Consumption

EC502 Macroeconomics
Lecture 8

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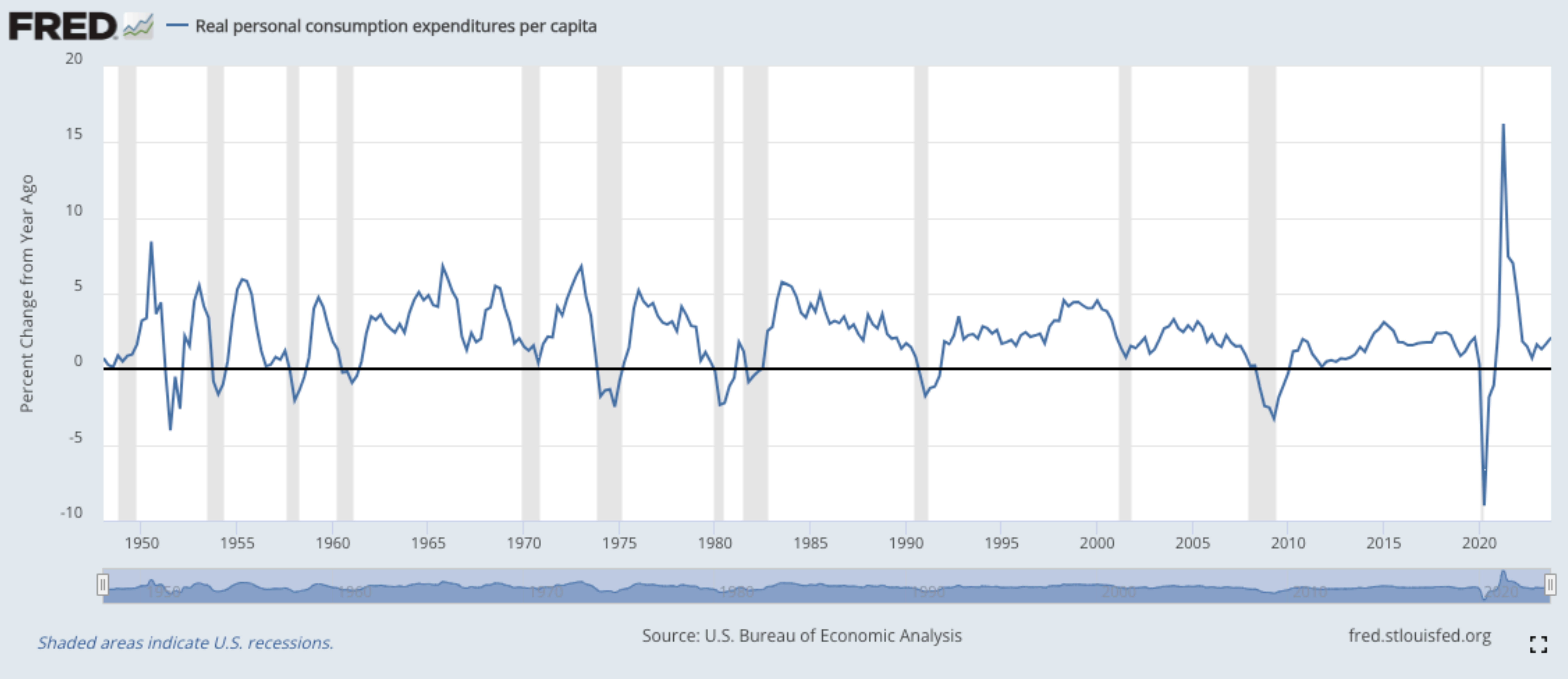
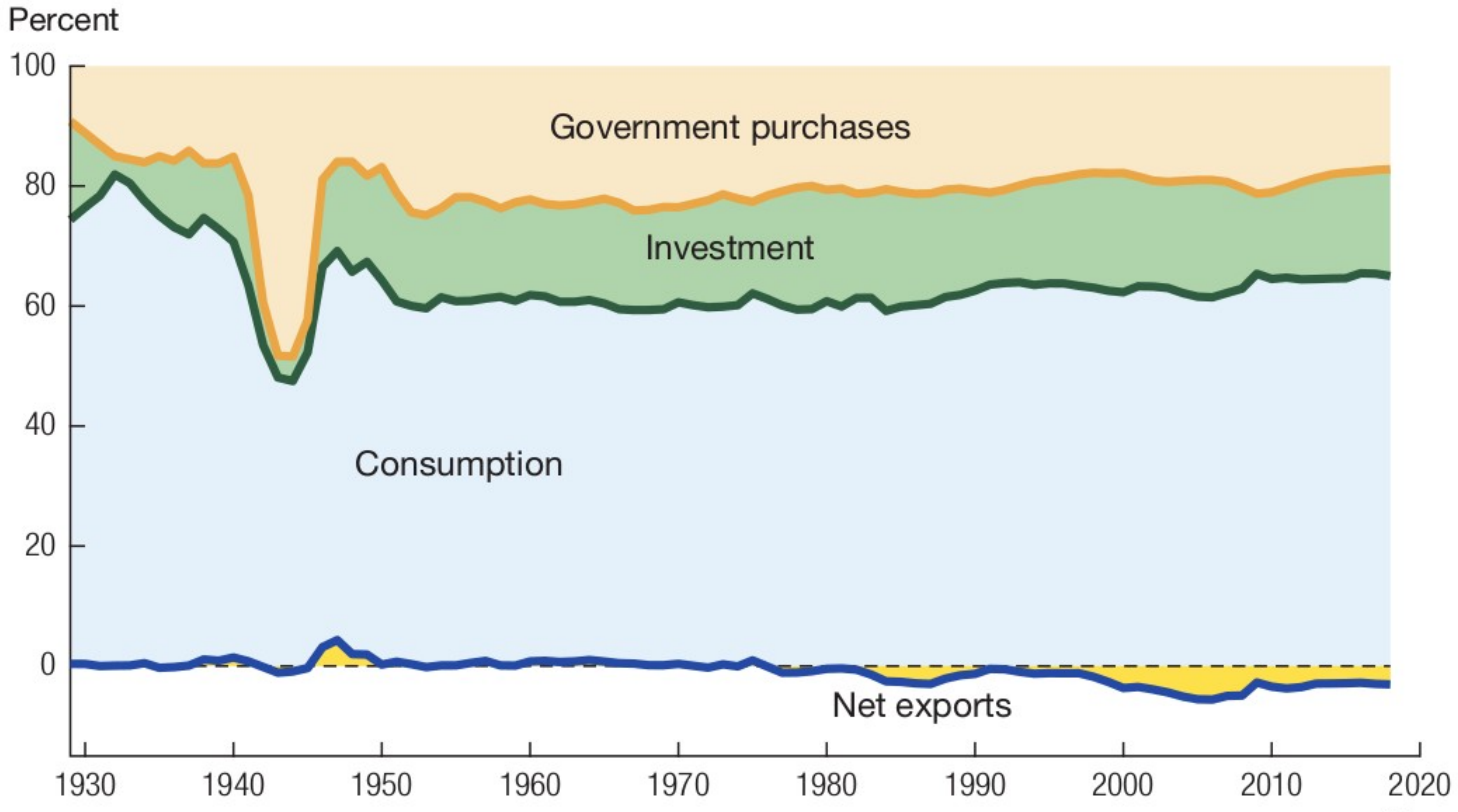
Consumption

Consumption Growth



Consumption in GDP



Source: Jones (2020)

Questions

- In Solow model, we took the saving rate, s, as exogenous
- This is perhaps a good approximation to study long-run
- But Solow model cannot answer questions like
  - How does consumption respond to COVID-19 relief stimulus checks?
  - How does consumption respond to future income changes?
  - How does consumption respond to the Fed's interest rate hikes?
  - How does consumption respond to changes in future uncertainty?

Consumption and Savings with Two Periods

Preferences

- Two-periods, $t = 0{,}1$
- Houhold's preferences are

$$u(c_0) + \beta u(c_1)$$

  where $\beta \in [0{,}1]$ is a discount factor

- The utility function is increasing and concave:

$$u'(c) > 0, \quad u''(c) < 0$$

- We will later assume iso-elastic utility function

$$u(c) = \frac{c^{1-\sigma}}{1-\sigma}$$

Budget Constraint

- The households can freely borrow and save at interest rate r_0
  - $a_0 > 0$: saving, $a_0 < 0$: borrowing
- Households receive (exogenous) income of y_t at time t
- The budget constraints are

$$c_0 + a_0 = y_0$$

$$c_1 = (1 + r)a_0 + y_1$$

- The household's problem is

$$\max_{c_0, c_1, a_0} u(c_0) + \beta u(c_1)$$

$$\text{s.t.} \quad c_0 + a_0 = y_0$$

$$c_1 = (1 + r)a_0 + y_1$$

Solving with Lagrangian

- The Lagrangian is

$$L = u(c_0) + \beta u(c_1) + \lambda_0 \left[y_0 - c_0 - a_0\right] + \lambda_1 \left[y_1 + (1 + r)a_0 - c_1\right]$$

- The first-order conditions are

$$u'(c_0) = \lambda_0$$

$$\beta u'(c_1) = \lambda_1$$

$$\lambda_0 = \beta(1 + r)\lambda_1$$

and the budget constraints

Euler Equation

- Eliminating Lagrangian multipliers, we obtain the following condition

$$u'(c_0) = \beta(1 + r)u'(c_1)$$

- This is called Euler equation and is at the heart of modern macroeconomics
- This summarizes the key trade-off in consumption-saving decisions
- LHS: marginal cost of saving one more dollar
  - If you save a dollar, you consume a dollar less today. You are less happy by $u'(c_0)$
- RHS: marginal benefit of saving one more dollar
  - If you save a dollar, you get $(1 + r)$ tomorrow. You are happier by $(1 + r) \times \beta u'(c_1)$

Two Equations, Two Unknowns

- Eliminating a_0 from the budget constraint, we obtain

$$c_0 + \frac{1}{1+r}c_1 = y_0 + \frac{1}{1+r}y_1$$

Lifetime (presented discounted) sum of consumption = lifetime sum of income

- Therefore $\{c_0, c_1\}$ solve

$$u'(c_0) = \beta(1+r)u'(c_1)$$

$$c_0 + \frac{1}{1+r}c_1 = y_0 + \frac{1}{1+r}y_1$$

Drawing Figure

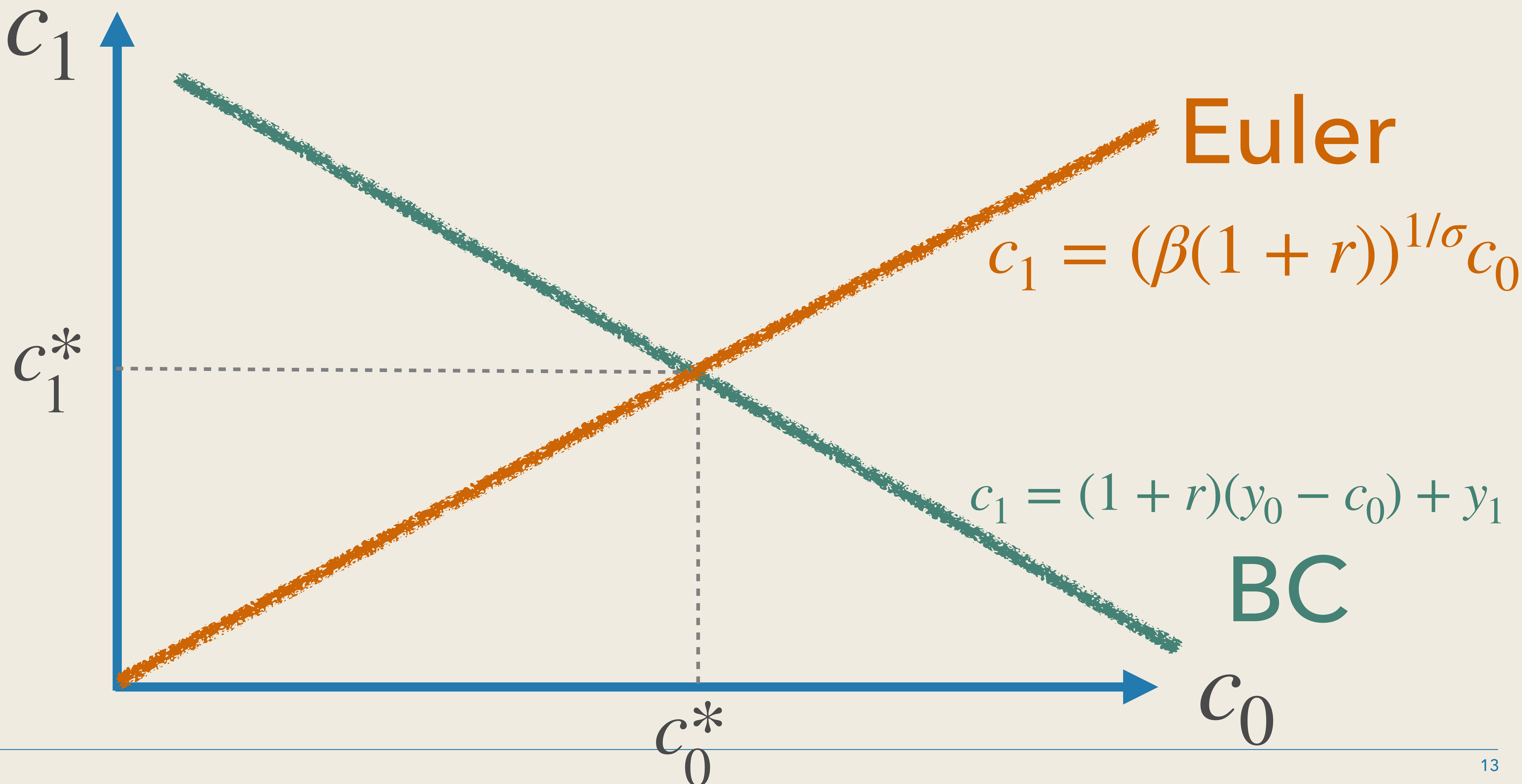
- It is convenient to impose functional form assumption, $u(c) = \dfrac{c^{1-\sigma}}{1-\sigma}$

$$(c_0)^{-\sigma} = \beta(1+r)(c_1)^{-\sigma} \quad \textbf{(Euler)}$$

$$c_0 + \frac{1}{1+r}c_1 = y_0 + \frac{1}{1+r}y_1 \quad \textbf{(BC)}$$

- **(Euler)** provides an increasing relationship between c_0 and c_1
- **(BC)** provides a decreasing relationship between c_0 and c_1
- Now we can draw a figure!

