False promises, real harm: Why Illinoisans should reject a progressive income tax

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Executive summary

With Illinoisans already shouldering a record $5 billion income tax hike passed in 2017 – which still could not keep up with Springfield's spending demands – many state lawmakers are trying to justify further tax hikes without drawing the ire of the voting public.

How? By calling for a progressive income tax. Some members of the Illinois General Assembly, as well as many Democratic gubernatorial candidates, have been pushing the idea of scrapping Illinois' constitutionally protected flat income tax in favor of a progressive income tax that would make "the rich" pay their "fair share."

Proponents of scrapping this constitutional protection make three key claims regarding a progressive income tax: it would reduce taxes on the middle class, it would go a long way toward reducing income inequality and it would benefit the state's economy.

An evaluation of current progressive tax proposals in the Illinois General Assembly, economic literature on progressive income taxes and outcomes in all 50 states reveal these claims are misleading at best.

First, states with progressive income taxes have seen slower economic growth and faster growth in inequality.

Second, most economists agree that more progressive tax structures reduce economic growth.

And finally, Illinois' spending problems dictate that a progressive tax would entail large tax hikes on the middle class, leading to severe economic damage. A leading progressive tax proposal in the Illinois General Assembly – House Bill 3522 – would hike income taxes for a vast majority of Illinoisans. Economic modeling estimates that if this proposal had been enacted in 2016, it would have cost Illinoisans 34,500 jobs and cost the state economy $5.5 billion in the first year after enacted, erasing nearly 75 percent of the employment growth Illinois saw in 2017.

This potential economic harm is the most important reason Illinoisans should not allow a progressive income tax. It would likely lead to tax hikes on the middle class, fewer job prospects and lower incomes.

In short, a progressive tax is not the solution Illinoisans need to turn their state around.

Instead, lawmakers must look to rein in the growth in state spending, which outpaced personal income growth by 25 percent from 2005-2015. This lack of discipline has forced tax hikes, unsustainable debt and enormous uncertainty in the private sector over the future of Illinois. Rather than introducing more uncertainty with a progressive income tax system, lawmakers should adopt a spending cap that ties state spending growth to growth in Illinois' economy. Illinoisans can then rest assured they're getting a state government they can afford.

Introduction

With Illinoisans already shouldering a record $5 billion income tax hike passed in 2017, which still could not keep up with Springfield's spending demands, many state lawmakers are trying to justify even further tax hikes on Illinoisans without inciting the rage of taxpayers. They are doing this by calling for a progressive income tax.

Currently, the Illinois Constitution mandates that state income taxes remain at a single, flat rate. Amending the constitution requires a three-fifths vote of the Illinois House and Senate, and that amendment would also have to be approved by voters in one of two ways in the next election. The first method is through a majority vote of all voters in the election (for example, if 1 million Illinoisans vote in the election, 500,001 would need to vote in support of the amendment for it to pass). The second method is through a three-fifths majority of those voting specifically on the referendum question (of those 1 million total voters, if only 500,000 voted on the referendum question, it would require 300,000 votes to pass). Constitutional amendments do not require the governor's signature.

Under a progressive income tax system, taxpayers pay increasingly higher tax rates the more they earn. In other words, low-income earners would pay the smallest share of their income in taxes, while high-income earners would end up paying the highest share of their income in taxes.

Advocates of a progressive income tax at the state level make three key claims, all of which are misleading to varying degrees:

- A progressive income tax would reduce taxes on the middle class.
- A progressive income tax would go a long way toward reducing income inequality.
- A progressive income tax could actually benefit the state's economy.

On the opposite side of the debate are those who believe the income tax rate should remain flat, as it is currently in Illinois. Proponents of the flat tax system pose three main arguments:

- A flat tax system is fairer because all taxpayers pay the same tax rate.
- Wealthier Illinoisans already pay the bulk of all income taxes collected in the state.
- A progressive income tax will do little to improve income equality while harming economic outcomes for all.

Since the publication of the seminal work of Hall and Rabushka (1995)[1], academics have been arguing in favor of a simplification of the tax code, a broadening of the tax base and a reduction of marginal taxes. Progressive taxation does the opposite: it makes the tax code more complex and can have disastrous effects on economic growth.

The progressive tax and income inequality

Politicians frequently point to income inequality when arguing in favor of a progressive income tax. Despite good intentions, it is not clear from the evidence that progressive tax schemes are successful at reducing income inequality. In fact, states with a progressive income tax see greater income inequality, and have seen income inequality rise faster than states without a progressive income tax.

Although there are different ways to measure inequality, the most widely used measure is the Gini coefficient. The Gini coefficient of income measures the disparity in income between segments of the population. Lower Gini coefficients indicate a lower level of income inequality.

According to the U.S. Census Bureau's American Community Survey, the five states in 2006 with the lowest Gini coefficients – meaning the lowest levels of income inequality – were Utah, Wyoming, Alaska, New Hampshire and Vermont. Only Vermont had a progressive income tax. In 2016, Alaska, Utah, New Hampshire,

Wyoming and Hawaii had the lowest Gini coefficients. Only Hawaii has a progressive income tax.

By 2016, Vermont was more unequal, falling to 17th place from 5th place based on the Gini coefficient. Hawaii moved up the rankings to 5th place from 18th place between 2006 and 2016. Hawaii's rise in the rankings was only due to rising inequality across the U.S.

Where states rank on income inequality
50-state ranking by Gini coefficient in 2006 vs. 2016 (50=most unequal; 1=most equal)

Progressive income tax?	State	2006	2016
Yes	Alabama	46	45
No	Alaska	3	1
Yes	Arizona	29	31
Yes	Arkansas	35	32
Yes	California	42	47
No	Colorado	28	21
Yes	Connecticut	49	48
Yes	Delaware	15	14
No	Florida	43	46
Yes	Georgia	38	43
Yes	Hawaii	18	5
Yes	Idaho	6	12
No	Illinois	40	40
No	Indiana	13	15
Yes	Iowa	7	6
Yes	Kansas	20	18
Yes	Kentucky	36	42
Yes	Louisiana	48	49
Yes	Maine	10	13
Yes	Maryland	14	11
No	Massachusetts	39	37
No	Michigan	23	28
Yes	Minnesota	11	9
Yes	Mississippi	45	44
Yes	Missouri	26	24
Yes	Montana	9	25
Yes	Nebraska	12	7
No	Nevada	16	19
No	New Hampshire	4	3
Yes	New Jersey	33	41
Yes	New Mexico	32	34
Yes	New York	50	50
Yes	North Carolina	34	35
Yes	North Dakota	17	16
Yes	Ohio	27	26
Yes	Oklahoma	37	23
Yes	Oregon	24	20
No	Pennsylvania	30	27
Yes	Rhode Island	21	36
Yes	South Carolina	41	33
No	South Dakota	19	8
No	Tennessee	44	38
No	Texas	47	39
No	Utah	1	2
Yes	Vermont	5	17
Yes	Virginia	31	29
No	Washington	22	22
Yes	West Virginia	25	30
Yes	Wisconsin	8	10
No	Wyoming	2	4

