Macrosim Economics Simulation Models

Part 1 - Macrosim1

MacroSim1 and MacroSim2

... Mudd designed

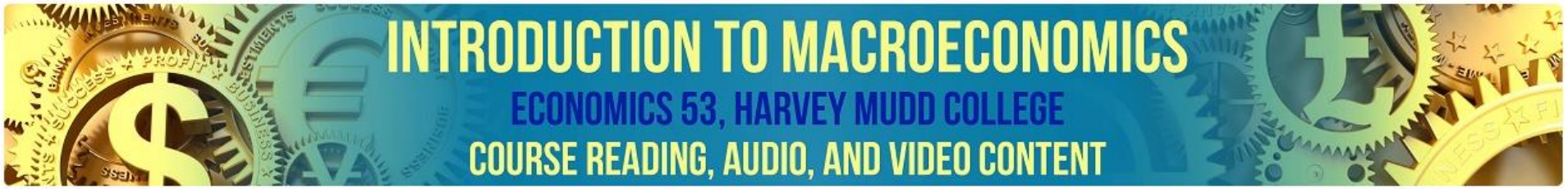
To get much from this, you should experiment with the Python versions of these models. They are intended to demonstrate the complicated interactions that arise when multiple variables are changing simultaneously in an economy.

MacroSim1 is an elementary national income determination model that is drawn from the vintage standard textbook treatment of national income determination. MS1 does not include a financial sector.

MSLF is the standard Loanable Funds model, which models credit and the interest rate.

MacroSim2 is largely MS1 with a financial sector added, represented by MSLF. The financial part of the model is more or less the simulation version of the loanable funds model.

Actual models (optional) found here:



E53 Course Outline | E53 Course Calendar | E53 Lecture Slides | Prof E's Courses

Course Content Page for 2020

Written material used in this class mostly consist of essays, some of them written like book chapters, and government documents, all online and made available from this page. They are presented below in more or less the order in which they are assigned.

Audio and video files are also assigned in this class, and like the written material, they are linked below in the approximate order in which they are assigned.

Some of this material is topical and updated at least once per year. If there is a listing below but the link is dead, that indicates that we are waiting for a current version of the content. Once that becomes available, the link becomes active.

Reading and related assignments are made in the Course Calendar. Because the essays are frequently updated, you are advised to not read any material as earmarked for revision until it has been formally assigned. Material that is not earmarked can be read at any time.

Software (Python) used in Economics 53 for Spring 2020

Note!: Students are not required to use or to be familiar with the software models below even though they were used in the MacroSim lecture set. Interested students are encouraged to download them and experiment with them, which is why they are provided here.

- MacroSim1 (zip file with Python model)
- Loanable Funds (zip file with Python model)
- MacroSim2 (zip file with Python model)
- MS2OMO (zip file with Python model)
- All models (zip file with all four Python models)

General design of MacroSim1

MacroSim1 replicates the standard "Keynesian Cross" model that appears in most introductory macroeconomics textbooks. As such, it does not include a financial sector. Although it allows for the existence of a budget deficit, it does not concern itself with how that deficit is financed. Likewise, it treats investment as purely autonomous (not determined within the model), unaffected by interest rates (there are no interest rates in the model). The user of the model arbitrarily chooses the level of investment.

The variables in the model

Y:	National Income
C:	Consumption
b:	Consumption coefficient (sometimes called the Marginal Propensity to Consume)
t:	Income tax rate
YD:	Disposable (after-tax) income
I:	Investment (autonomous)
G:	Government spending (autonomous)
S:	Savings
D:	Budget deficit (government)
m:	The multiplier

Macrosim1

Equations

1. $Y = C + I^o + G^o$
2. $C = a + b(YD)$
3. $YD = (1 - t)Y$
4. $D = G - tY$
5. $S = I + D$
6. $M = 1/(1 - b(1 - t))$

Derivation of the multiplier

1. $\Delta Y = \Delta C + \Delta X^{o}$ (where X is I or G)
2. $\Delta Y = b(\Delta YD) + \Delta X$
3. $\Delta YD = (1 - t)\,\Delta Y$
4. $\Delta Y = b(1 - t)\,\Delta Y + \Delta X$
5. $1 - b(1 - t)\,\Delta Y = \Delta X$
6. $\Delta Y = m\,\Delta X = 1/(1 - b(1 - t))\,\Delta X$

Application of the multiplier

For example, if the consumption coefficient is .80 and the income tax rate is .25, then the multiplier is equal to

$$1 / (1 - .8(1 - .25)) = 2.50 = m$$

This means that if autonomous government spending or investment is increased by $1, national income will rise by $2.50. This reflects the secondary and later spending that arises from an initial stimulus. In other words, if one person earns additional income, she spends it and another party earns additional income, he spends it, and so forth.

The MacroSim1 Python model, ms1.py


```
# MacroSim1 2018 Developed by Prof Evans for Econ 53
# This is the initial model converted from C++ to Python.
# This is version 3.4, dated March 1, 2018.
# Default model values: a:100,b:0.75,t:0.20,G:600,I:420
# Initialize variables
# Assumptions
#
a = 100.0
b = 0.75
I = 420
#
# Policy variables
t = 0.20
G = 600
#
#
# Solve
#
m = (1/(1-b*(1-t)))
Y = (I + G + a)*m
YD = (1-t)*Y
C = a + (b*YD)
taxes = t*Y
D = G - taxes
S = YD - C
```

```
ASSUMPTIONS
Autonomous consumption(a) = 100.000
Consumption coefficient(b) = 0.750
Investment (I) =  420.00

POLICY VARIABLES
Tax rate (t) = 0.200
Government spending (G) =  600.00

SIMULATION RESULTS
Multiplier (m) = 2.500
GDP (Y) =  2800.00
Disposable Personal Income (YD) =  2240.00
Consumption (C) =  1780.00
Taxes collected (taxes) =  560.00
Budget Deficit (D) = 40.00
Savings (S) = 460.00

IDENTITY CHECKS
Check S = 460.00
Check Y =  2800.00
```

MS1 default assumptions / solutions (stable economy)

GDP (Y):	2800.00	
Consumption (C):	1780.0	
autonomous consumption (a):	100	Assumed
consumpation coefficient (b):	0.75	
tax rate (t):	0.20	Solution
disposable income (YD):	2240.0	
Investment (I):	420.0	
Government Spending (G):	600.0	
Savings (S):	460	
Budget Deficit (D):	40.0	
multiplier (m):	2.50	

Macrosim Economics Simulation Models

Part 2 – Applications of Macrosim1

Questions we can ask …?