Optimal Consumption



Analytical Soutions

- We can also directly solve for optimal c_0 and c_1

$$c_0 = \frac{1}{\left(1 + \frac{(\beta(1+r))^{1/\sigma}}{1+r}\right)} \left[y_0 + \frac{1}{1+r} y_1\right]$$

Presented discounted value (PDV) of lifetime income

$$c_1 = \frac{(\beta(1+r))^{1/\sigma}}{\left(1 + \frac{(\beta(1+r))^{1/\sigma}}{1+r}\right)} \left[y_0 + \frac{1}{1+r} y_1\right]$$

$$a_0 = \frac{1}{\left(1 + \frac{(\beta(1+r))^{1/\sigma}}{1+r}\right)} \left[\frac{(\beta(1+r))^{1/\sigma}}{1+r} y_0 - \frac{1}{1+r} y_1\right]$$

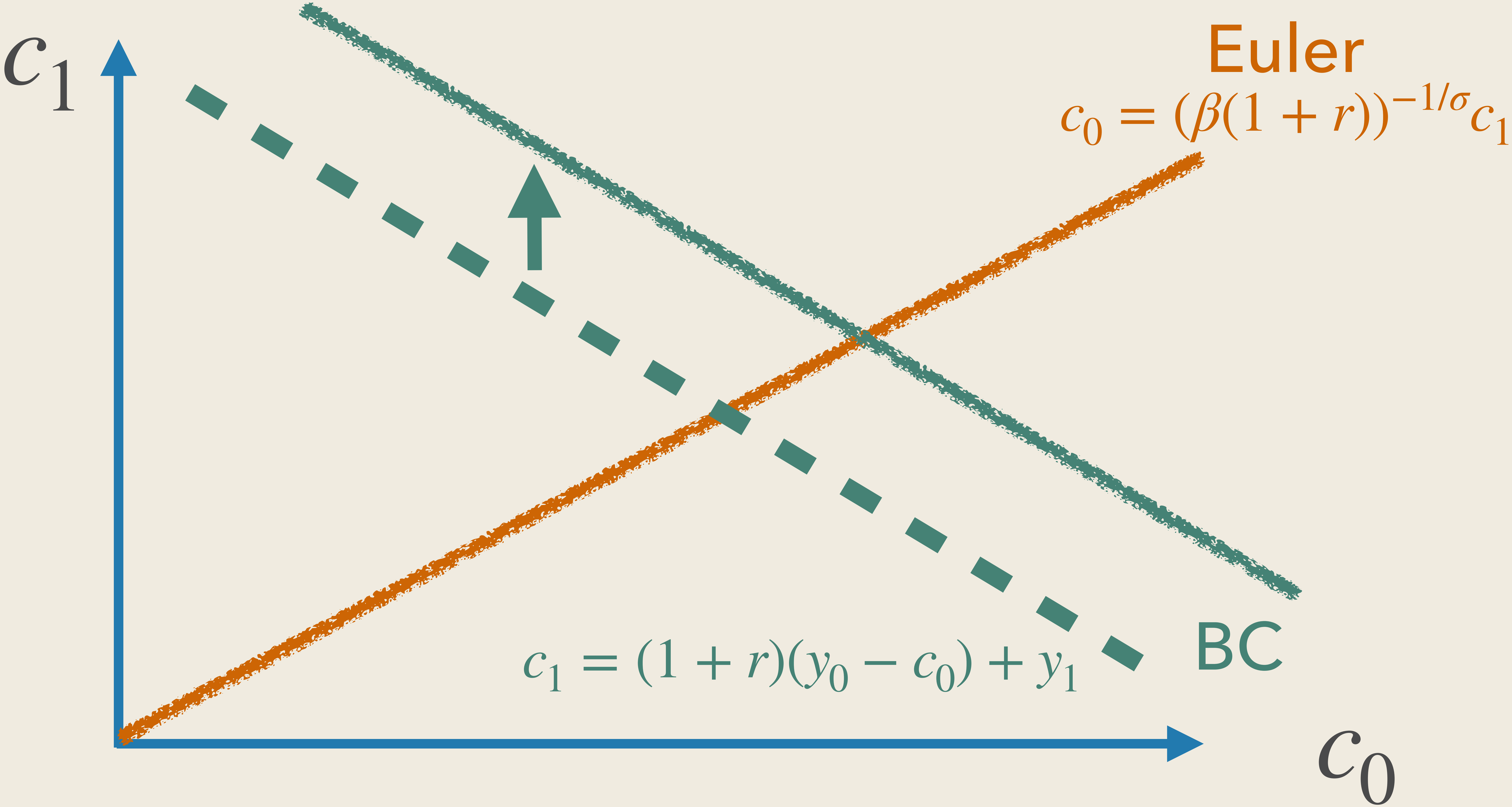
Q1: Impact of Current Income

- Now let us study our original questions!
- **Q1**: How does consumption respond to an increase in y_0? (e.g., COVID transfer)

$$c_1 = (\beta(1+r))^{1/\sigma} c_0$$

$$c_0 + \frac{1}{1+r} c_1 = y_0 + \frac{1}{1+r} y_1$$

Consumption Response to Current Income



Consumption Response to Current Income

- We can derive the effect analytically as well

$$MPC_{0,0} \equiv \frac{\partial c_0}{\partial y_0} = \frac{1}{\left(1 + \beta^{1/\sigma}(1+r)^{\frac{1-\sigma}{\sigma}}\right)} \in (0,1)$$

  - If you get \$1, you will spend less than \$1 immediately
  - Households save the remaining to smooth consumption over time:

$$\frac{\partial c_1}{\partial y_0} = \frac{\beta^{1/\sigma}(1+r)^{1/\sigma}}{\left(1 + \beta^{1/\sigma}(1+r)^{\frac{1-\sigma}{\sigma}}\right)} \in (0,1), \quad \frac{\partial a_0}{\partial y_0} = 1 - \frac{\partial c_0}{\partial y_0}$$

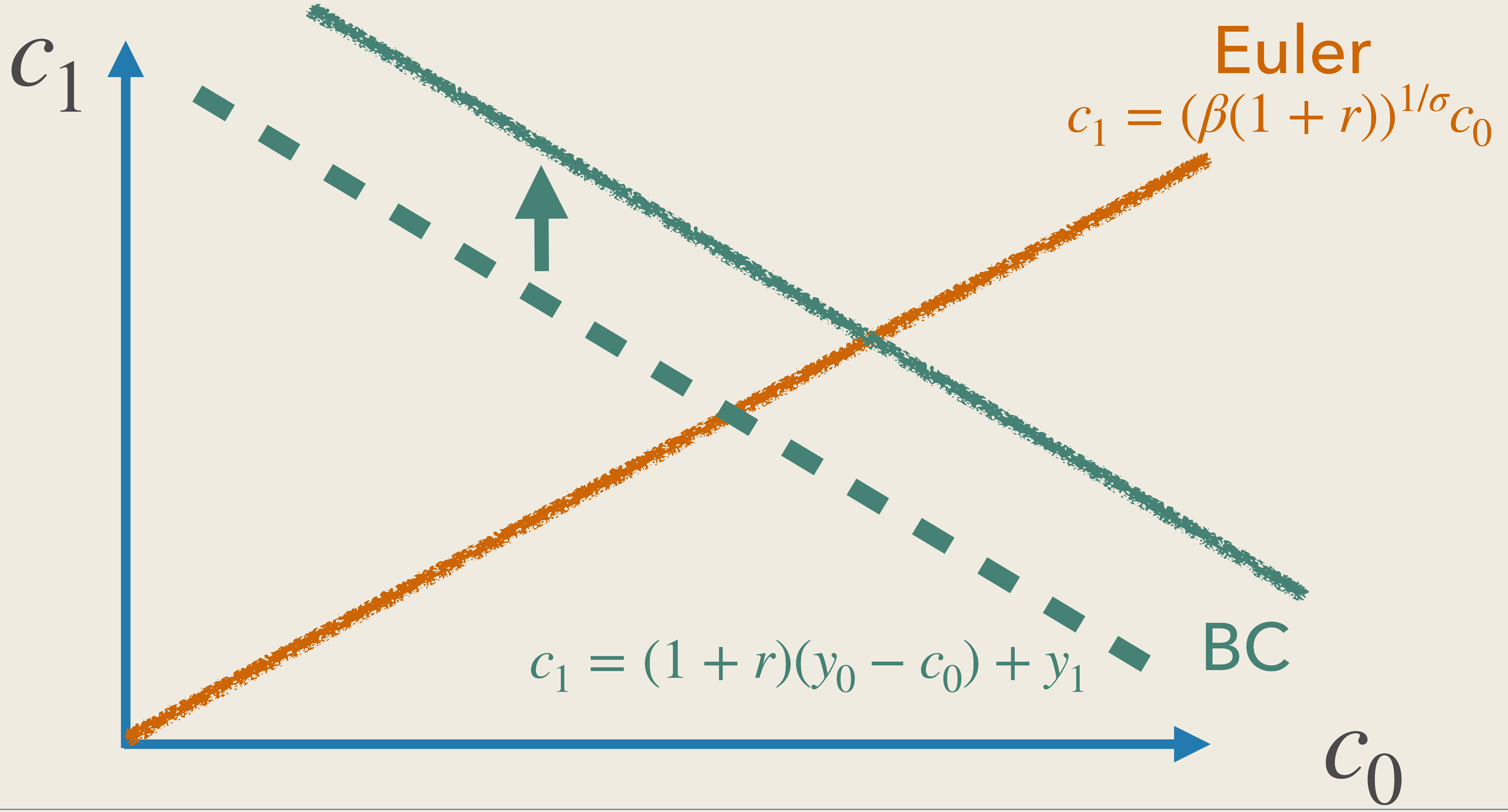
Consumption Response to Future Income

- **Q2**: How does consumption respond to future income changes, y_1?

$$(c_0)^{-\sigma} = \beta(1+r)(c_1)^{-\sigma}$$

$$c_0 + \frac{1}{1+r}c_1 = y_0 + \frac{1}{1+r}y_1$$

Consumption Response to Future Income



Consumption Response to Future Income

- We can derive the effect analytically as well

$$\frac{\partial c_0}{\partial y_1} = \frac{1}{\left(1 + \beta^{1/\sigma}(1+r)^{\frac{1-\sigma}{\sigma}}\right)} \frac{1}{1+r} \in (0,1)$$

- If you expect higher income in the future, you start increasing consumption today
- How? – You borrow more to consume more today

$$\frac{\partial a_0}{\partial y_1} = -\frac{1}{\left(1 + \beta^{1/\sigma}(1+r)^{\frac{1-\sigma}{\sigma}}\right)} \frac{1}{1+r} < 0$$

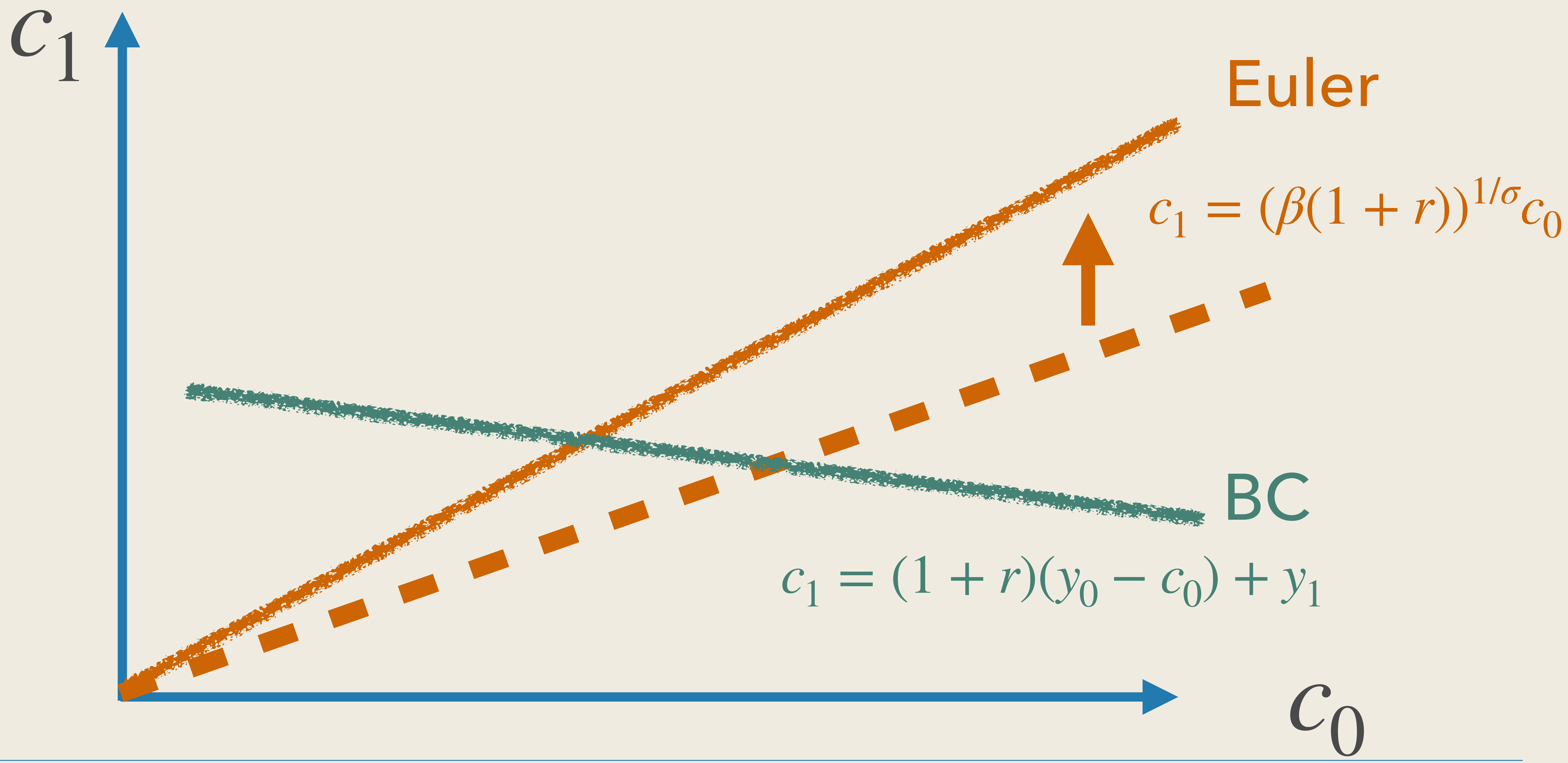
Interest Rate Response

- **Q3**: How does consumption respond to changes in interest rate, r?

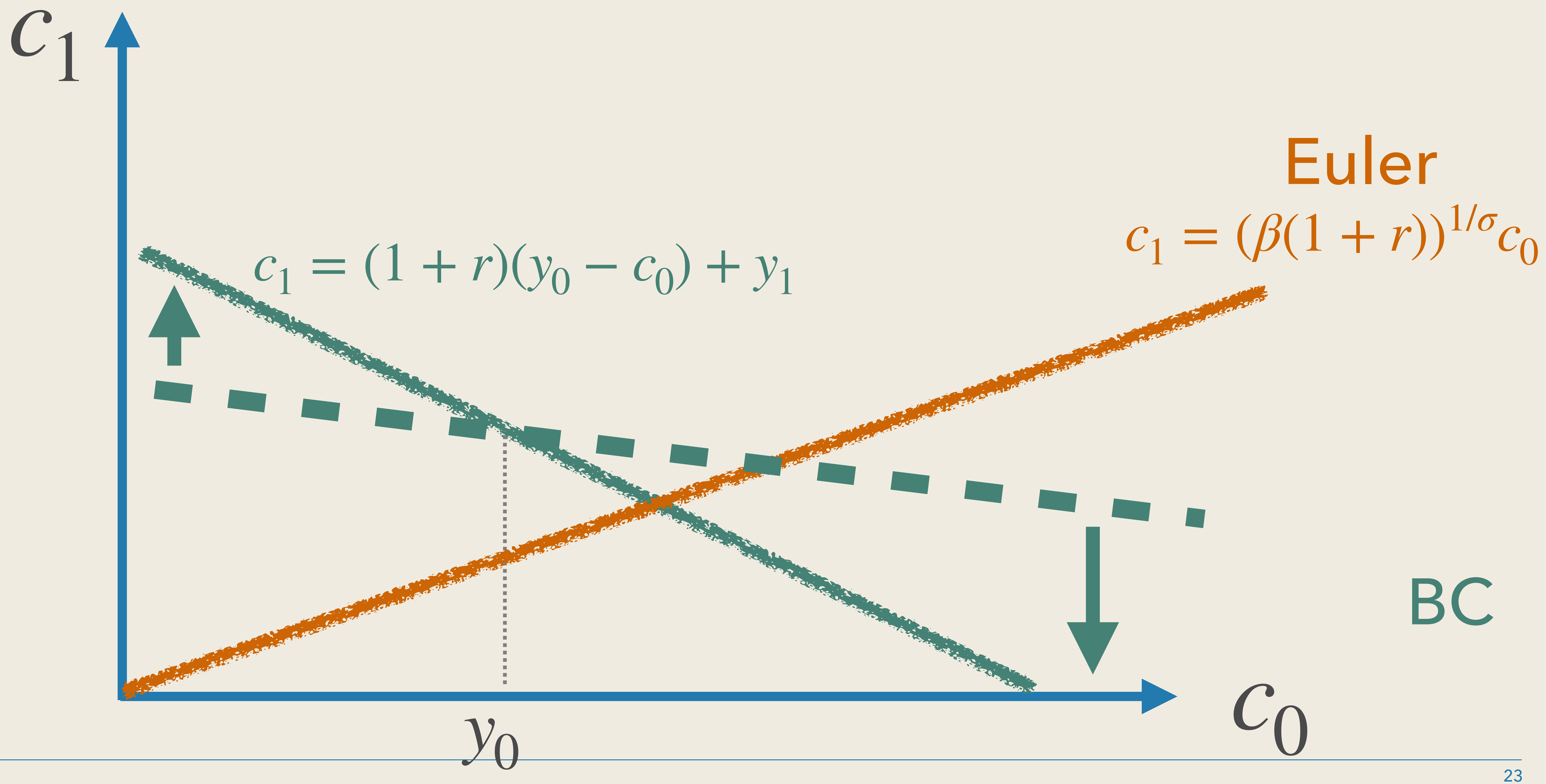
$$(c_0)^{-\sigma} = \beta(1+r)(c_1)^{-\sigma}$$

