Intertemporal Macroeconomics:
Basic Two-Period Small Open Economy Model of Consumption and Saving and the Current Account

In this section, we develop our first dynamic model. It will have only two time periods, but that turns out to give us a lot of important insight compared to a static model (with only one period). Later we'll look at models with many more time periods, but the key insights from the two period model will carry over.

This model will help us analyze the economy's decision about how much of its income to spend on current consumption and how much to save for the future. In the context of our model of the entire economy (general equilibrium), it will provide a way to think about supply of saving in the capital market.

Like most modern macroeconomic model, this one will be "based on microeconomic foundations". This means we will use *microeconomic* principle to model the behavior of an individual (also often called "a representative household", as in our circualr flow diagram). The entrie economy is assumed to behave "as if it were that one household". This is a simplification, which can be limiting but is often a very good way to start.

Initially, we'll also neglect the production side of the economy.

The basic set-up is like this.

A representative household exists for two periods. We can call them “years” and I often do that but you can think of this as two years, or now vs. future, etc.

Since the household IS the economy, we will often use these term interchangeably: either calling it “household” or “the economy”.

There is only ***one type of goods and services, called GDP or output.***

Everything (quantities, prices, etc.) is in ***REAL terms*** (i.e. in terms of “goods and services” or GDP).

The economy starts in year 1 with some ***assets inherited from before time began*** (where did these come from? Doesn’t matter. You can think of the model as looking at a household (or the economy) starting today and moving forward. The initial assets are the starting condition that are a result of everything that happened before now -- which is the period when we start of our analysis). These initial assets could be positive, negative (debt), or zero.

There is only ***one type of assets (bonds)*** and they pay an ***endogenously given interest rate***. The small open economy assumption kicks in here. Open means the economy trades goods AND assets (here just bonds, so it borrows/lends) across the border with the rest of the wold. But it is so small relative to the world market that whatever it does or whatever happens to it has no effect on the rest of the world, including the world prices such as the interest rate.

The household gets some ***exogenous labor income in period 1.*** (We call it ***labor income***, although here the household isn’t supplying any labor; the “labor” income simply “falls from the sky” . We could also call the household’s endowment). The household also earns some ***interest on its assets***.

It then decides how much of its total period 1 income (“labor” and interest on assets) to ***spend on current consumption and how much to save***. The saved parts gets re-invested in interest-bearing assets.

Then year 2 rolls around. Everything repeats itself.

The household again gets some exogenous “labor” income in period 2 and again earns interest on its assets.

It then decides how much of its total period 2 income (“labor” and interest on assets) to spend on current consumption and how much to save.

Two Period Model: The Set-up

The basic 2 period consumption model looks like this:

1. Basic assumptions:

a. Economy starts in year 1 and end after year 2.

b. Output is given exogenous.

c. There is an endogenously (from the point of view of the household) given world real interest rate $r \geqslant 0$.

2. Basic definitions for s = 1 and 2 we will define:

a. C_s consumption in year s.

b. Y_s output (income) in year s.

c. B_s assets (bonds) accumulated at the end of year *s-1* ; interest on these assets is paid in year *s*.

So specifically, B_1 is the stock of assets the economy starts year 1 with. The household earns interest on B_1 in year 1 and changes it asset position to B_2 during this period by buying/selling bonds so that at the end of year 1 it has B_2 . This is the asset amount carried into year 2 on which interest will be earned in that year, etc.

d. The change (denoted by capital Greek delta "Δ") in assets is defined $\triangle B_2 = B_2 - B_1$

3. The household will have some preferences described by a ***life-time utility*** U_1(evaluated starting in the first year (i.e. year 1), hence the subscript) given by:

Out[2]=
$$U_1 = u(C_1) + \beta u(C_2)$$

where the "little u(C)'s" (i..e the within-period utility functions) satisfy: u'(C) > 0 and u''(C) < 0.

More on this later.

2. The representative agent maximizes U subject to the following “flow” budget constraints:

Out[5]=
$$rB_1 + Y_1 = C_1 + \Delta B_2$$
$$rB_2 + Y_2 = C_2 + \Delta B_3$$

What do these equations mean? They are ***budget constraints!***
The first one says that the total income in year 1 must equal total spending in year 1.
What is the total income in year 1? It is equal to labor income (Y_1) plus interest earned on assets (rB_1).
What is the total spending? It is spending on consumption (C_1) and spending on new asset purchases ($\triangle B_2 = B_2 - B_1$).

For example, if the economy started with B_1 = 54, the wold interest rate was r =7% and year 1 labor income was Y_1= 87, then its year 1 total income would be 0.07x54 + 87 = 90.78.
Here's that the year 1 budget constraint says the households could do:
This household could spend it all on consumption and not change its asset position: C_1 = 90.78 and $\triangle B_2 = 0$ (so that assets carried into year 2 are unchanged $B_2 = B_1$= 54).
This household could spend it all on new bonds and not consume anything: C_1 = 0 and $\triangle B_2 = 90.78$ (so that assets carried into year 2 are $B_2 = B_1$+ 90.78 = 54 + 90.78 = 144.78).
This household could spend it some of it on new bonds and some of it on consumption. For example: C_1 = 50 and $\triangle B_2 = 40.78$ (so that assets carried into year 2 are $B_2 = B_1$+ 40.78 = 54 + 40.78 =94.78).
And so on...

Notice that this works regardless of whether the economy is a net creditor ($B_1 > 0$) or a net debtor ($B_1 < 0$), and regardless of whether it buys ($\triangle B_2 > 0$)or sells ($\triangle B_2 < 0$) assets on net.

For example, if the economy started with $B_1 = -100$, the wold interest rate was r =10% and year 1 labor income was $Y_1 = 30$, then its year 1 total income would be 0.1x(-100) + 30 = 20.
This household could spend it some of it on new bonds and some of it on consumption. For example: $C_1 = 15$ and $\triangle B_2 = 5$ (so that assets carried into year 2 are $B_2 = B_1 + 5 = -100 + 5 = -95$).
This household could sell some bonds (borrow more) and spend it all on consumption. For example: $C_1 = 25$ and $\triangle B_2 = -5$ (so that assets carried into year 2 are $B_2 = B_1 - 5 = -100 - 5 = -105$).

The same applies to year 2 budget constraint.

Model Quantities vs. Real-World Statistics

Let’s see how our model quantities align with real-world macro statistics. Let’s do this for year 1:

Y_1 = year 1 GDP

C_1 = year 1 GNE (no I or G in this model)

$TB_1 = Y_1 - C_1$ = year 1 trade balance (recall that GDP = GNE + TB)

$r\,B_1$ = year 1 NIFA

$r\,B_1 + Y_1$ = year 1 GNI (equal to GNDI since we don’t have NUT in this model)

$CA_1 = r\,B_1 + Y_1 - C_1 = \mathrm{NFIA} + \mathrm{TB}$ = year 1 current account balance

$-\triangle B_2$ = year 1 financial account

B_2 = external (and total) wealth at the end of year 1

These budget constraints can be re-stated as

Out[6]=

$$
\begin{aligned}
B_2 &= (1+r)rB_1 + Y_1 - C_1 \\
B_3 &= (1+r)B_2 + Y_2 - C_2
\end{aligned}
$$

and combined to create the ***life-time budget constraint***:

$$(1+r)\ B_1 + Y_1 + \frac{1}{1+r} Y_2 = C_1 + \frac{1}{1+r} C_2 + \frac{1}{1+r} B_3$$

We know that $B_3 = 0$. Why?

If we additionally assume that $B_1 = 0$, we get the simple ***life-time budget constraint***:

$$Y_1 + \frac{Y_2}{1+r} = C_1 + \frac{C_2}{1+r}$$

The problem of the household is to maximize life-time utility subject to the life-time budget constraints, which is:

$$\max_{\{C_1,C_2\}} \{u(C_1) + \beta u(C_2)\}$$

$$\text{subject to}$$

$$Y_1 + \frac{Y_2}{1+r} = C_1 + \frac{C_2}{1+r}$$

The solution to this problem is a ***consumption path*** that the household chooses (with tow periods the “path” is just C $_1$ and C_2, later on it will be a longer path).

Two Period Model: Finding the Solution

There are several ways to solve this problem. We'll do a graphical solution later. First, let's do the math.

The most straight-forward one is to substitute for C_1 using the budget constraint and solve the univariate maximization problem.

Start by re-writing the life-time budget constraint as

$$C_2 = [Y_1(1+r) + Y_2] - (1+r)C_1$$

Then substitute it into the utility function to reduce the problem to a univariate, unconstrained maximization

$$\max_{\{C_1,C_2\}} U_1(C_1, C_2) = \max_{\{C_1\}} U_1\left(C_1, \left[Y_1(1+r) + Y_2\right] - (1+r)C_1\right)$$

and take the first order necessary condition (FONC) $\frac{\partial U_1}{\partial C_1} = 0$

Using this approach -- substituting the budget constraint into the utility function -- is the most straight-forward. We end up with a univariate (one variable, C_1 in this case), unconstrained maximization problem. This means we only have one first order condition; the derivative of the objective function with respect to C_1 set equal to 0.

$$\frac{dU_1(C_1, C_2)}{dC_1} = \frac{dU_1(C_1, [Y_1(1+r)+Y_2]-(1+r)C_1)}{dc_1} = \frac{\partial U_1(C_1, C_2)}{\partial C_1} + \frac{\partial U_1(C_1, C_2)}{\partial C_2}\frac{\partial C_2}{\partial C_1} = 0$$

Remember that we have assumed

$$U_1(C_1, C_2) = u(C_1) + \beta u(C_2)$$

so the derivatives of the ***life-time utility*** U_1 are simply the derivatives of the ***within-period utility functions*** $u(C_1)$ and $\beta u(C_2)$

$$\frac{\partial U_1(C_1, C_2)}{\partial C_1} = \frac{\partial u(C_1)}{\partial C_1}$$
$$\frac{\partial U_1(C_1, C_2)}{\partial C_2} = \beta \frac{\partial u(C_2)}{\partial C_2}$$

This means the first order condition looks like this

$$\frac{dU_1(C_1, C_2)}{dC_1} = \frac{\partial u(C_1)}{\partial C_1} - \beta \frac{\partial u(C_2)}{\partial C_2}(1 + r) = 0$$

which -- by re-arranging terms and using the simplified notation for the derivatives of the within-period utility functions: $\frac{\partial u(c)}{\partial c} = u'(c)$ -- can be re-written as

$$\frac{\frac{\partial u(C_1)}{\partial C_1}}{\frac{\beta \partial u(C_2)}{\partial C_2}} = \frac{u'(C_1)}{\beta u'(C_2)} = 1 + r$$

This first order condition is nothing new to us; it is the tangency of the indifference curve -- with a slope of $-u'(C_1)/(\beta u'(C_2))$ -- to the life-time budget constrain -- with a slope of (1+r).

This simple first-order condition is a ***key condition in most modern dynamic macro models***. It is known as ***the Euler equation***:

$$u'(C_1) = (1 + r)\beta u'(C_2)$$

This equation will serve a key role (sometimes alongside other equations) in helping us analyze what is the equilibrium of out model.

