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Fiscal Policy, Theory and Measurement
The State of Wyoming: A Case Study

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Executive Summary

As the overall United States economy expands, the economy of the state of Wyoming has been contracting with the number of non-farm jobs falling since 2015. The main reason for this contraction is disruption in energy markets due to both technology and government regulations. Over a third of the Wyoming economy is based on the energy sector and with falling energy prices, Wyoming's economy is struggling to grow.

Wyoming policymakers face many different decisions on how to change fiscal policy to improve growth or fund the government. Currently the state of Wyoming primarily depends on sales and severance taxes to fund government programs. There are also other smaller taxes, including one on business assets, and non-tax revenues such as coal leases and trust fund transfers.

Using a dynamic macroeconomic model to simulate the Wyoming economy, this paper examines several different policy scenarios where taxes can be raised or lowered to pay for more or less government spending. The model is dynamic, because individuals and businesses will change how much they work, invest or spend due to changes in fiscal policy. These policy scenarios involve changes to capital taxation, the sales tax, the severance tax and net exports.

Using these results, Wyoming policymakers will be able to anticipate the impact of specific changes in fiscal policy over the next two years. The most productive form of tax reform is eliminating the franchise tax as this tax discourages investment, which slows growth and makes work less productive. Eliminating this tax can increase employment by over 1500 job opportunities each quarter for the next two years.

The most economically damaging tax change is if Wyoming alters its constitution to create a labor income tax. The job losses from a 1% labor income tax will reduce job opportunities by 1500 each quarter for the next two years.

Finally, certain fiscal reforms can be enacted that would reduce the burden of taxation and the amount of government spending. As government spending declines, the economy and job opportunities can grow quickly if taxes on the productive sector of the economy fall.

Introduction

Since peaking in 2008, the Wyoming economy has remained weak even as the United States economy has expanded. Wyoming's job creation has stagnated, and its labor force is dwindling. Not surprisingly, given the state's heavy reliance on energy commodities, Wyoming's tax revenues have also receded as those commodities' prices have plummeted in recent years—a downturn that is largely responsible for Wyoming's current economic struggles.

Unfortunately, the economic and fiscal headwinds Wyoming faces seem likely to persist. Mineral production—especially coal, oil, and gas—generate most of the state's revenues, and the energy minerals market is not expected to rebound soon. Federal regulations have also adversely affected much of Wyoming's energy sector, and technological changes have shifted market demands away from coal. Thus, under current conditions, state revenues appear likely to remain suppressed.

The Buckeye Institute developed a dynamic macroeconomic model to analyze how various state policies and external economic conditions might affect economic activity and tax revenues.[1] Applying the calibrated model to fiscal policies reveals, for example, that tax policies that penalize investment are more harmful to productive economic activity than sales taxes that effectively penalize consumption. Taxes that lower returns on investments—including taxes on labor and capital—tend to have lasting negative impacts on the capital available for the productive sectors of the economy, thereby weakening the economy more severely than consumption taxes.

The Buckeye Institute's calibrated model also shows that despite generating additional tax revenues, raising tax rates to finance more government spending actually *increases* the government's revenue shortfall because of taxation's negative effect on economic activity. The dynamic revenue shortfall is the difference between state tax receipts and government spending.

This paper first provides an overview of Wyoming's recent economy and then a summary of the model's economic projections when applied to a range of fiscal policy proposals in order to

1 All data series are expressed in per capita terms after dividing by the state population. All series are also expressed in real terms (2009$).

The measure of GDP is the real GDP from the Bureau of Economic Analysis (BEA) accounts. The measure of consumption is the sum of non-durable and services consumption, also from the BEA accounts. The government share of GDP is taken from the BEA. Hours worked are taken from the Bureau of Labor Statistics (BLS). The nominal interest rate is measured as the three-month Treasury bill rate.

Since both investment and the capital stock are not reported at the state level, we use the US long-run average investment to GDP ratio (20%) to construct a series for investment. We also assume that capital depreciates at the US long-run average quarterly depreciation rate. In reality, there are different kinds of capital goods, some with very low depreciation rates and others with very high rates of depreciation. However, since the model only has one kind of capital good, the yearly average makes for a good approximation. We can then construct the capital stock series using the perpetual inventory method (Harberger 1978; Berlemann and Wesselhoft 2014). document the implementation of the perpetual inventory method using the steady state approach to estimate the quarterly capital stock using investment data and the depreciation rate of capital.

offer policymakers a solid starting point for exploring future reforms.

Stylized Facts: Overview of the Wyoming Economy (2005Q1–2015Q4)

Table 1: Long-Run Averages for 2005Q1-2015Q4

Variable	Value
Quarterly Growth Rate of GDP	0.51%
Consumption (as % of GDP)	62.00%
Investment (as % of GDP)	20.00%
Government (as % of GDP)	14.00%
Net Exports (as % of GDP)	4.00%
Hours Worked as Share of Total Time Available	0.204

Note: All variables are rounded to the nearest hundredth.

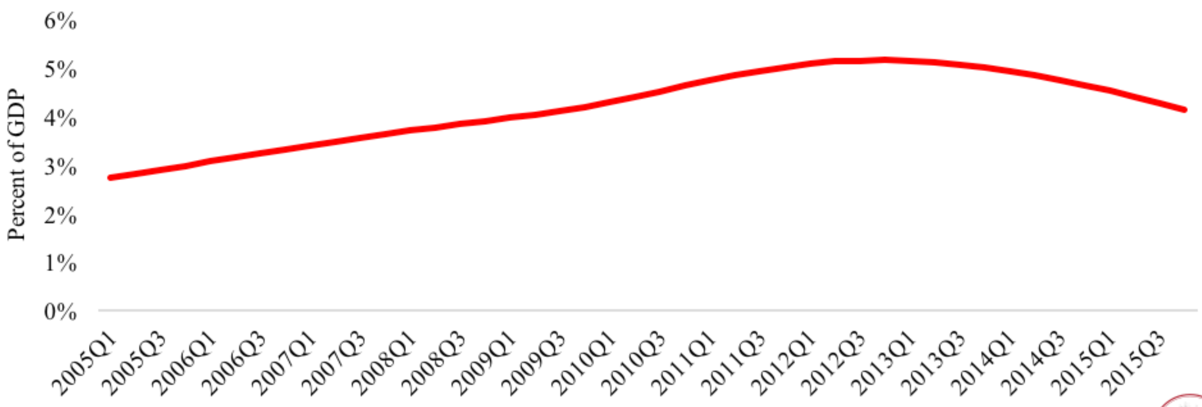
Wyoming's economy relies heavily on its "Mining and Logging" sector, which averaged nearly 32% of the state's aggregate GDP from 2005 to 2015. (*See* Table 2.) Such a significant dependence on mining is not surprising. With eight of the ten largest U.S. coal mines found in Wyoming's Powder River Basin, Wyoming's coal producers account for roughly 40% of all coal mined in the United States (US EIA 2016a). Wyoming also supplies 2-3% of all U.S. crude oil production, and ranks among the top ten natural gas and oil producing states (US EIA 2016b). With 94% of its mineral production exported (US EIA 2016b), Wyoming is the top energy exporter to other U.S. states. And although exporting has its economic advantages, Wyoming's heavy dependence on out-of-state demand for energy leaves it vulnerable to the volatile boom-and-bust cycles of global energy markets.

Table 2: Largest Sectors (as % of GDP) for 2005Q1-2015Q4

Variable	Value
Mining and Logging	31.87%
Government	13.52%
Finance, Insurance	11.29%
Transportation	6.02%
Manufacturing	5.62%
Construction	5.38%

Remarkably, even through energy market cycles, Wyoming's export trend had remained positive through 2011. But since 2012, that trend has been in decline. (*See* Chart 1.) Not surprisingly, with energy mineral markets in disarray globally, Wyoming's severance tax revenues have declined. Chart 2 highlights the state's revenue distribution.

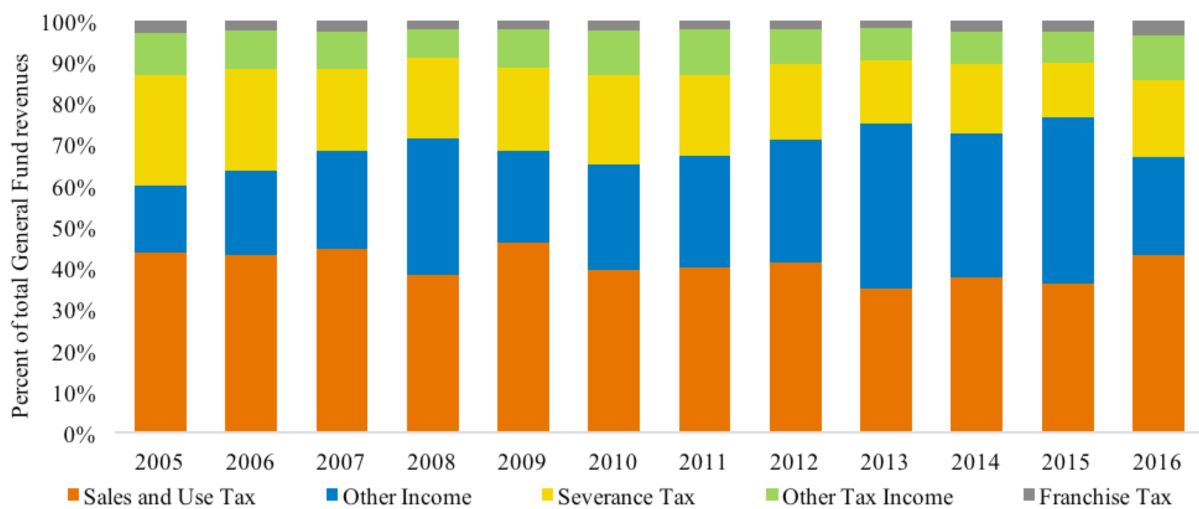
Chart 1: Net Exports as a Share of GDP in Decline since 2012



Source: Economic Research Center at The Buckeye Institute, calculations based on data from the BEA.
Note: The graph shows HP-filtered trend component of net exports as share of GDP.

