3,309 million in 2010. Actual PIT collections stayed approximately $3,300 million. We assume the $351 million was an error. We did not find any other noticeable errors in NASBO.

[31] We identify influential observations by calculating Cook's distance (Cook's D) for each observation. Cook's D is calculated by first removing each observation (one at a time) and re-estimating the model. Cook's D measures the change in fitted values change when the observation is removed. An observation with a "large" Cook's D suggests that the observation strongly influences the fitted values. We calculate Cook's D for each observation in each column of Tables 3, 4, and 6, and remove any observation that yields a value greater than 4/n (Belsley, Kuh, and Welsch 1980), and re-estimate each equation. Lastly, we calculate the DFBETAs for each observation in each equation and re-estimate the equation after removing observations with DFBETAs greater than $2/\sqrt{n}$ (Belsley et al. 1980). DFBETA measures the effect on the regression coefficients of deleting each observation.

conjecture that researchers could benefit from using an industry-weighted earnings assignment for questions about other state fiscal and economic effects.

We also find that aggregate earnings growth, aggregate returns, and aggregate analysts' forecasts of earnings growth all improve state tax revenue forecasts, but that earnings growth outperforms the two other measures. These results suggest that earnings growth is the firm-level performance measure that can provide the most improvement to forecasts made by resource-constrained state tax forecasters.

Finally, we evaluate whether the improvement depends on the type of tax revenue. We find that including earnings growth improves the adjusted R^2 of the forecasted growth in personal income tax, sales tax, and corporate income tax by 27, 6, and 10 percentage points. The improvement is greatest for personal income tax, consistent with business health spilling over into employment, wages, bonuses, and stock compensation. Mediation analyses reveal that the omitted earnings growth information is correlated with future growth in state GDP, employment, total number of employees, total compensation, and personal consumption expenditures.

In sum, we show that financial accounting earnings can improve state tax revenue forecasts. Our aggregate earnings growth measure improves state revenue forecasts, which are especially important in subnational jurisdictions with more budget constraints than federal governments. State tax forecasters can add earnings growth to their historical models, test the extent to which earnings growth improves their forecasts, and update their forecast procedures accordingly.[32] Additionally, our study offers an observable and readily available benchmark that could be used by those who monitor tax revenue forecasts, budgets, and other fiscal projections.

[32] Although each state may have unique forecasting inputs and procedures that we do not observe, our method for computing earnings growth should be implementable for any forecaster with access to the underlying data.

References

Ball, R. and G. Sadka. 2015. Aggregate earnings and why they matter. *Journal of Accounting Literature* 34(2015): 39-57.

Ball, R., G. Sadka, and R. Sadka. 2009. Aggregate Earnings and Asset Prices. *Journal of Accounting Research* 47(5): 1097-1133.

Beaver, W. R. Lambert, and D. Morse. 1980. The information content of security prices. *Journal of Accounting and Economics* 2(1980): 3-28.

Beaver, W. R. Lambert, and S. Ryan. 1987. The information content of security prices: A second look. *Journal of Accounting and Economics* 9(1987): 139-157.

Belsley, D.A., E. Kuh, and R.E. Welsch. 1980. Regression Diagnostics: Identifying Influential Data and Sources of Collinearity. New York: John Wiley.

Blanchflower, D., A. Oswald, and P. Sanfey. 1996. Wages, profits, and rent-sharing. *Quarterly Journal of Economics* 111(1): 227-251.

Blankespoor, E., E. deHaan, and I. Marinovic. 2020. Disclosure Processing Costs, Investors' Information Choice, and Equity Market Outcomes: A Review. *Journal of Accounting and Economics* 70(2020): 1-46.

Bourdeaux, C., E. Franklin, and A. Hathaway. 2019. State Revenue Forecasting Practices: Accuracy, Transparency, and Political Acceptance. *Volcker Alliance Project Paper* (as included in *The Palgrave Handbook of Government Budget* 2019, pp. 155-175).

Boyd, D. and L. Dadayan. 2014. State Tax Revenue Forecasting. *The Nelson A. Rockefeller Institute of Government.* Albany, New York.

Boyd, D., L. Dadayan, S. Emmans, S. Fehr, L. Grange, K. Huh, A. Russell, C. Swope, and R. Ward. 2011. States' Revenue Estimating: Cracks in the Crystal Ball. *The Nelson A. Rockefeller Institute of Government* (Albany, New York) and *The Pew Center on the States* (Washington, D.C.).

Cheng, S. 2020. The Information Externality of Public Firms' Financial Information in the State-Bond Secondary Market. Working paper.

Costello, A., R. Petacchi and J. Weber. 2017. The impact of balanced budget restrictions on states' fiscal actions. *The Accounting Review* 92(1): 51-71.

Davis, M., and M. Palumbo. 2001. A Primer on the Economics and Time Series Econometrics of Wealth Effects. Discussion paper. Federal Reserve Board of Governors (Washington, DC).

Dyreng, S. and R. Hills. 2018. Foreign Earnings Repatriations and Domestic Employment. Working paper.

Dyreng, S., B. Lindsey, and J. Thornock. 2013. Exploring the role Delaware plays as a domestic tax haven. *Journal of Financial Economics* (2013): 751-772.

Garrett, T. A., R. Hernandez-Murillo, and M.T. Owyang, 2005. Does consumer sentiment predict regional consumption? *Federal Reserve Bank of St. Louis Review*, March/April 2004, 87(2, Part 1), pp. 123-35.

General Accountability Office, United States. 1993. *Balanced Budget Requirements: State Experiences and Implications for the Federal Government*. Report #GAO/AFMD-93-58BR. Washington, D.C.

Green, D., E. Henry, S. Parsons and G. Plesko. 2020. Incorporating financial statement information to improve forecasts of corporate taxable income. Fordham University working paper.

Hann, R., C. Li, and M. Ogneva. 2020. Another Look at the Macroeconomic Information Content of Aggregate Earnings: Evidence from the Labor Market. *The Accounting Review.*

Heider, F., and A. Ljungqvist. 2015. As certain as debt and taxes: Estimating the tax sensitivity of leverage from state tax changes. *Journal of Financial Economics* 118(3): 684-712.

Hou, K., A.M. van Dijk, and Y. Zhang. 2012. The implied cost of capital: A new approach. *Journal of Accounting and Economics* 53(2012): 504-526.

Hou, Y., and D. L. Smith. 2010. Do state balanced budget requirements matter? Testing two explanatory frameworks. *Public Choice* 145: 57–79.

Howe, J., E. Unlu, and X. Yan. 2009. The Predictive Content of Aggregate Analyst Recommendations. *Journal of Accounting Research* 74(3): 799-821.

Huh, K. 2019. States face increasingly uncertain revenue forecasts. *The Pew Charitable Trusts*: https://www.pewtrusts.org/en/research-and-analysis/articles/2019/10/24/states-face-increasingly-uncertain-revenue-forecasts.

Hutton, A., L.F. Lee, and S. Shu. 2012. Do Managers Always Know Better? The Relative Accuracy of Management and Analysts' forecasts. *Journal of Accounting Research* 50(5): 1217-1244.

Ivkovic, Z. and S. Weisbenner. 2005. Local does as local is: Information content and the geography of individual investors' common stock investments. *Journal of Finance* 60: 267-306.

Joyce, P. and R. Rodgers. 1996. The Effect of Underforecasting on the Accuracy of Revenue Forecasts by State Governments. *Public Administration Review* 56(1): 48-56.

Kalay, A., S. Nallareddy, and G. Sadka. 2018. Uncertainty and Sectoral Shifts: The Interaction Between Firm-Level and Aggregate-Level Shocks, and Macroeconomic Activity. *Management Science* 64(1): 198-214.

Ke, B. and Y. Yu. 2006. The Effect of Issuing Biased Earnings Forecasts on Analysts' Access to Management and Survival. *Journal of Accounting Research* 44(5): 965-999.

Khan, U. and N.B. Ozel. 2016. Real Activity Forecasts Using Loan Portfolio Information. *Journal of Accounting Research* 54(3): 895-937.

Konchitchki, Y. and P. Patatoukas, 2014, Accounting earnings and gross domestic product. *Journal of Accounting and Economics* 47: 76-88.

Kothari, S. P., J.W. Lewellen, and J.B. Warner. 2014. The behavior of aggregate corporate investment. Working Paper.

Lettau, M., S. Ludvigson, and N. Barczi. 2001. A Primer on the Economics and Time Series Econometrics of Wealth Effects: A Comment. Staff report. Federal Reserve Bank of New York (New York, New York).

Li, K. and P. Mohanram. 2014. Evaluating cross-sectional forecasting models for implied cost of capital. *Review of Accounting Studies* (2014) 19: 1152-1185.

Lilien, D. 1982. Sectoral Shift and Cyclical Unemployment. *Journal of Political Economy* 90(4): 777-793.