$$c_0 + \frac{1}{1+r}c_1 = y_0 + \frac{1}{1+r}y_1$$

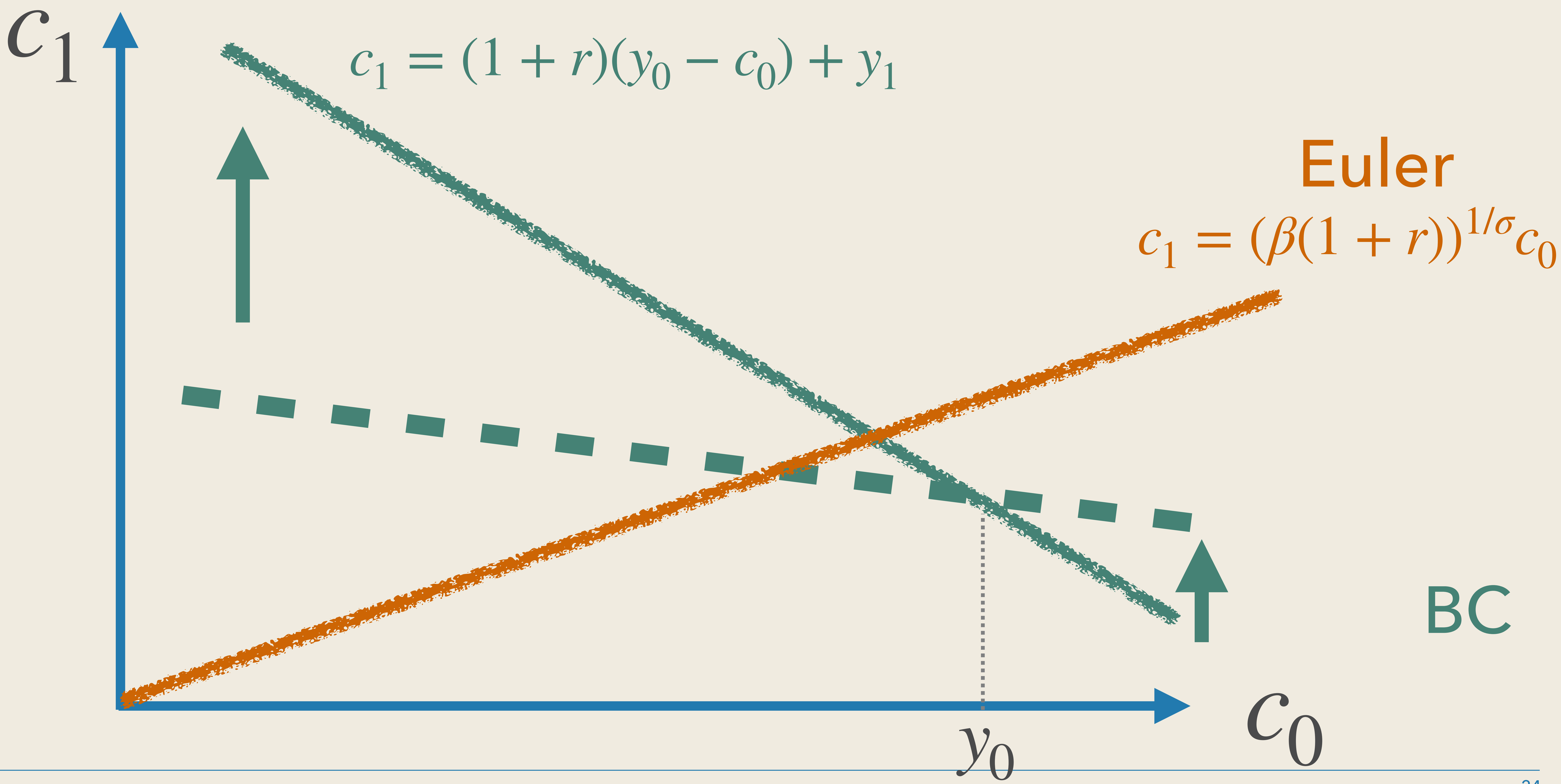
Substitution Effect of Interest Rate Rise



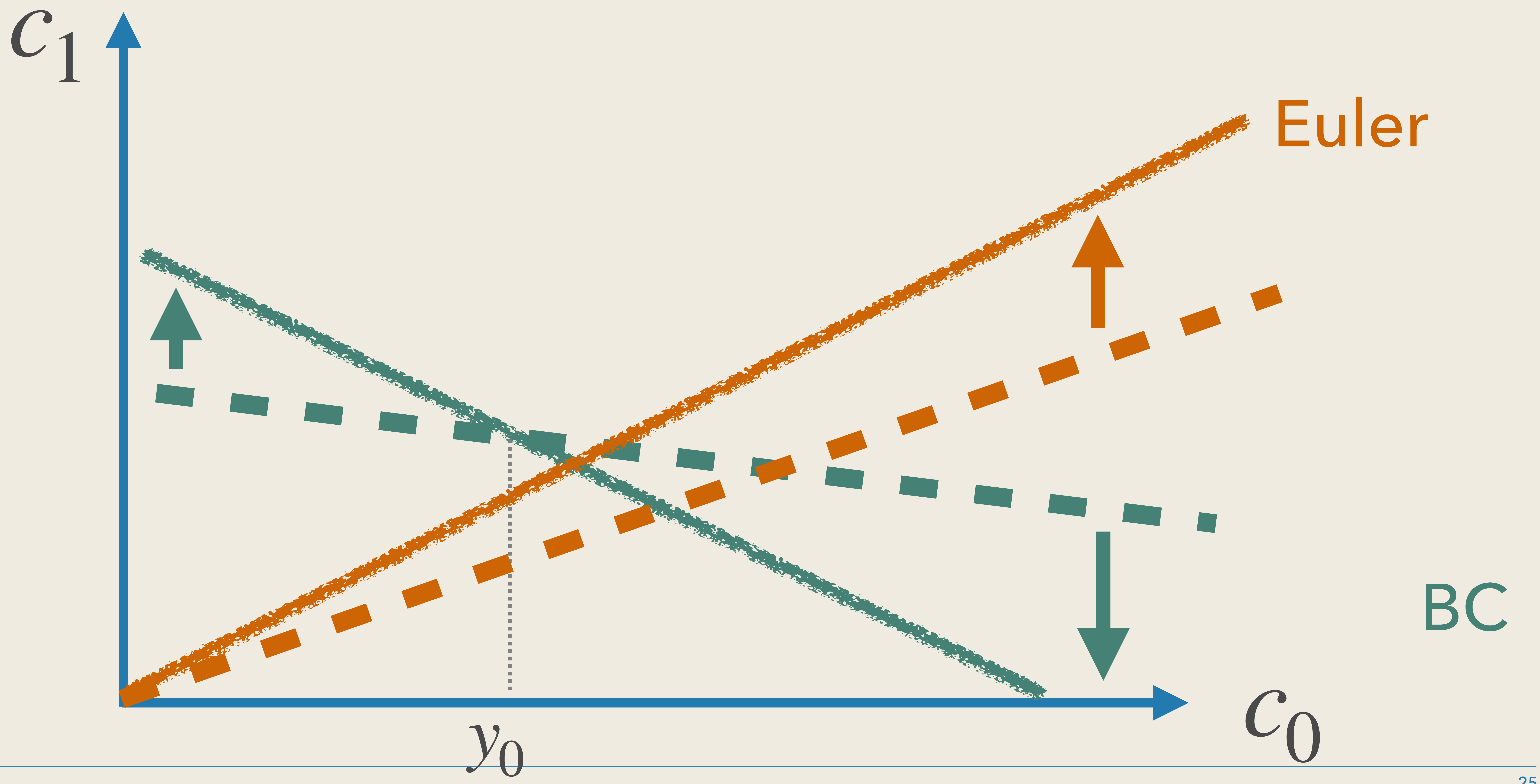
Income Effect of Interest Rate Rise with Small y_0



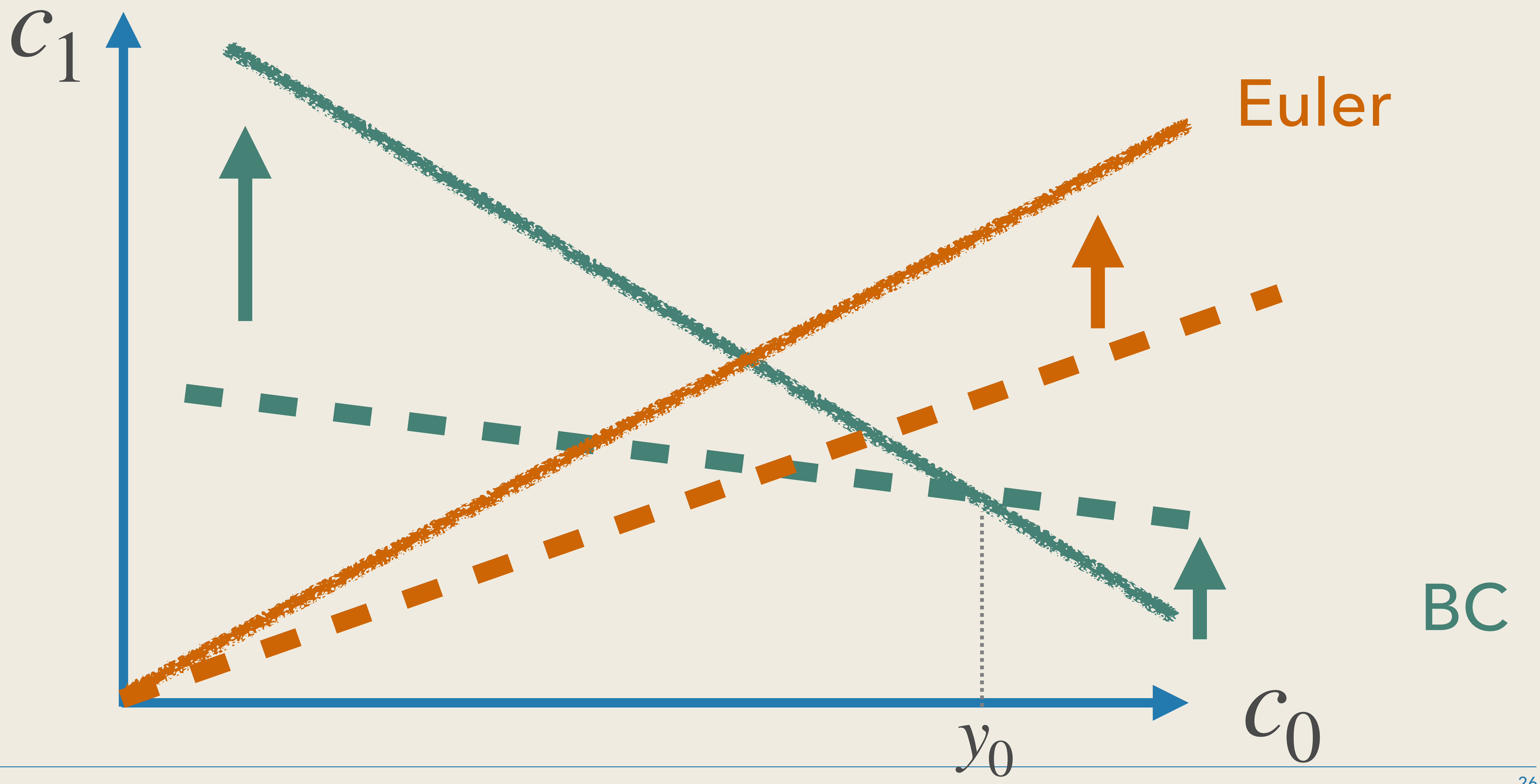
Income Effect of Interest Rate Rise with Large y_0



Putting Together when y_0 Small



Putting Together when y_0 Large



Interest Rate Response

- **Q3**: How does consumption respond to changes in interest rate, r?

$$\frac{\partial \log c_0}{\partial \log(1+r)} = \underbrace{-\left(1 - MPC_{0,0}\right)\frac{1}{\sigma}}_{\text{substituition effect (r)}} + \underbrace{\frac{1}{\left[y_0 + \frac{1}{1+r}y_1\right]}a_0}_{\text{income effect (r)}}$$

- Substitution effect (**always negative**): effect through Euler equation
  - Higher $r \Rightarrow$ borrow less to consume less today and more tomorrow
- Income effect (**ambiguous**): effect through budget constraint
  - Higher $r \Rightarrow$ If I am a borrower ($a_0 < 0$), I suffer from higher repayments
  - Higher $r \Rightarrow$ If I am a saver ($a_0 > 0$), I benefit from higher returns
- The net effect is ambiguous!

When Does Higher r Lower c_0?

- If a household is a borrower, $a_0 < 0$, then $\frac{\partial c_0}{\partial r} < 0$
- If a household is a saver ($a_0 > 0$), then it depends on
  1. Savings, a_0
     - If a_0 is high, positive income effect is strong enough $\frac{\partial c_0}{\partial r} > 0$
     - If a_0 is low, positive income effect is not strong enough $\frac{\partial c_0}{\partial r} < 0$
  2. Curvature of utility σ
     - If σ is low, substitution effect is strong enough. So $\frac{\partial c_0}{\partial r} < 0.$
     - If σ is high enough, substitution effect is weak. So $\frac{\partial c_0}{\partial r} > 0.$
- Higher r tends to stimulate the consumption of people with large savings

Consumption and Savings with Borrowing Constraints

How Realistic Was Our Model?

- Suppose that $y_0 = 0$ and but y_1 is very large (students!)
- What would they do?

$$a_0 = -\frac{1}{\left(1 + \beta^{1/\sigma}(1+r)^{\frac{1-\sigma}{\sigma}}\right)} \frac{1}{1+r} y_1 \ll 0$$

Borrow a lot today

- Is this realistic? How much can you borrow?

Borrowing Constraint

- We impose the borrowing constraint:

$$a_0 \geq \underline{a}$$

- Now the problem is

$$\max_{c_0, c_1, a_0} \; u(c_0) + \beta u(c_1)$$

$$\text{s.t.} \quad c_0 + a_0 = y_0$$

$$c_1 = (1 + r_0)a_0 + y_1$$

$$a_0 \geq \underline{a}$$

- If the borrowing constraint is not binding, $a_0 > \underline{a}$, then the same solution as before
- What if the borrowing constraint binds?

Consumption with Binding Borrowing Constraint

- If the borrowing constraint is binding, $a_0 = \underline{a}$, we have

$$c_0 = y_0 - \underline{a}$$

$$c_1 = (1 + r_0)\underline{a} + y_1$$

- Now let us revisit all the questions

Q1: Response to Current Income

- **Q1**: How does consumption respond to an increase in y_0?

$$\frac{\partial c_0}{\partial y_0} = 1, \qquad \frac{\partial c_1}{\partial y_0} = 0$$

- Binding borrowing constraints imply that households cannot smooth consumption
- Consume all the increase in temporary income (high MPC)

Q2: Response to Future Income

- **Q2**: How does consumption respond to future income changes?

$$\frac{\partial c_0}{\partial y_1} = 0$$

- Households cannot borrow against future income
- Completely unresponsive to future income changes

Effect of Interest Rate

- **Q3**: How does consumption respond to changes in interest rate, r?

$$\frac{\partial c_0}{\partial r} = 0$$

- Households are already hitting the borrowing limit
- Cannot make any borrowing adjustment at the margin

Summary

Q1: How does consumption respond to an increase in y_0?

