Chapter 7

ElectricityBills and Income Taxes — Linear Functions

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7.7 Federal payroll taxes

Income tax

Taxes are a part of life (the only other certainty is death), so it's only common sense to learn how they work. In Section **??** we studied sales taxes. Cities and states collect them; they are computed as a percentage of the purchase price. In this section we'll explain two important federal taxes that depend on your income, not on how you spend it.

Federal income tax is not simply a proportion of your income. It's a *progressive graduated tax*. When you make more money you not only pay more tax, some of your income may be taxed at a higher rate. Table 7.1 shows the 2019 *tax brackets* for single taxpayers.

That tells you that the first $9,700 of your income is taxed at 10%. If you make exactly that much, you pay $970 in tax. If you make more, the extra income is taxed at a higher rate — you have moved to a higher *tax bracket*. For example, if you make between $9,700 and $39,475 you will pay $970 for the first $9,700 and 12% of the amount you earn over $9,700. If you earn more than $39,475 you start paying at a 22% rate on the extra.

Bracket ($)	Marginal Tax Rate (%)
0 – 9,700	10
9,701 – 39,475	12
39,476 – 84,200	22
84,201 – 160,725	24
160,726 – 204,100	32
204,101 – 510,300	35
510,301 –	37

Table 7.1: 2019 single taxpayer brackets and rates

Individual Taxpayers

If Taxable Income Is Between:	The Tax Due Is:
0 - $9,700	10% of taxable income
$9,701 - $39,475	$970 + 12% of the amount over $9,700
$39,476 - $84,200	$4,543 + 22% of the amount over $39,475
$84,201 - $160,725	$14,382.50 + 24% of the amount over $84,200
$160,726 - $204,100	$32,748.50 + 32% of the amount over $160,725
$204,101 - $510,300	$46,628.50 + 35% of the amount over $204,100
$510,301 +	$153,798.50 + 37% of the amount over $510,300

Figure 7.2: 2019 tax brackets [R1]

Let's try an example. If your taxable income is $50,000, then your total tax is

$$\begin{aligned} \text{total tax} &= 0.10 \times \$9,700 + 0.12 \times (\$39,475 - \$9,700) \\ &\quad + 0.22 \times (\$84,281 - \$39,475) \\ &= \$970.00 + \$3573.00 + \$2315.50 \\ &= \$6858.50\ . \end{aligned} \tag{7.1}$$

Note carefully that when you are in a higher tax bracket the higher rate applies only to the extra income. The taxpayer in this example is in the 22% bracket, but that rate applies only to her earnings in that bracket.

Figure 7.2 explains this rule in another way.

The first graph in Figure 7.3 from the spreadsheet `GraduatedTax2019.xlsx` shows that the dependence of tax on income is *piecewise linear* — built from pieces of straight lines that become steeper as income increases.

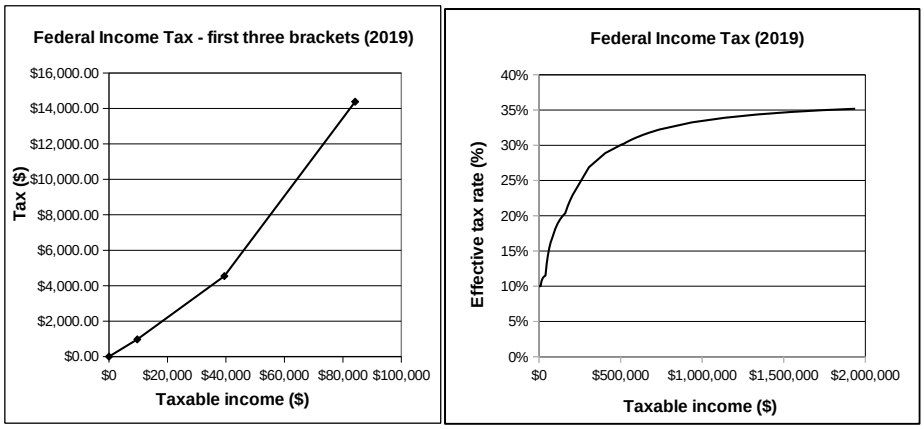

Figure 7.3: 2019 single taxpayer tax liability

The second graph shows the effective tax rate — the percentage of your income you pay in federal income tax. In Equation 7.1 we found that the total tax on a taxable income of %50,000 was $6858.50. The effective tax rate is $\$6858.50/\$50,000 = 13.72\%$. This is a weighted average of the three bracket rates 10%, 12% and 22%, with weights the amount of income taxed at each rate. The effective tax rate is less than the rate in your top bracket because you pay at a lower rate on the first part of your income. The effective rate does not reach 35% until about $2 million in income — well into the top 37$ bracket.

