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SYSTEM DYNAMIC MODELING OF TAXES IMPACT ON INCOME

The tax rate is a very important aspect of fiscal policy, which determines the level of taxation of citizens and enterprises in the state. This rate of taxes directly affects the amount of tax contributions coming to the budget and determines the resources that are available to finance various programs and services.

Choosing the optimal tax rate is a very important aspect in order to stimulate economic growth and regulate the distribution of income in society.

In economy, high rate of taxes can affect entrepreneurship and various investments, thereby reducing incentives to produce and retain capital in the state. Already low tax rates can provide stimulation of economic activity, but at the same time can lead to insufficient funding of public services or programs.

In general, the study of the impact of the income tax rate allows to optimize a certain level between ensuring financial stability and stimulating economic development in the state. Therefore, in this work, the impact of different rate of tax on income will be investigated.

To begin with, let's build a dynamic model according to the following specification:

$$C(t) = a + b\ Yd(t).$$
$$E(t) = C(t) + I + G\ .$$
$$\Delta Y(t+1) = \lambda\ (\ E(t) - Y(t)\ )\ , \qquad \lambda>0$$
$$Yd(t) = Y(t) - Tx(t),$$
$$Tx(t) = Tx_0 + txY(t).$$

Consumption depends on autonomous consumption and marginal propensity to consume and disposable income. Therefore, consumption is represented by a linear function of income.

Planned expenses are the sum of consumption, investment and government spending.

Changes in income are described by income discrepancy, which is equal to the difference between the Y and the planned expenses, and this difference is adjusted using some coefficient λ.

Disposable income ($Yd(t)$) is income ($Y(t)$) minus taxes ($Tx(t)$).

Taxes depend on income ($Y(t)$) multiplied by the marginal rate of tax (tx) and on autonomous taxes (Tx_0). That is, even if the firm has no income, it will pay autonomous taxes.

We will derive the formula for finding the equilibrium mathematically, using the equations written above.