Sometimes we'll make specific assumptions about the utility function u(C), which will allow us to get ***closed-form solutions*** for the consumption path that the household chooses, i.e. C_1 and C_2 expressed as functions of only the exogenous variables in the model, $C_1(Y_1, Y_2, r, \beta, B_1)$ and $C_2(Y_1, Y_2, r, \beta, B_1)$.

Sometimes, we won't even have to assume anything about *u(C)* to learn about the consumption path that the household chooses (C_1 and C_2).

Specifically, to learn about the consumption path that the household chooses (C_1 and C_2) -- sometimes getting a closed form solutions, which require further assumptions on *u(C)*, and sometimes not -- we can proceed in one of the following ways:

1. If we assume ***(1+r)β = 1***, then we don't need to know anything about *u(C)* (beyond what we've already assumed). The ***optimal path*** must be: $C_1 = C_2$ (can you see why?) and we have

$$C_1\,(Y_1,\,Y_2,\,r,\,\beta,\,B_1) = \frac{1+r}{2+r}\left[Y_1 + \frac{Y_2}{1+r}\right]$$

2. If we assume ***u(C) = ln(C)***, then

$$C_1\,(Y_1,\,Y_2,\,r,\,\beta,\,B_1) = \frac{1}{1+\beta}\left[Y_1 + \frac{Y_2}{1+r}\right]$$

2. If we assume ***u(C) =*** $\boldsymbol{\frac{C^{1-1/\sigma}}{1-1/\sigma}}$.

$$C_1\,(Y_1,\,Y_2,\,r,\,\beta,\,B_1) = \frac{1}{1+(1+r)^{\sigma-1}\beta^{\sigma}}\left[Y_1 + \frac{Y_2}{1+r}\right]$$

Practice problem : derive all of the above using the Euler equation and the budget constraint. (Note: we continue to assume A = 0. As an exercise, derive these without this assumption.)

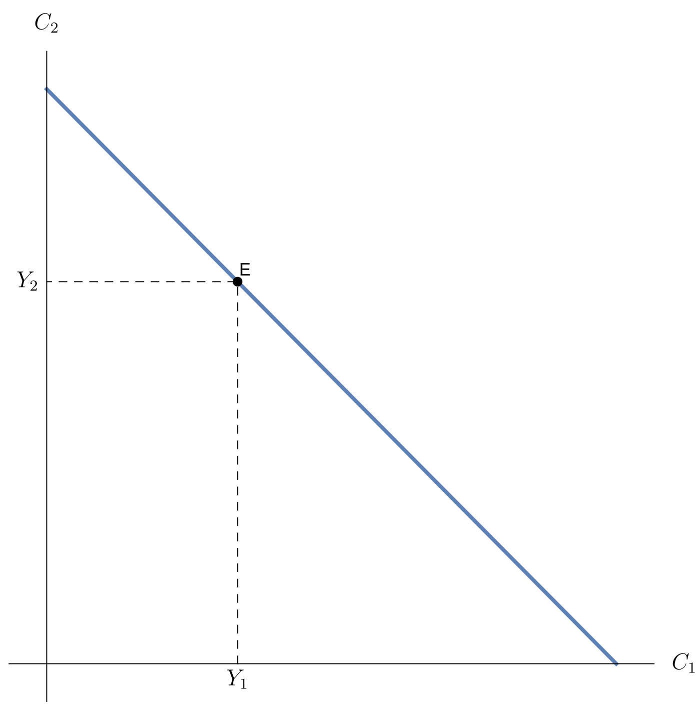
Two Period Model: Graphical Solution

Let’s draw some graphs!

Start by drawing the budget constraint

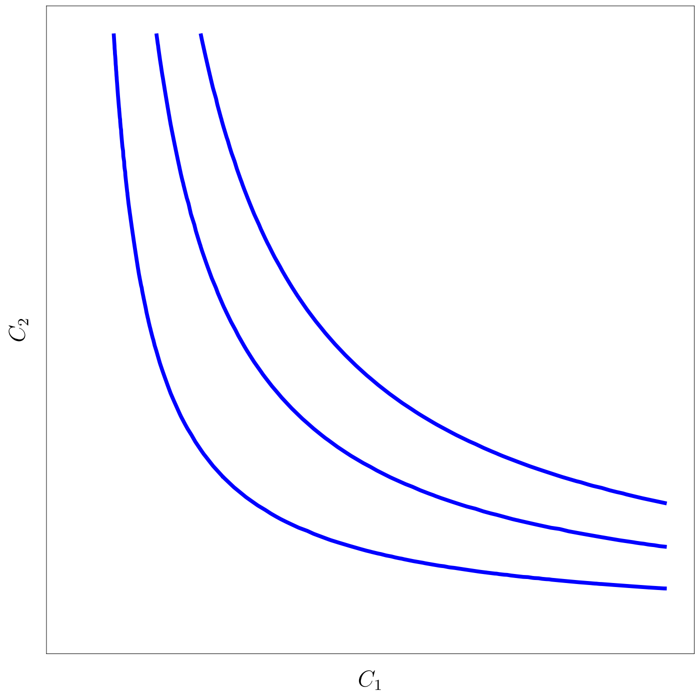
$$C_2 = \Big[Y_1(1+r) + Y_2\Big] - (1+r)C_1$$

which is a straight line with a slope -(1+r). I have marked the endowment on the budget line. Recall, that this line always passes through the endowment (it is always feasible to consume Y_1 in period 1 and Y_2 in period 2). Here I assumed, $Y_2 > Y_1$.

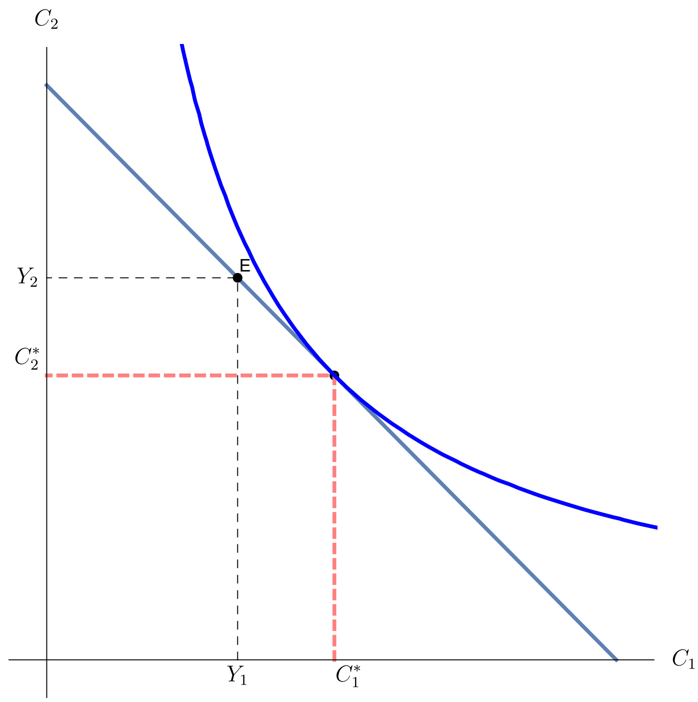


Of course the indifference curves have the usual shape and a slope of

$$-\frac{\frac{\partial u(C_1)}{\partial C_1}}{\frac{\beta \partial u(C_2)}{\partial C_2}} = -\frac{u'(C_1)}{\beta u'(C_2)}$$



Now we can put them together

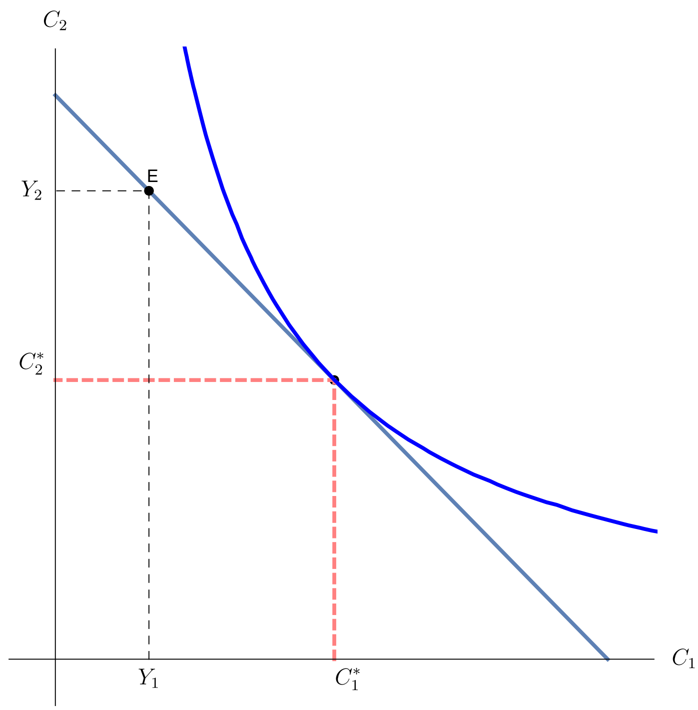


Small Open Economy

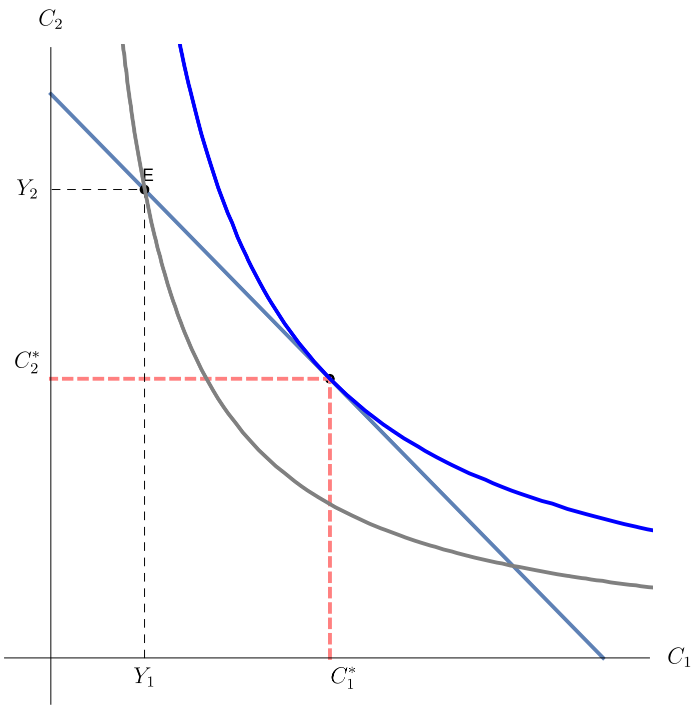
Remember our interpretation, the household we are looking at is assumed to be a small economy that is open to flow of goods and assets.
The goods that are traded are the aggregate outputs (Y_1 and Y_2).
The assets that are traded are the bonds (B); in other words, the economy can borrow or lend to the rest of the world.
It does so at a real rate r.
It is small relative to the rest of the world so it takes r as given.

SOE: Graphical Solution

Here is an example of a solution when $Y_2 > Y_1$ and $(1+r)\beta = 1$.
This could be China (why?)