- If unconstrained, c_0 increases less than one-for-one
- If constrained, c_0 increases one-for-one

Q2: How does consumption respond to an increase in y_1?

- If unconstrained, c_0 increases
- If constrained, c_0 do not react

Q3: How does consumption respond to an increase in r?

- If unconstrained, c_0 may increase or decrease depending on σ and a_0
- If constrained, c_0 do not react

Consumption and Savings with Many Periods

Setup with Many Periods

- Many periods, $t = 0, \ldots, T$ (years)
- Households preferences are

$$\sum_{t=0}^{T} \beta^t u(c_t)$$

- The budget constraints are

$$c_t + a_t = (1 + r_{t-1})a_{t-1} + y_t$$

where $a_{-1} = 0$

- The household chooses $\{c_t, a_t\}_{t=0}^{T}$ to maximize utility subject to budget constraints

Equilibrium Characterization

- As before, we have the Euler equation

$$u'(c_t) = \beta(1 + r_t)u'(c_{t+1})$$

- The lifetime budget constraint (after eliminating a_t) is

$$\underbrace{\sum_{t=0}^{T} \frac{1}{\prod_{s=0}^{t-1}(1 + r_s)} c_t}_{\text{PDV of consumption}} = \underbrace{\sum_{t=0}^{T} \frac{1}{\prod_{s=0}^{t-1}(1 + r_s)} y_t}_{\text{PDV of income}}$$

- $\{c_t\}_{t=0}^{T}$ are given by the solutions to the above equations

Consumption Smoothing

- Assume $u(c) = \dfrac{c^{1-\sigma}}{1-\sigma}$, then we obtain a closed-form expression for c_t:

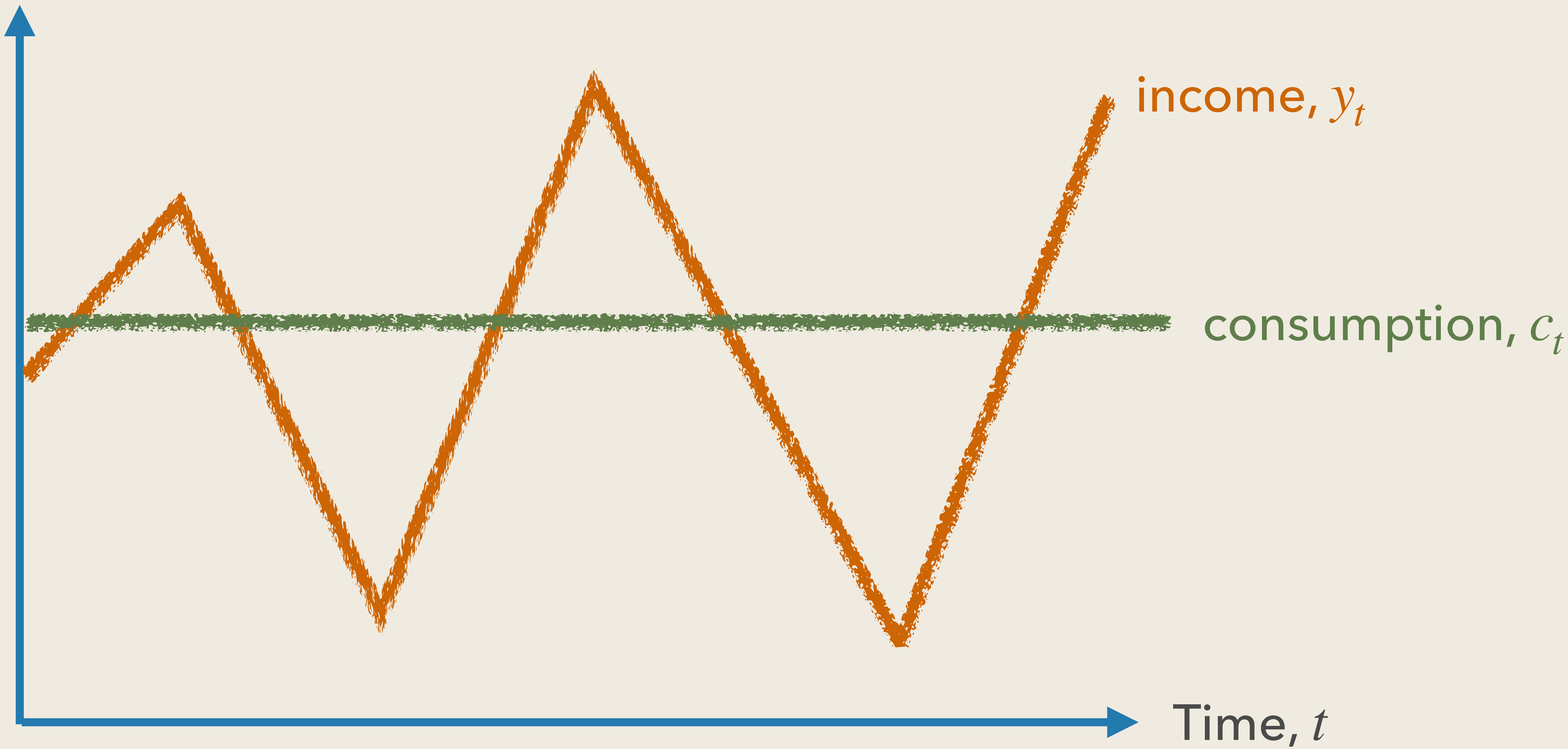
$$c_t = \frac{\prod_{s=0}^{t-1} \left(\beta(1+r_s)\right)^{1/\sigma}}{\sum_{\tau=0}^{T} \frac{\prod_{s=0}^{\tau-1} \left(\beta(1+r_s)\right)^{1/\sigma}}{\prod_{s=0}^{\tau-1}(1+r_s)}} \sum_{\tau=0}^{T} \frac{1}{\prod_{s=0}^{\tau-1}(1+r_s)} y_\tau$$

- When $\beta(1+r_t) = 1$ for all t, it simplifies to

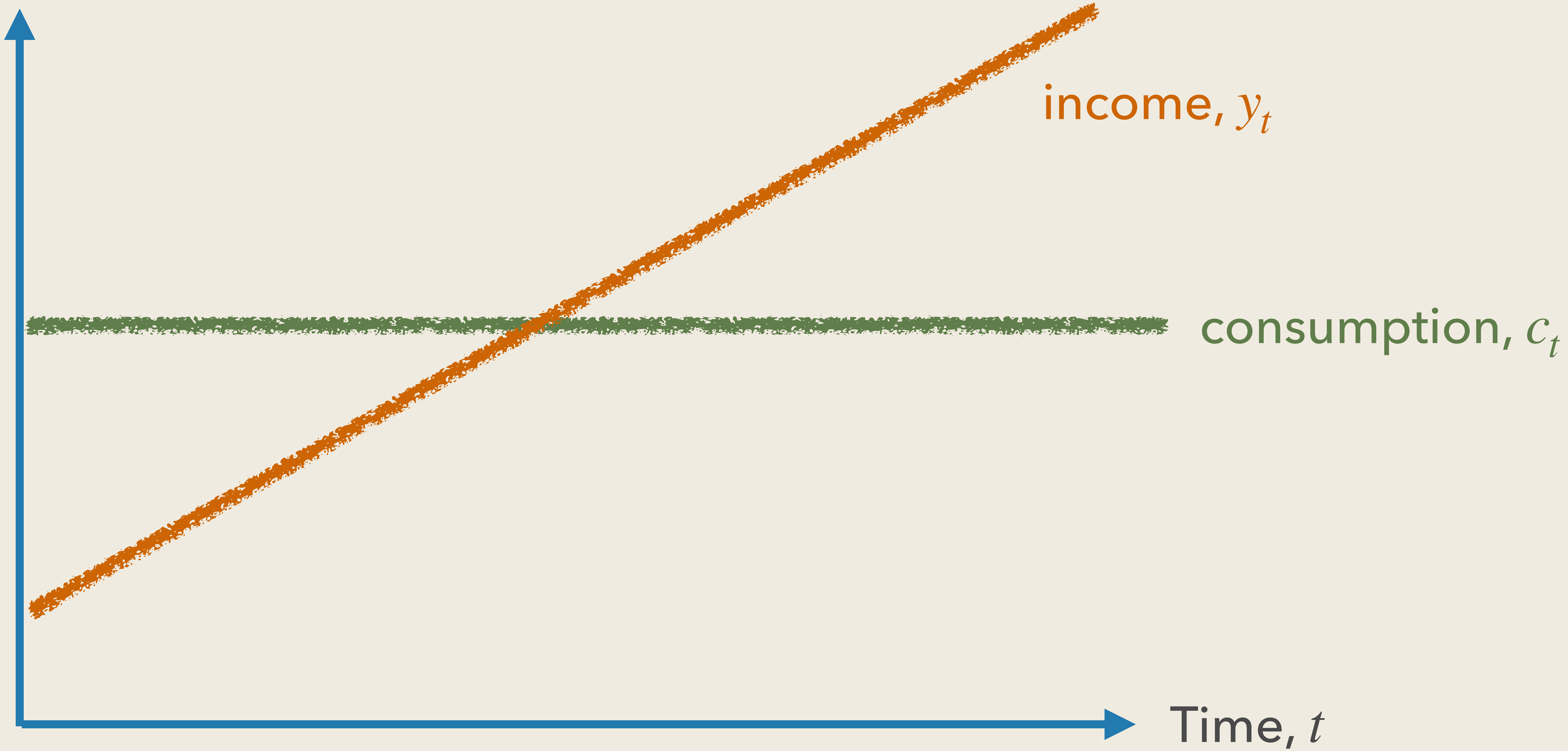
$$c_t = \frac{1}{\sum_{\tau=0}^{T} \frac{1}{(1+r)^\tau}} \sum_{\tau=0}^{T} \frac{1}{(1+r)^\tau} y_\tau$$

$\Rightarrow c_t = c$ (perfect consumption smoothing) even when y_t changes over time

Consumption Smoothing



Consumption Smoothing



Marginal Propensity to Consume

- How does consumption at $t = 0$ react if there is an increase in y_0?
- With $\beta(1 + r_t) = 1$,

$$\frac{\partial c_0}{\partial y_0} = \frac{r}{1+r} \frac{1}{\left[1 - \left(\frac{1}{1+r}\right)^{T+1}\right]}$$

- Suppose $r = 2\,\%$, $T = 40$ years, then

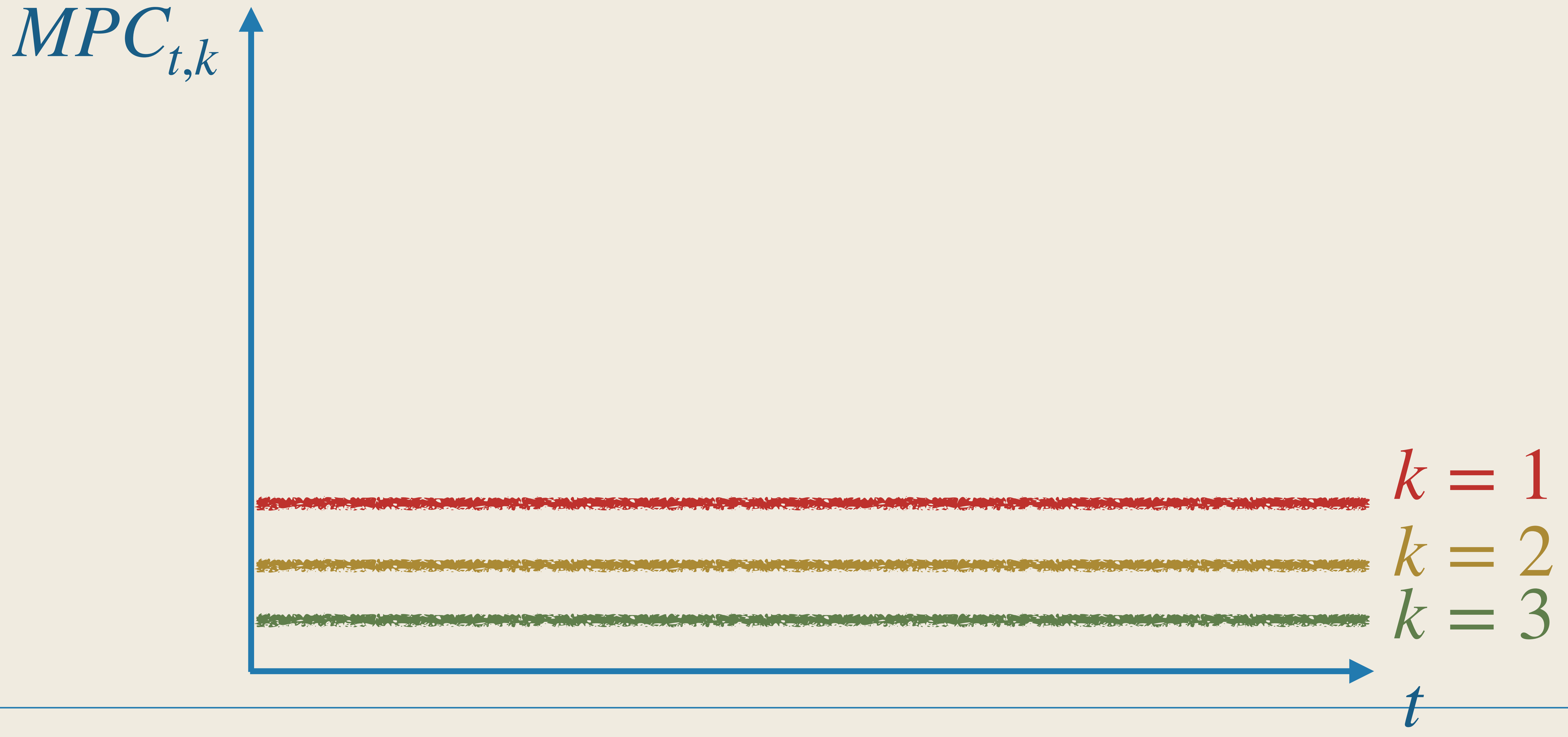
$$\frac{\partial c_0}{\partial y_0} \approx 0.036$$

$\Rightarrow$ spend 3.6 cents out of \$1 within one year

MPC More Generally

- More generally, response c_t to an increase in y_k is

$$MPC_{t,k} \equiv \frac{\partial c_t}{\partial y_k} = \frac{\prod_{s=0}^{t-1} \left(\beta(1+r_s)\right)^{1/\sigma}}{\sum_{\tau=0}^{T} \frac{\prod_{s=0}^{\tau-1} \left(\beta(1+r_s)\right)^{1/\sigma}}{\prod_{s=0}^{\tau-1}(1+r_s)}} \frac{1}{\prod_{s=0}^{k-1}(1+r_s)}$$



Consumption Response to Interest Rate

- How does consumption at $t = 0$ react if there is an increase in r_0?