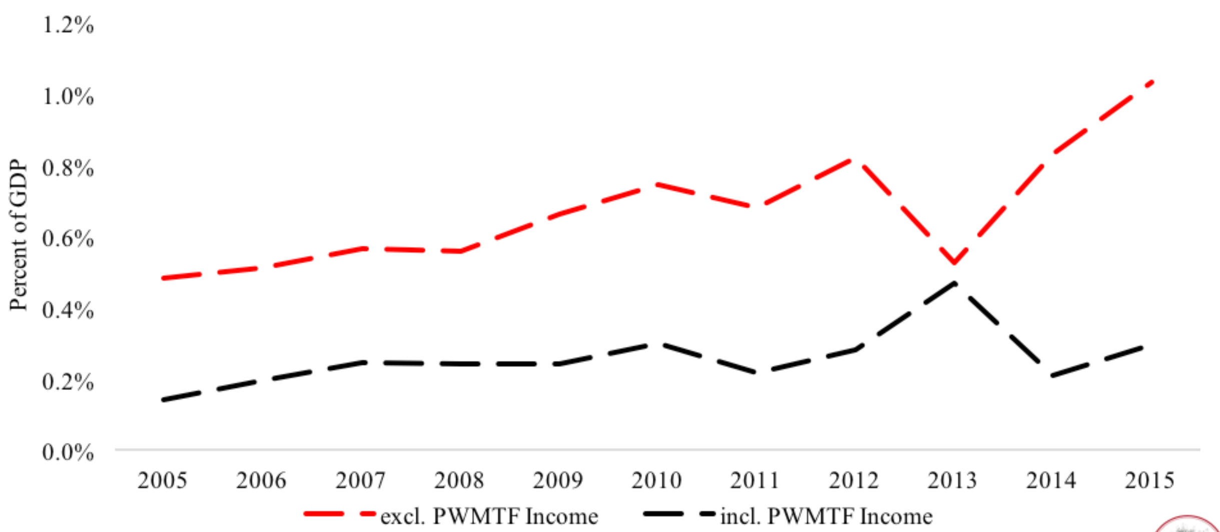
Although Wyoming currently balances its biennial budget, it relies on more than its own state tax collections to do so. The state's revenue shortfall—that is, the difference between government spending and the state's total tax revenues gleaned from taxes, licenses, permits and other charges paid by Wyoming's public—is mostly filled with Federal funds, trust fund payments, and other sources of state income that mask a structural deficit. In Wyoming, the state and local governments are growing faster than the tax revenues that finance their expenditures. *See* Chart 3).

Chart 2: Distribution of Wyoming General Fund Revenues



Source: CREG Report (October 2016).
Note: Other Income consists of PWMTF Income, Pooled Income, and Federal Aid and Grants. Other Tax Income includes Charges - Sales and Services, Revenue from Others, Penalties and Interest, and All Other. See Table 1 in CREG Report.

Chart 3: Total Government (State and Local) Revenue Shortfall



Source: Economic Research Center at The Buckeye Institute, calculations based on data from the BEA and CREG Report (October 2016).

Economic Model Projections for Wyoming: Analyzing Policy Effects

The Buckeye Institute applied its dynamic economic model of growth and business cycles to analyze the potential economic effects and implications of various fiscal policies. [2] The model is calibrated to replicate the long-run behavior of the state's economy, providing a baseline for evaluating the effects of declining economic conditions and several plausible fiscal reforms [3]

2 For all scenarios, the model assumes that GDP grows at the long-run average rate observed from 2005Q1 to 2015Q4. This is a very optimistic view since the quarterly growth rate of GDP turned negative after 2015.

3 A full description of the model and its equations is included in the Appendices.

Scenario 1: Continued Decline in Wyoming's Net Exports

Economics research has shown that when net exports rise by 1%, for example, investment also rises by 0.79%, and the number of employed hours per capita increases by 0.79%. Households choose to work more because their wages increase with the value of exports. And a rising labor supply raises the marginal product of capital, which leads to higher aggregate investment, which, in turn, produces more economic growth and greater tax revenues generated by the additional economic activity.

Wyoming, however, has suffered the opposite effects—a decline in net exports leading to a decline in investment, labor, wealth, and growth. A decline in investment suggests a prolonged decline in output because of investment's important role in the availability of capital for production. If the decline to net exports persists, and aggregate investment does not increase sufficiently in non-tradable sectors, Wyoming's economy could take much longer to recover. Thus, aggregate investment is the key to predicting how soon Wyoming's economy will rebound from its current condition.

To help policymakers prepare for any further disruption in the energy markets, the model examines the potential effect of an immediate 4% decline in net exports as a share of Wyoming GDP. The behavior of the model economy is consistent with the behavior of the Wyoming economy after mineral exports began to decline in 2012. The simulated decline in net exports leads to a decrease in employment, a decrease in GDP, and a decrease in severance tax revenues relative to the long-run trend. Table 3 (below) shows the model projections for a 4% decline in net exports assuming that the Wyoming economy grows at the average quarterly growth rate for the 2005Q1-2015Q4 period.[4]

Table 3: Effects of Continued Decline in Wyoming Net Exports

Baseline Levels	**2017Q1**	**2017Q2**	**2017Q3**	**2017Q4**	**2018Q1**	**2018Q2**	**2018Q3**	**2018Q4**
GDP	6,538.7	6,571.4	6,604.2	6,637.3	6,670.4	6,703.8	6,737.3	6,771.0
Tax Revenue	191.6	192.6	193.5	194.5	195.5	196.4	197.4	198.4
Post Shock Levels								
GDP	6,386.3	6,421.5	6,450.4	6,479.9	6,509.7	6,540.2	6,570.2	6,601.0
Tax Revenue	190.0	191.0	191.8	192.7	193.5	194.4	195.3	196.1
Effect of Tax Reform from Baseline								
GDP	-152.4	-149.8	-153.9	-157.3	-160.8	-163.6	-167.1	-170.0
Tax Revenue	-1.6	-1.6	-1.7	-1.8	-1.9	-2.0	-2.2	-2.3
Employment	-8,200	-8,000	-8,000	-7,900	-7,900	-7,800	-7,800	-7,700

Notes: GDP in millions of 2009 $, tax revenue in millions of current $.
Tax revenues are total General Fund revenues excl. PWMTF Income, Pooled Income, and Federal Aid and Grants.
Employment in units of full-time equivalent jobs, rounded to the nearest hundred.

4 The assumption that Wyoming grows at its 10-year average represents a "best case" scenario for Wyoming since the quarterly growth rate of GDP turned negative in 2015.

Scenario 2: Eliminating The Franchise Tax

Wyoming currently imposes a franchise tax that is the greater amount of either $50 per year or 0.02% of business capital assets located in Wyoming. In FY 2015, the franchise tax collected almost $40 million for the state's general revenue fund. Franchise taxes are taxes on business assets. Taxing assets effectively taxes capital—a potent ingredient for production—which reduces the incentives for investment and capital accumulation. Thus, taxing capital is generally considered one of the most harmful forms of taxation (Divounguy et al 2016). In fact, economics research suggests that to produce the most economic growth the optimal tax rate on capital is *zero* (Chamley 1986).

The model predicts that cutting Wyoming's franchise tax to zero would stimulate investment and spur employment, which will boost the state's GDP.[5] Of all the policies modeled, eliminating taxes on capital to increase investment will create the most employment growth—adding over 1500 new job opportunities each quarter.

The model also predicts, however, that eliminating the franchise tax will immediately decrease state tax revenues. A static estimate shows total tax collections falling by 4.6%, while the dynamic estimate shows a 4.3% decrease in tax collections immediately following the tax cut. Eventually, this negative effect on tax revenues will lessen over time as the pro-growth policy increases economic activity. (*See* Table 4.) Unfortunately, if the government's spending continues to grow at its current rate, the revenue shortfall will continue to increase.

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5 Since the model measures employment in hours worked *(intensive margin)*, the number of jobs lost or gained is computed by the change in total hours worked per quarter divided by the number of hours a full-time worker works per quarter, which is 520 hours (2080 divided by 4). This approach is also used by the Congressional Budget Office (CBO) which defines a full-time equivalent employee to work 2080 hours per year (Harris and Mok 2015).

Table 4: Effects of Elimination of Franchise Tax

Baseline Levels	**2017Q1**	**2017Q2**	**2017Q3**	**2017Q4**	**2018Q1**	**2018Q2**	**2018Q3**	**2018Q4**
GDP	6,538.7	6,571.4	6,604.2	6,637.3	6,670.4	6,703.8	6,737.3	6,771.0
Tax Revenue	191.6	192.6	193.5	194.5	195.5	196.4	197.4	198.4
Franchise Tax Revenue	8.9	8.9	9.0	9.0	9.1	9.1	9.2	9.2
Post Reform Levels								
GDP	6,574.0	6,603.6	6,639.9	6,675.7	6,711.8	6,748.0	6,784.5	6,820.4
Tax Revenue	183.5	184.4	185.4	186.5	187.5	188.6	189.6	190.7
Franchise Tax Revenue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Effect of Tax Reform from Baseline								
GDP	35.3	32.2	35.7	38.5	41.4	44.2	47.2	49.4
Tax Revenue	-8.1	-8.2	-8.1	-8.0	-7.9	-7.9	-7.8	-7.7
Employment	1,900	1,700	1,700	1,600	1,600	1,500	1,500	1,400

Notes: GDP in millions of 2009 $, tax revenue in millions of current $.
Tax revenues are total General Fund revenues excl. PWMTF Income, Pooled Income, and Federal Aid and Grants.
Employment in units of full-time equivalent jobs, rounded to the nearest hundred.

Scenario 3: Reforming the Sales Tax

The state sales tax provides Wyoming's largest source of revenue. Wyoming's sales tax rate is 4%—with some exemptions for certain goods and services. Localities can also levy sales taxes, which can bump the effective tax rate to over 5%.

Sales taxes are considered one of the more efficient forms of taxation because they do not impose higher burdens on capital or workers. Thus, cutting consumption taxes has a lesser impact on the economy than cutting taxes on labor and capital because the latter taxes have a direct negative effect on productive inputs. Production relies heavily on capital accumulation, so taxing labor and capital discourages investment and slows the economy.

The model predicts that a 1% cut in Wyoming's effective sales tax rate would have a positive effect on GDP. Sales taxes make goods and services more expensive. Thus, reducing sales taxes makes those goods and services less expensive, which boosts demand as more people purchase more goods and services. (*See* Table 5.) The increased demand causes investment and employment to increase, which results in a higher GDP. But cutting sales tax rates would also trigger a decline in tax revenues. The model's static estimate shows a revenue decline of 16.6%, whereas the dynamic estimate indicates only a 4.9% decrease. The static estimate does not account for the economic responses that individuals have to policy changes—highlighting the importance of dynamic analysis for making policy decisions.

The model also projects that eliminating all of Wyoming's sales tax exemptions would cause the state GDP to decrease. Eliminating tax exemptions would raise the price of goods, and thus lower their demand. By eliminating the tax exemptions, the state would effectively increase the sales tax, which would cause tax revenues to rise. (*See* Table 6.) Significantly, however, even if Wyoming eliminates its sales tax exemptions—and thereby increasing tax revenues—the state's revenue shortfall will still increase over time if government spending continues to rise faster than GDP and tax collections.

Table 5: Effects of Sales Tax Cut

Baseline Levels	**2017Q1**	**2017Q2**	**2017Q3**	**2017Q4**	**2018Q1**	**2018Q2**	**2018Q3**	**2018Q4**
GDP	6,538.7	6,571.4	6,604.2	6,637.3	6,670.4	6,703.8	6,737.3	6,771.0
Tax Revenue	191.6	192.6	193.5	194.5	195.5	196.4	197.4	198.4
Sales Tax Revenue	108.5	109.1	109.6	110.2	110.7	111.3	111.8	112.4
Post Reform Levels								
GDP	6,561.6	6,594.4	6,627.3	6,661.1	6,694.5	6,727.9	6,762.2	6,796.7
Tax Revenue	182.3	183.2	184.1	185.1	186.0	187.0	187.9	188.9
Sales Tax Revenue	76.8	77.2	77.6	78.0	78.4	78.8	79.2	79.6
Effect of Tax Reform from Baseline								
GDP	22.9	23.0	23.1	23.9	24.0	24.1	24.9	25.7
Tax Revenue	-9.3	-9.4	-9.4	-9.4	-9.4	-9.5	-9.5	-9.5
Employment	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200

Notes: GDP in millions of 2009 $, tax revenue in millions of current $.
Tax revenues are total General Fund revenues excl. PWMTF Income, Pooled Income, and Federal Aid and Grants.
Employment in units of full-time equivalent jobs, rounded to the nearest hundred.