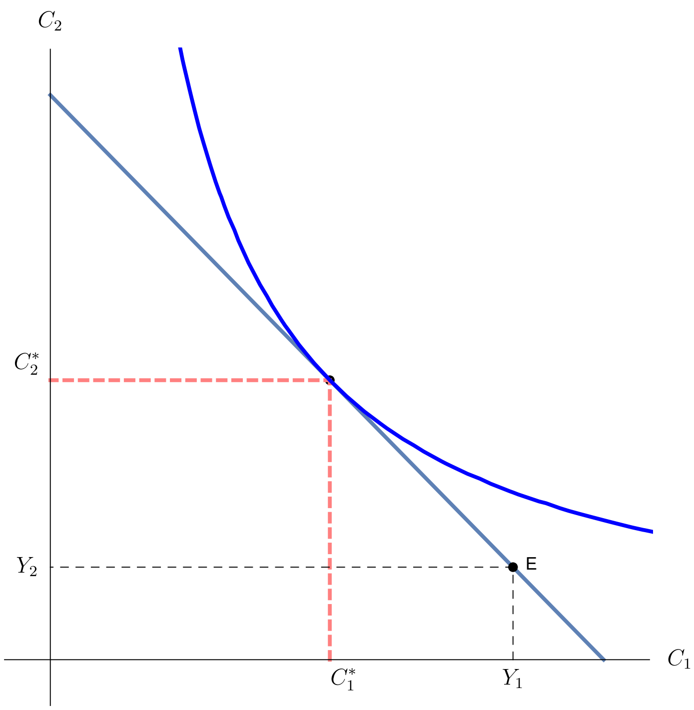
Notice that China is better off (on a higher indifference curve) when it is open to capital flows than when it is closed (autarky) and had to have $C_1 = Y_1$ and $C_2 = Y_2$; this is the gray indifference curve.



SOE: Graphical Solution

Here is an example of a solution when $Y_2 < Y_1$ and $(1+r)\beta = 1$.

This could be Norway (why?). Is Norway better off than in autarky?



Interest Rate in Autarky

Another interpretation of the model is that of an economy In autarky (closed economy). However, in this case *r* becomes endogenous: a small open economy faces the world interest rate, a closed economy has its own interest rate! We need to figure out how it is determined.

The answer is that it is determined by the supply and demand in the loanable funds market (market for bonds in our model).
Since there is only one asset (bonds) we need to look at the supply/demand of it. Without access to the rest of the world, the economy cannot transfer resources across time. Recall that the representative household is a shorthand for saying that there are multiple households but they are all the same. That means that

(a) if the representative household's optimal solution involves borrowing in period 1, everyone in this economy would like to optimally borrow in year 1. But everyone cannot simultaneously borrow in a closed economy (there is no one to borrow from!) What would happen is that the interest rate would go up to reduce the desire to borrow.

or

(b) if the representative household's optimal solution involves saving in period 1, everyone in this economy would like to optimally save in year 1. But everyone cannot simultaneously save in a closed economy (there is no one to lend to!) What would happen is that the interest rate would go down to reduce the desire to save.

The equilibrium interest rate, would one where the representative household desires to neither borrow nor save, which happens when $C_1 = Y_1$ and $C_2 = Y_2$ (the optimal consumption is exactly equal to the endowment).

Interest Rate in Autarky: an example

Let’s assume $u(C) = \frac{C^{1-1/\sigma}}{1-1/\sigma}$, so that we have a closed form solution

$$C_1(Y_1, Y_2, r, \beta, B_1) = \frac{1}{1 + (1+r)^{\sigma-1}\beta^{\sigma}}\left[Y_1 + \frac{Y_2}{1+r}\right]$$

Saving is then given by (suppressing all arguments except r and assuming $B_1 = 0$)

$$S(r) = Y_1 - \frac{1}{1 + (1+r)^{\sigma-1}\beta^{\sigma}}\left[Y_1 + \frac{Y_2}{1+r}\right]$$

The equilibrium interest rate r* is the value that solves

$$S(r^*) = 0$$

Simplifying by setting σ=1 (log utility), we can quickly solve this to get

$$r^* = \frac{Y_2}{Y_1} \times \frac{1}{\beta} - 1$$

If we define the growth rate of output as $g = Y_2/Y_1 - 1$, we ca write the above equation as

So the equilibrium real interest rate is

$$r^* = \frac{1+g}{\beta} - 1$$

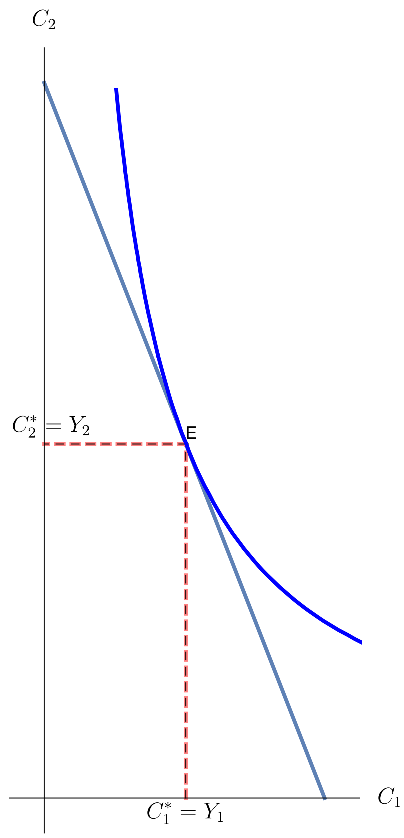
1. increasing in the rate of economic growth (g); the higher future income is relative to today's (high growth), the higher must the interest rate be in order to "discourage" people from borrowing.

2. Decreasing in β (the discount factor); the more patient people are, the lower the interest rate required to "encourage" them to save

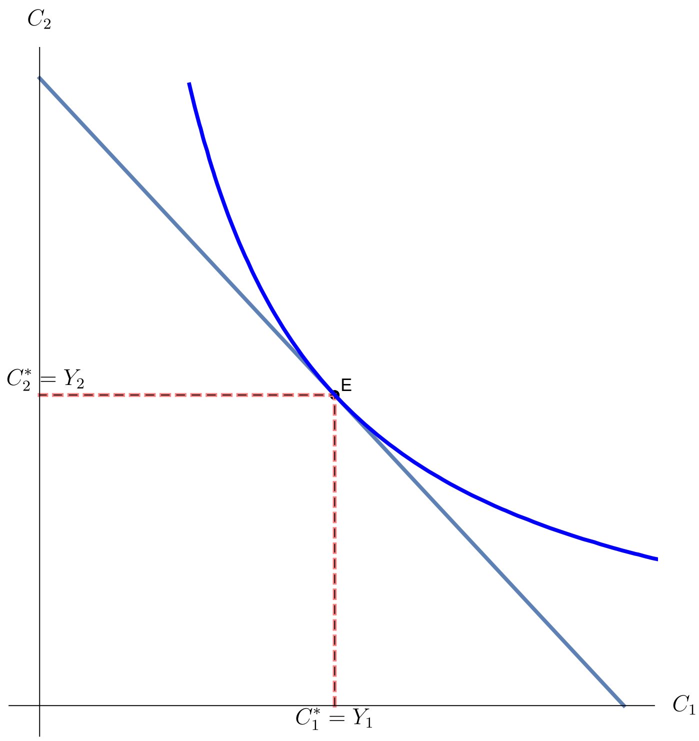
Additionally, notice that in the absence of economic growth ($Y_2/Y_1 = 1$), the equilibrium interest rate is $r^* = \frac{1}{\beta} - 1$, which implies $(1+r^*)\beta = 1$, which was an assumption we considered above.

Also, note that even if we want to use this model to think of a small open economy, the above results is still important. It tells us how the wold interest rate (taken as given by the small open economy) is determined. The world as a whole is, after all, a closed economy.

This is what it looks like in an economy with high economic growth



And this is an economy with low economic growth



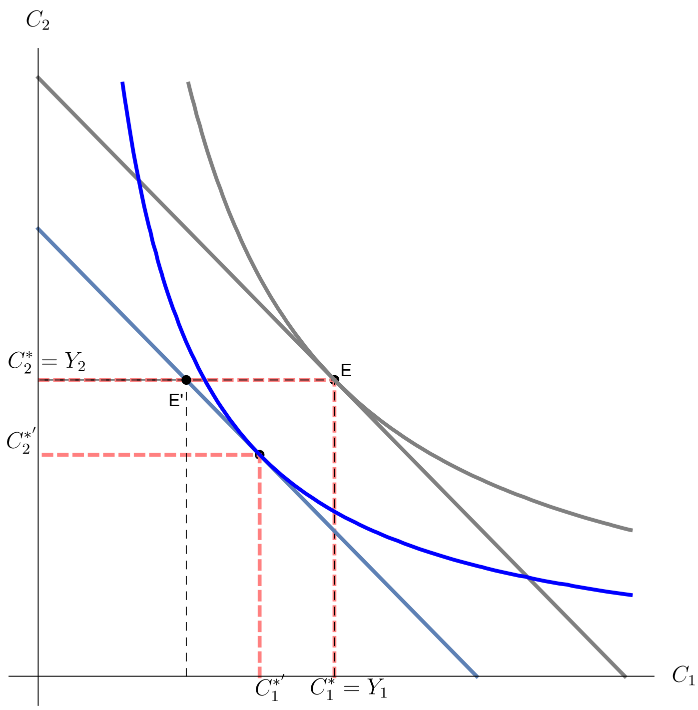
Income Shocks: a transitory income shock in a SOE

Let’s go back to the small open economy interpretation and think of shocks to GDP.

With just two periods a transitory shock is a fall in Y_1 without a change in Y_2. (depicted by the change in endowment from E to E’).

For simplicity, let’s assume we start with $Y_2 = Y_1$ and $(1+r)\beta = 1$ so that initially (before the shock) the optimal consumption would have been $C_1 = Y_1$ and $C_2 = Y_2$.

What will happen to consumption? It falls but by less than the income shock. Why? Consumption smoothing. How? International borrowing! Current account goes into deficit.



Does the math check out? For example, when $(1+r)\beta = 1$ we got

$$C_1 = \frac{1+r}{2+r}\left[Y_1 + \frac{Y_2}{1+r}\right]$$

Which implies

$$\triangle C_1 = \frac{1+r}{2+r}\triangle Y_1 < \triangle Y_1$$

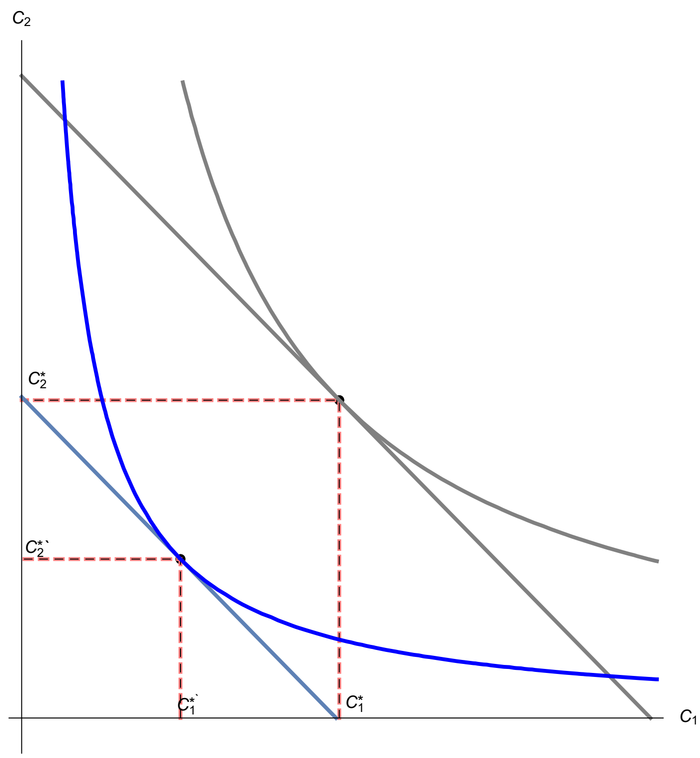
Check other cases on your own.