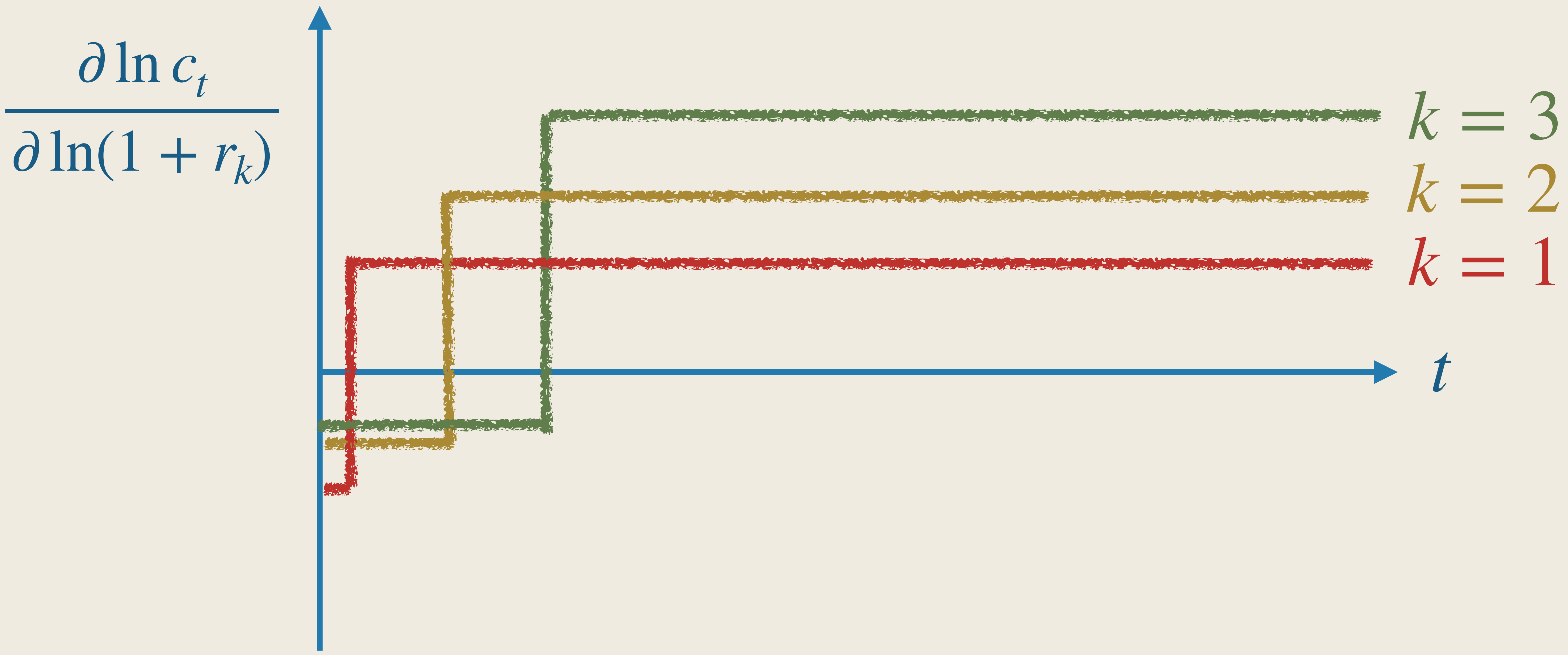
$$\frac{\partial \ln c_0}{\partial \ln(1 + r_0)} = \underbrace{-\left(1 - MPC_{0,0}\right)\frac{1}{\sigma}}_{\text{substituition effect}} + \underbrace{\frac{1}{\sum_{\tau=0}^{T}\frac{1}{\prod_{s=0}^{\tau-1}(1+r_s)}y_\tau}a_0}_{\text{income effect}}$$

- Once again:
  1. substitution effect is always negative
  2. income effect is
     - negative if borrower at $t = 0$ $(a_0 < 0)$
     - positive if saver at $t = 0$ $(a_0 > 0)$

Consumption Response to Interest Rate: General Case

- More generally,

$$\frac{\partial \log c_t}{\partial \log(1+r_k)} = \underbrace{\frac{1}{\sigma}\mathbb{I}[k<t] - \frac{1}{\sigma}\left(1 - \sum_{\tau=0}^{k} MPC_{\tau,\tau}\right)}_{\text{substitution effect}} + \underbrace{\frac{1}{\sum_{\tau=0}^{T} \frac{1}{\prod_{s=0}^{\tau-1}(1+r_s)} y_\tau} \frac{1}{\prod_{\tau=0}^{k}(1+r_\tau)} a_k}_{\text{income effect}}$$



Consumption and Savings with Many Periods … and Borrowing Constraints

Borrowing Constraints

- Now we introduce the borrowing constraints

$$a_t \geq \underline{a}$$

- Households solve

$$\max_{\{c_t, a_t\}_{t=0}^{T}} \sum_{t=0}^{T} \beta^t u(c_t)$$

$$\text{s.t.} \quad c_t + a_t = (1 + r_{t-1})a_{t-1} + y_t$$

$$a_t \geq \underline{a}$$

- If $a_t \geq \underline{a}$ does not bind for all t, then we have the same solutions as before
- What if $a_t \geq \underline{a}$ binds at some time T^*?

Binding Borrowing Constraint

- If $a_{T*} = \underline{a}$, then $\{c_t, a_t\}_{t=0}^{T*}$ do not influence $\{c_t, a_t\}_{t=T*+1}^{T}$
  - At $t = T*$, you have to start from $a_{t-1} = \underline{a}$ anyway
- Therefore $\{c_t, a_t\}_{t=0}^{T*}$ solve

$$\max_{\{c_t, a_t\}_{t=0}^{T^*}} \sum_{t=0}^{T*} \beta^t u(c_t)$$

$$\text{s.t.} \quad c_t + a_t = (1 + r_{t-1})a_{t-1} + y_t$$

$$a_{T*} = \underline{a}$$

- Effective time horizon is shorter:

$$c_t = \frac{\prod_{s=0}^{t-1}\left(\beta(1+r_s)\right)^{1/\sigma}}{\sum_{\tau=0}^{T*}\frac{\prod_{s=0}^{\tau-1}\left(\beta(1+r_s)\right)^{1/\sigma}}{\prod_{s=0}^{\tau-1}(1+r_s)}}\left(\sum_{\tau=0}^{T*}\frac{1}{\prod_{s=0}^{\tau-1}(1+r_s)}y_\tau - \frac{1}{\prod_{s=0}^{T*-1}(1+r_s)}\underline{a}\right)$$

MPC with Borrowing Constraint

- With $\beta(1+r_t)=1$, it simplifies to

$$c_t = \frac{1}{\sum_{\tau=0}^{T*} \frac{1}{(1+r)^\tau}} \left(\sum_{\tau=0}^{T*} \frac{1}{(1+r)^\tau} y_\tau + \frac{1}{(1+r)^{T*}} y_\tau \right)$$

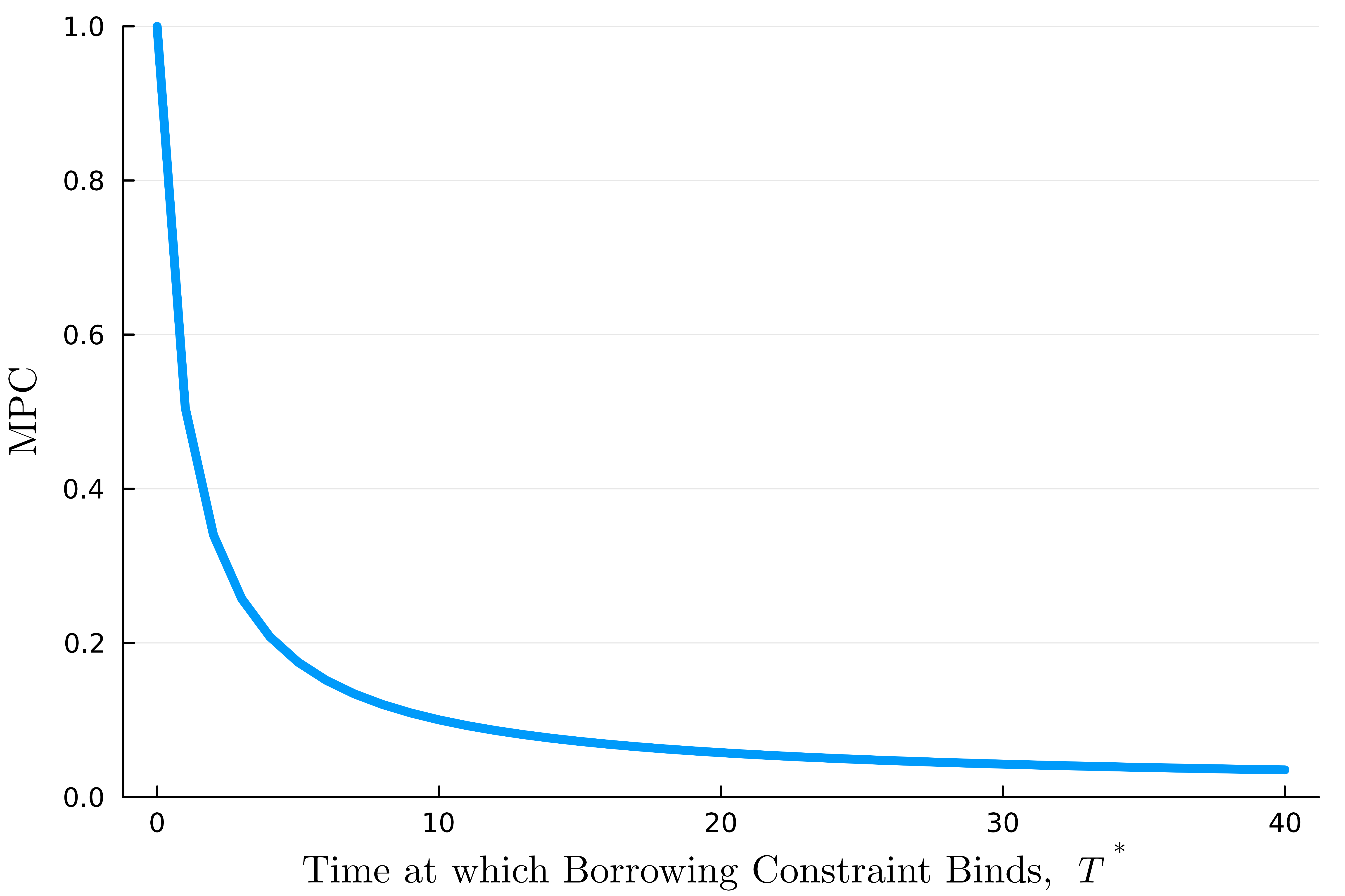
- MPC is

$$MPC_{0,0} = \frac{\partial c_0}{\partial y_0} = \frac{r}{1+r} \frac{1}{\left[1 - \left(\frac{1}{1+r}\right)^{T*+1}\right]}$$

- MPC can be very large if the borrowing constraint binds in the near future
- In fact, if $T* = 0$, $MPC_{0,0} = 1$!

MPC Increases as T^* Gets Closer to Today

- Assume $r = 2\,\%$ and vary T^*



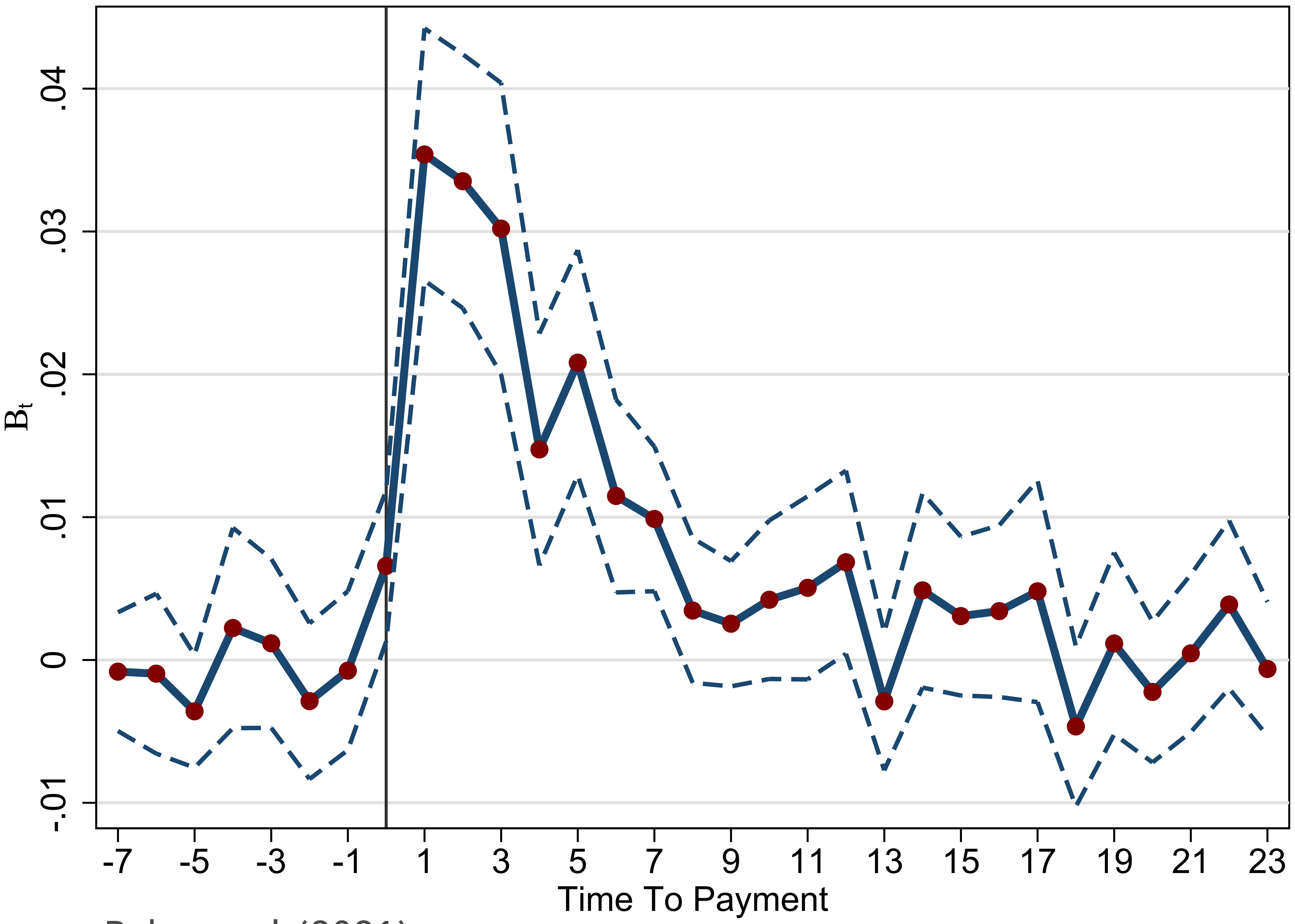
Marginal Propensity to Consume in the Data

– Baker, Farrokhnia, Meyer, Pagel, & Yannelis (2021)

MPC in the Data

- How large is the MPC in the data?
- 2020 CARES Act:
  - Directed cash transfers to households
  - $1,200 per adult and an additional $500 per child under the age of 17
- How much did households spend in response to the transfers?
- Compare households who received the transfer to those who haven’t
- Use transaction-level data from a financial app (SaverLife)

Spending Response



Source: Baker et al. (2021)

MPC at Different Horizons

	(1) Total	(2) Total	(3) Total	(4) Total	(5) Total
1-Week MPC	0.140***				
	(0.0124)				
2-Week MPC		0.190***			
		(0.0171)			
1-Month MPC			0.219***		
			(0.0254)		
2-Month MPC				0.286***	
				(0.0490)	
3-Month MPC					0.265***
					(0.0757)
Date FE	**X**	**X**	**X**	**X**	**X**
Individual FE	**X**	**X**	**X**	**X**	**X**
Observations	523208	523208	523208	523208	523208
R^2	0.200	0.200	0.199	0.199	0.199

Source: Baker et al. (2021)

What Do High MPCs Mean?

- MPCs are high $\approx$ 25-30% over three months
- Recall a model without borrowing constraint suggests MPC of 3% over a year
- This suggests many households are borrowing constrained
- Are they really constrained?

Are Households Borrowing Constrained?

