Introduction to Macroeconomics

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Outline

Gross domestic product

(These slides follow the original slides of Quijano/Quijano that accompany the Blanchard textbook)

Recall the basic national accounts identity (Account 0 identity):

$$Y = C + I + G + X - Im$$

Here, Y denotes gross domestic product, C is private consumption, I is investment, G is government consumption (government spending), X is exports, and Im is imports.

Definition of domestic demand aggregates

- **Consumption** (C) refers to the goods and services purchased by consumers (private households);
- **Investment** (I), in SNA capital formation, consists of fixed investment and of inventory investment. Fixed investment is the purchase of capital goods: nonresidential and residential investment, construction and equipment investment, private and public investment. Inventory investment or inventory changes comprises unsold goods minus goods sold from inventories;
- **Government Spending** (G) refers to the purchases of (consumer) goods and services by the federal, state, and local governments. It does not include government transfers, nor interest payments on the government debt.

Composition of GDP: demand across borders

- **Imports** (Im) are the purchases of foreign goods and services by consumers, business firms, and the government;
- **Exports** (X) are the purchases of domestic goods and services by foreigners.

Both imports and exports may refer to consumer goods as well as investment goods. Tourism by residents abroad is part of service imports, tourism by foreigners to domestic destinations is part of service exports.

The demand for goods

The total demand for (domestic) goods is written as:

$$Z \equiv C + I + G + X - Im.$$

The symbol $\equiv$ means that this equation is an **identity**, or definition.

Z refers to the demand for goods, Y to the production of goods, $Y = Z$ will be an equilibrium condition. 'Goods' is meant to include services.

To develop a model of aggregate behavior, we will make some simplifying assumptions.

Demand for goods: model assumptions

- Assume that all firms produce the same good, which can then be used by consumers for consumption, by firms for investment, or by the government;
- Assume that firms are willing to supply any amount of the good at a given price, P, to satisfy demand in that market;
- Assume that the economy is closed, i.e. that it does not trade with the rest of the world. Then, both exports and imports are zero ($X = Im = 0$), and the aggregate demand identity changes to:

$$Z \equiv C + I + G.$$

Modeling aggregate consumer demand

In nearly all economic models, the main determinant of private consumption C is **disposable income**. Disposable income Y_D is the income that remains once households have paid taxes and received transfers from the government:

$$Y_D = Y - T,$$

with T denoting net (direct) taxes. BLANCHARD writes

$$C = \underset{(+)}{C(Y_D)},$$

with $C(.)$ denoting a **consumption function**.

Consumption function: functional form

In the general formulation of the model, no specific functional form is assumed. Plausible consumption functions $C(.)$ should obey:

- Consumer demand should increase monotonically with income: the symbol $(+)$;
- Consumer demand should be non-negative for any $Y_D > 0$.

Often, it is convenient to assume a specific form for $C(.)$. Here, we consider the linear consumption function

$$C = c_0 + c_1 Y_D,$$

with $c_0, c_1 > 0$.

Parameters of the linear consumption function

The linear consumption function $C = c_0 + c_1 Y_D$ has two **parameters**, c_0 and c_1:

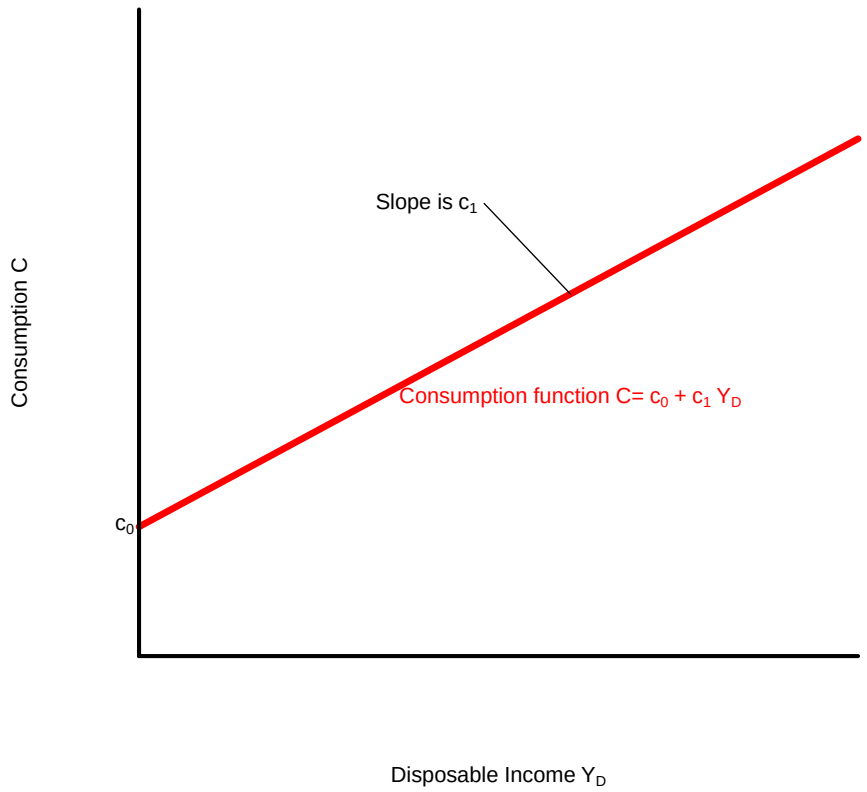
- c_1 is called the (marginal) propensity to consume $\partial C / \partial Y_D$, or the effect of an additional (infinitesimal) unit of disposable income on consumption. Geometrically, c_1 is the slope of the line in a (Y_D, C)–diagram;
- c_0 is the intercept of the consumption function. It is the aggregate consumption for given zero income. Geometrically, it is the point where the line intersects the ordinate axis.

A parameter is a constant. In theory, it is simply assumed. In statistics, it is unobserved and must be estimated from data.

Restrictions on the parameters of the consumption function

- The parameter c_0 should be positive or at least $c_0 \geq 0$. Even if income is 0, households will still consume, maybe out of their wealth if it exists. c_0 is also interpreted as **autonomous consumption**.
- The parameter c_1 should be positive and less than unity: $0 < c_1 < 1$. Households will consume more when their income increases, but part of the additional income is not spent but saved.

The graph of the consumption function



Consumption increases with disposable income but less than one-for-one.

Endogenous and exogenous variables

- **Endogenous variables** (generated within) are variables explained in the model;
- **Exogenous variables** (generated without) are variables coming from outside and not explained by the model. In a sense, their role is similar to that of parameters. In the real world, however, exogenous variables are observed while parameters usually are not.

Exogenous variables of the model

- Investment I is taken as given, for simplicity (this will be changed later):
$$I = \bar{I}$$
- Government spending G is also taken as given: $G = \bar{G}$, but the bar is dropped in the following. This assumption is made mainly for two reasons:
  - Modelling the reaction of single agents is avoided in macroeconomic models. Government is seen as acting like a single agent;
  - These models are often used for advising the government on policy.
- Similarly, taxes T are assumed exogenous. In economic terms, they are assumed 'lump-sum' and do not depend on income.

Summary of the full model

The identity of aggregate demand $Z = C + I + G$ and substitution for the consumption function

$$C = c_0 + c_1 Y_D$$

and for the Y_D definition $Y_D = Y - T$ yield

$$Z = c_0 + c_1(Y - T) + \bar{I} + G$$

The determination of equilibrium output

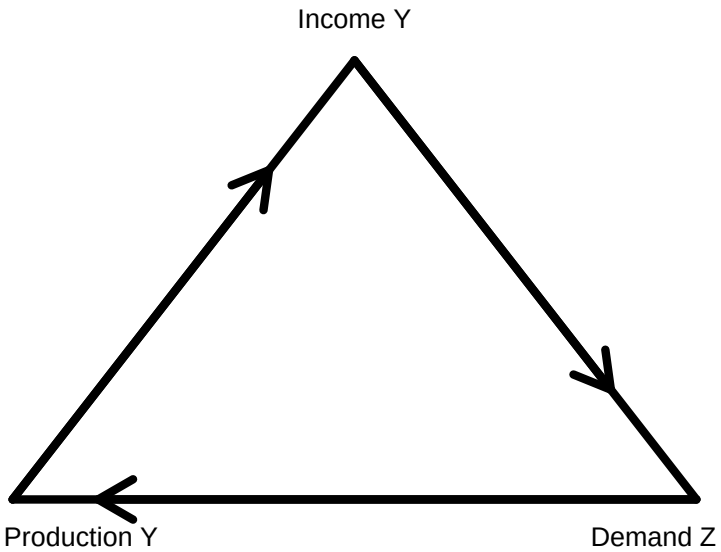
The economy is seen as being in **equilibrium** when supply (production) Y equals demand Z for goods:

$$Y = Z.$$

Income equals production, both are Y, as firms are owned by households and hence all production becomes income for households. Then, $Y = Z$ is satisfied if and only if:

$$Y = c_0 + c_1(Y - T) + \bar{I} + G.$$

The assumed causal flow chart: production, income, demand



Demand creates production creates income creates demand.

Three aspects of macroeconomic models

Macroeconomic models often have three aspects:

1. Algebra to make sure the logic is correct;
2. Graphs to build the intuition;
3. Words to explain the results.

For example, the equilibrium in the goods market can be derived analytically and also graphically.

Deriving the equilibrium using algebra

Rewrite the equilibrium equation:

$$Y = c_0 + c_1 Y - c_1 T + \bar{I} + G$$

Move $c_1 Y$ to the left and reorganize the right side:

$$(1 - c_1) Y = c_0 + \bar{I} + G - c_1 T$$

Divide both sides by $(1 - c_1)$:

$$Y = \frac{1}{1 - c_1}(c_0 + \bar{I} + G - c_1 T)$$

Interpreting the equilibrium solution

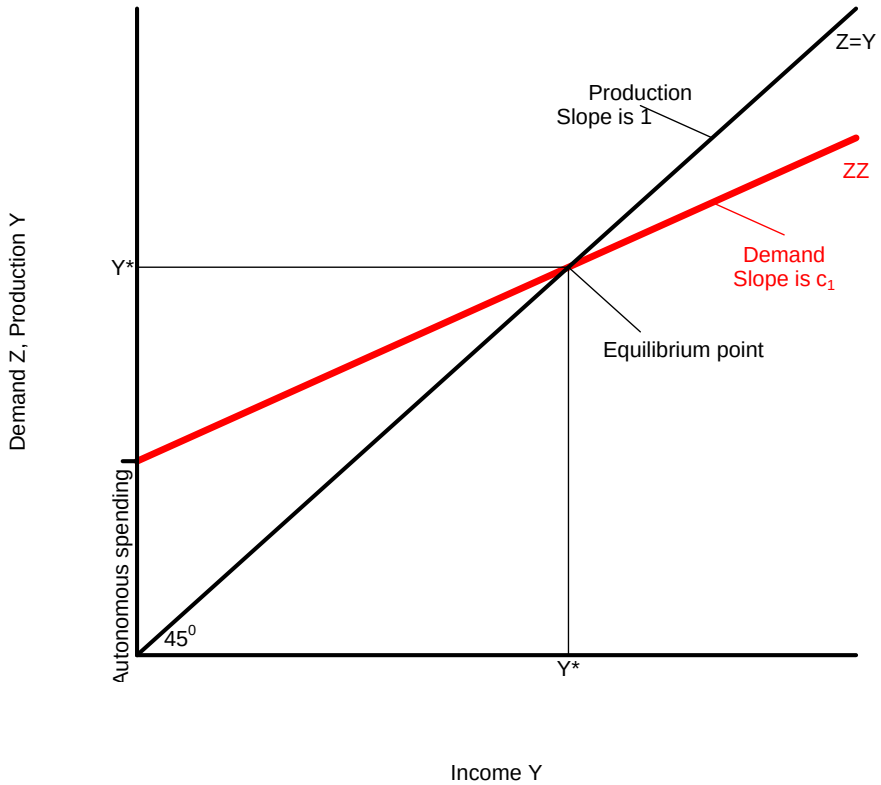
The expression

$$Y = \frac{1}{1 - c_1}(c_0 + \bar{I} + G - c_1 T)$$

has two factors:

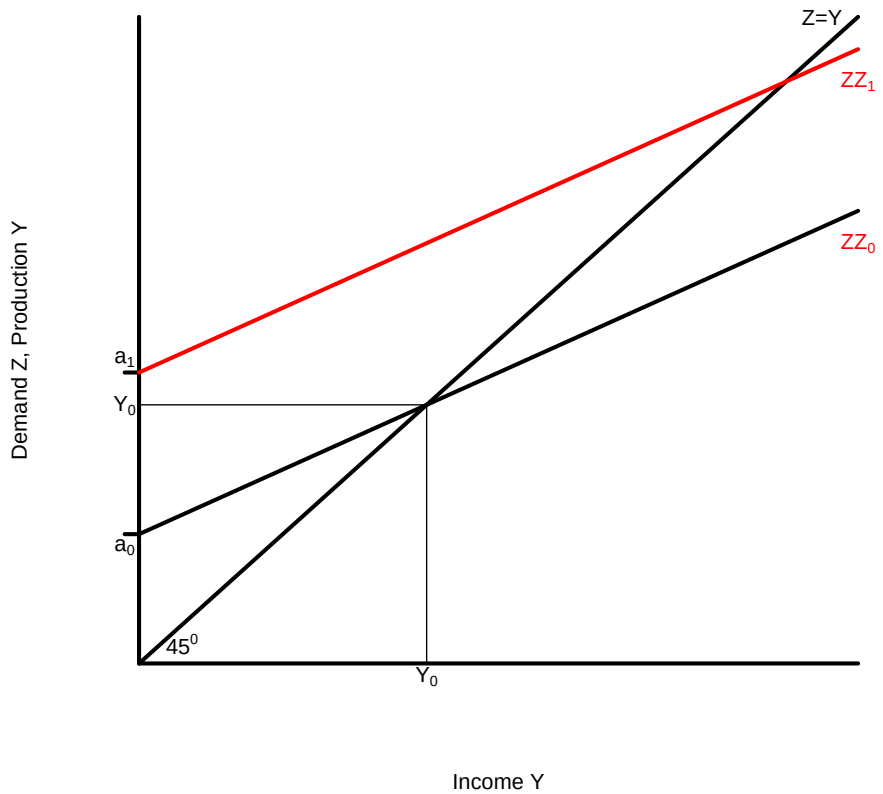
- The term $c_0 + \bar{I} + G - c_1 T$ contains fixed parameters and exogenous variables. G and T can be autonomously set by the government (fiscal policy). This term is called **autonomous spending**. Note $c_0, I, G > 0$. Unless taxes T are extremely high, autonomous spending will be positive.
- The term $\frac{1}{1-c_1}$ has a denominator $1 - c_1 \in (0, 1)$ because of $c_1 \in (0, 1)$. The term is greater one and amplifies autonomous spending. Increases in G, c_0, or I imply larger increases in equilibrium output. The term $\frac{1}{1-c_1}$ is called the (fiscal) **multiplier**.

