

# Economic Dynamics

***David Wheat, PhD, MPP***

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Lecture 5: Simple Keynesian Dynamics

October 10, 2019

*Professor  
ISM University, Lithuania*

*Professor  
Virginia Western College, USA*



UNIVERSITETET I BERGEN

System Dynamics Group



# I. David Wheat

Professor of System Dynamics, University of Bergen, Norway  
Adjunct Professor of Economics, Virginia Western Community College, U.S.A.  
Professor, Monetary Policy, ISM University of Management & Economics, Lithuania  
Professor, Economic Dynamics, National University of Kyiv-Mohyla Academy, Ukraine

Professor Wheat studies economic systems. His research specialty is simulation modeling of European economies, including Ukraine, Lithuania, Latvia, and the Euro Area.

He teaches monetary policy and economic dynamics to graduate students in Lithuania and Ukraine. He also teaches macroeconomics and microeconomics to undergraduates in the United States. In Norway, after teaching the system dynamics modeling process for many years, he continues to offer courses in macroeconomic dynamics and policy design & implementation. Current projects include collaboration with Ukrainian economists to build dynamic modeling capacity at national universities in Kyiv and Lviv, plus development of monetary policy models with economists at Ukraine's central bank. He has worked with economists at Lithuania's central bank to develop a multi-industry system dynamics model of price dynamics in Europe.

For nearly twenty years, his system dynamics-based *MacroLab* model has been used by macroeconomics students in the United States. That model is available online, and students can use it without special software. He is currently writing a textbook to supplement student use of *MacroLab*. His latest economics journal article is *Teaching Endogenous Money with Systems Thinking and Simulation Tools*, and the most recent conference paper was *The Canonical New Keynesian Monetary Policy Model: A System Dynamics Translation* (with M. Oliskevych). He is co-editor of *Feedback Dynamics*, a book that will be published by Springer in 2020.

Wheat is past-president of the economics chapter of the International System Dynamics Society. He served as Associate Editor of the *System Dynamics Review* and on the Advisory Board of the *International Journal of Pluralism and Economics Education*. He has given more than thirty international guest lectures. For three decades, he was president of Wheat Resources Inc, a consulting firm serving business and government clients. His current firm, Praktika LLC, specializes in coaching others to build useful models. He received his PhD at the University of Bergen, his master's degree at Harvard University, and his bachelor's degree at Texas Tech University. During the 1970s, he served at the White House as staff assistant to the President of the United States.

# Our Schedule



Sep 5	Introduction to Dynamic Modeling
Sep 12	<b><i>Structure &amp; Behavior of Dynamic Systems</i></b>
Sep 19	Guest Lecture: Alina Novik
Sep 26	Demand & Supply Dynamics
Oct 3	Simple Keynesian Dynamics
Oct 10	IS-LM Dynamics: Where's the Money?
Oct 17	New Keynesian Inflation Dynamics
Oct 24	<b>Autumn Break</b>
Oct 31	<b>Mid-term Exam</b>
Nov 7	Economic Growth
Nov 14	Price Dynamics
Nov 21	Employment Dynamics
Nov 22-Dec 11	review for exam
Dec 5 - 10	review lectures at LNU and NaUKMA (dates not yet set)
Dec 12	<b>Final Exam</b>

# Attendance: 10% of final grade



One attendance grade will be calculated:

It will be the percentage of lectures and labs that a student attends.

To illustrate ... the attendance grade will be:

100 if the student has perfect attendance,

50 if the student attends only half the time.

# Assignments: 40% of final grade



Each student will get a grade of 0, 80, or 100 for every assignment. An average assignment grade will be calculated and will count 40% in the final grade.

The grade depends on whether the work is 'acceptable' and whether it's submitted 'on-time.'

A submission is NOT 'acceptable' if it shows little or no effort by the student, or shows that the student has no clue about what to do.

- If the first submission is on-time and acceptable, the grade is 100.
- If the first submission is on-time but not acceptable, the student can still get an 80 if the re-submission is acceptable.
- In all other cases, the grade will be 0.



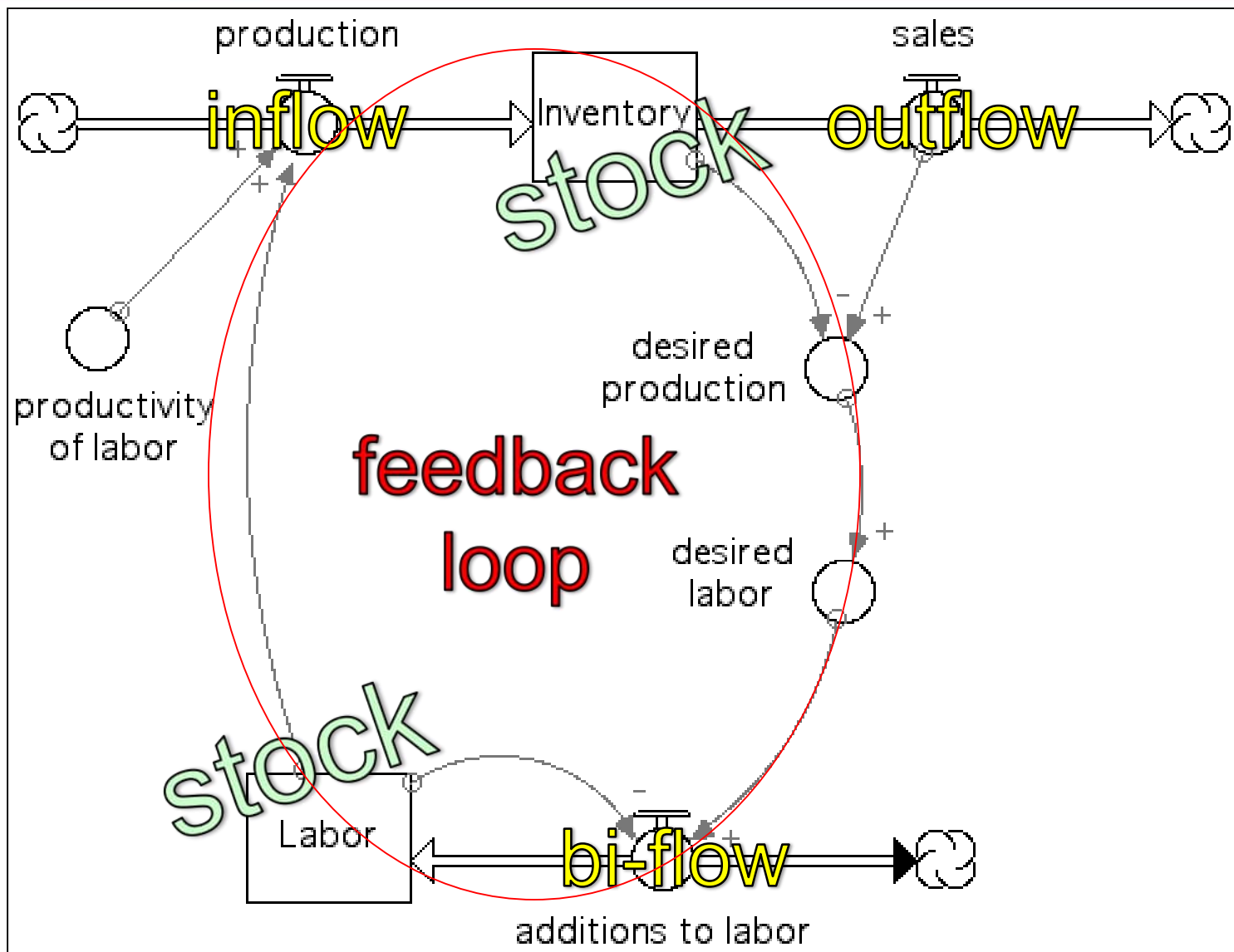
## Key Concepts:

- **Structure**: stocks, flows, and feedback loops
- **Behavior**: (1) levels of the stocks and (2) rates of the flows

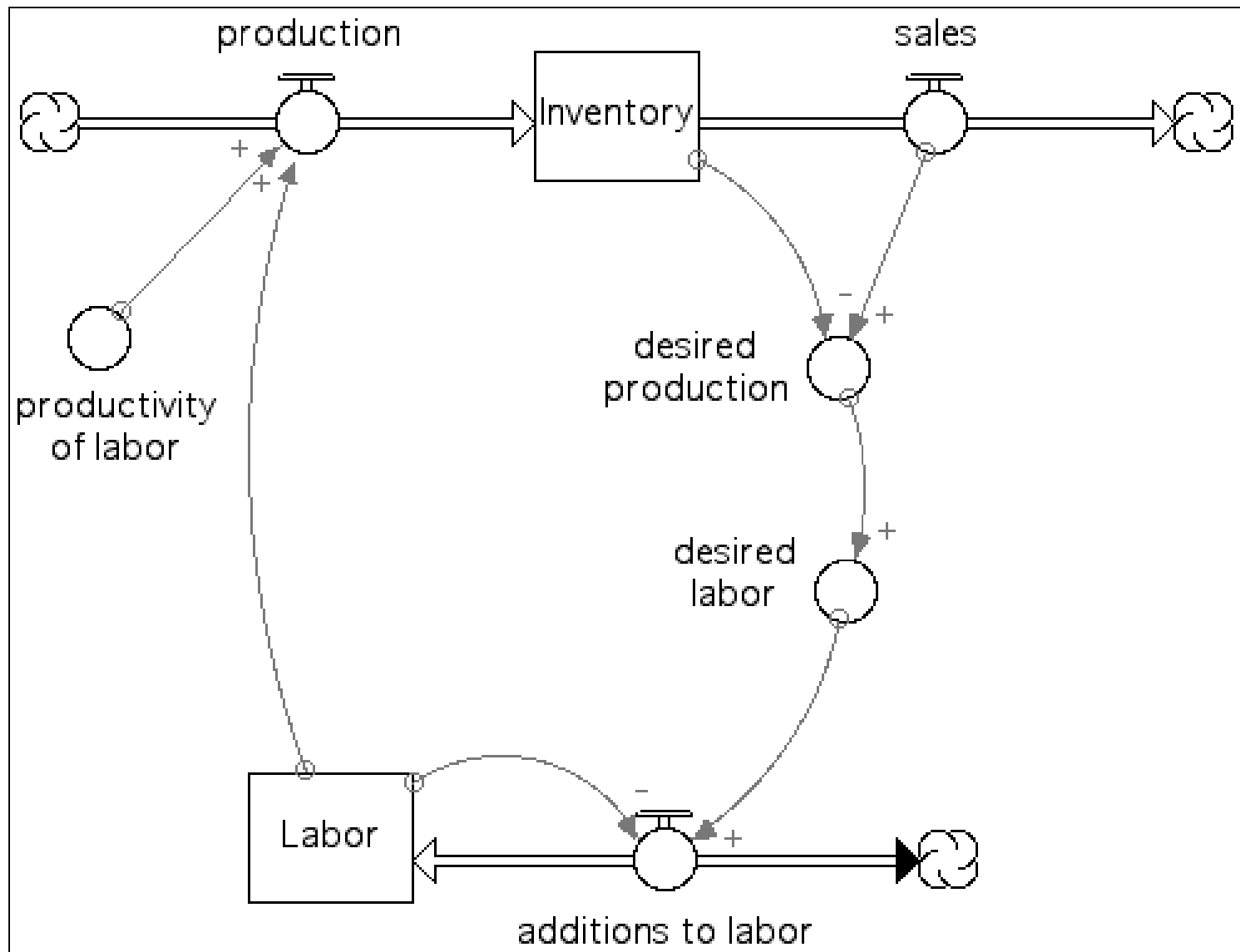
## Key Principles:

- The dynamic behavior of a system depends on the structure of that system.
- To understand dynamic behavior, build a model of the underlying structure.
- To alleviate problematic dynamic behavior, re-design the underlying structure.

# Stocks, Flows, Feedback



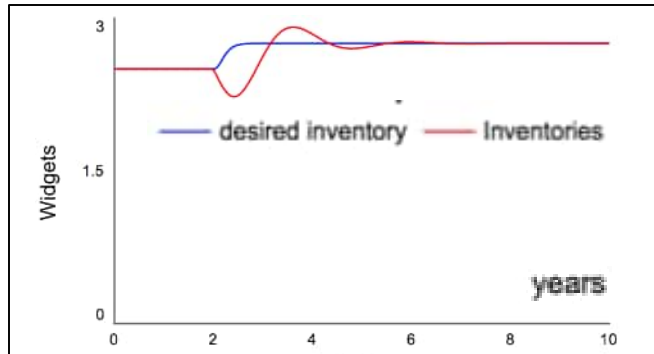
# Inventory-Labor Model



# It's your business. Which would you prefer?



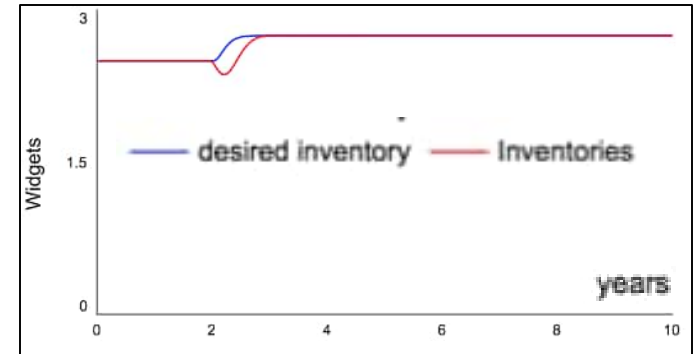
Assume you produce & sell widgets, and the market has been stable for a while. Suddenly, there's an increase in demand. And that affects your inventories & workforce.