Source: U.S. Census Bureau American Community Survey, 1-year estimates

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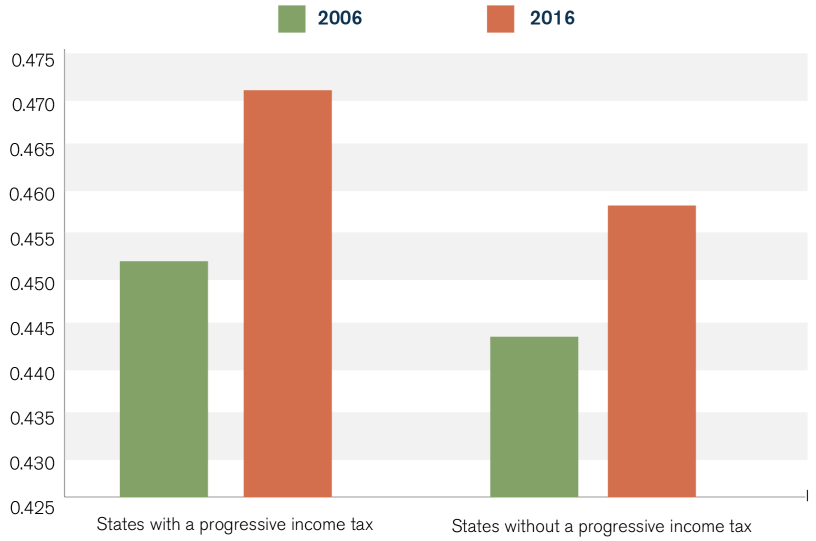
While changes in inequality reflect a host of factors, it is certainly not the case that states with a progressive income tax are more equal. In 2016, the average Gini coefficient in states with a progressive tax was 2.8 percent higher than states without a progressive income tax.

Inequality is higher in states with a progressive income tax
Gini coefficient, 2006 and 2016



Source: U.S. Census Bureau American Community Survey, 1-year estimates @illinoispolicy

Not only is inequality higher in states with a progressive income tax, but inequality has risen faster in those states as well. Inequality in states with a progressive income tax grew 4.2 percent from 2006 to 2016, while inequality grew by 3.3 percent in states without a progressive income tax.

States with progressive income taxes see inequality rise faster
Average change in Gini coefficient, 2006-2016

Source: U.S. Census Bureau American Community Survey, 1-year estimates @illinoispolicy

Would a progressive income tax reduce inequality in Illinois? Economists remain divided as to whether tax progressivity reduces inequality or has any effect on inequality whatsoever (see Appendix A).

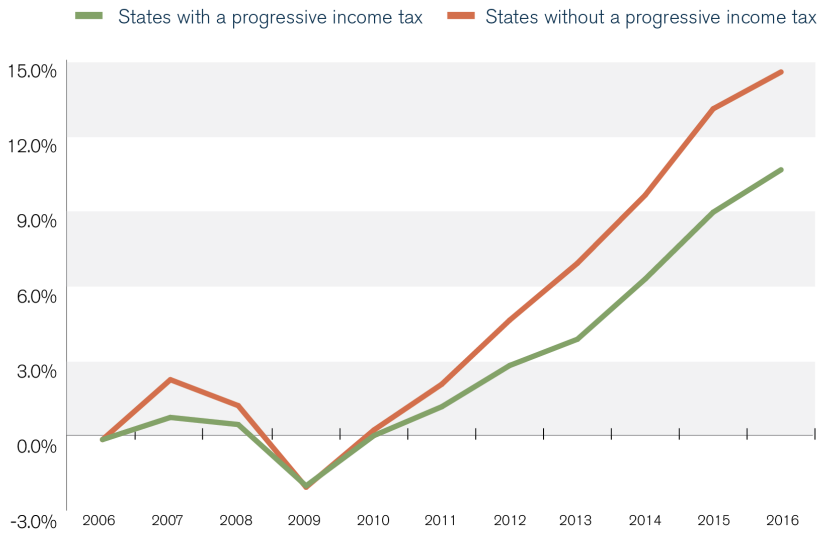
The progressive tax and economic growth

Although the academic literature hasn't reached a definitive conclusion on the impact of progressive income taxation on inequality, most economists agree that more progressive tax structures reduce economic growth. And the data point to the same conclusion: States without a progressive income tax have performed better than states with a progressive income tax.

Examining the past decade of the most recently available macroeconomic data reveals overall economic activity – measured as real gross state product, or GSP – has grown faster in states without a progressive income tax than in states with a progressive income tax. Since 2006, states without a progressive income tax have seen GSP grow by 14.7 percent, while states with a progressive income tax have seen 10.8 percent GSP growth.

States without a progressive income tax see faster economic growth than states with a progressive income tax

