**MACROECONOMIC Principles**

**Hannes Kvaran**

E

F

FxM

K

G

Tn

Def

TP

Tg

dMD

dMS

Y

Cd

PrM

CrM

I

S

X = dMD + dMS

X

LaM

e

$

S$

10

100

D$

p

q

AS

AD

3%

3%

wr

n

SL

1%%%

2%%

DL

i

Z, X

L

8%

250

B

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **m** | **v** | **x** | **p** | **q** |
| **0** | **6** | **0** | **6** | **3** | **3** |
| **1** |  |  |  |  |  |

+

m + v = x = p + q

+

m + v = x = p + q

= + v = x = p + q

= + v = x = p + q

P0

P

Q

S

Q0

D

P0

P

Q

S

Q0

D

**IDEAS FOR TEACHING**

**PRINCIPLES OF MACROECONOMICS**

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**INTRODUCTION**

This paper presents four related innovations[[1]](#footnote-1) in macroeconomic instruction by the use of:

1. ***circular flow diagrams*** with numerical values

2. the ***rate of change form of variables*** when possible, including in aggregate supply and demand, and

3. the “***equations of exchange,”*** derived from the standard equation of exchange that make for simple numerical examples.

4. the use of the ***slopes of supply and demand curves*** to illustrate theoretical differences.

My intention in teaching macroeconomics has been to make current news more comprehensible to those in the class. Consequently:

1. I take the inclusion of political perspectives as important. It is difficult or impossible to separate economics from politics in macro.

2. I want the vocabulary of the class to be as similar as possible to the vocabulary of the popular press.

3. I downplay what I see as the theoretical niceties of logical, tight model construction. I try to convey the “consensus of the discipline” -- the “what we think” of economics over the “how we arrive at our conclusions.”

4. I don’t think that it crucial that students understand the details of how specific macro terms are defined or statistics gathered.

5. I operate by the dictum, “I would rather be clear than correct.”

All of these are arguable angles from which to teach the course. I respect others’ rights to approach the class from very different perspectives.

I have been asked whether this material is too hard for students. I don’t think so. Presented in a rush and a heap as it is here, it may well appear to be. I spent thirty years teaching at a community college in a modest-income city. I developed all the approaches in order to make understanding economics simpler. I have never used all of the information I present here in a single semester. That is, I don’t think the material here is too hard but I do think there is too much of it.

At some point in my career I decided that I had essentially no obligation to teach future economics majors. The incredibly few majors I knew of made it unconscionable that I would teach, for those few, things irrelevant to the vast majority of those I faced: Hence my willingness to embrace the unorthodox.

I gave up using a textbook many years ago. Instead I used a class web site on which Powerpoints, Text and Exercises are posted. Students appreciate being saved the money. No one ever complained about the teaching materials.

I leave it a teacher to elaborate this material with relevant examples. Frankly, I have found that a drawback to my approach is that it very quickly propels one into real-life examples and applications – sometimes faster than a class can handle. But I find that preferable to teaching irrelevancies. This is a “how to teach” manual only in the sense that it presents pedagogical tools, rather than a specific menu of topics to be covered in a course. What we teach ought to be determined by currently relevant issues.[[2]](#footnote-2)

While I am supposedly presenting principles-level pedagogical tools I do believe that these approaches present perspectives that can be novel and useful even to the economically sophisticated. I particularly think these presentations could be a useful summary for upper-level students, perhaps still struggling to integrate what they have learned.

**BASIC CONCEPTS[[3]](#footnote-3)**

1. The macro world is controlled by Aggregate Demand and Aggregate Supply. By “Demand” and “Supply” we can get started by saying:

Demand = Spending = nominal GDP, which can change fast. (This view of Aggregate Demand, as synonymous with spending, will remain significant in this material)

Supply is determined by the “quantity, quality and price of the Factors of Production,” which rarely change rapidly. Historically the most important advances of supply have been due to increases of Capital, which requires Investment. Investment is therefore crucial to long run growth.

The general rule is:

*Supply dominates the Long Run;*

*Demand dominates the Short Run.*

(The major exceptions may be the oil shocks of the 1970s, and the 2020s)

2. There are two economic/political theories: Classical/monetarist theory (CMT)[[4]](#footnote-4) and Keynesian Theory (KT). Some characteristics are summarized below.

|  |  |  |
| --- | --- | --- |
| ISSUE | CMT | KT |
| time horizon | long run | short run |
| economy has … | full employment | high unemployment |
| politics | conservative/  Republican | liberal/  Democrat |
| role of government | limited *laissez faire* | activist |

I initiated description of these theories by way of very short biographies of Smith, Marx, Keynes and Friedman.

One can see and stress the differences in two ways. First one can see them as relatively objective descriptions of different things: an economy at full employment behaves differently than one with high unemployment; an economy responds differently in months than it does in years. In this view the two theories are highly complementary offering, as Keynes promised, a general theory, a “Classical/Keynesian synthesis.” Secondly, one can see these differences as manifestations of political biases where economists can “prove” anything that suites their own opinions. Here we get the “Monetarist/Keynesian debate.”

In all that follows, I am hard-pressed to say exactly which parts of it belong in a principles class. Some of the material is included to orient a teacher to the way I see things, without suggesting that it belongs in a beginner’s class. That said, I have taught almost all of this. “***CirF*** Market Mode” is used sparingly and “The Slopes of Curves” has not been specifically used in some years. Both of these topics do, however, inform my own understanding of macro and the way I present many topics.

**I. THE CIRCULAR FLOW DIAGRAMS**

**Versions of the Circular Flow**.

Various forms of the Circular Flow Diagram are ubiquitous in economics instruction. I expanded the use of these diagrams to the point where I found them as useful and necessary in teaching macro as supply and demand graphs. I refer to the diagrams as ***CirF*** diagrams. The most significant innovation of ***CirF*** is the use of numbers. By attaching values to macroeconomic variables, making changes to those variables and then readjusting other values to accommodate, ***CirF*** becomes a simple macro simulator, capable of presenting some fairly sophisticated concepts and “what if” scenarios.

***CirF*** exists in three visual forms. (1) the painstakingly-rendered versions you will see drawn in this paper (2) computerized constructions – mainly done in spreadsheets (3) quick, drawn-by-hand versions used frequently in class to illustrate concepts and issues. The last is the most important.

In much of the following I use the words *endogenous* and *exogenous*, particularly in reference to the attached computer programs.

An *exogenous* variable is one that is “outside” the model in use. It can “just change” for no given reason. Usually exogenous changes are the “givens” in a problem. That is, “Let’s suppose that people decide to spend more,” states an exogenous change. No reason is given; the exogenous change will then be the cause of what follows. One can think of exogenous as cause and endogenous as effect.

*Endogenous* (“inside”) variables (or changes) are the effects that follow. These are typically implicit in the structure of the model. One is able to say *why* these changed.

In the supposition, “If Income rises, Consumption will increase,” Income is exogenous, Consumption is endogenous.

Macro flow diagrams typically present the circular nature of income and spending as an exchange between the household and business sectors, mediated by the markets for goods and factors, organized around the National Income Accounts. A somewhat different view arises by using the Federal Reserve’s Flow of Funds Accounts. In this taxonomy the economy’s actors are: The Domestic, Private, Non-Financial Sector; the Rest of the World; the Government; the Financial Sector.

Y

X

Cd

PrM

LaM

Figure 1. The Circle

***CirF***’s approach is much closer to this treatment, showing the simplest circular flow as occurring between the Domestic, Private, Non-Financial Sector (labeled Households/Businesses) and the Product Market, mediated by the Labor Market. See Figure 1.

The first (of many) words on notation:

H/B = the Household/Business sector

Y = (National) Income

X = Total Spending aka Nominal GDP aka Aggregate Demand

Cd = Domestic Consumption – the purchase of domestically produced goods. The “d” can be ignored unless/until the foreign sector is in the model.[[5]](#footnote-5)

Figure 2 represents the simplest model I use, which includes Savings, Investment and the Credit Market. As it is here, the Labor Market is often ignored.[[6]](#footnote-6)

Figure 2. The Simplest Model

Y

X

C

PrM

CrM

I

S

We can already write the basic macro equations:  
Y = C + S

X = C + I

S = I

In the numerical exercises that follow, we are only concerned with changes of variables. So C actually means ‘the change of consumption.’

Figure 3 shows the complete model.

More notational comments:

The **Foreign Exchange Market** (FxM) consists of:

F = Imports (“Fimports” as a mnemonic)

E = Exports

K = Foreign Capital Flows

The **Treasury** includes

Tg = Gross taxes

TP = Transfer Payments

Tn = Net Taxes = Tg – TP

G = Gov’t Purchases of goods and services

BB = the Budget Balance = Tn – G (or Tg – G – TP)

Def = the Gov’t Budget Deficit (the negative of the Budget Balance)

Unusual is the inclusion of the “monetary variables” the **Federal Reserve** and the change of the money supply (MS, recalling that *all* variable values indicate ‘a change of …’) and, weirder yet, “**Cash**” and the change of the demand for money (MD). More on them soon.[[7]](#footnote-7)

In equations, we can characterize the economy as:

1. Y = C + F + S + Tn.

The four uses of income

2. X = C + E + I + G.

The four types of spending

3. G + TP = Tg + Def

Uses of gov’t funds = Sources of funds

4. Tn = Tg – TP.

Definition of net Taxes

5. F = E + K

Foreign Exchange equilibrium. [[8]](#footnote-8)

5. S + K + MS + MD = I + Def

E

F

FxM

K

G

Tn

Def

TP

Tg

MD

MS

Y

X

Cd

PrM

CrM

I

S

Figure 3. The Complete Model

LaM

Credit Market equilibrium. (If one ignores the monetary variables, this is the “National Savings Identity.”)

**ASIDE**

Many of the terms used actually take on a different meaning than is usual. For instance, according to the diagram:

C is defined as, “The purchase, by households and businesses, of domestically produced goods and services *using current income as the source of funds.”*

I is defined as “The purchase, by households and businesses, of goods and services *using credit as the source of funds.*

In other words the diagram classifies spending by the source of funds, not by which sector does the spending. As noted above this seems closer in spirit to the Fed’s Flow of Funds approach.

The main differences are:

1. The purchases of Household goods *using credit* would usually be classified as “C”, but are here classified as “I.”

2. The purchase of capital goods by business using retained earnings (i.e. current income) would usually be classified as “I” but are here classified as “C.”

These are subtleties that can easily be ignored in a principles class. Using the common definitions of C and I creates no problems, but it is worth being aware of the logic of the diagram. Furthermore, it is reasonable to ask, “Which *is* the more important way of classifying spending, by sector or by source of funds?”

Debt repayment – a flow from the privates sector to the Credit Market – is part of Saving. Debt repayment is merely *ex post* saving.

Interest is a payment for the use of money. It is part of C.

END OF ASIDE

I have had classes “act out” the diagram using monopoly money, with students designated as the various actors in the economy.

The use of equations is, of course, a matter of instructor taste. To a large degree, it is possible to see the diagram as an alternative to equations. I have found that some students like the equation format, especially when it is stressed that these are merely shorthand sentences.

**THE ROLE and MEANING OF CASH**

I consider the inclusion of CASH and MD in this model the most significant advance in my own understanding of macroeconomics. CASH was added in an attempt to model the Demand for Money and its *doppelganger*, the velocity of money (which will receive an alternate treatment later.) This in turn, is an attempt to add Keynesian outcomes to the model, which I take to be important for the presentation of political perspectives. In Keynesian Theory, the demand for money is crucial for establishing equilibrium in the Credit Market while in Classical Theory, equilibrium in the Credit Market is achieved via the equality of Savings and Investment. As such, the existence (or not) of the “Cash Box” serves as a crucial way to distinguish the two theories. A class rule is, “If it’s Keynesian it will use CASH; if it’s Classical, it will not.”

Y

X

Cd

PrM

CrM

I

S

MD

LaM

MS

The Great Recession was (and continues to be, as I write in 2018) characterized by massive levels of excess bank reserves. They serve as the most tangible example of Money Demand, but money demand has long been considered important, even if it has not generally been fare for introductory courses. A simple way of visualizing the demand for money can bring discussion of money demand into the domain of principles. One can imagine ‘money under the mattress.’ One can see money coming out CASH (in the direction of the arrow in the diagram) as indicating a decrease of the demand for money (someone is letting go of money) and an increase of the velocity of money (Money that was “sitting around” is now moving.) The arrow can be reversed to show the opposite cases. This will get considerable attention as we go.

An implication of CASH is that it effectively disconnects F, S and T (the Keynesian leakages) from E, I and G (the Keynesian injections), since the Credit and Foreign Exchange Markets do not necessarily equate these. If there are changes of the monetary variables (MD and MS) there is no guarantee that the National Savings Identity holds at any moment.

**SOLVING THE SYSTEM**

Solving the system of equations above results in the equation X = Y + MD + MS. This says that the economy will have Spending equal to an initial level of Income unless either MD or MS changes. **Absent a change of MD or MS, GDP cannot change!**

(Since Y indicates the change of Income it is generally taken to be 0 in numerical exercises. The equation thus often appears as X = MD + MS)

Consider how the Equation of Exchange (to be explored later) explicates this. We all know MV = PQ, PQ and MV being just two statements of nominal spending – what I am calling X. Saying

X = MV illustrates that nominal GDP can change only if at least one of two things happens. Either M (MS in my treatment) must change or V (MD in my treatment) must change.

This is what X = MD + MS says.

The Quantity Theory actually goes further. By assuming the constancy of velocity (MD = 0 in my treatment) the theory posits that nominal GDP changes if and only if there is a change of the money supply.[[9]](#footnote-9)

My model further asserts:

-- expansion (X > Y) requires MD + MS > 0

-- contraction (X < Y) requires MD + MS < 0

See the Appendix for proof. These conditions, slightly disguised, are the Keynesian assertions that that economic expansion (contraction) requires that Injections be greater than (less than) Leakages.

One can, without even demonstrating the algebraic details, present the equation X = MD + MS as a description of every problem that ***CirF*** can do. It serves as a check on the problems to be worked. It also accomplishes a neat theoretical dichotomy.

Keynesian Theory –

**Fiscal policy** is effective if and because it can change Money Demand

**Monetary policy** is ineffective if and when changes of the money supply are offset by changes of money demand.

Classical/Monetarist Theory –

**Fiscal policy** only causes crowding out. If neither Money Demand nor Money Supply changes, when GDP cannot change. Any change of government spending is offset by spending changes elsewhere.

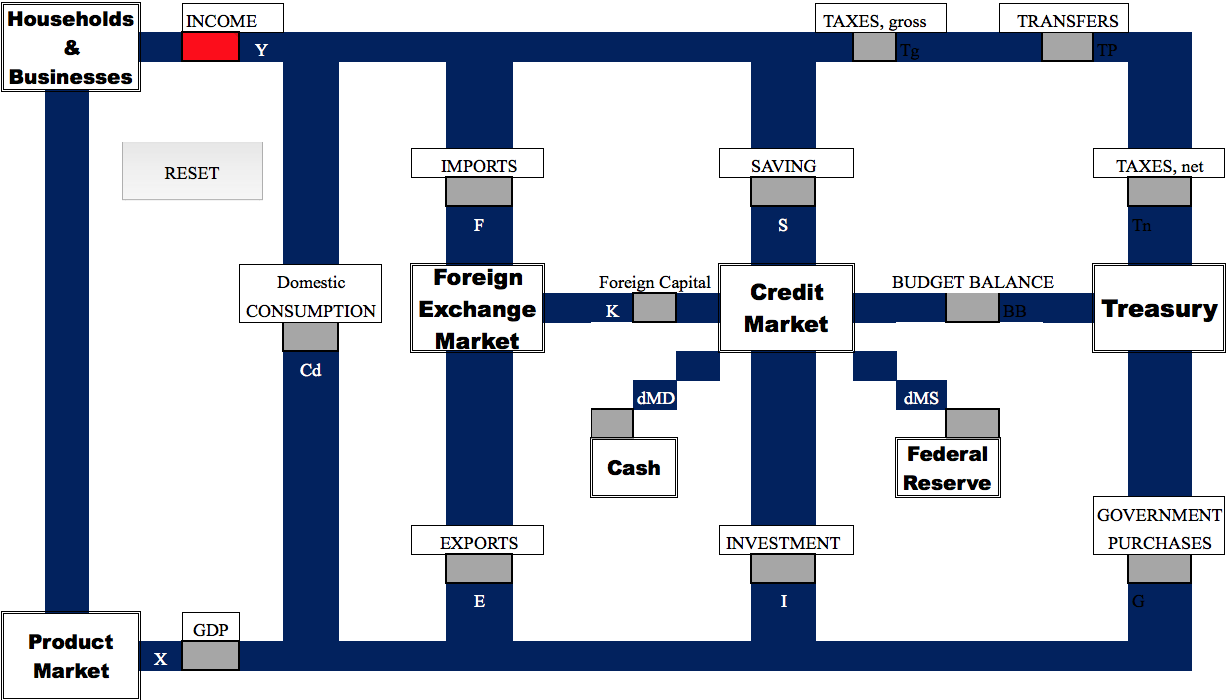
**Monetary policy** can change nominal GDP.