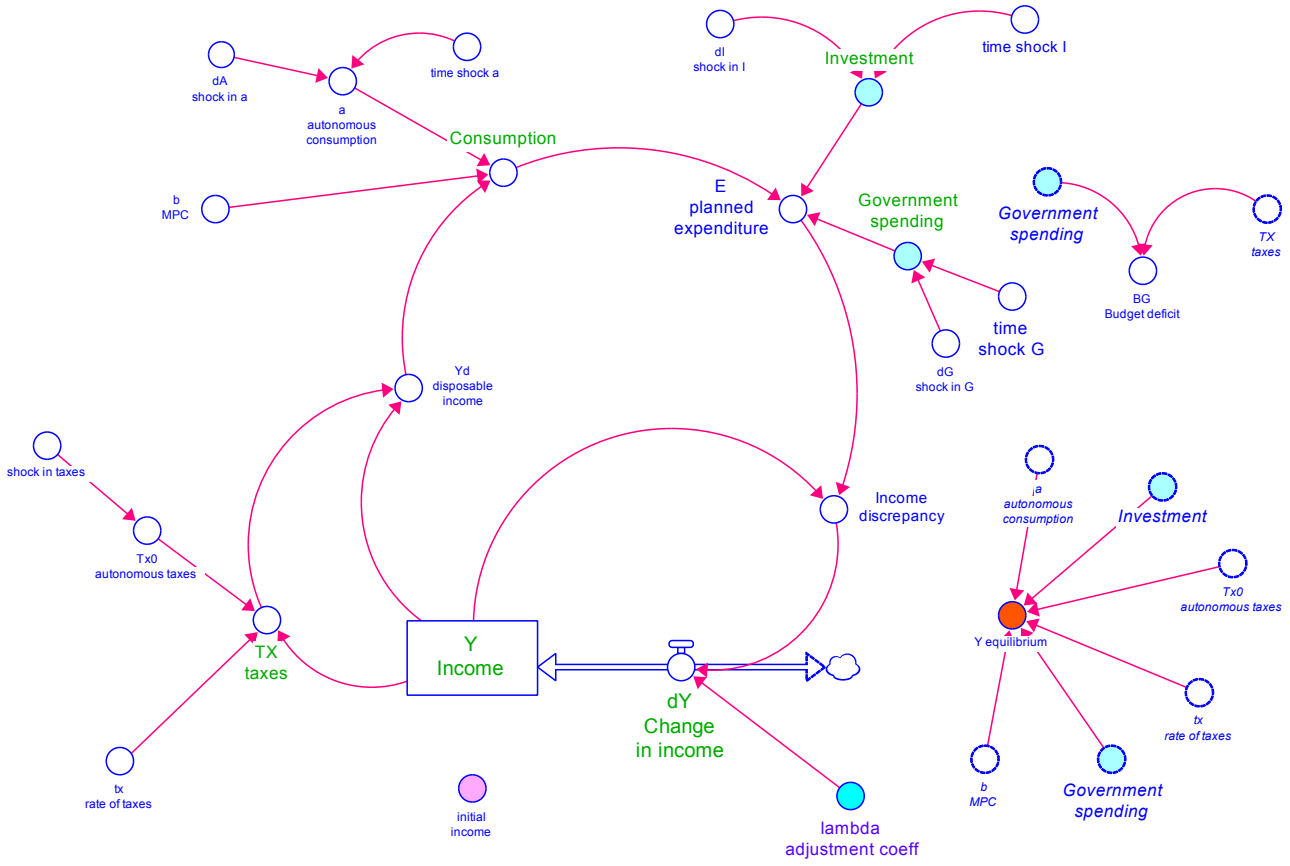

Figure 1. Dynamic Model with Taxes

$$Yd(t) = Y(t) - [Tx_0 + txY(t)] = -Tx_0 + (1- tx)Y(t) ,$$

$$C(t) = a + b[-Tx_0 + (1 - tx)Y(t)] = (a - bTx_0) + b(1 - tx)Y(t),$$

$$E(t) = (a - bTx_0) + b(1 - tx)Y(t) + I + G = (a - bTx_0 + I + G) + b(1 - tx)Y(t).$$

$$\Delta Y(t + 1) = \lambda[(a - bTx_0 + I + G) + b(1 - tx)Y(t) - Y(t)] =$$

$$=\lambda(a - bTx_0 + I + G) - \lambda[1 - b(1 - tx)]Y(t)$$

$$0 = \lambda(a - bTx_0 + I + G) - \lambda[1 - b(1 - tx)]Y^*$$

$$Y^* = \frac{a - bTx0 + I + G}{1 - b(1 - tx)}$$

Now we introduce specific values into our model.

$$C(t) = 130 + 0,72Yd(t)$$

$$E(t) = C(t) + I + G$$

$$\Delta Y(t+1) = 0.88(E(t)-Y(t))$$

$0.88>0$ (the firm adapts to changes a little slower)

$$Yd(t) = Y(t)-Tx(t)$$

$$Tx(t) = -100 + 0.25Y(t)$$

$$I = 300 , \quad G = 350 .$$

When taxes are equal to 0, then we got the equilibrium level: 2785.71.

When we add taxes to our model, we get that the equilibrium is 1852.17.