	Median ($2001)	Mean ($2001)	Fraction Positive	Return (%)
Earnings plus benefits (age 22-59)	41,000	52,745	–	–
Net worth	62,442	150,411	0.90	1.67

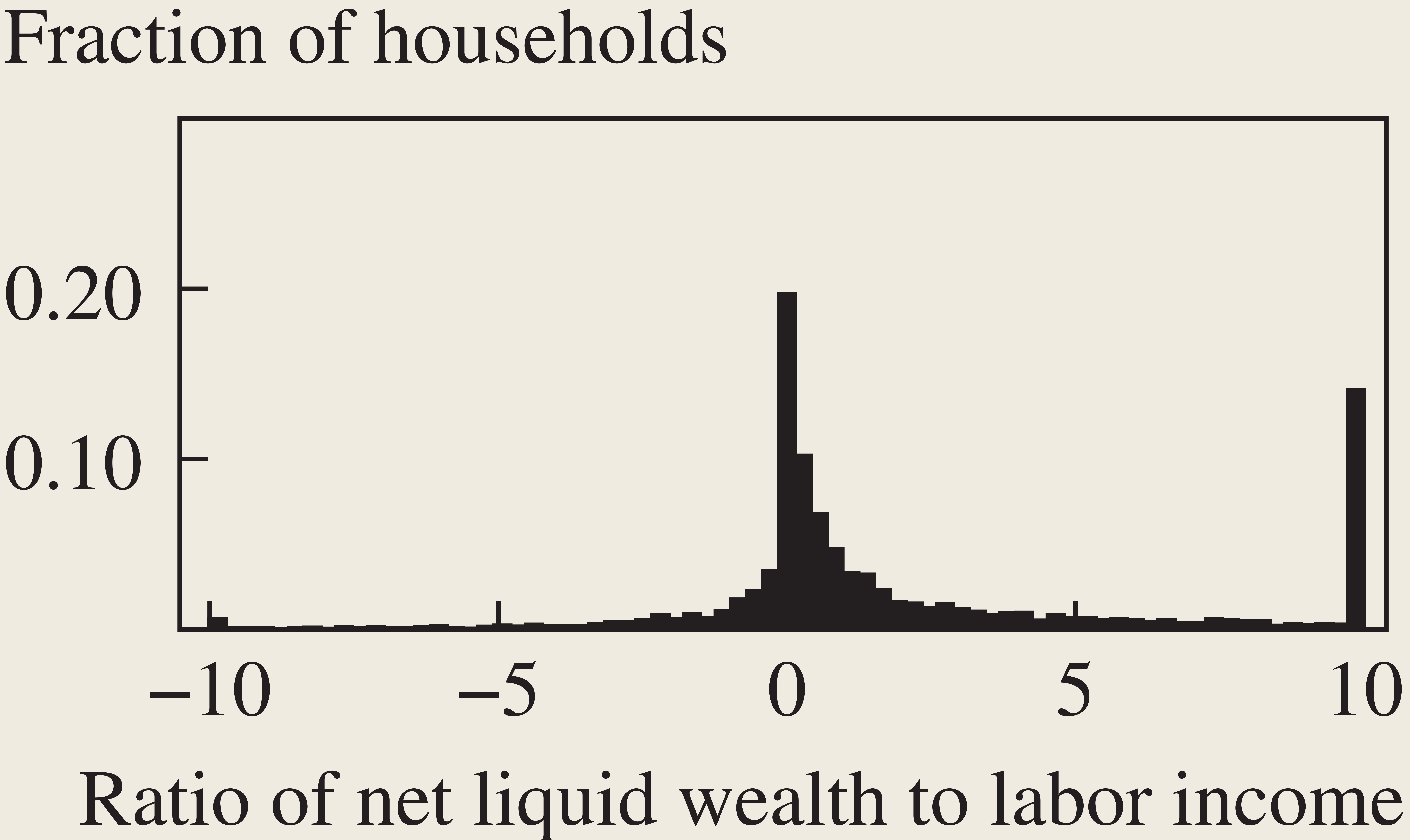
Source: Kaplan and Violante (2014)

Are Households Borrowing Constrained?

	Median ($2001)	Mean ($2001)	Fraction Positive	Return (%)
Earnings plus benefits (age 22-59)	41,000	52,745	–	–
Net worth	62,442	150,411	0.90	1.67
Net liquid wealth	2,629	31,001	0.77	-1.48
Cash, checking, saving, MM accounts	2,858	12,642	0.92	-2.2
Directly held stocks, bonds, T-Bills	0	19,920	0.29	1.7
Revolving credit card debt	0	1,575	0.41	–
Net illiquid wealth	54,600	119,409	0.93	2.29
Housing net of mortgages	31,000	72,592	0.68	2.0
Retirement accounts	950	34,455	0.53	3.5
Life insurance	0	7,740	0.27	0.1
Certificates of deposit	0	3,807	0.14	0.9
Saving bonds	0	815	0.17	0.1

Source: Kaplan and Violante (2014)

Distribution of Liquid Assets

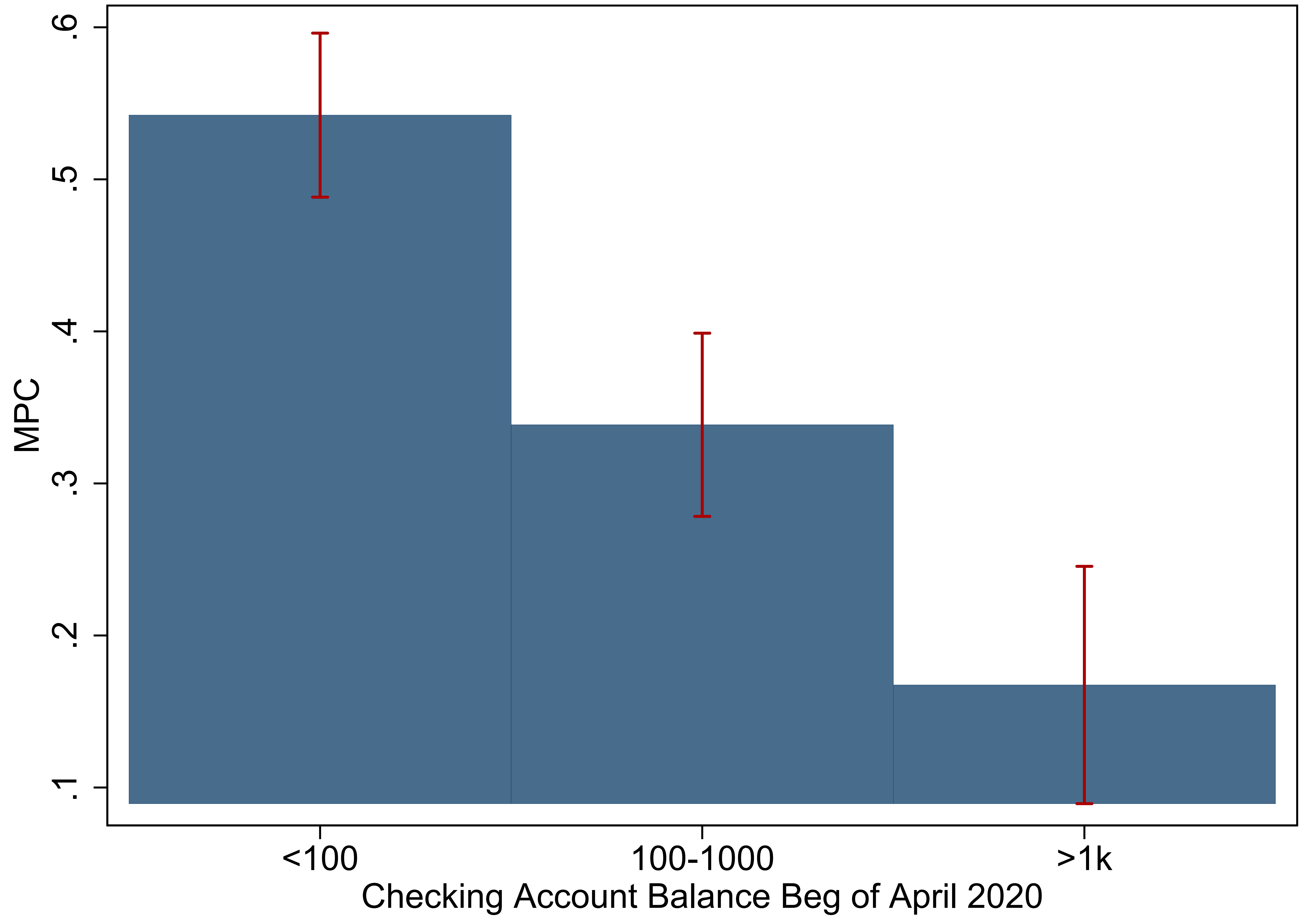


Source: Kaplan, Violante and Weidner (2014)

Liquidity Constrained

- The majority of households do appear to have enough net worth
  - At first, they do not seem to be borrowing constrained
- Yet, a large fraction of net worth consists of illiquid assets
  - Housing, retirement account
  - It's not easy to sell these assets (illiquid)
- The majority of households hold little liquid assets
  - cash, checking/deposit accounts
- Households do appear to have little a_t that they can easily transact

MPC by Liquidity



Source: Baker et al. (2021)

Uncertainty and Consumption: Theory

Uncertainty

- So far, everything is deterministic
  - Households perfectly anticipate what their future income y_1 is going to be
- In reality, households face a large uncertainty in future income
- How does uncertainty affect consumption?

Introducing Uncertainty

- Consider two-period model without borrowing constraint
- At period 1, households can be high- or low-income
- Suppose now

$$y_1 = \begin{cases} y_1^h = \bar{y}_1 + \epsilon & \text{with prob } 1/2 \\ y_1^l = \bar{y}_1 - \epsilon & \text{with prob } 1/2 \end{cases}$$

- The mean is $\mathbb{E}y_1 = \bar{y}_1$
- When $\epsilon = 0$, we go back to the deterministic model

Preferences and Budget Constraints

- Household's preferences are

$$u(c_1) + \beta \mathbb{E}_s u(c_2^s)$$

where $\mathbb{E}_s u(c_2^s) = \frac{1}{2} u(c_2^h) + \frac{1}{2} u(c_2^l)$

- More generally define $\mathbb{E}_s x^s = \sum_s \pi^s x^s$, where π^s is Probability of s happening
- Now budget the budget constraints are

$$c_0 + a_0 = y_0$$

$$c_1^h = (1 + r)a_0 + y_1^h$$

$$c_1^l = (1 + r)a_0 + y_1^l$$

Household Optimization

- Household's problem

$$\max_{c_0, a_0, c_1^h, c_1^l} u(c_0) + \beta \mathbb{E}_s u(c_1^s)$$

subject to

$$c_0 + a_0 = y_0$$

$$c_1^h = (1 + r)a_0 + y_1^h$$

$$c_1^l = (1 + r)a_0 + y_1^l$$

- Lagrangian:

$$L = u(c_0) + \beta \mathbb{E}_s u(c_1^s) + \lambda_0 \left[y_0 - c_0 - a_0 \right] + \mathbb{E}_s \lambda_1^s \left[y_1^s + (1 + r)a_0 - c_1^s \right]$$

- FOCs:

$$u'(c_0) = \lambda_0, \quad \beta u(c_1^s) = \lambda_1^s, \quad \lambda_0 = \beta(1 + r)\mathbb{E}_s \lambda_1^s$$

Euler Equation with Uncertainty

- Combining previous FOCs give

$$u'(c_0) = \beta(1+r)\mathbb{E}_s u'(c_1^s)$$

- Now RHS, the marginal benefit of saving, reflects uncertainty in c_1^s

- Substituting budget constraints, $\{c_0, a_0\}$ jointly solve

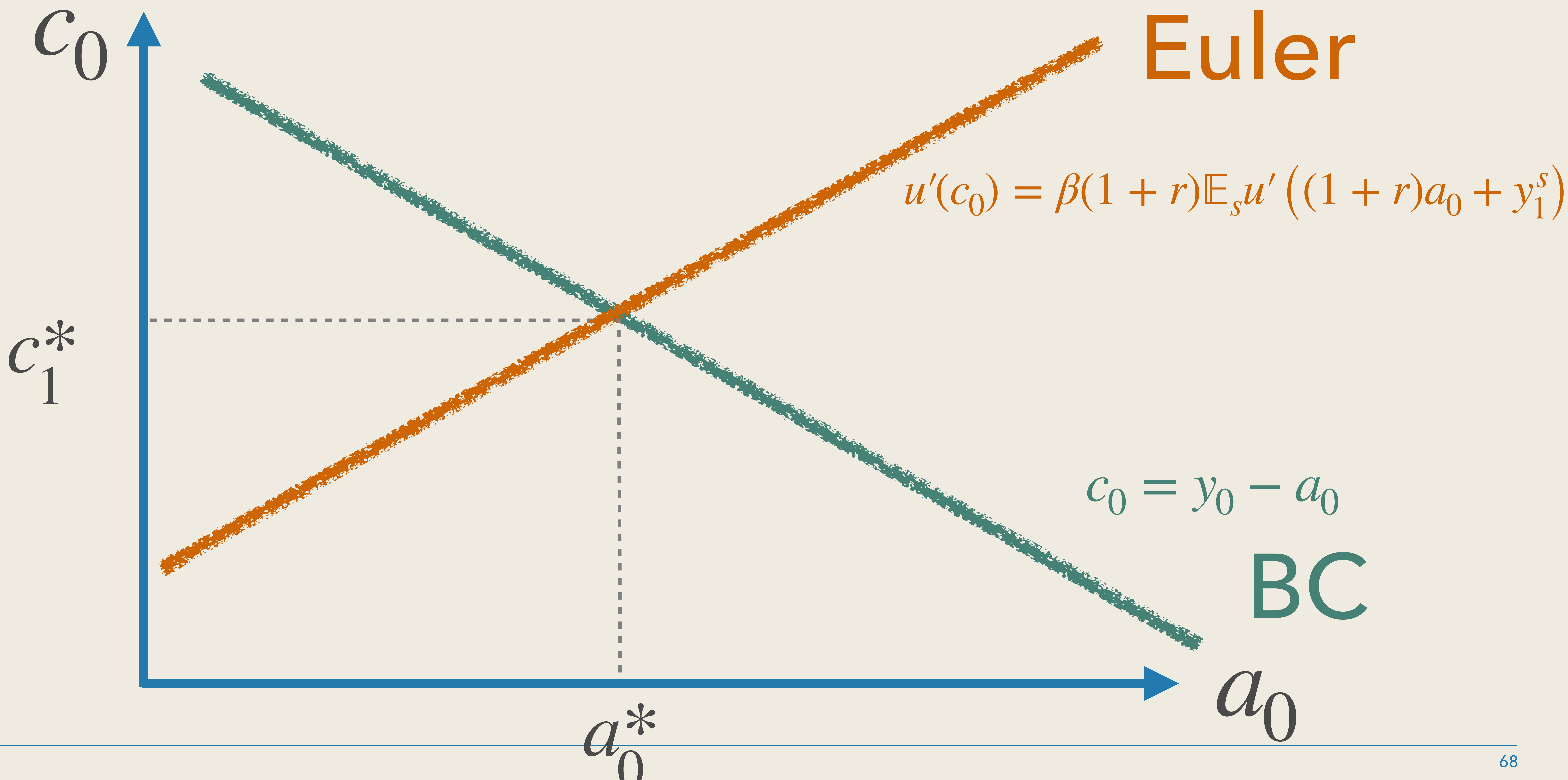
$$u'(c_0) = \beta(1+r)\mathbb{E}_s u'\left((1+r)a_0 + y_1^s\right) \qquad \textbf{(Euler)}$$