**NUMERICAL EXAMPLES ON THE COMPUTER. FLAG MODE**

Adding numbers to these diagrams dramatically increases their value. I am going to use the computer incarnation of CirF for illustration at this point. In fact, I use the computer sparingly in class. Hand-drawn diagrams are the delivery and testing mechanism. ***CirF*** exists in two modes: Flag and Market. Let’s start with Flag, which corresponds closely to how the material is done in class.

To see how this works, open the Excel program Program\_FlagMode (enable macros). Imagine as you read that these diagrams are being drawn and the exercises are being done on a board for students taking notes and working problems as homework. The computerized diagram has never been a crucial part of my delivery.

To start, hit the “RESET” button. Locate the “SHOW” buttons. Set them all to “SHOW”. This displays the entire model for an overview. The diagram illustrates the equations that describe the economy:



1. Y = C + F + S + Tn

2. X = C + E + I + G.

3. G + TP = Tg + Def

4. Tn = Tg – TP.

5. F = E + K

**The procedure** for all problems is to enter values that represent *the change of* variables. (This is why Y is zero. Y is actually the *change* of income.) *Values are entered in the grey cells*. Generally the first variable changed is the ‘given’ of the problem. Yellow ‘Flags’ appear, indicating that one of the above equations does not hold. It is then up to the user to find values for the other variables that result in all Flags being off. [[10]](#footnote-10)

The red color at Income indicates that we will generally not change the value of income in these problems. We are looking to describe the effect of exogenous changes occurring *at a given level of income.* Income itself comes from spending. No problem ever starts with “Suppose Income changes” or “Suppose Total Spending changes.”

To start with a simple problem, uncheck all the SHOW boxes. What remains is what was described as “the simplest model to be used.”

The Flags appear:

|  |  |
| --- | --- |
| **AT** | **IF** |
| Households & Businesses: | Y ≠ C + S |
| Product Market: | X ≠ C + I |
| Credit Market: | S ≠ I |

**Example 1**. “What happens if Consumption increases by $50?” (Classical answer)

Type the number 50 into the grey box beneath “Consumption.” Two yellow “Flags” appear. They indicate that the corresponding equations describing the circular flow do not hold. Your job is to fix this by entering more numbers. Typically one starts at the upper left and moves roughly clockwise around the diagram, finishing at GDP.

So … reduce Saving by 50 (enter -50). (“If we Consume more, we must Save less.”) The Flag at H/B goes off since we now have Y = C + S, but the Credit Market is now out of equilibrium (i.e. it turned yellow). To fix that, enter -50 for Investment. (“With less Saving, we can lend less.”) With this, two flags disappear and the economy is in equilibrium. The problem is solved. What have we learned?

LESSONS:

1. If you consume more, you must save less.

2. Opportunity cost (or “crowding out”) is at work. Someone spending more leads to someone spending less.

3. The amount we consume, because it ultimately impacts S and I, has implications for how fast this economy will accumulate capital and, therefore, how fast it will grow in the future. The decrease of Investment does not bode well for the future.

4. X, total spending, did NOT change. This is significant in that it points in the direction that denies the efficacy of expansionary fiscal policy. Note this is consistent with X = MD + MS (and the Quantity Theory) in that there has been no change in either of the monetary variables, so X cannot have changed.

The next problems to be solved are:

1. what if S falls by 50? This is identical to the first problem. If C rises, S *must* fall.

2. what if I falls by 50? This looks identical to the first two problems, but later analysis proves the two cases to be somewhat different. (Specifically, in the problem of C rising – aka S falling – interest rates should rise; in the case of I falling, interest rates should fall. This can be mentioned briefly and re-examined when the use of Supply and Demand in the Credit Market is available.)

3. change the same three variables -- C, S, I – in the opposite directions from the first three problems.

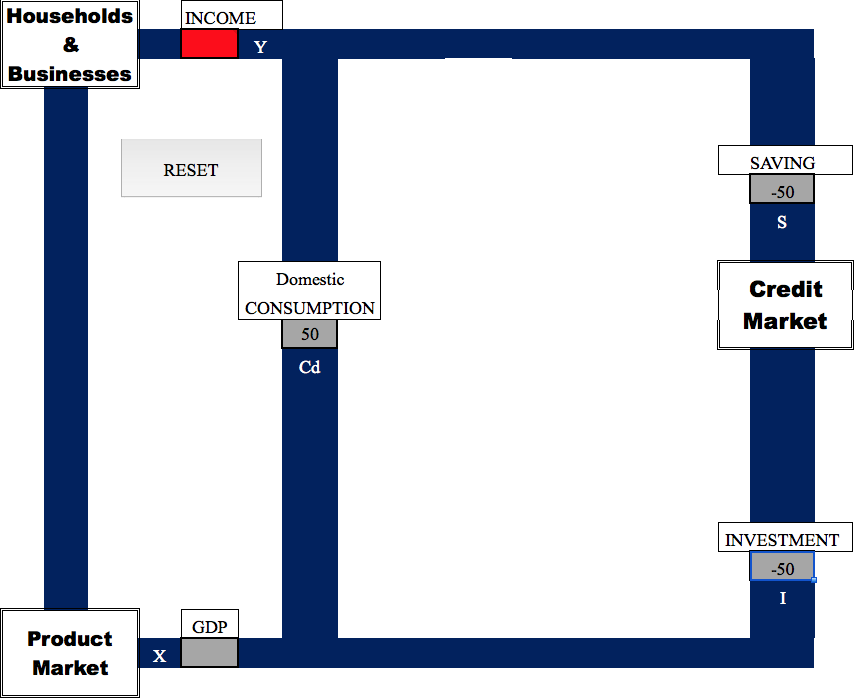
The diagram shows the results of the three problems:

a. Change Consumption by 50

b. Change Saving by -50

c. Change Investment = -50

We have essentially exhausted what this model can do. It is not much, but it has revealed some profound concepts, not least of which is the trade-off of Consumption (now) and Investment (the future). Hopefully, discussion has explicated the importance of Investment to long run growth.



We have also revealed a spectacular weakness in this model. According to the explorations so far, we have a world in which nominal GDP never changes. All we are doing is rearranging the *types* of spending without affecting the total.[[11]](#footnote-11) This is obviously unsatisfying. The solution to this weakness lies in the equation X = MD + MS. Let’s tackle that problem now.

**The Money Supply.**

LESSON: changing the supply of money can cause nominal GDP to change.

If the money supply is increased, that increase will raise spending (aka nominal GDP).[[12]](#footnote-12) From the perspective of the reality of the model this is big. It means we now have some way of accounting for changes of GDP. In terms of the Quantity Theory, this is equivalent to seeing that M can change nominal GDP. Probably a brief description of the Fed is in order. The appropriate level of detail about the Fed, the money creation process and the pre-Fed financial world are pedagogical challenges. I have opted for rather little information at this point.

**Example 2. MS = 50.**

RESET. SHOW the Fed. The model now has the ability to discuss changes of the money supply.

Enter a number (I use 50 a lot) in the box by the Fed. The Credit Market flag lights up. Resolve this by raising I by 50. That is, banks found customers for the $50 made available by the Fed. The only remaining Flag is at the Product Market. This is resolved by raising X by $50. Nominal GDP has changed.

Here comes a serious challenge for econ teachers. This is, as far as I am concerned, the end of the problem. That is, the problem says, “The effect of increasing the money supply is to raise nominal GDP; an expansion occurs.” The problem ends with the economy out of equilibrium. Clearly the problem is not really done: the increase GDP will raise Income, which will raise Consumption, etc. What has been curtailed is a discussion of the multiplier process. I contend that the multiplier process is a distraction from the lesson intended.[[13]](#footnote-13)

*CirF* often results in this outcome. A problem often ends with, “X changes.” Essentially these problems are content to say that an expansion (or contraction) has occurred, without saying how large that expansion will be.[[14]](#footnote-14)

How to deal with the multiplier:

1. Acknowledge that the problem is in fact not done; that we have left aside the question of how large the expansion (or contraction) would be, but declare that problem to be, “Outside the scope of this class.”

2. Use the ***CirF*** module specifically created to demonstrate the multiplier. (I typically didn’t.)

3. Use a brief, non-numerical explanation. (“If I get a job, I will spend more, so someone else will spend more …”)

4. Admit to yourself that multipliers – both spending and money – are smaller, and thus less deserving of our time, than we were led to believe and teach.

**Other Problems.**

Change the Money Supply any way you want and work through the rest of the problems any way you like. All solutions will lead to the conclusion that X changes by an amount equal to the change of the money supply. It needs to be stressed to a class that we are not making a quantitative prediction: I do not mean to say that we always observe a change of nominal GDP equal to any change of the money supply. This is, at best, predicting the direction of change.

We have now (for the moment) explicated Classical theory 1.Money moves nominal spending(“That’s why they are called ‘monetarists’ and why he wrote *A Monetary History*.”) 2. Spending changes by one sector cause ‘crowding out’ of some other sector(s) – aka opportunity cost.

**You figure it out**

I would like to point out the somewhat different pedagogical approach at work here. When the student is presented with a problem, ***CirF*** provides the tools to find the answer, and verifies that an answer has been found. ***CirF*** does not give you the answer. This seems to promote investigation over memorization.

As will be addressed later, it is possible to get different answers for almost any problem. There are generally better and worse answers. Understanding the difference is part of the process.

**CASH and KEYNES.**

Using the model we have at this point, it is not possible to demonstrate fluctuations of nominal GDP without a change of the money supply. CASH now steps center stage.[[15]](#footnote-15)

To show Christmas, RESET the model. SHOW CASH. Enter C = 50.

|  |  |  |  |
| --- | --- | --- | --- |
| Flag | because | fix it | because |
| H/B | We Consume more | S = -50 | If we spend more we must Save less |
| CrM | Less Saving | MD = 50 | we can finance out of Cash |
| PrM | More C | X = 50 | the economy has expanded |

The role of CASH is to illustrate that, if money is available, it is possible for someone to spend more without causing anyone to spend less. The result is an economic expansion. Note that this flexible demand for money implies a flexible *supply of credit.* This is what we would expect in two cases: 1. the short run and 2. an underemployed economy. These are precisely the elements that Keynes sought to add to Classical theory.

If this seems esoteric, consider that I take this to be a picture of what happens every Christmas. Somehow we find the money to finance an expansion of total spending. You don’t have to be very Keynesian to believe that it is possible for nominal GDP to change.

If one allows for MD then almost any change of spending behavior can lead to economic expansions and contractions (to X being positive and negative). Importantly this will point in the direction of the possibility of expansionary fiscal policy, Keynes’s solution to the Depression. And we can see why this kind of behavior cannot go on forever – we would run out of CASH eventually.[[16]](#footnote-16)

Here we have what Keynes promised – a General Theory – a much fuller picture of short run macroeconomic changes and of the workings of an underemployed economy: Hence my enthusiasm for the inclusion of CASH in the model. ***CASH is the only endogenous agent capable of explaining changes of nominal GDP.***

**The liquidity trap.** In ***CirF***, a liquidity trap is modeled by entering (say) 60 for MS (money from the Fed) *and* entering -60 for MD – money going into CASH. We have here the Keynesian proposition that monetary policy may not be terribly effective, expressed in the extreme form of the liquidity trap. Many people find the extreme liquidity trap implausible but might consider the exercise shown here. (I.e. MS = 60, MD = -20, I = 40.) In addition to illustrating a “partial liquidity trap,” it can be used to discuss lags in monetary policy effectiveness since Keynesianism is the short run model.

Note that in every problem, X = MD + MS.

Allowing for the possibility that MD might change by small amounts also means that it is possible to be theoretically middle-of-the-road, that one need not take a hardline “all or nothing” approach to theory or policy. There is plenty of middle ground.

PrM

CrM

60

-20

40

40

We have now established a major element of the entire model: The inclusion and use of CASH determines whether, and to what extent, one describes the economy as behaving according to Classical or Keynesian theory. Any problem can be done twice – with and without CASH. (Actually, given that CASH can vary by any amount, one can do any problem any number of ways.) Having established that, we can go back and add the two remaining sectors to the model – a fuller treatment of fiscal policy and the foreign sector.

The Appendix **Examples\_Flag**  includes a variety of examples to explicate the preceding and the following topics. ([Click here to go there](#Examples_Flag)).

**Fiscal Policy.** One can now add fiscal policy to the model by SHOWing the TREASURY. You now have the option of changing Gross Taxes, Transfers, Net Taxes, Government Purchases and the Budget Balance. The same rules apply: change what you want and flags will alert you if any equation is not met.

The two new Flags are:

1. The Treasury: Net Taxes = Gov’t Purchases + Budget Balance (Note a deficit must be entered as a negative number)

2. Net Taxes: Net Taxes = Gross Taxes – Transfers

**The Tax and Transfers Worksheet**. Problems involving changes of Gross Taxes (Tg) or Transfers (TP) immediately cause a problem. A change of either Tg or TP must result in changes of Consumption and Savings. The question is, “How much of each?” The worksheet suggests values. The hypothesis embedded in the worksheet is that Tax changes – effecting mostly the rich – have a fairly large impact on Savings, while changes of Transfers – effecting mostly the poor – have larger effects on Consumption. This has implications for the effects of various fiscal policy changes.

**The Foreign Sector**. SHOWing Foreign Exchange allows one to explore issues of Exports, Imports and Foreign Capital Flows. The FLAG at the Foreign Exchange Market indicates that Imports must equal Exports plus Foreign Capital Flows. F = E + K.

This point actually deserves some thought, at least on the part of the teacher. The logic of Imports = Exports + Capital Flows is that a currency is essentially useless outside of its country of original. This statement is less true of American dollars than of any other currency in the world. Mexican pesos are really only good when in Mexico. So any peso that “leaves” Mexico will come home; if not, it is a worthless piece of paper. There are essentially two ways for the peso to return: as payment for an export or as a capital inflow.

But US dollars (and to a lesser extent the currencies of other important countries) are different. The US dollar is a unit of exchange throughout the world. It is not necessary for a dollar to return “home” to be of value. I am here pretending that dollars, like other currencies, must come back to their nation of origin either by buying goods (US exports) or as bank deposits (Capital Flows). One could (should?) draw a line from the Foreign Exchange Market to CASH to describe dollars that are, for instance, held by the world as international reserves. I mention this and then ignore it. The level of attention to this point is clearly a matter of teacher preference.

It will become apparent that even adding the Treasury and the Foreign Sector does not allow for GDP to change in the absence of monetary changes. X=MD+MS still holds.

***SUMMARY.***

***CirF***, so far,is a look at the economy’s demand side. It has as its objective, the description of how and why X – nominal GDP – and its components change. *En route* to this end it is capable of illustrating many topics and motivating much discussion. Not least of these are the side-by-side comparisons of Keynesian and classical/monetarist theories.

It is possible to illustrate the standard arguments and counter-arguments for a variety of issues. Notice that, so far, the differences between Keynesian and Classical economics rest on a single variable, here called CASH, but also known as the degree of flexibility of the demand for money, aka the velocity of money, aka the elasticity of supply of credit.

Second, it becomes apparent that we have for too long cast the theories as the monetarist/Keynesian *debate*, when we should be seeing the monetarist/Keynesian *synthesis*. If one takes the Keynesian model as a description of (a) the short run and (b) the workings of a depressed economy, and Classical theory as its complement, we arrive at a much fuller picture of economics, two halves of a whole. Furthermore, much argument reveals itself as either politically motivated posturing or the result of profound disagreements based on personal views of what is important: growth versus stability or equity versus efficiency. These are non-trivial matters, and they show the possibility (necessity?) of acknowledging the role of personal beliefs and ethical and political considerations in economics.