Deriving the equilibrium in a graph



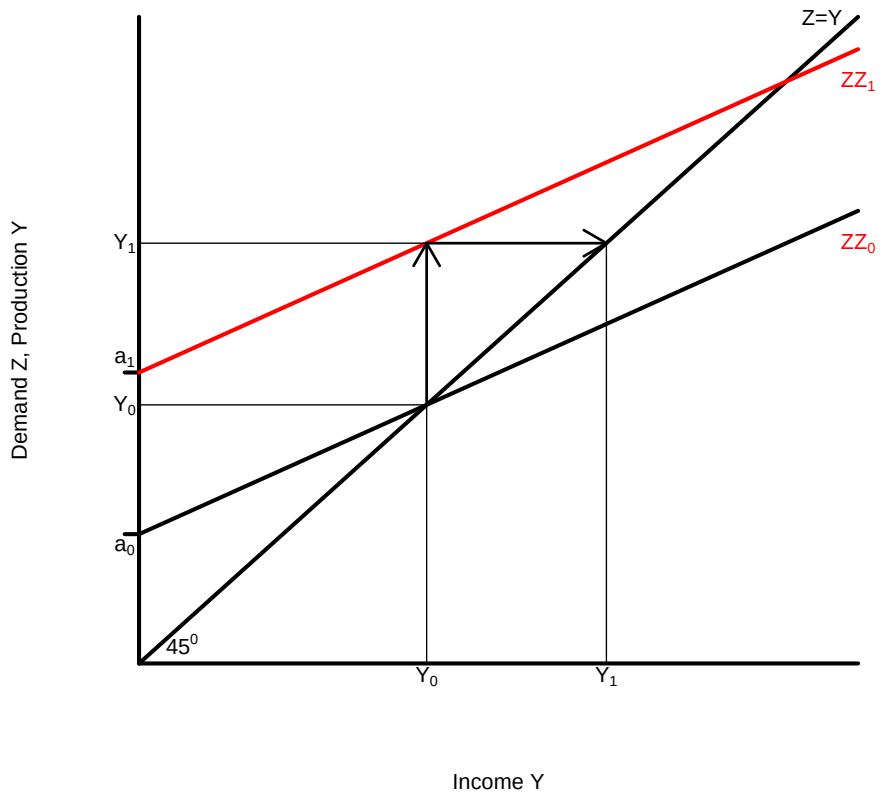
Production as a a function of income is a 45^0 line. Demand as a function of income is the line $Z = c_0 + c_1 Y - c_1 T + \bar{I} + G$. The intersection of the two lines is the unique equilibrium.

Effects of an increase in autonomous spending



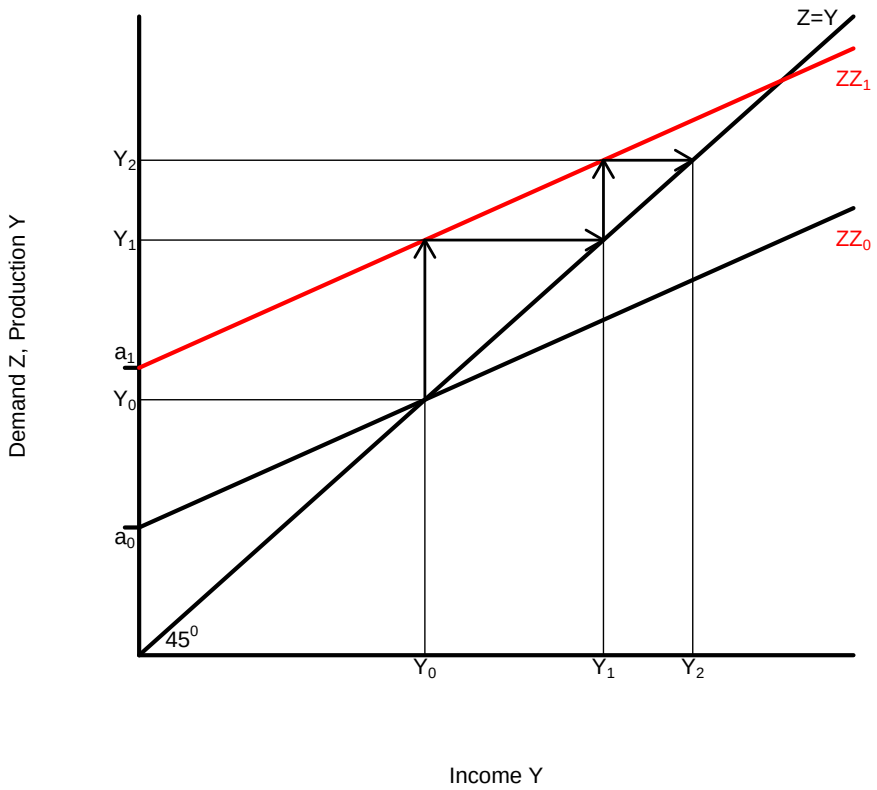
An experiment: autonomous spending increases from a_0 to a_1, for example by increased government spending G. Demand exceeds supply at Y_0.