Nallareddy, S. and M. Ogneva. 2017. Predicting Restatements in Macroeconomic Indicators using Accounting Information. *The Accounting Review* 92(2): 151-182.

National Association of State Budget Officers (NASBO). 2019. *State Expenditure Report.* Washington, DC: NASBO.

National Association of State Budget Officers (NASBO). 2015. *Budget Processes in the States.* Washington, DC: NASBO.

National Conference of State Legislatures (NCSL). 2010. *NCSL Fiscal Brief: State Balanced Budget Provisions*. Washington, DC: NCSL.

Pirinsky, C., and Q. Wang. 2006. Does Corporate Headquarters Location Matter for Stock Returns? *Journal of Finance* 61(4): 1991-2015.

Poterba, J. M. 1994. State responses to fiscal crises: The effects of budgetary institutions and politics. *Journal of Political Economy* 102 (4): 799–821.

Poterba, J. M. 1995. Balanced budget rules and fiscal policy: Evidence from the states. *National Tax Journal* 48 (3): 329–336.

Poterba, J. M. 1996. Budget institutions and fiscal policy in the U.S. states. *American Economic Review* 86 (2): 395–400.

Randall, M., and K. Rueben. 2017. Sustainable Budgeting in the States Evidence on State Budget Institutions and Practices. *Urban Institute*: https://www.urban.org/research/publication/sustainable-budgeting-states-evidence-state-budget-institutions-and-practices

Shivakumar and Urcan. 2017. Why Does Aggregate Earnings Growth Reflect Information about Future Inflation? *The Accounting Review* 92(6): 247-276.

Appendix A: Variable Definitions

Variable Name	Definition	Source(s)
ACTUAL TOTAL REVENUE GROWTH $_{st}$	Total general fund revenue growth for state *s* at the end of the state's fiscal year, *t*. Computed as: (TOTAL REVENUE$_{st}$ - TOTAL REVENUE$_{st-1}$) / TOTAL REVENUE$_{st-1}$	Constructed using NASBO's *The Fiscal Survey of States*
ACTUAL CIT GROWTH $_{st}$	Corporate income tax revenue growth for state *s* at the end of the state's fiscal year, *t*. Computed as: (CIT REVENUE$_{st}$ - CIT REVENUE$_{st-1}$) / CIT REVENUE$_{st-1}$	Constructed using NASBO's *The Fiscal Survey of States*
ACTUAL PIT GROWTH $_{st}$	Personal income tax revenue growth for state *s* at the end of the state's fiscal year, *t*. Computed as: (PIT REVENUE$_{st}$ - PIT REVENUE$_{st-1}$) / PIT REVENUE$_{st-1}$	Constructed using NASBO's *The Fiscal Survey of States*
ACTUAL SALES TAX GROWTH $_{st}$	Sales tax revenue growth for state *s* at the end of the state's fiscal year, *t*. Computed as: (SALES TAX REVENUE$_{st}$ - SALES TAX REVENUE$_{st-1}$) / SALES TAX REVENUE$_{st-1}$	Constructed using NASBO's *The Fiscal Survey of States*
FORECAST GROWTH ERROR $_{st}$	Actual total revenue growth for fiscal year *t* minus forecasted total revenue growth for fiscal year *t*.	Constructed using NASBO's *The Fiscal Survey of States*
FORECASTED TOTAL REVENUE GROWTH $_{st}$	Forecasted total general fund revenue growth for state *s* for the state's fiscal year, *t*. Computed as: (FORECASTED TOTAL REVENUE$_{st}$ - TOTAL REVENUE$_{st-1}$) / TOTAL REVENUE$_{st-1}$	Constructed using NASBO's *The Fiscal Survey of States*
FORECASTED CIT GROWTH $_{st}$	Forecasted corporate income tax revenue growth for state *s* for the state's fiscal year, *t*. Computed as: (FORECASTED CIT REVENUE$_{st}$ - CIT REVENUE$_{st-1}$) / CIT REVENUE$_{st-1}$	Constructed using NASBO's *The Fiscal Survey of States*
FORECASTED PIT GROWTH $_{st}$	Forecasted personal income tax revenue growth for state *s* for the state's fiscal year, *t*. Computed as: (FORECASTED PIT REVENUE$_{st}$ - PIT REVENUE$_{st-1}$) / PIT REVENUE$_{st-1}$	Constructed using NASBO's *The Fiscal Survey of States*
FORECASTED SALES TAX GROWTH $_{st}$	Forecasted sales tax revenue growth for state *s* for the state's fiscal year, *t*. Computed as: (FORECASTED SALES TAX REVENUE$_{st}$ - SALES TAX REVENUE$_{st-1}$) / SALES TAX REVENUE$_{st-1}$	Constructed using NASBO's *The Fiscal Survey of States*
NATIONAL PI GROWTH $_{t}$	The value-weighted growth in pre-tax income for all firms during year *t*. Growth rates are value-weighted by firm based on firm *i*'s market-value of equity compared to the total market-value of equity of all firms.	Constructed using Compustat Databases
HQ WEIGHTED PI GROWTH $_{st}$	The value-weighted growth in pre-tax income for firms headquartered in state *s* during year *t*. Growth rates are value-weighted by firm based on firm *i*'s market-value of equity compared to the total market-value of equity of all firms headquartered in the same state as firm *i*.	Constructed using Compustat Databases and Scott Dyreng's Exhibit 21 Data
INDUSTRY WEIGHTED PI GROWTH $_{st}$	The industry-weighted growth in pre-tax income in state *s* during year *t*. Growth rates are first computed at the firm level, and are value-weighted by firm based on firm *i*'s market-value of equity compared to the total market-value of equity of all firms in the same industry as firm *i*. Growth rates are then aggregated by industry, multiplied by state-specific industry weights, and aggregated at the state level. The state-specific industry weights are computed using the relative share of the industry's contribution to total Gross State Product in state *s*. Industry classifications are based on the two-digit NAICS code.	Constructed using Compustat Databases and Bureau of Economic Analysis' Regional Economic Accounts

Appendix A (continued)

Variable Name	Definition	Source(s)
TOTAL REVENUE $_{st}$	Total general fund revenues actually collected by state *s* during the state's fiscal year, *t*	NASBO's *The Fiscal Survey of States*
CIT REVENUE $_{st}$	Corporate income tax revenues actually collected by state *s* during the state's fiscal year, *t*	NASBO's *The Fiscal Survey of States*
PIT REVENUE $_{st}$	Personal income tax revenues actually collected by state *s* during the state's fiscal year, *t*	NASBO's *The Fiscal Survey of States*
SALES TAX REVENUE $_{st}$	Sales tax revenues actually collected by state *s* during the state's fiscal year, *t*	NASBO's *The Fiscal Survey of States*
FORECASTED TOTAL REVENUE $_{st}$	Total general fund revenues forecasted by state *s* for the state's fiscal year, *t*	NASBO's *The Fiscal Survey of States*
FORECASTED CIT REVENUE $_{st}$	Corporate income tax revenues forecasted for state *s* for the state's fiscal year, *t*	NASBO's *The Fiscal Survey of States*
FORECASTED PIT REVENUE $_{st}$	Personal income tax revenues forecasted by state *s* for the state's fiscal year, *t*	NASBO's *The Fiscal Survey of States*
FORECASTED SALES TAX REVENUE $_{st}$	Sales tax revenues actually forecasted by state *s* for the state's fiscal year, *t*	NASBO's *The Fiscal Survey of States*
PI GROWTH $_{it}$	Growth in pre-tax income for firm *i* during calendar year *t*. Computed as: (pre-tax income$_{it}$ - pre-tax income$_{it-1}$) / sales$_{it-1}$. Pre-tax income during calendar year *t* is computed using the firm's total pre-tax income for the four fiscal quarters ending nearest (but not after) 12/31 for calendar year *t*.	Constructed using Compustat's Fundamentals Annual and Quarterly Databases
INDUSTRY WEIGHTED RETURNS $_{st}$	Industry-weighted stock returns in state *s* during year *t*. We first compute the firm level buy-and-hold return from April 1 of year *t-1* to March 31 of year *t* using returns from the CRSP monthly stock file. Returns are value-weighted based on firm *i* 's market-value of equity compared to the total market-value of equity of all firms in the same industry as firm i. Returns are then aggregated by industry, multiplied by state-specific industry weights, and aggregated at the state level. The state-specific industry weights are computed using the relative share of the industry's contribution to total Gross State Product in state *s*. Industry classifications are based on the two-digit NAICS code.	Constructed using CRSP monthly stock file
INDUSTRY WEIGHTED ANLST FCST $_{st}$	The industry-weighted growth in analysts' forecasts of pretax income in state *s* during year *t*. Growth rates are first computed at the firm level, and are value-weighted by firm based on firm *i* 's market-value of equity compared to the total market-value of equity of all firms in the same industry as firm *i* . Growth rates are then aggregated by industry, multiplied by state-specific industry weights, and aggregated at the state level. The state-specific industry weights are computed using the relative share of the industry's contribution to total Gross State Product in state *s*. Industry classifications are based on the two-digit NAICS code. We use the consensus analyst forecast of firm *i* 's pretax income (IBES variable "PRE") made in March of year *t* for the firm's fiscal year ending on or after March 31st of year *t*. The forecast of pretax income growth is computed as: (forecast of pretax income$_{it-1}$ - actual pretax income$_{it}$) / actual sales$_{it}$.	Constructed using the IBES Summary Statistics File