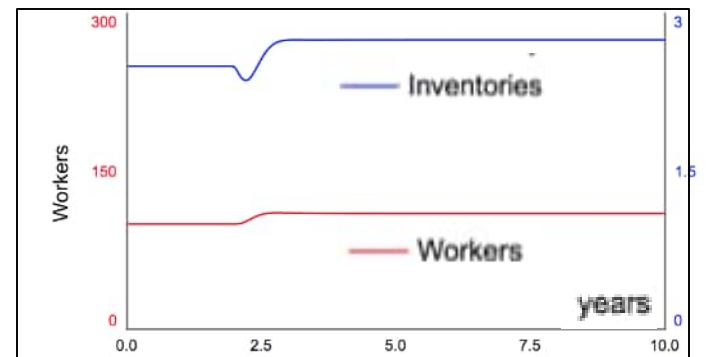
A



Which behavior pattern would you prefer?



B

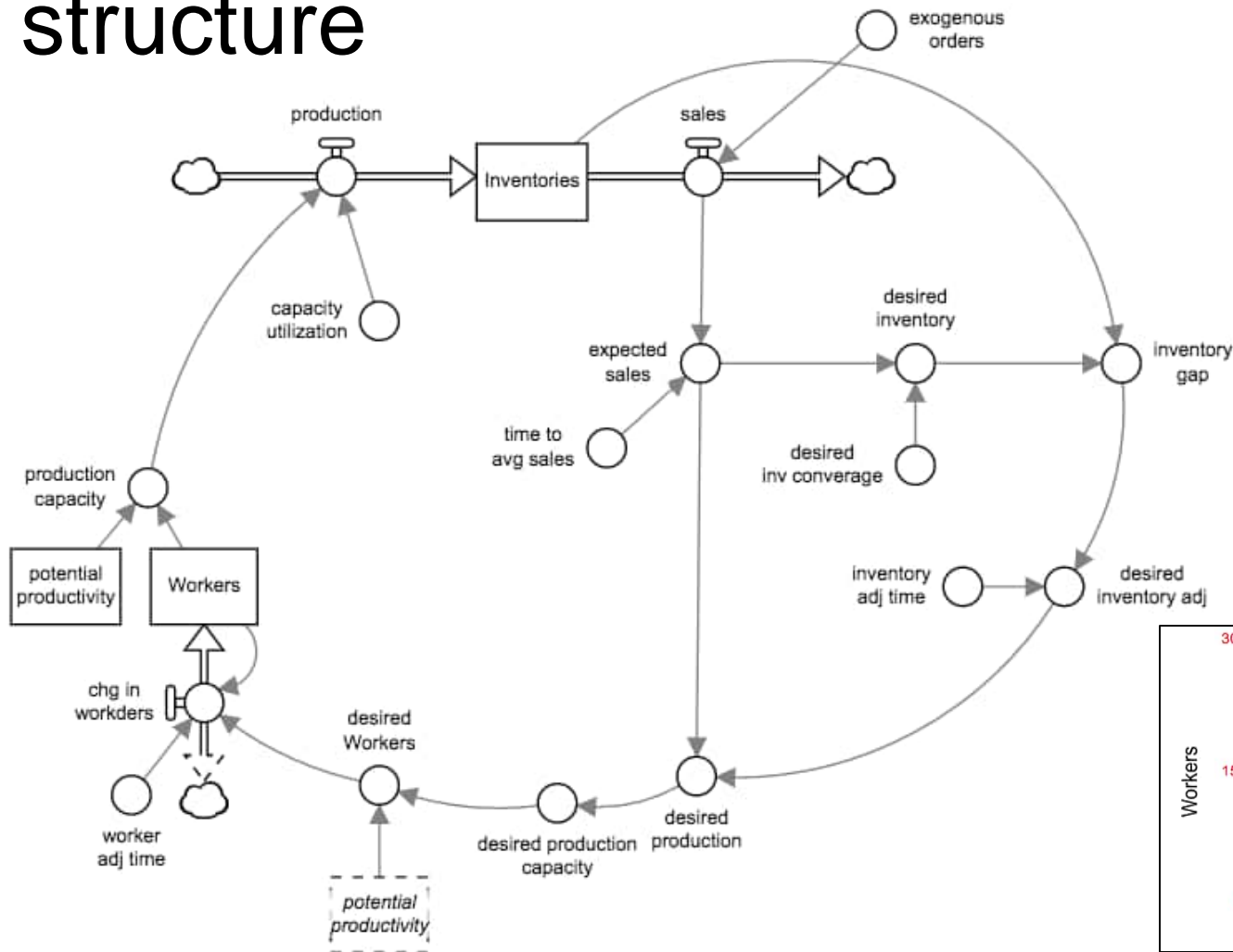


How can you get B instead of A?