Income Shocks: a permanent income shock in a SOE

With just two periods a permanent shock is a fall in both Y_1 and Y_2 (of equal size).

For simplicity, let's assume we start with $Y_2 = Y_1$ and $(1+r)\beta = 1$ so that initially (before the shock) the optimal consumption would have been $C_1 = Y_1$ and $C_2 = Y_2$.

What will happen to consumption? It falls by exactly the same amount as the income shock. Why? Consumption smoothing is not possible; this is a permanent shock. No change in international borrowing! Current account is unchanged.



Does the math check out? For example, when $(1+r)\beta = 1$ we got

$$C_1 = \frac{1+r}{2+r}\left[Y_1 + \frac{Y_2}{1+r}\right]$$

Which implies (with $\triangle Y_1 = \triangle Y_2 = \triangle Y$)

$$\triangle C_1 = \frac{1+r}{2+r}\left[\triangle Y_1 + \frac{\triangle Y_2}{1+r}\right] = \frac{1+r}{2+r}\left[\triangle Y + \frac{\triangle Y}{1+r}\right] = \frac{1+r}{2+r}\left[\frac{2+r}{1+r}\triangle Y\right] = \triangle Y$$

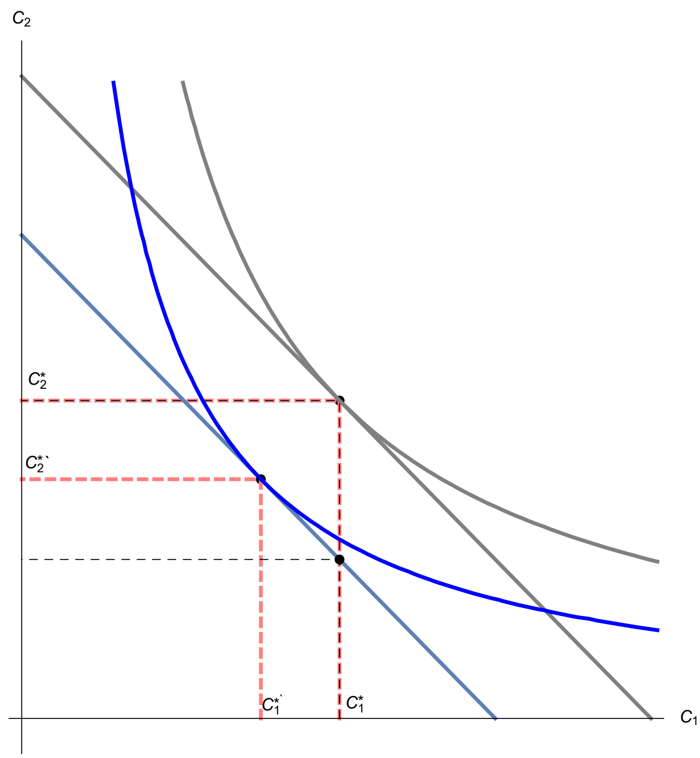
Check other cases on your own.

Income Shocks: a shock to future income in a SOE

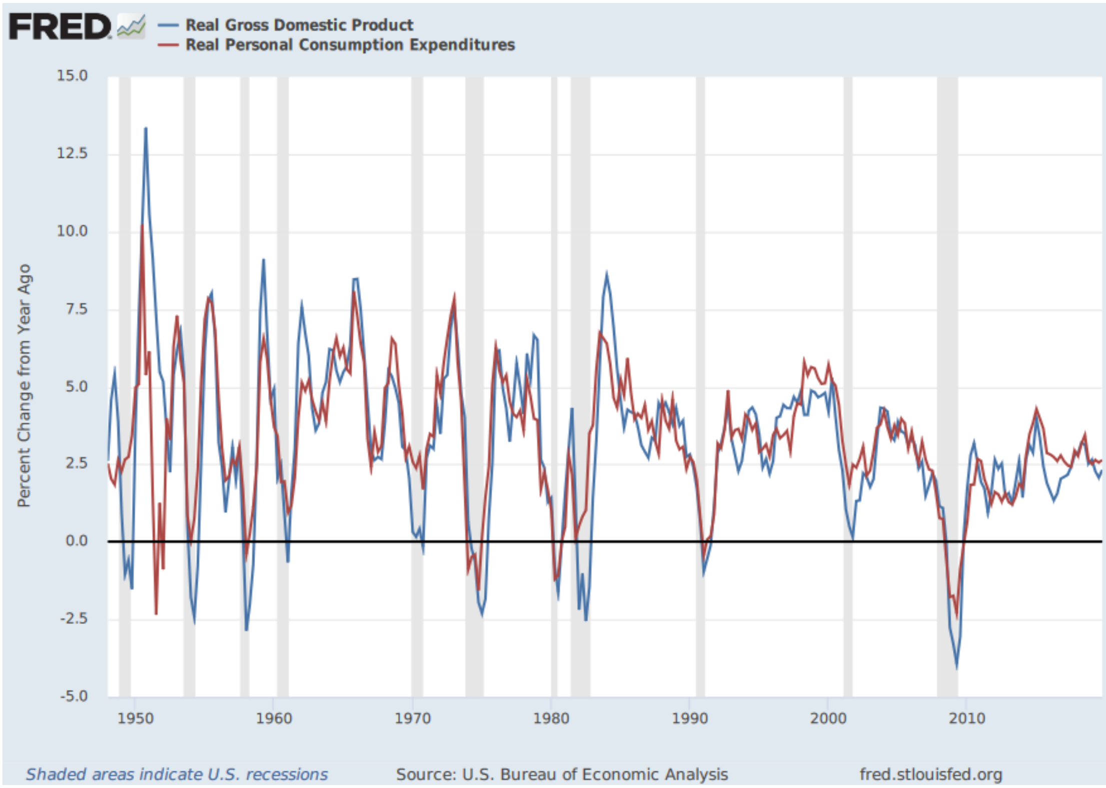
A fall in Y_2 without a change in Y_1.

For simplicity, let’s assume we start with $Y_2 = Y_1$ and $(1+r)\beta = 1$ so that initially (before the shock) the optimal consumption would have been $C_1 = Y_1$ and $C_2 = Y_2$.

What will happen to consumption? It falls. Why? Consumption smoothing. How? International lending! Current account goes into surplus.

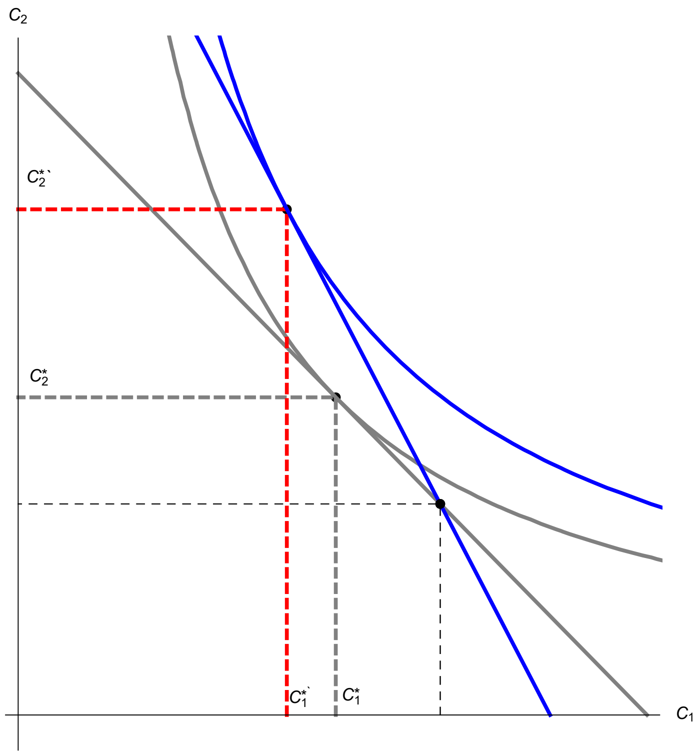


Evidence-check: consumption is indeed much less volatile than output.



Change in Interest Rate

What happens to C_1 and savings S =Y_1 - C_1 in a SOE when the world interest rate goes up?
In the graph below, C_1 falls and savings increase.



Change in Interest Rate

In the above graph, C_1 falls and savings increase in response to an increase in the real interest rate *r*. But is this necessarily always true? The answer is no. As usual we have the income and substitution effects working in opposite directions.

1. An increase in *r* is an decrease in the relative price of future consumption in terms of current consumption (recall that this price is given by $\frac{1}{1+r}$). This causes ***substitution*** towards the cheaper alternative (future consumption C_2) and away from the more expensive alternative (current consumption C_1). This leads to more saving.

2. The ***income effect*** means the household can afford more of both C_1 and C_2 at the new lower price. This pushes towards choosing more of both C_1 and C_2 and thus less saving.

3. There is actually a third effect, called the ***wealth effect***. It occurs because a fall in causes a fall in the present discounted value of the household endowment $(Y_1 + \frac{Y_2}{1+r})$. This pushes towards choosing less of both C_1 and C_2 and thus more saving.Y

Which effects dominate depends on the utility function. Fore example, if we assume the CES unity, we have

$$S(r) = Y_1 - \frac{1}{1+(1+r)^{\sigma-1}\beta^{\sigma}}\left[Y_1 + \frac{Y_2}{1+r}\right]$$

The balance between income and substitution effects is contained in the term $(1+r)^{\sigma-1}$. When σ is higher than 1, substitution effect dominates otherwise the income effect does. In the case of log utility (σ=1), the substitution and income effects cancel out since $C_1 = \frac{1}{1+\beta}\left[Y_1 + \frac{Y_2}{1+r}\right]$. Remember, that the effect on consumption also includes the wealth effect (unless Y_2 =0), so in log utility case, we do get an increase in saving (again unless Y_2 =0)).