***CirF*** is a truly useful piece of macroeconomic pedagogy: It allows for illustration of a wide range macro topics, it is amenable to numerical exercises, and it shows how the four markets are all connected -- how changes in any one part of the economy must induce changes elsewhere. It is, in short, a macro, general-equilibrium tool, as simple and as profound for its purposes as supply and demand is for partial equilibrium analysis.

The next extension of ***CirF*** is the inclusion of the supply side and the incorporation of Supply and Demand description of markets. Before tackling that, however, another issue – the use of rates of change – needs to be explored.

**AN ASIDE: *CirF* meets SnD**

There are some unexpected subtleties in ***CirF.*** For instance, look at the problem of increasing the money supply. One can proceed as follows:

Given: ΔMS = 50

|  |  |  |  |
| --- | --- | --- | --- |
| Flag | because | fix it | because |
| CrM | change of MS | S = -50 | ?? It is a solution that eliminates a flag |
| H/B | Less Saving | C = 50 | Saving less, we will Consume more |
| PrM | More C | X = 50 | the economy has expanded. X = MS |

I would take a *better* answer to be that Investment rises by 50. But the program accepts the decrease of Saving as a correct solution. Is this answer defensible? The question is, *why* would there be reduced saving and increased consumption in response to an increase of the money supply?The answer – even though ***CirF*** does not “know” it – is that interest rates will fall. It is usually true (as far as I can discover, *always* true) that solutions to ***CirF*** can be defended, even when the reason may not be immediately evident.

**A procedure to test that thought.** Let’s proceed by assuming that the response to any exogenous change will be to change *all* available endogenous variables in the direction that tends to “solve” the problem. Is this procedure reasonable? I will suggest, “yes.”

Example #1: Using the full circular flow (SHOW all), show an increase of the Money Supply by 50.

Because we are adding money into the Credit Market, we should reduce other flows *into* the market and increase flows *out of* the market. An increase of the Money Supply (more $ in) would then cause:

1. in the Credit Market:

a. less Saving (less $ in),

b. more money going into Cash (more $ out)

c. a foreign capital outflow (more $ out)

d. more Investment (more $ out)

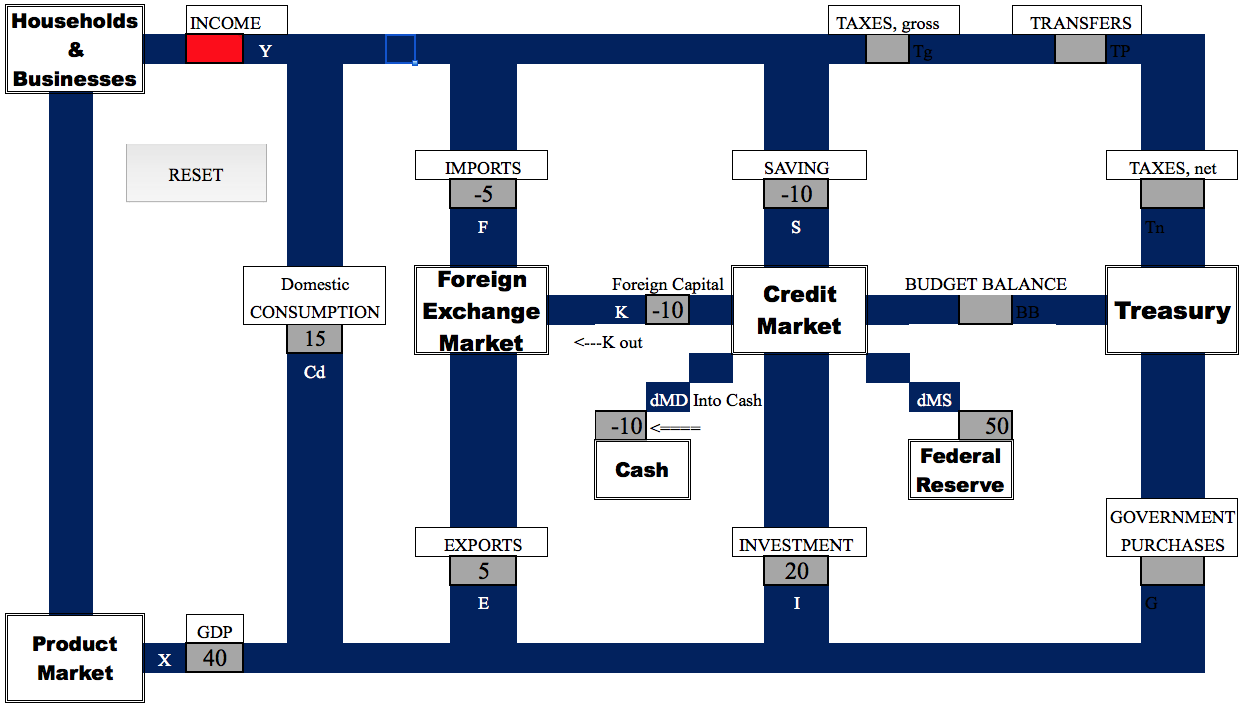
2. in the Foreign Exchange Market, more money (the capital outflow) into Foreign Exchange should cause:

a. a decrease of imports (less $ into FxM) and

b. an increase of exports (more $ out of FxM).

Finally, we can use (an increase of) Consumption to reconcile the whole flow. A possible solution is shown. As always, X = MS + MD.

Effects of MS = 50



I submit that all of these changes make economic sense. An effect of increasing the money supply is to reduce interest rates. Lower interest rates would be expected to cause the illustrated effects: less Saving, a Capital Outflow, more Investment and Consumption and an increase of Money Demanded.

In the Foreign Exchange Market, the lower demand for US dollars (due to reduced interest rates) plus a capital outflow should reduce the exchange rate. A lower exchange rate encourages fewer imports and more exports.

The rise of domestic consumption is a combination of the effects of low interest and exchange rates. All of the effects posited by following the “procedure” seem reasonable.

I believe the point is this: Any exogenous change to a market (the increase of the money supply in this case) can be seen as an input of energy. *Markets attempt to dissipate energy in as many directions as possible;* markets operate so as to ‘change everything’ so that no one thing changes more than necessary. I take this to be a point worth making, more so in micro than macro.[[17]](#footnote-17)

Example #2: A change of Government Purchases, financed by an increased deficit, with no change of Taxes. (Note that since the government does not operate according to Supply and Demand, the rule of ‘change everything’ does not apply. If it did, we would raise Taxes some, reduce Transfers some and Borrow some). Below is a possible solution, based on the proposed “procedure.”

The budget deficit, takes money *out* of the Credit Market, causing:

a. more Saving, (more $ in)

b. less Investment (less $ out)

c. a capital inflow (more $ in)

d. less Money Demanded (more $ in)

All of these are consistent with a deficit raising interest rates.

In the Foreign Exchange market, rising US interest rates increase the Demand for Dollars and, hence, the exchange rate. The higher exchange rate encourages Imports and discourages Exports and creates a (larger) trade deficit.[[18]](#footnote-18)

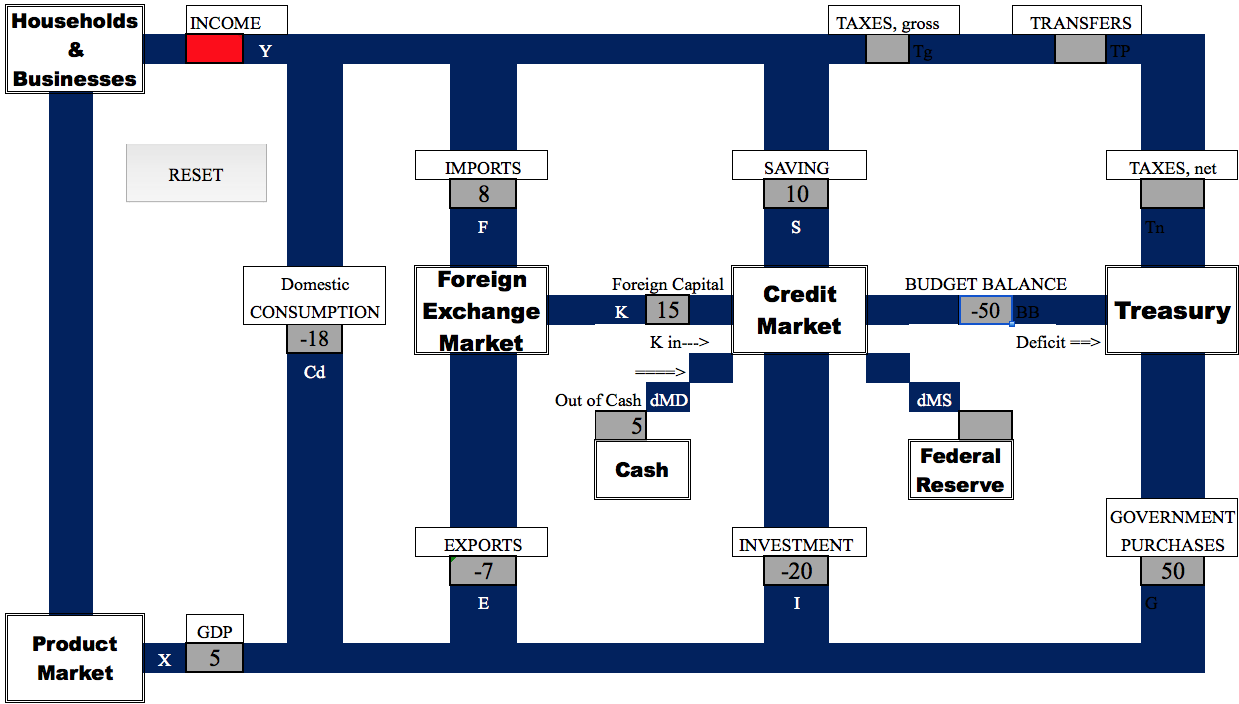
The fall of domestic Consumption is motivated by both higher interest and exchange rates.

I feel that this level of complexity does two things:

1. It confirms ***CirF***’s ability to get the “right” answer, even to complex solutions.

2. It betrays ***CirF***’s best use, which is in providing simple answers. That is to say, I do *not* see problems of these types as appropriate for a principles class. I am happy to do a problem that says an increase of the money supply of 50 will lead to Investment rising by 50 and leaving it at that.

Supply and Demand offers an additional layer of sophistication by adding the role of prices in determining *why* the changes shown by ***CirF*** are brought about by a market system.



Effect of ΔG = 50

This also explains why I think ***CirF*** is best done before Supply and Demand. It provides simple, straightforward answers to a variety of problems, allowing Supply and Demand to add sophistication and complexity to those answers.

**II. RATES OF CHANGE 1.**

**Supply and Demand**

I believe that macro instruction should take place in the most relevant vocabulary. For the most part, that is the vocabulary of rates of change. The inflation rate is more important than the price level; the real growth rate matters more than the level of real GDP; the rate of money growth matters more than the amount of the money supply. By “more important” and “matters more” I mean for the purposes of reading the popular press and participating in the discussion of macro topics. An interesting distinction is that the questions, “What were real GDP and the price level in the year 2018?” have no meaningful answers. These numbers change whenever the base year changes. The growth rates, however, remain unchanged.

I use a fairly consistent notational scheme: capital letters denote levels (P for the price level, Q for real GDP, X for nominal GDP, M for the money supply, etc.), lower case letters denote rates of change (p for inflation, q for the real growth rate, x for nominal growth, m for the rate of monetary growth, etc.) See [Appendix](#Notation_Appendix) for a complete listing. See [Appendix](#RatesOfChange_App) for more comments on AD/AS instruction, including a defense of the use of rates of change.

**The Product Market**

3

**Figure 7.** AD/AS with rates of change

q

p

3

AD

AS

3

I use AD/AS graphs that use inflation (p) and real growth (q) as the variables on the axes. Note the following in Figure 7:

a) Negative numbers become important: it is now possible, and important, to distinguish graphically between disinflation and deflation; between slow growth and recession. Compare this to standard AD/AS analysis, which proclaims that any decrease of AD creates deflation and recession.

b) I usually use p = 3 and q = 3 as my starting place for examples, in as much as those values represent a fairly good impression of the average rates of inflation and growth in the US, and are easy to remember.

c) It is significant to describing the US economy that the AS curve passes through the second quadrant, rather than the fourth. In most of twentieth century US, a decrease of AD has generally created recession before deflation. The 1920s may form an exception to that generalization.

Using rates of change means that converting a nominal growth rate into a real growth merely involves subtracting the inflation rate.

For GDP: q = x – p

For interest rates: r = i – p

For wages: w\_real (wr) = w – p

**Curve Shifters**

I find that for principles purposes I can say that AD is synonymous with total spending. Anything that raises total spending raises AD.

AS is shifted by the quantities and costs of the factors of production. Under this we can include wages, energy costs, technological change, business taxes and regulation.[[19]](#footnote-19)

Using rates of change provides the bonus of bringing the insights of the Phillips Curve -- short-run or long -- back into use. If one assumes that real growth is inversely related to the unemployment rate (which is a decent principles-level truth), then AD/AS is merely the mirror image of the Phillips curve.

Using rates of change has its pitfalls and raises interesting questions about the difference between “causes inflation” and “raises the price level.” The oil-price increases of the 1970s are shown as “causing inflation” in this treatment; in standard treatment they are represented as “raising the price level.” On the principles level I don’t think the difference is profound. The fact is, we all tell tales and half-truths in teaching macro. The tales and half-truths are different if you use this method. I prefer the stories I tell in this fashion, but that may well be a matter of taste.

The long-run AS curve, drawn vertically, states that there is an equilibrium *growth rate*, rather than an equilibrium *level* of real GDP. I find this appealing.

**The Labor Market**

I also present the labor market using rates of change: the variables on the x-axis n, is the growth rate of employment; on the y-axis is either w, the growth rate of wages, or wr, the growth rate of real wages (wr = w – p). Personally I think the labor market works better if one thinks of the price as being real wage growth (wr), though I rarely bother to make the distinction in class. I am far less likely to use numerical examples in the labor market than in the product market so the issue can be easily sidestepped. (The computerized Market Mode Circular Flow Diagram has a “real” or “nominal” option in the labor market.)

1

**Figure 8**. The Labor Market

n

wr

2

DL

SL

Through which quadrant the supply curve passes is an interesting question. (I noncommittally drew it through the origin). That depends partly how one defines “wages.” I would hazard a guess that the nominal Supply of Labor passes through the second quadrant and the real supply curve through the fourth. This predicts the following: a decrease of the demand for labor will first cause real wages to fall, then cause employment to fall, then cause nominal wages to fall.

I mention this not because it necessarily belongs in a principles class, but to point out that thinking in rates of change has a way of throwing new light on old subjects even for those of us quite familiar with them.

**Labor Market Curve Shifters**

Demand shifters Supply Shifters  
real GDP size of the labor force

labor productivity taxes

**The Other Markets, The Other Variables**

**When NOT to use rates of change:**

The two other macro markets I use are the Credit Market (I prefer the flow market for credit to the market for the stock of money) and the Foreign Exchange Market. See Figures 9 and 10 for my presentations of those markets. I do *not* represent these two markets using rates of change. Interestingly, both of their “price” variables are already rates.

This means that the left side of the CF diagram is done in rates of change, the rest in done in levels.

**The Credit Market.** L and B stand for Lending and Borrowing respectively. The price variable in the Credit Market is the interest rate (whether this is better real or nominal is unclear to me. In the computer versions real/nominal is an option).

i0

**Figure 9.** Credit Market

Z, X

i

Z0

X0

B

L

There are two quantity variables. The first is Z – defined as the dollar value of credit; the second is X, nominal GDP. The rationale for putting both credit and spending on the axis is that the two “always” move in the same direction. I use the Z variable when the issue at hand is confined to the credit market (E.g. “What is the effect on interest rates of increasing money growth?”). When the X (spending) variable is used, the result is essentially an IS/LM graph -- with no four-quadrant derivation required! The effect is to link events in the Credit Market to results on the Product Market.

e0

**Figure 10**. Foreign Exchange Market

$

e

$0

D$

S$

**The Foreign Exchange Market** uses the exchange rate (e) as its price variable and the number of dollars traded ($) as the quantity variable. The demand for dollars is seen as equal to Exports + Foreign Capital (D$ = E + K); the supply of dollars is equal to Imports (S$ = F).[[20]](#footnote-20)

The relationship of the four macro markets is well presented by the circular flow diagrams. Here is a way to picture the model this creates. Adopt the fiction[[21]](#footnote-21) that nominal spending is determined by the Credit Market and the Foreign Exchange Market (or in IS/LM space) so that nominal GDP (and its growth rate) is exogenous to the Product Market. Clearly this is a simplification, but it makes much exposition radically easier. The job of the Product Market is now seen as merely dividing a given rate of spending into its inflation and real growth components.