Change in real gross state product relative to 2006, 2006-2016



Source: Bureau of Economic Analysis

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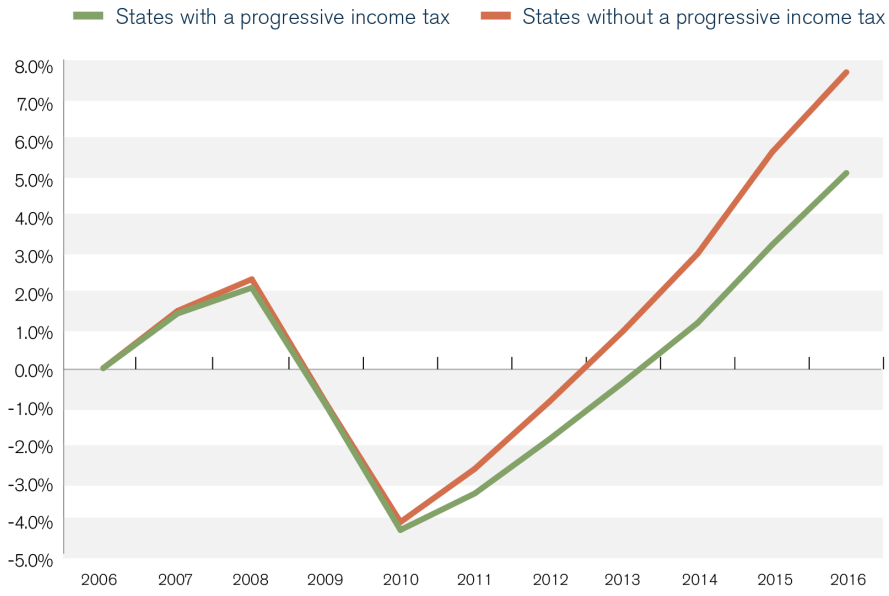
Additionally, employment has increased faster in states without progressive income taxes. In states without a progressive income tax, nonfarm payrolls have increased 7.8 percent, while payrolls have only increased 5.1 percent in states with a progressive income tax, since 2006.

Employment in states without a progressive income tax grows faster than in states with a progressive income tax

Change in nonfarm employment relative to January 2006, January 2006 – January 2016, seasonally adjusted



Source: Bureau of Labor Statistics

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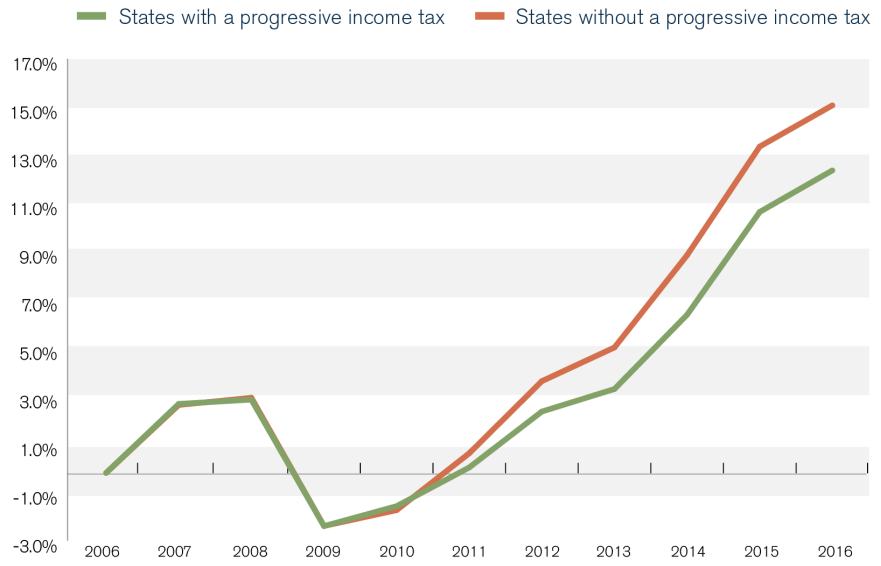
Wages and salaries have also been growing faster in states without a progressive income tax. Since 2006, states without a progressive income tax have seen wages and salaries increase 15.3 percent. Meanwhile, in states with a progressive income tax, wages and salaries have only increased 12.6 percent.

Wages and salaries in states without a progressive income tax grow faster than in states with a progressive income tax

Change in real wages and salaries relative to 2006, 2006-2016



Source: Bureau of Economic Analysis

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A majority of economists seem to agree that under plausible assumptions, tax progressivity has had a negative impact on the U.S. economy (see Appendix B).

The FRIENDLY Act and the harm of a progressive tax

House Bill 3522, filed in the Illinois House of Representatives in 2017 by state Rep. Robert Martwick, D-Chicago, would set the tax rates for a progressive income tax. Also known as the FRIENDLY Act, this proposal would raise taxes on Illinoisans making as little as $17,300 a year by enacting the following income tax rates:

- 4 percent for income between $0-$7,500
- 5.84 percent for income between $7,501-$15,000
- 6.27 percent for income between $15,001-$225,000
- 7.65 percent for income above $225,000

These rates would cause an increase in income taxes for a vast majority of Illinoisans.

FRIENDLY Act would increase income taxes between 5 and 50 percent
Change in effective income tax rates for various income groups under House Bill 3522, 2018

	Under $50,000	$50,001-$100,000	$100,001-$500,000	$500,001 or more
Population distribution	59.0%	22.6%	17.4%	1.0%
Current effective tax rate	3.6%	3.6%	4.0%	4.7%
Increase in tax rate under FRIENDLY Act	5.3%	21.0%	24.3%	50.2%

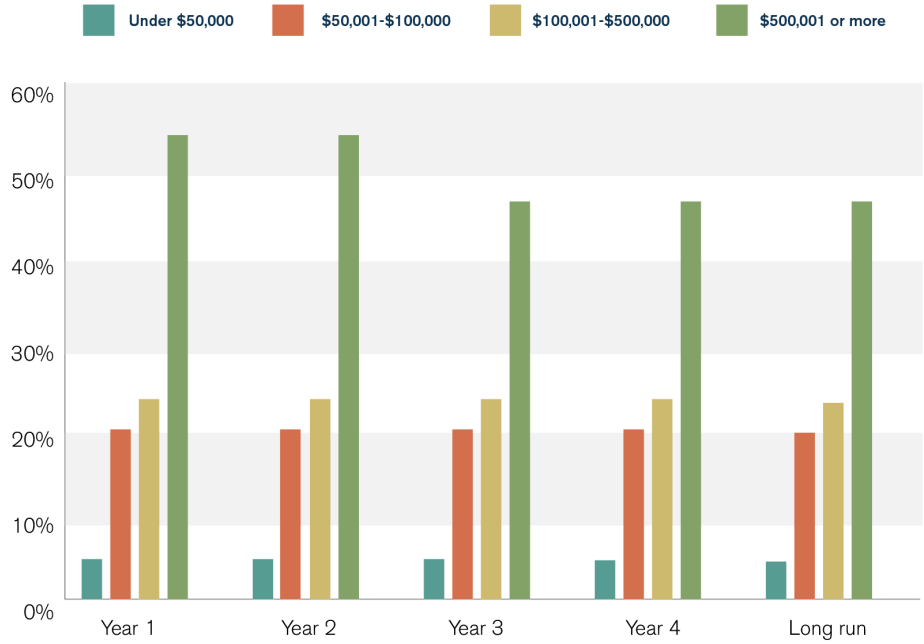
Source: IRS and Illinois Department of Revenue **@illinoispolicy**

Measuring the effects of tax changes on the economy is a challenging task. Fortunately, there's a large body of expert literature that addresses difficult empirical challenges and that proposes economic theories that are consistent with the data. Romer and Romer (2010) find that tax increases have a negative impact on real gross domestic product.[2] This is because tax increases have a large and sustained negative impact on investment. These results are consistent with the findings of Blanchard and Perotti (2002)[3] and Mountford and Uhlig (2009).[4]

As expected, simulating Martwick's progressive income tax in a dynamic macroeconomic model (see Appendix C and Appendix D) would raise additional income tax revenues, because most Illinoisans face a higher tax burden under this proposal.