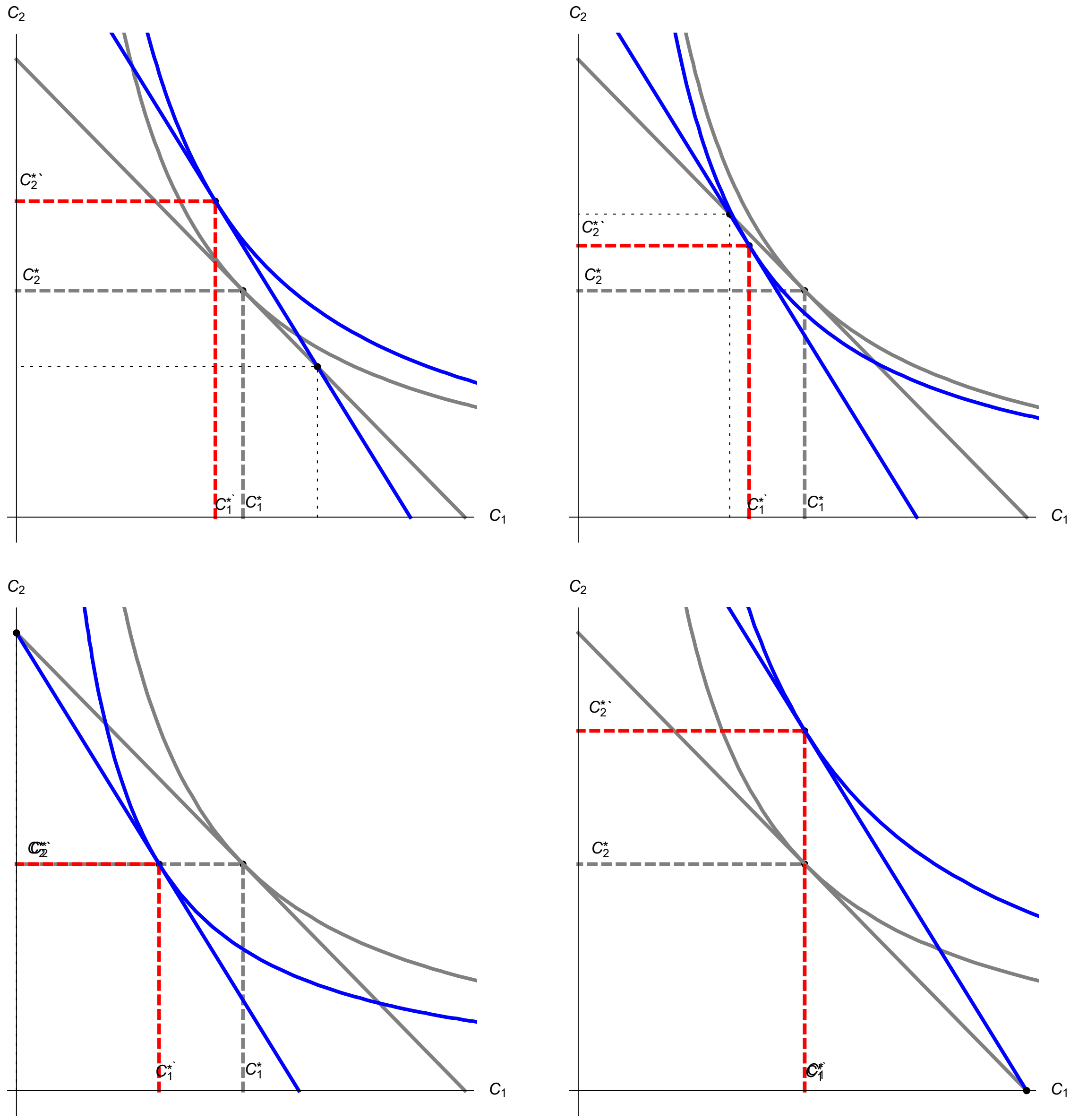
Also, it can be show that the ***sum of the income and wealth effects*** is

(a) always positive when (prior to the change in *r*), the household's optimal choice was $C_1^* < Y_1$ (the household is a net saver in period 1)
(b) always negative when (prior to the change in *r*) , the household's optimal choice was $C_1^* > Y_1$ (the household is a net borrower in period 1)
It follows that saving can only decrease when r increases, when the household is a net saver in period 1.

The figures below illustrate some of these effects (the second row of figures on each page case illustrates $Y_2 = 0$ or $Y_2 =0$).

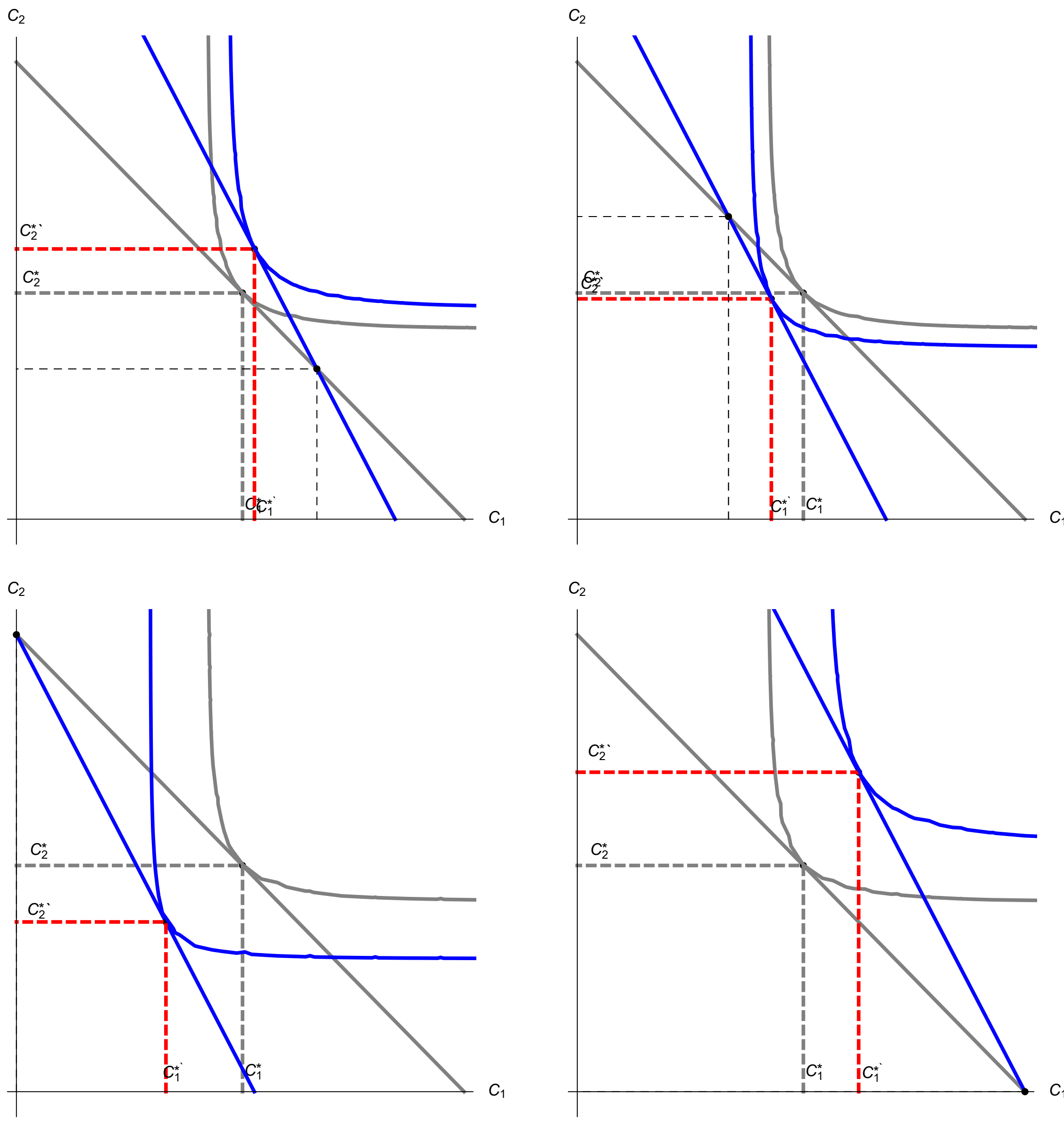
Change in Interest Rate ($\sigma = 1$; log-utility)

What happens to C_1 and saving $S = Y_1 - C_1$ when the interest rate goes up? Consider the following cases:

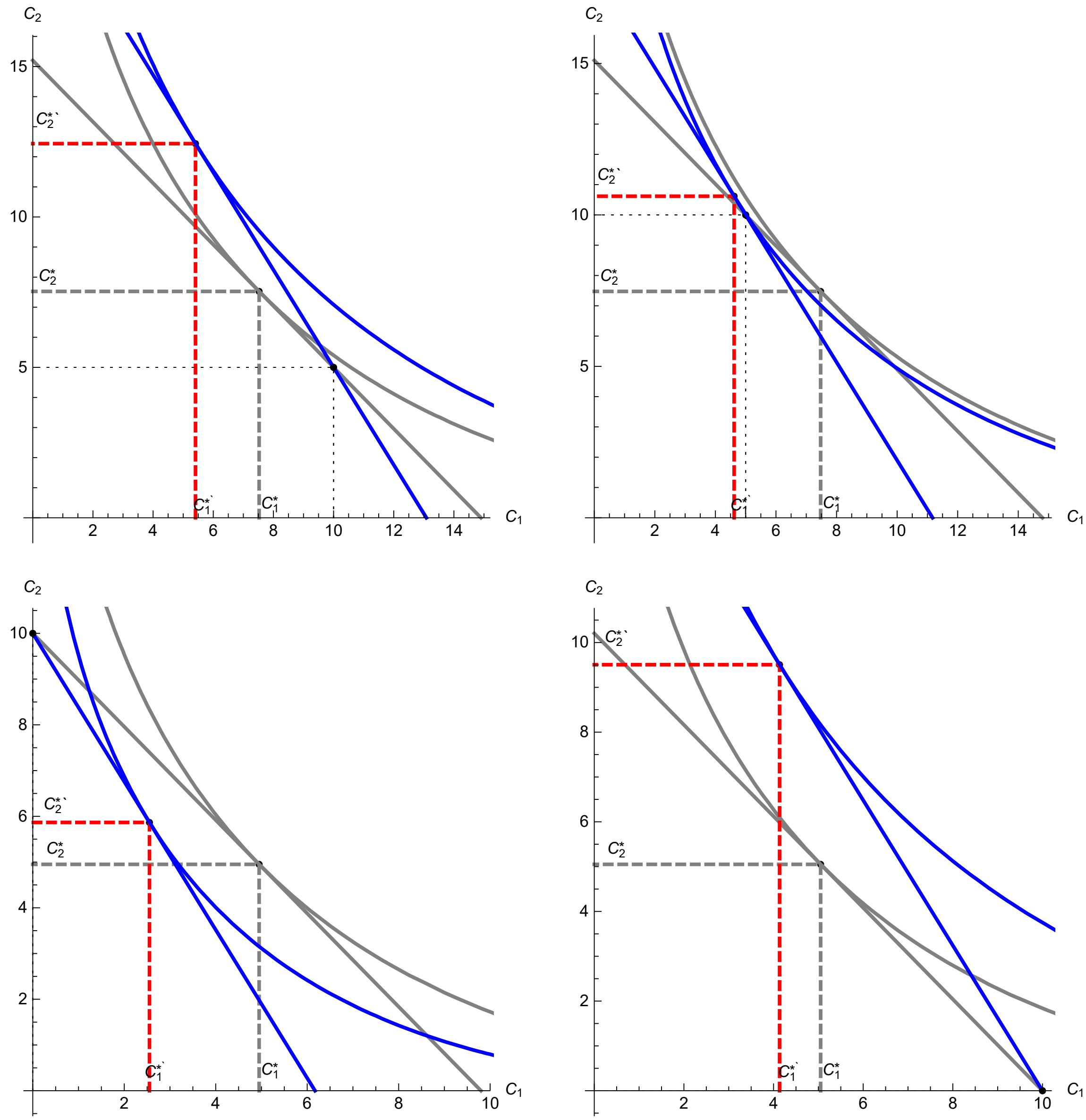


Change in Interest Rate ($\sigma < 1$)