Appendix A (continued)

Variable Name	Definition	Source(s)
GSP GROWTH $_{st}$	Growth in gross state product in state *s* during calendar year *t*. Computed as: (GSP_t - GSP_{t-1}) / GSP_{t-1}. GSP is measured in current dollars.	BEA's Regional Economic Accounts
EMPLOYMENT RATE GROWTH $_{st}$	Growth in the employment rate in state *s* during calendar year *t*. Computed as: (employment $rate_t$ - employment $rate_{t-1}$) / employment $rate_{t-1}$. The employment rate is computed as 1 - state unemployment rate.	U.S. Bureau of Labor Statistics
POPULATION GROWTH $_{st}$	Growth in population in state *s* from July 1st in year *t-1* to July 1st in year *t*.	U.S. Census Bureau
# OF EMPLOYEES GROWTH $_{st}$	Growth in the total number of employees in state *s* during calendar year *t*. Computed as: (# of $employees_t$ - # of $employees_{t-1}$) / # of $employees_{t-1}$. The total number of employees consists of the average annual number of full-time and part-time jobs (all jobs for which wages and salaries are paid are counted).	BEA's Regional Economic Accounts
TOTAL COMPENSATION GROWTH $_{st}$	Growth in total compensation of employees in state *s* during calendar year *t*. Computed as: (total $compensation_t$ - total $compensation_{t-1}$) / total $compensation_{t-1}$. Total compensation consists of the total remuneration, both monetary and in kind, payable by employers to employees in return for their work. Consists of wages and salaries and of supplements to wages and salaries.	BEA's Regional Economic Accounts
PERSONAL CONSUMPTION EXPENDITURES GROWTH $_{st}$	Growth in personal consumption expenditures in state *s* during calendar year *t*. Computed as: (personal consumption $expenditures_t$ - personal consumption $expenditures_{t-1}$) / personal consumption $expenditures_{t-1}$.	BEA's Regional Economic Accounts
STATE LEADING INDEX $_{st}$	The revised leading index for state *s* in April of year *t*. The leading index for each state predicts the six-month growth rate of the state's coincident index. Inputs to the model include the state coincident index and other variables that lead the economy: state-level housing permits (1 to 4 units), state initial unemployment insurance claims, delivery times from the Institute for Supply Management (ISM) manufacturing survey, and the interest rate spread between the 10-year Treasury bond and the 3-month Treasury bill. A time-series model (vector autoregression) is used to construct the leading index. Revisions occur when the underlying data are updated (e.g., the release of the actual coincident indexes normally cause the revisions). Note: the coincident indexes combine four state-level indicators to summarize current economic conditions in a single statistic. The four state-level variables in each coincident index are nonfarm payroll employment, average hours worked in manufacturing by production workers, the unemployment rate, and wage and salary disbursements deflated by the consumer price index (U.S. city average). The trend for each state's index is set to the trend of its gross domestic product (GDP), so long-term growth in the state's index matches long-term growth in its GDP.	Federal Reserve Bank of Philadelphia
ABS EARNINGS DISPERSION $_{st}$	The absolute value of earnings dispersion in state *s* during calendar year *t*. Earnings dispersion is computed by first taking the standard deviation of firm-level pretax income divided by total assets within an NAICS code-year . The standard deviation is then scaled by the mean of pretax income within an NAICS code-year. Earnings dispersion for each NAICS code-year is then multiplied by state-specific industry weights and aggregated at the state level. The state-specific industry weights are computed using the relative share of the industry's contribution to total Gross State Product in state *s* during year *t*.	Constructed using Compustat Databases

Appendix B: State forecasting methods

A) Virginia - corporate income tax forecasting model

Corporate Income Tax

diffya(corp)

= 2.18067 * diffya(zbva) - 0.47661 * diffya(sp500va)
(3.51128) (0.60278)

+ 4.41244
(0.91923)

Sum Sq	51415.0	Std Err	31.4444	LHS Mean	6.6527
R Sq	0.2032	R Bar Sq	0.1725	F 2, 528	6.6295
D.W.(1)	2.2746	D.W.(4)	2.1227		

Quarterly data for 55 periods from 2005Q1 to 2018Q3

diffya	Year-over-year difference function
corp	Gross corporate income tax receipts
zbva	Virginia portion of national pre-tax profits
sp500va	Virginia specific Standard and Poor's 500 stock index

B) Virginia - personal income tax forecasting model (withholding only)

Individual Income Tax - Withholding

diffya(with)

= 0.00736 * diffya(ywstran) + 36.06156
(4.34177) (2.38815)

Sum Sq	143635	Std Err	52.5568	LHS Mean	95.7828
R Sq	0.2547	R Bar Sq	0.2261	F 2, 52	8.8874
D.W.(1)	2.2271	D.W.(4)	1.9295		

Quarterly data for 55 periods from 2005Q1 to 2018Q3

diffya	Year-over-year difference function
with	Withholding tax receipts
ywstran	Virginia income from wages and salaries and transfer payments

Appendix B (continued)

C) Virginia - sales tax forecasting model

State Sales Tax

diff(sales)

$$= 0.00102 * \text{diff(yrpicva)} - 0.66085$$
$$(0.91475) \qquad (0.12788)$$

Sum Sq	45754.6	Std Err	33.4061	LHS Mean	2.7068
R Sq	0.0769	R Bar Sq	0.0319	F 2, 41	1.7080
D.W.(1)	2.2737	D.W.(4)	0.6883		

Quarterly data for 44 periods from 2007Q3 to 2018Q2

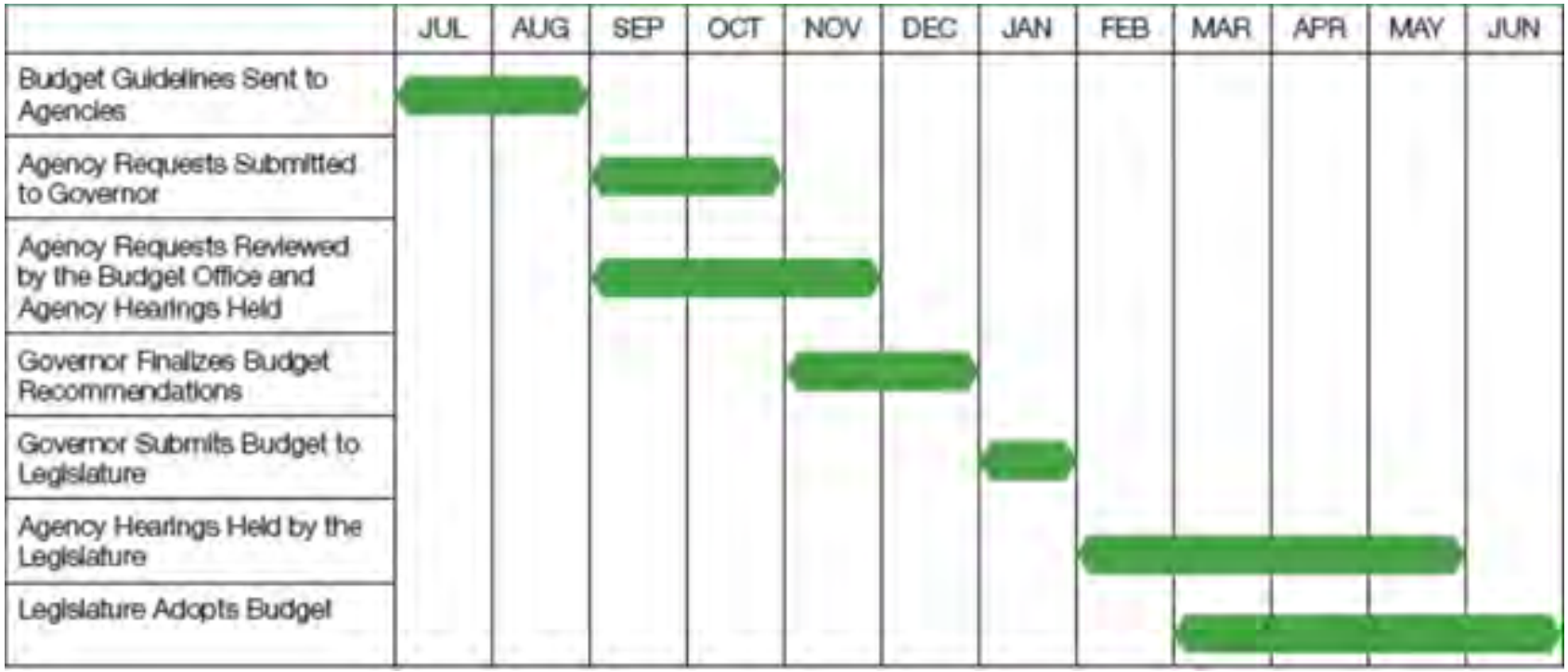
diff	Quarter-over-quarter difference function
sales	Sales tax receipts
yrpicva	Virginia personal income