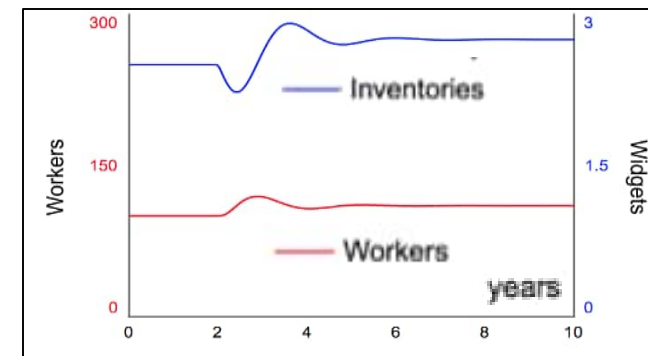
# Inventory Labor Model, version 1



## structure



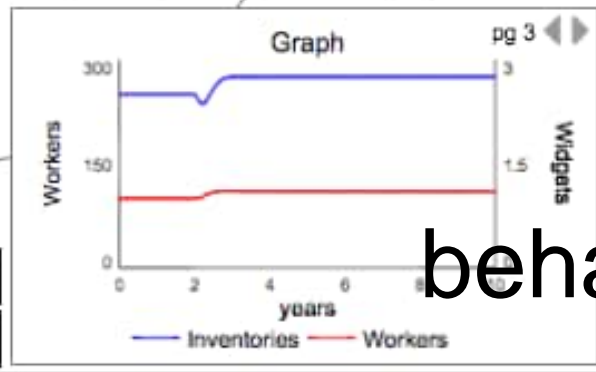
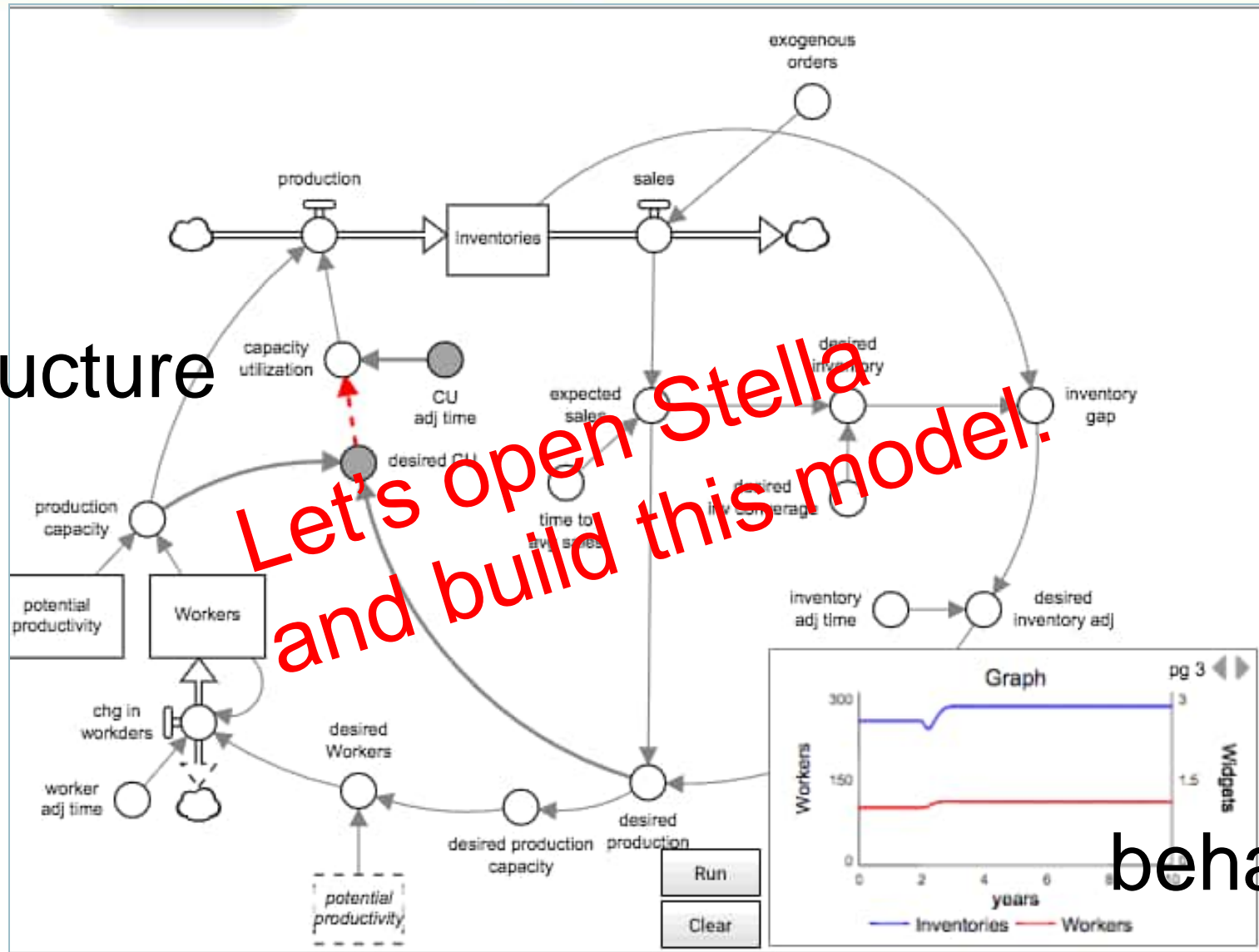
## behavior



