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Sustaining Economic Growth

Tax and Budget Principles for Ohio

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Executive Summary

If Ohio is to sustain its recent economic success and prosperity, state policymakers must follow prudent tax and spending principles as they prepare the state's budget for 2020-2021. To ignore sound fiscal principles risks stunting the recent economic growth Ohio has experienced through job creation and business development.

To maintain Ohio's economic growth, policymakers should adhere to the following principles:

- Tax policy should promote economic growth and private investment.
- Tax codes should be simple, transparent, and make local governments more efficient.
- Budget surpluses should be saved or returned to taxpayers.
- Budgets should grow proportionately with inflation and population.

To implement these fundamental principles, The Buckeye Institute recommends: 1) lowering Ohio's commercial activity tax and the individual income tax; 2) simplifying Ohio's tax code, standardizing municipal tax collections, and making local governments more efficient; 3) returning recent budget surpluses to families and businesses through lower taxes; and 4) tying state spending to inflation and population growth.

The Buckeye Institute's Economic Research Center (ERC) has developed a dynamic scoring model to better predict the effects of various fiscal policy choices that policymakers face. Applying that scoring model to Buckeye's fiscal policy recommendations, Buckeye experts found that returning $210 million in surplus to taxpayers through permanent lower taxes will lead to 2,100 more jobs annually while encouraging more economic activity and business investment.

By reducing tax rates, simplifying the tax code, returning surpluses, and tying state spending to inflation and population growth, Ohio's economy will continue to grow and its people prosper.

Introduction

Deciding which government services to offer residents, how much to spend on those selected services, and how to raise sufficient revenue to cover them without burdening taxpayers and hindering economic growth are just some of the competing concerns that policymakers must balance when crafting a state budget. Fortunately, as Ohio's new governor and General Assembly begin working on the state's 2020-2021 budget, they inherit a budget surplus buoyed by years of economic growth. To sustain rather than squander that growth and prosperity, Ohio policymakers should rely on fundamental fiscal principles to guide them.

Ohio's tax policy and budget setting process should adhere to the following four principles and their respective policy recommendations:

Tax Policy Should Promote Economic Growth and Private Investment

Recommendation: Lower or eliminate Ohio's commercial activity tax—or CAT—for businesses to make Ohio more attractive to business investment, and reduce the income tax burden on families and allow them to keep more of their hard-earned money.

Tax Codes Should Be Simple, Transparent, and Make Local Governments More Efficient

Recommendation: Simplify the state tax code, especially the municipal tax collection process, to sustain economic growth in FY2020 and FY2021, and make local governments more efficient in providing services to the communities they serve.

Budget Surpluses Should Be Saved or Returned to Taxpayers

Recommendation: Expand the statutory limit on the state's rainy day fund to ensure a quicker recovery from future economic downturns, and return budget surpluses that exceed the rainy day fund cap to taxpayers through lower taxes. Resist spending more taxpayer money or raising taxes to pay for new services. More government spending and higher taxes slow and reverse economic gains.

Budgets Should Grow Proportionately with Inflation and Population

Recommendation: Avoid excessive spending increases based on overly optimistic economic forecasts. Tie state spending to the rates of inflation and dynamic population trends. Ohio's budget should grow at a rate of 2.35 and 2.48 percent in FY2020 and FY2021, respectively.

Economists from The Buckeye Institute's Economic Research Center have applied a dynamic scoring model to these principles and recommendations in order to better anticipate their effects on the state's gross domestic product, job market, and government revenues. The model predicts that adhering to the four fiscal principles and adopting their respective recommendations will provide Ohio with 2,100 more jobs annually, and help the state realize new business growth and a more efficient use of taxpayer dollars. Following these fiscal principles will expand economic prosperity to all Ohioans across the state.

Principle 1: Tax Policy Should Promote Economic Growth and Private Investment

Taxes are necessary to fund essential government services, such as infrastructure and public safety. Unfortunately, taxes also burden individuals, families, and employers, and can restrict economic investments and distort capital markets that spur job-creation and statewide economic growth. As economists with the Organization for Economic Community Development (OECD) observed, "the tax system…is likely to impinge on many of [the] factors [that affect the rate of economic growth]."[1] State policymakers should look for ways to limit the adverse economic effects of taxation and promote pro-growth tax policies that help relieve taxation's burden.[2]

High business tax rates—corporate income taxes or gross receipts taxes—take funds from businesses that they might otherwise spend on corporate investments and employment. Businesses reinvest in themselves and their employees to improve productivity and increase output. They hire workers to complement their investments and capital improvements. Thus, tax policies, such as Ohio's CAT, that discourage corporate investment and remove funds from job-creating employers, ultimately reduce long-term economic growth and productivity.

Although the Kasich administration successfully eliminated the state's corporate income tax, Ohio still has a harmful CAT that directly taxes a business's gross receipts rather than its profits and therefore penalizes economic productivity.[3] It is a "cost-of-doing-business" tax that does not distinguish between a business's profitable and unprofitable activities.[4] By penalizing all corporate output, such tax regimes penalize all investments immediately—even those that later turn out not to be profitable—and thus discourage businesses from taking the sort of investment risks that contribute to growing economies. The CAT also taxes every stage of the production process, assessing purchases of multiple, intermediate inputs before then taxing the final product itself—making it a very costly tax for manufacturers and raising prices on goods for households and consumers. By contrast, taxes on corporate profits allow for business investments to prove themselves profitable before being burdened by taxes and they do not have the CAT's "pyramid effect" on prices. Reducing or eliminating both tax forms would be preferred, but short of that ideal lowering or eliminating the CAT would make Ohio more attractive to new businesses and increase investment in existing businesses. Indeed, the empirical economics literature confirms findings by OECD economists showing that corporate taxes and personal income taxes have the most harmful effects on economic growth.[5]

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[1] Organisation for Economic Cooperation and Development, ***Tax Policy Reform and Economic Growth***, November 3, 2010, p. 9.

[2] Rea S. Hederman Jr., Tom Lampman, Greg R. Lawson, and Joe Nichols, ***Tax Reform Principles for Ohio***, The Buckeye Institute, February 2, 2015; and Orphe Pierre Divounguy and Bryce Hill, ***Building a Better Future: An Analysis of Ohio's Tax and Spending Policies***, The Buckeye Institute, October 10, 2017.

[3] Jared Walczak, ***Ohio's Commercial Activity Tax: A Reappraisal***, Tax Foundation, September 2017.

[4] Robert Cline, John Mikesell, Tom Neubig, and Andrew Phillips, ***State Taxation of Business Inputs: Existing Tax Distortions and the Consequences of Extending the Sales Tax to Business Services***, Council on State Taxation, January 25, 2005.

[5] Organisation for Economic Cooperation and Development, ***Tax Policy Reform and Economic Growth***, November 3, 2010, p. 3.; William McBride, ***What Is The Evidence on Taxes and Growth?***, Tax Foundation, December 18, 2012; Randall G. Holcombe and Donald J Lacombe, "**The Effect of State Income Taxation on Per Capita Income Growth**" *Public Finance Review*, Volume 32, Number 3 (May 2004), p. 292-312; Maximilian Baylor, **Ranking Tax Distortions in Dynamic General Equilibrium Models: A Survey**, working paper, Department of Finance Canada,

Just as high corporate taxes discourage private investment and enterprise, high personal income tax rates on households discourage work, which limits labor's important role in economic output and thus negatively affects economic growth. Personal income taxes discourage labor because they reduce how much of their hard-earned money workers take home to spend as they deem fit. The Kasich administration lowered the marginal rates on the state's personal income tax and eliminated the corporate income tax, strengthening the state's ongoing economic recovery following the Great Recession with job creation, increased incentives to work, and business development. Further reductions in the state's CAT and personal income taxes will spur further private economic activity and help make businesses more productive and families more prosperous.

Policymakers worried that tax rate cuts may lead to lower revenues should consider two related and significant benefits of lowering taxes: encouraging employers and employees to migrate to Ohio, and the recouped state revenues generated by that positive migration.

First, lower CAT and income tax rates encourage businesses and workers from other states to relocate to Ohio.[6] Ohio's population has grown more slowly than the national average for several decades due in large part to the state's slow jobs market.[7] Recent tax cuts have helped reverse that trend with strong net job creation years, but more work remains to be done to woo out-of-state employers and employees to Ohio. Continuing to reduce taxes that are "highly contractionary" and prevent economies from growing faster is one way to entice new business and investment in the state.[8] According to the Economic Research Center's (ERC) dynamic scoring state tax model, by lowering the CAT and individual income taxes by the amount of the current budget surplus, Ohio can add 2,100 more jobs to the economy and allow families and businesses to keep more of their earnings.

Second, reducing the "highly contractionary" tax burdens and thus attracting more investment and employment may mean lower overall collections, but the state will recoup some of the foregone revenue through higher economic output and new job creation.[9] In Ohio's case, recent budget surpluses and a well-run, well-funded state government make permanent tax rate reductions affordable, especially since they will ultimately spur greater economic growth.

April 2005; and Karel Mertens and Morten O. Ravn, "**The Dynamic Effects of Personal and Corporate Income Tax Changes in the United States**," *American Economic Review*, Volume 103, Number 4 (June 2013), p. 1212-1247.