1. Does the multiplier work as we predict? For example, if we increase investment by 10, will GDP grow by 25?
2. [Related to 1]: If GDP grows by 25 but Investment grows by only 10, where did the other 15 come from?
3. [Related to 1]: If GDP rises by 25, will the budget deficit fall?
4. If we increase Government spending by 10, will that also increase Y by 25?
5. [Related to 4]: If we increase Government spending by 10, what happens to the budget deficit?
6. If we cut the tax rate from 0.20 to 0.18, what will be the effect upon GDP?
7. [Related to 5]: If we cut the tax rate from 0.20 to 0.18, will tax collections increase (why might they)?
8. [Related to 5 & 6]: Will the budget deficit rise or fall?
9. [These models are supposed to be used to simulate complex tradeoffs]: If we increase Government spending by 20, how much will we have to increase the tax rate to keep the deficit from rising? What happens to GDP?

Answers to 1,2, and 3

1. Does the multiplier work as we predict? For example, if we increase investment by 10, will GDP grow by 25?
2. [Related to 1]: If GDP grows by 25 but Investment grows by only 10, where did the other 15 come from?
3. [Related to 1]: If GDP rises by 25, will the budget deficit fall?

```
ASSUMPTIONS
Autonomous consumption(a) = 100.000
Consumption coefficient(b) = 0.750
Investment (I) =  420.00

POLICY VARIABLES
Tax rate (t) = 0.200
Government spending (G) =  600.00

SIMULATION RESULTS
Multiplier (m) = 2.500
GDP (Y) =  2800.00
Disposable Personal Income (YD) =  2240.00
Consumption (C) =  1780.00
Taxes collected (taxes) =  560.00
Budget Deficit (D) = 40.00
Savings (S) = 460.00

IDENTITY CHECKS
Check S = 460.00
Check Y =  2800.00
```

Default

```
# Assumptions
#
a = 100.0
b = 0.75
I = 420
#
# Policy variables
t = 0.20
G = 600
```

```
ASSUMPTIONS
Autonomous consumption(a) = 100.000
Consumption coefficient(b) = 0.750
Investment (I) =  430.00

POLICY VARIABLES
Tax rate (t) = 0.200
Government spending (G) =  600.00

SIMULATION RESULTS
Multiplier (m) = 2.500
GDP (Y) =  2825.00
Disposable Personal Income (YD) =  2260.00
Consumption (C) =  1795.00
Taxes collected (taxes) =  565.00
Budget Deficit (D) = 35.00
Savings (S) = 465.00

IDENTITY CHECKS
Check S = 465.00
Check Y =  2825.00
```

```
# Assumptions
#
a = 100.0
b = 0.75
I = 430
#
# Policy variables
t = 0.20
G = 600
```

Answers to 4 and 5

4. If we increase Government spending by 10, will that also increase Y by 25?
5. [Related to 4]: If we increase Government spending by 10, what happens to the budget deficit?

```
ASSUMPTIONS
Autonomous consumption(a) = 100.000
Consumption coefficient(b) = 0.750
Investment (I) =  420.00

POLICY VARIABLES
Tax rate (t) = 0.200
Government spending (G) =  600.00

SIMULATION RESULTS
Multiplier (m) = 2.500
GDP (Y) =  2800.00
Disposable Personal Income (YD) =  2240.00
Consumption (C) =  1780.00
Taxes collected (taxes) =  560.00
Budget Deficit (D) = 40.00
Savings (S) = 460.00

IDENTITY CHECKS
Check S = 460.00
Check Y =  2800.00
```

Default

```
ASSUMPTIONS
Autonomous consumption(a) = 100.000
Consumption coefficient(b) = 0.750
Investment (I) =  420.00

POLICY VARIABLES
Tax rate (t) = 0.200
Government spending (G) =  610.00

SIMULATION RESULTS
Multiplier (m) = 2.500
GDP (Y) =  2825.00
Disposable Personal Income (YD) =  2260.00
Consumption (C) =  1795.00
Taxes collected (taxes) =  565.00
Budget Deficit (D) = 45.00
Savings (S) = 465.00

IDENTITY CHECKS
Check S = 465.00
Check Y =  2825.00
```

Answer 4: Yes

Answers to 6,7, and 8

6. If we cut the tax rate from 0.20 to 0.18, what will be the effect upon GDP?
7. [Related to 5]: If we cut the tax rate from 0.20 to 0.18, will tax collections increase (why might they)?
8. [Related to 5 & 6]: Will the budget deficit rise or fall?

```
ASSUMPTIONS
Autonomous consumption(a) = 100.000
Consumption coefficient(b) = 0.750
Investment (I) =  420.00

POLICY VARIABLES
Tax rate (t) = 0.200
Government spending (G) =  600.00

SIMULATION RESULTS
Multiplier (m) = 2.500
GDP (Y) =  2800.00
Disposable Personal Income (YD) =  2240.00
Consumption (C) =  1780.00
Taxes collected (taxes) =  560.00
Budget Deficit (D) = 40.00
Savings (S) = 460.00

IDENTITY CHECKS
Check S = 460.00
Check Y =  2800.00
```

Default

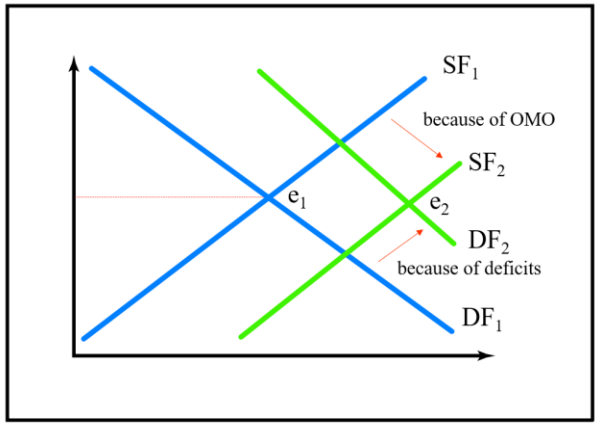
```
6   # Assumptions
7   #
8   a = 100.0
9   b = 0.75
10  I = 420
11  #
12  # Policy variables
13  t = 0.20
14  G = 600
```

```
ASSUMPTIONS
Autonomous consumption(a) = 100.000
Consumption coefficient(b) = 0.750
Investment (I) =  420.00

POLICY VARIABLES
Tax rate (t) = 0.180
Government spending (G) =  600.00

SIMULATION RESULTS
Multiplier (m) = 2.597
GDP (Y) =  2909.09
Disposable Personal Income (YD) =  2385.45
Consumption (C) =  1889.09
Taxes collected (taxes) =  523.64
Budget Deficit (D) = 76.36
Savings (S) = 496.36

IDENTITY CHECKS
Check S = 496.36
Check Y =  2909.09
```

```
6   # Assumptions
7   #
8   a = 100.0
9   b = 0.75
10  I = 420
11  #
12  # Policy variables
13  t = 0.18
14  G = 600
```

But is this good enough??