**III. RATES OF CHANGE 2.**

**The Equations of Exchange**

The famous equation of exchange (MV = PQ) is actually the combination of two separate descriptions of total spending. Each of these two equations is useful in its own right for presenting a variety of issues. The utility of the two equations is greatly increased when they are recast in their rate-of-change forms.

Using X to stand for nominal GDP, the two equations are: X = MV and X = PQ.

As approximations, these equations can be recast as:

1. the **Credit Market Equation**: x = m + v

2. the **Product Market Equation:**  x = p + q

That is: m + v = x = p + q

WHERE:

x = nominal GDP growth rate

m = growth rate of the money supply

v = rate of change of the velocity of money

q = real GDP growth rate

p = inflation rate

I find each of these equations extremely useful, largely because of their simplicity and their ability to tell stories through numerical examples.

**Justifying the equations**

I have tried several ways to justify the equations to classes. Straightforward description seems best.

-- The Credit Market Equation (x = m + v) is presented as, “For spending to rise, at least one of two things must happen: either there is more money, or the money that is there is being spent faster.”[[22]](#footnote-22)

-- The Product Market (x = p + q) is described as saying, “If spending rises there must be some combination of raising prices and more real output.” (‘Stuff’ is my preferred description of “real output.”)

-- “Trust me that the math of adding the percents is a good approximation of the truth.[[23]](#footnote-23) If you want the details see me after class.[[24]](#footnote-24)”

Changes of v are depicted on CirF as money going into or out of the Cash Box. That is, the velocity of money is considered to be inversely related to the demand for money. The long run constancy of the velocity of money means v = 0. In that case, we are left with x = m, a statement indicating the power of the quantity of money in determining spending and, hence, macro performance, especially in monetarist theory.

**Theories.** These equations are an important part of comparing Keynesian and Classical theories.

1. **Credit Market Equation assumptions:**

In Classical theory v = 0

In Keynesian theory v can change.

This is equivalent to: In Classical theory there is no CASH box; in Keynesian theory there is.

2. **Product Market Equation assumptions:**

In Classical theory a rise of x will lead mostly (entirely?) to a change of p (inflation) with little or no effect on real growth.

In Keynesian theory a rise of x will lead mostly (entirely?) to a change of q (real growth) with little or no effect on p (inflation).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| m | v | x | p | q |
| 6 | 0 | 6 | 3 | 3 |

In numerical examples I typically start with these numbers.

**The Relationship to Supply and Demand and CirF**

The equations become another way to present conclusions about the behavior of the Product and Credit Markets that complement the use of supply and demand and the Circular Flow, especially in the ability to generate simple numerical examples.

The Credit Market Equation relates to the credit market in that changes of m shift the supply curve in the Credit Market. Changes of v, at least those caused by changes of borrowing behavior, such as fiscal policy, show up as shifts of the credit demand curve. This establishes that shifts in the Credit Market, shown by changes of m or v, result in changes of x, as summarized by x = m + v. This is also shown by having X on the x-axis of the Credit Market.

The Product Market Equation has that name because p and q are the endogenous variables in the AD/AS view of the Product Market. If one takes x as being generated in the Credit Market, then it can be treated as (short-run) exogenous to the Product Market. The equation of AD is now p = x - q, an easily drawn, easily shifted curve. AD is equivalent to spending.

The Product Market Equation illustrates that an increase of spending (x) will likely lead to increases of both p and q – an alternative description of the supply and demand result. A supply shift is shown by changing either p or q without changing x.

Another use of the Product Market Equation is in defining “real growth.” Nominal growth (x) is presented as data collected largely from tax records. A brief description of the process of measuring the price of a representative basket of goods is sufficient to tell where the measure of inflation (p) comes from. So what is real growth? It is q = x – p, the part of the extra spending that did not just turn into higher prices; the part that actually bought “more stuff.” We can see, quite literally, that real GDP is nominal GDP “adjusted for (minus) inflation.”

**Some Applications.**

1. A Keynesian increase of Government Purchases. Since there is no monetary policy involved we leave m = 6. Financing G out of CASH means that velocity rises and, along with it, spending rises (x). The effects are salutary – lots of real growth, not much inflation

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | m | v | x | p | q |
| 0 | 6 | 0 | 6 | 3 | 3 |
| SR | 6 | +2 | 8 | 3 | 5 |
| LR | 6 | 0 | 6 | 3 | 3 |

In the LR, spending returns to its 6% level and it appears that nothing has happened. What has happened is that we now have a larger government sector and a smaller private sector. Someone got crowded out.

2. Friedman’s money growth rule. Assume we want zero inflation (p = 0)[[25]](#footnote-25) and that, as quasi-Classicals, we believe that in the Long Run v = 0 and q = q\* (here taken to be q\* = 3). Inserting those numbers into the equations we are led to m = x = 3. Monetary expansion should equal long-run real growth. If you substitute q = 0 for q = 3, you have the Quantity Theory of Money.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | m | v | x | p | q |
| 0 | 3 | 0 | 3 | 0 | 3 |

|  |  |  |
| --- | --- | --- |
| m | v | x |
| 6 | 0 | 6 |
| 9 | -3 | 6 |

3. A liquidity trap looks like:

4. The effects of monetary expansion. **Does money matter?**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | m | v | x | p | q | matters? |
| 0 | 6 | 0 | 6 | 3 | 3 |  |
| 1 | 9 | -3 | 6 | 3 | 3 | no. “Liquidity trap” |
| 2 | 9 | 0 | 9 | 4 | 5 | yes. Looks good |
| 3 | 9 | 0 | 9 | 5 | 4 | yes. Looks less good |
| 3 | 9 | 0 | 9 | 6 | 3 | no. “Money is a veil.” |

5. Supply Side Growth due to increases or improvements of the factors of production or reductions of business costs look like this. Note that by keeping x = 6 we are asserting that AD did *not* shift.

Almost any problem can be illustrated with a numerical example.

|  |  |  |
| --- | --- | --- |
| x | p | q |
| 6 | 3 | 3 |
| 6 | 1 | 5 |

**Procedure**

1. For a general demand change.

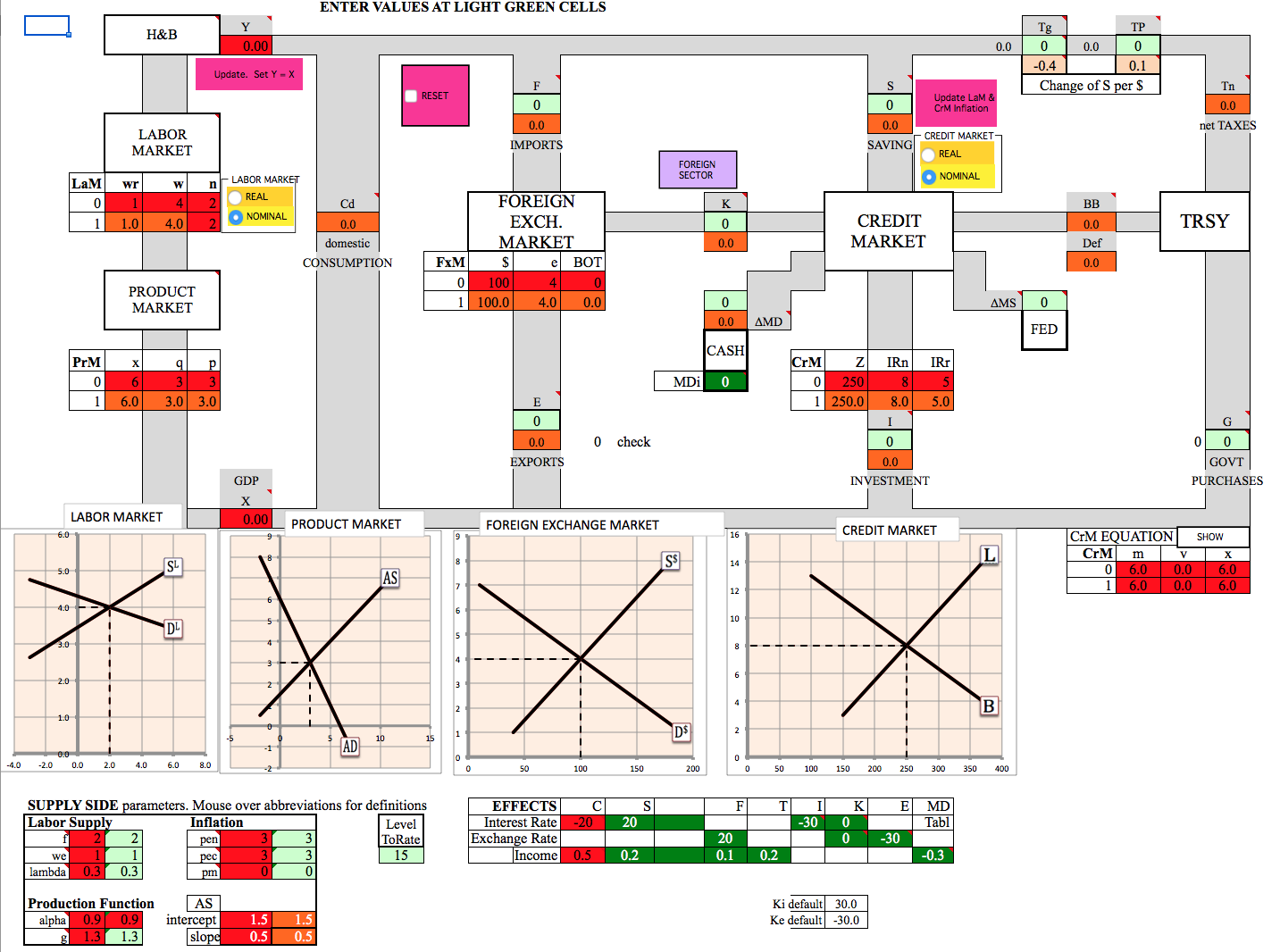
* Change x to show the demand/spending change
* Change p and q, both in the direction that tends to solve the problem. E.g. If x rises, increase both p and q
* Be sure x = p + q

2. For a general supply change.

* Change q in the direction of the supply change
* Do NOT change x (we are looking at a *ceteris paribus* change of supply)
* Change p to keep x = p + q.

In both cases we get the sense (mentioned in a different “procedure”) that markets change “everything” as little as possible.

***IV. CirF Market Mode***

******

[http://HannesK.com/Macro/Program\_MarketMode.xls](http://HannesK.com/Macro/CirF_MarketMode.xls)

***CIRF* MARKET MODE** uses the basic Circular Flow Diagram put to a different use. Market Mode integrates the Circular Flow with the Supply and Demand treatments of the four macro markets – Product, Labor, Credit and Foreign Exchange. In this mode the user enters the value of one or more exogenous variables and the program calculates and presents the values for the affected endogenous variables.

While ***CirF***’s Flag Mode is amenable to easy blackboard presentation, Market Mode requires the computer program. I have never used this program much in class. It gets complicated quickly. I still think it makes good teaching as a higher-level review of the basics. It has served to clarify my own understanding of economics in many ways.

Shown above is the tableau used by the program, which features the four markets as treated by supply

and demand. The user can enter values into any of the light green cells; the program computes and displays the other values.

The program divides the economy into its demand and supply sides. Everything to right of, and including GDP, constitutes the demand side. The fiction (aka “assumption”) adopted is that nominal GDP is determined in the Credit and Foreign Exchange Markets (i.e. in IS/LM Space). That is, nominal GDP is determined by Income, Interest Rates and the Exchange Rate. Nominal GDP is then “presented” to the economy’s supply side – the Product and Labor Markets – to determine output, inflation, employment and wages. While this assumption lacks some elegance it pays off in considerable simplification. One quirk it allows is that the demand side is modeled using levels while the supply side is modeled using rates of change.

ASIDE. The RESET button and various other buttons sometimes look like check boxes. There is no significance to whether the boxes are checked or not.

**THE DEMAND SIDE**

**The Format of the Demand Side Equations**

All equations are linear, of a form such as:

K = Ka+Ki⋅(ir-ir0)+Ke⋅(e-e0) +Ky⋅(Y – Y0).

This particular equation is that of Foreign Capital Flow (K). ir0, er0, Y0 represent respectively the initial values of interest rates, exchange rates and Income.

K (and all the other demand-side variables) is thus determined by:

a. **An autonomous component** (In this case Ka). These are shown in light green. These variables are exogenous and may be changed by the user. ***The primary use of the program is to change these exogenous variables.***These values are initially set to zero. That is, any values entered by the user represent the *changes* from some (generally unspecified) values. A problem could start by saying, “What happens if K rises by 40?” The user would then enter 40 into the green cell under K on the tableau and observe the results.

As can be seen on the tableau, one can change the autonomous values for of Imports, Savings, Gross Taxes, Transfer Payments, Government Purchases, Change of the Money Supply, Change of Money Demand, Foreign Capital Flows, Investment and Exports.

**You cannot exogenously change:**

1. Consumption (it is a residual, used to complete the model)

2. Net Taxes (which are computed as Gross Taxes minus Transfers)

3. The Budget Balance = Net Taxes - Government Purchases (or its negative, the Budget Deficit)

4. Total Spending = the sum of the types of spending 5. Total Income (more on that later).

No problem should start by asking you to change one of these variables.

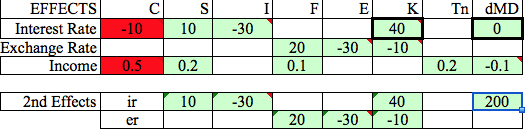
|  |
| --- |
| Following is a description of some of the more esoteric features of the program. One can skip ahead to the heading labeled **A Summation of the Demand Side** |

**b. The Effects**

Beneath the tableau is the table showing “Effects.” These are the slope parameters used in computing results. In the above example,

K = Ka+Ki⋅(ir-ir0)+Ke⋅(e-e0) +Ky⋅(Y – Y0),

the “effects” are the values for Ki, Ke and Ky. The user can input values for these.



Continuing with K as the example, the value of 40 under K in the row “Interest Rates” (the parameter Ki) indicates that K will change by 40 for every 1% that interest rates change.

The -10 in the next row down (Ke) indicates that every time the exchange rate rises by one, Capital Inflows will fall by 10.

With a few exceptions (to be discussed), the user can just accept my values for the “effects.” If these seem unacceptable then I imagine that a user would experiment with these values, find numbers that were satisfactory and then not change them very often.

The parameters shown are those that have been programmed. The blank cells indicate that I thought it best to make that particular value zero.

The notation scheme and the variables included are shown here. ## indicates parameters not used.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| EFFECTS | C | S | I | F | E | K | Tn | dMD |
| Interest Rates | -Si | Si | Ii | ## | ## | Ki | ## | MDi |
| Exchange Rates | ## | ## | ## | Fe | Ee | Ke | ## | ## |
| Income | 1-Sy-Fy - Ty | Sy | ## | Fy | ## | ## | Ty | dMDy |

**Some slopes of interest**

1. Ki – the effect of interest rates on the foreign capital inflow. If this value is zero, the foreign exchange market is largely disconnected from the domestic economy. This is useful if one wishes to ignore the foreign sector. A non-zero (positive) value for Ki will mean that the foreign sector responds to changes of domestic spending, by way of any changes of interest rates.

2. MDi – the effect of the interest rate on Money Demand. This is an important parameter that separates Keynesian and Classical theories. A value of zero gives a completely classical result; the larger the value, the more Keynesian the result.

The red cells indicate that the “effects” on C cannot be exogenously changed. The interest rate effect on Consumption is set equal to the negative of the interest rate sensitivity of Saving; the marginal propensity to Consume is one minus the sum of the other propensities.