[6] Xavier Giroud and Joshua Rauh, "**State Taxation and the Reallocation of Business Activity: Evidence from Establishment-Level Data**," (No. 21534), National Bureau of Economic Research; and Richard J. Cebula, Maggie Foley, and Joshua C. Hall, "**Freedom and gross in-migration: an empirical study of the post-great recession experience**," *Journal of Economics and Finance*, Volume 40, Issue 2 (April 2016), p. 402-420.

[7] Richard L. Forstall, ***Population of States and Counties of the United States: 1790-1990***, U.S. Department of Commerce, Bureau of the Census, March 1996, p. 2; Marc J. Perry and Paul J. Mackun, ***Population Change and Distribution, 1990-2000: Census 2000 Brief***, U.S. Department of Commerce, U.S. Census Bureau, April, 2001; and **Annual Estimates of the Resident Population: April 1, 2010 to July 1, 2017**, Census.gov (Last visited January 11, 2019).

[8] Christina D. Romer and David H. Romer, "**The Macroeconomic Effects of Tax Changes: Estimates Based on a New Measure of Fiscal Shocks**," *American Economic Review*, Volume 100, Number 3 (June 2010), p. 763-801.

[9] Lawrence B. Lindsey, "**Individual taxpayer responses to tax cuts: 1982-1984: With implications for the revenue maximizing tax rate,**" *Journal of Public Economics*, Volume 33, Issue 2 (July 1987), p. 173-206; and Alan J. Auerbach, "**The Bush Tax Cut and National Saving**," *National Tax Journal*, Volume 55, Issue 3 (September 2002), p. 387-407.

Recommendation

As the governor and General Assembly consider potential tax policies for the forthcoming budget cycle, they should resist raising personal income or business taxes, but should instead reduce tax rates on households and corporations to make Ohio a worker- and business-friendly economy. Lowering (or eliminating) the CAT and reducing individual income taxes will push Ohio forward economically, drawing in new businesses, creating more jobs and spurring investment, encouraging labor, and allowing families to keep more of their hard-earned money.

Principle 2: Tax Codes Should Be Simple, Transparent, and Make Local Governments More Efficient

Ohio's economy grew significantly during the past year. In 2018, the state had a net increase of 104,800 new private sector jobs and 125,204 new business filings in the state.[10] The state's booming economy contributed to a budget surplus for Fiscal Year 2018, and Fiscal Year 2019 continues that trend with a current surplus of more than $210 million.[11] This recent economic growth has occurred in spite of Ohio's complex and burdensome municipal tax system layered on top of state and federal taxes.

Only a handful of states still collect municipal income taxes, and Ohio's collection process is needlessly complex. Some municipalities, for example, offer tax offsets for taxpayers who do not live and work in the same jurisdiction, but others do not. This disparity makes it difficult for taxpayers—both employers and employees—to know which localities have this reciprocity and which do not, adding complexity to a tax code that varies from region to region and requires investigation and professional consultation, especially for businesses that operate in multiple jurisdictions. Businesses are required to pay local taxes for each jurisdiction in which they do any amount of business, compounding high administrative costs for small businesses that serve customers across multiple jurisdictions. Rather than confuse taxpayers with multiple tax forms, and rather than adding to the administrative burdens of local businesses, the legislature should standardize reciprocal income tax credits across jurisdictions and allow businesses to file a simple form indicating that they do not need to file a full return in a given municipality. Taxes should be simple and transparent, not complex and opaque.

Some policymakers may be tempted to use Ohio's improved economy as an opportunity to distribute more tax revenue to the Local Government Fund (LGF) or to otherwise fund new state projects that benefit certain localities. This would be a short-sighted mistake and risks undermining future economic growth opportunities[12] by making local governments depend on the state for a recurring but inconsistent and unreliable revenue stream.

Conversely, allowing local governments to control their own spending and revenue collections will help ensure that they use tax dollars more efficiently because the beneficiaries of the local services or projects are also those paying the taxes. Rather than forcing local municipalities to rely on unpredictable payments from the LGF, the state should adopt policies that encourage localities to keep municipal spending low and local, and that reward fiscal discipline, sustainable budgets, and greater transparency. Low and local municipal spending will make residents more aware of how much their local government spends and what they, as taxpayers, receive in return. Such accountability will help local governments better decide how to adjust future budgets.

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[10] **Employees on nonfarm payrolls by State and major industry, seasonally adjusted (Table D-1)**, bls.gov (Last visited January 18, 2019); and Kara Driscoll, **Ohio Sees Record-Breaking Year for New Business Growth**, *Springfield News-Sun*, January 4, 2019.

[11] State of Ohio Office of Budget and Management, ***Annual Report Fiscal Year 2018***, August 1, 2018; and Timothy S. Keen, ***Monthly Economic Summary and State Financial Report***, State of Ohio Office of Budget and Management, January 10, 2019.

[12] Greg R. Lawson, ***Revenue Sharing Reform: On the Road to Ohio's Recovery***, The Buckeye Institute, September 4, 2014.

Redistributing state-collected money to fund local projects is not an efficient use of taxpayer dollars. Too often, state spending on local projects tends to crowd-out more efficient private investment or philanthropy, or devolves into a type of "corporate welfare" that benefits select special interests rather than the public at-large.[13] Economic and political realities have taught us that once a funding stream has been opened, it is difficult to close—and that difficulty leads to government expansion and overspending taxpayer dollars on costly projects that most state taxpayers may never enjoy. As The Buckeye Institute's Piglet Book has explained, local projects and programs should be paid for with local dollars to avoid spending state taxpayer funds on projects that only benefit a select few.[14]

Recommendation

Lawmakers should look to simplify the state's tax code by standardizing and streamlining the municipal tax collection process. Local governments should be responsible for providing local services to the communities they serve, which will encourage local government autonomy and accountability, and help keep spending from depending on highly variable revenue sources.

[13] Matthew D. Mitchell and Jakina R. Debnam, **In the Long Run, We're All Crowded Out**, working paper, Mercatus Center, George Mason University, September 22, 2010.
[14] Greg R. Lawson, ***2017 Ohio Piglet Book***, The Buckeye Institute, March 29, 2017.

Principle 3: Budget Surpluses Should Be Saved or Returned to Taxpayers

In 2018, Ohio's economy enjoyed a good year. Job creation grew at a faster rate than the national average, and it was the third highest job growth year in three decades.[15] It also was the ninth straight year of record-breaking new business creation.[16] The state reported a budget surplus of more than $600 million for Fiscal Year 2018 and currently has a budget surplus of more than $210 million.[17] But budget surpluses should be saved for leaner years ahead or returned to taxpayers, not used as an excuse for more government spending.

Recent budget surpluses wisely have been saved in Ohio's rainy day fund to help insure against the hardships of a future economic downturn. But as that rainy day fund approaches its statutory cap, policymakers should also consider returning surplus tax revenues to the people who earned them—Ohio taxpayers. Ohio families and businesses deserve to keep more of their earnings and paychecks. Prudent budgeting and fiscal discipline should benefit taxpayers directly through lower income and CAT rates.

Economists have shown that whereas tax increases reduce economic activity and discourage individuals from working, lower income taxes increase the number of people working and create incentives for workers to work and earn more.[18] As more people work and earnings rise, the state can recoup some lost revenue from tax cuts and become more prosperous in the long run.

When lowering tax rates and allowing taxpayers to keep more of their earnings, policymakers should look to reduce tax rates on the most distortionary and disruptive taxes: income taxes. OECD economists and economic studies show that taxing businesses and earned incomes do far more economic harm than broad-based taxes such as property and sales taxes.[19] Therefore, when reducing tax rates, policymakers should first reduce rates on the more distortionary taxes and thereby encourage more economic activity and growth, and replace them, if necessary, with less distortionary broad-based taxes.

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[15] **Employees on nonfarm payrolls by State and major industry, seasonally adjusted (Table D-1)**, bls.gov (Last visited January 8, 2019).

[16] Kara Driscoll, **Ohio Sees Record-Breaking Year for New Business Growth**, *Springfield News-Sun*, January 4, 2019.

[17] State of Ohio Office of Budget and Management, ***Annual Report Fiscal Year 2018***, August 1, 2018; and Timothy S. Keen, ***Monthly Economic Summary and State Financial Report***, State of Ohio Office of Budget and Management, January 10, 2019.

[18] Åsa Johansson, Christopher Heady, Jens Arnold, Bert Brys and Laura Vartia, "**Taxation and Economic Growth**," working paper, Organisation for Economic Cooperation and Development Economics Department, July 11, 2008; Rudolf Macek, "**The Impact of Taxation on Economic Growth: Case Study of OECD Countries**," *Review of Economic Perspectives*, Volume 14, Issue 4 (December 2014) p. 309-328; Martin Feldstein, "**The Effect of Marginal Tax Rates on Taxable Income: A Panel Study of the 1986 Tax Reform Act**," *Journal of Political Economy* Volume 103, Issue 3 (June 1995) p. 551-572; Stacy Dickert, Scott Houser, and John Karl Scholz, "**The Earned Income Tax Credit and Transfer Programs: A Study of Labor Market and Program Participation**," *Tax Policy and the Economy*, Volume 9 (January 1995) p. 1-50; Nada Eissa and Jeffrey B. Liebman, "**Labor Supply Response to the Earned Income Tax Credit**," *The Quarterly Journal of Economics*, Volume 111, Issue 2 (May 1996) p. 6054-637; and Bruce Meyer and Dan T. Rosenbaum, "**Welfare, The Earned Income Tax Credit, and the Labor Supply of Single Mothers**," *The Quarterly Journal of Economics*, Volume 116, Issue 3 (August 2001) p. 1063-1114.