Table 6: Effects of Eliminating Sales Tax Exemptions

Baseline Levels	**2017Q1**	**2017Q2**	**2017Q3**	**2017Q4**	**2018Q1**	**2018Q2**	**2018Q3**	**2018Q4**
GDP	6,538.7	6,571.4	6,604.2	6,637.3	6,670.4	6,703.8	6,737.3	6,771.0
Tax Revenue	191.6	192.6	193.5	194.5	195.5	196.4	197.4	198.4
Sales Tax Revenue	108.5	109.1	109.6	110.2	110.7	111.3	111.8	112.4
Post Reform Levels								
GDP	6,524.9	6,557.6	6,590.4	6,622.6	6,655.8	6,689.0	6,721.8	6,755.4
Tax Revenue	197.2	198.2	199.2	200.1	201.1	202.1	203.1	204.1
Sales Tax Revenue	127.6	128.2	128.8	129.5	130.1	130.8	131.4	132.0
Effect of Tax Reform from Baseline								
GDP	-13.7	-13.8	-13.9	-14.6	-14.7	-14.7	-15.5	-15.6
Tax Revenue	5.6	5.6	5.6	5.6	5.7	5.7	5.7	5.7
Employment	-800	-700	-700	-700	-700	-700	-700	-700

Notes: GDP in millions of 2009 $, tax revenue in millions of current $.
Tax revenues are total General Fund revenues excl. PWMTF Income, Pooled Income, and Federal Aid and Grants.
Employment in units of full-time equivalent jobs, rounded to the nearest hundred.

Scenario 4: Reforming the Severance Tax

Wyoming imposes severance taxes on the removal of mineral resources such as coal, crude oil, and natural gas. The state splits the severance tax receipts between localities, the Permanent Wyoming Mineral Trust Fund and the general revenue fund. Wyoming's current fiscal crisis is due in large part to the decline of its severance tax revenue.

When energy producers face higher tax rates, they simply pass on the additional costs to consumers or cut production. Thus, a severance tax means higher consumer prices, and will affect economic behavior much like consumption taxes. A higher severance tax can also discourage capital investment and future job opportunities (Deacon et al 1990), but because a severance tax only affects a subset of the economy, the effects are smaller in magnitude.

Using Wyoming's historical severance tax collections, the model estimates the effective severance tax rate, and shows that a 1% cut in that rate would cause employment and GDP to rise. (*See* Table 7.)

Table 7: Effects of Severance Tax Cut

Baseline Levels	**2017Q1**	**2017Q2**	**2017Q3**	**2017Q4**	**2018Q1**	**2018Q2**	**2018Q3**	**2018Q4**
GDP	6,538.7	6,571.4	6,604.2	6,637.3	6,670.4	6,703.8	6,737.3	6,771.0
Tax Revenue	191.6	192.6	193.5	194.5	195.5	196.4	197.4	198.4
Severance Tax Revenue	46.6	46.8	47.1	47.3	47.5	47.8	48.0	48.3
Post Reform Levels								
GDP	6,546.5	6,579.3	6,612.2	6,645.2	6,679.1	6,712.5	6,746.1	6,779.8
Tax Revenue	187.4	188.4	189.3	190.3	191.2	192.2	193.2	194.1
Severance Tax Revenue	38.9	39.1	39.3	39.5	39.7	39.9	40.1	40.3
Effect of Tax Reform from Baseline								
GDP	7.8	7.9	7.9	8.0	8.7	8.7	8.8	8.8
Tax Revenue	-4.2	-4.2	-4.2	-4.2	-4.2	-4.2	-4.2	-4.3
Employment	400	400	400	400	400	400	400	400

Notes: GDP in millions of 2009 $, tax revenue in millions of current $.
Tax revenues are total General Fund revenues excl. PWMTF Income, Pooled Income, and Federal Aid and Grants.
Employment in units of full-time equivalent jobs, rounded to the nearest hundred.

Scenario 5: Introducing a Labor Income Tax

Wyoming does not have a direct tax on individual labor or capital income. The state also has a constitutional provision that disallows any income tax without a full credit against sales and all other state tax liability. To analyze how an income tax would affect Wyoming's economy, this scenario assumes that the constitutional requirement is changed, and that Wyoming can impose a personal income tax on labor without the full credit for sales and other taxes.

Introducing a 1% tax on labor income in Wyoming would penalize labor and make leisure more attractive. Conversely, research examining the effect of income tax *cuts* has found that a 1% cut in an income tax will cause GDP to increase by up to 1.8% in subsequent quarters (Mertens and Ravn 2013). Penalizing labor through an income tax will decrease the labor supply—a finding consistent with the Congressional Budget Office s model that analyzes how federal policies affect the national economy and labor supply (Harris and Mok 2015). As individuals respond to the labor tax, employment falls and the marginal product of capital declines, causing investment and GDP to decline. (*See* Table 8.) Declining employment means that Wyoming households and businesses would pay a hefty price for this new tax. And although an income tax would add additional tax revenues, Wyoming's revenue shortfall would still persist if government spending continues to rise faster than GDP. Thus, as the model indicates, introducing an income tax is not a viable option for addressing the government's shortfall.

Table 8: Effects of Introduction of Labor Income Tax

Baseline Levels	**2017Q1**	**2017Q2**	**2017Q3**	**2017Q4**	**2018Q1**	**2018Q2**	**2018Q3**	**2018Q4**
GDP	6,538.7	6,571.4	6,604.2	6,637.3	6,670.4	6,703.8	6,737.3	6,771.0
Tax Revenue	191.6	192.6	193.5	194.5	195.5	196.4	197.4	198.4
Post Reform Levels								
GDP	6,509.9	6,543.1	6,575.2	6,608.0	6,640.4	6,673.0	6,706.3	6,739.2
Tax Revenue	200.6	201.6	202.6	203.6	204.6	205.6	206.6	207.7
Effect of Tax Reform from Baseline								
GDP	-28.8	-28.3	-29.1	-29.2	-30.0	-30.8	-31.0	-31.8
Tax Revenue	9.0	9.1	9.1	9.1	9.1	9.2	9.2	9.2
Employment	-1,500	-1,500	-1,500	-1,500	-1,500	-1,500	-1,500	-1,400

Notes: GDP in millions of 2009 $, tax revenue in millions of current $.
Tax revenues are total General Fund revenues excl. PWMTF Income, Pooled Income, and Federal Aid and Grants.
Employment in units of full-time equivalent jobs, rounded to the nearest hundred.

Scenario 6: Cut Government Spending and Eliminate the Franchise Tax

The model analyzed a scenario in which Wyoming eliminated the franchise tax and implemented a dollar-for-dollar reduction in government spending. (*See* Table 9.)

Keeping government spending-growth below GDP growth will cause Wyoming's revenue shortfall to decrease. By spending less on government, there are more resources for investment and consumption, which leads to job growth and a more fiscally sound economy in the long-run

Although government spending cuts will cause a short-term decline in the number of government jobs, if government spending cuts are also paired with eliminating the state's franchise tax, the net effect on Wyoming's employment and GDP is positive. By increasing the return on investment, the economy and employment grow as government spending shrinks.

Table 9: Effects of Government Cuts with Elimination of Franchise Tax

Baseline Levels	**2017Q1**	**2017Q2**	**2017Q3**	**2017Q4**	**2018Q1**	**2018Q2**	**2018Q3**	**2018Q4**
GDP	6,538.7	6,571.4	6,604.2	6,637.3	6,670.4	6,703.8	6,737.3	6,771.0
Tax Revenue	191.6	192.6	193.5	194.5	195.5	196.4	197.4	198.4
Franchise Tax Revenue	8.9	8.9	9.0	9.0	9.1	9.1	9.2	9.2
Post Reform Levels								
GDP	6,570.7	6,600.9	6,637.3	6,673.1	6,709.1	6,744.7	6,781.1	6,817.0
Tax Revenue	183.4	184.4	185.4	186.4	187.5	188.5	189.6	190.6
Franchise Tax Revenue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Effect of Tax Reform from Baseline								
GDP	32.0	29.6	33.0	35.8	38.7	40.9	43.8	46.0
Tax Revenue	-8.2	-8.2	-8.1	-8.1	-8.0	-7.9	-7.8	-7.8
Employment	1,700	1,600	1,500	1,500	1,400	1,400	1,300	1,300

Notes: GDP in millions of 2009 $, tax revenue in millions of current $.
Tax revenues are total General Fund revenues excl. PWMTF Income, Pooled Income, and Federal Aid and Grants.
Employment in units of full-time equivalent jobs, rounded to the nearest hundred.

Scenario 7: Cut Government Spending and Cut the Severance Tax

The model estimates that a 1% cut in Wyoming's effective severance tax rate along with a 1% cut in the government's share of GDP would cause a net decline in employment because the positive effects of a 1% severance tax cut are insufficient to o fset the government cut. (*See* Table 10.) Unlike taxes on labor and capital, severance and consumption taxes do not have a large enough impact on economic growth. Thus, Wyoming would need a larger severance tax cut in order to increase employment and GDP in the short-term.

Table 10: Effects of Government Cuts with Severance Tax Cut

Baseline Levels	**2017Q1**	**2017Q2**	**2017Q3**	**2017Q4**	**2018Q1**	**2018Q2**	**2018Q3**	**2018Q4**
GDP	6,538.7	6,571.4	6,604.2	6,637.3	6,670.4	6,703.8	6,737.3	6,771.0
Tax Revenue	191.6	192.6	193.5	194.5	195.5	196.4	197.4	198.4
Severance Tax Revenue	46.6	46.8	47.1	47.3	47.5	47.8	48.0	48.3
Post Reform Levels								
GDP	6,508.6	6,541.8	6,573.9	6,606.1	6,638.4	6,671.6	6,704.3	6,737.1
Tax Revenue	187.1	188.0	188.9	189.8	190.8	191.7	192.6	193.6
Severance Tax Revenue	38.8	39.0	39.1	39.3	39.5	39.7	39.9	40.1
Effect of Tax Reform from Baseline								
GDP	-30.1	-29.6	-30.4	-31.2	-32.0	-32.2	-33.0	-33.9
Tax Revenue	-4.5	-4.6	-4.6	-4.6	-4.7	-4.7	-4.8	-4.8
Employment	-1,600	-1,600	-1,600	-1,600	-1,500	-1,500	-1,500	-1,500

Notes: GDP in millions of 2009 $, tax revenue in millions of current $.
Tax revenues are total General Fund revenues excl. PWMTF Income, Pooled Income, and Federal Aid and Grants.
Employment in units of full-time equivalent jobs, rounded to the nearest hundred.

Scenario 8: Cut Government Spending and Cut the Sales Tax

Like a severance tax cut, a 1% cut in the sales tax rate along with a similar cut to Wyoming's government spending would reduce jobs and economic growth in the short-run. (*See* Table 11.) The pro-growth effects of a sales tax cut would not offset the negative effects of government cuts. A much larger sales tax cut would be needed in order to increase employment and GDP in the short-term.