**Changes of Income** (Y) are treated differently than other variables. Income can be changed by hitting the button labeled “Update Income.” The result is that the existing X (spending) is pasted in as the new level of Y and the program is recomputed. This illustrates the playing out of the multiplier process. In the table of “effects” the values in the row labeled “Income” are marginal propensities. To see the full multiplier play out, one must repeatedly press the Update button until nothing changes. As I say elsewhere, I am largely inclined to ignore multipliers so I am happy to leave this facility unused. But there it is.

**A Summation of the Demand Side**

The entire demand side is a system of two equations in interest rates and exchange rates (Income, Y, is treated as exogenous at any moment). When the system is solved for interest and exchange rates, all other variables can be computed. These values are displayed on the red/orange cells.

We now have values for all the variables:  
Y = Cd + F + S + Tn

X = Cd + E + I + G, and

the budget deficit, Gross taxes, Transfers, Capital inflows (equal to the negative of the trade deficit),

Money Demand and Money Supply

The results in the orange cells are the combination of any exogenous changes, plus the effects of changes of interest rates, exchange rates and income.

Having solved for all those variables, one can compute X. So, the right (demand) side of the diagram culminates in the determination of X aka Aggregate Demand aka Nominal GDP aka Total Spending. To repeat what was said elsewhere: The fiction of the model is that the Credit Market, the Foreign Exchange Market and the Treasury together determine nominal spending (X). The model will now convert that number to x – the growth rate of nominal spending – via x = 6 + X/LevelToRate.[[26]](#footnote-26) This rate is then handed to the supply side of the economy to see how much of that spending turns into inflation and how much turns into real growth.

Likewise (using LevelToRate) the program turns the Money Supply and the Velocity of Money into rates of change as displayed by the “Equations of Exchange.” It is now the job of the Supply Side to resolve x into inflation and real growth and to determine the growth rates of wages and employment.

**2. THE SUPPLY SIDE**

The important variables on the Supply Side – those in the Product and Labor Markets – are presented primarily as rates of change.

**The Supply Side Equations**

The supply side of this economy is composed of:

1. a production function from which can be derived a demand for labor curve (Wage = Marginal Revenue Product)

2. a labor supply function

Those two elements are sufficient to derive the elements of the product and labor markets.

EQUATIONS, VARIABLES and VALUES

|  |  |  |  |
| --- | --- | --- | --- |
| **Equation** | | **Level Form** | **Rate of Change Form** |
| 1 | Aggregate Demand | X = P⋅Q | x = p + q |
| 2 | Production Function[[27]](#footnote-27) | Q = G⋅Nα | q = g + αn |
| 3 | Labor Demand | W = αP/Pm⋅G⋅Nα-1 | w = (p – pm)[[28]](#footnote-28) + g  - (1-α)n |
| 4 | Labor Supply | W = We⋅Pn⋅(N/F)λ | w = we+pen + λ(n-f) |

|  |  |  |
| --- | --- | --- |
| **Variable** | **Abr.** | **Initial Value** |
| production function labor coefficient | α | .85 |
| labor force growth rate | f | 2 |
| labor’s expected inflation | pen | 3 |
| labor’s expected real wage growth | we | 1 |
| credit market expected inflation | pec | 3 |
| relative material inflation | pm | 0 |
| AS intercept |  | 1.5 |
| AS slope |  | .5 |
| exogenous growth | g | 1.3 = q-alpha⋅f |
| labor supply slope | λ | .28 = 1.5alpha-1 |

g and λ are computed to initialize the model at the desired values. These values imply – are derived from – an initial aggregate supply curve of:

p = 1.5 + .5q

The various values were arrived at partly from regressions run on various combinations of variables, partly from my own impressions and partly from the desire to work with numbers that are ball-park representative of the US economy and are easy to remember. There is a tendency to make numbers larger than actual, to round upwards, just so that there is room to reduce them without encountering uncomfortable fractions.

|  |  |  |
| --- | --- | --- |
| **Variable** | **Abr.** | **Initial Value** |
| nominal GDP growth | x | 6% |
| money growth | m | 6% |
| velocity growth | v | 0 |
| inflation | p | 3% |
| real GDP growth | q | 3% |
| employment growth | n | 2% |
| wage growth | w | 4% |
| real wage growth | wr | 1% |

One can think of the supply side as having two purposes:

1. Illustrate supply side responses to demand changes. This would result from changing one of the demand side variables which (generally) results in a change of Aggregate Demand (X, converted to x). The Product and Labor Markets then illustrate the effects of the change of demand.

2. Illustrate changes of Supply Side parameters.

The box showing “**Supply Side Parameters**” allows one to change a variety of values. These values only directly impact the Product and Labor Markets, they have no direct effect on the Demand Side of the economy. Probably the most useful of these variables are:

1. f – the labor force growth rate – to illustrate effects of, say, immigration and the retirement of the baby boom.

2. g – the rate of exogenous technical change.

3. pm—the rate of raw material inflation – to illustrate events such as the 1970s oil price increases.

4. we – labor expected rate of real wage increase – to show the effect of labor demanding more or less compensation.

The variables pen and pec can be changed to illustrate the effects in the labor and credit markets of changing inflationary expectations. There are buttons on the program that can be used to set these two equal to the rate of inflation, modeling adaptive expectations.

**EXPERIMENTS**

What follows invites you to open the MarketMode program and do some experiments

Beneath the Credit and Foreign Exchange Markets are tables of numbers that given illustrative values for the variables that correspond to the graphed results.

The results for the Credit Market are also displayed in the format of the Credit Market Equation,

(m + v = x). Under the Product Market, the results are similarly displayed using the format of the Product Market Equation (x = p + q).

These ‘experiments’ suppose the parameter values shown in the “effects” table, with two exceptions.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| EFFECTS | C | S | I | F | E | K | Tn | MD |
| Int. Rate | -20 | 20 | -30 |  |  | 0 |  | 0 |
| Exch. Rate |  |  |  | 20 | -30 | 0 |  |  |
| Income | 0.5 | 0.2 |  | 0.1 |  |  | 0.2 | -0.2 |

The two exceptions are accommodated by check boxes beneath the table of effects.

*1. MDi to compare Classical and Keynesian theories*

Macintosh HD:Users:hanneskvaran:Desktop:Screen Shot 2022-09-18 at 9.53.44 PM.pngClassical*.* When the box is unchecked MDi = 0, the Cash box does not operate; the results are classical.

*Macintosh HD:Users:hanneskvaran:Desktop:Screen Shot 2022-09-18 at 9.52.19 PM.png*Keynesian. When the box is checked MDi = 100, the Cash box is in operation; the results are Keynesian.

*Macintosh HD:Users:hanneskvaran:Desktop:Screen Shot 2022-09-18 at 10.02.29 PM.png2. Ki, to connect or disconnect the foreign sector*

When unchecked, Ki = 0 and the foreign sector is effectively ignored.

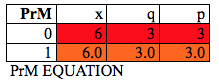
Macintosh HD:Users:hanneskvaran:Desktop:Screen Shot 2022-09-18 at 10.02.50 PM.pngWhen checked Ki = 50 and the foreign sector is included.

EXAMPLE 1: **Classical Monetary Policy**

Set: MDi = 0; Ki = 0

**Enter: MS = 100**. You see:

1. The supply of credit (L) shifts right. Interest rates fall; credit use rises. I rises by 60 and S falls by 40 (due to lower interest rates). C rises by 40, X rises by 100.



2. The value of X (100) is converted into x, nominal GDP growth of 12.7%. (A 12.7% rate of GDP growth means that increasing M by 100 was a lot!)

In the **Product Market**, the rightward shift of AD, with the ensuing rise of real growth and inflation.

**Labor Market.** At the upper right of the Labor Market is a choice of REAL or NOMINAL. Set to

NOMINAL and we see a reasonable result. The Demand for Labor rises, so the (nominal) wage and employment growth rise.

Now set the choice to REAL and get (to me) a more surprising result. It was not the Demand for Labor that rose, it was the Supply. *Real* wage growth has not risen; it has fallen. The increase of nominal wages has been less than the increase of inflation. This results from labor’s unchanged expected inflation rate (pen) in the Labor Supply equation. This may either be construed as “money illusion” or as the time lag necessary for wages to be renegotiated. Labor has been forced off its real Labor Supply curve due to the lag in incorporating inflation into labor’s supply decisions.

The Credit Market can also be viewed as real or nominal (Locate the buttons that give you that choice at the upper right of the Credit Market graph). Trying both real and nominal suggests that the two are not radically different. (The only difference is that the nominal case adds inflation to the interest rate). Set CrM to NOMINAL and LaM to REAL.[[29]](#footnote-29) Locate the button labeled “Update CrM & LaM Inflation.” With every click of the button, expected inflation in the Credit and Labor Markets is updated to the current level of inflation. I.e. we are modeling adaptive expectations.

1. **In CrM**: If CrM is REAL, we see the increase of the money supply. If CrM is set to NOMINAL, both supply and demand shift upward as everyone adds inflation to the supply and demand curves.

2. **In PrM**: AS shifts left as inflation progressively forces wages upward. The wage-price spiral has set in, as higher prices require higher wages, which require higher prices, etc. As AS shifts to the left we see the derivation of the vertical Long Run AS.

3. **In LaM**: (set to REAL) we see the supply of Labor return to its “real” position as money illusion is dissipated.

By pushing the “Update” enough times, all the real variables – real output, real wages, and employment return to their initial positions. The exception is the real interest rate, which has been lowered.[[30]](#footnote-30) Nothing “really” happened. This is the meaning of Classical theory’s “Money is a veil.”

EXPERIMENT 2. **Keynesian Monetary Policy**

Set: MDi = 100; Ki = 0

**Enter: MS = 100**

All the effects of changing the money supply are muted compared to the Classical case. Interest rates fall by less, Investment rises by less, GDP rises by less, real growth and inflation are affected less. The big difference is that money flowed into Cash, reducing the velocity of money and offsetting the increase of the money supply.

EXAMPLE 3**.** **Classical Fiscal Policy**

RESET

Set: *MDi =* 0; Ki = 0

***Enter: G* = 100,** to illustrate fiscal expansion.

You observe total crowding out. X does not change.

The increase G is offset by reduced C and I.

EXAMPLE 4**.** **Classical Fiscal Policy with a foreign sector**

Set: MDi = 0; Ki = 50

***Enter: G* = 100**

Higher interest rates induce a foreign capital inflow. The rising exchange rate encourages Imports and discourages Exports, creating a trade deficit. This illustrates the “Twin Deficits” problem of the 1980s.

The increase of G is offset by reduced C, E and I so GDP does not change.

EXPERIMENT 5**. Keynesian Fiscal Policy with a foreign sector.**

*Set: MDi =* 100; *Ki =* 50

**Enter: G = 100**

The results are much like the previous case: Capital inflow and a Trade deficit are induced by higher interest rates. The effects are less pronounced than in the Classical case. X (GDP) rises, showing that, in the Keynesian case, fiscal explanation can stimulate the economy.[[31]](#footnote-31)

EXAMPLE 6**.** **An increase of Saving; Classical case**

RESET

Set: MDi = 0; Ki = 0

**Enter: S = 50**.

Observe:

1) The supply of Credit shifts right. Interest rate fall, the quantity of loans made (Z) rises

2) The orange value of S has risen, but by less than 50. This is because falling interest rates discouraged Saving. (Visually the Supply of Credit curve shifted horizontally by 50. It intersects the Demand for Credit curve at a quantity changed by less than 50.) There is a common and potentially confusing set of results from this: The final change of a variable has an exogenous and an endogenous component.[[32]](#footnote-32) The user inputs the former; the rest of ‘the economy’ contributes the latter.

3) X has not changed. The increased saving had off-setting effects. The reduction of Consumption and the increase of Investment exactly canceled each other out. As explained elsewhere, the Classical view in this world is that changes of spending by any sector do not result in changes of X. It’s all crowding and opportunity cost.

EXAMPLE 7**. Keynesian Saving.** Try this EXPERIMENT again with *MDi = 100.* You see growth slow (0 < q < 3). See how far you have to increase Savings to get an actual recession (q < 0). The point is that we have a model with sufficient sophistication to distinguish between slow growth and negative growth.

My best advise is that you skip this section, do not push the “button “Update Income” and never let Y Change. But if you must …

The button “Update Income” allows one to set the new Income equal to spending. Repeatedly pushing the button, traces out the multiplier.

Remarks on the multiplier

1. If the parameter *MDi* equals zero (i.e. the extreme Classical case) then no change of spending by any sector can change X and the multiplier is zero. A change of the money supply can, however, change X and is therefore subject to the income multiplier effect.[[33]](#footnote-33)

2. If one adopts the given parameters and adopts a seriously Keynesian view (i.e. set *MDi* = 5000) you still only get a multiplier of 2. I.e. the MPC is .5 (unless you change that in the “Effects” table).

3. If one uses other parts of the program (to be described) that illustrate Labor Market responses to inflation, then the multiplier gets smaller.

Is it really worth that much attention?

**Other Experiments**

Increase pm to show the oil embargo. By using the “Update” button see how little of the inflation is due to the initiating cause, and how much is due to the ensuing wage/price spiral.

**V. THE SHAPES OF MARKETS**

This paper presents what is essentially a mnemonic device for generating the standard results of Keynesian and Classical/Monetarist theories and for imagining other market configurations not covered by those theories.

The trick is to assume that the macro markets under discussion appear as shown in Figure 6. The particular concavities of the curves are central to the argument to be developed.

Q

P

AS

Fig. 7 Effects of a horizontal rise of demand

AD

Q

P

AS

Fig. 8 Effects of a vertical rise of demand

AD

D

Q

P

S

PS

PD

Qmin

Qcap

Fig. 6 Macro Markets

The rationales for the assumed concavities are:

1. Supply becomes less elastic as a capacity level of output is approached. Subsequent increases of demand become progressively harder to meet with increased output and result instead in progressively larger price increases as a state of full employment is reached. (This is fairly standard.)
2. Demand is inelastic at low levels of output because buyers will seek to maintain some “necessary” minimum level of this commodity, even at the expense of paying higher prices. (This seems a less standard assumption)

Each curve can be treated as if it were controlled by two parameters: the vertical and horizontal asymptotes shown in Figure 6. Changing either quantity asymptote will shift a curve horizontally side to side, while changing a price asymptote will shift a curve vertically up or down. The asymptotic parameters have the following uses/interpretations:

Q

P

AS

AD

Q

Fig. 9 Keynesian Markets

Q

PP

AS

AD

Q

Fig. 10. Monetarist Markets

Qmin -- a minimum (perhaps “subsistence”) quantity of the good in question.

Qcap -- capacity output possible from the market.

Ps -- is changed by altered production costs.

Pd -- is changed by an altered consumer reservation price.

The number of curve shifts of supply and demand is now doubled. For example, there are now two distinct ways for a demand curve to increase: by shifting to the right (increasing Qmin) or by rising vertically (raising Pd). Although the laws of supply and demand apply in both cases -- price and quantity will both rise -- a somewhat different situation results in each case. Figure 7 shows the effect of demand shifting to the right: in this case the inelastic portions of the two curves intersect. If, however, demand were to increase by rising vertically Figure 8 results: the elastic portion of the demand curve would contact the inelastic portion of the supply curve. Similar results can be had by decreasing demand horizontally or vertically and by increasing or decreasing supply either horizontally or vertically.

Put another way, this says that we might fruitfully divide demand increases into two types: those in which demand becomes less elastic as it rises and those in which it becomes more elastic as it rises. I contend that each of those has a reasonable interpretation and that that interpretation is significantly captured by the images provided by the changing of the four asymptotes.

**USES OF THE MODEL[[34]](#footnote-34)**

**The monetarist-Keynesian debate**

This market set-up can quite compactly contain the essentials of the monetarist-Keynesian debate. The trick is to assume that the Keynesian world (a demand-deficient economy) results from vertical decreases of demand, while the monetarist world (a demand-sufficient economy) results from vertical increase of demand. See Figures 9 and 10. I suspect the novelties here are two: first, the depiction of the slope of the demand curve, and second, the presumption that at least the Product, Credit and Labor markets, can all be viewed this way. Figure 11 depicts the monetarist and Keynesian versions of fiscal and monetary expansion. The results are quite standard though a few elements (the Keynesian view of fiscal policy, for instance) might require some rethinking.