[19] Organisation for Economic Cooperation and Development, ***Tax Policy Reform and Economic Growth***, November 3, 2010, p. 3.

If policymakers decide against reducing taxes, Ohio should use its budget surplus to continue growing its rainy day fund. Despite approaching its statutory maximum, the rainy day fund remains well below what the state needs to weather even a moderate recession, let alone a severe downturn.[20] Therefore, raising the fund's statutory cap and continuing to save surpluses will better position Ohio to withstand the next economic slowdown.

Recommendation

Policymakers should use budget surpluses to lower the tax burden on households and businesses to propel economic growth, add 2,100 more jobs, and increase business investment. If policymakers do not lower taxes, they should raise the statutory limit on the state's rainy day fund to better prepare for the next recession.

[20] Associated Press, **Ohio governor eyes surplus to top off state rainy day fund**, fox45now.com, August 8, 2018; and Dan White, Sarah Crane, Todd Metcalfe, ***Stress-Testing States 2018***, Moody's Analytics, September 18, 2018.

Principle 4: Budgets Should Grow Proportionately with Inflation and Population

State budgets must anticipate and prepare for the future. Changing populations, inflation, and demographic shifts all affect the state's spending needs and ability to raise revenue. As Ohio's population ages, for example, and more workers retire than are added to the workforce, income tax revenues will likely decline. Budget makers must account for such effects and the potential budget shortfalls. Unrealistic optimism, including the false assumption that economic prosperity will last forever, makes governments vulnerable to budget crises that too often lead policymakers to raise distortionary taxes that only exacerbate the pain of economic downturns.

To better prepare for the state's economic future, policymakers should use projections that consider changing population dynamics, rather than simply look to historical trends. One way to account for such dynamics is to tie government spending increases to population trends and inflation. Using this method, a state budget should account for price changes for goods and services, but should also rise and fall in proportion to the population it serves.[21]

Currently, Ohio applies a statutory implied growth rate to the General Reserve Fund (GRF) called the State Appropriation Limitation, which limits how much the GRF can grow from year to year based on the greater of either 3.5 percent or the sum of inflation plus population change. Unfortunately, Ohio's population growth rate is relatively flat and when combined with inflation is below 3.5 percent. This means that the portion of the budget controlled by the statutory limitation is tied to a growth rate that is above what would be needed by the state, while still giving policymakers authority to raise other parts of the budget at whatever levels they desire.

The Congressional Budget Office (CBO) calculates forecasts of general price inflation for policymakers to use when estimating the necessary cost increases for general spending. The CBO projects an inflation rate of 2.11 percent for FY2020 and 2.24 percent for FY2021.[22] Ohio's population is projected to grow by 0.07 percent annually.[23] Therefore, to maintain current spending in line with inflation and population growth, Ohio's budget will need to increase spending by 2.18 percent in FY2020 and another 2.31 percent in FY2021.

But not all costs increase at the standard rate of inflation. Medical care costs, for example, usually rise an average of 0.8 percent faster than general inflation, which will affect state spending for Medicaid.[24] Thus, the CBO's inflation forecast and Ohio's population projections suggest that

[21] This may roughly approximate how much the spending obligations of a government may change as its population changes, but does not consider demographic changes that are different from overall population growth, or changes to costs of government services that may be different from inflation, so a more rigorous calculation is possible with just a few added considerations.

[22] **10-Year Economic Projections – August 2018**, Congressional Budget Office (Last visited on January 10, 2019).

[23] **Annual Estimates of the Resident Population: April 1, 2010 to July 1, 2017**, Census.gov (Last visited January 11, 2019); and **Projections for the 50 States and D.C.**, University of Virginia's Weldon Cooper Center for Public Service, December 2018.

[24] Sheila Smith, Joseph P. Newhouse and Mark S. Freeland, "**Income, Insurance, And Technology: Why Does Health Spending Outpace Economic Growth?**" *Health Affairs*, Volume 28, Number 5 (September/October 2009) p. 1276-1284; and Steven T. Mnuchin, R. Alexander Acosta, Alex M. Azar II, Nancy A. Berryhill and Seema Verma, ***2018 Annual Report of The Boards of Trustees of the Federal Hospital Insurance and Federal Supplementary Medical Insurance Trust Funds***, Centers for Medicare and Medicaid Services, June 5, 2018.

Medicaid spending should increase by 2.98 percent in FY2020 and another 3.11 percent in FY2021.

Similarly, population dynamics also affect state expenses and must be anticipated. Spending on K-12 education, for instance, should account for changes to public school enrollment specifically, rather than just shifts in the general population. The 10-year trend in Ohio's K-12 public school enrollment shows an average annual decrease of 0.71 percent.[25] Taken with forecasts for general price inflation, this trend implies that to maintain current spending per pupil, the state's K-12 public education budget should increase by 1.4 percent in FY2020 and an additional 1.53 percent in FY2021.

Recommendation

Spending increases should be tied to dynamic inflation and population growth in order to avoid future fiscal crises, budget shortfalls, and tax increases, and to keep the state budget flexible enough to govern new problems and programs. Considering the dynamics in Medicaid and public education, for example, Ohio's general revenue fund should increase by 2.35 percent in FY2020 and 2.48 percent in FY2021, thereby maintaining an appropriate spending ratio that does not jeopardize future solvency or risk raising taxes.[26]

[25] **Frequently Requested Data – Enrollment Data**, Ohio Department of Education (Last visited January 11, 2019).
[26] **Budget in Detail – As Enacted**, obm.ohio.gov (Last visited January 11, 2019).

Policy Recommendations in Action

Economists at The Buckeye Institute's Economic Research Center (ERC) developed a dynamic scoring model to analyze how changes to tax policy impact government revenues, economic activity, job creation, and business investment. The model, calibrated for Ohio with publicly available state and federal data, is based on a similar dynamic scoring framework currently used at the federal level, which includes decisions made by businesses and households. The ERC model analyzes state policy proposals using the same methods for analyzing federal tax policy proposals, modified to address a state's specific economic conditions. The model is explained more fully in Appendix A.

By reducing distortionary taxes on businesses (the CAT) and workers (individual income tax), Ohio policymakers can reallocate $209 million (in 2018 dollars; $190 million in 2012 dollars) annually back to taxpayers.

Table 1 illustrates the recommended reduction to Ohio's CAT. Taxpayers earning between $150,000 and $1 million in gross receipts will no longer pay any CAT. Taxpayers with more than $1 million in gross receipts will remain subject to the current CAT rate of 0.26 percent, although the minimum payment is reduced by $800 across the board. According to static estimates, this change would return approximately $51 million (in 2018 dollars; $46 million in 2012 dollars) annually to Ohio businesses, which they can use to invest, hire more workers, and generate more economic growth across the state.

Table 1: CAT Proposal

Taxable Gross Receipts	Current Law CAT Liability	Proposed Policy CAT Liability
$0-$150,000	$0	$0
$150,000-$1 million	$150	$0
$1 million-$2 million	$800 + 0.26% x (Gross Receipts in excess of $1M)	0.26% x (Gross Receipts in excess of $1M)
$2 million-$4 million	$2,100 + 0.26% x (Gross Receipts in excess of $1M)	$1,300 + 0.26% x (Gross Receipts in excess of $1M)
>$4 million	$2,600 + 0.26% x (Gross Receipts in excess of $1M)	$1,800 + 0.26% x (Gross Receipts in excess of $1M)

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Table 2 illustrates the recommended reduction in the personal income tax (2018 tax brackets and rates). Adopting our recommendation would return approximately $158 million (in 2018 dollars; $144 million in 2012 dollars) annually to Ohioans.

Table 2: Income Tax Proposal

Ohio Taxable Income	Current Law	Proposed Policy
<$10,850	$0	$0
$10,850 - $16,300	$80.56 + 1.980% of excess over $10,850	$75.19 + 1.9305% of excess over $10,850
$16,300 - $21,750	$188.47 + 2.476% of excess over $16,300	$180.40 + 2.4265% of excess over $16,300
$21,750 - $43,450	$323.41 + 2.969% of excess over $21,750	$312.64 + 2.9195% of excess over $21,750
$43,450 - $86,900	$967.68 + 3.465% of excess over $43,450	$946.17 + 3.4155% of excess over $43,450
$86,900 - $108,700	$2,473.22 + 3.960% of excess over $86,900	$2,430.20 + 3.9105% of excess over $86,900
$108,700 - $217,400	$3,336.50 + 4.597% of excess over $108,700	$3,282.69 + 4.5475% of excess over $108,700
>$217,400	$8,333.44 + 4.997% of excess of $217,400	$8,225.82 + 4.9475% of excess of $217,400

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As shown in Table 3, adopting our policy recommendations will increase economic output, lead to more job creation, and still allow for a budget surplus, given current government spending. The ERC's model estimates job growth at 1,300 in first year, trending toward 2,100 more jobs within three years. Although the estimated static revenue loss due to this proposal is $190 million (in 2012 dollars), the predicted revenue loss is less due to the increase in the number of workers paying income taxes and the economic activity generated by businesses. Sound tax policy and prudent spending can strengthen Ohio's economic growth.