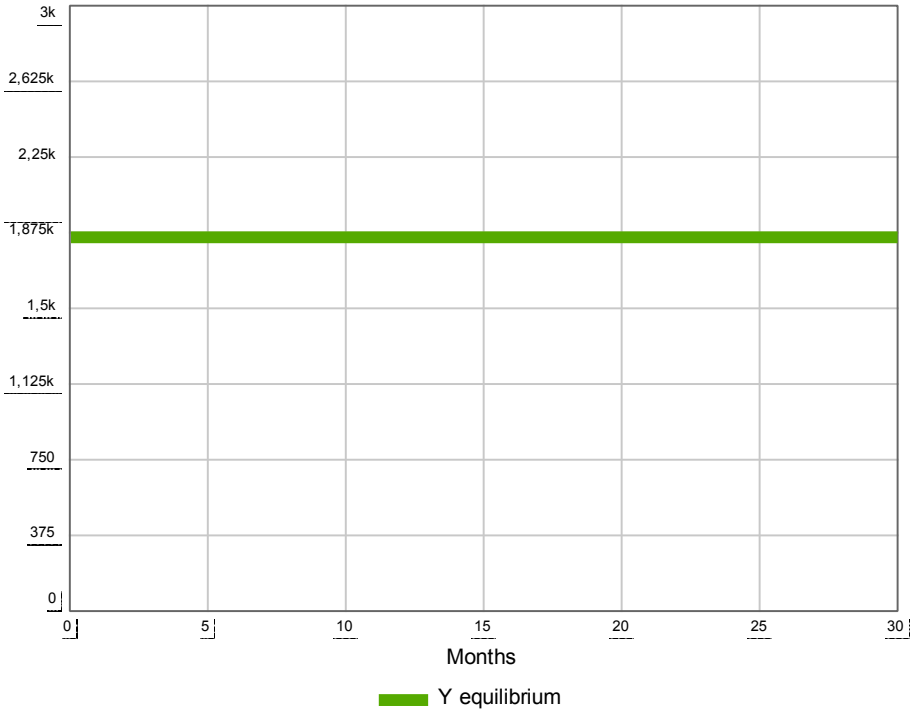

Figure 2. Equilibrium at given Taxes

The new equilibrium turned out to be smaller than the previous one.

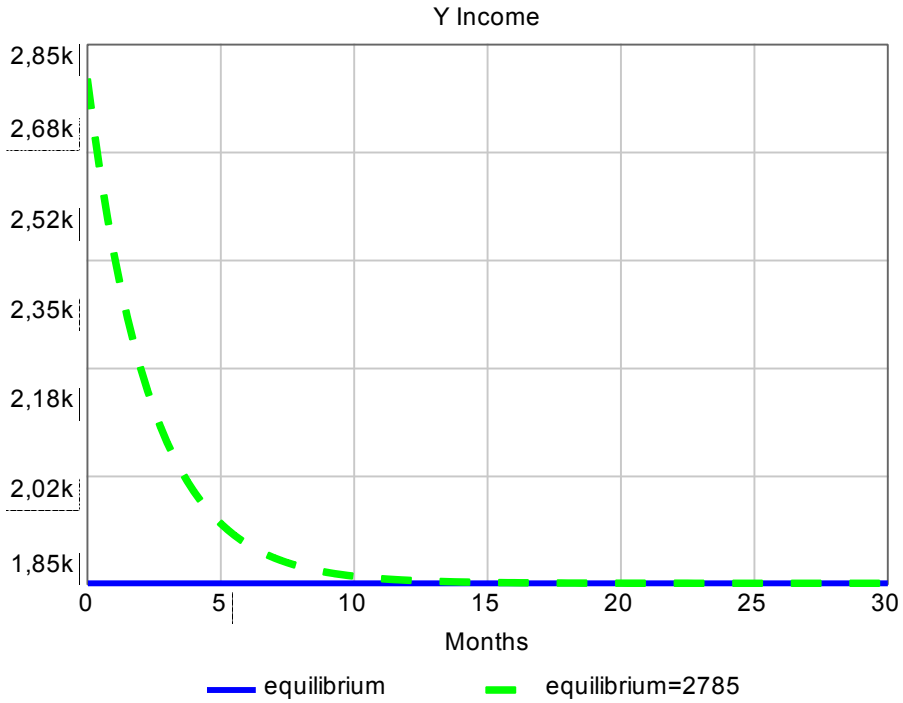

Figure 3. Comparison of equilibria with and without taxes

We create a budget deficit in the model, which is equal to the difference between government spending and taxes. If government spending are greater than taxes, we will have a deficit.