AD

P

i

Q

AD0

AS

B0

L

AD

P

i

Q

AS

L0

B0

AD1

L1

AD0

B1

AD1

AD

i

L

B0

Q

P

AS

AD0

B1

AD1

AD

i

L0

B

Q

P

AS

AD0

L1

AD1

Fig. 11 Monetarist and Keynesian views of fiscal and monetary policies in the credit and product markets

KEYNESIAN FISCAL EXPANSION

KEYNESIAN MONETARY EXPANSION

CLASSICAL FISCAL EXPANSION

CLASSICAL MONETARY EXPANSION

The “Credit Market” might require a bit of explanation. I am assuming for simplicity that total spending (nominal GDP, aka AD) is determined in the Credit Market on the basis of interest rates. Actually what I am calling the Credit Market, can well be thought of as an IS/LM diagram.

Apart from merely summarizing the typical theoretical arguments, I think this approach goes a step further. It suggests that there is a larger frame into which both theories fit, that the theories are actually deeply complementary, that economies have different reactions depending on the state of employment, that each of the theories works better when applied to the type of economy it was devised to explain.

**Dynamics**

An abiding stereotype of Classical/Monetarist and Keynesian thinking is that the former is long run and that the latter is short run. Using those characterizations, we may develop pictures of the dynamic reactions of economies. Figures 12 and 13 show the resulting analysis. Let me point two particularly appealing pieces of analysis. The first is the sense of the lags inherent in the monetary policy, given the number of steps that interpose between monetary expansion and subsequent inflation. The second is the image that the primary evil of expansionary fiscal policy is not that it is inflationary but in precisely its inability to move aggregate demand at all, implying that crowding out must be occurring.

Q

P

AD1

AD0

ASSR

ASLR

AD2

AD

i

B1

B0

LSR

LLR

\*

\*

\*

Figure 12. Fiscal Expansion. The Short and Long Run

AD

i

BSR

BLR

L0

L1

P

Q

ASLR

ASSR

AD0

AD1

\*

\*

\*

Figure 13. Monetary Expansion. The Short and Long Run

**A taxonomy beyond.**

Returning to the idea that supply and demand curves can each shift in four possible ways, we can construct eight market types based on the predominant curve shift. Monetarism and Keynesianism have accounted for two. The other six all seem to have reasonable interpretations, abetted by the stories suggested by the asymptotes of the macro markets. See Figure 14**.**

Let me present examples of the two contrasting types of supply decreases: post-war Germany had suffered a decrease of its capital stock -- a leftward shift of AS -- resulting in a highly inflationary situation. Any further curve shifts would have serious impact on the inflation rate. The supply decrease in the US in the 1970s was of a different type. Rising factor costs lifted the supply curve vertically, taking the economy further from capacity output. Based on this observation, let me make a “testable” prediction, in a strange sense of the word. I earlier suggested that what pass for “facts” in economics are only consensus opinions. So I submit a prediction to see if it squares with “the facts.” My logic leads to the following conclusion: an aggregate demand increase in the 1970s, induced by expansionary monetary policy for instance, should *not* have been highly inflationary, since it would have been pushing against a fairly elastic, underutilized supply side. Supply side inflation -- such as the upward pressure on factor costs induced by inflationary expectations and a wage-price spiral -- would not be expected to be significant. (If true, there’s a considerable irony here: monetary policy was inflationary not because it was

Q

P

D

S

Q

P

D

S

Q

P

D

S

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Q

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VERT

I CAL

HOR I ZONT

A

LAL

DEMAND Increase

DEMAND Decrease

SUPPLY Increase

SUPPLY Decrease

HOR I ZONT

A

L

VERT

I CAL

Figure 14. Eight possible states of a macro market.

inherently so, but merely because the unwarranted expectation of monetary-induced inflation.) Does that fit “the facts?” (i.e. the consensus of the discipline)

Finally, I will mention that there actually far more than merely eight macroeconomic states, because there are four markets, each of which can have eight states. Interestingly, in the monetarist and Keynesian cases, it seems as if all markets tend to assume the same shapes but this need not be so. Consequently, with four markets and eight possible states we have 84 = 4096 possible economies. Let’s get started!

**CONCLUSION**

At this point we have multiple tools for analyzing the economy: CirF for the general equilibrium overview, supply and demand to illustrate each of the four macro markets, and the two market equations to provide simple numerical examples. If one cares for more, one can use the slopes of supply and demand curves to represent theoretical perspectives. I contend that these tools can serve to explicate virtually any topic at the principles level, including many issues that might often be considered too advanced. I will not argue that everyone loves my class or that everyone learns to use these tools properly. I believe similar complaints can be made against any approach.

I stated that I do not take a lot of care in the details of the construction of models. I will still claim that my methods richly illustrate the economic approaches of simplifying problems, constructing models and drawing conclusions.

Finally, there is the opportunity cost question: If this much is added to the class, what must be left out? Some suggestions for omission: most of National Income Accounting, the Production Possibilities Curve (you *can* describe scarcity and choice without drawing a picture of it, and diminishing returns aren’t a big deal in macro), the Keynesian Cross, multipliers, details of micro supply and demand such as price ceilings and price floors (I spend a lot of time using macro markets; micro gets less treatment). I have long thought it unconscionable that the first four chapters of micro and macro are the same. This is macro: Let’s get on with it! Instead of the details of demands and quantities demanded and Laws of Supply and Demand we get to demonstrate the working of Supply and Demand in four markets. It changes the way it is taught. It still leaves a crowded semester, but one where the intention (if not the reality, I admit) is to turn as much of our time toward thinking about the economy now and making sense out of the competing arguments as to appropriate policy responses.

I will end with a brief *mea culpa* for the topics I have not covered here because I feel I do not understand them well enough, nor do the tools I have seem sufficient to tackle these problems.

1. Income Distribution

2. Supply-side tax effects

I take both of these to be pressingly important and worthy of class discussion if not systematic analysis.

APPENDICES

**[APPENDIX: NOTATION](Appendix_Notation" \l "Notation_Appendix)**

**(**[**Return**](#ReturnToText2) **to text)**

|  |  |
| --- | --- |
| ***CirF*** – “Places” | |
| H/B | Households and Businesses |
| PrM | Product Market |
| CrM | Credit Market |
| FxM | Foreign Exchange Market |
| Trsy | Government Treasury |
| Fed | the Federal Reserve |
| Cash | Public Demand for Liquidity |
| LaM | Labor Market |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***CirF*** – Demand Side Variables | | | | |
| Y | National Income |  | X | Total Spending, Nominal GDP |
| Cd | domestic Consumption |  | S | Saving |
| I | Investment |  |  |  |
|  |  |  |  |  |
| Tn | Taxes, net of transfers |  | G | Government Purchases |
| Tg | gross Taxes |  | BB | Government Budget Balance |
| TP | Transfer Payments |  | Def | Gov’t Budget Deficit = -BB |
|  |  |  |  |  |
| E | Exports |  | F | Imports |
| K | Foreign Capital Flows |  |  |  |
|  |  |  |  |  |
| ΔMD | change of Money Demand |  | ΔMS | change of Money Supply |
|  |  |  |  |  |
| Z | quantity of Credit used |  | $ | dollars exchange in foreign markets |
| i | nominal interest rate |  | e | exchange rate |
| r | real interest rate |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **Equation** | | **Level Form** | **Rate of Change Form** |
| 1 | Aggregate Demand | X = P⋅Q | x = p + q |
| 2 | Production Function[[35]](#footnote-35) | Q = G⋅Nα | q = g + αn |
| 3 | Labor Demand | W = αP/Pm⋅G⋅Nα-1 | w = (p – pm)[[36]](#footnote-36) + g  - (1-α)n |
| 4 | Labor Supply | W = We⋅Pn⋅(N/F)λ | w = we+pen + λ(n-f) |

|  |  |  |
| --- | --- | --- |
| **Variable** | **Abr.** | **Initial Value** |
| nominal GDP growth | x | 6% |
| money growth | m | 6% |
| velocity growth | v | 0 |
| inflation | p | 3% |
| real GDP growth | q | 3% |
| employment growth | n | 2% |
| wage growth | w | 4% |
| real wage growth | wr | 1% |

|  |  |  |
| --- | --- | --- |
| **Variable** | **Abr.** | **Initial Value** |
| production function labor coefficient | α | .85 |
| labor force growth rate | f | 2 |
| labor’s expected inflation | pen | 3 |
| labor’s expected real wage growth | we | 1 |
| credit market expected inflation | pec | 3 |
| relative material inflation | pm | 0 |
| AS intercept |  | 1.5 |
| AS slope |  | .5 |
| exogenous growth | g | 1.3 = q-alpha⋅f |
| labor supply slope | λ | .28 = 1.5alpha-1 |

AS EQUATIONS, VARIABLES and VALUES

g and λ are computed to initialize the model at the desired values. These values imply – are derived from – an initial aggregate supply curve of:

p = 1.5 + .5q

The various values were arrived at partly from regressions run on various combinations of variables, partly from my own impressions and partly from the desire to work with numbers that are ball-park representative of the US economy and are easy to remember. There is a tendency to make numbers larger than actual, to round upwards, just so that there is room to reduce them without encountering uncomfortable fractions.

**APPENDIX: SOLVING THE DEMAND SIDE**

The equations are:

1. Y = Cd + F + S + Tn.

This is what spending (X) was “last year.”

2. X = Cd + E + I + G.

This is what spending is “this year.”

3. I + Def = S + K + ΔMD + ΔMS.

4. F = E + K ⇒ K = F – E

5. Def = G – Tn

Substituting equations #4 and #5 into #3 gets:

I + [G – Tn] = S + [F – E] + ΔMD + ΔMS.

Rearrange a few terms:

I + E + G = S + F + Tn + ΔMD + ΔMS.

Add Cd to both sides of the equation:

[Cd + I + E + G] = [Cd + S + F + Tn] + ΔMD + ΔMS

X = Y + ΔMD + ΔMS.

From this we see:

1. If ΔMD + ΔMS = 0, then X = Y, the economy has not moved. Spending this year is what it was last year. There are two possibilities.

a. neither ΔMD nor ΔMS changed, or

|  |  |  |  |
| --- | --- | --- | --- |
| ***CirF*** – Rate of Change (Supply Side) Variables | | | |
| LEVELS | | RATES of CHANGE[[37]](#footnote-37) | |
| X | Nominal GDP | x | %ΔX |
| M | Money Supply | m | %ΔM |
| V | Velocity of Money | v | %ΔV |
| P | Price Level | p | %ΔP |
| Q | Real GDP | q | %ΔQ |
| N | Labor/Employment | n | %ΔN |
| W | Wage Rate | w | %ΔW |
| Wr | Real Wage Rate | wr | %ΔWr |

b. ΔMD + ΔMS changed so as to exactly off-set each other.

2. ΔMD + ΔMS > 0 means the economy has grown. Spending this year is greater than it was last year. At least nominal economic expansion has occurred.

3. ΔMD + ΔMS < 0 means the economy has shrunk. Spending this year is less than it was last year. A nominal contraction contraction has occurred.

**Market Mode: SUPPLY SIDE VARIABLE**

**Some of the Math**[[38]](#footnote-38)

Using the rate of change forms, the model can be solved. Some of the solution properties are:

. This is obtained by equating labor supply and demand.



In Long Run equilibrium we expect p = pen (i.e. labor correctly anticipates inflation) and this simplifies to a Classical result of .



Note that, in the first equation, n *is* a function of prices, and therefore spending. In the second, Classical case, n is not a function of prices or spending. This implies a vertical AS curve.

Alternatively, one can establish the AS curve

p = a + b⋅q. Where

a = ASintercept = 

b = AS slope = and



Values for all variables follow from equating:

AS: p = a + b⋅q and

AD: p = x – q, to get:

q = (x – a)/(1+b) and p = (a + bx)/(1 + b)

**APPENDIX: FLAG MODE.**

**Transfers vs Taxes Worksheet**

As a first approximation, one may consider Transfers as merely negative Taxes. However, the effect of changing Transfer and Taxes is likely to be non-symmetrical because the parties subject to Transfers and Taxes are different and likely have different propensities to consume.

The worksheet suggests values to be used. Try this example to see the point.

Increase Gross Taxes by 100. This increase of gross (and net) Taxes must require that Consumption and Saving together fall by 100. The program will accept any C and S values that accomplish that.

The worksheet suggests (as a changeable default) that Consumption will fall by 60 while Saving falls by 40.

If, one the other hand, you reduce Transfers by 100, the program suggests that Consumption falls by 90, while Saving falls by 10. The different values have implications for the efficacy of the policies in terms of stimulating short-run demand or Saving and Investment.

**APPENDIX Market Mode: AD MATH**

S = (Sa+Stp\*TP+Stg\*Tg) +Si\*(ir-ir0)

F = Fa+Fe\*(er-er0)

K = Ka+Ki⋅(ir-ir0)+Ke⋅(e-e0).

E = Ea+Ee\*(er-er0)

Tn = Tg – TP

I = Ia+Ii\*(ir-ir0)

dMD = dMDa+dMDi\*(ir-ir0)

Cd = Y - S - F – Tn is an endogenous residual

X = Cd + E + I + G is an endogenous residual

The user can change all subscripted variables, as well as Stp and Stg.

The ‘i’ and ‘e’ variables can be changed in two ways. If changed on the diagram, the new value is used. If changed under the table labeled, “2nd Effects” two curves are drawn, one with each of the slopes. Using RESET makes the EFFECTS and 2nd EFFECTS values the same.

EXOGENOUS

G, Tg, TP

ΔMS

The system is merely two equations in two variables – the interest rate and the exchange rate. Those equations can be solved for the equilibrium values of exchange and interest rates. With these and all the parameters, the values of all variables can be had.

**APPENDIX: EXAMPLES\_Flag.** The answers given are rarely the only answers possible. The answers given are chosen to illustrate specific points. ([Return to text)](#ReturnToText1)

FLAGS

|  |  |  |
| --- | --- | --- |
|  | FLAG at… | means |
| 1 | Households & Businesses | Y ≠ Cd + F + S + T |
| 2 | Product Market | X ≠ Cd + E + I + G |
| 3 | Credit Market | K + S + ΔMD + ΔMS ≠ I + Deficit |
| 4 | TAXES, net | Tn ≠ Tg - TP |
| 5 | Treasury | Tn + BB ≠ G (i.e. Tg + BB ≠ TP + G) |
| 6 | Foreign Exchange Market | F ≠ E + K |

**FISCAL POLICY EXAMPLES**

In arguments about government fiscal policy I make the assumption that (1) Classical conservatives think that a policy that increases (reduces) Investment is good (bad) and (2) Keynesian liberals think that a policy that raises (lowers) GDP is good (bad). I.e. conservatives think that long-run growth is the important goal, liberals think that short-run stimulus is the important goal.

#1. Should we increase government purchases (G)?

a. the Classical answer. **RESET**. **SHOW**: Treasury**. ENTER: G = 50**

|  |  |  |  |
| --- | --- | --- | --- |
| **Flag** | **because** | **Fix** | **because** |
| Treasury  PrM | Where will gov’t get the money?  (Wait on PrM) | BB = -50 | gov’t decides to borrow the money |
| CrM | money has been removed from CrM | I = -50 | less money is available for business to borrow (PrM Flag is gone, too) |

LESSON: Running deficits is dangerous because it “crowds out” Investment, resulting in reduced long run growth.

b. the Keynesian answer. Reset. SHOW: Treasury, Cash. **G = 50**.

|  |  |  |  |
| --- | --- | --- | --- |
| **Flag** | **because** | **Fix** | **because** |
| Treasury  PrM | Where will gov’t get the money?  (Wait on PrM Flag) | BB = -50 | gov’t decides to borrow the money |
| CrM | money has been removed from CrM | dMD = 50 | gov’t borrows from CASH (e.g. War Bonds) |
| PrM | total spending has risen | X = 50 | the economy has expanded; benefited from the G increase. |

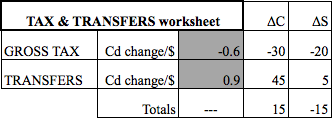
LESSON: Running deficits can help the economy. This is Keynes’s message in a nutshell.

