Multipliers in Neoclassical and New Keynesian models are not that different in most instances.

- Both feature wealth effects that raise labor supply and reduce consumption.

- With standard production function and no short-run effects of government spending on productivity, multiplier depends crucially on how much hours increase.

- The following is a useful to formalize some of the results for the lump sum case.
Neoclassical Model with Lump-Sum Taxation
(follows Aiyagari, Christiano, Eichenbaum (1992))

\[ E_0 \sum_{t=0}^{\infty} \beta^t [u(c_t, n_t) + v(g_t)], \quad 0 < \beta < 1, \]

subject to

\[ c_t + g_t + k_{t+1} - k_t \leq f(k_t, n_t) \]

\[ g_t = G(g_t^T + g_t^P) \]

\(c_t = \) consumption \hspace{1cm} \(k_t = \) capital stock, beginning of period
\(n_t = \) hours worked \hspace{1cm} \(g_t = \) government purchases

superscript “T” denotes transitory and “P” persistent. The transitory component is iid.
Social Planner Problem

\[ v(k, g^P, g^T) = \max \left\{ W(k, k' + g) + E(\beta v(k', g^{\prime P}, g^{\prime T}) \mid g^P) \right\} \]
\[ k' \leq f(k, N) - g \]

where

\[ W(k, k' + g) = \max \ u(c, n) \]
\[ c, n \in \{0 \leq n \leq N; 0 \leq c \leq f(k, n) - (g + k')\} \]
There exist unique solutions,

\[ n = h(k, k' + g) \quad \text{and} \quad c = q(k, k' + g) \]

\( h \) is strictly increasing in \( g \) since a rise in \( g \) represents a negative wealth effect.

For the same reason, the function \( q \) is strictly decreasing in \( g \).
Effect of Increase in Government Spending on Hours

The effect of \( g \) on equilibrium hours can be decomposed as:

\[
\frac{dn}{dg} = \frac{\partial h}{\partial g} \left[ 1 + \frac{\partial k'}{\partial g} \right]
\]

Static Effect +
due to wealth effect

Dynamic effect through capital +

\[
\left( \frac{\partial k'}{\partial g} \right)^{P} > \left( \frac{\partial k'}{\partial g} \right)^{T}
\]

A persistent increase in government spending raises next period's desired capital stock by more. Thus, a persistent increase in government spending raises hours more now.
Key Results for Lump-Sum Tax Case

• Because of the assumption of lump-sum taxes, Ricardian Equivalence holds.

  Thus, it does not matter whether the increase in government spending is financed by an increase in current taxes or deficit spending.

• A persistent increase in government spending leads to a larger increase in hours.

• An increase in transfers has no effect as long as government purchases don’t change.
Distortionary Taxation

With distortionary taxes, the decentralized problem is different from the social planner problem.

The household budget constraint becomes:

\[ c_t + i_t \leq (1 - \tau_{nt})w_t n_t + (1 - \tau_{kt})r_t k_t + \delta \tau_{kt} k_t - \psi_t \]

where

- \( i \) = investment
- \( \tau_{nt} \) = labor income tax rate
- \( w \) = real wage
- \( \tau_{kt} \) = capital tax rate
- \( r \) = return on capital
- \( \psi \) = net lump-sum taxes less transfers
Effects of Labor Income Taxation

For illustration, assume perfect foresight, no capital taxation, and separable utility:

2 key effects:

1. Wedge in MRS of substitution condition

\[ MRS = (1 - \tau_{nt})w_t \]

2. Intertemporal effects: the growth rate of hours depends on

\[ \frac{(1 - \tau_{nt+1}) \cdot w_{t+1}}{(1 - \tau_{nt}) \cdot w_t} \]
Key Results for Distortionary Case

• If an increase in government spending is financed at least in part by an increase in current distortionary taxes, hours will rise less.

• The time path of tax rates can have a significant effect on the response of hours.

• Government spending multipliers can be much lower than in the lump-sum tax case.
Quantitative Impact on Output Responses in a Simple Model

\[ y_t = n_t^{0.67} k_t^{0.33} \]

\[ c_t + i_t + g_t \leq y_t \]

\[ u = \ln c_t + 1.75 \cdot \ln(1 - n_t) \]

\[ k_{t+1} = i_t + 0.977 \cdot k_t \]

\[ g_t = constant + 1.4 g_{t-1} - 0.18 g_{t-2} - 0.25 g_{t-3} + \varepsilon_t \]

3 financing schemes

1. Lump-sum taxation, deficit spending

2. Concurrent increase in labor income tax

\[ \tau_{nt} = \frac{g_t}{w_t n_t} \]

3. 2-quarter lagged increase in labor income tax

\[ \tau_{nt} = \frac{g_{t-2}}{w_t n_t} \]
Consider an unanticipated increase in government spending

Effect of Government Spending Under Various Financing Schemes
Red line: \( \tau_{nt} = \frac{g_t}{w_t n_t} \)

Orange line: \( \tau_{nt} = \frac{g_t - 2}{w_t n_t} \)
The Effect of Anticipations

My paper “Identifying Government Spending Shocks: It’s All in the Timing” highlighted the role of anticipations.

Consider the what happens when government spending is anticipated 2-quarters in advance:
Compare 2 experiments: unanticipated versus anticipated
In both labor tax cases, the tax on labor income is set to finance 50% of current increase in $g$. 
New Keynesian Multiplier

• Key additional mechanism: Because of sticky prices, \( \uparrow G \) reduces markup and increases competition (Rotemberg and Woodford, 1992).

• The multiplier depends crucially on the extent of monetary accommodation.

• Coenen + 16 co-authors (AEJ-Macro 2012) explore the effects in leading NK models and central bank models.

• Consider the implied cumulative multipliers for a 2-year temporary increase in government spending
From Coenen et al: Effects of 2-year increase in G
Gali, Lopez-Salido, and Valles (2007) show the extremes to which one must go to produce a substantial multiplier and a rise in consumption. In the absence of increasing returns, both of the following are necessary:

- Households are off their labor supply curves – hours determined by employers

- A significant fraction of consumers are rule-of-thumb. Consider the following graph from their paper:
From Gali, Lopez-Salido, and Valles (2007)

B. Non-Competitive Labor Market

**Figure 3.** Impact multipliers: sensitivity to $\lambda$.

Note: Baseline calibration for remaining parameters.
Summary of Theoretical Results on Government Multipliers

**Low multipliers**
- Temporary increase in spending
- Balanced budget distortionary taxation
- Non-accommodative monetary policy
- Rational Consumers

**High multipliers**
- Persistent increase in spending
- Deficit spending with future distortionary taxes
- Zero Lower Bound
- Rule-of-Thumb Consumers
Other Considerations

• Productive government spending
  Baxter and King (1992) show that it raises multiplier in long-run, but not the short-run.

• Transfers
  Oh and Reiss (2010) and Cogan and Taylor (2011) point out that most stimulus packages in U.S. and Europe involved increases in transfers. Romer & Romer (2013) have new evidence on the effect of transfers.

• Underutilized resources
  Can government spending have a greater effect when the unemployment rate is high?