Income tax collections increase for all groups under the FRIENDLY Act

Increase in income tax collections in years 1-4 and in the long run for various income groups



Source: Illinois Policy Institute neoclassical growth model predictions

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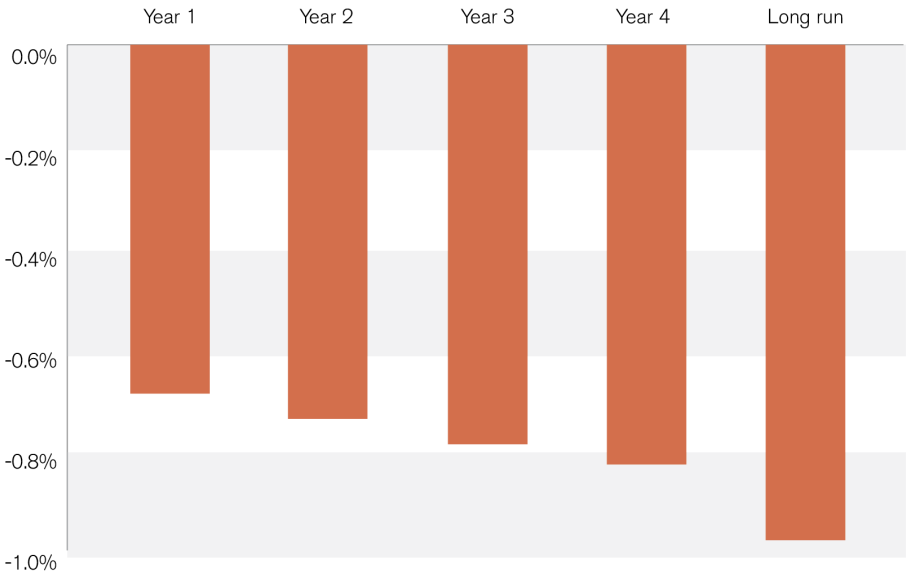
Simulating the proposed level of tax progressivity lowers aggregate economic activity. This is because the tax plan implies a tax hike that results in decreased aggregate investment. The increase in the tax burden has a negative impact on investment expenditures. When the marginal productivity of labor and capital decline, real wages fall.

If this policy had been enacted in 2016, Illinois' economy would have shrunk by $5.5 billion in the first year alone.

Illinois' economy would shrink under the FRIENDLY Act

Change in gross state product in years 1-4 and in the long run



Source: Illinois Policy Institute neoclassical growth model predictions

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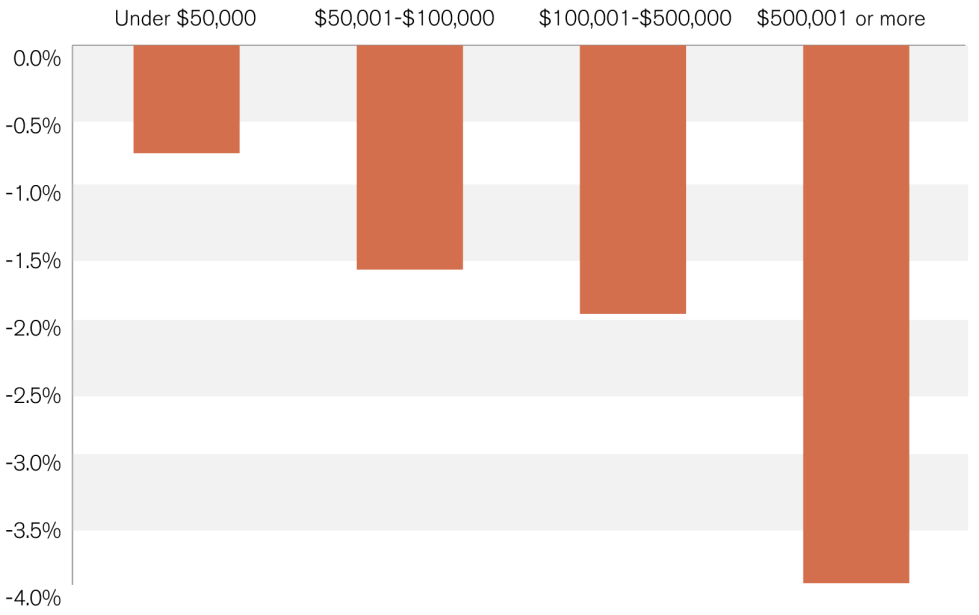
In the long term, Illinoisans would see reduced incomes as a result of the FRIENDLY Act. Adjusted for cost of living, after-tax incomes would drop 0.8 percent for the average income earner making less than $50,000; drop 1.6 percent for the average earner making between $50,001 and $100,000; drop 1.9 percent for the average earner making between $100,001 and $500,000; and drop 4.1 percent for the average earners making over $500,001.