$$c_0 + a_0 = y_0 \qquad \textbf{(BC)}$$

- **(Euler)** gives an increasing relationship between c_0 and a_0

- **(BC)** gives a decreasing relationship between c_0 and a_0

Optimal Consumption



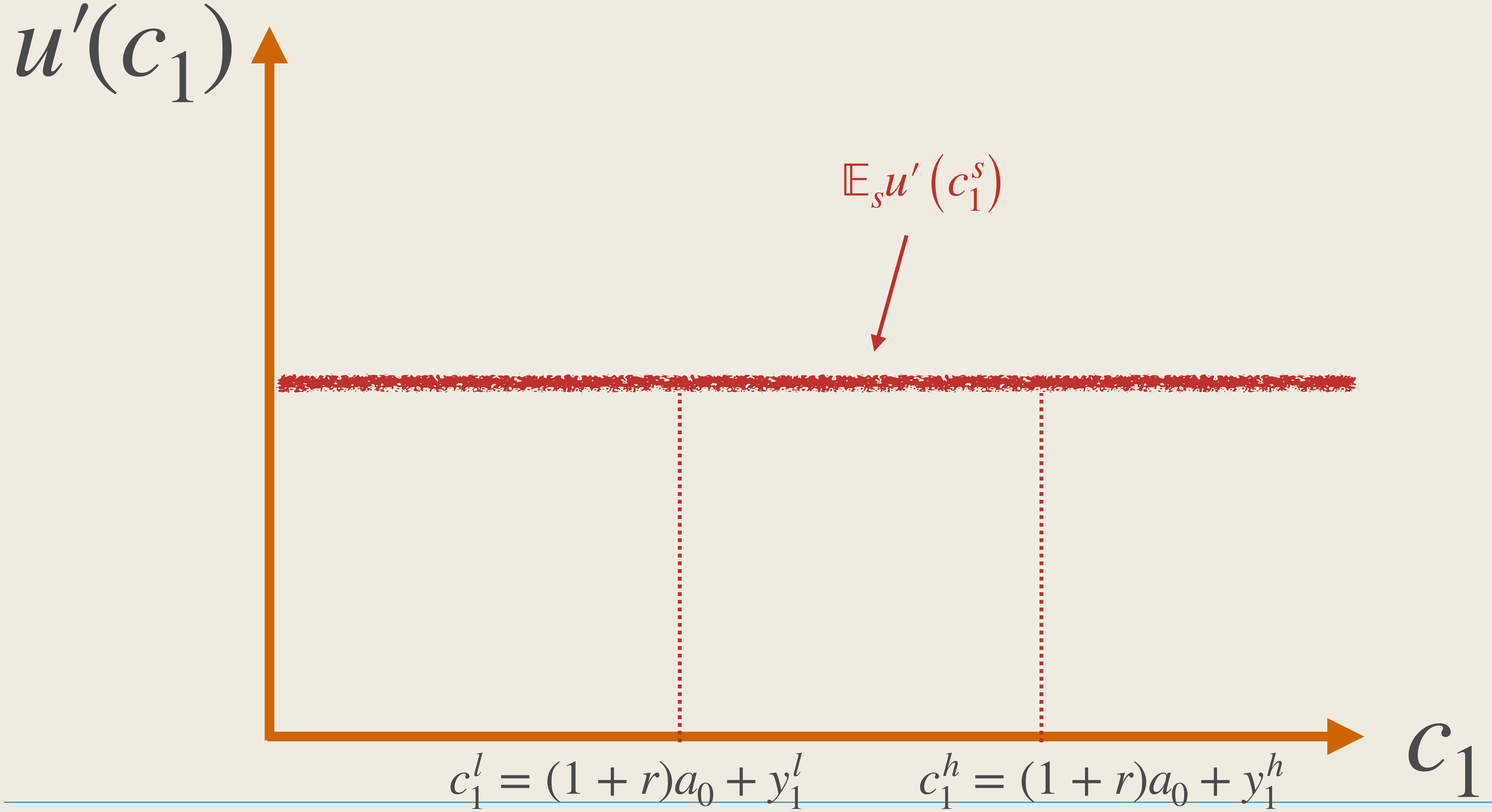
An Increase in Uncertainty

- Now suppose that uncertainty increases
- We capture this through an increase in ϵ
  - Note that it leaves the mean of future income unchanged
  - Only changes the variance of future income
- This wouldn't affect **(BC)**
- How does it affect **(Euler)**?

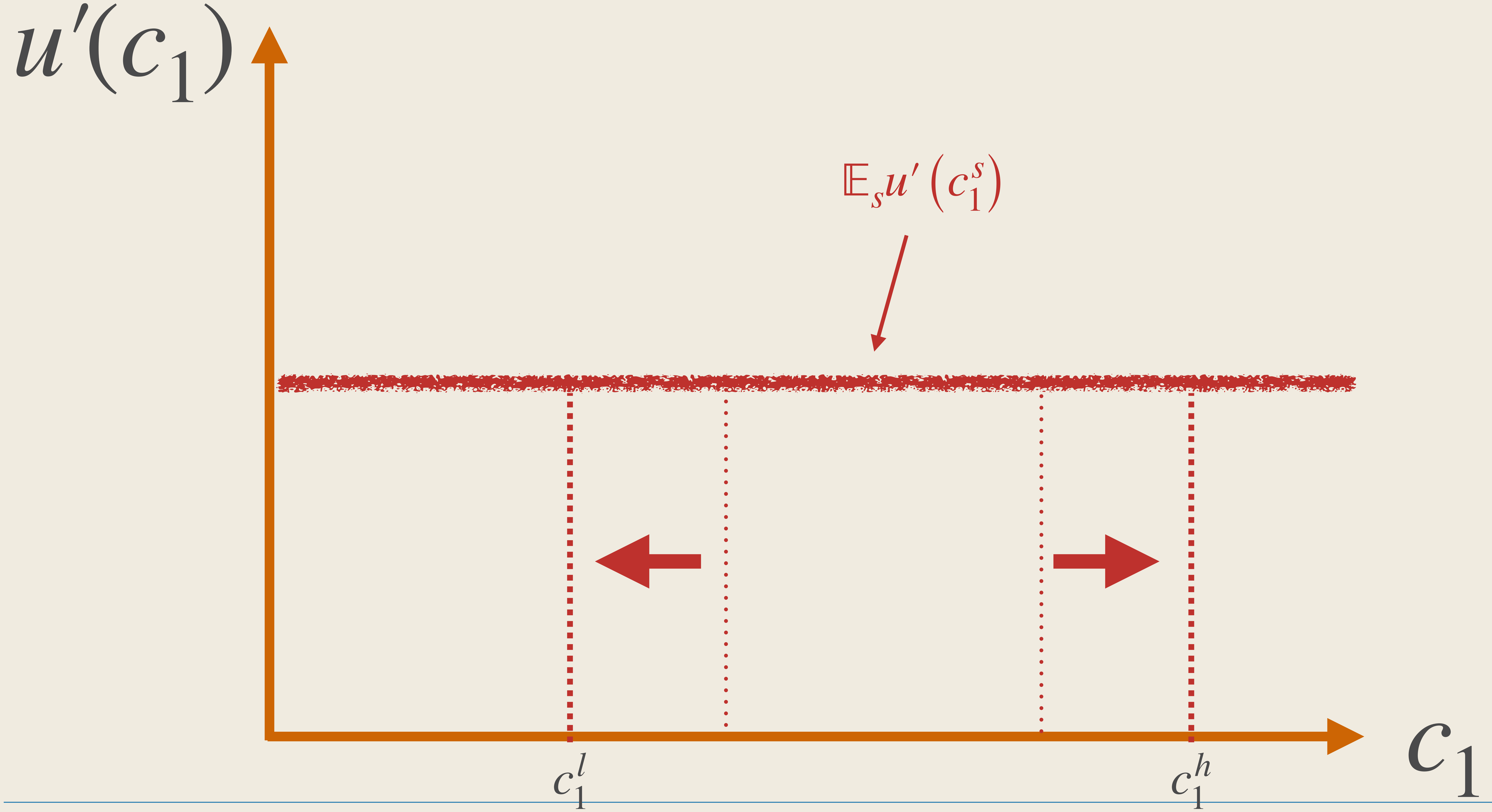
$$u'(c_0) = \beta(1+r)\mathbb{E}_s u'\left((1+r)a_0 + y_1^s\right)$$

$$\mathbb{E}_s u'(c_1^s)$$

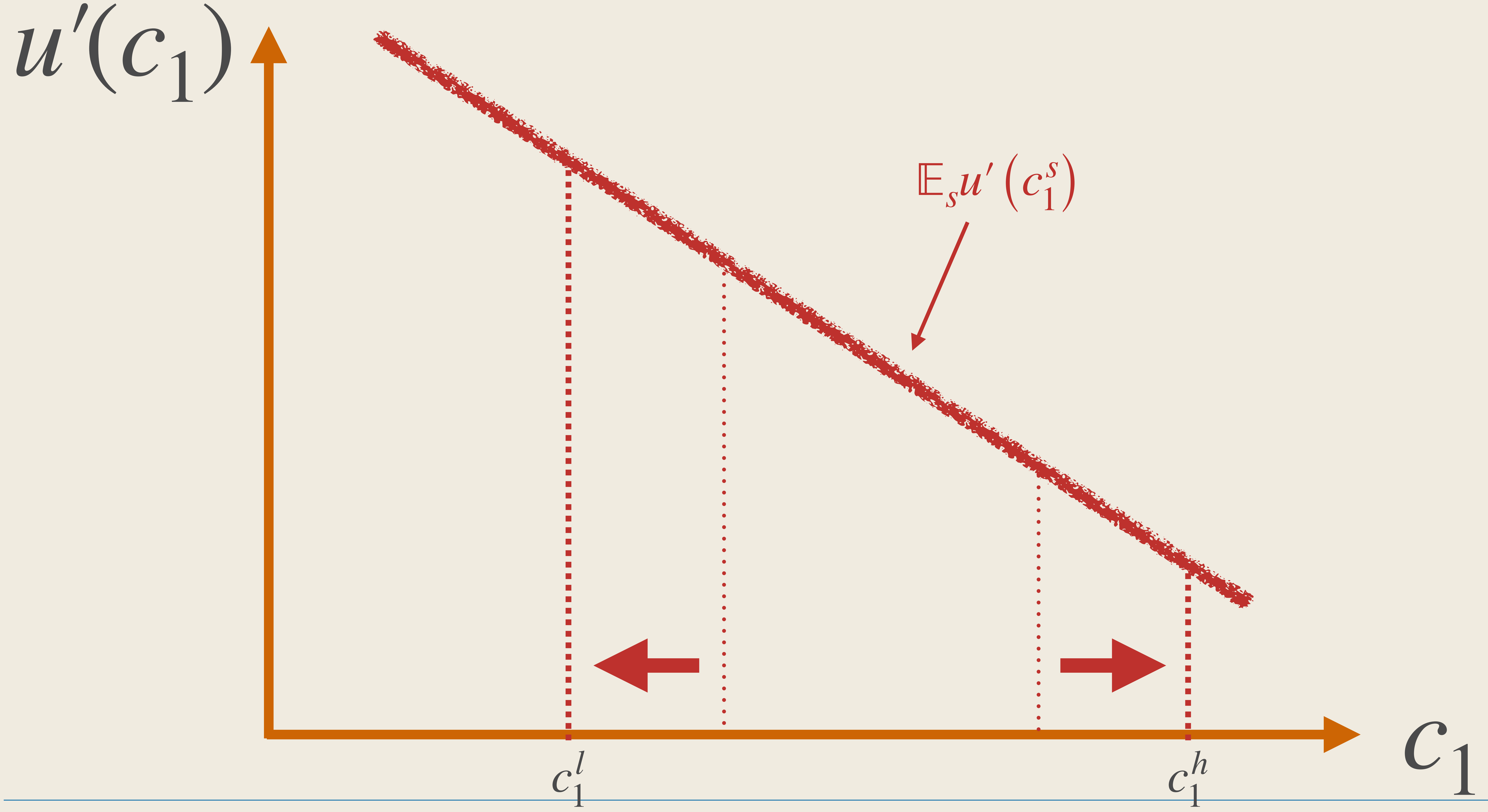
Constant Marginal Utility



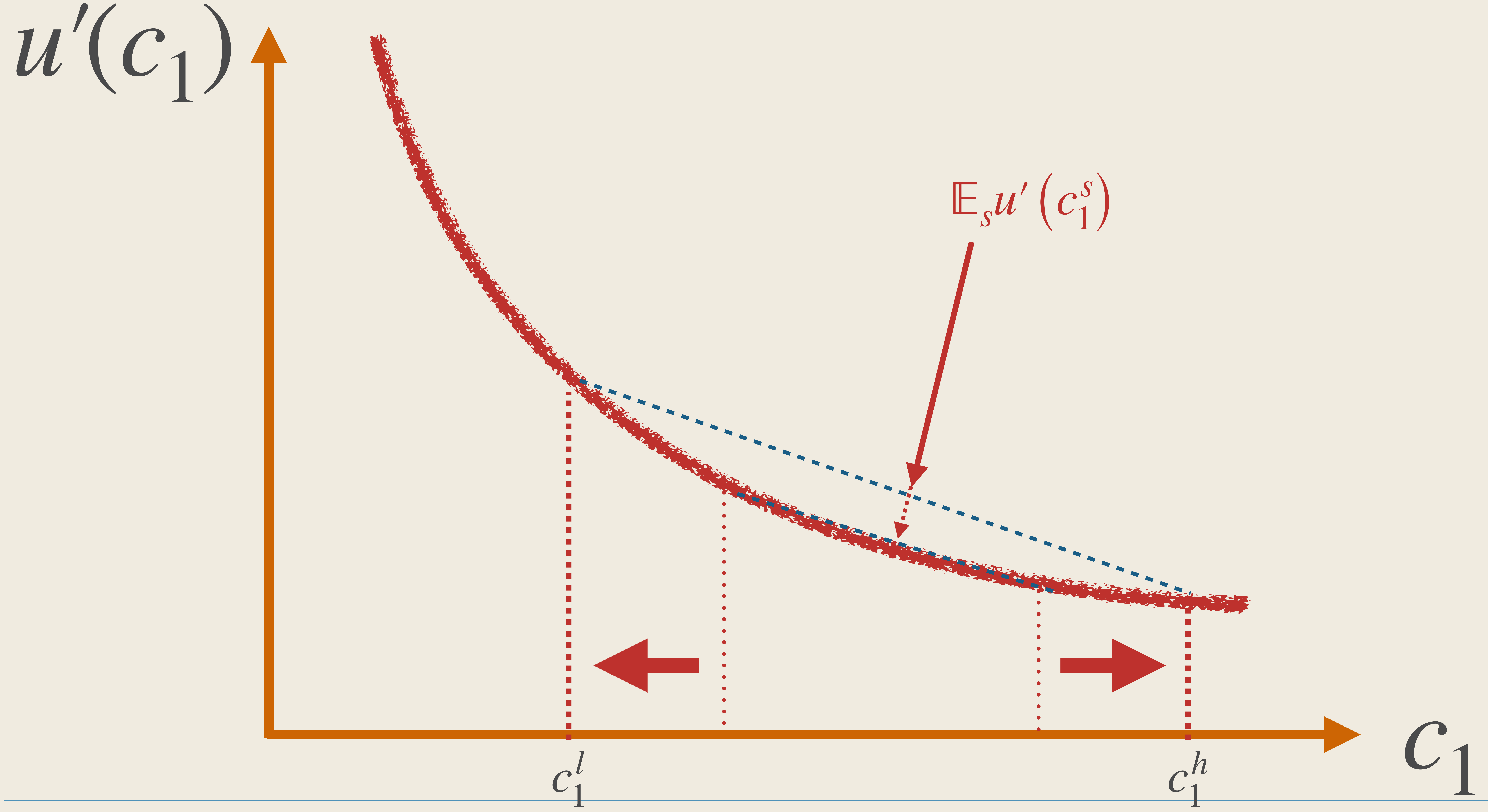
Constant Marginal Utility: An Increase in Uncertainty