What happens to C_1 and saving $S = Y_1 - C_1$ when the interest rate goes up? Consider the following cases:

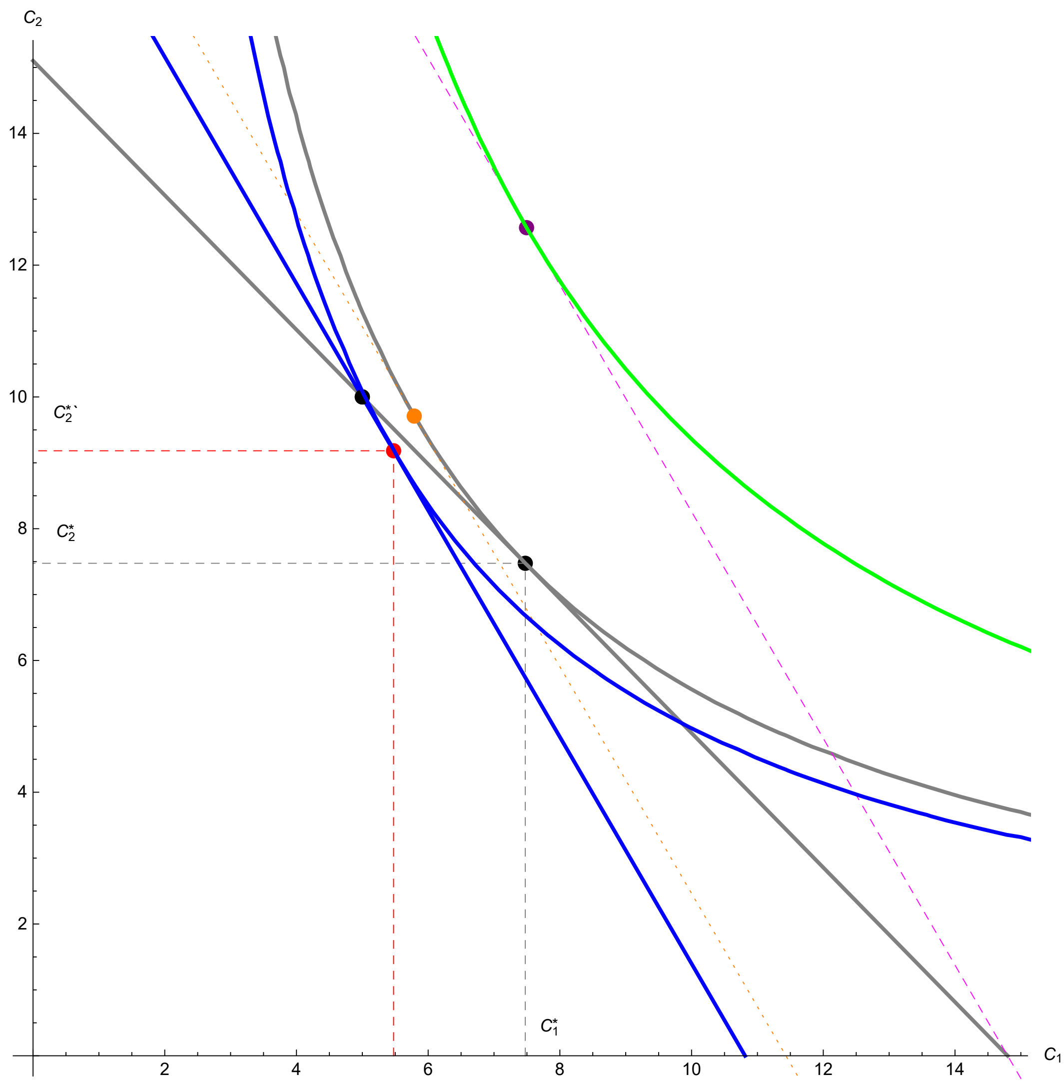


Change in Interest Rate (σ >1)

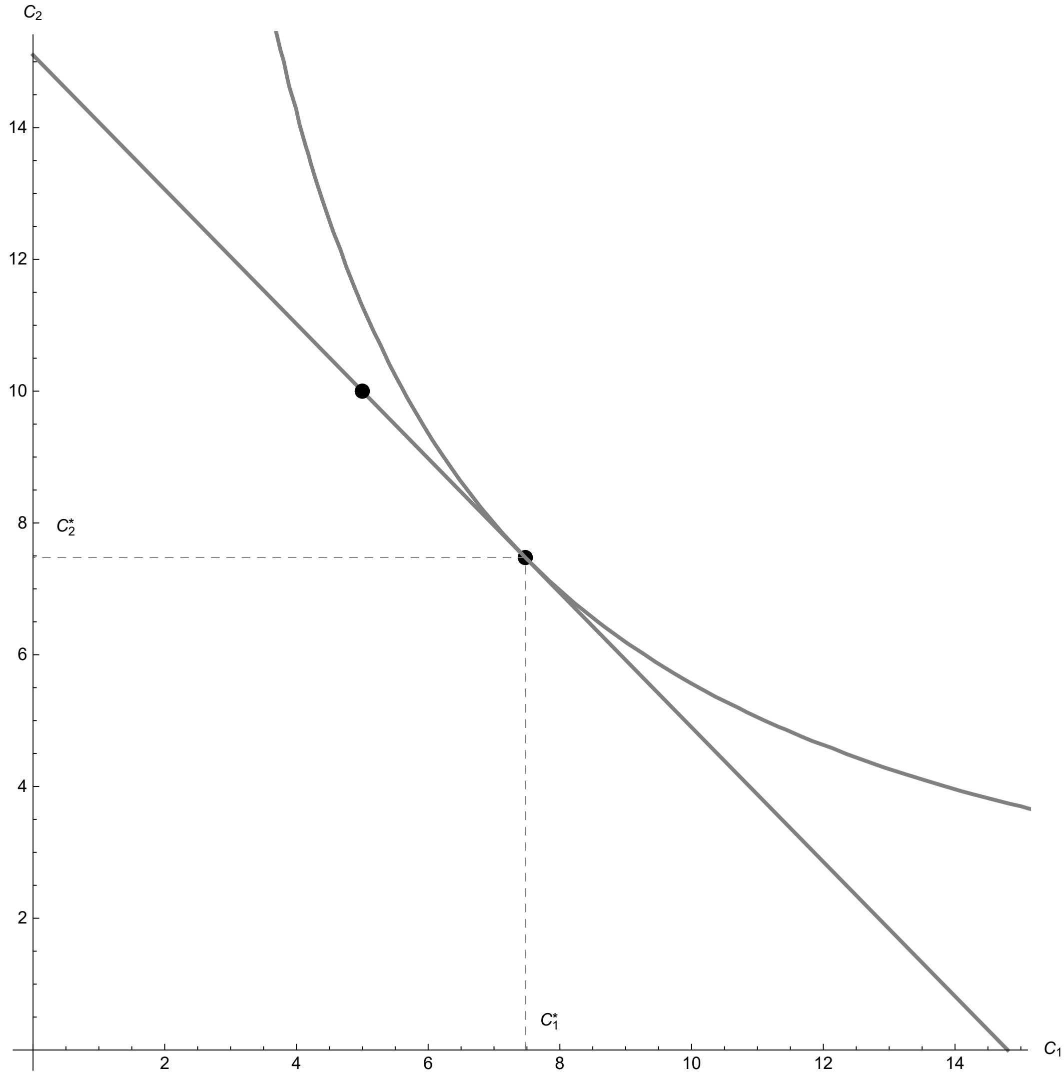


Substitution, Income and Wealth Effects: Graphical Analysis (optional)

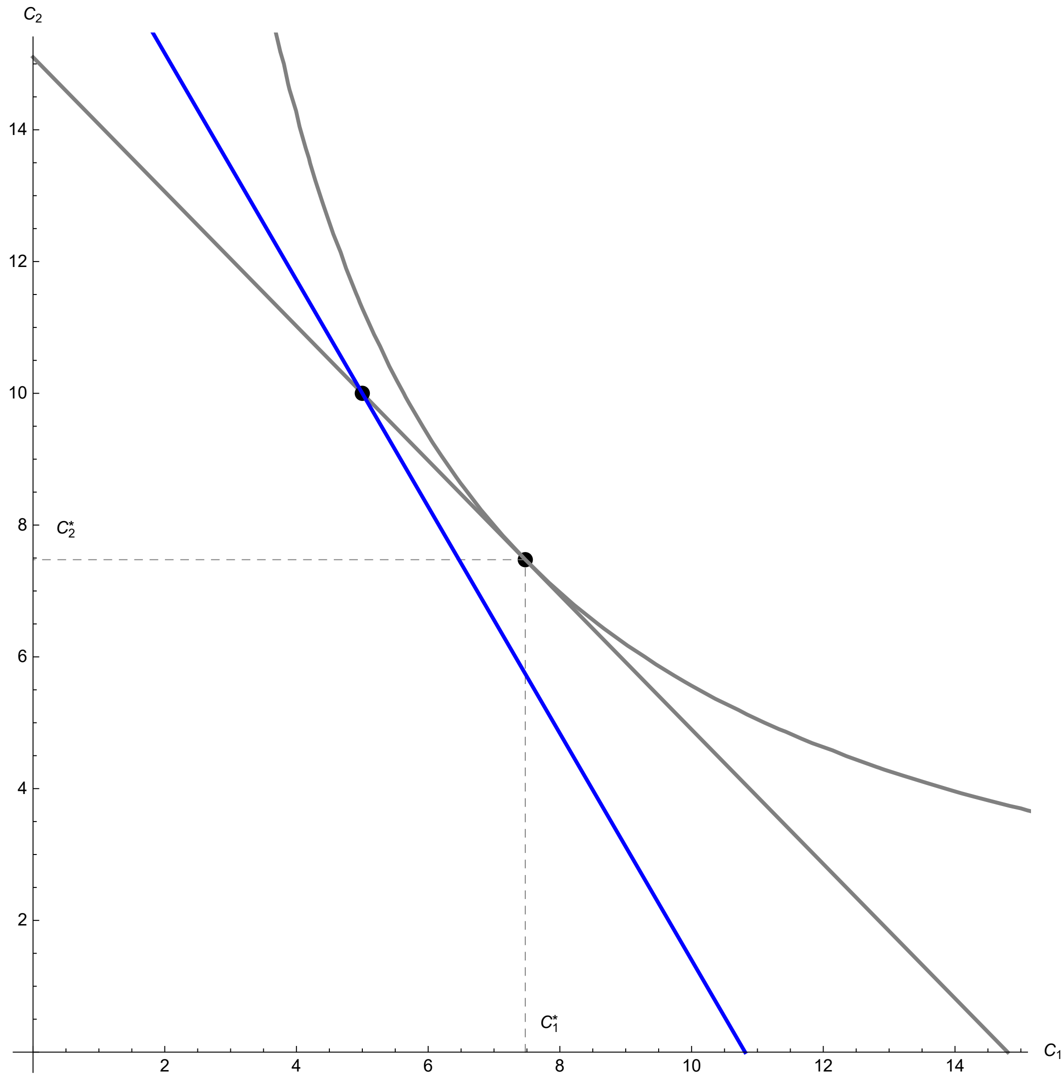
Let’s decompose the change in C1 into the substitution, income and wealth effects. The Original optimal choice is the black dot where the gray curves are tangent. The new optimum is the red point.