1. This model is too simple.
2. This model does not really let us evaluate simultaneous policies or complex feedback effects, which are the advantages of good model.
3. Investment is autonomous and exogenous in this model. It should be endogenous.
4. … which raises the point that there is no finance market and no interest rate in this model, which would influence investment.
5. We need to bring the loanable funds model in to this model!

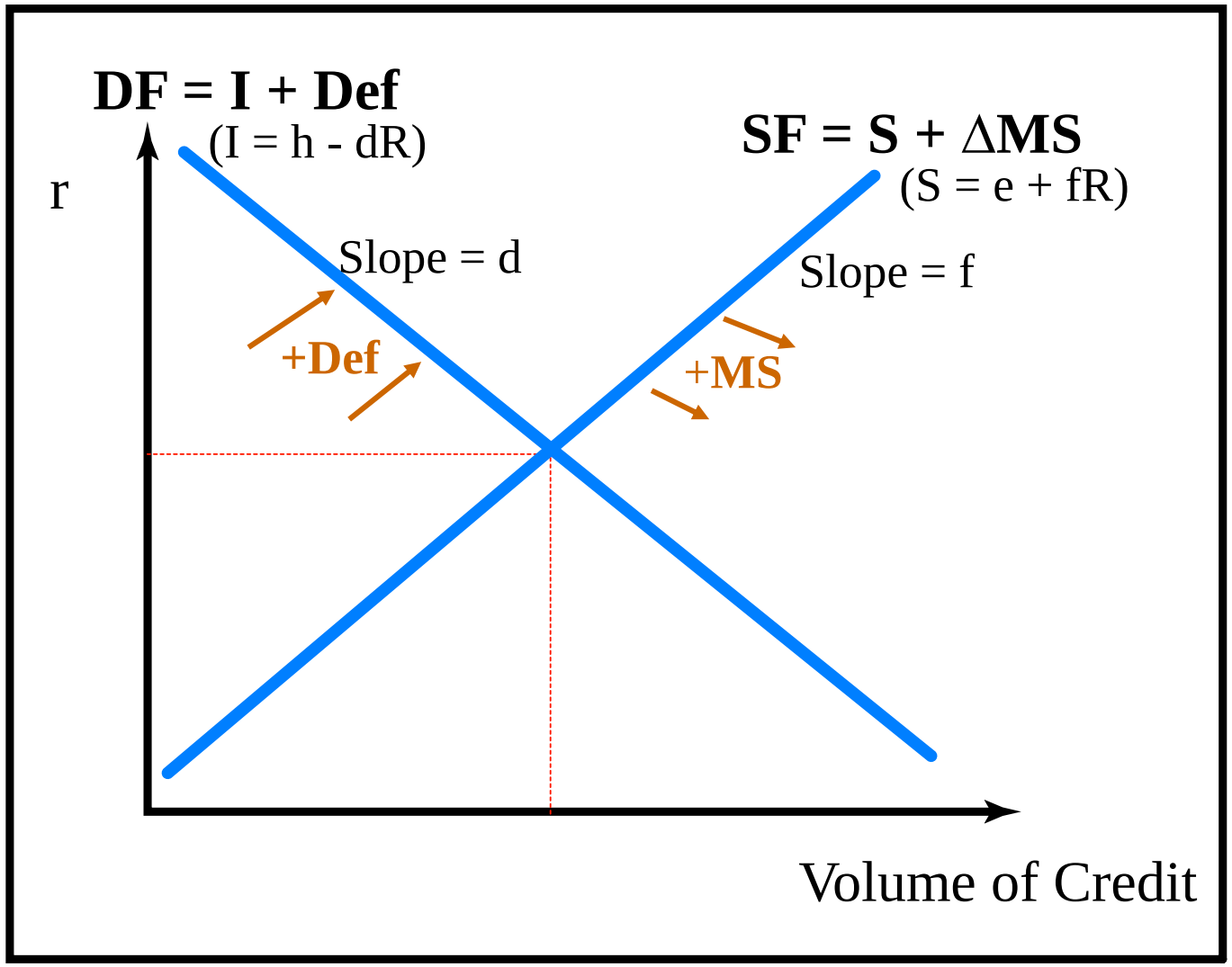


Macrosim Economics Simulation Models

Part 3 – The Loanable Funds Model

A model for interest-rate determination

… adding the loanable funds model



5. **DF = I + Def**
6. **SF = S + ΔM**
7. S + ΔM = I + Def
8. ΔM = MSGR **X** MS
9. I = h - dR
10. S = e + fR

The loanable funds model in Python

```
# Assumptions
#
h = 600
d = -4500.0
f = 6000.0
ms = 1200.0
e = 160.0
#
# Policy inputs
msgr = 0.05
D = 40.0
#
# Solve for the interest rate
#
dMS = ms*msgr
r = (D - dMS + h - e)/(f-d)
I = h + (d*r)
DF = I + D
S = e + (f*r)
SF = S + dMS
#
# Solve for elasticities
#
eS = f*(r/S)
eI = d*(r/I)
```

Note that you are no longer assuming that investment is a certain level. Likewise, you are **not** assuming an interest rate! Both are being *solved* by the model!

```
ASSUMPTIONS:
Investment intercept (h) = 600.0
Investment slope (d) = -4500.00
Savings intercept(e) = 160.0
Savings slope (f) = 6000.00
Money supply (ms) = 1200.0

POLICY VARIABLES:
Money supply growth rate (msgr) = 0.0500
Budget Deficit (D) = 40.0

SIMULATION RESULTS:
Money Supply Increase (dMS) = 60.0
Interest Rate (r) = 0.0400
Investment (I) = 420.0
Savings (S) = 400.0
Demand for Funds (DF) = 460.0
Supply of Funds (SF) = 460.0

ELASTICITIES
Savings elasticity (eS) = 0.600
Investment elasticity (eI) = -0.429
```