In fact, the actual effective tax rate is lower than this for wealthier households because income tax is collected only on income from wages and earnings. Income from capital gains — returns on investment — is taxed at a lower rate. Figure 7.4 shows the effective federal tax rate by total household income for the year 2007. The effective tax rate for the wealthiest households was just 16.6% — less than half the 35% rate for the top bracket that year.

Social security

Social security tax payroll deductions show up labelled “FICA” on your pay stub. That acronym is from the “Federal Insurance Contributions Act”. Those taxes pay for Social Security and Medicare.

In 2019 the starting tax rate was 6.2% for Social Security and 1.45% for Medicare. The Social Security tax is collected only on the first $132,900 of your earnings. Up to that income level the combined rate is 7.65%.

When your earnings exceed $132,900$ you pay no more Social Security tax, but you

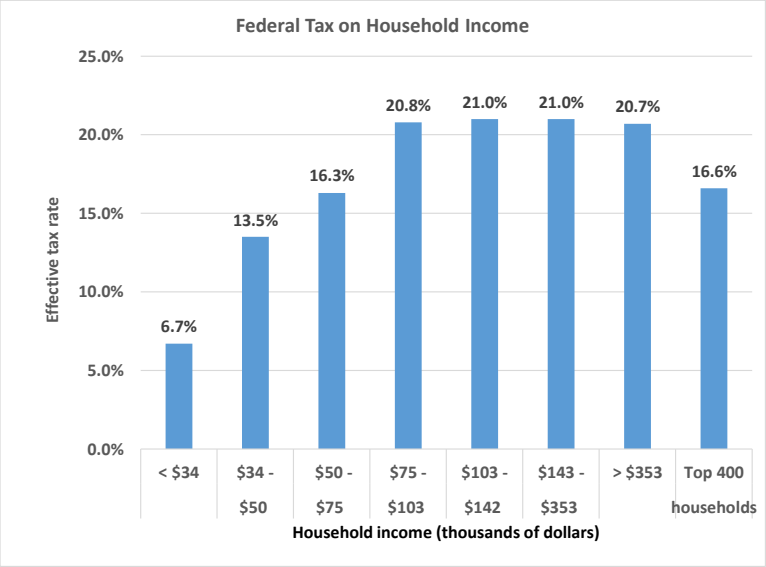

Figure 7.4: Effective federal tax rate by income, 2007 [R2]

continue to pay Medicare tax at the 1.45% rate. When your income reaches $200,000 the Medicare rate increase to 2.35% on the amount over $200,000.

The actual rules are a little more complicated. First, the tax applies only to wages. Other income (like stock dividends or interest) are not subject to this tax. Second, the real rates are twice the quoted amounts, but your employer is required to pay half. If you're self-employed you pay it all.

If you earn $500,000 your FICA tax is

$$\begin{aligned} 0.062 \times \$132,9000 + 0.0145 \times \$200,000 + 0.0235 \times (\$500,000 - \$200,000) \\ = \$18,190. \end{aligned}$$

Since you pay no Social Security on wages over $132,900 the percentage of your earnings collected for FICA taxes decreases as your earnings increase even though you still pay for Medicare. So FICA taxes are *regressive*. Up to $139,700 the effective rate is 7.45%. For $500,000 the effective rate is just $\$18,190/\$500,000 = 3.64\%$. For higher incomes, the effective rate is even smaller. At huge incomes It levels off at the top Medicare rate of 2.35%.

Figure 7.5 from spreadsheet `SocialSecurityTax2019.xlsx` shows the amount of FICA tax paid and the effective tax rate as a function of FICA earnings. Social Security taxes are *regressive* — the effective rate decreases as earnings increase,