After-tax income would fall for all income groups under the FRIENDLY Act
Decrease in after-tax income in the long run by income group (adjusted for cost of living)



Source: Illinois Policy Institute neoclassical growth model predictions

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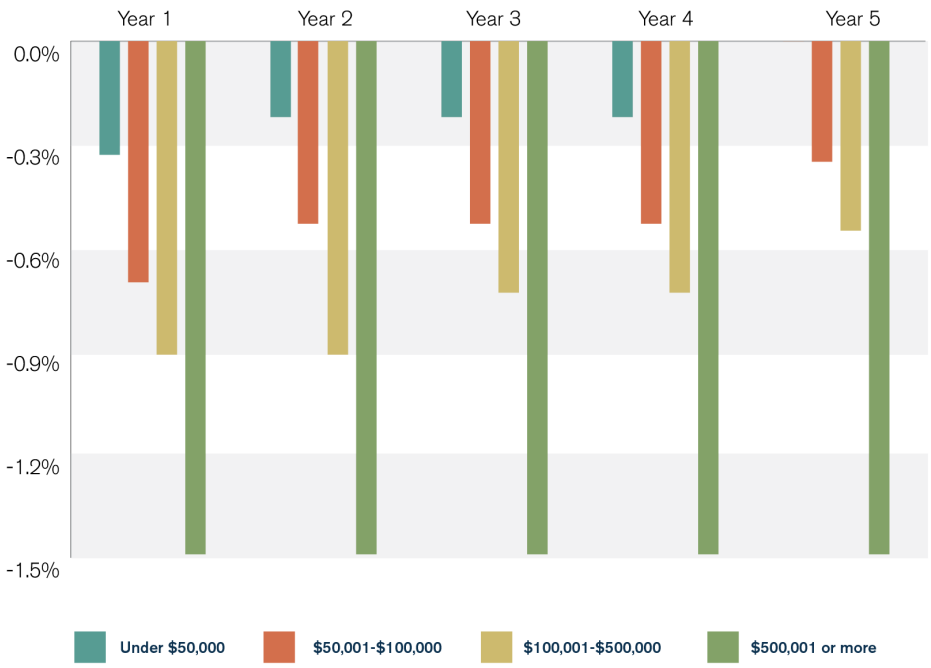
Declining real wages make workers worse off and reduce the incentive for market work relative to leisure or time spent in home production. On the other hand, a lower after-tax income raises the need to work longer hours in order to keep the value of take-home pay constant. The first effect lowers economic activity – economists refer to it as the substitution effect – while the second effect normally can offset any decline in labor supply through the so-called income effect. The impact of the tax hike depends on which one of these effects dominates the other in magnitude. Permanent (or very persistent) shocks have large income effects; hence labor works to offset the wage shock in the transmission to earnings.

The decline in the after-tax real wage results in Illinoisans choosing to work less because of the increased burden of taxation. The largest decline comes from those who are taxed at the highest rates.

Labor supply decreases for all groups under the FRIENDLY Act
Decrease in time spent working in years 1-4 and in the long run



Source: Illinois Policy Institute neoclassical growth model predictions

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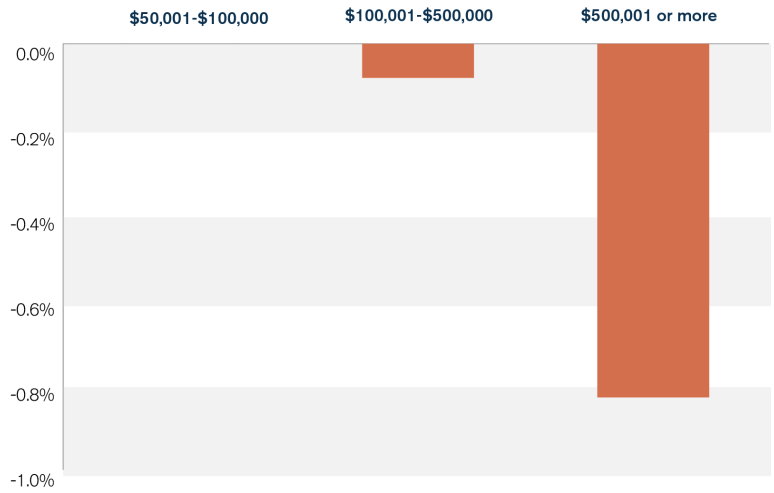
The FRIENDLY Act would reduce economic activity by nearly a full percentage point in Illinois, costing the state tens of thousands of jobs and billions of dollars in economic activity. In exchange for this economic harm, the proposal would reduce the income gap between those making less than $50,000 and those making more than $500,000 by 0.8 percent in the long run. The income gap between those making less than $50,000 and those making $100,000 to $500,000 would be reduced by less than 0.1 percent. Making all income groups worse off in exchange for these small reductions in the income gap is a foolish trade.

The FRIENDLY Act would do very little to reduce income inequality
Long-run change in income gap relative to group earning less than $50,000



Source: Illinois Policy Institute neoclassical growth model predictions

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The effects of a shift to a progressive income tax on income inequality and individual welfare strongly depend on the specific assumptions made about individual preferences, labor supply and the income tax schedule. However, regardless of these assumptions (within reason), the effect of a progressive tax on economic activity is clearly negative.

The results from this analysis show transitioning from a flat tax system to a progressive income tax system results in reduced output, reduced labor supply and a slight reduction in the long-run income gap between earning groups. These results are consistent with Altig, Auerbach, Kotlikoff, Smetters, and Walliser (2001), Conesa and Krueger (2006), Peterman (2012), Li and Sarte (2004), Echevarria (2012), Rhee (2008), Carroll and Prante (2012), Gimenez and Pijoan-Mas (2006), Ventura (1999), and Erosa and Korkeshova (2007) (see Appendix A and Appendix B).

This potential economic harm is why Illinoisans should not allow a progressive income tax. Any progressive tax amendment would inevitably lead to tax hikes on the middle class, fewer job prospects and lower incomes.

Conclusion

Claims that a progressive tax in Illinois would produce a meaningful reduction in income inequality are dubious at best. Claims that it would spur economic growth fly in the face of macroeconomic data and the prevailing economic literature. And claims that it would provide middle-class tax relief are disingenuous, as demonstrated by the FRIENDLY Act.

Instead, efforts to pass a progressive income tax in Illinois are best understood as desperate revenue grabs in the face of persistent government overspending.

Illinois spending has consistently grown faster than residents can afford, with state spending growing 25 percent faster than Illinoisans' personal incomes from 2005 to 2015.[5] Over the same time, state debt grew to $64 billion from $51 billion – not including the $250 billion the state owes in pension debt on benefits that cannot be reduced, according to the Illinois Supreme Court.[6]

A progressive income tax is not the solution to Illinois' overspending. And it will likely inflict further damage on the state's economy. Instead, lawmakers must look to rein in the growth in state spending. Their lack of discipline has forced tax hikes, unsustainable debt and enormous uncertainty in the private sector over the future of Illinois. Rather than introducing more uncertainty with a progressive income tax system, lawmakers should adopt a spending cap that ties state spending growth to growth in Illinois' economy. Illinoisans can then rest assured they're getting a state government they can afford.