Remembering a concept from the book: Crowding Out

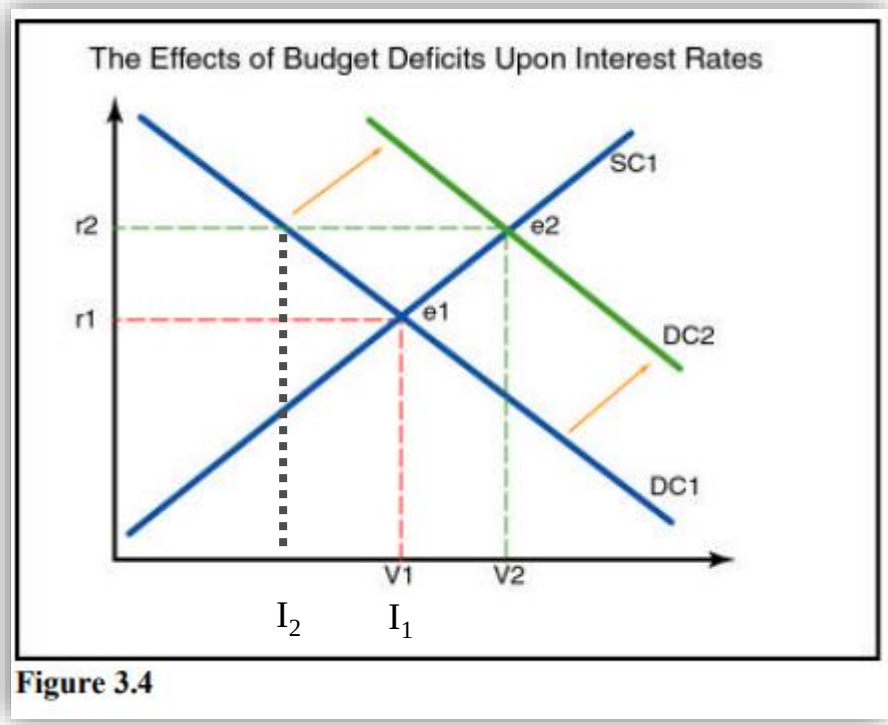


Figure 3.4

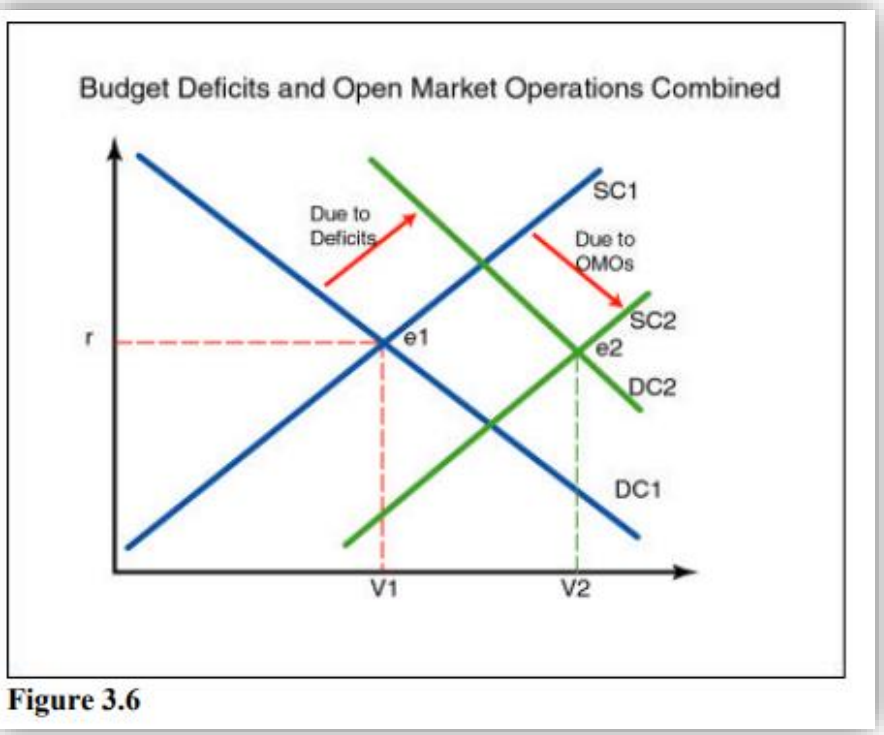


Figure 3.6

This effect of budget deficits upon interest rates introduces the possibility of an economic phenomenon called **crowding out**. Economic theory tells us that if interest rates are rising because of budget deficits, then the demand for funds in the private sector – corporate, consumer, and mortgage borrowing - might *fall* because of these higher rates.

(lfm) Crowding out in the Loanable Funds Model

```
ASSUMPTIONS:
Investment intercept (h) = 600.0
Investment slope (d) = -4500.00
Savings intercept(e) = 160.0
Savings slope (f) = 6000.00
Money supply (ms) = 1200.0

POLICY VARIABLES:
Money supply growth rate (msgr) = 0.0500
Budget Deficit (D) = 40.0

SIMULATION RESULTS:
Money Supply Increase (dMS) = 60.0
Interest Rate (r) = 0.0400
Investment (I) = 420.0
Savings (S) = 400.0
Demand for Funds (DF) = 460.0
Supply of Funds (SF) = 460.0

ELASTICITIES
Savings elasticity (eS) = 0.600
Investment elasticity (eI) = -0.429
```

```
ASSUMPTIONS:
Investment intercept (h) = 600.0
Investment slope (d) = -4500.00
Savings intercept(e) = 160.0
Savings slope (f) = 6000.00
Money supply (ms) = 1200.0

POLICY VARIABLES:
Money supply growth rate (msgr) = 0.0500
Budget Deficit (D) = 60.0

SIMULATION RESULTS:
Money Supply Increase (dMS) = 60.0
Interest Rate (r) = 0.0419
Investment (I) = 411.4
Savings (S) = 411.4
Demand for Funds (DF) = 471.4
Supply of Funds (SF) = 471.4

ELASTICITIES
Savings elasticity (eS) = 0.611
Investment elasticity (eI) = -0.458
```

As can be seen, the larger deficit raises interest rates by 19 basis points, which crowds out 9.6 units of investment.

(lfm): Offsetting this with MS growth

```
ASSUMPTIONS:
Investment intercept (h) = 600.0
Investment slope (d) = -4500.00
Savings intercept(e) = 160.0
Savings slope (f) = 6000.00
Money supply (ms) = 1200.0

POLICY VARIABLES:
Money supply growth rate (msgr) = 0.0500
Budget Deficit (D) = 60.0

SIMULATION RESULTS:
Money Supply Increase (dMS) = 60.0
Interest Rate (r) = 0.0419
Investment (I) = 411.4
Savings (S) = 411.4
Demand for Funds (DF) = 471.4
Supply of Funds (SF) = 471.4

ELASTICITIES
Savings elasticity (eS) = 0.611
Investment elasticity (eI) = -0.458
```

```
ASSUMPTIONS:
Investment intercept (h) = 600.0
Investment slope (d) = -4500.00
Savings intercept(e) = 160.0
Savings slope (f) = 6000.00
Money supply (ms) = 1200.0

POLICY VARIABLES:
Money supply growth rate (msgr) = 0.0666
Budget Deficit (D) = 60.0

SIMULATION RESULTS:
Money Supply Increase (dMS) = 79.9
Interest Rate (r) = 0.0400
Investment (I) = 420.0
Savings (S) = 400.0
Demand for Funds (DF) = 480.0
Supply of Funds (SF) = 480.0

ELASTICITIES
Savings elasticity (eS) = 0.600
Investment elasticity (eI) = -0.429
```

An increase in the money supply growth rate from 5% to 6.66% drops interest rates and eliminates crowding out … (but)

Macrosim Economics Simulation Models

Part 4 – Building MacroSim2

A macro-economy model with a financial sector

General structure of MS2

We found fault with MS1 because it did not include a financial sector. Because of that, budget deficits were always stimulating … there was no impact upon finance markets because there are no finance markets in MS1. Plus investment was endogenous and there is no FRS policy represented (like the ability to increase the supply of credit or reduce the interest rate.