Table 11: Effects of Government Cuts with Sales Tax Cut

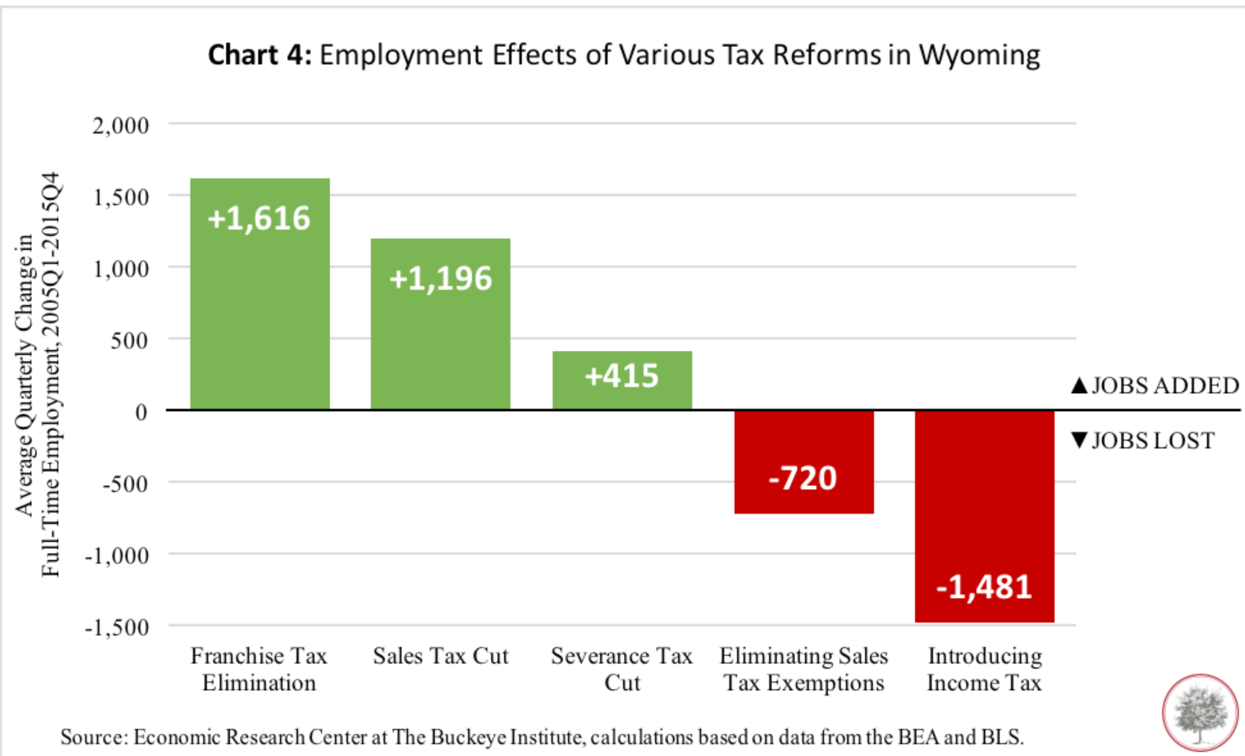
Baseline Levels	**2017Q1**	**2017Q2**	**2017Q3**	**2017Q4**	**2018Q1**	**2018Q2**	**2018Q3**	**2018Q4**
GDP	6,538.7	6,571.4	6,604.2	6,637.3	6,670.4	6,703.8	6,737.3	6,771.0
Tax Revenue	191.6	192.6	193.5	194.5	195.5	196.4	197.4	198.4
Sales Tax Revenue	108.5	109.1	109.6	110.2	110.7	111.3	111.8	112.4
Post Reform Levels								
GDP	6,523.6	6,556.3	6,589.0	6,622.0	6,654.4	6,687.7	6,721.1	6,754.1
Tax Revenue	181.9	182.8	183.7	184.6	185.5	186.5	187.4	188.3
Sales Tax Revenue	78.2	78.6	79.0	79.3	79.7	80.1	80.5	80.9
Effect of Tax Reform from Baseline								
GDP	-15.0	-15.1	-15.2	-15.3	-16.0	-16.1	-16.2	-16.9
Tax Revenue	-9.7	-9.7	-9.8	-9.9	-9.9	-10.0	-10.0	-10.1
Employment	-800	-800	-800	-800	-800	-800	-800	-800

Notes: GDP in millions of 2009 $, tax revenue in millions of current $.
Tax revenues are total General Fund revenues excl. PWMTF Income, Pooled Income, and Federal Aid and Grants.
Employment in units of full-time equivalent jobs, rounded to the nearest hundred.

The Estimated Employment Effects of Tax Reforms

The economic model estimates that tax cuts have a positive effect on employment, while removing sales tax exemptions and introducing new income taxes have negative employment effects—confirming taxation s negative effect on economic activity. (*See* Chart 4.) The model's results are similar to those of Romer and Romer (2007) who found that tax increases are highly contractionary; and are also consistent with Alesina and Ardgna (2010) who found that fiscal stimuli based upon tax cuts are more likely to increase growth than those based upon spending increases.

Reducing taxes on the value of capital produces the strongest employment growth because of the relationship between labor and capital. Severance and sales tax reforms have the least effect on economic growth because they are relatively efficient taxes. Introducing an income tax—the worst form of taxation—would be far less efficient for raising revenue than eliminating sales tax exemptions. A tax that directly reduces incentives to work also has a negative effect on the incentive to invest—and lower investment stunts economic growth.



Conclusion

This paper offers an investigative tool for policymakers to use as they consider ways to revitalize Wyoming's economy. As the model reveals, policies that penalize investment—whether capital or labor—tend to have the most negative effects on economic activity by reducing the investment incentive that makes capital available to the productive sectors of the economy. Taxing capital and labor have been shown to be more damaging to the economy than taxes on consumption. The findings presented are consistent with other studies that have found capital taxation to be extremely inefficient and harmful to growth both in the short and long run (Feldstein 2006; Feldstein 2008).

The model shows that restraining the growth of the government sector below the growth rate of an economy is crucial for eliminating a revenue shortfall.

Finally, and perhaps most significantly, the calibrated model highlights the differences between a static analysis and a dynamic analysis to score policy. By using a dynamic model to simulate a variety of policy proposals, policymakers gain a better understanding of how the economy is most likely to respond to the proposed reforms.

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APPENDIX A: DESCRIPTION OF THE BASIC FRAMEWORK

For a more complete exposition of the basic neoclassical model of growth with business cycles, see the seminal work of Kydland and Prescott (1982) or the overview by King and Rebelo (1999). Our model is similar to Trabandt and Uhlig (2011). Time is discrete, $t = 0, 1 \ldots \infty$. The representative household maximizes the discounted sum of lifetime utility subject to an intertemporal budget constraint and a capital flow equation. Formally,

$$\max_{\{C_t, N_t, K_{t+1}, X_t,\}} E_0 \sum_{t=0}^{\infty} \beta^t \left(log(C_t) \text{-} \chi N_t^{1+\frac{1}{\varphi}} + \vartheta(G_{S,t}, G_{F,t}) \right)$$

subject to:

$$\begin{aligned} (1 + \tau^C)C_t + X_t + \\ \leq \left(1\text{-}\tau_t^{S,W}\text{-}\tau_t^{F,W}\right)w_t N_t + \left(1\text{-}\tau_t^{S,D}\text{-}\tau_t^{F,D}\right)(d_t\text{-}\delta)K_t + \delta K_t\text{-}\tau_t^K K_t + S_{s,t} \\ + S_{F,t}\text{-}Nx_t\text{-}\tau_t^S\,(\mu_S Y_t)\text{-}\tau_t^L Y_t \end{aligned}$$

The capital stock evolves according to:

$$K_{t+1} = X_t + (1\text{-}\delta)K_t$$

where δ is the rate of depreciation. It is assumed that government spending may be valuable as it is assumed to provide utility. We assume $\beta \in (0,1)$ represents the rate with which the household discounts utility over time. $\varphi > 0$ plays an important role in the analysis as it measures the elasticity of labor supply with respect to a change in the real wage. C_t, N_t, K_t, X_t, Nx_t denote consumption, hours worked, capital, investment, and an exogenous stream of payments. The household takes the value of government $\vartheta\left(G_{S,t}, G_{F,t}\right)$ as given. Further the household receives wages w_t, dividends, d_t from the firm, and lump-transfers S_t from the government. The household pays a "sales" tax for all consumption τ_t^C to the state government. The household pays labor income taxes to the state government and to the federal government $\tau_t^{S,W}$ and $\tau_t^{F,W}$ respectively. The household pays investment income taxes to the state and to the federal government: $\tau_t^{S,D}\tau_t^{F,D}$ respectively. The household also pays a tax on fixed assets ownership τ_t^K. A fixed share μ_s of output is taxed at rate τ_t^S. This tax is the severance tax applied to a fixed share of economic output (the mining sector). Households pay a share of income τ_t^L in licenses to the state government. The payments Nx_t can be positive or negative. This feature captures a negative or positive trade balance, equating Nx_t to net exports, and introducing international trade in a minimalist way. This is similar to Trabandt and Uhlig (2011). This is an important simplification since households in our model economy cannot react to expansionary periods with higher imports. In most countries, net exports are countercyclical, indicating that countries borrow from international capital markets during high income periods (see Sachs, 1981, Backus and Kehoe, 1992, and Raffo, 2006). Since net exports are procyclical in Wyoming, our simplification is fully justified.

In the balanced growth path equilibria, the model is consistent with an open-economy interpretation with source-based capital income taxation, where the rest of the world grows at the same rate and features households with the same time preferences. The trade balance influences the reaction of steady state consumption, labor and investment decisions.

NX_t is assumed to follow a stationary mean zero AR(1) process in the log. The shock ϵ_{NXt} is drawn from a standard normal distribution.

$$(NX_t) = (1\text{-}\rho_G)(NX) + \rho_G(NX_{t\text{-}1}) + \epsilon_{NXt}$$

where NX is the steady-state share of net exports in GDP. This implies that $Nx_t = NX_t Y_t$. This specification implies that the size of net exports grows as GD grows.

The representative firm borrows capital from the household K_t and hires all available labor hours N_t to maximize profits

$$\max_{\{N_t,K_t\}} Z_t\, K_t^{\theta} N_t^{1\text{-}\theta}\text{-}w_t N_t\text{-}d_t K_t$$

where Z_t denotes a random productivity shock variable which is assumed to follow a stationary mean zero AR(1) process in the log. The shock ϵ_t is drawn from a standard normal distribution.

$$(Z_t) = \rho_Z(Z_{t\text{-}1}) + \epsilon_t$$

The state government faces the budget constraint:

$$G_{S,t} + S_{s,t} = T_t^S$$

where state government tax revenues are given by:

$$T_t^S = \tau_t^C C_t + \tau_t^{S,W} w_t N_t + \tau_t^{S,D}(d_t\text{-}\delta)K_t + \tau_t^K K_t + \tau_t^S\,(\mu_S Y_t) + \tau_t^L Y_t$$

The federal government faces the following budget constraint:

$$G_{F,t} + S_{F,t} \leq T_t^F$$

The federal government tax revenues are given by:

$$T_t^F = \tau_t^{F,W} w_t N_t + \tau_t^{F,D}(d_t\text{-}\delta)K_t$$

Government spending is assumed to evolve according to:

$$g_{S,t} = (1\text{-}\rho_G)(g_S) + \rho_G\big(g_{S,t\text{-}1}\big) + \epsilon_{gS}$$

$$g_{F,t} = (1\text{-}\rho_F)(g_F) + \rho_F\big(g_{F,t\text{-}1}\big) + \epsilon_{gF}$$

where g_S is the state share of income such that total government spending in steady-state is simply: $G = G_S + G_F = g_S Y + g_F Y$. Once more, this specification implies that the size of government can grow endogenously as GDP grows.