# Inventory Labor Model, with overtime



structure

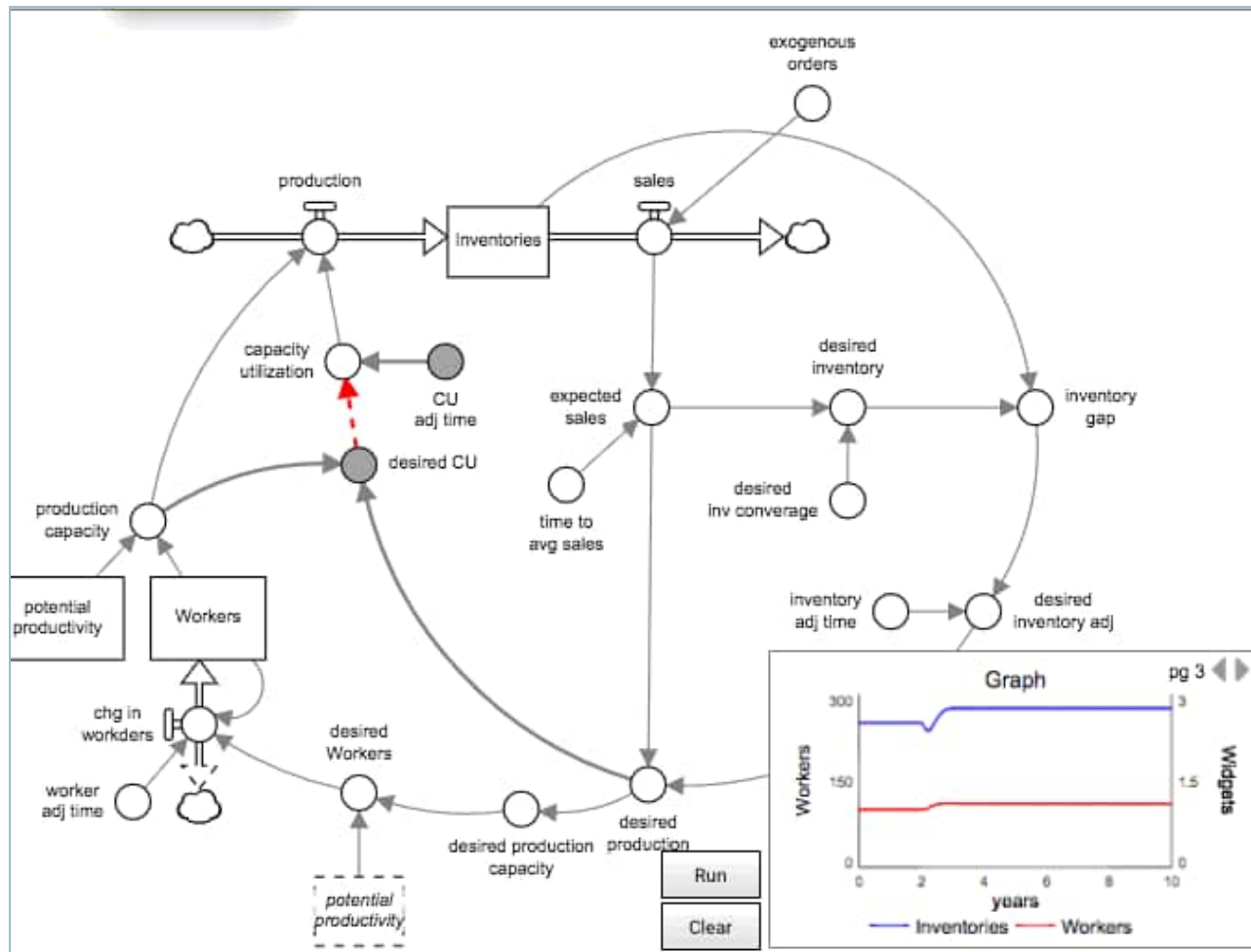


behavior

# Online Version



<https://exchange.iseesystems.com/public/david-wheat/inventorylabor/index.html#page1>



# Assignments

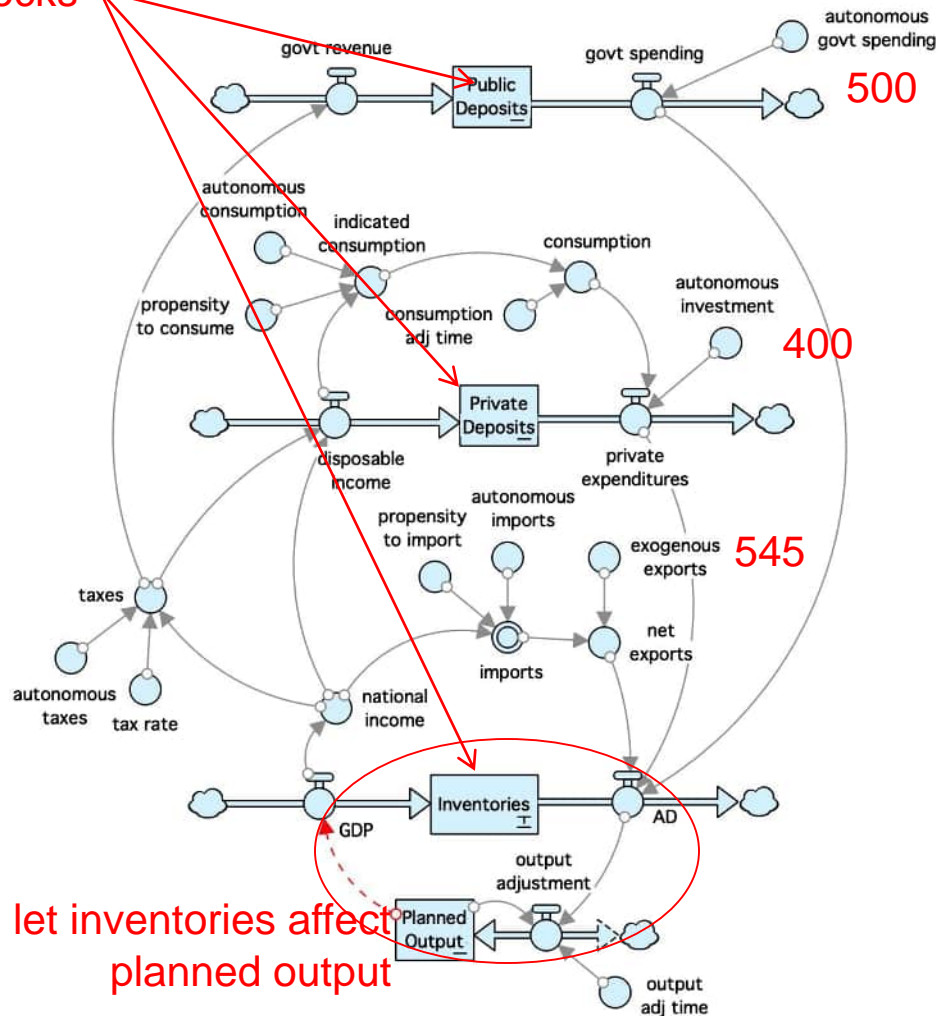
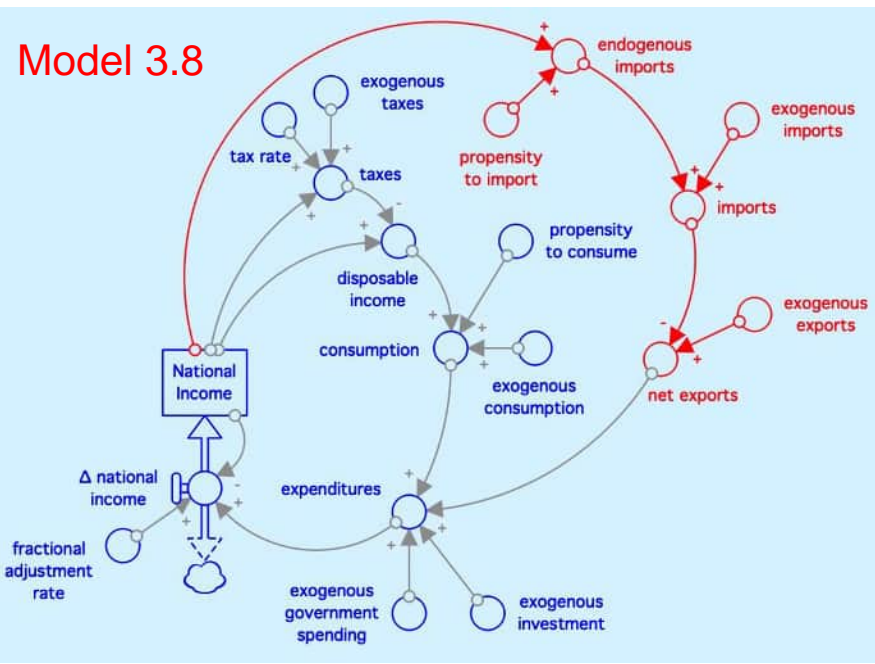