MS2 adds a finance market by adding a special version of the loanable funds model.

In this model, the supply of funds consists of the sum of savings plus any increase in the money supply produced by the federal reserve. The demand for funds consists of the sum of investment demand (all investment is borrowed) and the budget deficit.

New variables for MS2

MS: money supply

MSGR: money supply growth rate (policy variable)

ΔMS: change in the money supply

r: interest rate

Investment is now a linear function of interest rates **(+)**

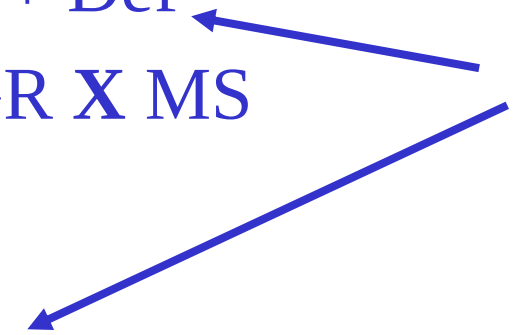
Savings is now a linear function of interest rates **(-)**

Policy variables - the user sets policy with these: MSGR, G, t

Sensitivity variables - "elasticities" (slope) of savings and investment lines

MS2 equations

1. **Y = C + I + G**
2. C = a + b(YD)
3. YD = (1 - t)Y
4. Def = G - tY
5. **DF = I + Def**
6. **SF = S + ΔM**
7. S + ΔM = I + Def
8. ΔM = MSGR **X** MS
9. I = h - dR
10. S = e + fR
11. S = YD - C



Loanable funds part of the model

MS2 default assumptions / solutions (stable economy)

GDP (Y):	2800.00
Consumption (C):	1780.0
autonomous consumption (a):	100.0
consumpation coefficient (b):	0.75
disposable income (YD):	2240.0
Investment (I):	420.0
Savings (S):	400
Budget Deficit (D):	40.0

Investment intercept (h):	600.0
Investment slope (d):	4500.0
Savings intercept (e):	160.0
Savings slope (f):	6000.0
Money supply (ms):	1200.0
Money Supply [credit] growth rate (msgr):	0.0500
Government spending (G):	600.00
Tax rate (t):	0.200

Assumed

Solution

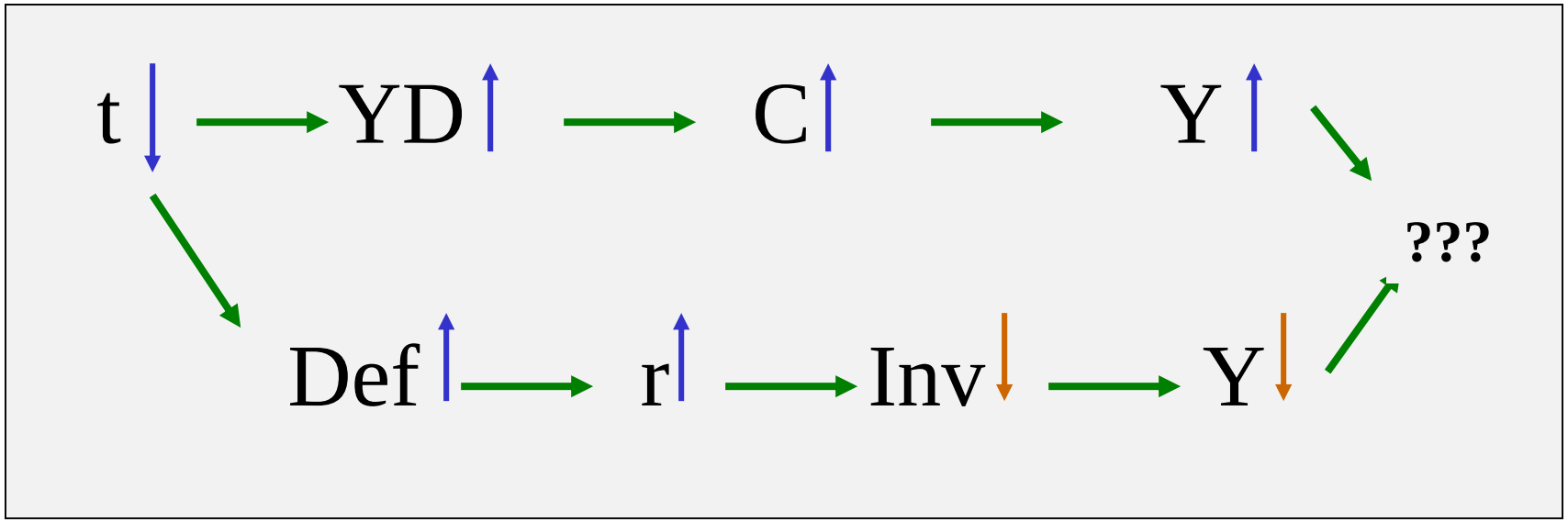
Assumed policy variables

Questions raised by MS2

- What is "crowding out?“
- How is crowding out offset by monetary policy?
- What are the policy implications of these tests?
- What happens to our results when we adjust the sensitivity variables (of savings and investment to interest rates)?
- What are the feedback (secondary) effects of manipulating policy variables (money supply growth rate, tax rates, govt. spending)?

Thinking of secondary (feedback) effects

Question: What happens to GDP (Y) when you decrease taxes (t) without cutting government spending (G)?