The tax instruments follow AR(1) processes with a non-negative response to the deviation of government spending from an exogenous long-run level G^*:

$$\tau_t^W = (1\text{-}\rho_{S,W})\tau^W + \rho_{S,W}\tau_{t\text{-}1}^W + \gamma_W \epsilon_{gS}$$

$$\tau_t^D = (1\text{-}\rho_{S,D})\tau^D + \rho_{S,D}\tau_{t\text{-}1}^D + \gamma_D \epsilon_{gS}$$

$$\tau_t^C = (1\text{-}\rho_{S,C})\tau^C + \rho_{S,C}\tau_{t\text{-}1}^C + \gamma_C \epsilon_{gS}$$

$$\tau_t^K = \left(1\text{-}\rho_{S,K}\right)\tau^K + \rho_{S,K}\tau_{t\text{-}1}^K + \gamma_K \epsilon_{gS}$$

$$\tau_t^S = (1\text{-}\rho_{S,S})\tau^S + \rho_{S,S}\tau_{t\text{-}1}^S + \gamma_S \epsilon_{gS}$$

$$\tau_t^L = (1\text{-}\rho_{S,L})\tau^L + \rho_{S,L}\tau_{t\text{-}1}^L + \gamma_L \epsilon_{gS}$$

$$\tau_t^{F,W} = (1\text{-}\rho_{F,W})\tau^{F,W} + \rho_{F,W}\tau_{t\text{-}1}^{F,W} + \gamma_{F,W} \epsilon_{gF}$$

$$\tau_t^{F,D} = (1\text{-}\rho_{F,D})\tau^{F,D} + \rho_{F,D}\tau_{t\text{-}1}^{F,D} + \gamma_{F,D} \epsilon_{gF}$$

where $\tau^W, \tau^D, \tau^C, \tau^K, \tau^S, \tau^L, \tau_t^{F,W}, \tau_t^{F,D}$ are the steady state values of the tax rates. We also assume that $\gamma_W, \gamma_D, \gamma_C, \gamma_K, \gamma_S, \gamma_L, \gamma_{F,W}, \gamma_{F,D}$ are exogenous parameters that govern which tax the government uses to raise additional tax revenue.

The implication of these exogenous processes is that the government tax rates never deviate from their steady-state values so long as there is no change in government spending.

The definition of equilibrium is standard: given exogenous processes and endogenous states, it is a set of prices and non-explosive allocations such that all markets clear, household and firm first order conditions are satisfied and the fiscal policy rules are obeyed

Combining these conditions gives rise to a somewhat standard aggregate resource constraint:

$$Y_t = C_t + X_t + G_{S,t} + G_{F,t} + Nx_t$$

Our resource constraint makes explicit the difference between the state government and the federal government's share of GDP.

A ***competitive equilibrium*** in our model is a set of prices and a set of optimal allocations for consumption, investments and hours worked such that:

(1) Households maximize utility
(2) Firms maximize profit
(3) The government budget constraint is balanced each period

The full set of equilibrium conditions are:

$$\frac{1}{(1+\tau_t^C)C_t} = \beta E_t \left[\frac{1}{(1+\tau_{t+1}^C)C_{t+1}} \begin{pmatrix} \left(1\text{-}\tau_{t+1}^{S,D}\text{-}\tau_{t+1}^{F,D}\right)d_{t+1} \\ +\tau_{t+1}^{S,D}\delta + \tau_{t+1}^{F,D}\delta + (1\text{-}\delta)\text{-}\tau_{t+1}^K \end{pmatrix}\right]$$

$$\frac{\chi\left(1+\frac{1}{\varphi}\right)N_t^{1/\varphi}}{(1\text{-}\tau_t^{S,W}\text{-}\tau_t^{F,W})w_t} = \frac{1}{(1+\tau_t^C)C_t}$$

$$w_t = (1\text{-}\theta)\frac{Y_t}{N_t}$$

$$d_t = \theta\frac{Y_t}{K_t}$$

$$Y_t = Z_t\, K_t^{\theta} N_t^{1\text{-}\theta}$$

$$Y_t = C_t + X_t + G_{S,t} + G_{F,t} + Nx_t$$

$$K_{t+1} = X_t + (1\text{-}\delta)K_t$$

The model is solved by linear approximation:

1. Find the deterministic steady-stat*e (the solution to the above set of equations with* $Z^* = 1$, $\epsilon_{gS} = 0$)

2. Linearize all equations around the steady-state.

3. Obtain a linearized solution: $V_t = AV_{t\text{-}1} + B\epsilon_t$ where V_t is the vector of all variables in the model.

For further explanation, Uhlig (1997) provides a complete description of the techniques used to solve these models.

Model Calibration

In this section, we calibrate the model. The calibration procedure involves choosing functional forms of the utility and production functions, and assigning values to the parameters of the model based on either micro-evidence or long-run growth facts. Cooley and Prescott (1995) provide an overview of the general strategy. For our calibration, we use data collected for the period 2005Q1-2015Q4.

In our model, we assumed a Cobb-Douglas market production function as in Prescott (1986). Swan (1964), Phelps (1966), King et al. (1988), and Kydland (1995) provide sufficient justification for this technology assumption

As for the model parameters, we begin with the tax rates. Income tax liability is obtained from the Internal Revenue Service (IRS) Statistics of Income (SOI) to calculate the effective income tax rates. While the state of Wyoming does not have a state income tax, Wyomingites remain liable for federal income taxes. The methodology used to estimate the federal tax rates is detailed in Appendix B.

The estimated tax rates for the 2005Q1-2015Q4 period are $\tau^{S,W} = 0, \tau^{S,D} = 0,$

$\tau^{F,W} = 0.1487, \tau^{F,D} = 0.2438$ for labor income and investment income respectively. The superscripts *S* and *F* denote state and federal respectively while superscripts *W* and *D* denote wage and dividend respectively.

While the state sales tax is 4%, Wyomingites face a range of other consumption related taxes that vary across counties. Depending on the county of residence, a Wyomingite can face from 4% to 10% in sales and use taxes. Some exemptions also exist for a large number of household expenditures. In order to account for the total tax liability, we use effective tax rate to estimate the average effective tax on consumption $\tau^C = 0.0034$ for the 2005Q1-2015Q4 period. Wyomingites also face a franchise tax. We model this as a tax per unit of capital by dividing total franchise tax revenues by the estimated capital stock to obtain the effective tax rate $\tau^K = 0.00078106$.

We then proceed with a value for the quarterly discount factor. Evaluated in the steady state, the discount factor β is simply the inverse of the real interest rate, i.e. $\beta = \frac{1}{1+r}$. From the data, the quarterly interest rate is $r \approx 1\%$, so we obtain $\beta = 0.99$.

In the macroeconomics literature, the Frisch labor supply elasticity is assumed to range from 1 to 3. We begin with $\varphi = 1$. While the microeconomics literature suggests smaller elasticities, $\varphi = 3$is the value that is in line with Cooley and Prescott (1995).

Given that total income Y is the sum of labor compensation wN and investment income dK, $Y = wN + dK = K^{\theta} N^{1-\theta}$, we can measure θ the capital share of income from the data: $\theta = 1 - \frac{wN}{Y}$. Doing this simple calculation yields $\theta = 0.37$.

Next, we use the model equilibrium relationships. The steady-state capital-labor ratio is

$$\frac{K}{N} = \left(\frac{\left(\frac{(1+\vartheta)}{\beta}\right) - (1-\delta) + \tau^K - \delta\tau^{S,D} - \delta\tau^{F,D}}{(1-\tau^{S,D} - \tau^{F,D})\theta} \right)^{1/(\theta-1)}$$

where $N, K, \delta, \theta, \vartheta$ are hours worked, capital, the depreciation rate of capital, the capital share of income, and the quarterly growth rate of GDP respectively.

Using our parameter values for $\theta = 0.37, \beta = 0.99, \delta = 0.02675, \tau^K = 0.00078106, \tau^{S,D} = 0$, $\tau^{S,W} = 0, \tau^{F,W} = 0.1487, \tau^{F,D} = 0.2438$, BLS data on hours worked per capita $n = 0.204$, we find the steady-state capital-labor ratio

$$\frac{K}{N} = \left(\frac{\left(\frac{1+0.005}{0.99}\right) - (1-0.02675) + 0.00078106 - 0.02675(0.2438)}{(1-0.2438)0.37} \right)^{1/(0.37-1)}$$
$$= 25.6820$$

We can use the capital-labor ratio to compute the steady-state level of capital $K = 5.2391$, which implies that steady-state investment $\delta K = 0.02675 * 5.2391 = 0.1401$. The model steady-state level of output $Y = (5.2391)^{0.37}(0.204)^{(1-0.37)} = 0.6779$. From the data, we know the share of net exports in GDP $\frac{NX}{Y} = 0.04$, the share of state and local government spending in GDP $g_s = 0.11$, and the share of GDP that goes to the federal government $g_F = 0.03$. By using the economy-wide resource constraint $GDP = Y = C + I + G + NX$, we find consumption $C = 0.4158$ which implies a consumption-output ratio $\frac{C}{Y} \approx 0.61$.

Equipped with the model optimal consumption, labor supply equations and the effective tax rates, we estimate the parameter that governs the Wyomingite household's preference for leisure (disutility of market work):

$$\chi = \frac{(1 - \tau^{S,W} - \tau^{F,W})w}{n^{1/\varphi}\left(1 + \frac{1}{\varphi}\right)(1 + \tau^C)c} = \frac{(1 - 0.1487)2.0935}{0.204(2)(1 + 0.034)0.4158} = 10.1599$$

Calibrating Tax Revenues

Using the calibrated model, we can compare the model steady-state state government tax revenues with state government spending to gain some insight about the sustainability of the state's fiscal policy.

In the model, the state government tax revenues are defined as

$$\boldsymbol{T_t^S} = \begin{matrix} \boldsymbol{\tau_t^C C_t + \tau_t^{S,W} w_t N_t + \tau_t^{S,D}(d_t - \delta)K_t + \tau_t^K K_t} \\ \boldsymbol{+\tau_t^S\,(\mu_S Y_t) + \tau_t^L Y_t} \end{matrix}$$

From the data, we know the long-run average state revenues net of the PWMTF and federal funds as a share of GDP, $\frac{T_t^S}{Y_t} = 0.08$.

We also know that the long-run average severance tax base as a share of GDP is $\frac{(\mu_S Y_t)}{Y_t} = 0.39$.

Given $\tau^K = 0.00078106, \tau^{S,D} = 0, \tau^{S,W} = 0\,, \tau^{F,W} = 0.1487, \tau^{F,D} = 0.2438, \tau_t^S = 0.06145$ we estimate the remaining tax burden $\tau_t^L = 0.0282$.

The non-stochastic long-run equilibrium of the model is now fully calibrated to the Wyoming economy, thus providing a good starting point for policy analysis.