1. Convert SD Model 3.8 by adding 3 stocks: inventories, private deposits, and public deposits.
2. Only these parameter values are different from model 3.8
  - initial planned output = 2675 euros/year
  - autonomous government spending = 500 euros/year
  - autonomous investment = 400 euros/year
  - autonomous exports = 545 euros/year
3. Add new structure so that inventories will be 'managed' towards a goal for inventories.
  - desired inventory coverage = .25 years
  - inventory adjustment time = 1 year
4. Create a story for 'Model 3.8 with Stocks'

see next slide

add 3 stocks

Model 3.8



let inventories affect planned output

# Shone, Fig 3.5

Fig 3.5 in Shone (p. 58)

$a = 110$   
 $b = 0.75$   
 $Tx_0 = -80$   
 $tx = 0.2$        $Y^* = 1800$   
 $I = 250$        $BD^* = 20$   
 $G = 300$   
 $\lambda = 0.8$

**Dynamic model with taxes**

$$C(t) = a + bYd(t)$$

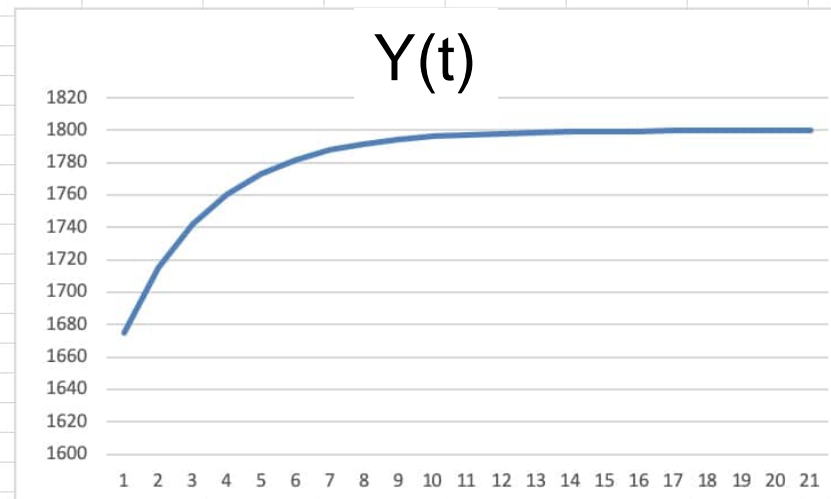
$$Yd(t) = Y(t) - Tx(t)$$

$$Tx(t) = Tx_0 + txY(t)$$

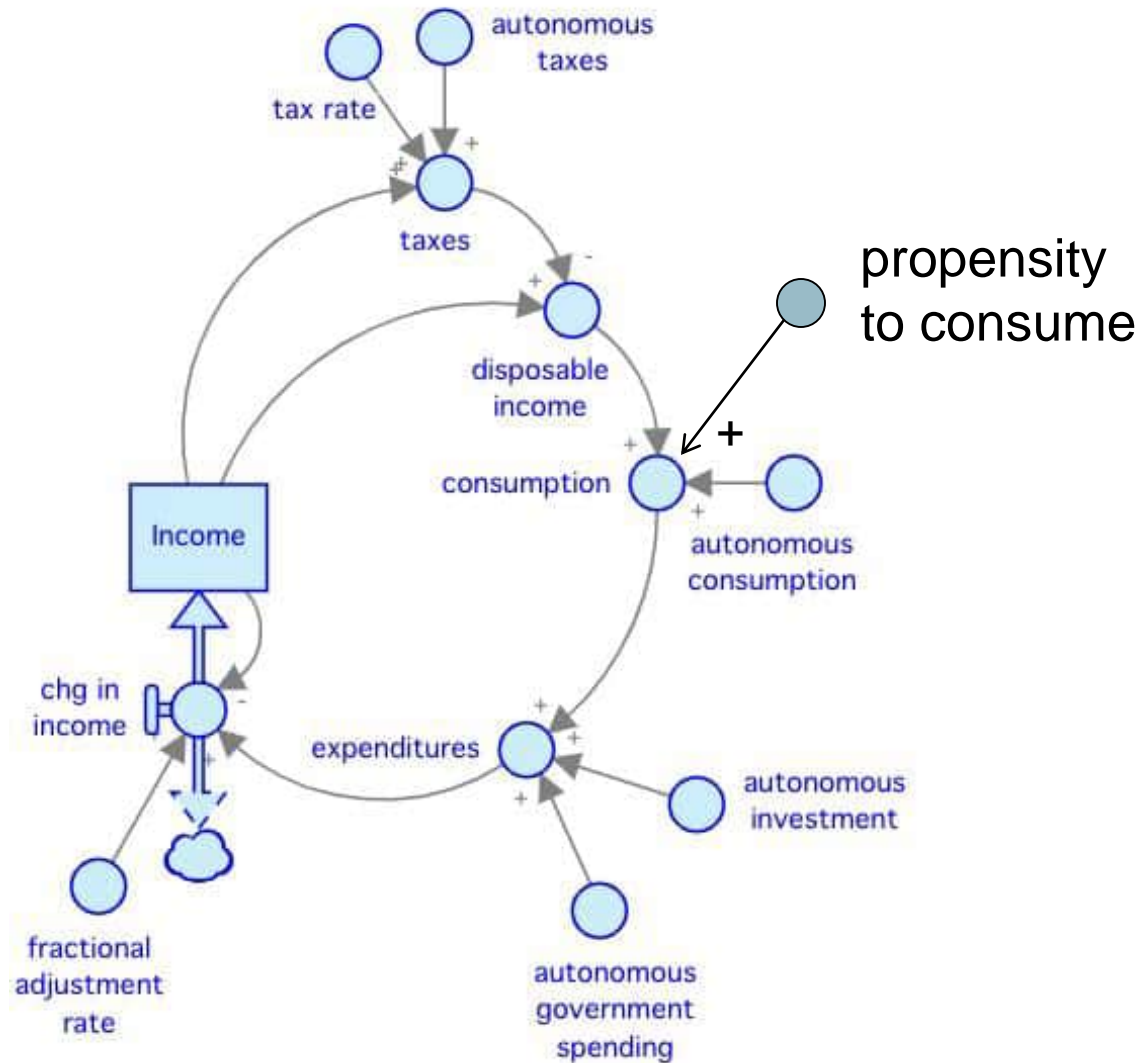
$$E(t) = C(t) + I + G$$

$$\Delta Y(t+1) = \lambda(E(t) - Y(t)) \quad \lambda > 0$$