D) State X – summary of budget and forecasting process

State X employs an executive agency to certify and administer the budget enacted by the legislature. The state constitution requires the enacted budget be balanced. The state budget includes two fiscal years, beginning on July 1 of each odd-numbered year. In the second year of the biennium, the executive agency develops recommended adjustments to the budget. The state uses a consensus forecasting process that relies on estimates from a forecasting group in the executive branch and a group in the legislative branch. The state uses historical tax returns and tax payments along with macroeconomic data to predict future tax revenues. Revenues are estimated separately for each tax type (corporate income, personal income, sales, etc.). The state develops a consensus forecast for the Governor's initial budget in the fall, and then a revised consensus forecast in April, after estimated payments arrive.

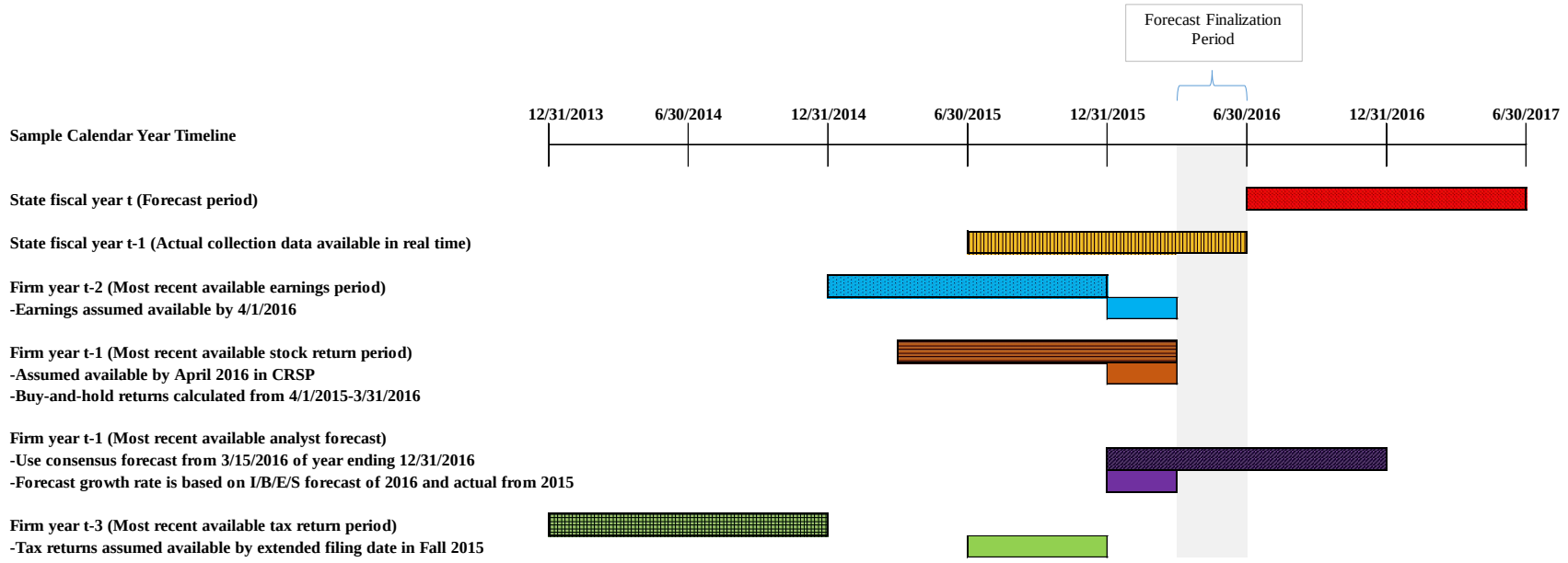
Note: Appendix B displays Virginia's formulas for forecasting corporate income tax (Panel A), personal income tax withholding (Panel B), and sales tax (Panel C). The formulas were pulled from Appendix C of Virginia's *The Economic Outlook and Revenue Forecast through Fiscal Year 2022* (November 19, 2018). The full document is available at: https://www.finance.virginia.gov/media/governorvirginiagov/secretary-of-finance/pdf/master-revenue-reports/GACRE-Nov-2018-notebook.pdf.
Information in Panel D is based on private discussions with an economic analyst in State X.

Figure 1: Timeline of state budget cycle[1].



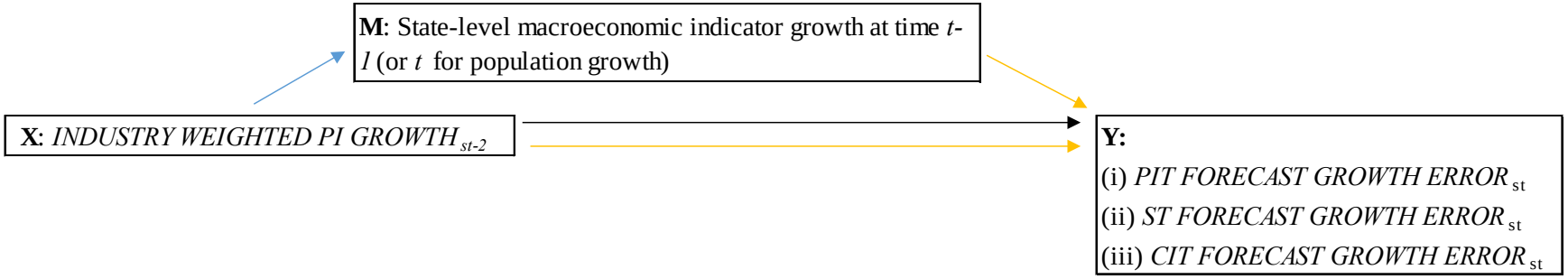
[1]See NASBO's Budget Processes in the States (Spring 2015). The figure reflects a typical budget cycle for states with June 30th fiscal year-ends.

Figure 2: Timing and availability of potential forecasting inputs



Notes: This figure illustrates the timing and availability of firm-level information relevant to state tax forecasts. Specifically, it uses a calendar-year taxpayer as an example and plots the periods summarized by financial statements, analysts' forecasts, and income tax returns, as well as the different reporting lags for each information source. A revenue forecast of the state fiscal year ending 6/30/2017 will be finalized in the Spring of 2016. At that time, the forecaster will know: (i) a significant portion of actual collections for the state fiscal year ending 6/30/2016, (ii) firm-level accounting earnings for the firm year ending 12/31/2015, (iii) annual stock returns ending 3/31/2016, and (iv) analysts' forecasts for the firm year ending 12/31/2016. Further, the forecaster obtains complete income tax return information for the firm year ending 12/31/2014 by the extended due date of 9/15/2015 or 10/15/2015. Sales tax information (not depicted in this figure) is typically reported on a monthly or quarterly basis.

Figure 3: Mediation Analysis



Notes: This figure illustrates the mediation analysis presented in Table 7. The mediation analysis tests what macroeconomic information associated with aggregate earnings growth is being omitted from state tax forecasts. The mediation analysis includes the following steps:

Step 1: show X predicts Y (black line; tabulated as Table 6, Panel B)
Step 2: show X predicts M (blue line; untabulated for parsimony)
Step 3: show M predicts Y after controlling for X (yellow lines; untabulated for parsimony)
Step 4: show the effect of X on Y decreases after controlling for M (tabulated as Table 7, Panels A-C for each tax type)

Table 1: Sample selection

Panel A: State-level observations for state forecasts and collections	
Selection for regressions using *ACTUAL TOTAL REVENUE GROWTH* as dependent variable[1]	
State-year observations for all available years (1999-2018: 20 years * 50 states)[2]	1,000
Less: observations with missing Compustat data within a given HQ state	(32)
Less: observations with missing state forecasted total revenue data[3]	(4)
Final sample (state-year observations)	964

[1]The sample will vary across the regressions by tax type because (i) not every state imposes each tax type, and (ii) certain state-year observations may be missing from the NASBO reports.

[2]Data was pulled from NASBO's *The Fiscal Survey of States.*

[3]This includes missing forecasted data for the following state-years: TX 2001, PA 2004, IL 2016, and PA 2016.