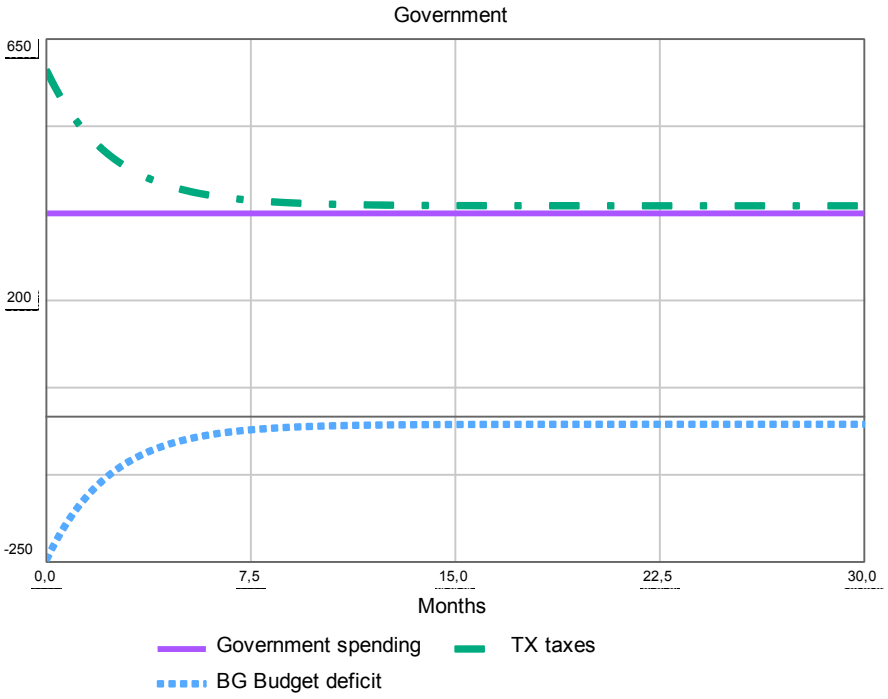

Figure 4. Comparison of taxes, government spending and budget deficit

We see that government spending is always the same, taxes are reduced because income is reduced, and therefore the budget deficit is growing.

We change the tax rate from 0.25 to 0.35. When we spend more on taxes, then disposable income becomes less and less is spent on consumption, which in turn affects subsequent incomes.