Table 3: Effect of CAT and Income Tax Proposal on Ohio's Economy

	Baseline				
Year	GDP	Employment	Tax Revenue	Consumption	Investment
2019	$621,431	5,507,905	$26,945	$442,083	$127,147
2020	$633,335	5,524,338	$27,461	$450,551	$129,583
2021	$645,467	5,540,819	$27,988	$459,182	$132,065
2022	$657,831	5,557,350	$28,524	$467,977	$134,595
2023	$670,432	5,573,930	$29,070	$476,942	$137,173
2024	$683,274	5,590,560	$29,627	$486,078	$139,800
2025	$696,363	5,607,239	$30,194	$495,389	$142,478
2026	$709,702	5,623,968	$30,773	$504,878	$145,208

	Difference from Baseline				
Year	GDP	Employment	Tax Revenue	Consumption	Investment
2019	$39	1,300	$(168)	$30	$443
2020	$116	2,000	$(170)	$31	$120
2021	$131	2,100	$(173)	$32	$68
2022	$136	2,100	$(176)	$33	$59
2023	$139	2,100	$(180)	$34	$58
2024	$142	2,100	$(183)	$35	$59
2025	$144	2,100	$(187)	$35	$60
2026	$147	2,100	$(190)	$36	$61

Note: GDP, tax revenues, consumption and investment in millions of 2012 dollars.
Employment is full-time equivalent non-farm jobs, rounded to the nearest hundred.

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Conclusion

Ohio's new governor and General Assembly should maintain the disciplined and prudent fiscal policy that has pulled the state out of the economic doldrums of the Great Recession. Policymakers should resist the temptation to use current economic success and surpluses to justify increased spending, and should instead save budget surpluses for rainy days ahead or return them to taxpayers through lower tax rates that will, in turn, spur greater economic growth.

Lowering the state's commercial activity tax and the individual income tax will add 2,100 more jobs to Ohio's economy and allow families and businesses to keep more of their hard-earned income. Making Ohio's tax code simpler, more transparent, and making local governments more efficient will ensure that it can sustain and strengthen the economic growth it has recently enjoyed. Using budget surpluses to lower taxes or grow the state's rainy day fund will encourage more economic growth, prepare for a recession, and ensure a quicker recovery from the next economic downturn. Tying Ohio's budget to inflation and dynamic population trends will help root state spending in economic data and not special interests, and thus maintain government spending growth rates at 2.35 and 2.48 percent in FY2020 and FY2021, respectively.

Adopting these policy recommendations during this budget cycle will provide more Ohioans with the opportunity for greater economic prosperity and help safeguard the state against future economic downturns.

Appendix A: The Economic Research Center Tax Model

Economists at The Buckeye Institute's Economic Research Center (ERC) have developed and maintain a dynamic scoring model to analyze how changes to tax policy impact not only government revenues but also economic output, job creation, and business investment. Unlike static models that do not account for human or market responses to policy changes, the ERC's dynamic model predicts how individuals, households, and businesses will alter their economic choices in response to changes in the private economy and public policy over time.

For this paper, the ERC calibrated the model for Ohio using publicly available state and federal data, and relied on a similar dynamic scoring framework used by federal agencies to evaluate federal tax proposals to predict how certain policy changes will affect gross domestic product (GDP), job creation or loss, and government revenue.

The ERC's model has undergone a double-blind peer review and incorporated comments from those reviews consistent with current academic standards and methodologies. The model's full technical description provided below will allow researchers to validate the model's accuracy and the conclusions that we have drawn.

The Model Framework

The ERC's dynamic model provides a framework representing a generic state economy, with its parameters calibrated to the specific state being analyzed. It allows researchers to study the interaction of households' economic choices and firms' profit maximizing decisions with a state government that pays for its budget by taxing households and businesses. The model framework is similar to those used to study national policy, modified with some conditions tailored to the specific economic conditions of a state. Because states have more limits to trade and debt relative to a national economy, for example, the ERC's model includes a condition in which state governments satisfy a budget constraint where debt cannot increase beyond a certain level. Our model is comprised of the following three parts:

1) *The Household Problem*: Households choose how much to consume and how much to work based on their preferences and their budgets. Households can also choose to take on debt or invest in capital used by firms. Their budgets factor in sales and excise taxes on consumption, labor income (both at the state and federal level), capital income (both at the state and federal level), and licensing. The parameters governing these taxes are estimated using state and federal data.

2) *The Firm Problem*: Firms choose labor and capital, supplied by the household, to maximize profits taking the costs of production (wages, the price of capital, and taxes) as given. Using state-level data, the model simulates production within separate sectors. The output produced is used for consumption, government expenditures, or investments in factors of production.

3) *The Government Sector*: The government sets taxes to collect revenue to pay for its expenditures; however, deficits and surpluses are allowed to a limited degree. The state's

trade balance is a mathematical output of what is consumed, invested in, and government expenditures less total production in the economy.

With this framework, we then explicitly define how households and firms make their economic choices.

In the model environment, time is discrete and lasts forever. In every period the economy is populated by heterogeneous households specialized in the production of one of s types of goods. The Bureau of Economic Analysis (BEA) reports macroeconomic data for the 50 states in yearly intervals, so each period represents a year in this framework. Each sector s is populated by a large number of firms specialized in the production in their sector. The economy also features a government sector that collects taxes and purchases goods from all sectors. A share $q^e \in (0,1)$ of households has earning ability $e = \{1, \dots, E\}$. These shares are such that the total population is $\sum_{e=1}^{E} q^e = 1$. The share of households with the required skills to work in sector s is $\mu_s \in (0,1)$ such that $\sum_{s=1}^{S} \mu_s = 1$. We then outline each part of the model: the household problem, the firm problem, and the government sector.

The Household Problem

The household has preferences between consumption and leisure. These preferences are represented by a period t utility function U_t, which takes the following form:

$$U_t = \sum_{s=1}^{S} \alpha_s \ln\left(c_{e,t}(s)\right) - \chi_e l_{e,t}(s)^{\left(1+\frac{1}{\psi_e}\right)}$$

Taking the prices, taxes, and previous period $t-1$ choices as given, each period t, household e chooses: how much to consume $c_{e,t}(s)$ from each sector s; the amount of future capital stock $k_{e,t}(s)$ for each sector s; investment $x_{e,t}(s)$ for each sector s; how much to borrow in debt $d_{e,t}$; and how much to work $l_{e,t}(s)$ in each sector s. Households place a utility weight on consumption goods according to $\alpha_s \in (0,1)$ where α_s represents the share of total GDP in sector s. Period time is split between labor and leisure such that total time is normalized to 1. Leisure $h_{e,t}$ can be defined as:

$$h_{e,t} = 1 - \sum_{s=1}^{S} l_{e,t}(s)$$

where $h_{e,t} \in [0,1]$ and $l_{e,t}(s) \in [0,1]$. The parameter that regulates the Frisch elasticity of labor supply is denoted ψ_e. χ_e is a scaling factor that helps match hours worked observed in the data. The household seeks to maximize its utility by solving the following problem:

$$V_{e,t}(s) = \max_{c_{e,t}(s), x_{e,t}(s), l_{e,t}(s), k_{e,t}(s), d_{e,t}} U\left(c_{e,t}\right) - \chi_e l_{e,t}(s)^{\left(1+\frac{1}{\psi_e}\right)} + \beta E[V_{e,t+1}(s)]$$

The economic decisions for period t are subject to the following constraints:

$$d_{e,t} = (1+\tau_t^c+\tau_t^{ex})\sum_{s=1}^{S} c_{e,t}(s) + \sum_{s=1}^{S} x_{e,t}(s) + \left(1+i_{r,t-1}\right)d_{e,t-1} + \tau_t^k \sum_{s=1}^{S} k_{e,t-1}(s)$$
$$+\left[\frac{\phi}{2}\left(\sum_{s=1}^{S} k_{e,t}(s) - \sum_{s=1}^{S} k_{e,t-1}(s)\right)^2\right] - \left(1-(1-\eta_{e,t}^{i,n})\tau_{e,t}^{i,n} - \tau_t^o\right.$$
$$\left. - \tau_{e,t}^{i,n,f}\right)\sum_{s=1}^{S} w_{e,t}(s)l_{e,t}(s) - \left(1-(1-\eta_{e,t}^{i,r})\tau_{e,t}^{i,r} - \tau_t^o - \tau_{e,t}^{i,r,f}\right.$$
$$\left. - \tau_t^{corp}\right)\sum_{s=1}^{S} r_{e,t}(s)k_{e,t-1}(s)$$
$$k_{e,t}(s) = x_{e,t}(s) + (1-\delta)k_{e,t-1}(s)$$
$$c_{e,t}(s) \geq 0$$
$$k_{e,t}(s) \geq 0,\ k_{e,T+1}(s) = 0$$

$V_{e,t}(s)$ defines expected utility discounted at a patient factor $\beta \in [0,1]$. As in Mendoza (1991), ϕ denotes a capital adjustment cost. The return on capital lent to firms is $r_{e,t}(s)$. The wage paid to workers of type e in sector s is $w_{e,t}(s)$. Future capital stock $k_{e,t}(s)$ is the sum of current capital stock $k_{e,t-1}(s)$, accounting for depreciation δ, and investment $x_{e,t}(s)$. $i_{r,t}$ denotes the interest rate at which domestic residents can borrow from international markets in period t, and $d_{e,t}$ is household debt.