Table 1 (continued)

Panel B: Firm-level observations for financial statement measures

Selection for regressions using *ACTUAL TOTAL REVENUE GROWTH* as dependent variable and *PI GROWTH* as independent variable [4]

Compustat: 1996-2016 (growth rates computed for 1997-2016):	
All firm-quarter observations	834,252
Less: observations missing four quarters of PIQ and SALEQ	(193,795)
Less: duplicate values (to drop three quarters and keep one observation per year)	(480,388)
Firm-year observations	160,069
Less: observations missing data to compute MVE	(23,797)
Less: observations with missing prior year data	(23,948)
Less: observations in top and bottom percentile of *PI GROWTH*	(2,266)
Final sample for national growth rates: firm-year observations	**110,058**
Less: observations without a valid HQ state	(72,423)
Final sample for headquarter-weighted growth rates: firm-year observations	**37,635**
Final sample for national growth rates: firm-year observations	110,058
Less: observations without a valid NAICS code	(1,224)
Final sample for industry-weighted growth rates: firm-year observations	**108,834**

[4]The sample will vary across the regressions by tax type because (i) not every state imposes each tax type, and (ii) certain state-year observations may be missing from the NASBO reports.

Table 2: Descriptive Statistics and Correlation Table

Panel A: Descriptive Statistics - state tax revenue, forecast, and macroeconomic data								
Variable	**N**	**Mean**	**Std. Dev.**	**p10**	**p25**	**p50**	**p75**	**p90**
ACTUAL TOTAL REVENUE GROWTH	964	0.0365	0.0760	-0.0499	0.0063	0.0404	0.0728	0.1094
ACTUAL PIT GROWTH	817	0.0431	0.0875	-0.0665	0.0018	0.0513	0.0945	0.1326
ACTUAL SALES TAX GROWTH	882	0.0342	0.0784	-0.0407	0.0073	0.0356	0.0619	0.0978
ACTUAL CIT GROWTH	856	0.0598	0.2930	-0.2609	-0.0949	0.0275	0.1845	0.3824
TOTAL FORECAST GROWTH ERROR	964	0.0130	0.0740	-0.0618	-0.0150	0.0131	0.0434	0.0804
PIT FORECAST GROWTH ERROR	817	0.0098	0.0869	-0.1004	-0.0308	0.0148	0.0543	0.1012
ST FORECAST GROWTH ERROR	882	-0.0024	0.0648	-0.0620	-0.0248	-0.0017	0.0214	0.0554
CIT FORECAST GROWTH ERROR	856	0.0349	0.2706	-0.2459	-0.1011	0.0207	0.1592	0.3416
FORECASTED TOTAL REVENUE GROWTH	964	0.0234	0.0463	-0.0256	0.0018	0.0254	0.0465	0.0770
FORECASTED PIT GROWTH	817	0.0332	0.0638	-0.0338	0.0097	0.0370	0.0626	0.0950
FORECASTED SALES TAX GROWTH	882	0.0366	0.0550	-0.0146	0.0181	0.0357	0.0541	0.0787
FORECASTED CIT GROWTH	856	0.0249	0.2305	-0.2000	-0.0863	0.0118	0.0980	0.2292
GSP GROWTH	964	0.0406	0.0311	0.0101	0.0268	0.0404	0.0558	0.0750
EMPLOYMENT RATE GROWTH	964	0.0004	0.0109	-0.0114	-0.0031	0.0031	0.0064	0.0106
POPULATION GROWTH	964	0.0074	0.0176	-0.0117	0.0001	0.0097	0.0174	0.0258
# OF EMPLOYEES GROWTH	964	0.0080	0.0074	0.0008	0.0030	0.0069	0.0119	0.0173
TOTAL COMPENSATION GROWTH	964	0.0385	0.0272	0.0109	0.0265	0.0403	0.0539	0.0663
PERSONAL CONSUMPTION EXPENDITURES GROWTH	964	0.0442	0.0211	0.0234	0.0331	0.0433	0.0569	0.0691
STATE LEADING INDEX	964	0.0124	0.0120	-0.0006	0.0074	0.0139	0.0192	0.0246

Panel B: Descriptive Statistics - financial accounting information								
Variable	**N**	**Mean**	**Std. Dev.**	**p10**	**p25**	**p50**	**p75**	**p90**
NATIONAL PI GROWTH	964	0.0046	0.0455	-0.0498	0.0004	0.0107	0.0264	0.0591
HQ WEIGHTED PI GROWTH	964	0.0193	0.2395	-0.0749	-0.0157	0.0129	0.0400	0.0949
INDUSTRY WEIGHTED PI GROWTH	964	0.0089	0.0316	-0.0429	0.0031	0.0152	0.0246	0.0434
INDUSTRY WEIGHTED RETURNS	964	0.1021	0.2263	-0.2202	-0.0306	0.1042	0.1731	0.4882
INDUSTRY WEIGHTED ANLST FCST	698	0.0205	0.0157	0.0062	0.0109	0.0184	0.0249	0.0442
ABS EARNINGS DISPERSION	964	32.6316	116.2830	2.9908	4.4946	8.2376	11.7951	37.2907

Table 2 (continued)

Panel C: Correlation Table

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. ACTUAL TOTAL REVENUE GROWTH $_{st}$	1.0000													
2. ACTUAL PIT GROWTH $_{st}$	0.4547	1.0000												
3. ACTUAL SALES GROWTH $_{st}$	0.3767	0.1832	1.0000											
4. ACTUAL CIT TAX GROWTH $_{st}$	0.3766	0.2481	0.1966	1.0000										
5. TOTAL FORECAST GROWTH ERROR $_{st}$	0.7310	0.3075	0.2548	0.3291	1.0000									
6. PIT FORECAST GROWTH ERROR $_{st}$	0.3805	0.4547	0.2310	0.2795	0.4955	1.0000								
7. SALES FORECAST GROWTH ERROR $_{st}$	0.3225	0.2368	0.5984	0.2587	0.3780	0.4324	1.0000							
8. CIT FORECAST GROWTH ERROR $_{st}$	0.3395	0.2418	0.2168	0.6577	0.4021	0.4383	0.3838	1.0000						
9. FORECASTED TOTAL REVENUE GROWTH $_{st}$	0.4006	0.2011	0.1810	0.0754	-0.3323	-0.1417	-0.0491	-0.0767	1.0000					
10. FORECASTED PIT GROWTH $_{st}$	0.2098	0.7476	0.0199	0.0578	-0.0360	-0.2517	-0.0782	-0.0684	0.3243	1.0000				
11. FORECASTED SALES GROWTH $_{st}$	0.1631	0.0086	0.6707	0.0036	-0.0390	-0.1106	-0.1928	-0.0865	0.2679	0.0953	1.0000			
12. FORECASTED CIT TAX GROWTH $_{st}$	0.0712	0.0274	-0.0073	0.4752	-0.0573	-0.1626	-0.1238	-0.3502	0.1784	0.1487	0.1039	1.0000		
13. GSP GROWTH $_{st-1}$	0.3964	0.2430	0.2852	0.2458	0.3695	0.3401	0.3554	0.3113	0.0513	0.0098	0.0199	-0.0562	1.0000	
14. EMPLOYMENT RATE GROWTH $_{st-1}$	0.2421	0.2219	0.1934	0.1380	0.2869	0.3939	0.2595	0.1907	-0.0481	-0.0530	-0.0034	-0.0524	0.3723	1.0000
15. POPULATION GROWTH $_{st}$	0.3205	0.3971	0.2314	0.0977	0.3510	0.4121	0.2976	0.1724	-0.0179	-0.0219	-0.0331	-0.0790	0.6259	0.7560
16. # OF EMPLOYEES GROWTH $_{st-1}$	0.1246	0.1177	0.1135	0.0385	0.1549	0.1226	0.1430	0.1036	-0.0411	-0.0067	-0.0129	-0.0747	0.3563	0.0272
17. TOTAL COMPENSATION GROWTH $_{st-1}$	0.3348	0.4110	0.2426	0.1101	0.3690	0.4119	0.3208	0.1952	-0.0237	-0.0020	-0.0457	-0.0856	0.7372	0.5945
18. PERSONAL CONSUMPTION EXPENDITURES GROWTH $_{st-1}$	0.3785	0.4023	0.2740	0.1998	0.3846	0.3545	0.3202	0.2413	0.0181	0.0658	-0.0005	-0.0282	0.7204	0.4812
19. STATE LEADING INDEX GROWTH $_{st-1}$	0.3496	0.4008	0.2569	0.2052	0.3139	0.3377	0.2541	0.2104	0.0821	0.0869	0.0563	0.0082	0.3948	0.6493
20. NATIONAL PI GROWTH $_{t-2}$	0.2946	0.4614	0.1217	0.2109	0.3431	0.5123	0.2446	0.3207	-0.0669	-0.0631	-0.0890	-0.1208	0.3151	0.4762
21. HQ WEIGHTED PI GROWTH $_{st-2}$	0.1654	0.1710	0.0378	0.0794	0.2224	0.1496	0.0416	0.0841	-0.0840	0.0311	0.0074	0.0018	0.0278	0.0808
22. INDUSTRY WEIGHTED PI GROWTH $_{st-2}$	0.3431	0.4917	0.1857	0.2602	0.3807	0.5479	0.2968	0.3919	-0.0308	-0.0760	-0.0977	-0.1433	0.3981	0.5326
23. INDUSTRY WEIGHTED RETURNS $_{st-1}$	0.2729	0.3642	0.1729	0.1916	0.2471	0.3259	0.1973	0.2022	0.0645	0.0516	0.0060	0.0052	0.2941	0.4468
24. INDUSTRY WEIGHTED ANLST FCST $_{st-1}$	0.3197	0.2508	0.2522	0.2121	0.3128	0.2236	0.2752	0.2390	0.0349	0.0562	-0.0314	-0.0180	0.4010	0.1795
25. ABS EARNINGS DISPERSION $_{st-2}$	0.0502	0.0650	0.0317	0.1105	0.0195	0.0360	0.0276	0.0349	0.0512	0.0398	0.0116	0.0962	0.0256	0.1959