Model Parameters

Variable	Value	Description	Restriction
θ	0.37	Capital share in production	Data
δ	0.02675	Quarterly depreciation rate of capital	Data
φ	1	Labor supply elasticity	Data

Baseline Calibration Wyoming 2005Q1-2015Q4

Variable	Value	Description	Restriction
$\tau^{S,W}$	0	State labor income tax rate	Data

$\tau^{F,W}$	0.1487	Federal labor income tax rate	Data
$\tau^{S,D}$	0	State capital income tax rate	Data
$\tau^{F,D}$	0.2438	Federal capital income tax rate	Data
τ^{K}	0.00078106	Effective Franchise tax rate	Data
τ^{C}	0.034	Effective sales tax rate	Data
ϑ	0.0051	Quarterly growth rate of GDP	Data
c/y	0.62	Consumption to GDP	Data
i/y	0.20	Investment to GDP	Data
g/y	0.14	Government spending to GDP	Data
nx/y	0.04	Net exports to GDP	Implied
n	0.204	Hours worked per capita	Data
r	0.01	Quarterly interest rate	Data

The Long-Run Implications of Tax Reform

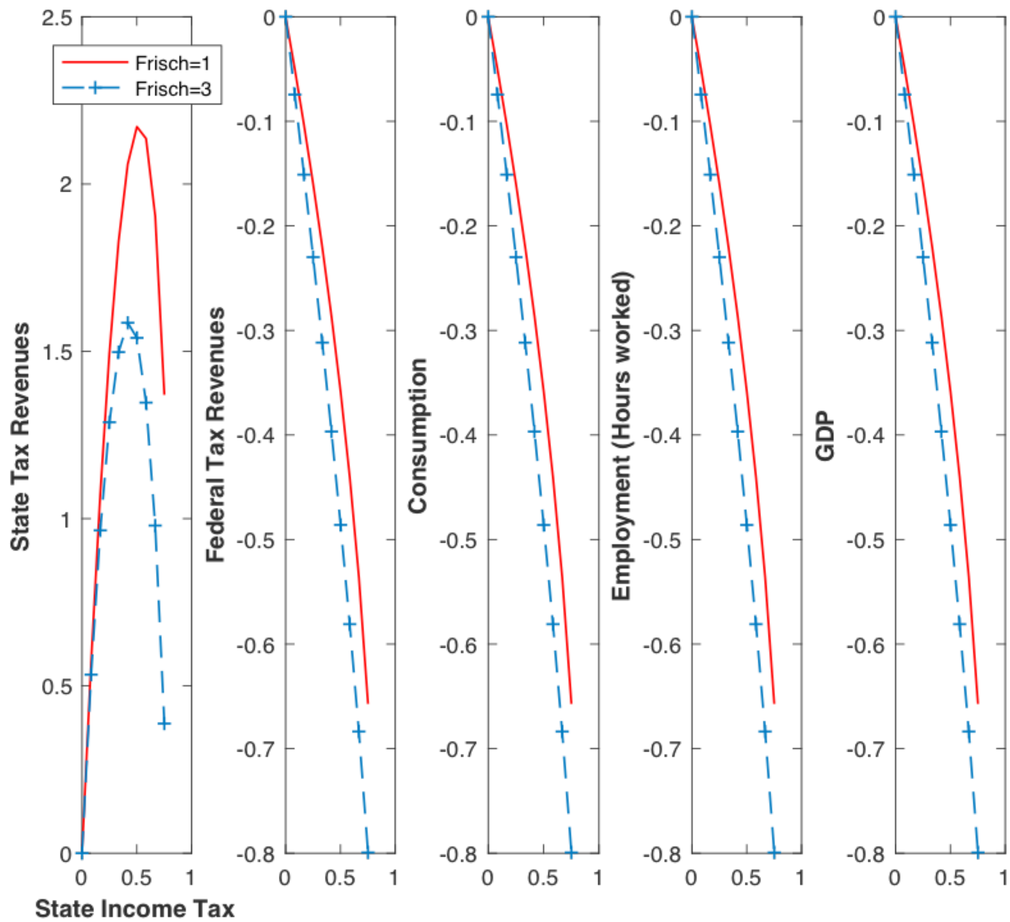
In this section, we construct Laffer curves for Wyoming, and use our dynamic macroeconomic model to investigate how tax revenues and production adjust when labor or capital income taxes change.

The Laffer curve represents the relationship between tax rates and government revenues. It reveals that when tax rates reach extreme levels of 0% and 100% no tax revenues will be collected, and also demonstrates that at least one tax rate will maximize government tax revenue—but at price that may be unbearable for families and businesses in the state of Wyoming.

The parameter that governs the responsiveness of labor supply—often called the "Frisch labor supply elasticity" (*see*, Peterman, 2012)—factors significantly in our analysis. It represents the response of labor supply to a change in the real wage while holding consumption constant. 'Frisch labor supply elasticity" has been highly debated because "holding consumption constant" is open to two interpretations. Some economists argue that "holding consumption constant" means that elasticity refers to the response of labor supply to a change in the real wage that is so short that the household's wealth—and thus, consumption—remains unaffected. Others argue, however, that elasticity refers to the response of labor supply to a change in the real wage associated with an offsetting lump sum transfer payment that keeps wealth unchanged. In both cases, the more responsive individuals are to changes in the real wage, the less tax the state government is able to collect.

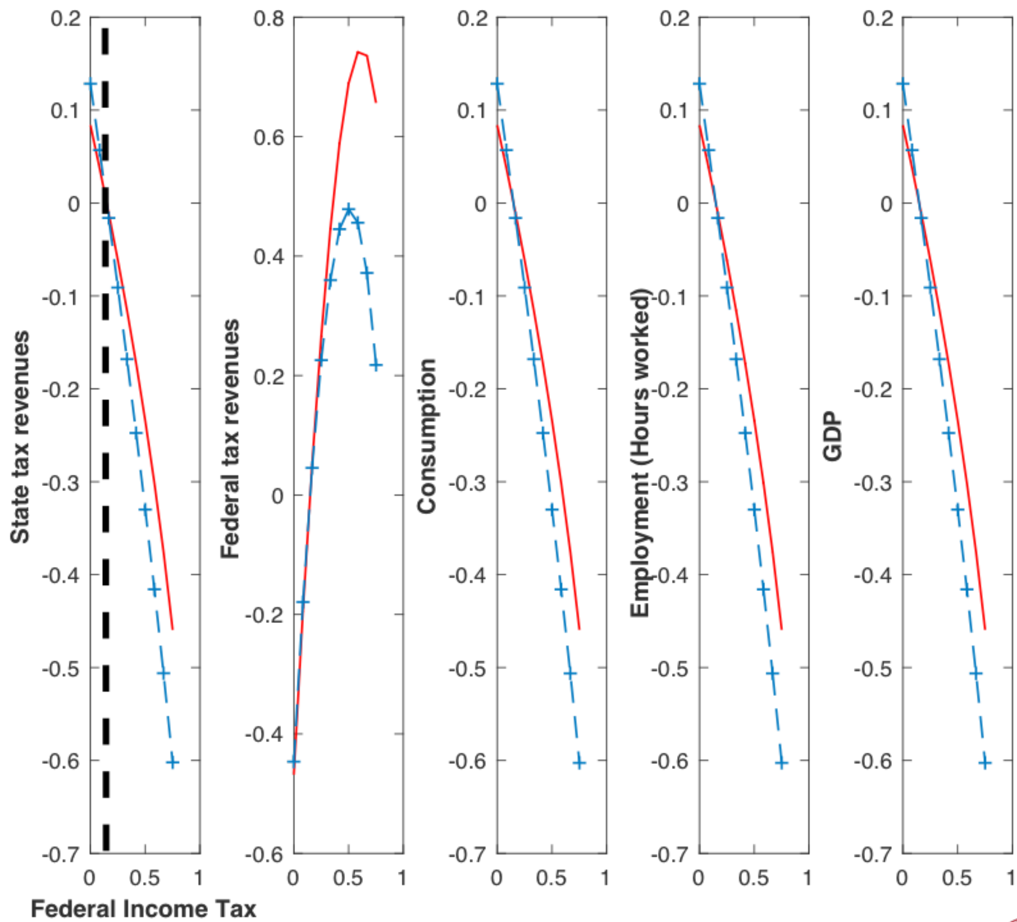
Chart 5 illustrates the Laffer curve for Wyoming if the state were to implement a labor income tax. The curve provides an optimistic, but limited, view of the potential long-run tax revenues generated by an income tax because our model of a closed-state economy does not account for migration, capital flight, or tax evasion. As Chart 5 shows, although Wyoming may collect more tax revenue from a labor income tax, the effect on households and businesses will be disastrous. A 45% labor income tax will maximize the state government's revenues, but employment *(measured in total hours worked)* will fall by 40%—making the actual "cost" of the tax revenue catastrophically expensive for Wyoming residents. Thus, raising tax revenues by introducing an income tax proves to be an anti-growth policy that would further cripple Wyoming's economy and lead to less prosperity across the state (*see* Feldstein (2006, 2008)).

Chart 5: The Labor Laffer Curve



Source: Economic Research Center at The Buckeye Institute.
Note: The vertical axis represents % changes. The horizontal axis is the state labor income tax rate.

Chart 6: The Burden of the Federal Government on the State



Source: Economic Research Center at The Buckeye Institute.
Note: The vertical axis represents % changes. The horizontal axis is the Federal labor income tax rate.

Chart 6 highlights the foregone state tax revenues due to the current federal government tax on labor income *(represented by the black dotted line in Chart 6)*. Our model results suggest that in the absence of the federal labor income tax, the state tax collections would be 7.9% - 12.9% higher depending on the assumed elasticity of labor supply ($\varphi = 1$ / $\varphi = 3$). Our estimates provide a measure of the burden of the federal government tax policy on the state economy.

APPENDIX B: FEDERAL TAX RATES ESTIMATION

Average Marginal Federal Tax Rate on Labor Income for Wyoming Residents

In order to calculate the average marginal federal tax rate on labor income for Wyoming residents, we follow Tuerck et al. (1999). The data used is obtained from the IRS Statistics of Income publication. For each Adjusted Gross Income (AGI) group, the marginal federal tax rate is computed as the change in tax liability per change in gross income. Therefore, the marginal federal tax rate for income group *i* is written as:

$$\tau_{t,i}^{fpy} = \frac{T_{t,i}^{fpy} - T_{t,i-1}^{fpy}}{Y_{t.i}^{fy} - Y_{t.i-1}^{fy}}$$

where $T_{t,i}^{fpy}$ is the average federal tax liability for AGI group *i* in period *t*, calculated by dividing the total tax liability by the number of returns for the respective AGI group; and $Y_{t,i}^{fy}$ is the average gross income for AGI group *i* in period *t*, calculated by dividing the total gross income by the number of returns for AGI group *i*.

In the next step, the average marginal federal tax rate on labor income for Wyoming, which is $\tau_{i}^{F,W}$, is calculated by multiplying wages and salaries in each AGI class by the marginal tax rate for that class, and then, dividing by the total wages and salaries in period *t*.

$$\tau_{i}^{F,W} = \frac{\sum_i Y_{t,i}^{F,W} \tau_{t,i}^{fpy}}{\sum_i Y_{t\ i}^{F,W}}$$

where $Y_{t,i}^{F,W}$ represents total wages and salaries for AGI group *i* in period *t*.