Macrosim Economics Simulation Models

Part 5 – Running MacroSim2 trials

Policy applications with MacroSim2

```
6    # Initialize variables
7    #
8    h = 600.0
9    d = -4500.0
10   f = 6000.0
11   ms = 1200.0
12   msgr = 0.05
13   e = 160.0
14   a = 100.0
15   b = 0.75
16   t = 0.20
17   G = 600
18   #
19   # Solve for the interest rate, ms growth, I,
20   # (Loanable Funds Model)
21   #
22   dMS = ms*msgr
23   X1 = a + G + h + d*((e + dMS - h - G)/(d-f))
24   X2 = (1 - (b*(1 - t)) - ((d*t)/(d - f)))
25   Y = (X1/X2)
26   YD = (1-t)*Y
27   C = a + (b*YD)
28   taxes = t*Y
29   D = G - taxes
30   r = (e + dMS - h - D)/(d-f)
31   I = h + (d*r)
32   DF = I + D
33   S = e + (f*r)
34   SF = S + dMS
```

```
ASSUMPTIONS:
Autonomous consumption(a) = 100.000
Consumption coefficient(b) = 0.750
Investment intercept (h) = 600.0
Investment slope (d) = -4500.00
Savings intercept(e) = 160.0
Savings slope (f) = 6000.00
Money supply (ms) = 1200.0

POLICY VARIABLES:
Money Supply [Credit] Growth Rate (msgr) = 0.0500
Government spending (G) =  600.00
Tax rate (t) = 0.200

SIMULATION RESULTS:
GDP (Y) =  2800.00
Disposable Personal Income (YD) =  2240.00
Consumption (C) =  1780.00
Interest Rate (r) = 0.0400
Investment (I) = 420.0
Taxes collected (taxes) =  560.00
Budget Deficit (D) = 40.00
Demand for Funds (DF) = 460.0
Savings (S) = 400.00
Supply of Funds (S) = 460.0
Y test =  2800.00
```

MS2 in Python (default)

MS2 default compared to MS1:

```
ASSUMPTIONS
Autonomous consumption(a) = 100.000
Consumption coefficient(b) = 0.750
Investment (I) =  420.00

POLICY VARIABLES
Tax rate (t) = 0.200
Government spending (G) =  600.00

SIMULATION RESULTS
Multiplier (m) = 2.500
GDP (Y) =  2800.00
Disposable Personal Income (YD) =  2240.00
Consumption (C) =  1780.00
Taxes collected (taxes) =  560.00
Budget Deficit (D) = 40.00
Savings (S) = 460.00

IDENTITY CHECKS
Check S = 460.00
Check Y =  2800.00
```

MS1

```
ASSUMPTIONS:
Autonomous consumption(a) = 100.000
Consumption coefficient(b) = 0.750
Investment intercept (h) = 600.0
Investment slope (d) = -4500.00
Savings intercept(e) = 160.0
Savings slope (f) = 6000.00
Money supply (ms) = 1200.0

POLICY VARIABLES:
Money Supply [Credit] Growth Rate (msgr) = 0.0500
Government spending (G) =  600.00
Tax rate (t) = 0.200

SIMULATION RESULTS:
GDP (Y) =  2800.00
Disposable Personal Income (YD) =  2240.00
Consumption (C) =  1780.00
Interest Rate (r) = 0.0400
Investment (I) = 420.0
Taxes collected (taxes) =  560.00
Budget Deficit (D) = 40.00
Demand for Funds (DF) = 460.0
Savings (S) = 400.00
Supply of Funds (S) = 460.0
Y test =  2800.00
```

MS2

All default variables are the same, but now we have a money supply, an interest rate, and investment is endogenous.

Questions we can ask …?

1. Now if we increase Government spending by 10, what happens to the budget deficit? But also what happens to the interest rate and to the level of investment?
2. If we cut the tax rate from 0.20 to 0.18, what will be the effect upon GDP, tax collections, the Deficit, the interest rate, and the level of investment?
3. What happens if we increase the money supply?
4. What happens if we decrease taxes, increase government spending, and increase the money supply?

Trial 1 : Increase G by 10%

```
ASSUMPTIONS:
Autonomous consumption(a) = 100.000
Consumption coefficient(b) = 0.750
Investment intercept (h) = 600.0
Investment slope (d) = -4500.00
Savings intercept(e) = 160.0
Savings slope (f) = 6000.00
Money supply (ms) = 1200.0

POLICY VARIABLES:
Money Supply [Credit] Growth Rate (msgr) = 0.0500
Government spending (G) =  600.00
Tax rate (t) = 0.200

SIMULATION RESULTS:
GDP (Y) =  2800.00
Disposable Personal Income (YD) =  2240.00
Consumption (C) =  1780.00
Interest Rate (r) = 0.0400
Investment (I) =  420.0
Taxes collected (taxes) =  560.00
Budget Deficit (D) = 40.00
Demand for Funds (DF) = 460.0
Savings (S) = 400.00
Supply of Funds (S) = 460.0
Y test =  2800.00
```

Default

```
ASSUMPTIONS:
Autonomous consumption(a) = 100.000
Consumption coefficient(b) = 0.750
Investment intercept (h) = 600.0
Investment slope (d) = -4500.00
Savings intercept(e) = 160.0
Savings slope (f) = 6000.00
Money supply (ms) = 1200.0

POLICY VARIABLES:
Money Supply [Credit] Growth Rate (msgr) = 0.0500
Government spending (G) =  660.00
Tax rate (t) = 0.200

SIMULATION RESULTS:
GDP (Y) =  2909.09
Disposable Personal Income (YD) =  2327.27
Consumption (C) =  1845.45
Interest Rate (r) = 0.0436
Investment (I) =  403.6
Taxes collected (taxes) =  581.82
Budget Deficit (D) = 78.18
Demand for Funds (DF) = 481.8
Savings (S) = 421.82
Supply of Funds (S) = 481.8
Y test =  2909.09
```

Crowding Out

G up 10%

Trial 2: Cut taxes

```
ASSUMPTIONS:
Autonomous consumption(a) = 100.000
Consumption coefficient(b) = 0.750
Investment intercept (h) = 600.0
Investment slope (d) = -4500.00
Savings intercept(e) = 160.0
Savings slope (f) = 6000.00
Money supply (ms) = 1200.0

POLICY VARIABLES:
Money Supply [Credit] Growth Rate (msgr) = 0.0500
Government spending (G) =  660.00
Tax rate (t) = 0.200

SIMULATION RESULTS:
GDP (Y) =  2909.09
Disposable Personal Income (YD) =  2327.27
Consumption (C) =  1845.45
Interest Rate (r) = 0.0436
Investment (I) = 403.6
Taxes collected (taxes) =  581.82
Budget Deficit (D) = 78.18
Demand for Funds (DF) = 481.8
Savings (S) = 421.82
Supply of Funds (S) = 481.8
Y test =  2909.09
```