Table 2 (continued)

Panel C: Correlation Table

Variable	15	16	17	18	19	20	21	22	23	24	25
1. ACTUAL TOTAL REVENUE GROWTH $_{st}$											
2. ACTUAL PIT GROWTH $_{st}$											
3. ACTUAL SALES GROWTH $_{st}$											
4. ACTUAL CIT TAX GROWTH $_{st}$											
5. TOTAL FORECAST GROWTH ERROR $_{st}$											
6. PIT FORECAST GROWTH ERROR $_{st}$											
7. SALES FORECAST GROWTH ERROR $_{st}$											
8. CIT FORECAST GROWTH ERROR $_{st}$											
9. FORECASTED TOTAL REVENUE GROWTH $_{st}$											
10. FORECASTED PIT GROWTH $_{st}$											
11. FORECASTED SALES GROWTH $_{st}$											
12. FORECASTED CIT TAX GROWTH $_{st}$											
13. GSP GROWTH $_{st-1}$											
14. EMPLOYMENT RATE GROWTH $_{st-1}$											
15. POPULATION GROWTH $_{st}$	1.0000										
16. # OF EMPLOYEES GROWTH $_{st-1}$	0.4251	1.0000									
17. TOTAL COMPENSATION GROWTH $_{st-1}$	0.8743	0.4229	1.0000								
18. PERSONAL CONSUMPTION EXPENDITURES GROWTH $_{st-1}$	0.7481	0.4415	0.8578	1.0000							
19. STATE LEADING INDEX GROWTH $_{st-1}$	0.5409	0.1622	0.4327	0.4031	1.0000						
20. NATIONAL PI GROWTH $_{t-2}$	0.4273	0.0383	0.4187	0.3706	0.2781	1.0000					
21. HQ WEIGHTED PI GROWTH $_{st-2}$	0.0713	0.0101	0.0719	0.0503	0.0242	0.1200	1.0000				
22. INDUSTRY WEIGHTED PI GROWTH $_{st-2}$	0.4678	0.0372	0.4548	0.3977	0.3708	0.9022	0.1542	1.0000			
23. INDUSTRY WEIGHTED RETURNS $_{st-1}$	0.3480	-0.0133	0.3414	0.3315	0.5224	0.3651	0.0613	0.4239	1.0000		
24. INDUSTRY WEIGHTED ANLST FCST $_{st-1}$	0.1327	0.0651	0.2466	0.3287	0.3465	0.4785	0.1129	0.4861	0.6132	1.0000	
25. ABS EARNINGS DISPERSION $_{st-2}$	0.0981	-0.0527	0.0382	-0.0183	0.1545	0.0432	-0.0001	0.0337	0.0673	-0.0124	1.0000

Notes: This table presents the descriptive statistics for the state tax revenue, forecast, and macroeconomic variables (Panel A) and the financial accounting information variables (Panel B). Panel C presents correlations for all of our main variables. We define all variables in Appendix A.

Table 3: Total Revenue Growth Predicted by Pretax Income Growth
Dependent Variable: *ACTUAL TOTAL REVENUE GROWTH$_{st}$*

Variable	Column 1	Column 2	Column 3
NATIONAL PI GROWTH $_{t-2}$	0.4806***		
	(0.0531)		
HQ WEIGHTED PI GROWTH $_{st-2}$		0.0554***	
		(0.0089)	
INDUSTRY WEIGHTED PI GROWTH $_{st-2}$			0.8400***
			(0.1095)
Constant	0.0343***	0.0354***	0.0291***
	(0.0016)	(0.0015)	(0.0014)
Observations	964	964	964
Adjusted R^2	0.0824	0.0294	0.121

Clustered standard errors by state in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: This table presents the results of estimating the effect of pretax income growth on actual total tax revenue growth (equation (1)). We define all variables in Appendix A. Columns 1-3 estimate the ability of the following aggregated measures of pretax income growth to predict *TOTAL REVENUE GROWTH: NATIONAL, HQ WEIGHTED,* or *INDUSTRY WEIGHTED*.

Table 4: Total Revenue Growth Predicted by State Forecasts and Pretax Income Growth

Panel A: Regression Results when Dependent Variable = *ACTUAL TOTAL REVENUE GROWTH*$_{st}$

Variable	Predicted Sign	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8
FORECASTED TOTAL REVENUE GROWTH$_{st}$		0.5721***	0.6110***	0.6027***	0.6030***	0.6725***	0.7115***	0.6814***	0.7005***
		(0.0718)	(0.0715)	(0.0654)	(0.0758)	(0.0712)	(0.0722)	(0.0791)	(0.0711)
NATIONAL PI GROWTH$_{t-2}$	+		0.5269***				0.5244***		
			(0.0509)				(0.0484)		
HQ WEIGHTED PI GROWTH$_{st-2}$	+			0.0659***				0.0575***	
				(0.0137)				(0.0118)	
INDUSTRY WEIGHTED PI GROWTH$_{st-2}$	+				0.8850***				0.8740***
					(0.1026)				(0.0975)
Constant		0.0231***	0.0198***	0.0211***	0.0145***	0.0207***	0.0174***	0.0194***	0.0124***
		(0.0031)	(0.0030)	(0.0025)	(0.0029)	(0.0017)	(0.0017)	(0.0020)	(0.0021)
State Fixed Effects		N	N	N	N	Y	Y	Y	Y
Observations		964	964	964	964	964	964	964	964
Adjusted R^2		0.121	0.219	0.162	0.255	0.150	0.251	0.180	0.285

Clustered standard errors by state in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 4 (continued)

Panel B: Regression Results when Dependent Variable = *TOTAL FORECAST GROWTH ERROR*$_{st}$

Variable	Predicted Sign	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
NATIONAL PI GROWTH$_{t-2}$	+	0.5564***			0.5438***		
		(0.0566)			(0.0501)		
HQ WEIGHTED PI GROWTH$_{st-2}$	+		0.0728***			0.0593***	
			(0.0168)			(0.0134)	
INDUSTRY WEIGHTED PI GROWTH$_{st-2}$	+			0.9147***			0.8920***
				(0.1032)			(0.0950)
Constant		0.0105***	0.0116***	0.0050**	0.0106***	0.0119***	0.0052***
		(0.0027)	(0.0024)	(0.0025)	(0.0002)	(0.0003)	(0.0008)
State Fixed Effects		N	N	N	Y	Y	Y
Observations		964	964	964	964	964	964
Adjusted R^2		0.117	0.0545	0.152	0.123	0.0360	0.159

Clustered standard errors by state in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Notes: We define all variables in Appendix A. Panel A presents the results of estimating the effect of pretax income growth on actual total tax revenue growth, incremental to the state's own forecast. Panel A, column 1 estimates the predictive ability of the state's own forecast. Panel A, columns 2-4 present results from estimating equation (2), which tests the ability of the following aggregated measures of pretax income growth to predict *TOTAL REVENUE GROWTH* incremental to the state's own forecast*: NATIONAL, HQ WEIGHTED,* or *INDUSTRY WEIGHTED*. Columns 5-8 replicate columns 1-4 with state fixed effects. Panel B presents the results of estimating the effect of pretax income growth on the *FORECAST GROWTH ERROR*, defined as actual total revenue growth for fiscal year *t* minus forecasted total revenue growth for fiscal year *t.* Columns 1-3 estimate the ability of the following aggregated measures of pretax income growth to predict *FORECAST GROWTH ERROR: NATIONAL, HQ WEIGHTED,* or *INDUSTRY WEIGHTED.* Columns 4-6 replicate columns 1-3 with state fixed effects.