Additional demand is satisfied by increased production



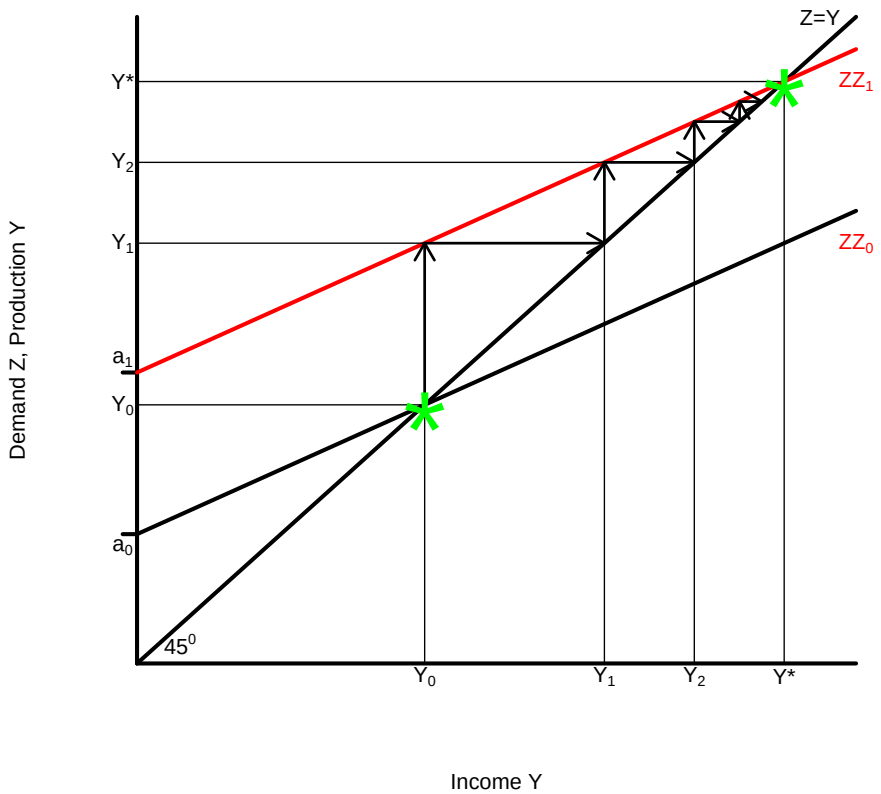
Production satisfies the additional demand at Y_1. Income increases accordingly, as income equals production. Again, demand exceeds supply.

A second round



Again, additional production satisfies the additional demand, now at Y_2, followed by an identical increase in income. Still, demand exceeds supply.

A stairway to heaven



These iterations continue until a new equilibrium at Y^* is attained. There, demand equals supply.

A geometric series

Denote the additional shock in autonomous demand by $\Delta = a_1 - a_0$. The first round increases Y by Δ, the second round by Δc_1. After $n+1$ rounds, we have

$$Y_n = Y_0 + \Delta(1 + c_1 + c_1^2 + \ldots + c_1^n).$$

This is a geometric series, which converges as $n \to \infty$ to

$$Y^* = Y_0 + \frac{\Delta}{1 - c_1}.$$

The impulse is multiplied by $1/(1 - c_1)$, thus this term is called the (fiscal) multiplier.

How long does it take for output to adjust?

- Formally, infinitely many iterations are needed to move from Y_0 to Y^*;
- The model assumes that all reactions happen immediately;
- In the real world, reactions take time: several quarters up to several years;
- Models describing **dynamics**, i.e. the entire adjustment process, are more complex. For this reason, many models like ours are restricted to **comparative statics** and compare equilibrium situations only.

Where does the demand shock originate from?

In this model, there are several possible causes:

- Government increases spending G: **fiscal expansion**;
- Government reduces taxation T: fiscal expansion;
- Investment increases autonomously;
- Autonomous consumption c_0 increases.

If G is reduced or T increases, the stair is directed downward. This is a **fiscal contraction**.

Summary: the equations of the model

$$
\begin{aligned}
Z &= C + I + G && (1)\\
C &= c_0 + c_1 Y_D && (2)\\
Y_D &= Y - T && (3)\\
Y &= Z && (4)
\end{aligned}
$$

The model has a **behavioral equation** (2) and three **identities**. Identities can be definitional (3) or equilibrium conditions (4). There are as many endogenous variables as equations. The remaining variables G, T, I are exogenous.