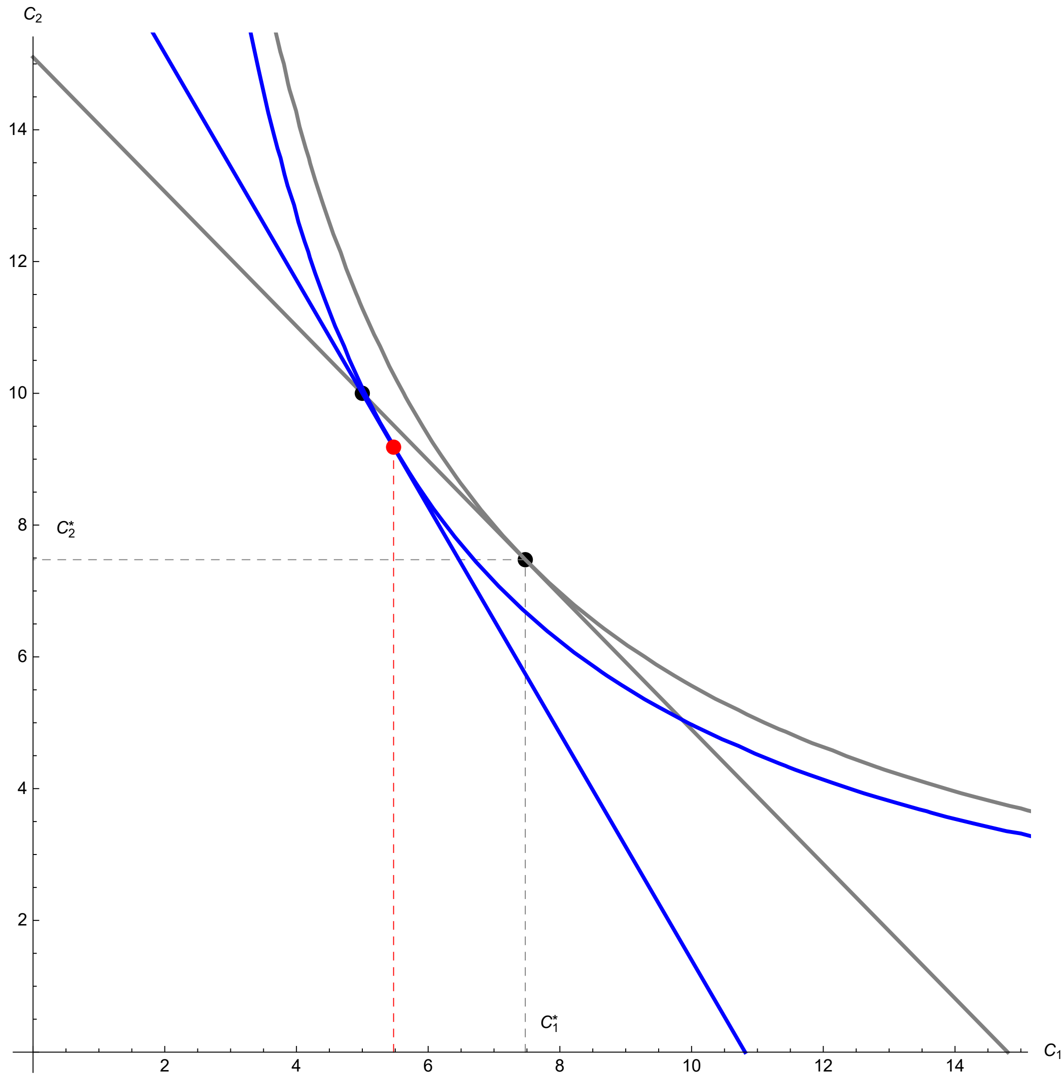
Original optimal choice



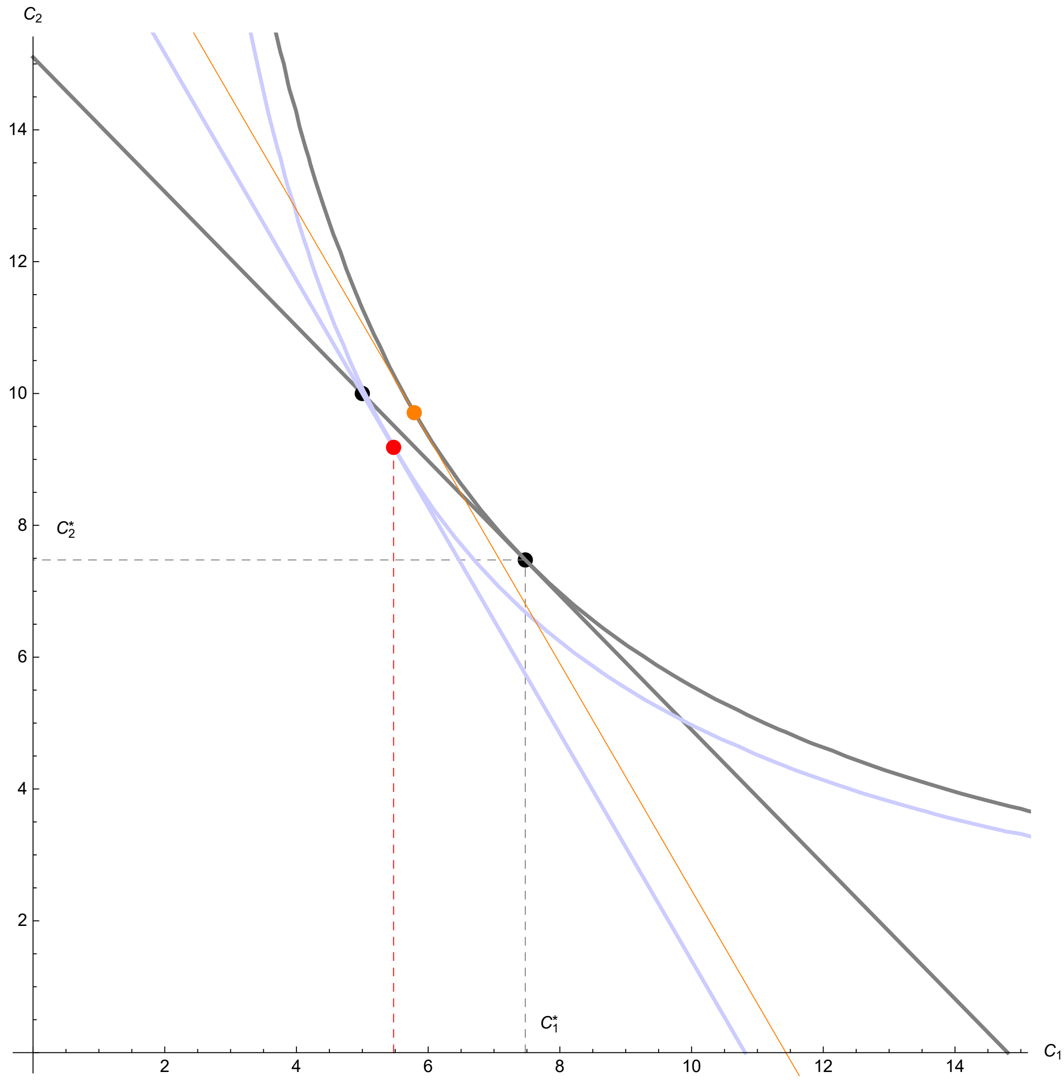
Original optimal choice + new budget line with higher *r*.



Original optimum choice + new optimal choice (red)



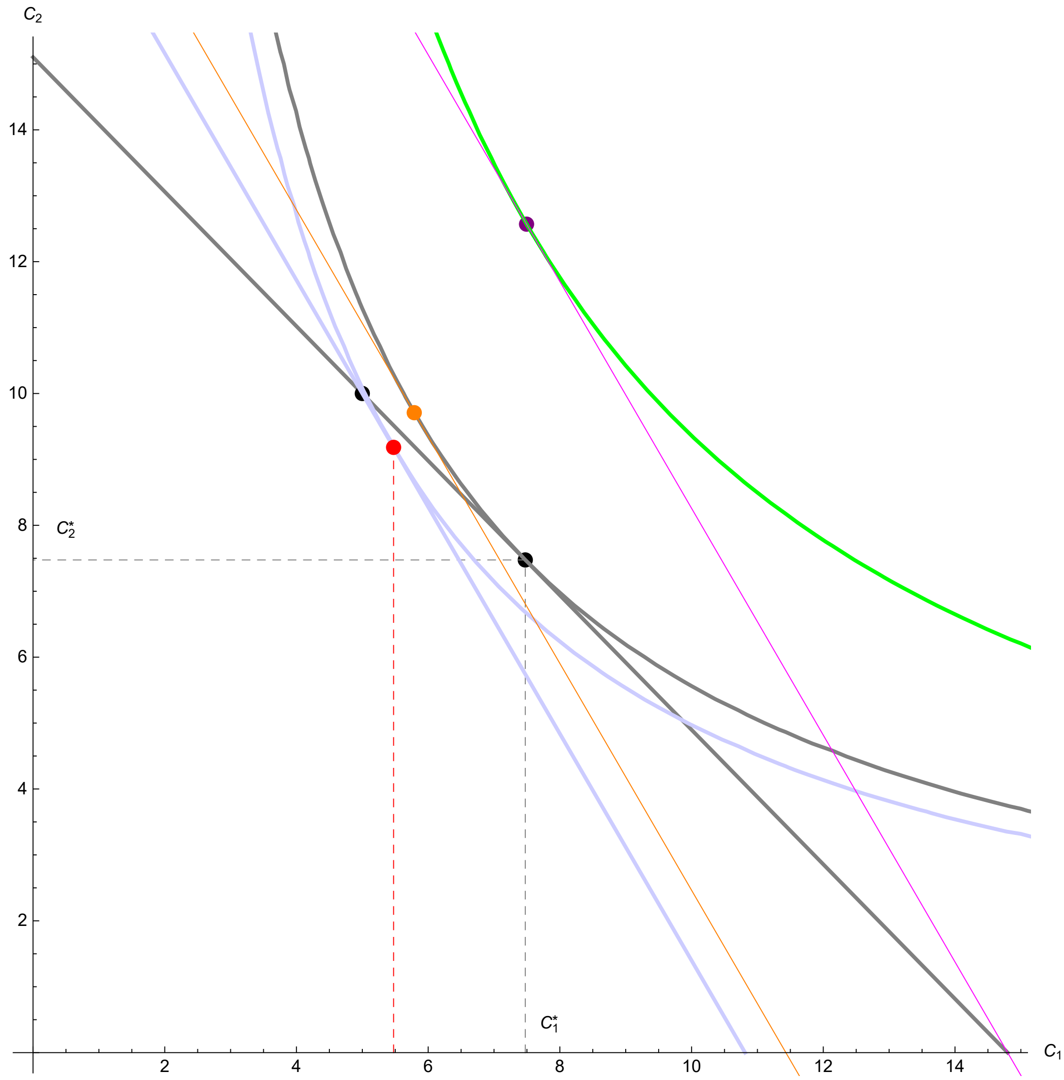
Original optimal choice + new optimal choice (red) + substitution effect (orange)



Original optimal choice + new optimal choice (red) + substitution effect (orange) + substitution & income effects (purple).