Following Schmitt-Grohé and Uribe (2003), we assume a debt elastic interest rate. This is modeled as $i_{r,t} = i_{r,w} + \zeta(e^{D_t - D} - 1)$ where $i_{r,w}$ is the world interest rate faced by domestic agents and is assumed to be constant and ζ and D are constant parameters that are calibrated to match the state's economy. $\zeta(e^{D_t - D} - 1)$ is the state specific interest rate premium that increases with the level of debt. D_t represents the aggregate state level of debt, such that $D_t = \sum_{e=1}^{E} d_{e,t}$.

τ_t^c is the tax on household consumption purchases, which includes general sales tax, and τ_t^{ex} is the excise tax rate. $\tau_{e,t}^{i,n}$ is the statutory individual labor income tax rate, and $\tau_{e,t}^{i,r}$ is the individual capital income tax rate. $\eta_{e,t}^{i,n}$ and $\eta_{e,t}^{i,r}$ are the proportions of labor income and capital income respectively that are deducted or otherwise exempt from income taxes. $\tau_{e,t}^{i,n,f}$ is the individual labor income tax collected by the federal government, and $\tau_{e,t}^{i,r,f}$ is the individual capital income tax collected by the federal government. Income tax rates depend on the individual earning ability e. τ_t^k is a tax on fixed assets owned by households. $\tau_t^{corp}$is the corporate income tax faced by the owners of capital. τ_t^o is the share of income paid to all other taxes, fees, and revenue sources for the state government not included specifically in the model.

The variables representing households' economic decisions for each period t and sector s can be summarized as the set: $\left\{\left\{c_{e,t}(s), x_{e,t}(s), l_{e,t}(s), k_{e,t+1}(s)\right\}_{s=1}^{S}, d_{e,t}\right\}_{t=0}^{\infty}$. The household then maximizes the utility function subject to the resource constraint and a no-Ponzi scheme constraint

that implies that the household's debt position must be expected to grow at a rate lower than the interest rate in the long-run.

The Firm Problem

In each sector s, a large number of competitive firms produce goods according to the following constant elasticity of substitution (CES) production function:

$$y_t(s) = a_t\left(\sum_{e=1}^{E}\left((\theta_s)\left(k_{e,t-1}(s)\right)^{-\rho} + (1-\theta_s)\left(z_e\, l_{e,t}(s)\right)^{-\rho}\right)^{-\frac{1}{\rho}}\right)$$

where a_t is total factor productivity (TFP), θ_s is associated with the capital share of total output in sector s, and $\sigma_{CES} = \frac{1}{1-\rho}$ is the constant elasticity of substitution between capital and labor. z_e is labor productivity specific to a household member's earning ability. These firms solve the following profit maximization problem:

$$\Pi_t = (1-\tau_t^{CAT})a_t\left(\sum_{e=1}^{E}\left((\theta_s)\left(k_{e,t-1}(s)\right)^{-\rho} + (1-\theta_s)\left(z_e\, l_{e,t}(s)\right)^{-\rho}\right)^{-\frac{1}{\rho}}\right) - \sum_{e=1}^{E} w_{e,t}(s)l_{e,t}(s) - \sum_{e=1}^{E} r_{e,t}(s)k_{t-1}(s)$$

It is important to note that the demand for labor and capital is sector s specific. τ_t^{CAT} is a commercial activity tax, modeled as a tax on a firm's revenues.

The representative firm in sector s hires labor according to the following condition:

$$(1-\tau_t^{CAT})\,(1-\theta_s)a_t\left((\theta_s)\left(k_{e,t-1}(s)\right)^{-\rho} + (1-\theta_s)\left(z_e\, l_{e,t}(s)\right)^{-\rho}\right)^{-\frac{1}{\rho}-1}\left(z_e l_{e,t}(s)\right)^{-\rho-1} z_e = w_{e,t}(s),$$

where $w_{e.t}(s)$ is the wage rate for type e in sector s. The demand for capital is such that:

$$(1-\tau_t^{CAT})(\theta_s)a_t\left((\theta_s)\left(k_{e,t-1}(s)\right)^{-\rho} + (1-\theta_s)\left(z_e\, l_{e,t}(s)\right)^{-\rho}\right)^{-\frac{1}{\rho}-1}\left(k_{e,t-1}(s)\right)^{-\rho-1} = r_{e,t}(s),$$

We assume a_t follows a stationary mean zero autoregressive process of order 1 in the log, which can be represented in the following way:

$$(a_t) = \rho_A(a_{t-1}) + \epsilon_{A,t}$$

The innovation shock $\epsilon_{A,t}$ is drawn from a standard normal distribution.

The Government Sector

The government sets taxes and collects revenue to make purchases. Its contribution to the rainy day fund RF_t is the excess of tax revenue plus federal government transfers net of government spending added to the previous period's balance.

$$RF_t = TR_t + FF_t - g_t + \left(1 + i_{r,t}\right)RF_{t-1}$$

Deficits—negative contributions—to the rainy day fund reduce the fund's balance.

The state government's tax revenues TR_t are given by:

$$TR_t = \sum_{s=1}^{S}\left(\sum_{e=1}^{E}\Big(\tau_{\mathrm{t}}^{\mathrm{CAT}} y_{(e,t)}(s) + (\tau_t^c + \tau_t^{ex})c_{e,t}(s) + (1-\eta_{e,t}^{i,n})\tau_{e,t}^{i,n}\, w_{e,t}(s)l_{e,t}(s) + (1-\eta_{e,t}^{i,r})\tau_{e,t}^{i,r}\, r_{e,t}(s)k_{e,t-1}(s) + \tau_t^k k_{e,t-1}(s)\Big) + \tau_t^o\, y_t(s)\right)$$

Government spending is proportional to GDP and is specified as $g_t = \hat{g}_t y_t$. This implies that government spending is assumed to grow as the economy grows. Spending policy $\hat{g}_t$ is assumed to evolve according to:

$$\hat{g}_t = \left(1 - \rho_{g,h}\right)(\hat{g}) + \rho_{g,h}(\hat{g}_{t-1}) + \epsilon_g$$

where $\hat{g}$ is the state share of income spent by the government sector in the long-run, the steady-state equilibrium. Variables without the time subscript denote steady-state values.

The tax instruments follow the exogenous processes:

$$\tau_t^{i,n} = (1-\rho_{i,n})\tau^{i,n} + \rho_{i,n}\tau_{t-1}^{i,n} + \epsilon_{i,n}$$
$$\tau_t^{i,r} = (1-\rho_{i,r})\tau^{i,r} + \rho_{i,r}\tau_{t-1}^{i,r} + \epsilon_{i,r}$$
$$\tau_t^{c} = (1-\rho_{c})\tau^{c} + \rho_{c}\tau_{t-1}^{c} + \epsilon_{c}$$
$$\tau_t^{ex} = (1-\rho_{ex})\tau^{ex} + \rho_{ex}\tau_{t-1}^{ex} + \epsilon_{ex}$$
$$\tau_t^{corp} = (1-\rho_{corp})\tau^{corp} + \rho_{corp}\tau_{t-1}^{corp} + \epsilon_{corp}$$
$$\tau_t^{k} = (1-\rho_{k})\tau^{k} + \rho_{k}\tau_{t-1}^{k} + \epsilon_{k}$$
$$\tau_t^{o} = (1-\rho_{o})\tau^{o} + \rho_{o}\tau_{t-1}^{o} + \epsilon_{o}$$
$$\tau_t^{i,n,f} = (1-\rho_{i,n,f})\tau^{i,n,f} + \rho_{i,n,f}\tau_{t-1}^{i,n,f} + \epsilon_{i,n,f}$$
$$\tau_t^{i,r,f} = (1-\rho_{i,r,f})\tau^{i,r,f} + \rho_{i,r,f}\tau_{t-1}^{i,r,f} + \epsilon_{i,r,f}$$

$$\eta_t^{i,n} = (1-\rho_{\eta,n})\eta^{i,n} + \rho_{\eta,n}\tau_{t-1}^{i,n} + \epsilon_{\eta,n}$$
$$\eta_t^{i,r} = (1-\rho_{\eta,r})\eta^{i,r} + \rho_{\eta,r}\eta_{t-1}^{i,r} + \epsilon_{\eta,r}$$

As in Schmitt-Grohé and Uribe (2003), we write the trade balance to GDP ratio (TB) in steady-state as:

$$TB = 1 - \frac{[c + x + g]}{y}$$

The Competitive Equilibrium

A competitive equilibrium is such that given the set of exogenous processes, households solve the household utility maximization problem, firms solve the profit maximization problem, and the capital and labor markets clear.

The Deterministic Steady-State

The characterization of the deterministic steady state is of interest for two reasons. First, the steady-state facilitates the calibration of the model. This is because the deterministic steady-state coincides with the average position of the model economy to a first approximation. Because of this, matching average values of endogenous variables to their observed counterparts (e.g., matching predicted and observed average values of the labor share, the consumption shares, or the trade-balance-to-output ratio) can reveal information about structural parameters that can be used in the calibration of the model. Second, the deterministic steady-state is often used as a convenient point around which to approximate equilibrium conditions of the stochastic economy (see Schmitt-Grohe and Uribe, 2003). For any variable, we denote its steady-state value by removing the time subscript.