G up 10%

```
ASSUMPTIONS:
Autonomous consumption(a) = 100.000
Consumption coefficient(b) = 0.750
Investment intercept (h) = 600.0
Investment slope (d) = -4500.00
Savings intercept(e) = 160.0
Savings slope (f) = 6000.00
Money supply (ms) = 1200.0

POLICY VARIABLES:
Money Supply [Credit] Growth Rate (msgr) = 0.0500
Government spending (G) =  660.00
Tax rate (t) = 0.180

SIMULATION RESULTS:
GDP (Y) =  2969.84
Disposable Personal Income (YD) =  2435.27
Consumption (C) =  1926.45
Interest Rate (r) = 0.0481
Investment (I) = 383.4
Taxes collected (taxes) =  534.57
Budget Deficit (D) = 125.43
Demand for Funds (DF) = 508.8
Savings (S) = 448.82
Supply of Funds (S) = 508.8
Y test =  2969.84
```

More Crowding Out

t cut 10%

Trial 3: Increase the money supply

```
ASSUMPTIONS:
Autonomous consumption(a) = 100.000
Consumption coefficient(b) = 0.750
Investment intercept (h) = 600.0
Investment slope (d) = -4500.00
Savings intercept(e) = 160.0
Savings slope (f) = 6000.00
Money supply (ms) = 1200.0

POLICY VARIABLES:
Money Supply Increase (dMS) = 60.0
Government spending (G) =  660.00
Tax rate (t) = 0.180

SIMULATION RESULTS:
GDP (Y) =  2969.84
Disposable Personal Income (YD) =  2435.27
Consumption (C) =  1926.45
Interest Rate (r) = 0.0481
Investment (I) =  383.4
Taxes collected (taxes) =  534.57
Budget Deficit (D) = 125.43
Demand for Funds (DF) = 508.8
Savings (S) = 448.82
Supply of Funds (S) = 508.8
Y test =  2969.84
```