APPENDIX A: Income inequality literature review

The progressive income tax system is designed to reduce the tax burden of those with a lower ability to pay and shift the burden increasingly to those with a higher ability to pay. Thus, it is commonly believed that an increase in tax progressivity will shift the burden of taxation from the poor to the rich.

While most experts agree that higher progressivity reduces economic growth, they remain divided as to whether tax progressivity reduces inequality or even have any effect on inequality whatsoever.

On one hand, some researchers found that by discouraging human capital investments, tax progressivity leads to higher inequality. Caucutt et al. (2003) show that reductions in the progressivity of labor income tax can positively affect growth and, furthermore, that "a less progressive tax system, which is rarely perceived as an egalitarian measure, gives rise to increased growth, decreased inequality, and greater mobility for the poor in the long run." This mobility up the ladder of success is caused by the increased incentive for human capital accumulation.[7]

Meanwhile, Heathcote, Storesletten and Violante (2010) find that even if a progressive tax succeeds in reducing inequality, such policies can have a negative effect on welfare. For example, more progressive taxation dissuades individuals from acquiring additional education more than under a flat tax. This is because the expected income increase due to additional education would be taxed less, and therefore more valuable.[8]

Gimenez and Pijoan-Mas (2006) find that more progressive tax reform reduces economic output by 2.6 percent but results in a more egalitarian after-tax income distribution.[9] Ventura (1999) also concludes that changes from tax progressivity to a flat-tax regime can bring about large gains in output and productivity at the expense of significant increases in inequality.[10] Erosa and Korkeshova (2007) find that although progressive income taxes can reduce inequality, they have a negative effect on output.[11]

Others have found that tax policy has little impact on inequality. Sarte (1997) highlights that since individuals are endowed with different rates of impatience, they face a different rate of return on both human and physical capital leading to income dispersion. It is because individuals have different rates of impatience that some states are more unequal than others and not necessarily because of their tax regime. As a result, higher top marginal tax rates seem more effective at reducing economic growth than at reducing the degree of long-run income inequality.[12]

Kaymak and Poschke (2016) use 50 years of U.S. data from 1960 to 2010 to find that reductions in the progressivity of the U.S. tax code over this time can explain nearly half of the growth in wealth inequality, but that income inequality is attributable to skill-biased technological change and changes in the wage structure.[13]

Making matters more unclear is the question of whether reductions in the progressivity of individual income taxes have reduced the progressivity of the tax code as a whole. Piketty and Sanz (2007) find the decline in top marginal individual income tax rates in the U.S. since the 1960s has contributed only moderately to the decline in tax progressivity.[14]

Roine, Vlachos and Waldenstrom (2009) found a strong positive affect on lower earners associated with a high top marginal tax rate that suggests progressivity of income taxes has equalizing effects even beyond the direct impact of taxation.[15]

Similarly, Guvenen, Kuruscu, and Ozkan (2014) found that progressive taxation was negatively correlated with a rise in wage inequality when studying the U.S. and countries in Europe.[16]

APPENDIX B: Economic growth literature review

The standard theory of optimal taxation argues that a tax system should maximize social welfare subject to a set of constraints. The goal should be to enact a tax system that maximizes households' welfare, given the knowledge that household members respond to whatever incentives the tax system provides.

Pioneering work on optimal taxation is the research of Frank Ramsey (1927), who suggested that if a social planner must raise a given amount of tax revenue, he must do so such that only commodities with inelastic demand are taxed.[17] Another important contribution on this topic is the work of James Mirrlees (1971), who posited that when a tax system aims to redistribute income to low-income individuals from high-income individuals, the tax system should provide sufficient incentive for high-income taxpayers to keep producing at the high levels that correspond to their ability, even though the social planner would like to target this group with higher taxes.[18] This is because a higher tax on high-income individuals would discourage them from exerting as much effort to earn that income.

Altig, Auerbach, Kotlikoff, Smetters and Walliser (2001) found that moving away from a flat income tax to a progressive income tax results in aggregate output losses.[19]

Bakija and Slemrod (2004) found that higher taxes on the wealthiest individuals have a significant effect on migration. High top tax rates encourage the wealthiest taxpayers to flee to states with lower top tax rates.[20] This means enacting a progressive tax could exacerbate Illinois' existing outmigration crisis.

Conesa and Krueger (2006) found that the optimal tax code is a flat tax coupled with a fixed deduction. Lowering the top tax rates encourages work and saving, while the deduction ensures that lowest earners aren't taxed.[21] Peterman (2012) obtains a similar result in a closely related paper that takes into account human capital accumulation under alternative tax specifications.[22]

Wenli and Sarte (2004) found that the decrease in progressivity from the 1986 Tax Reform Act helped raise U.S. per capita GDP growth by 0.12 to 0.34 percentage points, as individuals are encouraged to work more or accumulate more skills.[23]

When analyzing the effects of the increase in the Medicare tax and its expansion to unearned income for high-income earners under the Patient Protection and Affordable Care Act of 2010, Carroll and Prante (2012) find that higher marginal tax rates on high-income taxpayers result in a smaller economy, fewer jobs, less investment and lower wages.[24]

Echevarria (2012) similarly found that higher levels of progressivity give rise to lower long-run growth rates via a reduction in savings and capital accumulation.[25] And Rhee (2008) found that with a three-year lag, higher income tax progressivity has a significant negative effect on the economic growth.[26]

APPENDIX C: Estimating the impact of progressive taxation in the neoclassical growth model

This paper examines the effect of taxing the labor income of workers with different ability levels in a standard neoclassical economy.

Individuals make consumption, labor supply and savings decisions in each period so as to maximize their lifetime utility. Firms operate a neoclassical production technology: factors are paid their marginal products. The payments received by individuals on their factors (capital and labor) are subject to proportional taxes. The government uses the revenues from taxation to finance an exogenously given stream of government purchas-

es. Note that for any given fiscal policy, individual behavior implies a particular allocation.