Using the solution from the households' and firms' choice problems, the steady-state implies that:

$$1 = \beta\left[\left(1-(1-\eta_e^{i,r})\tau_e^{i,r} - \tau^o - \tau_e^{i,r,f} - \tau^{corp}\right)r_e(s) + 1 - \delta - \tau^k\right]$$
$$y(s) = a\left(\sum_{e=1}^{E}\left((\theta_s)\left(k_e(s)\right)^{-\rho} + (1-\theta_s)\left(z_e\, l_e(s)\right)^{-\rho}\right)^{-\frac{1}{\rho}}\right)$$
$$(1-\tau^{CAT})a\left[\theta_s\left(\frac{k_e(s)}{l_e(s)}\right)^{-\rho} + (1-\theta_s)z_e^{-\rho}\right]^{-\frac{1}{\rho}-1}\theta_s\left(\frac{k_e(s)}{l_e(s)}\right)^{-\rho-1} = r_e(s)$$

These expressions deliver the steady-state capital-labor ratio, which we denote $\omega_e(s)$

$$\omega_e(s) \equiv \frac{k_e(s)}{l_e(s)}$$
$$= (1-\theta_s)^{-\frac{1}{\rho}}(z_e)\left(\frac{\beta^{-1}-1+\delta+\tau^k}{a(1-\tau^{CAT})\theta_s\left(1-(1-\eta_{e,t}^{i,r})\tau_e^{i,r}-\tau^o-\tau_e^{i,r,f}-\tau^{corp}\right)}-\theta_s\right)^{\frac{1}{\rho}}$$

The steady-state level of capital is:

$$k_e(s) = \omega_e(s) l_e(s)$$

Finally, the steady-state level of consumption can be obtained by evaluating the resource constraint at the steady-state:

$$\sum_{e=1}^{E} c_e(s) = y(s) - \delta \sum_{e=1}^{E} k_e(s) - g\mu_s - TBy(s)$$

which implies: $y = c + x + g + TBy$

As for the parameter that dictates households' preference for leisure:

$$\chi_e = \frac{\alpha_s}{(1+\tau^c+\tau^{ex})c_e(s)} \times \frac{(1-(1-\eta_{e,t}^{i,n})\tau_e^{i,n}-\tau^o-\tau_e^{i,n,f})w_e(s)}{\left(1+\frac{1}{\psi_e}\right) l_e(s)^{\frac{1}{\sigma_e}}}$$

Data and Calibration

Our data for calibrating the model come from publicly available federal and state data sources. First, we present our sources for the model's output variables. Then we present the sources for the model parameters and our empirical methodology for calibrating the model.

Output Variables

Primarily, we utilize BEA Regional Economic Accounts for Ohio for our output. All GDP variables are reported in real (2012 dollars) per capita terms using the U.S. GDP deflator reported by the BEA and, if not declared otherwise, we refer to the period of 1963-2017.

Our GDP projections use the latest GDP values and apply the state's GDP long-run annual growth rate of 1.92 percent from 1992-2017.

For our measure of consumption, consumption expenditures on durable goods are subtracted from total personal consumption expenditures (PCE). We consider durable goods as investment goods,

as is standard in the macroeconomics literature. The values for PCE are not available on the state-level prior to 1997.

We therefore use the long-run average share of consumption in GDP to obtain the level of consumption for each year from 1963-1997. Because the BEA does not report private fixed investment at the state level, we use the U.S. share of non-residential investment in GDP from the BEA, and multiply it by the state GDP to estimate non-residential gross investment. The sum of non-residential investment and consumption expenditures on durable goods represents our measure of investment. Our methodology excludes residential investment from our measure of investment (residential investment is excluded from GDP as well).

We base our employment data for the number of non-farm jobs on data from the Bureau of Labor Statistics. We calculate the employment shares per sector using data from the BEA Regional Economic Accounts. We took the average weekly hours worked from the Annual Social and Economic Supplement of the Current Population Survey. The average weekly hours worked at all jobs is divided by the total number of hours per week (168 hours) to calculate average labor supply used for the model calibration. For the baseline projections, employment is assumed to grow at its annual growth rate for 1992-2017 of 0.3 percent.

We used the following methodology to estimate the effects of the tax policy scenarios on employment because the model measures employment in hours worked (intensive margin). First, we use employment multiplied by the average hours worked per year (2,155 hours). This total number of hours worked per year is multiplied by the effect of the corresponding scenario in order to obtain the change in total hours worked for each scenario. Finally, the change in hours is converted into the number of full-time equivalent jobs gained or lost by dividing it by 2,080, which is the number of hours worked by a full-time equivalent employee according to the CBO's definition (Harris and Mok, 2015).

Model Parameters and Calibration

Typically, a calibration assigns values to the model parameters by matching first and second moments of the data that the model aims to explain. We utilize moments in state and federal data to estimate the model parameters.

Because depreciation data are not reported at the state level by the BEA, we refer to data for the U.S. economy. The sum of current cost depreciation in nonresidential private fixed assets and consumer durable goods is divided by the sum of current cost net stock of nonresidential private fixed assets and consumer durable goods for the years 1963-2015. The average over this period represents the depreciation rate in our model. The depreciation rate of capital is $\delta = 0.1$.

The world interest rate is $i_{r,w} = 0.04$, based on the difference between the nominal interest rate for three-month treasury bill and the GDP deflator.

To compute the sector-specific labor shares, we use data from the BEA Regional Income Division. Similar to Gomme and Rupert (2004), we divide the compensation of employees by the personal income for each sector. As personal income is not available for sectors, we construct it by

multiplying the earnings per sector by the total economy's personal income-to-earnings ratio, which is from the BEA Regional Income Division. The capital share is simply one minus the labor share. The values refer to the years 1998-2017. The sector specific parameter θ_s is set to match the observed average labor shares for each of the $S = 9$ production sectors.[27] In the present model, the labor share is given by the ratio of labor income to output which is $1 - \theta_s$ at all times. To ensure that capital and investment are not being overstated (or understated), the parameter ν, a cost on holding capital, is applied to adjust the steady state rental rate of capital, calibrating it to match the state's investment share of GDP.[28]

The earning ability for household types is based on the distribution of income and population as reported in the Ohio Department of Taxation annual report for Fiscal Year 2018.[29]

- Earning ability 1 has an adjusted gross income (AGI) of up to $50,000 per year;
- Earning ability 2 is from $50,000-$200,000;
- Earning ability 3 has an AGI of more than $200,000-$500,000;
- Earning ability 4 has an AGI of more than $500,000-$1,000,000; and
- Earning ability 5 has an AGI of more than $1,000,000 per year.

The share of household members by earning ability, q^e, is the share of returns per earning ability group. The labor productivity per earning ability, z_e, is the income per return for each earning ability with the labor productivity for group 1 being normalized to one. We take our Frisch elasticity estimate $\psi_e = 0.4$ from Reichling and Whalen (2012). The parameter D is set to match the observed average trade-balance to output ratio since $TB = i_{r,w}\frac{D}{y}$. We estimate tax rates similar to the methodology used by McDaniel (2007).[30]

The full list of parameters is included in Appendix B.

[27] See complete list of sectors in Appendix B.

[28] The holding cost of capital is incorporated mathematically in the following way to steady state rental rate of capital: $r^*_{e,s} = \frac{\frac{1}{\beta}+\tau^k_e+\nu-(1-\delta)}{(1-(1-\eta^{i,r}_{e,t})\tau^{i,r}_e-\tau^{i,r,f}_e-\tau^{co}-\tau^s_s-\tau^o)}$.

[29] Ohio Department of Taxation, ***Annual Report Fiscal Year 2018***.

[30] A complete explanation of the methodology is included in Appendix B.

Appendix B: Tax Model Parameters

Tax Rate Estimates

The state tax rates calculated in this paper are average Ohio tax rates. The general strategy employed is as follows. First, total income is categorized as labor income or capital income and private expenditures are categorized as consumption or investment. Second, tax revenues are classified as revenues generated from taxes on labor income, capital income, private consumption expenditures, or private investment. To find a given tax rate, we divide each category of tax revenue by the corresponding income or expenditure. Since we compute tax rates in the same fashion each year, we drop time subscripts for the rest of this section.

Data on tax revenues come from U.S. Census Bureau Survey of State Government Tax Collections (STC) and the Ohio Department of Taxation annual report for Fiscal Year 2018.[31] Data on income and expenditures come from regional BEA data. In any given year, total tax revenues collected by the government are the sum of taxes on production and imports (TPI), social security contributions, direct taxes on households (HHT), and direct taxes on corporations. The following sections detail the steps we take to categorize these tax revenues and calculate average tax rates.

Share of the Income Tax that Falls on Labor

The average tax rate on labor income is found by dividing labor income tax revenues by economy-wide total wage and salary labor income. To compute the labor income tax rate, we calculate labor income tax revenues and labor income. Labor income tax revenues come from two sources: the household income tax and social security taxes. However, household income taxes represent taxes on total income. Since only a portion of this income is generated from labor, only a portion of these taxes reflects taxes on labor income.

Unfortunately, the STC and BEA do not break down household income taxes according to type of income. For this reason, papers calculating average tax rates on labor and capital income based on aggregate data, such as Mendoza et al. (1994), assume that the tax rate on household labor income is the same as the tax rate on household capital income. We make the same assumption.