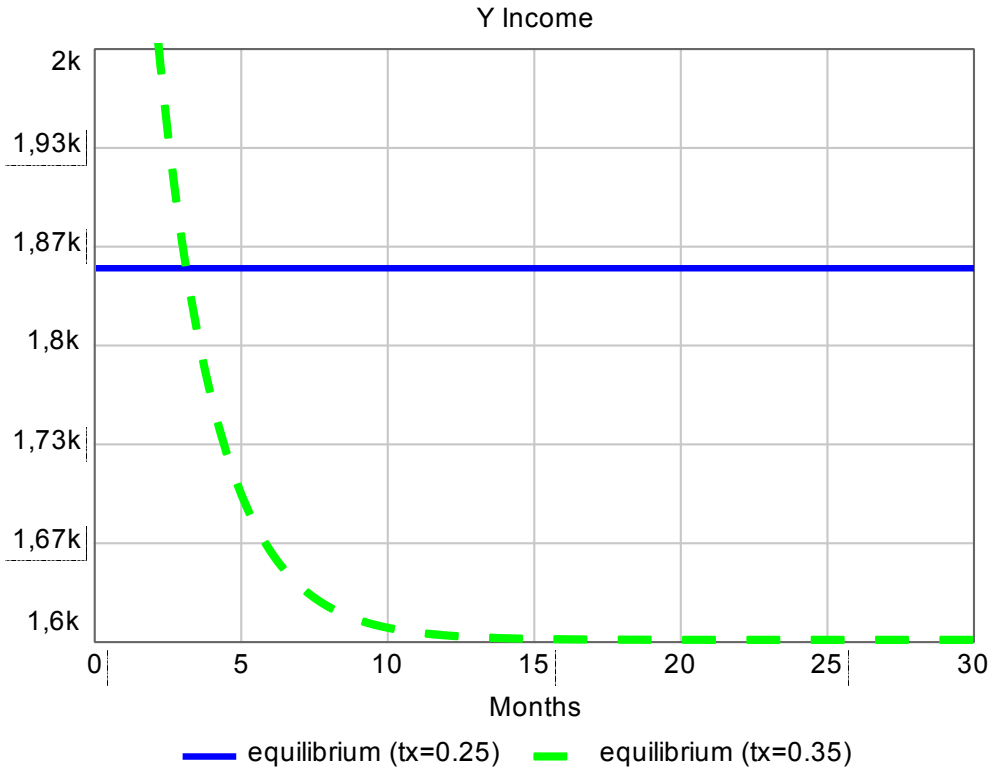

Figure 5. The impact of taxes on income

If the government raises the tax rate to compensate for its budget deficit, then revenue falls over time. If the taxes are significantly increased, the state will get out of the deficit and move into a surplus, but this is not good for consumers.

With the help of our model, we will look at different values of taxes rate and find the most optimal option that would be suitable for the state and for consumers.

We found that with rate of tax = 0.239, the budget deficit is up to 0.

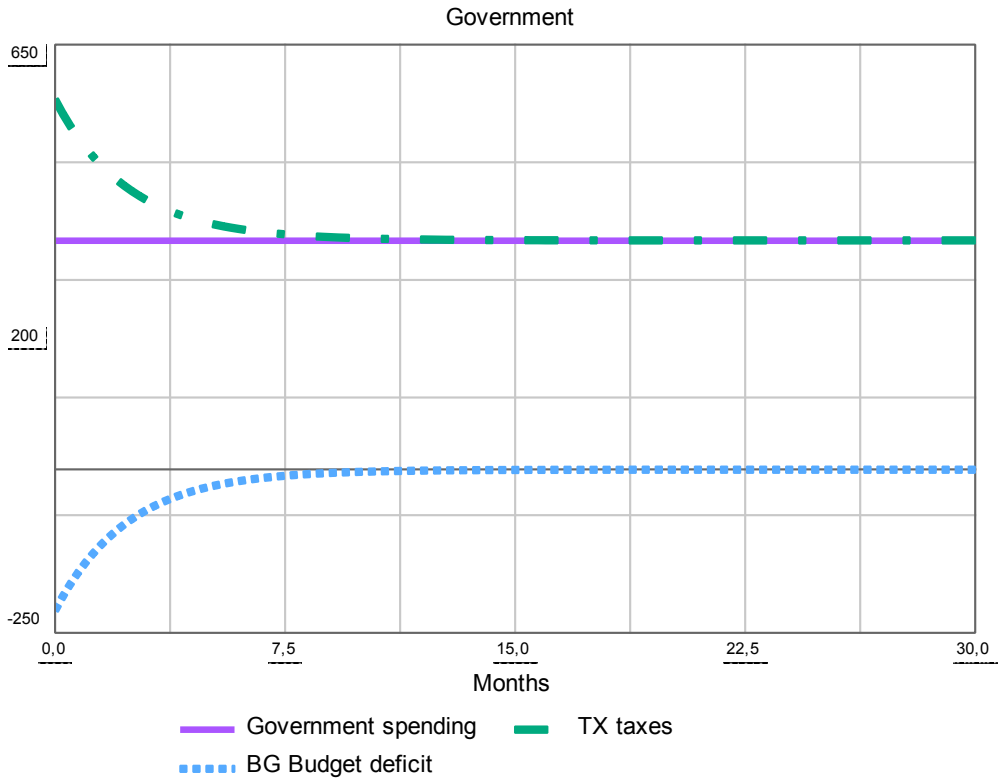

Figure 6. The best option for the tax rate

Therefore, we found that when taxes are raised, the level of consumption and income falls, but we also found out that it is possible to find an optimal option that will reduce the budget deficit to a minimum and not harm consumers.

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