Saving

In a closed economy, there are three types of saving:

- Private saving (S) is saving by households:

$$S = Y_D - C = Y - T - C;$$

- Public saving equals taxes minus government spending:

$$S_P = T - G$$

  If $T > G$, $S_P > 0$, there is a **budget surplus**. If $T < G$, then $S_P < 0$, and there is a **budget deficit**;
- In our model, firms distribute all profits to the households who own them: there is no saving of firms.

Investment equals saving

The sum of private and public saving yields investment:

$$S + S_P = Y - T - C + T - G = Y - C - G = I.$$

This is an important identity. In any closed economy, saving equals investment in equilibrium. This is also called the IS relation. What firms want to invest (uses) must be equal to what people and the government want to save (resources).

Duality of consumption and household saving

The saving of households follows a saving equation that is derived from the consumption equation:

$$S = Y - T - C = Y - T - c_0 - c_1(Y - T) = -c_0 + (1 - c_1)(Y - T)$$

Autonomous saving is negative: $-c_0 < 0$. Marginal propensity to save is $1 - c_1 \in (0, 1)$.

The paradox of saving

Two aspects:

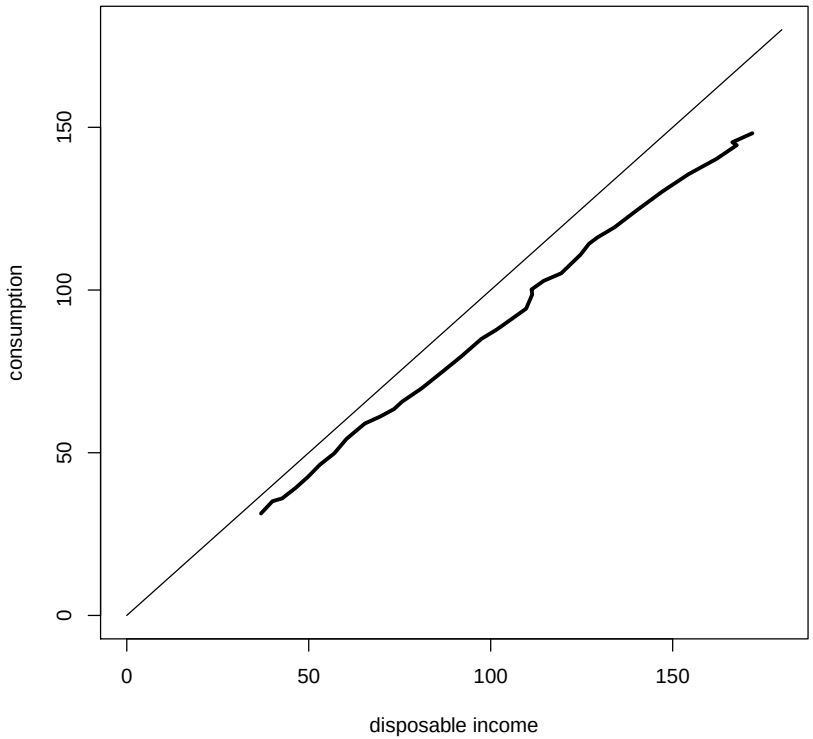
- If households want to save more and decrease c_0, this acts like a fiscal contraction: output Y decreases. **Saving is bad** for the economy;
- Household saving in equilibrium always is determined by $S = I$. If I did not change, S must remain the same. The lower c_0 causes Y to fall, and then S falls by exactly the same amount as c_0. **Households cannot increase saving**.

This paradox is also called the **paradox of thrift**. In the real world, saving may have positive effects in the longer run, though.

Is the government omnipotent? A warning

- Changing government spending or taxes is not always easy;
- The responses of consumption, investment, imports, etc. are hard to assess with much certainty;
- Anticipations are likely to matter;
- Achieving a given level of output can come with unpleasant side effects;
- Budget deficits and public debt may have adverse implications in the long run.

An empirical consumption function for Austrian data



Austrian households indeed consume less than their income. A fitted line through the sample yields a slope c_1 of 0.88 and a negative c_0. c_0 does not correspond to autonomous consumption, there are no data for low income, hence this estimate is statistically uncertain.