The federal income tax rate is found by dividing total federal taxes on income of the household, $FHHT$, by total household income in each period. Household income is defined as gross domestic product less net taxes on production and imports, or $GDP - (TPI - Sub)$. The household income tax rate is therefore measured as:

$$\tau^{i,f} = \frac{FHHT}{GDP - (TPI - Sub)}$$

It remains to divide income into payment to capital and payment to labor. Let θ be the share of income attributed to capital, with the remaining $(1 - \theta)$ share attributed to labor. Total household income taxes paid on labor income are represented by

[31] **2017 Annual Survey of State Government Tax Collections Detailed Table**, U.S. Department of Commerce, U.S. Census Bureau (Last visited January 14, 2019); and Ohio Department of Taxation, ***Annual Report Fiscal Year 2018***.

$$FHHT_L = \tau^{i,l,f}(1-\theta)\big(GDP-(TPI-Sub)\big)$$

The second source of tax revenue generated from taxes on labor income are social security taxes, *SS*. This corresponds to an exact entry in the BEA data, no further adjustment is required. Social security taxes combined with *HHTL* represent total tax revenues that are classified as taxes paid on labor income, so the average tax rate on labor income is measured as:

$$\tau^{i,n,f} = \frac{SS + FHHT_L}{(1-\theta)\big(GDP-(TPI-Sub)\big)}$$

At the state level, we calculate income tax rates for a variety of earning groups. The state income tax rate is found by dividing total state taxes on income of the household, $SHHT_e$, by total household income in each period. Household income, total state taxes on income of the household, as well as population are distributed according to the distribution reported in the Ohio Department of Taxation annual report for Fiscal Year 2018.[32] Household income is defined as gross domestic product less net taxes on production and imports, or $GDP-(TPI-Sub)$. The household income tax rate is therefore measured as:

$$\tau^{i} = \frac{SHHT_e}{\big(GDP-(TPI-Sub)\big)_i}$$

It remains to divide income into payment to capital and payment to labor. Let θ be the share of income attributed to capital, with the remaining (1 − θ) share attributed to labor. Total household income taxes paid on labor income are represented by

$$SHHT_{e,i} = \tau^{i,n}(1-\theta)\big(GDP-(TPI-Sub)\big)_i$$

The average state tax rate on labor income is measured as:

$$\tau^{i,n} = \frac{SHHT_{e,i}}{(1-\theta)\big(GDP-(TPI-Sub)\big)_i}$$

Consumption and Investment Tax Rates

Revenue collected from taxes levied on consumption and investment expenditures are included in taxes on production and imports, TPI. Consumption and investment expenditures are subsidized by the amount Sub. TPI includes general taxes on goods and services, excise taxes, import duties and property taxes. The task remains to properly allocate TPI to the relevant tax revenue category. This requires the proper division of TPI across consumption and investment. TPI includes the following components: Property taxes, general taxes on goods and services, excise taxes, taxes on specific services, and taxes on the use of goods to perform activities.

[32] Ohio Department of Taxation, ***Annual Report Fiscal Year 2018***.

Some of the taxes included in TPI fall only on consumption expenditures. Others fall on both consumption and investment expenditures. Revenue from taxes that fall on both consumption and investment expenditures are assumed to be split between consumption tax revenue and investment tax revenue according to consumption and investment share in private expenditures. Taxes that fall strictly on consumption are excise taxes and taxes on specific services, reported as select sales taxes in the STC data.

Taxes that fall on both consumption and investment are general sales and use taxes, and taxes on use of goods to perform activities, which includes motor vehicle taxes, highway taxes, license taxes, etc. These goods are used in the production of both investment goods and consumption goods, and can be calculated by subtracting select sales taxes, total income taxes, and corporation license taxes from total taxes in the STC data.

After identifying taxes that fall strictly on consumption expenditures, we calculate λ, their share of TPI. Revenue collected from taxes levied on consumption expenditures is calculated as:

$$TPI_C = \left(\lambda + (1-\lambda)\left(\frac{C}{C+I}\right)\right)(TPI - Sub)$$

Consumption expenditures are reported in the national accounts gross of taxes. Taxable consumption expenditures are then $C - TPI_c$ and the consumption tax is measured as:

$$\tau^C = \frac{TPI_C}{C}$$

Since TPI_c represents revenue from consumption taxes, the remaining portion of $TPI - Sub$ is attributed to taxes on investment.

$$TPI_X = TPI - Sub - TPI_C$$

Share of the Income Tax that Falls on Capital

As calculated previously, income paid to capital in the economy is $\theta(GDP - (TPI - Sub))$. $OSGOV$ is gross operating surplus earned by the government, and therefore is not subject to tax. Taxable capital income is therefore $\theta(GDP - (TPI - Sub)) - OSGOV$. Capital tax revenues come from the following sources: the household income tax, and taxes levied on corporate income. Federal household taxes on capital, $FHHT_K$, is then

$$FHHT_K = \tau^{i,r,f}\theta\big(GDP - (TPI - Sub)\big)$$

The federal household capital income tax rate is then

$$\tau^{i,k,f} = \frac{FHHT_k}{\theta\big(GDP - (TPI - Sub)\big) - OSGOV}$$

Federal corporate tax data (FCT) is only available at the national level, therefore we first approximate the share of corporate tax paid by Ohio.

The federal corporate tax rate is computed using national data as:

$$\tau^{CT,F} = \frac{FCT}{\theta\big(GGDP - (TPI - Sub)\big) - OSGOV}$$

As owners of corporations, households are subject to all corporate taxation. The total federal capital income tax is then:

$$\tau^{i,r,f} = \tau^{CT,F} + \tau^{i,k,f}$$

At the state level household capital income tax is

$$SHHT_{K,i} = \tau^{i,k}\left(\theta\big(GDP - (TPI - Sub)\big)_i\right)$$

Where the household income and tax burden are once again distributed according to the distribution reported in the Ohio Department of Taxation annual report for Fiscal Year 2018.[33]

The state household capital income tax rate is then

$$\tau^{i,r} = \frac{\big(SHHT_{K,i} + SCT_i\big)}{\theta\big(GDP - (TPI - Sub)\big)_i - OSGOV_i}$$

[33] Ohio Department of Taxation, ***Annual Report Fiscal Year 2018***.

Sectors

Our model uses nine production sectors. The BEA reports GDP for each two-digit North American Industry Classification System (NAICS) industries, which we use to calculate each sector's percentage in total GDP (see Table B-4). Some of our sectors are the same as reported by the BEA, the remaining sectors are constructed by combining several NAICS industries as shown in Table B-1.

Table B-1: Definition of Sectors

Sector	NAICS Sectors
Agriculture, Forestry, Fishing, and Hunting	Agriculture, Forestry, Fishing, and Hunting
Mining	Mining
Utilities, Transportation, and Warehousing	Utilities Transportation and Warehousing
Construction	Construction
Manufacturing	Manufacturing
Trade	Wholesale Trade Retail Trade
Services	Information Finance and Insurance Professional, Scientific, and Technical Services Management of Companies and Enterprises Administrative and Waste Management Services Educational Services Arts, Entertainment, and Recreation Accommodation and Food Services Other Services
Real Estate, Rental, and Leasing	Real Estate Rental and Leasing
Health Care and Social Assistance	Health Care and Social Assistance

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Parameters

The following tables present the calibrated parameters for the model.

Table B-2: Household Parameters

Disutility of Labor	$\chi_e = 44$
Real Interest Rate*	$i_{r,w} = 0.04$
Annual Depreciation Rate of Capital	$\delta = 0.1$
Frisch Elasticity of Labor Supply	$\psi_e = 0.4$
Holding Cost of Capital	$\nu = -0.034$

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*The real interest rate is based on the difference between the nominal interest rate for three-month Treasury bill and the GDP deflator from 1950 to 2015 using St. Louis Federal Reserve Bank FRED data. The annual depreciation rate of capital is based on data from the BEA for the U.S. economy. It is the average of the sum of current cost depreciation in nonresidential private fixed assets and consumer durable goods divided by the sum of current cost net stock of nonresidential private fixed assets and consumer durable goods for the years 1963 to 2015. The Frisch elasticity of labor supply is based on the central estimate from Reichling and Whalen (2012).