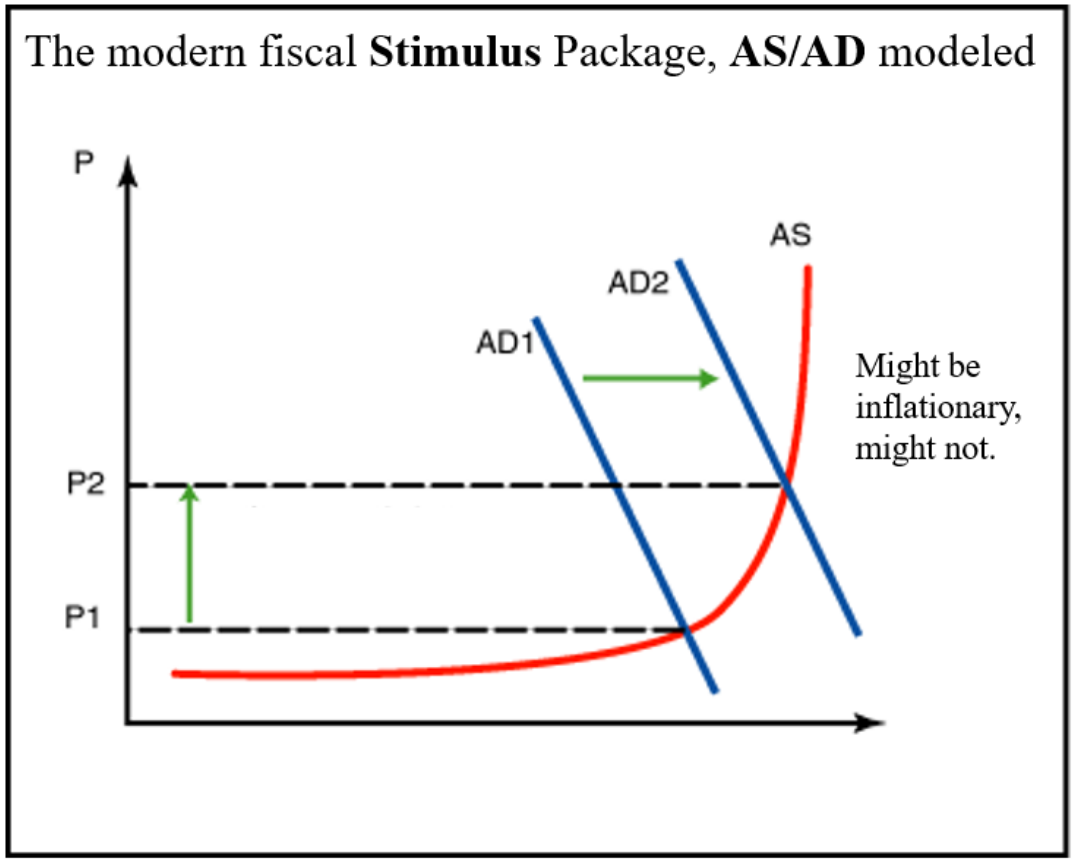
G up 10%
&
t cut 10%

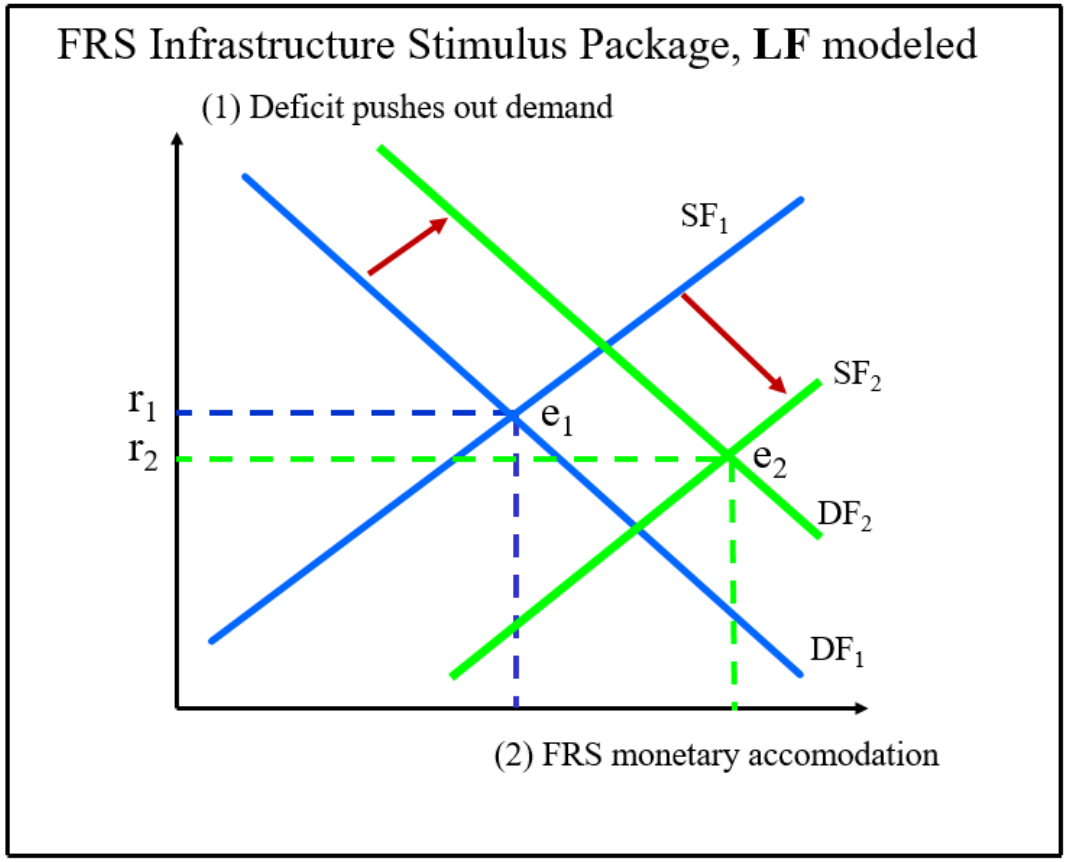
```
ASSUMPTIONS:
Autonomous consumption(a) = 100.000
Consumption coefficient(b) = 0.750
Investment intercept (h) = 600.0
Investment slope (d) = -4500.00
Savings intercept(e) = 160.0
Savings slope (f) = 6000.00
Money supply (ms) = 1200.0

POLICY VARIABLES:
Money Supply [Credit] Growth Rate (msgr) = 0.1100
Government spending (G) =  660.00
Tax rate (t) = 0.180

SIMULATION RESULTS:
GDP (Y) =  3070.07
Disposable Personal Income (YD) =  2517.46
Consumption (C) =  1988.09
Interest Rate (r) = 0.0396
Investment (I) =  422.0
Taxes collected (taxes) =  552.61
Budget Deficit (D) = 107.39
Demand for Funds (DF) = 529.4
Savings (S) = 397.36
Supply of Funds (S) = 529.4
Y test =  3070.07
```

Panacea: No Crowding Out

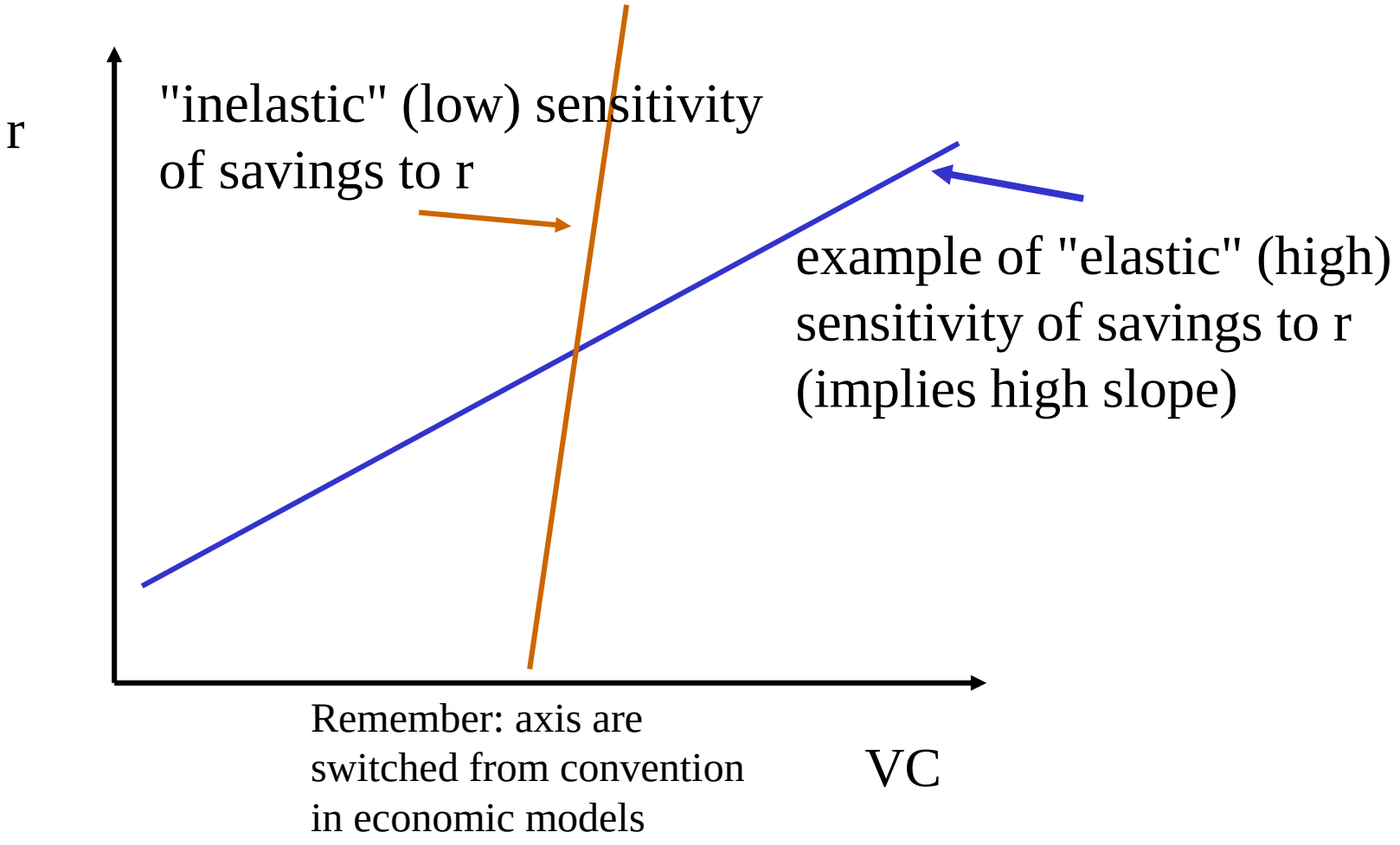
everything!

Haven't we seen this somewhere before ...??





Example of sensitivity: savings and the interest rate



Conclusions ..

This demonstrates the crowding out and the same solution to crowding out that was made evident in our use of the Aggregate Supply / Aggregate Demand model when combined with our Loanable Funds model when they were just two comparative statics models.

These simulation models show you how powerful monetary policy can be, especially when used to offset careless fiscal policy resulting in large budget deficits.

But even our simulation model still has a limitation. It does not have an aggregate supply curve built into it, so it cannot produce inflation. It says nothing about the price level.

What would it say if it did?