The model

This theory has a household that faces a labor-leisure decision and a consumption-savings decision. Each household is populated with household members differentiated by their earning ability. The household chooses paths of consumption and savings to solve:

$$\max_{c_t(z)\geq 0, i_t(z), 0\leq l_t(z)\leq 1} \sum_{t=0}^{\infty} \beta^t \ln C_t - \theta \left(\sum_j^J \mu_j l_t(z_j) \right)^{1+\frac{1}{\chi}} + \vartheta(G_t)$$

Such that: $$C_t(z) + I_t(z) = \left(\sum_j^J \left(1 - \tau_t^l(z_j)\right) \mu_j W_t(z_j) l_t(z_j) \right) + R_t K_{t-1} + S_t + M_t$$

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

$$K_0 > 0$$

Like Baxter and King (1993)[27] or McGrattan (1994)[28], it is assumed that government spending may be valuable only insofar as it provides utility separably from consumption and leisure. C_t, I_t, denote private consumption, investment in new physical capital. S_t is a government transfer when positive and lump sum tax when negative. Asset payments from abroad are denoted by M_t. The exogenous income or expenditure (when negative) captures a positive or negative trade balance, which introduces trade in a minimalist way. The trade balance influences the reaction of steady-state labor to tax changes. The household has to pay a tax on income τ_t^l. R_t is the interest rate. $W_t(z)$ is the wage, specific to each type of worker in the household. μ_j is the time-invariant fraction of household members with productivity z_j.

The parameter σ regulates the Frisch elasticity of labor supply and θ is a scaling factor that helps match total hours in the data. The Frisch elasticity of labor supply measures how hours respond to wage changes abstracting from its effect on wealth. The Frisch elasticity does not capture the total effect on hours from wage shocks. It captures the component due to inter-temporal substitution effects, but not the one due to wealth effects. This analysis follows Kimball and Shapiro (2008)[29] in setting this value equal to one.

The representative firm maximizes profits:

$$\max_{K_{t-1}, l_t(z_j)} Y_t - R_t K_{t-1} - \sum_j^J \mu_j W_t(z_j) l_t(z_j)$$

Where: $Y_t = K_{t-1}^{\alpha} L_t^{(1-\alpha)}$ and $L_t = \left(\sum_j^J \left(\mu_j l_t(z_j) \right)^{\rho} \right)^{1/\rho}$

In the model used for this analysis, the elasticity of substitution between different types of workers (that is, the percentage change in demand for low (high) skill workers for a percentage change in the price of high (low) skill workers) is given by $\chi \equiv 1/(1-\rho)$. The elasticity of substitution between factor inputs is a measure of the ease with which a varying factor can be substituted for others. Skilled and unskilled workers are gross substitutes, when the elasticity of substitution $\chi > 1$ (or $\rho > 0$) and gross complements when $\chi < 1$ (or $\rho < 0$). When two productive inputs are gross substitutes, a lower supply of one creates added demand for the other. When these inputs are gross complements, a lower supply of one reduces demand for the other. The consensus in the economics literature across estimates for the U.S. is that $\chi \approx 2$, with the most commonly used estimate of $\chi = 1.4$.

Government faces the budget constraint $G_t = T_t$. Tax revenues are given by:

$$T_t = \left[\left(\sum_j^J \tau_t^l(z_j) \mu_j W_t(z_j) l_t(z_j) \right) \right]$$

The aggregate resource constraint is:

$$Y_t = C_t + I_t + G_t + M_t$$

The definition of equilibrium is standard. In equilibrium, the household chooses plans to maximize its utility, the firm solves its maximization problem and the government sets policies that satisfy its budget constraint.

Model parameterization

Using regional data on Illinois from the Bureau of Economic Analysis and state tax collections from the Illinois Department of Revenue, the model is calibrated so that the steady state matches the average position of the Illinois economy between 2003 and 2015.

The characterization of the deterministic steady state of the model is of interest since the steady-state facilitates the calibration of the model. This is because, to a first approximation, the deterministic steady state coincides with the average position of the model economy. In turn, matching average values of endogenous variables to their observed counterparts (e.g., matching observed average values of the labor share, the consumption shares, or the investment to output ratio) can reveal information about structural parameters that can be exploited in the calibration of the model.

Parameters	Value	Restriction
Capital share of income	$\alpha = 0.30$	Bureau of Economic Analysis
Net flows from abroad	$M/Y = -0.06$	Implied from BEA data on consumption, investment and government expenditures
Depreciation rate of capital	$\delta = 0.08$	
Weight of labor	$\theta = 3.88$	Set to match hours L=0.21
Labor supply elasticity	$\sigma = 1$	
Elasticity of substitution between labor inputs	$\rho = 0.5$	
Fraction of individuals who earn $0-$50,000	$\mu_1 = 0.59$	$z_1 = 1$
Fraction of individuals who earn $50,001-$100,000	$\mu_2 = 0.23$	$z_2 = 3.74$
Fraction of individuals who earn $100,001-$500,000	$\mu_3 = 0.17$	$z_3 = 8.86$
Fraction of individuals who earn more than $500,001	$\mu_4 = 0.01$	$z_4 = 80.85$

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Individuals within the model are subject to an effective tax rate, calculated as follows:

$$\tau_t^l(z_j) = \frac{T_t(z_j)}{W_t(z_j)l_t(z_j)}$$

APPENDIX D: Estimating the impact of progressive taxation in the overlapping generations model

This appendix introduces another model that assumes finite lives for economic agents. The results are consistent with the findings of the model used in Appendix C. The basic model is taken from Echevarria (2012).[30] The model analyzes the implications of the progressivity of income taxation in a standard two-period, overlapping generations model economy.

There are two sectors in the economy: a private one (households and firms) which makes its decisions in a perfectly competitive market framework; and a government which levies a progressive income tax to finance some exogenous level of expenditure which is neither productive nor enters households' preferences.

As for the households, this is an OLG economy, populated by a continuum of young individuals and a continuum of old individuals which coexist at any time, in which population is assumed to grow at an exogenous, constant rate. The productive sector is represented by a continuum of competitive firms of measure one. All firms use the same production technology of constant returns to scale in capital and labor and are exposed to a positive externality given by the aggregate stock of capital per unit of labor. Furthermore, all firms are exposed to the same aggregate technological shock.

Suppose an individual born at time t who lives for two periods and whose preferences over young and old period consumption $(c_{1,t} and\ c_{2,t+1}$, respectively) are in the spirit of the preference class used by Weil (1990).[31] In particular, he/she maximizes the utility function:

$$V_t(c_{1,t}, c_{2,t+1}) = \frac{c_{1,t}^{1-1/\sigma}}{1-1/\sigma} + \beta \frac{c_{2,t+1}^{1-1/\sigma}}{1-1/\sigma}$$

$\beta \in (0,1)$ represents a time preference parameter which, in the case of no uncertainty, denotes the discount factor. The intertemporal elasticity of substitution for consumption (IES) being given by $\sigma > 0, \sigma \neq 1$.