Finally, $\tau^{F,W}$ is computed as the long-run average of $\tau_{i}^{F,W}$. The average marginal federal tax rate on labor income for Wyoming residents over the time period of 2005 through 2014 is $\tau^{F,W} = 0148725$.

Average Marginal Federal Tax Rate on Capital Income for Wyoming Residents

For the computation of the federal tax rate on capital income, we apply a similar methodology as above. First, for each AGI group *i* we compute the marginal tax rate as follows:

$$\tau_{t,i}^{fy} = \frac{T_{t,i}^{fy} - T_{t,i-1}^{fy}}{TY_{t,i}^{fy} - TY_{t,i-1}^{fy}}$$

where $T_{t,i}^{fy}$ is the average federal tax liability for AGI group *i* in period *t*, calculated by dividing the total tax liability by the number of returns for the respective AGI group; and $TY_{t,i}^{fy}$ is the average taxable income for AGI group *i* in period *t*, calculated by dividing the taxable income by the number of returns for AGI group *i*. The average marginal federal tax rate on capital income for Wyoming residents, $\tau_{i}^{F,D}$, is calculated by multiplying capital income *D* in each AGI class by the marginal tax rate for that class, and then, dividing by the total capital income from all AGI groups in period *t*.

$$\tau_i^{F,D} = \frac{\sum_i D_{t,i}\tau_{t,i}^{fy}}{\sum_i D_{t,i}}$$

where $D_{t,i}$ is the sum of income from *Ordinary Dividends* and *Net Capital Gains* for AGI group *i* in period *t*.

Finally, $\tau^{F,D}$is computed as the long-run average of $\tau_i^{F,D}$. The average marginal federal tax rate on capital income for Wyoming residents over the time period of 2005 through 2014 is $\tau^{F,D} = 0.243817$.

APPENDIX C: A MODEL WITH SECTORAL HETEROGENEITY

We consider an economy populated by many identical households with preferences over goods and leisure. Households are expected to maximize their lifetime utility. Households can consume, work and save through investments that add to the capital stock.

There are many symmetric firms in each of ***I*** sectors and so we can think of them as a representative firm in each secto . The representative firm in each sector ***i*** maximizes profits by borrowing capital from households and hiring all available labor inputs. The firm produces consumption goods which are sold to households for consumption. The firm also pays households a wage and a return for the borrowed capital. The goods market, the labor market and the capital market are assumed to be competitive.

Finally, the government finances its expenditures by levying taxes on households in the form of a tax on labor income, a tax on investment income, and a tax on the value of the capital stock.

A ***competitive equilibrium*** in our model is a set of prices *(rate of return on investments and wage rate),* and a set of optimal allocations for consumption, investments and hours worked such that all households maximize utility and all firms maximize profits. In addition, we impose that th government sector must balance its budget every period. A formal description of the model is as follows.

Time is discrete, $t = 0, 1 \ldots \infty$. There are ***I*** sectors. There is a large number of multiple goods producing firms in each secto . The representative household maximizes the discounted sum of lifetime utility subject to an intertemporal budget constraint and a capital flow equation.

Formally,

$$\max_{\{C_{i,t}, N_{i,t}, K_{t+1}, X_{i,t},\}} E_0 \sum_{t=0}^{\infty} \beta^t \left(\sum_{i=1}^{I} \kappa_i ln(C_{i,t}) - \chi \sum_{i}^{I} N_{i,t}^{1+\frac{1}{\varphi}} + \vartheta(G_{S,t}, G_{F,t}) \right)$$

subject to:

$$(1 + \tau^C) \sum_{i}^{I} C_{i,t} + \tau_t^S \mu_s \sum_{i}^{I} (C_{i,t}) + \sum_{i}^{I} X_{i,t}$$

$$\leq \left(\mathbf{1} - \tau_t^{S,W} - \tau_t^{F,W}\right) \sum_i^I w_{i,t} N_{i,t} + \left(\mathbf{1} - \tau_t^{S,D} - \tau_t^{F,D}\right) \sum_i^I (d_{i,t} - \delta) K_{i,t} + \sum_i^I \delta_i K_{i,t}$$

$$- \tau_t^K \sum_i^I K_{i,t} + S_{s,t} + S_{F,t} - \sum_i^I Nx_{i,t} - \tau_t^L \sum_i^I Y_{i,t}$$

The capital stock evolves according to:

$$K_{i,t+1} = X_{i,t} + (\mathbf{1} - \delta) K_{i,t}$$

where $\delta \in (\mathbf{0}, \mathbf{1})$ is the rate of depreciation of the capital stock.

$\kappa_i \in (\mathbf{0}, \mathbf{1})$ is a preference parameter that represents how much the household likes consuming the good produced by sector i. It is assumed that government spending may be valuable as it is assumed to provide utility. We assume $\beta \in (0,1)$ represents the rate with which the household discounts utility over time. $\varphi > 0$ plays an important role in the analysis as it measures the elasticity of labor supply with respect to a change in the real wage. $C_{i,t}$, $N_{i,t}$, $K_{i,t}$, $X_{i,t}$, $Nx_{i,t}$ denote consumption, hours worked, capital, investment, and an exogenous stream of payments in sector i in time t. The household takes the value of government $\vartheta\left(G_{S,t}, G_{F,t}\right)$ as given. Further the household receives wages $w_{i,t}$, dividends, $d_{i,t}$ from the firm, and lump-transfers S_t from the government. The household pays a "sales" tax for all consumption τ_t^C to the state government. The household pays labor income taxes to the state government and to the federal government $\tau_t^{S,W}$ and $\tau_t^{F,W}$ respectively. The household pays investment income taxes to the state and to the federal government: $\tau_t^{S,D} \tau_t^{F,D}$ respectively. The household also pays a tax on fixed assets ownership τ_t^K. A fixed share μ_s of goods produced are subject to a severance tax at rate τ_t^S. Households pay a share of income τ_t^L in licenses to the state government. The payments $Nx_{i,t}$ can be positive or negative. This feature captures a negative or positive trade balance, equating $Nx_{i,t}$ to net exports, and introducing international trade in a minimalist way. This is similar to Trabandt and Uhlig (2011). This is an important simplification since households in our model economy cannot react to expansionary periods with higher imports. In most countries, net exports are countercyclical, indicating that countries borrow from international capital markets during high income periods (see Sachs, 1981, Backus and Kehoe, 1992, and Raffo, 2006). Since net exports are procyclical in Wyoming, our simplification is fully justified. In the balance growth path equilibria, the model is consistent with an open-economy interpretation with source-based capital income taxation, where the rest of the world grows at the same rate and features households with the same time preferences. The trade balance influences the reaction of steady state consumption, labor and investment decisions.

$NX_{i,t}$ is assumed to follow a stationary mean zero AR(1) process in the log. The shock $\epsilon_{NXi,t}$ is drawn from a standard normal distribution.

$$(NX_{i,t}) = (\mathbf{1} - \rho_G)(NX_i) + \rho_G\left(NX_{i,t-1}\right) + \epsilon_{NXi,t}$$

where NX_i is the steady-state share of net exports from sector i in GDP. This implies that $Nx_{i,t} = NX_{i,t} Y_t$. This specification implies that the size of net exports grows as the economy grows.

The representative firm borrows capital from the household $K_{i,t}$ and hires all available labor hours $N_{i,t}$ to maximize profits

$$\max_{\{N_{i,t},K_{i,t}\}} Z_t\, K_{i,t}^{\theta} N_{i,t}^{1-\theta} - w_{i,t}N_{i,t} - d_{i,t}K_{i,t}$$

where Z_t denotes a random productivity shock variable which is assumes to follow a stationary mean zero AR(1) process in the log. The shock ϵ_t is drawn from a standard normal distribution.

$$(Z_t) = \rho_Z(Z_{t-1}) + \epsilon_t$$

The state government faces the budget constraint:

$$G_{S,t} + S_{s,t} = T_t^S$$

where state government tax revenues are given by:

$$T_t^S = \tau_t^C \sum_i^I C_{i,t} + \tau_t^{S,W} \sum_i^I w_{i,t}N_{i,t} + \tau_t^{S,D} \sum_i^I (d_{i,t} - \delta)K_{i,t} + \tau_t^K \sum_i^I K_{i,t} + \tau_t^S\,(\mu_s C_t) + \tau_t^L Y_t$$

The federal government faces the following budget constraint:

$$G_{F,t} + S_{F,t} = T_t^F$$

The federal government tax revenues are given by:

$$T_t^F = \tau_t^{F,W} \sum_i^I w_{i,t}N_{i,t} + \tau_t^{F,D} \sum_i^I (d_{i,t} - \delta)K_{i,t}$$

Government consumption of good i is assumed to evolve according to:

$$g_{i,S,t} = (1 - \rho_G)(g_{i,S}) + \rho_G(g_{i,S,t-1}) + \epsilon_{gS}$$

$$g_{i,F,t} = (1 - \rho_F)(g_{i,F}) + \rho_F(g_{i,F,t-1}) + \epsilon_{gF}$$

where $g_{i,S}$ is, the state share of income spent on good i such that total government spending in steady-state is simply $G_{i,S} = G_{i,S} + G_{i,F} = g_{i,S}Y + g_{i,F}Y$. Once more, this specification implies that the size of government can grow endogenously as the economy grows.

The tax instruments follow AR(1) processes with a non-negative response to the deviation of government spending from an exogenous long-run level G^*:

$$\tau_t^W = (1 - \rho_{S.W})\tau^W + \rho_{S.W}\tau_{t-1}^W + \gamma_W \epsilon_{aS}$$

$$\tau_t^D = (1 - \rho_{S.D})\tau^D + \rho_{S.D}\tau_{t-1}^D + \gamma_D \epsilon_{aS}$$

$$\tau_t^C = (1 - \rho_{S,C})\tau^C + \rho_{S,C}\tau_{t-1}^C + \gamma_C \epsilon_{gS}$$

$$\tau_t^K = \left(1 - \rho_{S,K}\right)\tau^K + \rho_{S,K}\tau_{t-1}^K + \gamma_K \epsilon_{gS}$$

$$\tau_t^S = (1 - \rho_{S,S})\tau^S + \rho_{S,S}\tau_{t-1}^S + \gamma_S \epsilon_{gS}$$

$$\tau_t^L = (1 - \rho_{S,L})\tau^L + \rho_{S,L}\tau_{t-1}^L + \gamma_L \epsilon_{gS}$$

$$\tau_t^{F,W} = (1 - \rho_{F,W})\tau^{F,W} + \rho_{F,W}\tau_{t-1}^{F,W} + \gamma_{F,W} \epsilon_{gF}$$

$$\tau_t^{F,D} = (1 - \rho_{F,D})\tau^{F,D} + \rho_{F,D}\tau_{t-1}^{F,D} + \gamma_{F,D} \epsilon_{gF}$$

where τ^W, τ^D, τ^C, τ^K, τ^S, τ^L, $\tau_t^{F,W}$, $\tau_t^{F,D}$ are the steady-state values of the tax rates. We also assume that $\gamma_W, \gamma_D, \gamma_C, \gamma_K, \gamma_S, \gamma_L, \gamma_{F,W}, \gamma_{F,D}$ are exogenous parameters that govern which tax the government uses to raise additional tax revenue.