Table 5: Earnings versus Returns and Analysts' Forecasts
Dependent Variable: *ACTUAL TOTAL REVENUE GROWTH$_{st}$*

Panel A: Regression Results - Earnings versus Returns

Variable	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
FORECASTED TOTAL REVENUE GROWTH $_{st}$	0.6725***			0.7005***	0.6444***	0.6819***
	(0.0712)			(0.0711)	(0.0646)	(0.0684)
INDUSTRY WEIGHTED PI GROWTH $_{st-2}$		0.8318***		0.8740***		0.7398***
		(0.1070)		(0.0975)		(0.0939)
INDUSTRY WEIGHTED RETURNS $_{st-1}$			0.0962***		0.0886***	0.0450***
			(0.0113)		(0.0093)	(0.0073)
Constant	0.0207***	0.0291***	0.0263***	0.0124***	0.0120***	0.0092***
	(0.0017)	(0.0009)	(0.0012)	(0.0021)	(0.0018)	(0.0020)
State Fixed Effects	Y	Y	Y	Y	Y	Y
Observations	964	964	964	964	964	964
Adjusted R^2	0.150	0.122	0.0822	0.285	0.220	0.299

Clustered standard errors by state in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 5 (continued)

Panel B: Regression Results - Earnings versus Analysts' Forecasts

Variable	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
FORECASTED TOTAL REVENUE GROWTH $_{st}$	0.7321***			0.6796***	0.6867***	0.6672***	0.6371***
	(0.0633)			(0.0654)	(0.0700)	(0.0695)	(0.0658)
INDUSTRY WEIGHTED PI GROWTH $_{st-2}$		1.2580***		1.1633***		0.9505***	0.8058***
		(0.1451)		(0.1237)		(0.1602)	(0.1239)
INDUSTRY WEIGHTED ANLST FCST $_{st-1}$			1.7354***		1.5513***	0.7529*	0.2863
			(0.4144)		(0.3671)	(0.4122)	(0.5300)
INDUSTRY WEIGHTED RETURNS $_{st-1}$							0.0602***
							(0.0173)
Constant	0.0223***	0.0151***	0.0005	0.0039*	-0.0087	-0.0078	-0.0033
	(0.0012)	(0.0024)	(0.0085)	(0.0020)	(0.0073)	(0.0066)	(0.0084)
State Fixed Effects	Y	Y	Y	Y	Y	Y	Y
Observations	698	698	698	698	698	698	698
Adjusted R^2	0.172	0.165	0.105	0.312	0.256	0.326	0.341

Clustered standard errors by state in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Notes: We define all variables in Appendix A. This table presents the results of estimating the effect of stock returns and analysts' forecasts of earnings on actual total tax revenue growth. In both Panels, column 1 estimates the predictive ability of the state's own forecast while column 2 estimates the predictive ability of industry-weighted pretax income growth. Panel A, column 3 estimates the predictive ability of industry-weighted stock returns, while Panel B, column 3 estimates the predictive ability of industry-weighted analysts' forecasts of earnings. The remaining columns test the three performance measures' ability to predict *TOTAL REVENUE GROWTH* incremental to the state's own forecast, separately and when included together.

Table 6: Revenue Growth by Tax Type Predicted by Pre-tax Income Growth

Panel A: Regression Results - Actual Revenue Growth as DV

Variable	Column 1 *ACTUAL PIT GROWTH* $_{st}$	Column 2 *ACTUAL PIT GROWTH* $_{st}$	Column 3 *ACTUAL SALES TAX GROWTH* $_{st}$	Column 4 *ACTUAL SALES TAX GROWTH* $_{st}$	Column 5 *ACTUAL CIT GROWTH* $_{st}$	Column 6 *ACTUAL CIT GROWTH* $_{st}$
FORECASTED PIT GROWTH $_{st}$	0.5527***	0.6075***				
	(0.0806)	(0.0630)				
FORECASTED SALES TAX GROWTH $_{st}$			0.8412***	0.8742***		
			(0.1034)	(0.0957)		
FORECASTED CIT GROWTH $_{st}$					0.6360***	0.6937***
					(0.0799)	(0.0636)
INDUSTRY WEIGHTED PI GROWTH $_{st-2}$		1.5187***		0.5961***		3.1170***
		(0.1066)		(0.0788)		(0.4278)
Constant	0.0247***	0.0096***	0.0034	-0.0030	0.0439***	0.0143***
	(0.0027)	(0.0022)	(0.0038)	(0.0032)	(0.0020)	(0.0034)
State Fixed Effects	Y	Y	Y	Y	Y	Y
Observations	817	817	882	882	856	856
Adjusted R^2	0.148	0.422	0.334	0.389	0.241	0.344

Clustered standard errors by state in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 6 (continued)

Panel B: Regression Results - Forecast Error as DV			
	Column 1	**Column 2**	**Column 3**
Variable	***PIT FORECAST GROWTH ERROR*** $_{st}$	***ST FORECAST GROWTH ERROR*** $_{st}$	***CIT FORECAST GROWTH ERROR*** $_{st}$
INDUSTRY WEIGHTED PI GROWTH $_{st-2}$	1.5765***	0.6169***	3.4307***
	(0.1235)	(0.0902)	(0.5313)
Constant	-0.0039***	-0.0078***	0.0038
	(0.0011)	(0.0008)	(0.0048)
State Fixed Effects	Y	Y	Y
Observations	817	882	856
Adjusted R^2	0.313	0.0878	0.151

Clustered standard errors by state in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Notes: We define all variables in Appendix A. Panel A presents the results of estimating the effect of pretax income growth on actual tax revenue growth by the following tax types: personal income, sales, and corporate income. Columns 1, 3, and 5 include only *FORECASTED REVENUE GROWTH* for the respective tax type as a predictor. Columns 2, 4, and 6 correspond to equation (2) described in Section 4, substituting the relevant tax type for total revenue. Columns 2, 4, and 6 include both *FORECASTED REVENUE GROWTH* and the industry-weighted measure of pretax income growth. Panel B presents the results of estimating the effect of pretax income growth on the *FORECAST GROWTH ERROR* for each tax type, defined as actual revenue growth for fiscal year *t* minus forecasted revenue growth for fiscal year *t* for each tax type.

Table 7: Mediation Analysis

Panel A: DV is *PIT FORECAST GROWTH ERROR*$_{st}$	Coefficient on *INDUSTRY WEIGHTED PI GROWTH*$_{st-2}$	Decrease from Original	Test Statistic	Test Stat P-value
Original Coefficient	1.5765***			
Coefficient after controlling for:				
GSP GROWTH$_{st-1}$	1.3717***	0.2048***	7.73	0.005
EMPLOYMENT RATE GROWTH$_{st-1}$	1.3544***	0.2221***	10.98	0.001
POPULATION GROWTH$_{st}$	1.5604***	0.0161	1.01	0.314
# OF EMPLOYEES GROWTH$_{st-1}$	1.3548***	0.2217**	6.33	0.012
TOTAL COMPENSATION GROWTH$_{st-1}$	1.3691***	0.2074**	5.78	0.016
PERSONAL CONSUMPTION EXPENDITURES GROWTH$_{st-1}$	1.4156***	0.1609***	8.97	0.003
All macroeconomic variables	1.2878***	0.2887***	12.40	0.000

Panel B: DV is *ST FORECAST GROWTH ERROR*$_{st}$	Coefficient on *INDUSTRY WEIGHTED PI GROWTH*$_{st-2}$	Decrease from Original	Test Statistic	Test Stat P-value
Original Coefficient	0.6169***			
Coefficient after controlling for:				
GSP GROWTH$_{st-1}$	0.3432***	0.2737***	11.18	0.001
EMPLOYMENT RATE GROWTH$_{st-1}$	0.4510***	0.1659***	12.88	0.000
POPULATION GROWTH$_{st}$	0.5889***	0.028	2.41	0.121
# OF EMPLOYEES GROWTH$_{st-1}$	0.3923***	0.2246***	9.04	0.003
TOTAL COMPENSATION GROWTH$_{st-1}$	0.3927***	0.2242**	6.39	0.012
PERSONAL CONSUMPTION EXPENDITURES GROWTH$_{st-1}$	0.4032***	0.2137***	12.16	0.001
All macroeconomic variables	0.3333***	0.2836***	18.48	0.000