Table B-3: Labor Productivity

Labor Productivity	Population Distribution
$z_1 = 1$	$q^1 = 0.60202$
$z_2 = 4.57$	$q^2 = 0.35917$
$z_3 = 13.07$	$q^3 = 0.02946$
$z_4 = 31.71$	$q^4 = 0.00559$
$z_5 = 288.01$	$q^5 = 0.00375$

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Table B-4: Sector Specific Parameters

Sector	Output Share	Employment Share	Capital Share
Agriculture, Forestry, Fishing, and Hunting	$\alpha_1 = 0.007$	$\mu_1 = 0.017$	$\theta_1 = 0.691$
Mining	$\alpha_2 = 0.007$	$\mu_2 = 0.004$	$\theta_2 = 0.516$
Utilities, Transportation, and Warehousing	$\alpha_3 = 0.054$	$\mu_3 = 0.042$	$\theta_3 = 0.369$
Construction	$\alpha_4 = 0.042$	$\mu_4 = 0.058$	$\theta_4 = 0.464$
Manufacturing	$\alpha_5 = 0.218$	$\mu_5 = 0.139$	$\theta_5 = 0.275$
Trade	$\alpha_6 = 0.143$	$\mu_6 = 0.168$	$\theta_6 = 0.314$
Services	$\alpha_7 = 0.317$	$\mu_7 = 0.400$	$\theta_7 = 0.356$
Real Estate, Rental, and Leasing	$\alpha_8 = 0.124$	$\mu_8 = 0.039$	$\theta_8 = 0.538$
Health Care and Social Assistance	$\alpha_9 = 0.089$	$\mu_9 = 0.132$	$\theta_9 = 0.317$

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Table B-5: Tax Parameters

Federal individual labor income tax rate for AGI 1	$\tau_1^{i,n,f} = 0.1141$
Federal individual capital income tax rate for AGI 1	$\tau_1^{i,r,f} = 0.0611$
Federal individual labor income tax rate for AGI 2	$\tau_2^{i,n,f} = 0.2099$
Federal individual capital income tax rate for AGI 2	$\tau_2^{i,r,f} = 0.1294$
Federal individual labor income tax rate for AGI 3	$\tau_3^{i,n,f} = 0.2668$
Federal individual capital income tax rate for AGI 3	$\tau_3^{i,r,f} = 0.1389$
Federal individual labor income tax rate for AGI 4	$\tau_4^{i,n,f} = 0.2330$
Federal individual capital income tax rate for AGI 4	$\tau_4^{i,r,f} = 0.1176$
Federal individual labor income tax rate for AGI 5	$\tau_5^{i,n,f} = 0.0719$
Federal individual capital income tax rate for AGI 5	$\tau_5^{i,r,f} = 0.0417$
State individual labor income tax rate for AGI 1	$\tau_1^{i,n} = 0.0125$
State individual capital income tax rate for AGI 1	$\tau_1^{i,r} = 0.0125$
State individual labor income tax rate for AGI 2	$\tau_2^{i,n} = 0.0280$
State individual capital income tax rate for AGI 2	$\tau_2^{i,r} = 0.0280$
State individual labor income tax rate for AGI 3	$\tau_3^{i,n} = 0.0392$
State individual capital income tax rate for AGI 3	$\tau_3^{i,r} = 0.0392$
State individual labor income tax rate for AGI 4	$\tau_4^{i,n} = 0.0455$
State individual capital income tax rate for AGI 4	$\tau_4^{i,r} = 0.0455$
State individual labor income tax rate for AGI 5	$\tau_5^{i,n} = 0.0488$
State individual capital income tax rate for AGI 5	$\tau_5^{i,r} = 0.0488$
General sales tax rate (effective rate)	$\tau^{c} = 0.0288$
Excise tax rate (effective rate)	$\tau^{ex} = 0.0138$
Severance tax rate (only applies to mining sector)	$\tau^{s} = 0.0230$
Corporate income tax rate	$\tau^{corp} = 0$
Franchise tax rate	$\tau^{k} = 0$
State tax revenues proportion of GDP	$\frac{TR}{Y} = 0.12$
Other state collections	$\tau^{o} = 0.0004$
Transfers from the federal government	$\frac{FF}{Y} = 0.12$

Appendix C: Glossary of Terms

Calibrated – Matching the simulated model to the observable, real-life data by adjusting parameters to ensure the model represents the economy.

Capital adjustment cost – The time and monetary costs of changing the capital a firm uses, such as installing new machinery at a factory.

Capital share – Relative to labor, the proportion of output attributable to capital.

Cobb-Douglas production function – A simple production function in which different combinations of labor and capital quantities are used to obtain a certain quantity of product.

Comparative statics – A method of comparing different economic outcomes before and after a specified change.

Constant elasticity of substitution production function – A production function that assumes the elasticity of substitution is constant, meaning that a change in input factors will result in a constant change in output.

Debt elastic interest rate – An economy-wide interest rate that changes based on the economy's foreign debt holdings.

Depreciation rate – The rate at which capital, such as a car or computer, loses value over time.

Discrete – Measured as separate, distinct points in time, e.g., a person's age in years.

Dynamic scoring – A model that evaluates how changes in policy will change people's economic behavior, or the secondary impacts of a change (e.g., examining the employment and GDP changes that occur as a result of a policy change).

Elasticity – A measure of how the demand of a good responds to a price change for that good.

Employment share – The proportion of the working population employed in each sector of the economy.

Exogenous processes – External factors that influence household decisions.

Lagrangian function – A function that allows you to optimize a variable dependent on constraints, effectively combining a function being optimized with constraint functions.

Markets clear – The result when producers use the price that consumers are willing to pay for a product and there is no shortage or extra product.

Output share – The proportion of the total output of the economy produced by each sector.

Ponzi scheme – An investment fraud in which old investors are paid with money from new investors. Scammers often promise high returns with little or no risk.

Production function – An equation that shows how much product can be made from every combination of input factors, such as capital and labor.

Return on capital – Reveals how well a company is using its capital to make a profit.

Static analysis – A policy analysis that does not consider the economic behavior changes that may occur as a result of a policy change. Primarily, such analysis focuses solely on the changes to tax revenue due to a policy change without factoring in the human response to that change.

Steady-state capital-labor ratio – The ratio of the amount of capital to the amount of labor utilized for production when all markets clear in an economy.

Steady-state equilibrium – The economic choices and prices when market supply and demand are balanced and constant over time.

Stochastic economy – An economy that is affected by random, outside effects.

Tax instruments – The different ways that a government can levy a tax, or different types of taxes (e.g, corporate income tax, sales tax, and property tax).

Utility – The total gratification received from a person consuming a good or service. Economists use utility to capture individual's preferences for differing goods and services. It is assumed that people want to maximize their utility.

About the Authors

Rea S. Hederman Jr. is the executive director of the Economic Research Center and vice president of policy at The Buckeye Institute. In this role, Hederman oversees Buckeye's research and policy output. A nationally recognized expert in healthcare policy and tax policy, Hederman has published numerous reports and papers looking at returning health care power to the states, the impact of policy changes on a state's economy, labor markets, and how to reform tax systems to spur economic growth.

Prior to joining Buckeye, Hederman was director, and a founding member of the Center for Data Analysis (CDA) at the Heritage Foundation, where he served as the organization's top "number cruncher." Under Hederman's leadership, the CDA provided state-of-the-art economic modeling, database products, and original studies.

While at Heritage, Hederman oversaw technical research on taxes, health care, income and poverty, entitlements, energy, education, and employment, among other policy and economic issues, and he was responsible for managing the foundation's legislative statistical analysis and econometric modeling.

In 2014, Hederman was admitted into the prestigious Cosmos Club as a recognition of his scholarship. He graduated from Georgetown Public Policy Institute with a Master of Public Policy degree and holds a Bachelor of Arts degree in history and foreign affairs from the University of Virginia.

Andrew J. Kidd, Ph.D. is an economist with the Economic Research Center at The Buckeye Institute. In this position, Kidd conducts and produces original economic research that looks at and analyzes the impact of state and federal policies on peoples' lives and on the economy.

Prior to joining The Buckeye Institute, Kidd worked in litigation consulting, providing expert testimony related to economic damages in legal cases. Kidd also served as a research assistant at the UW Population Health Institute at the University of Wisconsin-Madison, which, through its health policy group, performs research and analysis projects on health care access, cost, financing, health system performance, and quality. During his time at the University of Wisconsin-Madison, Kidd's research focus was in demography, education, labor outcomes, and the effects of public policy on labor, education, and health outcomes. He was a College of Letters and Science teaching fellow and was awarded the Anna Morris Ely Teaching Award from the Department of Economics. While there, he taught classes in wages and the labor market, analytical public finance, the principles of microeconomics, and the principles of macroeconomics.

Kidd continues to study questions regarding labor markets and the effects of public policy and demographics on labor market outcomes and behaviors, as well as evaluating health care policy and education policy. A native of Lima, Ohio, Kidd received his bachelor's degree in economics and mathematics from the University of Notre Dame before completing his master's degree and his doctorate in economics from the University of Wisconsin-Madison.

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Shankel attended the University of Colorado Boulder's economics doctorate program before returning to Columbus. While at the University of Colorado, he worked on a project that examined the causal factors relating to internal migration patterns within Canada, to be compared with their effects on new immigrants settling throughout Canada.

Shankel earned his bachelor's degree in economics and a minor in Persian from The Ohio State University. There, he worked on a comprehensive policy analysis project examining land tenure reform on Indian reservations, and other policy issues relating to economic development in Native American communities.

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Prior to joining The Buckeye Institute, Woodward earned his Master of Public Policy and a Ph.D. in public policy from the University of Kentucky. During his time there, Woodward worked for the commonwealth's Hazard Mitigation Grant program, helping to verify the quality of regional emergency preparedness plans. He also performed policy-related research for the Commonwealth Council on Developmental Disabilities, contributing to a paper on possible, new treatment options for those with disabilities.

Woodward has also spent time researching public economics, health economics, and occupational licensing. His dissertation, *American Obesity: Rooted in Uncertainty, Institutions, and Public Policy*, looked at the role bad public policy (as opposed to consumers and/or market forces) may have played in the rapid increase in obesity rates.

A native of Athens, Ohio, Woodward received his bachelor's degree in economics from Ohio University before going on to complete his graduate studies.

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