We can find the income effect by subtracting the substitution effect (purple - orange).

We can find the wealth effect by subtracting the substitution & income effects from total change (red - purple).

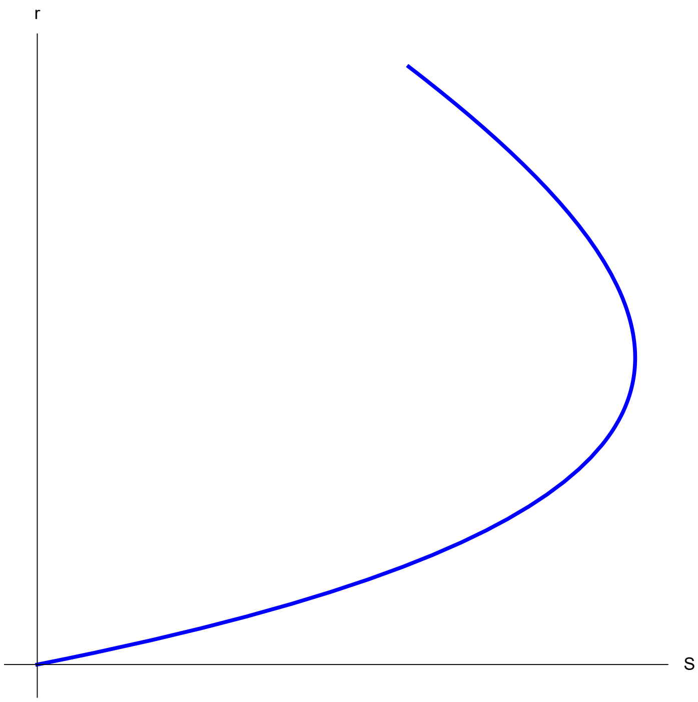


C_2
14
12
10
8
C_2^*
6
4
2
C_1^*
2
4
6
8
10
12
14
C_1

Example of a Backward-bending Saving Curve

With sufficiently low elasticity of intertemporal substitution (σ), saving increase with r for sufficiently high r.

Out[ ]=

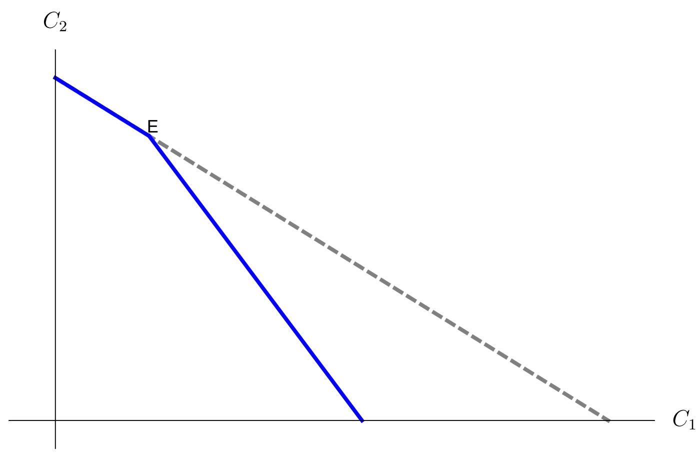


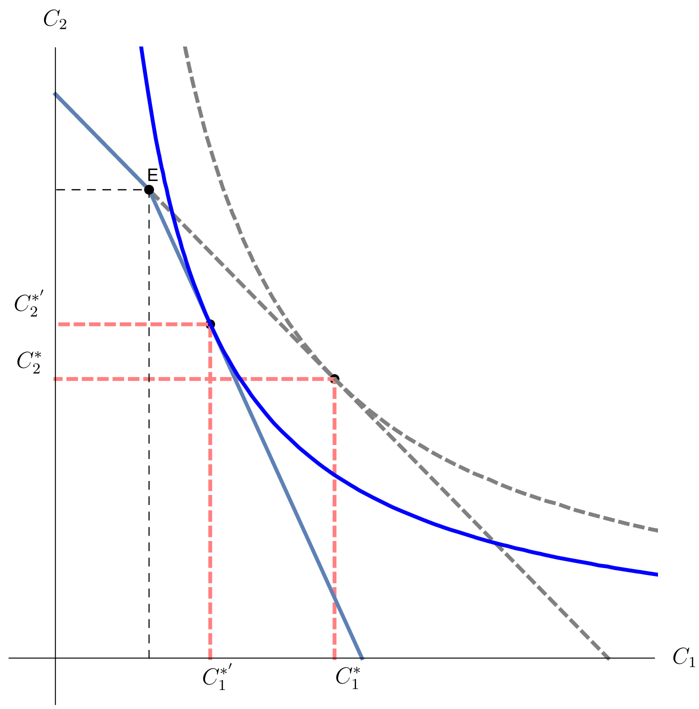
2. Risk of Defaults and Credit Constraints

There is no default in our model. We will not introduce uncertainty and defaults yet. But we can still think about some consequences of default in our simple model.

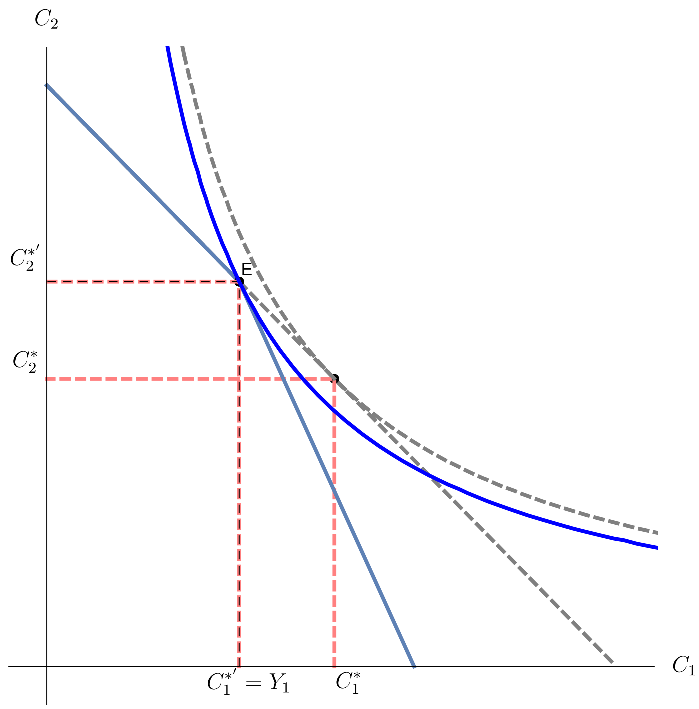
Assume, that for some reason (perhaps because of the possibility of default), a country is facing an interest rate *r'* that is higher than the world interest rate *r*. This higher rate applies only to borrowing, the country still can lend only at the rate *r*.

This will cause a "kink" in the budget line at the endowment point,, the slope above this point remains -*(1+r)* but below the slope becomes - *(1 + r'). (*This is illustrated below.) As a result, the country's budget set is more restricted and the optimal choice leads to less borrowing and a lower utility level.

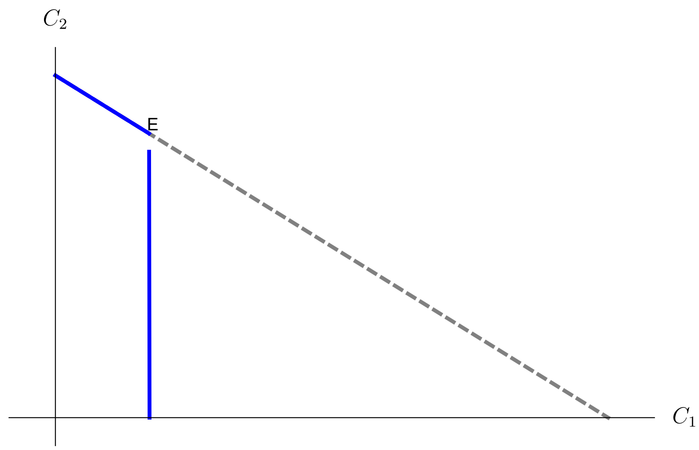


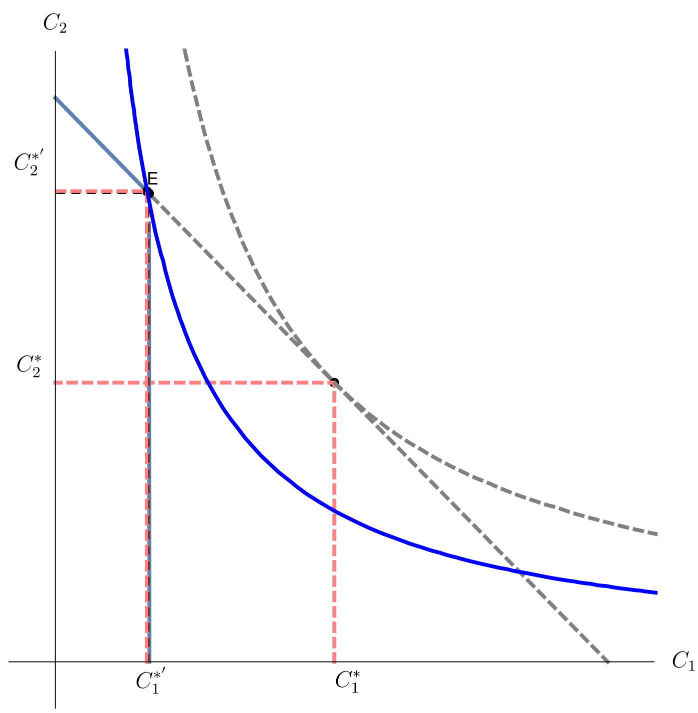

C_2
E
$C_2^{*\prime}$
C_2^*
$C_1^{*\prime}$
C_1^*
C_1

In an extreme case, the country may optimally end up at the “kink”, which implies no borrowing and confines it to the autarky outcome.



The economy always ends up at the “kink” in the extreme situation when it is completely credit-constrained (*r’* =+∞). This is what Argentina looked like after its 2001 default.





Evidence

Countries that are perceived as more risky, pay higher interest rates on international borrowing.