Panel C: DV is *CIT FORECAST GROWTH ERROR*$_{st}$	Coefficient on *INDUSTRY WEIGHTED PI GROWTH*$_{st-2}$	Decrease from Original	Test Statistic	Test Stat P-value
Original Coefficient	3.4307***			
Coefficient after controlling for:				
GSP GROWTH$_{st-1}$	2.7276***	0.7031***	10.86	0.001
EMPLOYMENT RATE GROWTH$_{st-1}$	3.6628***	-0.2321	1.68	0.195
POPULATION GROWTH$_{st}$	3.3801***	0.0506	1.53	0.216
# OF EMPLOYEES GROWTH$_{st-1}$	3.5685***	-0.1378	0.38	0.540
TOTAL COMPENSATION GROWTH$_{st-1}$	3.4135***	0.0172	0.01	0.942
PERSONAL CONSUMPTION EXPENDITURES GROWTH$_{st-1}$	3.1390***	0.2917	2.56	0.110
All macroeconomic variables	3.4205***	0.0102	0.00	0.970

Notes: We define all variables in Appendix A. This table presents a mediation analysis that tests what macroeconomic information associated with aggregate earnings growth is being omitted from state tax forecasts. The mediation analysis is illustrated in Figure 3. For each tax type (presented as separate panels), we first present the original coefficient from estimating the effect of pretax income growth on the *FORECAST GROWTH ERROR* (Table 6, Panel B). We then present the coefficient on pretax income growth after controlling for growth in each macroeconomic indicator at time *t-1*. We conduct Wald tests for whether the change in coefficient is statistically significant and present the *F* statistic and p-value from those tests. For parsimony, we do not present results showing each step of the mediation analysis illustrated in Figure 3. *** p<0.01, ** p<0.05, * p<0.1

Table 8: State Leading Index versus State's Forecast and Earnings Growth
Dependent Variable: *ACTUAL TOTAL REVENUE GROWTH$_{st}$*

Variable	Column 1	Column 2	Column 3	Column 4	Column 5
STATE LEADING INDEX $_{st-1}$	2.3284***			2.1925***	1.4964***
	(0.3240)			(0.3157)	(0.2624)
FORECASTED TOTAL REVENUE GROWTH $_{st}$		0.6725***		0.6391***	0.6709***
		(0.0712)		(0.0634)	(0.0662)
INDUSTRY WEIGHTED PI GROWTH $_{st-2}$			0.8318***		0.6619***
			(0.1070)		(0.1050)
Constant	0.0077*	0.0207***	0.0291***	-0.0055	-0.0035
	(0.0040)	(0.0017)	(0.0009)	(0.0041)	(0.0033)
State Fixed Effects	Y	Y	Y	Y	Y
Observations	964	964	964	964	964
Adjusted R-squared	0.129	0.150	0.122	0.264	0.329

Clustered standard errors by state in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Notes: We define all variables in Appendix A. This table compares the ability of the State Leading Index produced by the Federal Reserve Bank of Philadelphia to predict actual total revenue growth to the ability of state tax forecasts and pretax income growth. Columns 1-3 include the State Leading Index, the state's forecast, and pretax income growth separately. Column 4 includes the State Leading Index and the state's forecast. Column 5 includes all three measures.

Table 9: Holdout Tests
Test Sample Results

Panel A: Randomly Assigned Training Sample

Variable	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8
	ACTUAL TOTAL REVENUE GROWTH $_{st}$	*ACTUAL TOTAL REVENUE GROWTH* $_{st}$	*ACTUAL PIT GROWTH* $_{st}$	*ACTUAL PIT GROWTH* $_{st}$	*ACTUAL SALES TAX GROWTH* $_{st}$	*ACTUAL SALES TAX GROWTH* $_{st}$	*ACTUAL CIT GROWTH* $_{st}$	*ACTUAL CIT GROWTH* $_{st}$
FORECASTED TOTAL REVENUE GROWTH $_{st}$	0.7329***							
	(0.1169)							
FORECASTED PIT GROWTH $_{st}$			0.5129***					
			(0.1136)					
FORECASTED SALES TAX GROWTH $_{st}$					0.9179***			
					(0.0703)			
FORECASTED CIT GROWTH $_{st}$							0.6379***	
							(0.0862)	
PREDICTED VALUES FROM TRAINING SAMPLE		0.9931***		0.8819***		1.1943***		0.9833***
		(0.1303)		(0.0811)		(0.0815)		(0.0890)
Constant	0.0195***	0.0045	0.0277***	0.0092***	0.0013	-0.0055**	0.0406***	-0.0049
	(0.0029)	(0.0043)	(0.0038)	(0.0033)	(0.0024)	(0.0026)	(0.0021)	(0.0056)
State Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y
Observations	490	490	422	422	446	446	409	409
Adjusted R^2	0.173	0.292	0.135	0.406	0.407	0.447	0.221	0.315

Clustered standard errors by state in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 9 (continued)

Panel B: Pre-2015 as Training Sample

Variable	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8
	ACTUAL TOTAL REVENUE GROWTH $_{st}$	*ACTUAL TOTAL REVENUE GROWTH* $_{st}$	*ACTUAL PIT GROWTH* $_{st}$	*ACTUAL PIT GROWTH* $_{st}$	*ACTUAL SALES TAX GROWTH* $_{st}$	*ACTUAL SALES TAX GROWTH* $_{st}$	*ACTUAL CIT GROWTH* $_{st}$	*ACTUAL CIT GROWTH* $_{st}$
FORECASTED TOTAL REVENUE GROWTH $_{st}$	0.7604***							
	(0.2300)							
FORECASTED PIT GROWTH $_{st}$			0.8017***					
			(0.1503)					
FORECASTED SALES TAX GROWTH $_{st}$					0.3772			
					(0.2450)			
FORECASTED CIT GROWTH $_{st}$							0.8299***	
							(0.1463)	
PREDICTED VALUES FROM TRAINING SAMPLE		0.8645***		1.1282***		0.4910**		1.3127***
		(0.2396)		(0.1696)		(0.2348)		(0.1436)
Constant	0.0113*	-0.0038	0.0191***	-0.0023	0.0185*	0.0146	-0.0033	-0.0754***
	(0.0057)	(0.0094)	(0.0056)	(0.0077)	(0.0098)	(0.0091)	(0.0069)	(0.0122)
State Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y
Observations	246	246	166	166	182	182	178	178
Adjusted R^2	0.265	0.290	0.340	0.413	0.0491	0.0764	0.491	0.529

Clustered standard errors by state in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: We define all variables in Appendix A. This table presents results from holdout tests whereby we split the data into a training and test sample. Panel A presents the results of each tax type when we randomly assign observations to training and test samples. Panel B presents results of using observations for all years before 2015 as the training sample and observations from years 2015 to 2018 as the test sample. *PREDICTED VALUES FROM TRAINING SAMPLE* are the predicted values from estimating equation (2) using the training sample. The odd-numbered columns include the state's forecast and the even-numbered columns include predicted values. Results are from the test sample.

Table 10: Earnings Dispersion (Sectoral Shift Theory)

Variable	Column 1 *ACTUAL TOTAL REVENUE GROWTH* $_{st}$	Column 2 *ACTUAL TOTAL REVENUE GROWTH* $_{st}$	Column 3 *ACTUAL PIT GROWTH* $_{st}$	Column 4 *ACTUAL PIT GROWTH* $_{st}$
FORECASTED TOTAL REVENUE GROWTH $_{st}$	0.7005***	0.6963***		
	(0.0711)	(0.0723)		
FORECASTED CIT GROWTH $_{st}$				
FORECASTED PIT GROWTH $_{st}$			0.6075***	0.6059***
			(0.0630)	(0.0627)
FORECASTED SALES TAX GROWTH $_{st}$				
INDUSTRY WEIGHTED PI GROWTH $_{st-2}$ X *ABS EARNINGS DISPERSION* $_{st-2}$		0.0098**		-0.0050*
		(0.0047)		(0.0026)
INDUSTRY WEIGHTED PI GROWTH $_{st-2}$	0.8740***	0.7874***	1.5187***	1.5548***
	(0.0975)	(0.0949)	(0.1066)	(0.1111)
ABS EARNINGS DISPERSION $_{st-2}$		-0.0001**		0.0001**
		(0.0001)		(0.0000)
Constant	0.0124***	0.0124***	0.0096***	0.0087***
	(0.0021)	(0.0021)	(0.0022)	(0.0023)
State Fixed Effects	Y	Y	Y	Y
Observations	964	964	817	817
Adjusted R^2	0.285	0.289	0.422	0.423

Clustered standard errors by state in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Notes: We define all variables in Appendix A. This table presents the results of estimating the effect of earnings dispersion on actual tax revenue growth. Columns 1 and 2 show the effect using *ACTUAL TOTAL REVENUE GROWTH* as the dependent variable while columns 3 and 4 show the effect using *ACTUAL PIT REVENUE GROWTH* as the dependent variable. Columns 1 and 3 only include the state's forecast and pretax income growth. Columns 2 and 4 also include our measure of earnings dispersion and the interaction between earnings dispersion and pretax income growth.