**Using the TAX & TRANSFERS Worksheet**

The “TAX & TRANSFERS Worksheet” exists to help analyze the effects of changing gross taxes and changing transfer payments.

As a first approximation, lowering taxes by $50 and increasing transfers by $50 are just the same. That is, in both cases the government gets $50 less than it did and the Household sector gets $50 more than it did.

However, it is likely that taxes and transfers are not “the same” because they apply to different populations. Specifically, I assume that *those who pay taxes consume a smaller fraction of their incomes than do those who receive transfers.*

The “TAX & TRANSFERS Worksheet” embodies this assumption in the grey cell numbers. The -0.6 asserts that for every dollar of Tax increase (decrease), Consumption will fall (rise) by 60 cents. The number 0.9 asserts that for every dollar Transfers are raised (reduced) Consumption will rise (fall) by 90 cents. The user can set these numbers.

The numbers show in the table are for $50 changes of *both* Tg and TP.[[39]](#footnote-39) The column marked ΔC shows that Consumption was reduced by $30 due to the tax increase, and increased by $45 due to the transfer increase, for a total change of $15. The column ΔS tracks the resulting changes of Saving.

These are suggested values when one is working problems of this type.

#1. Should we raise taxes?

a. Classical answer Reset. SHOW: Treasury. **Tg = 50 and Tn = 50**

|  |  |  |  |
| --- | --- | --- | --- |
| **Flag** | **because** | **Fix** | **because** |
| H/B | With raised taxes we must reduce something. | Cd = -30  S = -20 | consult the Tg and TP worksheet |
| TRSY | gov’t has extra money | BB = 50 | higher taxes move the budget toward surplus |
| CrM | there’s extra money in CrM | I = 30 | $30 = $20 less Saving + $50 more from the Treasury. |
| PrM | flag is gone |  |  |

b. Keynesian answer. Reset. SHOW: Treasury, Cash. **Tg = 50 and Tn = 50**

|  |  |  |  |
| --- | --- | --- | --- |
| **Flag** | **because** | **Fix** | **because** |
| H/B | With raised taxes we must reduce something. | Cd = -30  S = -20 | consult the Tg and TP worksheet |
| TRSY | gov’t has extra money | BB = 50 | higher taxes move the budget toward surplus |
| CrM | there’s extra money in CrM | dMD = -30 | the extra money disappears into CASH |
| PrM | Cd has fallen, nothing has risen | X = -30 | X falls |

Interestingly, by this analysis liberals want lower taxes (to get spending up) while conservatives want higher taxes (to avoid government borrowing). This surely reflects an Eisenhower-era version of “fiscal conservatism” that asserts that public spending should be financed by a willingness to pay taxes. I think that Reagan (and “conservatives” since) changed this conclusion by stressing the supply side effects of taxes.

#2. Should we lower Transfers?

This exercise is part of the previous exercise. I want to compare raising taxes with lowering transfers. Note that both of these can be described as “raise net Taxes.”

a. Classical answer. Reset. SHOW: Treasury. **TP = -50 & Tn = 50**

|  |  |  |  |
| --- | --- | --- | --- |
| **Flag** | **because** | **Fix** | **because** |
| H/B | With raised taxes (less Transfers) we must reduce something. | Cd = -45  S = -5 | consult the Tg and TP worksheet |
| TRSY | gov’t has extra money | BB = 50 | lower transfers move the budget toward surplus |
| CrM | there’s extra money in CrM | I = 45 | 45 = $5 less Saving + $50 more from the Treasury. |
| PrM | flag is gone |  |  |

b. Keynesian answer. Reset. SHOW: Treasury, Cash. **TP = -50 & Tn = 50**

|  |  |  |  |
| --- | --- | --- | --- |
| **Flag** | **because** | **Fix** | **because** |
| H/B | With raised taxes we must reduce something. | Cd = -45  S = -5 | consult the Tg and TP worksheet |
| TRSY | gov’t has extra money | BB = 50 | lower transfers move the budget toward surplus |
| CrM | there’s extra money in CrM | dMD = -45 | the extra money disappears into CASH |
| PrM | Cd has fallen, nothing has risen | X = -45 | X falls |

A summary of G, TP and Tg.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | G = 50 | | Tg = 50 | | TP = -50 | |
|  | I | X | I | X | I | X |
| Classical | -50 | 0 | 30 | 0 | 45 | 0 |
| Keynesian | 0 | 50 | 0 | -30 | 0 | -45 |

Classical. Raising taxes is good; lowering transfers is better; lowering G is best.

Keynesian. Raising taxes is bad; lowering transfers is worse, lowering G is worst

Note that taxes such as FICA and sales taxes – i.e. regressive taxes – might well have effects more like those for TP than for Tg. (E.g. raising Social Security taxes might look more like a reduction of transfers than it looks like an increase of taxes, because of the population it affects.)

**FOREIGN SECTOR EXAMPLES**

#1. What is the effect of importing more? SHOW: Foreign Exchange.

ANSWER a. Classical. Reset. SHOW: Foreign Ex. **F = 50**

|  |  |  |  |
| --- | --- | --- | --- |
| **Flag** | **because** | **Fix** | **because** |
| H/B | If we Import more we must do less of something | Cd = -50 | we can buy fewer US goods |
| FxM | where does the extra money in FxM go? | E = 50 | if the world has more of our money they will buy more of our goods. |

Result. X has not changed. We lost jobs in the domestic Consumption sector but regained them in the Export sector.

ANSWER #b. Classical. Reset. SHOW Foreign Sector. **F = 50**

|  |  |  |  |
| --- | --- | --- | --- |
| **Flag** | **because** | **Fix** | **because** |
| H/B | If we Import more we must do less of something | Cd = -50 | we can buy fewer US goods |
| FxM | where does the extra money in FxM go? | K = 50 | if the world has more of our money they could put it in our banks rather than buying our Exports |
| CrM | there is extra money into CrM | I = 50 | the extra lending in the Credit Market is borrowed by businesses. |

Result. X has not changed. We lost jobs in the domestic Consumption sector but regained them in the Investment sector. These answers suggest that foreign trade is not a threat.

ANSWER #c. Keynesian. Reset. SHOW Foreign Ex. and Cash. **F = 50**

|  |  |  |  |
| --- | --- | --- | --- |
| **Flag** | **because** | **Fix** | **because** |
| H/B | If we Import more we must do less of something | Cd = -50 | we can buy fewer US goods |
| FxM | where does the extra money in FxM go? | K = 50 | if the world has more of our money they could put it in our banks rather than buying our Exports |
| CrM |  | dMD = -50 | the extra money in the market goes nowhere |
| PrM | Cd has fallen; nothing has risen | X = -50 | the economy is hurt. Foreign trade *is* a threat, precisely to the extent that CASH is operative. |

Result: Foreign trade is dangerous

#2. The twin deficits problem. SHOW Foreign Ex. & Trsy. **G = 50**

|  |  |  |  |
| --- | --- | --- | --- |
| **Flag** | **because** | **Fix** | **because** |
| Trsy | Gov’t spends more | BB = -50 | gov’t borrows more |
| CrM | where does the extra money come from? | K = 50 | let’s borrow from China! |
| FxM | where does the extra money come from? | E = -50 | foreigners can buy less from us if they lend more |

Result: The budget deficit has caused a trade deficit: these are the “twin deficits.”**MONEY EXAMPLES**

#1. An increase of the Money Supply

ANSWER a. The Classical Answer. SHOW Fed. **ΔMS = 50**

|  |  |  |  |
| --- | --- | --- | --- |
| **Flag** | **because** | **Fix** | **because** |
| CrM | There is more money in the Credit Market | I = 50 | banks lend the money |
| PrM | I has increased | X = 50 | spending rises |

ANSWER b. The Keynesian Answer. SHOW Fed, Cash. **ΔMS = 50**

|  |  |  |  |
| --- | --- | --- | --- |
| **Flag** | **because** | **Fix** | **because** |
| CrM | There is more money in the Credit Market | dMD = -50 | the money sits in banks |

Answer a. shows the Classical power of money; answer b. shows an extreme Liquidity trap

ANSWER c. The Intermediate Answer. SHOW Fed, Cash. **ΔMS = 50**

|  |  |  |  |
| --- | --- | --- | --- |
| **Flag** | **because** | **Fix** | **because** |
| CrM | There is more money in the Credit Market | I = 30  dMD = -20 | banks lend some of the money |
| PrM | I has increased | X = 30 | spending rises but by less than dMS |

You can be somewhere in between.

**MONEY DEMAND EXAMPLES**

#1. A decrease from ΔMD. SHOW Cash. **ΔMD = -50**

|  |  |  |  |
| --- | --- | --- | --- |
| **Flag** | **because** | **Fix** | **because** |
| CrM | banks don’t want to lend | I = -50 | businesses must borrow less |
| PrM | I has decreased | X = -50 | spending falls. |

This is essentially indistinguishable from ΔMS = 50.

#2. A decrease of I. SHOW Cash. **I = -50**

|  |  |  |  |
| --- | --- | --- | --- |
| **Flag** | **because** | **Fix** | **because** |
| CrM | businesses are worried about borrowing | ΔMD = -50 | banks are unable to find borrowers; banks hold the money |
| PrM | I has decreased | X = -50 | spending falls. |

Note that it would be hard to distinguish #1 and #2

#3. The Fed’s reaction to a decrease from ΔMD. SHOW Cash, Fed. **ΔMD = -50**

|  |  |  |  |
| --- | --- | --- | --- |
| **Flag** | **because** | **Fix** | **because** |
| CrM | banks start to lend less | dMS = 50 | the Fed reacts rather than having X fall. A recession is avoided. |

This is a significant picture of how the Fed sees its job.

**Appendix. Advantages of using rates of change.**

[Return to Text](#ReturnToText3)

1. Rates of change are more common news items than are levels. Growth rates of GDP, prices and the money supply are (justifiably) reported far more frequently than the levels of those variables. To the extent that one of the purposes of macro is make economic news comprehensible, making students familiar and fluent with the rate of change vocabulary is important.

2. Equilibrium *rates of change* better describe a dynamic economy than do equilibrium *levels*. I challenge anyone to look at post–war economic data and ascertain the equilibrium levels of the price index and of real GDP. Both inflation and GDP growth, for all the variation they show, can be interpreted as oscillating around (possibly changing) equilibrium values. Granted, this requires a somewhat more sophisticated view of the concept of equilibrium — that it can be used to describe a rate of change as well as a static level — but it is surely a more honest description of a dynamic world.

q

p

AS1

AD1

AD2

LRAS

1960

1979

Figure 1. LRAS

AS2

3. The notion of equilibrium *levels* suggests that equilibrium *rates of change* are zero. This then suggests that the “natural” state of affairs is zero inflation and no growth.

4. AD/AS analysis using rates of change is an easier way of explaining a lot of things than some of the alternatives. Trying to explain long run growth, or on-going inflation, with a totally static, level model requires asking one to imagine that AD and AS curves are continually shifting or that the whole diagram itself is moving, due to other factors such as labor force changes and technological growth. Using rates of change simply acknowledges and incorporates the “other” factors shifting the curves. Trying to describe the motion of a ball being bounced on a moving train is quite difficult when seen from outside the train. Once you get on the train it gets a lot easier.

5. Long run, classical/monetarist theory makes a lot more sense when described with rates of change. A vertical LRAS curve is frequently used to demonstrate the notion that demand shifts can, in the long run, affect only prices, not output. The LRAS curve, drawn vertically at some level of real GDP, represents the theory as saying that real GDP will be stationary over time. This is hardly the point of the theory. (Yes, you can explain that the diagram is not saying that real GDP has to be *constant* over time, only that it is not being changed by the exogenous variables in the problem, but that is the explanation I want to avoid.) The possibility of there being an equilibrium real growth rate is plausible.

6. Rate of change analysis can tell more accurate stories than does traditional analysis. A favorite use of the AD/AS model is to depict US economic history since 1960s, as in Figure 1.[[40]](#footnote-40) In this story, the excesses of the 1960s inevitably precipitated the doldrums of 1970s, forcing policy makers to implement the brutal recession of the early 1980s, finally leading to growth with lowered inflation. I personally find there to be enough truth in this story to make it worth telling. But the story is a lie if one interprets P and Q as levels and not as rates. Real GDP in 1979 far exceeded that of 1960 — but the growth rates in the two years are close. Furthermore, a major point of this drama is not merely that expansionary policies raise the price level: the *point* is that these policies raise the equilibrium inflation rate – that we are doomed to ever-rising prices.

7. AD/AS analysis using rates of change integrates the viewpoints presented in the Phillips curve analysis. My guess is that the Phillips curve passed from vogue largely by being replaced with the increased flexibility and generality of AD/AS analysis. Personally, I found it a bit sad to lose the one piece of elementary analysis that directly discussed inflation. Once rates of change are included, AD/AS analysis merely points out that the problem with the Phillips curve is that it assumed that the AS curve was stationary. The dramatic events of the 1970s rendered that view too simplistic. Yet there is no reason to lose the perspectives offered by Phillips Curve analysis. AD/AS analysis can now preserve and expand those perspectives. It seems plausible that the unemployment rate is inversely related to the rate of growth of output -- does anyone doubt that unemployment will rise as growth slows? So analysis using rates of change is therefore merely a better version of the Phillips curve analysis. This speaks again to what is perhaps the major virtue of using the rate of change variables. It keeps the significant issue and vocabulary of inflation (as opposed to the price level) in use in the classroom.

8. I suspect that most of us are really already using this analysis but find we must occasionally gloss over the distinctions between rates and levels and slyly slip from one to the other.

(In what follows X = nominal GDP, upper case letters represent levels, and lower case letters represent rates of change)

9. The arithmetic gets easier. Multiplicative relationships become additive. If one can buy the simplifying approximation, X = P∙Q, becomes

x = p + q. Numerical examples are simplified. For example, converting variables from nominal to real form requires merely subtracting the inflation rate. Consider a spectacular bonus. Any Cobb-Douglas type function, Y = AXα , is linear in its rate of change form, y = a + αx. The curve is concave down (as in a production function) for α < 1, concave up (as in a supply of labor curve) for α >1. Starting from a production function of Q=ANα, the demand for labor equation (wage equals marginal revenue product) becomes a politely linear w = **a +**p - (1-α)n, where ***a*** (the rate of change of A) represents growth of output from factors other than labor use, a good representation of technological growth. Even (especially?) for someone who does not use math in the classroom, so that these niceties remain hidden, the prospect of drawing linear curves with a clean conscience has to be appealing

10. The equation of exchange is now m + v = p + q. Classical theory assumes v = q = 0, implying m = p. There is no easier way to present the equation of exchange or the quantity theory of money. Incorporating an exogenous growth of real GDP of q\* quickly produces a non-inflationary money growth rule of m = q\*.

11. The Equation of Exchange decomposes into two equations that I find so useful, I have given them each a name.

The *Product Market Equation*  is x = p + q, stating that nominal growth must be divided into real growth plus inflation.

The *Credit Market Equation*  is x = m + v[[41]](#footnote-41). This asserts that increases in nominal growth can only occur if there is a change of either the money supply or the velocity of money. This is very useful in separating Keynesian Theory (v can change) from Classical Theory (v = 0)

12. We can use four-quadrant AS/AD diagrams to make some important distinctions: disinflation versus deflation, slow growth versus negative growth. We can graph the various types of recessions, as shown, without suggesting that every fall of AD will cause recession and deflation.

AS

AD0

AD1

p

q

Slowing growth,

slowing inflation

AS0

AD

AS1

p

q

Recession 1974

AS

AD0

AD1

p

q

Depression

AS

AD0

AD1

p

q

Recession 1981

**Curve Shifts and “all other things”**

AD/AS analysis suffers from the fact that, at the macro level, it is difficult to identify what “other things” are held constant when AD or AS shifts. This approach may throw some light on the problem. In this approach Aggregate Demand is synonymous with the growth rate of nominal GDP. That is, the equation of AD is x = p + q. The identity of nominal spending growth and AD can be thought of two ways.

1. The simple heuristic is to assume that spenders exogenously decide on a level of nominal spending for each period and then leave it to the supply side to allocate that between price and quantity effects.