Y(t)	Tx(t)	Yd(t)	C(t)	E(t)	E(t)-Y(t)	BD(t)	
0	1675	255	1420	1175	1725	50	45
1	1715	263	1452	1199	1749	34	37
2	1742	268	1474	1215	1765	23	32
3	1761	272	1489	1226	1776	16	28
4	1773	275	1499	1234	1784	11	25
5	1782	276	1505	1239	1789	7	24
6	1788	278	1510	1243	1793	5	22
7	1792	278	1513	1245	1795	3	22
8	1794	279	1515	1247	1797	2	21
9	1796	279	1517	1248	1798	2	21
10	1797	279	1518	1248	1798	1	21
11	1798	280	1519	1249	1799	1	20
12	1799	280	1519	1249	1799	0	20
13	1799	280	1519	1250	1800	0	20
14	1799	280	1520	1250	1800	0	20
15	1800	280	1520	1250	1800	0	20
16	1800	280	1520	1250	1800	0	20
17	1800	280	1520	1250	1800	0	20
18	1800	280	1520	1250	1800	0	20
19	1800	280	1520	1250	1800	0	20
20	1800	280	1520	1250	1800	0	20



# SD Version of Simple Keynesian Model





<https://exchange.iseesystems.com/public/david-wheat/model-35>

# Assignments



1. Create Spreadsheet Model 3.5
2. Create SD Model 3.5 and 'tell the story'
3. Create Spreadsheet Model in Fig 3.8
4. Create SD Model 3.8 and 'tell the story'

# Assignments

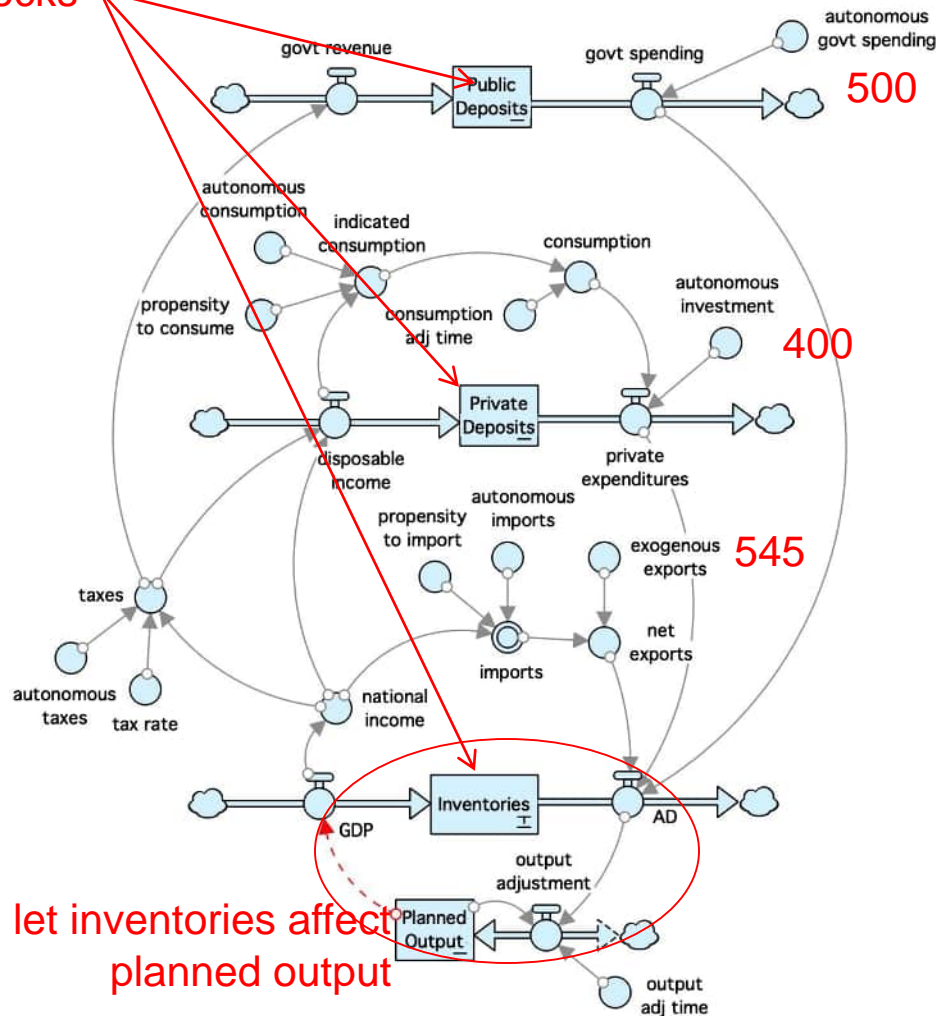
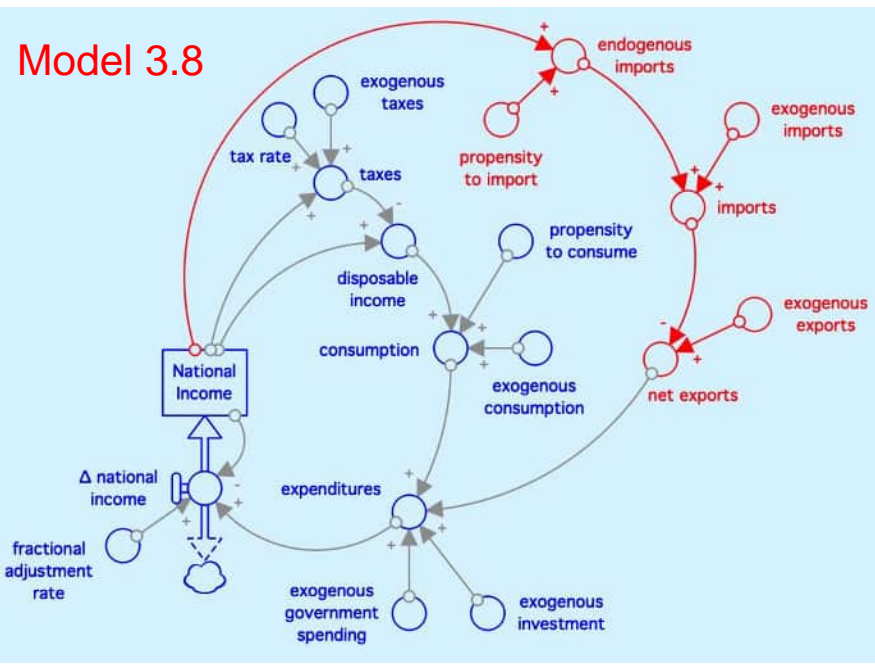