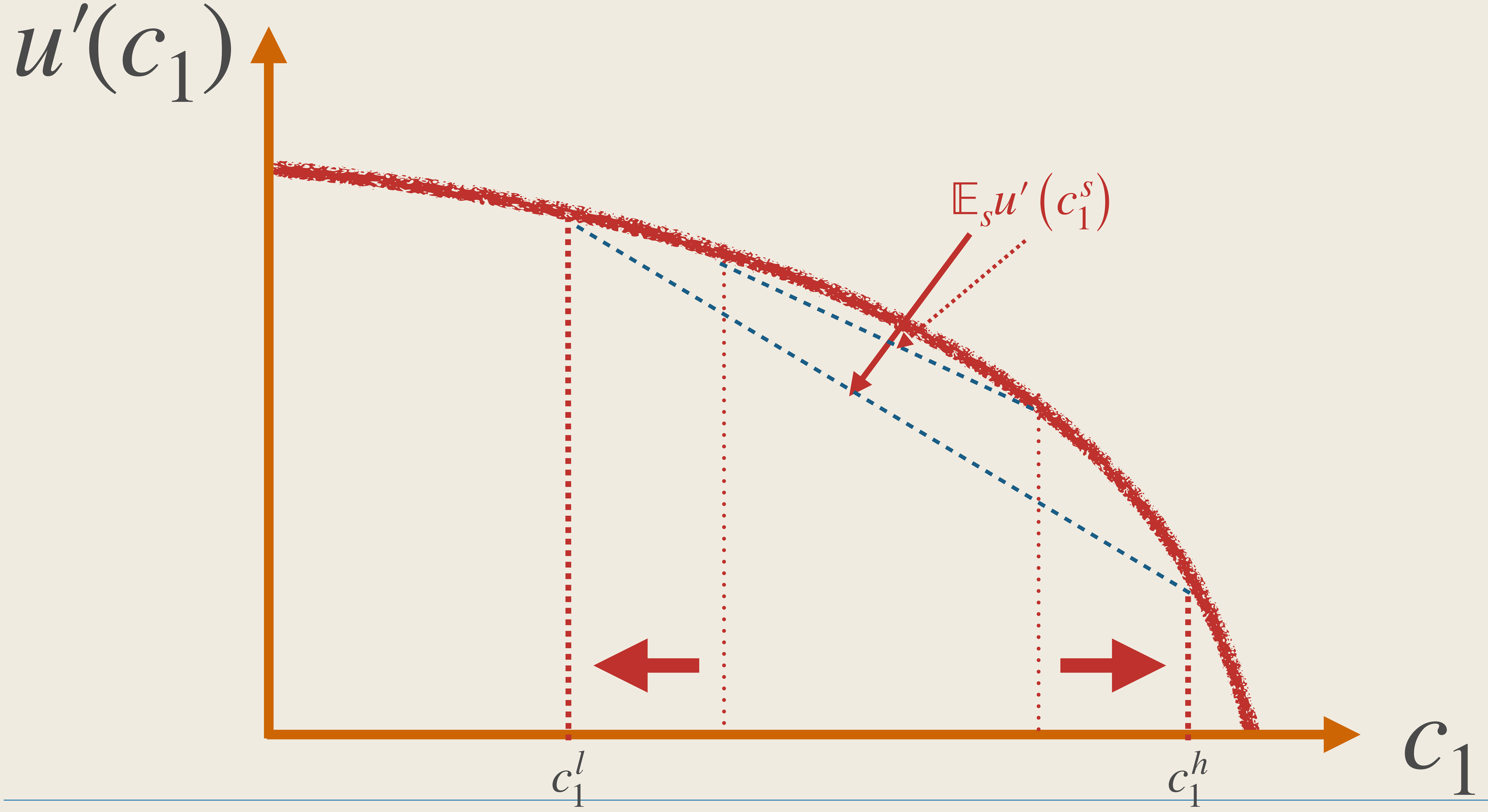
Linear Marginal Utility



Convex Marginal Utility



Concave Marginal Utility



Concave or Convex $u'(c)$?

- Jensen's inequality:

  1. If $u'(c)$ is linear, $\mathbb{E}_s u'(c_1^s)$ is unchanged with an increase in ϵ
  2. If $u'(c)$ is convex, $\mathbb{E}_s u'(c_1^s)$ increases with an increase in ϵ
  3. If $u'(c)$ is concave, $\mathbb{E}_s u'(c_1^s)$ increases with an increase in ϵ

- What happens when $u(c) = \dfrac{c^{1-\sigma}}{1-\sigma}$?

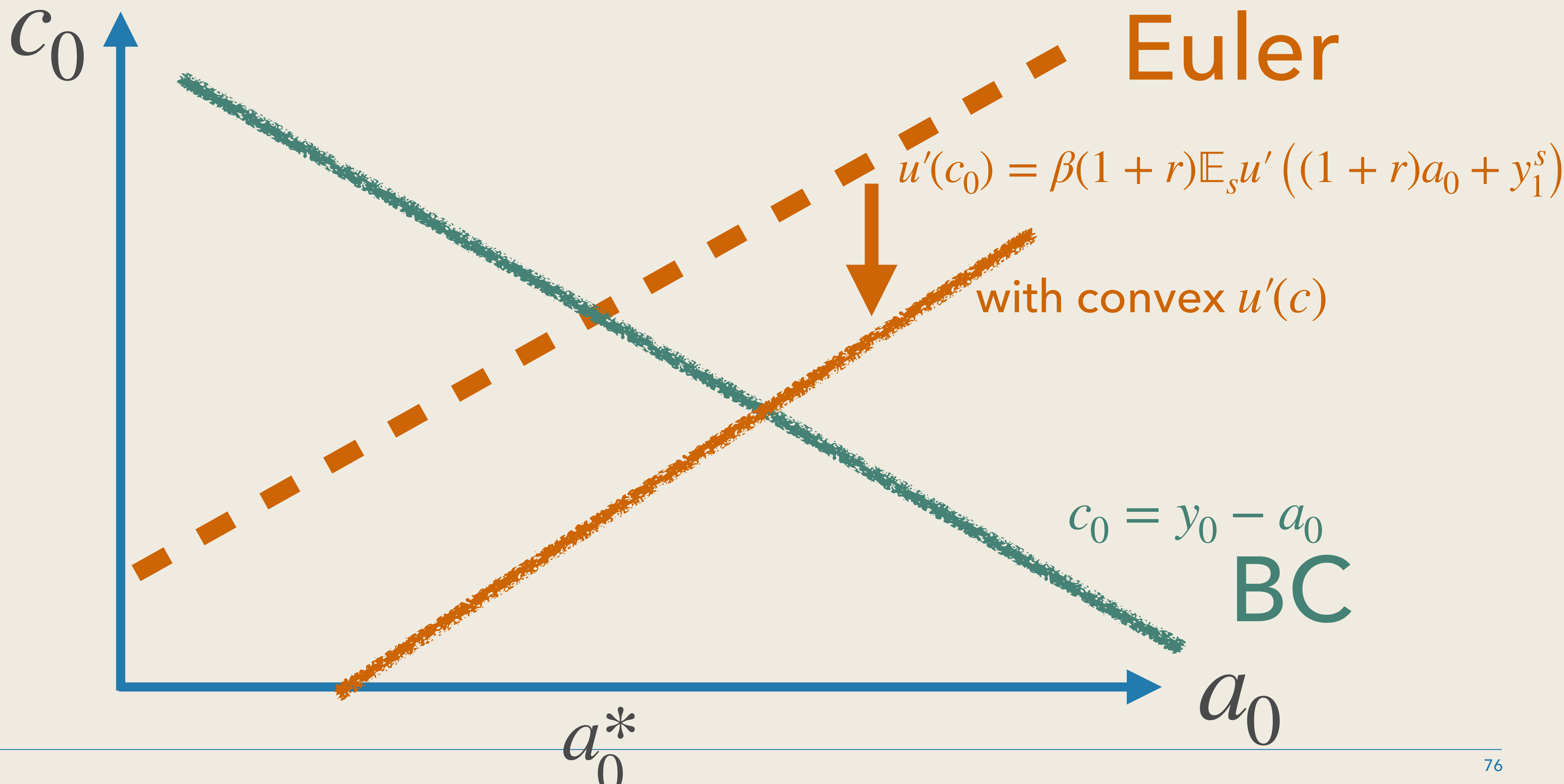
  - $u'(c) = c^{-\sigma} \Rightarrow u'(c)$ is convex!
  - In fact, for most utility functions we use, $u'(c)$ is convex

- This is not a coincidence. There is a natural reason why we expect convex $u'(c)$

- If $u'(c)$ were globally concave, $u'(c)$ needs to be negative at some point

  … but that means $u(c)$ is decreasing

Increase in Uncertainty



Precautionary Savings

- Therefore, an increase in uncertainty lowers consumption and increases savings
- We call it **precautionary savings**
- Do we have evidence for it?

Uncertainty and Consumption: Evidence

– Coibion, Georgarakos, Gorodnichenko, Kenny, Weber (2021)

Randomized Controlled Trials

- Survey 10,000 European households (Aug 2020 - Jan 2021)
- Elicit their subjective (macro) uncertainty:

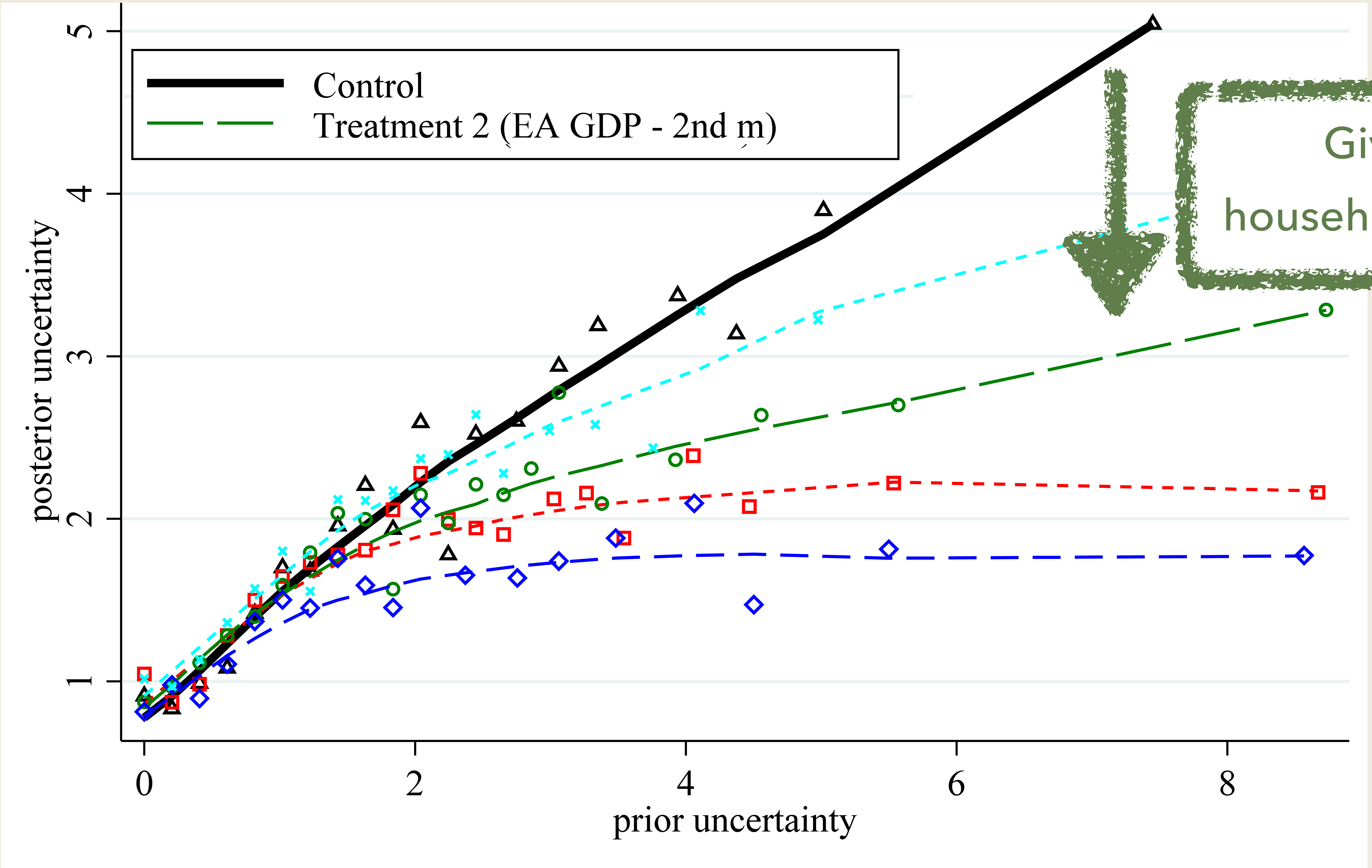
> *"Please give your best guess about the lowest growth rate (your prediction for the most pessimistic scenario for the euro area growth rate over the next 12 months) and the highest growth rate (your most optimistic prediction)."*

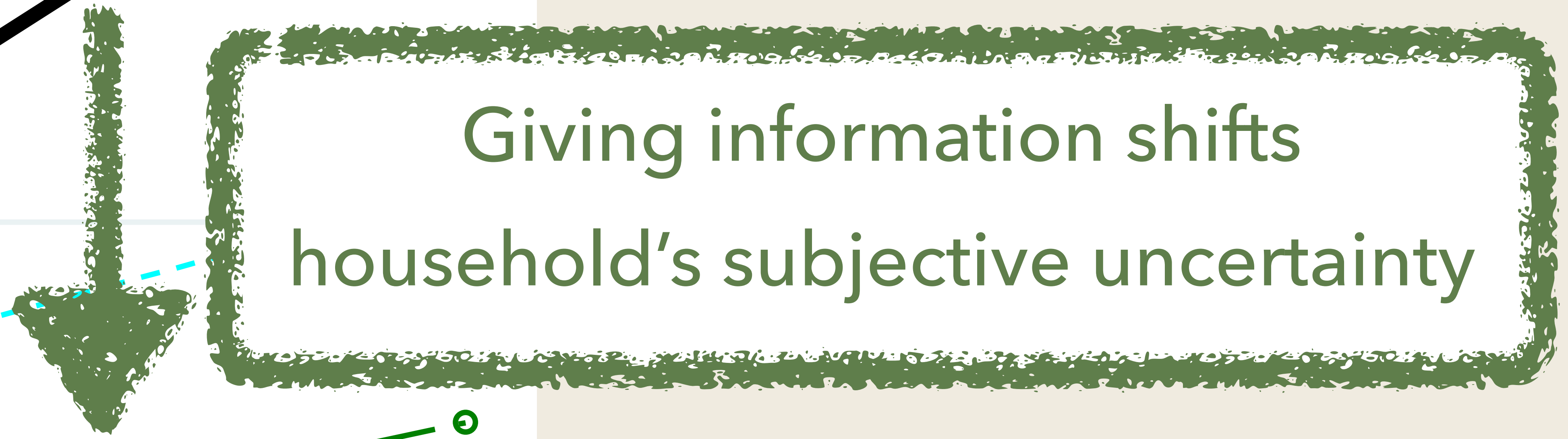
- Give the following information to a random subset of households:

> *"Professional forecasters are uncertain about economic growth in the euro area in 2021, with* ***the difference between the most optimistic and the most pessimistic predictions being 4.8 percentage points****. By historical standards, this is a big difference."*

RCT Shifts Perceived Uncertainty

- Now ask about their subjective uncertainty again:





Uncertainty Reduces Consumption

Consumption Response to Changes in Perceived Uncertainty

	One month after treatment (October 2020)	Four months after treatment (January 2021)
	(1)	(2)
Posterior: mean	-0.82	-0.26
	(0.52)	(0.49)
Posterior: uncertainty	-4.61**	-4.51**
	(2.23)	(2.25)

- 1 p.p. increase in (perceived) standard deviation of GDP growth reduces consumption by 4.5% even after several months

Macro Uncertainty ⇒ Micro Uncertainty

	Uncertainty about personal income growth		
	One month after treatment (October 2020)	Two months after treatment (November 2020)	Three months after treatment (December 2020)
	(1)	(2)	(3)
Posterior: mean	0.00	-0.01	-0.01
	(0.01)	(0.01)	(0.01)
Posterior: uncertainty	0.07**	0.11***	0.04
	(0.04)	(0.04)	(0.04)

- Perceived uncertainty about their own future income increases with macro uncertainty

Heterogeneity

Heterogenous Consumption Response

	'High Risk' Sector	'Low Risk' Sector	Retired	Portfolio incl. risky assets	Portfolio only in safe assets
	(1)	(2)	(3)	(4)	(5)
Posterior: mean	-0.58	-0.95	-0.52	-1.30	-0.53
	(1.02)	(0.73)	(1.47)	(1.07)	(0.68)
Posterior: uncertainty	-8.85**	2.48	-8.15	-14.15***	-1.06
	(3.71)	(3.13)	(7.69)	(5.11)	(2.79)

- The response is particularly negative for
  - households working in the high-risk sector with respect to COVID-19 (agriculture, manufacturing, construction, restaurants, transport, etc)
  - households with risky portfolios

Takeaway

- Strong evidence that supports precautionary savings
- This may explain why times with higher uncertainty are the times with low spending