The implication of these exogenous processes is that the government tax rates never deviate from their steady-state values so long as there is no change in government spending.

Combining these conditions gives rise to a somewhat standard aggregate resource constraint:

$$Y_t = \sum_i^I Y_{i,t} = \sum_i^I C_{i,t} + \sum_i^I X_{i,t} + G_{S,t} + G_{F,t} + \sum_i^I Nx_{i,t}$$

Our resource constraint makes explicit the difference between the state government and the federal government's share of GDP.

A ***competitive equilibrium*** in our model is a set of prices and a set of optimal allocations for consumption, investments and hours worked such that:

(4) Households maximize utility
(5) Firms maximize profit
(6) The government budget constraint is balanced each period

The full set of equilibrium conditions are:

$$\frac{\kappa_i}{(1 + \tau^C)C_{i,t}} = \lambda_t$$

$$\frac{\chi\left(1 + \frac{1}{\varphi}\right) N_{i,t}^{1/\varphi}}{\left(1 - \tau_t^{S,W} - \tau_t^{F,W}\right) w_{i,t}} = \lambda_t$$

$$\frac{\lambda_t}{\lambda_{t+1}} = \left[\begin{pmatrix} (1 - \tau_{t+1}^{S,D} - \tau_{t+1}^{F,D}) d_{i,t+1} \\ + \tau_{t+1}^{S,D}\delta + \tau_{t+1}^{F,D}\delta + (1 - \delta) - \tau_{t+1}^K \end{pmatrix}\right]$$

$$\boldsymbol{w_{i,t} = (1-\theta)\frac{Y_{i,t}}{N_{i,t}}}$$

$$\boldsymbol{d_{i,t} = \theta\frac{Y_{i,t}}{K_{i,t}}}$$

$$\boldsymbol{Y_{i,t} = Z_t\, K_{i,t}^{\theta} N_{i,t}^{1-\theta}}$$

$$\boldsymbol{Y_t = \sum_i^I Y_{i,t} = \sum_i^I C_{i,t} + \sum_i^I X_{i,t} + G_{S,t} + G_{F,t} + \sum_i^I Nx_{i,t}}$$

$$\boldsymbol{K_{i,t+1} = X_{i,t} + (1-\delta_i)K_{i,t}}$$

The model is solved by linear approximation:

1. Find the deterministic steady-stat*e (the solution to the above set of equations with* $\boldsymbol{Z^* = 1}$*,* $\boldsymbol{\epsilon_{gS} = 0}$*)*

2. Linearize all equations around the steady-state.

3. Obtain a linearized solution: $\boldsymbol{V_t = AV_{t-1} + B\epsilon_t}$ where $\boldsymbol{V_t}$ is the vector of all variables in the model

We now proceed to calibrate the model. Using our parameter values for $\theta = 0.37, \beta = 0.99, \delta = 0.02675, \tau^K = 0.00078106, \tau^{S,D} = 0, \tau^{S,W} = 0,$ $\tau^{F,W} = 0.1487, \tau^{F,D} = 0.2438$, we find the steady-state capital-labor ratio

$$\frac{K}{N} = \left(\frac{\left(\frac{1+0.005}{0.99}\right) - (1-0.02675) + 0.00078106 - 0.02675(0.2438)}{(1-0.2438)0.37}\right)^{1/(0.37-1)}$$
$$= 25.6820$$

Using sector specific hours worked, we can use the capital-labor ratio to compute the sector specific steady-state level of capital $K_1 = 0.08, K_2 = 1.84, K_3 = 0.12, K_4 = 0.32,$ $K_5 = 0.32, K_6 = 0.20, K_7 = 0.29, K_8 = 0.36, K_9 = 0.08, K_{10} = 0.67, K_{11} = 0.22,$ $K_{12} = 0.22, K_{13} = 0.20, K_{14} = 0.09$.

These levels of the capital stock imply the following steady-state levels of output: $Y_1 = 0.0111$, $Y_2 = 0.2456$, $Y_3 = 0.0156$, $Y_4 = 0.0424$, $Y_5 = 0.0434$, $Y_6 = 0.0272$, $Y_7 = 0.0383$, $Y_8 =$ 0.0483, $Y_9 = 0.0104$, $Y_{10} =$0.0901, $Y_{11} = 0.0297$,

From the data, we know the share of net exports in GDP $\frac{NX}{Y} = 0.04$, the share of state and local government spending in GDP $g_s = 0.11$ and the share of GDP that goes to the federal government $g_F = 0.03$. By using the sector specific resource constraint $GDP = Y_i = C_i + \delta K_i + G_i + NX_i$, we find a consumption-output ratio $\frac{C}{Y} \approx 0.61$.

Equipped with the model optimal consumption, labor supply equations and the effective tax rates, we can find the remaining parameters. Without loss of generality, we normalize $\chi = 1$ to find the preference weight for goods produced by each sector:

$$\frac{\chi}{\kappa_1} = \frac{(1 - \tau^{S,W} - \tau^{F,W})w_1}{{n_1}^{1/\varphi}\left(1 + \frac{1}{\varphi}\right)(1 + \tau^C)c_1} = 36362.87$$

$$\frac{\chi}{\kappa_2} = \frac{(1 - \tau^{S,W} - \tau^{F,W})w_2}{{n_2}^{1/\varphi}\left(1 + \frac{1}{\varphi}\right)(1 + \tau^C)c_2} = 73.75$$

$$\frac{\chi}{\kappa_3} = \frac{(1 - \tau^{S,W} - \tau^{F,W})w_3}{{n_3}^{1/\varphi}\left(1 + \frac{1}{\varphi}\right)(1 + \tau^C)c_3} = 18268.39$$

$$\frac{\chi}{\kappa_4} = \frac{(1 - \tau^{S,W} - \tau^{F,W})w_4}{{n_4}^{1/\varphi}\left(1 + \frac{1}{\varphi}\right)(1 + \tau^C)c_4} = 2476.36$$

$$\frac{\chi}{\kappa_5} = \frac{(1 - \tau^{S,W} - \tau^{F,W})w_5}{{n_5}^{1/\varphi}\left(1 + \frac{1}{\varphi}\right)(1 + \tau^C)c_5} = 2357.29$$

$$\frac{\chi}{\kappa_6} = \frac{(1 - \tau^{S,W} - \tau^{F,W})w_6}{{n_6}^{1/\varphi}\left(1 + \frac{1}{\varphi}\right)(1 + \tau^C)c_6} = 5973.49$$

$$\frac{\chi}{\kappa_7} = \frac{(1 - \tau^{S,W} - \tau^{F,W})w_7}{{n_7}^{1/\varphi}\left(1 + \frac{1}{\varphi}\right)(1 + \tau^C)c_7} = 3031.54$$

$$\frac{\chi}{\kappa_8} = \frac{(1 - \tau^{S,W} - \tau^{F,W})w_8}{{n_8}^{1/\varphi}\left(1 + \frac{1}{\varphi}\right)(1 + \tau^C)c_8} = 1908.65$$

$$\frac{\chi}{\kappa_9} = \frac{(1 - \tau^{S,W} - \tau^{F,W})w_9}{{n_9}^{1/\varphi}\left(1 + \frac{1}{\varphi}\right)(1 + \tau^C)c_9} = 41303.70$$

$$\frac{\chi}{\kappa_{10}} = \frac{(1 - \tau^{S,W} - \tau^{F,W})w_{10}}{{n_{10}}^{1/\varphi}\left(1 + \frac{1}{\varphi}\right)(1 + \tau^C)c_{10}} = 548.49$$

$$\frac{\chi}{\kappa_{11}} = \frac{(1-\tau^{S,W} - \tau^{F,W})w_{11}}{{n_{11}}^{1/\varphi}\left(1+\frac{1}{\varphi}\right)(1+\tau^{C})c_{11}} = 5057.04$$

$$\frac{\chi}{\kappa_{12}} = \frac{(1-\tau^{S,W} - \tau^{F,W})w_{12}}{{n_{12}}^{1/\varphi}\left(1+\frac{1}{\varphi}\right)(1+\tau^{C})c_{12}} = 5057.04$$

$$\frac{\chi}{\kappa_{13}} = \frac{(1-\tau^{S,W} - \tau^{F,W})w_{13}}{{n_{13}}^{1/\varphi}\left(1+\frac{1}{\varphi}\right)(1+\tau^{C})c_{13}} = 6426.07$$

$$\frac{\chi}{\kappa_{14}} = \frac{(1-\tau^{S,W} - \tau^{F,W})w_{14}}{{n_{14}}^{1/\varphi}\left(1+\frac{1}{\varphi}\right)(1+\tau^{C})c_{14}} = 28453.18$$

Baseline Parameters

Variable	Value	Description	Restriction
θ	0.37	Capital share in production	Data
δ	0.02675	Quarterly depreciation rate of capital	Data
φ	1	Labor supply elasticity	Data
χ	1	Disutility of labor	$Normalization$
χ/κ_1	36362.87	Agriculture, forestry, fishing, and huntin	$\frac{y_1}{y} = 0.017$
χ/κ_2	73.75	Mining	$\frac{y_2}{y} = 0.368$
χ/κ_3	18268.39	Utilities	$\frac{y_3}{y} = 0.024$
χ/κ_4	2476.36	Construction	$\frac{y_4}{y} = 0.062$
χ/κ_5	2357.29	Manufacturing	$\frac{y_5}{y} = 0.065$
χ/κ_6	5973.49	Wholesale Trade	$\frac{y_6}{y} = 0.041$
χ/κ_7	3031.54	Retail Trade	$\frac{y_7}{y} = 0.059$
χ/κ_8	1908.65	Transportation and Warehousing	$\frac{y_8}{y} = 0.070$
χ/κ_9	41303.70	Information	$\frac{y_9}{y} = 0.016$

χ/κ_{10}	548.49	Finance, insurance, real estate, rental, and leasing	$\frac{y_{10}}{y} = 0.131$
χ/κ_{11}	5057.04	Professional and Business Services	$\frac{y_{11}}{y} = 0.044$
χ/κ_{12}	5057.04	Educational services, health care, and social assistance	$\frac{y_{12}}{y} = 0.044$
χ/κ_{13}	6426.07	Arts, entertainment, recreation, accommodation, and food services	$\frac{y_{13}}{y} = 0.040$
χ/κ_{14}	28453.18	Other Services, except government	$\frac{y_{14}}{y} = 0.019$

Wyoming Calibration 2005Q1-2015Q4

Variable	Value	Description	Restriction
$\tau^{S,W}$	0	State labor income tax rate	Data
$\tau^{F,W}$	0.1487	Federal labor income tax rate	Data
$\tau^{S,D}$	0	State capital income tax rate	Data
$\tau^{F,D}$	0.2438	Federal capital income tax rate	Data
τ^{K}	0.00078106	Franchise tax rate	Data
τ^{C}	0.034	Effective sales tax rate	Data
ϑ	0.0051	Quarterly growth rate of GDP	Data
c/y	0.62	Consumption to GDP	Data
i/y	0.20	Investment to GDP	Data
g/y	0.14	Government spending to GDP	Data
nx/y	0.04	Net exports to GDP	Implied
n	0.204	Average Hours worked per capita	Data
r	0.01	Quarterly interest rate	Data