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Model 3.8



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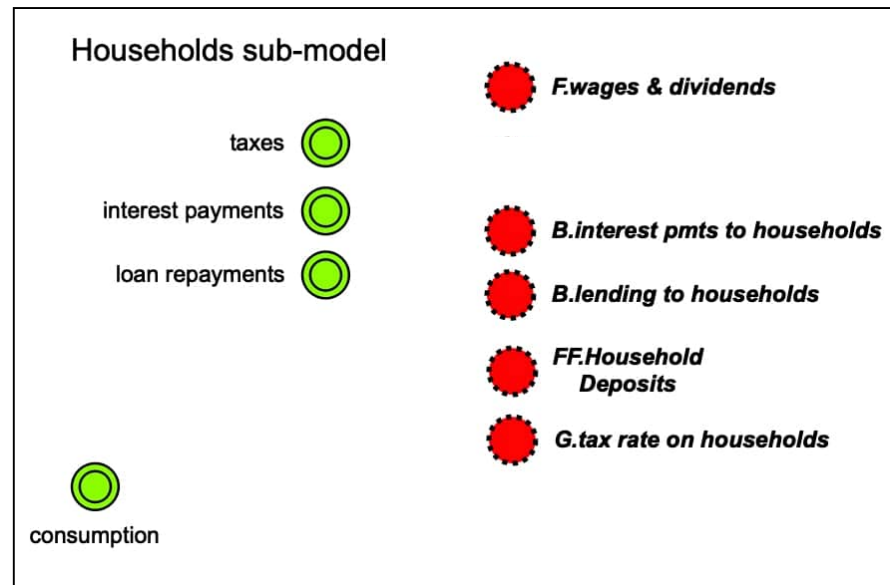
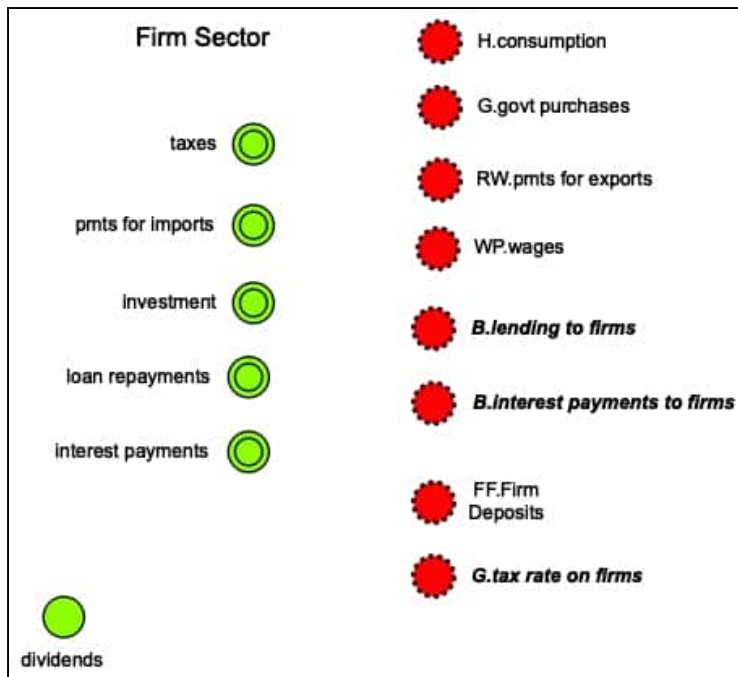
# New Assignment



Assignment: Develop a hypothesis\* and write an equation for

• Dividends paid by Firms (NaUKMA)

• Consumption paid by Households (LNU)

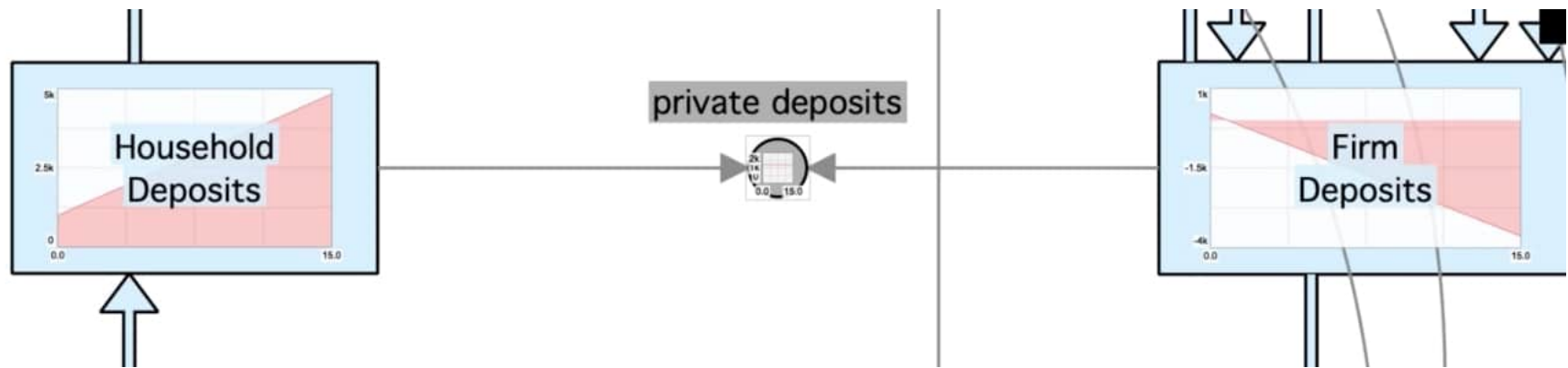


\*Be prepared to explain your hypothesis

# Keynesian Model: No Stocks



... but we found them



Some ways to balance the stocks:

1. Firms borrow from Households to fund exogenous investment
2. Firms withholding enough profits to fund exogenous investment

# Flow of Funds Model



Specify the Stocks and Flows of money.

All money that goes somewhere,  
comes from somewhere.



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