2. A more sophisticated approach is to say that a shift of the AS curve now describes the effect of a change of some supply shifter ignoring any effect that shift might have on nominal spending. (If we allow ourselves to wax classical for this purpose, we can assert that, absent change of the velocity of money, nominal GDP is set by the money supply: x = m.[[42]](#footnote-42) There is no *a priori* reason to assume that an AS shift will speed up or slow down nominal spending. That decision is in the hands of the monetary authorities.) So a rightward shift of AS -- due to technological advance, for instance -- will raise growth and lower inflation, *given that the AS shift does not alter aggregate spending.* In other words, when I shift AS, I am being quite clear as to what I am holding constant – the nominal GDP growth rate.

**Some other thoughts**

1. If one imagines the Fed as having a rough, long-run inflation target, then an AS increase will result in an increase of the money supply and, hence AD, sufficient to maintain the inflation target. This might describe the 1990s.

2. If one wanted to show a multiplier effect it would be necessary to show a sequence of AD shifts as the multiplier played itself out. Heuristically, one could merely say, “I’m now going to draw the new AD curve where it would wind up after all multiplier effects have played out.” The magnitude of the real multiplier is then clearly a function of the shape of the AS curve.

3. A change of AD describes a change of aggregate spending in the absence of changes of any AS shifters -- technology, resource costs, etc. The variables often used to get the slope of AD such as wealth effects and interest rate effects (which are frequently derided for being too insubstantial to produce interesting effects) are now curve shifters. The wealth effect states that a stock market boom will shift AD to the right.

**Why not use this approach?**

1. Inertia.

2. There’s a little more/new math to do. It is necessary to teach some (but not much) of the math of percents: the meaning and calculation of a rate of change, what it means for them to be added and subtracted, why some percents (the unemployment rate) are different from other percents (growth of GDP). We have to use four-quadrant, instead of one-quadrant, graphs.[[43]](#footnote-43) But given how much economic news is reported in percent terms, perhaps it should be incumbent on us to teach some of that arithmetic. Moreover, almost all rate-of-change arithmetic will be based on the approximation that the rates of change of multiplicative variables are additive. Some students are not comfortable with approximation and some examples don’t work out exactly.

3. It is more important to be correct than to be clear. I believe that clarity and precision are often at odds: It’s teaching’s version of Heisenberg’s uncertainty principle. We may need to sacrifice some theoretical precision for a more intuitive presentation. But this serves as a warning. I personally opt for clarity over rectitude when faced with the choice, but I understand that this is an arguable position. There are many angles from which to approach a macro course; one of them is the value of careful construction of models from logical premises. For some teachers an appeal to “informed consensus” is inimical to the goals of the course, and this approach is unsuitable.

4.Using inflation and growth in AD/AS analysis seems entirely *ad hoc* and lacking in theoretical underpinning. In particular, what are the possible functional relationships between inflation and growth underlying the AD and AS curves? My answer is that we need to recast AD/AS analysis as “merely” a compilation of the consensus of the discipline and not deny ourselves its use because the theoretical underpinnings are unclear to us.

**Miscellaneous Thoughts**

At a recent conference of economics teaching it was suggested that a first course in macro principles could (and should) dispense with the use of aggregate supply and demand analysis. A significant reason offered was that the theoretical underpinnings of the analysis are so suspect that teaching the rationale for the AD and AS curves is beyond the scope of a principles course. The apparatus was deemed respectable fare for a more advanced macro course.

In this paper I will respond with two suggestions for the use of AD/AS analysis. The first section of the paper addresses the perplexing foundations and rationale issues. The second part offers some simple suggestion for making the analysis more useful, appealing and relevant.

**Part I. New Rationales**

Macro supply and demand analysis has always had the striking shortcoming of being unable to specify clearly the functional relationships being posited by the aggregate curves. Microeconomics stands on immeasurably firmer grounds in this regard: it is quite easy to imagine the functional relationship between the prices and the quantities demanded or supplied of a product. The corresponding relationships in macro are, to say the least, less clear. What, for instance, is the functional relationship posited by Aggregate Demand that causes real GDP to rise as the price level falls?

The reasons offered for the downward slope of AD -- wealth effects and interest rate effects for example -- seem insufficient to produce effects of interesting magnitudes. The theoretical justifications for the AS curve are, if anything, even murkier. If these arguments lack appeal then there is no reason for teaching them in intermediate either. The fact that students will sit still for a complex argument is no reason to teach something that no one believes: The analysis should be dropped from economics altogether. The problem is that we do believe that supply and demand, transplanted in such an *ad hoc* fashion to the aggregate, has insights to offer: we know AD/AS analysis works, we just don’t quite know why.

**The Locus Approach**

Let me offer an alternative that is, I think, a possible way out of many macro conundrums. Think of the AD curve not as a function relating P and Q but rather as the locus of responses to an AS curve shift. A demand curve (or “the law of demand”) is an assertion that a change of supply will cause price and quantity to move in opposite directions. Think of the AS curve as the locus of outcomes of shifts of AD; the assertion that changes of demand cause price and quantity to change in the same direction. Put another way –

The Law of Demand states that (given no changes that shift the demand curve), an increase of supply will cause price to fall and quantity to rise.

The Law of Supply states that (given no changes that shift the supply curve), an increase of demand will cause price and quantity both to rise.

As economists, we have a sense of what events shift supply and which shift demand (or, equivalently, we have a sense of what events move price and quantity in the same direction and which events move them in opposite directions.) In macro, the exact sequence of changes that produces those effects is often less than perfectly clear. But we really do not need to appeal to, or believe in, simple functional relationships between the price level and the level of real GDP. We only need to believe that, for example, a change of energy prices will tend to move prices and output in opposite directions.

**The Consensus of the Discipline**

Lacking the functional relationships posited by the AD and AS curves, on what basis would we justify to students, and ourselves, the outcomes we predict? I suggest that the predictions are no more or less than “the consensus of the discipline.” Few students balk at being told that what we know, we know because it is generally agreed to be so. In fact, I submit that that *is* how we know what we know. A theory that does not conform to the facts is judged a poor theory. So we are not allowed to “know” purely on the basis of logical deduction. Facts trump theory in the scientific method. But “facts” are often (always?) no more than informed consensus, particularly in a field where little experimentation is possible. Put another way, I don’t believe that excess printing of money causes inflation *because* that is a prediction of a supply and demand model or the quantity theory of money. The models are merely means of expressing what history, thought, and common sense have made most economists believe. We teach that excessive monetary expansion is inflationary because most economists think that it is true, not because a model says so. A good model can offer truly non-obvious insights, but at the principles level (and often beyond), the purpose of models is to organize what economists think is known about the macroeconomy. We have found it useful to categorize events into two groups: those that make price and quantity move together (which we call “demand shifters”) and those that make price and quantity move opposite each other (which we call “supply shifters”). I don’t mean to suggest that economics should abandon the search for why AD/AS analysis works. I am suggesting that the analysis be taught, at the principles level, as a summary of what economists believe.

Let me even suggest that teaching concepts as the *results* of models grossly distorts the process of discovery and understanding. Typically models are constructed to communicate results that are arrived at either by observation or by intuitive leaps of faith.

**ON SUPPLY AND DEMAND**

The typical presentation of a market change imagines that we are looking at two snap-shots of a market in time, one before an exogenous change occurs, another after the change has occurred. We see the effect of the change of the exogenous variable. That is, “*First* we were at point A, *then* we were at point B.”

S

D0

D1

P

Q

A

B

There is another way to see it, (“the second way”) which I believe, is more theoretically defensible though much clumsier.

This is, “Point A shows where we would be *without* the exogenous change and point B shows where we would be *with* the exogenous change.”

Here’s the difference. In the first (intertemporal) interpretation I am predicting that Price will rise. In the second way I am saying that the Price is going to be higher than it would otherwise have been. This eliminates much of the need for *ceteris paribus* arguments. The prediction is, however, completely untestable, since we can’t know what would have happened.

Here’s an example of how the second method gets it right. We are looking at the markets for boots and shoes, considered to be substitutes. The Beatles hit town and youth want to wear boots (an increase of demand) instead of shoes (a decrease of demand). The standard analysis asserts that Db↑ ⇒ Pb↑ ⇒ Ds↑ (hmmm)

I think the most complete treatment would be:

-- in the market for boots, demand and price rise.

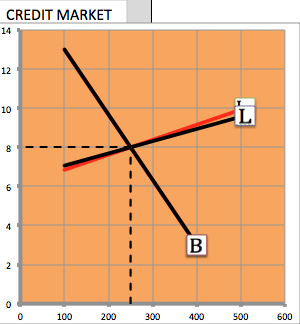
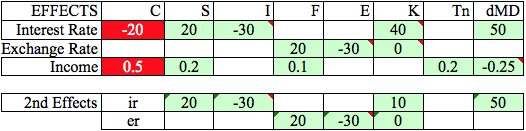
-- in the market for shoes, demand fall (tastes and preferences) and then rises a bit, due to the increased price of a substitute, but likely not to its original height. Drawn correctly this shows that the demand and the price of shoes will fall but not as much as they would have, due to the rise in boot prices.

The second way goes like this: In the market for shoes, the price of a substitute has risen, therefore the demand for shoes must rise *relative to where it otherwise would have been*. By that I am *not* saying that the price of shoes will rise but that the price will be higher than it otherwise would have been. In a treatment of substitute prices, this is the appropriate message.

**The following has been removed from the program. It remains for my historical memory**

**~~Second Effects.~~**

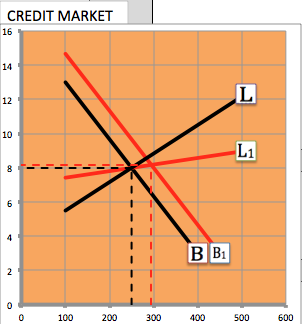
~~These parameters are even more esoteric and, hence, more easily ignored altogether.. If one changes the “2~~~~nd~~ ~~Effects” value of Ki, the result is to draw two curves, through the same initial equilibrium, each with the given slopes. By default, the “2~~~~nd~~ ~~Effects” are kept equal to the “Effects”. Any use of the RESET button returns them to being equal.~~

~~Changing Ki. The graph shows the effect of changing the “2~~~~nd~~ ~~Effect” of Ki from 40 to 10. That makes the supply of credit from overseas lending less interest rate sensitive as shown by comparing the black (initial) L curve with the red (changed 2~~~~nd~~ ~~effect) L curve. One could easily live without this facility, but there it is.~~

~~The Demand for Money (MDi)~~

~~The next graph shows the Credit Market given an increase of government purchases with the parameter MDi equal to zero (L, the pure Classical case) and to 200 (L~~~~1~~~~, a more Keynesian case).~~

~~As can be seen, the increase in government borrowing has a more expansionary effect, with a smaller effect on interest rates, in the Keynesian case.~~

~~1. Change “2~~~~nd~~ ~~Effect” of lambda to 2. We see both the supply of labor and the AS curve as much steeper. This testifies to the extent to which the slope of labor supply contributes to the slope of AS.~~

1. Yes, I know nothing is really “new” so “innovations” may not be wholly appropriate. [↑](#footnote-ref-1)
2. I think the great missing part of this material is a discussion of perceived wealth and income disparities, which I take to be the premier topic of our day. [↑](#footnote-ref-2)
3. I don’t see these are particularly novel, except perhaps in that they are offered early in the course. Furthermore I eschew the standard introductory material on micro supply and demand. Markets are taught largely as macro entities. I long ago abandoned the production possibilities curve. [↑](#footnote-ref-3)
4. I know it hurts some to think of Classical and monetarist theories as equivalent. Feel free to ignore the “M.” [↑](#footnote-ref-4)
5. I have waffled on, and remain inconsistent about, whether to use Cd or just define C as domestic consumption. [↑](#footnote-ref-5)
6. Leaving out the Labor Market points out the failure to address income distribution. [↑](#footnote-ref-6)
7. Throughout these notes. the notations dMD and dMS will occur. Just treat them as MD and MS. [↑](#footnote-ref-7)
8. There is an implicit assumption here that US dollars always return to the US, presumably because they are useless elsewhere. This ignores the role of the US dollar as an international medium of exchange. I mention this and then ignore it and use the equation. [↑](#footnote-ref-8)
9. I cannot reconcile this with another pillar of classical theory, Say’s Law, which asserts that demand – spending – follows from production, with no mention of changes of the money supply. [↑](#footnote-ref-9)
10. The FLAGS KEY section on the program indicates to which equation each flag refers. [↑](#footnote-ref-10)
11. Put another way, the Classical preoccupation was with the *distribution* of Income. It was left to Keynes to make the *amount* of Income the significant problem. [↑](#footnote-ref-11)
12. Unless it doesn’t. See the liquidity trap example below. [↑](#footnote-ref-12)
13. I contend that a discussion of the *money* multiplier is a worse distraction. [↑](#footnote-ref-13)
14. Personally I long ago decided that multipliers are not worth the time they take to teach. [↑](#footnote-ref-14)
15. Any time the model references a change of money demand, we could be phrasing the situation in terms of a change of the velocity of money. In fact, the

    presentation changes to that vocabulary later. [↑](#footnote-ref-15)
16. More realistically, interest rates would rise. [↑](#footnote-ref-16)
17. For example, an increase of demand typically raises *both* price and quantity somewhat, rather than raising just one of them by a lot. [↑](#footnote-ref-17)
18. This is a picture of what in the 1980s was considered the “twin deficits” problem. [↑](#footnote-ref-18)
19. Note that these very standard curve shifters. [↑](#footnote-ref-19)
20. Ignored in this treatment – but capable of being integrated – is the use of dollars as the international exchange and reserve currency and for foreign direct investment. I believe this is accomplished by connecting the Foreign Exchange Market to CASH on the Circular Flow Diagram. [↑](#footnote-ref-20)
21. In econ jargon, “adopt the fiction” is typically pronounced “assume.” [↑](#footnote-ref-21)
22. This being a restatement of X = MS + MD [↑](#footnote-ref-22)
23. Especially in macro where rates of change are typically small numbers. [↑](#footnote-ref-23)
24. Those with the math background and the curiosity are often delighted to be walked through an application of logarithms and their derivatives. [↑](#footnote-ref-24)
25. One can describe the actual targets – usually 1% - 2% – of many monetary authorities. [↑](#footnote-ref-25)
26. LevelToRate can be adjusted to the users taste. You can see that x = 6% is considered the normal nominal growth rate. [↑](#footnote-ref-26)
27. G stands here for exogenous growth, not Government Purchases. [↑](#footnote-ref-27)
28. pm represents the rate of increase of raw materials. pm = 0 means that material costs are rising at the rate of inflation, Since this would often be true, one can generally ignore pm. Its purpose is to model a period such as the 1970s when raw materials prices rose unusually quickly. [↑](#footnote-ref-28)
29. There are various other interesting combinations of REAL and NOMINAL. [↑](#footnote-ref-29)
30. This conclusion could be changed if the dollars of credit were denominated as “real dollars.” This adds considerable complexity to the model. [↑](#footnote-ref-30)
31. Note, as always X = MD + MS [↑](#footnote-ref-31)
32. This is, of course, true of any supply and demand problem. [↑](#footnote-ref-32)
33. No attempt is made to incorporate the money multiplier. [↑](#footnote-ref-33)
34. There are many uses of this approach in micro. I’ll stick to macro [↑](#footnote-ref-34)
35. G stands here for exogenous growth, not Government Purchases. [↑](#footnote-ref-35)
36. pm represents the rate of increase of raw materials. pm = 0 means that material costs are rising at the rate of inflation, Since this would often be true, one can generally ignore pm. Its purpose is to model a period such as the 1970s when raw materials prices rose unusually quickly. [↑](#footnote-ref-36)
37. All %Δ variables are imagined to be “per cent change since a year ago.” That is what I used for statistical estimates. [↑](#footnote-ref-37)
38. This is definitely not, to my mind, principle’s material. [↑](#footnote-ref-38)
39. I rarely advocate changing two variables at the same time. This is for illustrative purposes. [↑](#footnote-ref-39)
40. This bit of history may well have passed from pedagogical vouge. [↑](#footnote-ref-40)
41. m and v are the rate of change of the money supply and the rate of change of the velocity of money respectively. [↑](#footnote-ref-41)
42. I am unable to reconcile this part of Classical Theory with Say’s Law. [↑](#footnote-ref-42)
43. This may actually be an aid to the math-weak. If one’s only exposure to graphs is in an algebra class, then that exposure has involved only four-quadrant graphs. [↑](#footnote-ref-43)