Individuals inelastically supply one unit of labor in their first period and a fraction $\theta \in [0,1)$ of their time endowment in their second period. Progressive income taxation implies that individuals with different incomes face different average (and marginal) tax rates.

In this simple economy, there are only two types of individuals with, possibly, different incomes: young, whose incomes consist exclusively of wages; and old, who obtain capital and labor income (if $\theta > 0$). Thus, a distinction is made between the average tax rates faced by young and old at time t; τ_t^y and τ_t^o, respectively.

Denoting the first-period savings at t by st, the wage rate per unit of labor at t by wt, and the interest rate paid at $t + 1$ by r_{t+1}, one obtains the first and second-period individual budget constraints as:

$$c_{1,t} + s_t = (1 - \tau^{y}_{t})w_t$$

$$c_{2,t+1} = (1 + r_{t+1})s_t(1 - \tau^{o}_{t+1}) + \theta(1 - \tau^{o}_{t+1})w_{t+1}$$

Combining both budget constraints leads to:

$$s_t = \frac{[c_{2,t+1} - \theta(1 - \tau^{o}_{t+1})w_{t+1}]}{(1 + r_{t+1})(1 - \tau^{o}_{t+1})}$$

$$c_{1,t} + \frac{[c_{2,t+1} - \theta(1 - \tau^{o}_{t+1})w_{t+1}]}{(1 + r_{t+1})(1 - \tau^{o}_{t+1})} = (1 - \tau^{y}_{t})w_t$$

Let us suppose that a profit-maximizing firm acts competitively in the output and production factor (capital and labor) markets without adjustment costs in production inputs. Formally, the problem this firm faces at time t is written as:

$$\max_{K^i_t, N^i_t} Y^i_t - (r_t + \delta)K^i_t - w_t N^i_t$$

Where:

$$Y^i_t = A_t {K^i_t}^{\alpha} {N^i_t}^{(1-\alpha)} {k_t}^{(1-\alpha)}$$

Where Y^i_t denotes output, N^i_t denotes labor, K^i_t denotes physical capital, $\alpha \in (0,1)$ denotes the capital income share, and δ is the depreciation rate of capital. First, all firms (uniformly distributed on the interval $[0,1]$) are exposed to a common stochastic shock A_t.

Total factor productivity is assumed to be generated by the following process:

$$\ln A_t = \ln \hat{A} + \epsilon_t$$

It is assumed that there is a positive externality in the production process so that ith firm's output depends not only on the inputs hired by that firm, but also on the average number of units of capital per unit of labor for the whole economy:

$$k_t \equiv \frac{K_t}{N_t},$$

$$K_t \equiv \int_{[0,1]} K^i_t di$$

$$N_t \equiv \int_{[0,1]} N^i_t di$$

The solution to the firm's problem (with full capital depreciation) is given by:

$$r_t = \alpha A_t - 1$$

$$w_t = (1-\alpha)A_t k_t$$

The government taxes income to finance an exogenous stream of public expenditure $G_t = \gamma Y_t$ The income tax code is similar to Li and Sarte (2004)[32], where the tax rate positively depends on an individual's income relative to average income. Thus, the average tax rate paid by individual i is given by:

$$\tau_t^i = \zeta_t \left(\frac{y_t^i}{y_t}\right)^{\phi}$$

for some $\zeta_t \in [0,1)$ and $\phi \gg 0$ where $i \in \{y, o\}$. This expression implies that the marginal tax rate faced by an individual is $(1+\phi)\tau_t^i$. Note that if $\phi = 0$ then the tax is proportional. $1+\phi$ is the ratio between the marginal and the average tax rate, a natural indicator of the progressivity of the tax schedule.

Labor market equilibrium:

Using Jt to denote the number of young individuals at t, aggregate labor demand and labor supply are Nt and $\left[\frac{1+n+\theta}{1+n}\right]Jt$ respectively, so that:

$$Nt = \left[\frac{1 + n + \theta}{1 + n}\right]Jt$$

Goods market equilibrium:

As is standard in two-period OLG models with no financial assets at birth, equilibrium in the goods market requires that young individuals' savings be equal to next period's aggregate stock of capital. Therefore, given the equilibrium condition in the labor market, equilibrium in the goods market can be written as:

$$st = (1 + n + \theta)k_{t+1}$$

Tax rates in equilibrium:

A young individual's income at time t equals:

$$y_t^y = (1-\alpha)A_t k_t$$

An old individual's income equals:

$$y_t^o = \theta(1-\alpha)A_t k_t + (1+r_t)s_{t-1} = \Omega A_t k_t$$
$$\Omega = \theta(1-\alpha) + \alpha(1 + n + \theta)$$

Echevarria (2012)[33] shows that per capita income at t is given by:

$$y_t = \frac{(1-\alpha+(1+n)^{-1}\Omega)A_t k_t}{1+(1-n)^{-1}}$$

The tax rates for the young and the old respectively are:

$$\tau_t^y = \left(\frac{(1+(1+n)^{-1})(1-\alpha)}{1-\alpha+(1-n)^{-1}\Omega}\right)^{\phi}$$

$$\tau_t^o = \zeta_t \left(\frac{(1+(1+n)^{-1})\Omega}{1-\alpha+(1-n)^{-1}\Omega}\right)^{\phi}$$

$$\zeta_t = \frac{\gamma(1+n+\theta)[(1-\alpha)(1+n)+\Omega]^{\phi}}{(2+n)^{\phi}[(1-\alpha)^{\phi+1}(1+n)+\Omega^{\phi+1}]}$$

With full capital depreciation, the equilibrium growth rate for the stock of capital per capita is given by:

$$g_t = \frac{(1-\tau_t^y)(1-\alpha)A_t}{1+n+\theta+(\beta\alpha)^{-\sigma}\Omega[1-(1+\phi)\tau_t^o]^{-\sigma}(1-\tau_t^o)A_t^{1-\sigma}} - 1$$

Where: $\Omega \equiv \theta(1-\alpha)+\alpha(1+n+\theta)$

A stationary competitive equilibrium for this economy is a set of sequences (from $t = 0, \ldots \infty$) of allocations and factor prices that satisfy the individuals and the firm's problems, growth rates for the stock of capital per unit of labor and income tax rates are such that the government budget is balanced each period.

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