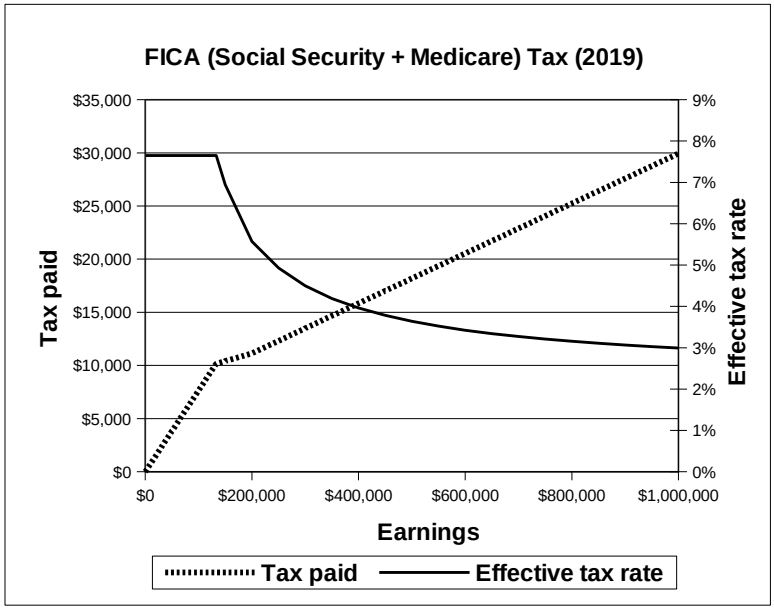

Figure 7.5: FICA (Social Security and Medicare) tax

Income tax history

The first federal income taxes were collected in 1913. For complex historical, legal and political reasons that required a constitutional amendment, the 16th, ratified in 1909 after the Supreme Court rejected earlier attempts to collect such a tax.

Figure 7.6 shows the significant fluctuations in the rate for the top bracket through 1919. They have been near their historic lows since the late 1980's.

To assess the social and economic impact of the changes in income tax rates would require much more time and knowledge than we can offer here. The spreadsheet `Federalindividualratehistory.xlsx` contains a complete history of income tax brackets and rates from the inception of the income tax in 1913 through its hundredth anniversary in 2013, in both dollars current in each year and adjusted for inflation (2012 dollars).

Even in years when Congress does not revise the tax code, the IRS routinely adjusts the brackets (not the rates) to take inflation into account. If that were not done then salaries increased by inflation would move people into higher brackets even when their increased wages did not correspond to increased purchasing power.

Figure **??** shows the brackets for the tax year 2018. You can check that the 2019 brackets are all just about 2% larger than these.

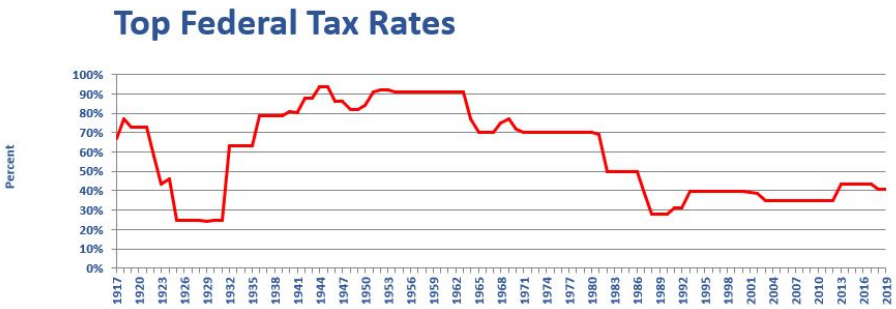

Figure 7.6: Historical top tax bracket rate [R3]

Individual Taxpayers

If Taxable Income Is Between:	The Tax Due Is:
0 - $9,525	10% of taxable income
$9,526 - $38,700	$952.50 + 12% of the amount over $9,525
$38,701 - $82,500	$4,453.50 + 22% of the amount over $38,700
$82,501 - $157,500	$14,089.50 + 24% of the amount over $82,500
$157,501 - $200,000	$32,089.50 + 32% of the amount over $157,500
$200,001 - $500,000	$45,689.50 + 35% of the amount over $200,000
$500,001 +	$150,689.50 + 37% of the amount over $500,000

Figure 7.7: 2018 tax brackets [R4]

R1 K. Phillips Erb, New: IRS Announces 2018 Tax Rates, Standard Deductions, Exemption Amounts And More, Forbes, March 7, 2018, `www.forbes.com/sites/kellyphillipserb/2018/03/07/new-irs-announces-2018-tax-rates-standard-deductions-exemption-amounts-and-more/\#6bb2ab533133` (last visited February 7, 2019).

R2 Data from G. Anrig, 10 Reasons to Eliminate the Tax Break for Capital Gains, The Century Foundation (October 20, 2011), `tcf.org/blog/detail/10-reasons-to-eliminate-the-tax-break-for-capital-gains` (last visited August 4, 2015).

R3 Bradford Tax Institute, History of Tax Rates: 1913 – 2019, `bradfordtaxinstitute.com/Free_Resources/Federal-Income-Tax-Rates.aspx` (last visited February 2, 2019).

R4 K. Phillips Erb, New: IRS Announces 2018 Tax Rates, Standard Deductions, Exemption Amounts And More, Forbes, March 7, 2018, `www.forbes.com/sites/kellyphillipserb/2018/03/07/new-irs-announces-2018-tax-rates-standard-deductions-exemption-amounts-and-more/\#16f3fe9f3133` (last visited February 7, 2019).