Comprehensible Macro-Economics

David W. Brown

January 15, 2017

Contents

Introduction **3**

1 The Closed Economy **6**

1.1 Key Issues 6
1.2 Analysis 7
1.2.1 Fiscal Sovereignty 8
1.2.2 Sectors 9
1.2.3 Stocks, Flows and an Equation or Two 12
1.2.4 The Basic Model 13
1.2.5 A Computer Representation 16
1.3 Investigation 17
1.3.1 Overview of Sectoral Balances 18
1.3.2 Taxation and Spending 21
1.3.3 Changing the Tax Rate 23
1.3.4 Steady States 25
1.3.5 Tax and Wealth 27
1.3.6 Government Expenditure and Wealth 30
1.3.7 Welfare and Taxation 31
1.3.8 Welfare and Aggregate Wealth 33
1.3.9 Varying Propensity to Consume 34
1.3.10 Imports and Exports 36
1.4 Comments, Conclusions and Caveats 38
1.4.1 National Debt 40
1.4.2 A Brief Reflection on Government Policy 40
1.4.3 The Left's Unrecognised Problem 40

What's Next? **42**

List of Figures

1.1 Sectoral balances in the US economy always sum to zero . . . 8
1.2 Four sectors of an open economy 12
1.3 Equations and default parameters of the Basic Model 17
1.4 Sectoral balances of the Basic Model 18
1.5 Government expenditure and taxation 22
1.6 Changing the tax rate 24
1.7 Household sector balance increases without limit if tax is zero 25
1.8 Effect on wealth of changing tax rate 28
1.9 Effect on wealth of changing government expenditure 30
1.10 Effect of welfare payments on taxation 31
1.11 Effect of welfare payments on aggregate wealth 33
1.12 Varying propensity to consume out of income 34
1.13 Varying propensity to consume out of savings 35
1.14 Unbalanced trade without exchange rate adjustment 36

Introduction

Economics is a subject few people profess to understand, although it shapes our lives in many ways. It is a determining factor in where we live, what we eat, what sort of work we do, how we occupy our leisure time (and whether we have any leisure time), and even such intensely personal issues as how many children we have.

Nevertheless, for most of us it is a mystery of which we have little understanding and over which we have virtually no control. Such control as we do have is limited to our ability to influence which political party holds the reins of government, and whose policies are therefore brought to bear on the levers of the economic system.

It is crucial therefore that we should have some understanding of how the economy works so we can make a sound judgment on the question of whom to vote for. But do we? Absolutely not! How could we when our only sources of information are academic works that few people read and fewer understand, and the facile but almost entirely inaccurate punditries of the national media and politicians?

It is often said by people who have taken the time and trouble to look into the issues carefully that 'everything you know about economics is wrong'. Sadly this seems to apply not only to the public at large, but also to the politicians—from the chancellor down—who are notionally responsible for the regulation of the economy. Many, possibly most, government interventions in the economy seem to be counter-productive and often to have the opposite effect to what was (ostensibly at least) intended.

One thing of the untrue things we all know about economics is that it is difficult. Perhaps this is partly true—no doubt there are highly complex technicalities that would be difficult for a lay person to follow, but the basic principles and mechanisms, how it 'works' on the macro scale, are actually quite simple.

I realised how simple it was after I was introduced to sectoral analysis—an approach pioneered by (among others) the eminent economists Wynne

Godley and Marc Lavoie [3], and one of the building blocks in something called Modern Money Theory (or sometimes Modern Monetary Theory) developed by Randall Wray, Bill Mitchell *et al* [6]. These and other writers combined the insights of sectoral analysis with the recognition that money is created by governments through the agency of the treasury and central banks, and succeeded in constructing a complete and (as Godley would put it) 'stock-flow consistent' conceptual model of striking simplicity.

Having a software development background, I was intrigued by the possibility of building a computer model based on these ideas. Essentially all that would be needed was a record of sectoral balances, a representation of the flows between them that could be simulated to maintain the changing balances, an internal timeline that would drive the process, and a graphical display of the resulting behaviour. Indeed Godley and Lavoie describe a conceptually similar model [3, Chapter 3]. Their proposed implementation however is spreadsheet-based, and it is not dynamic, in the sense that it does not attempt to model changes over a period of time.

I was encouraged by an unpublished paper by Charles Melville [4], in which he described a Haskell implementation of the model. This served as a proof of concept, but required Haskell programming knowledge to run. However, it did establish that useful results could be obtained from a very simple model.

This report then is based on the construction of such a computer model (which I called SimX, in deference to Godley and Lavoie's SIM model), and its use in verifying and clarifying some of the underlying ideas of Modern Money Theory.

Who is this for?

I wrote this report primarily for myself, secondarily for my friends in the Peace Party, and lastly for anyone else who might just possibly be interested. Despite its academic format there is nothing in it that is difficult to understand.

The inclusion of graphs, equations, and a few other mathematical expressions should alarm no one as they are all very simple. It is impossible, in my view, to discuss even simple relationships between numerical quantities with any exactness without using formulae and graphs, but none of the relationships is at all complicated.

So why do I need to write it at all if it's so simple that anyone could understand it? Part of the problem is, I think, that if you 'know' something is complicated, you will instinctively tend to reject any explanation that purports to be simple. Or as J.K. Galbraith [2] put it:

> The process by which banks create money is so simple that the mind is repelled.

It is perhaps surprising that our four extremely simple equations (see section 1.3) can give rise to results that may not be obvious. The reason for this is just that the variables in the equations are not static but subject to change on every period transition.

Nevertheless the unexpectedness of the the results (and of the claims of Modern Money Theory in general) may go some way to explaining why no major political party, in or out of office, is prepared to recognise the insights of MMT publicly. There is little doubt that if they did they would be comprehensively rubbished by the media and economics pundits, and it would amount to electoral suicide.

There is a paradox: most people do not understand, or even think they understand economics, but they nevertheless have strong views on what is 'correct' economic policy. And for the most part they are wrong. They are wrong principally because they do not realise that money is now created by the government, and has been since the US left the gold standard and the UK ceased to peg its currency to the dollar.

Even a Prime Minister (Margaret Thatcher) has claimed to believe that a government's 'budget' was subject to the same constraints as a household's. This belief signally failed to take on board the fact that a government can, and does, create money. A household that attempted to do the same would quickly fall foul of the law.

So what I have tried to do in this note is to show, using a simple computer model, what some of the practical and logical implications of Modern Money Theory are. If this interests you and you're not afraid of a few simple graphs and formulae, this is for you!

Chapter 1

The Closed Economy

1.1 Key Issues

We are all familiar with a relatively small number of key economic terms that affect or appear to affect our lives: terms such as 'taxation', 'government spending', 'austerity', 'recession', 'deficit', 'debt', 'benefits' and 'welfare'. But though we may be familiar with the terms, our grasp of what they actually mean and how they interact may be rather slender. Worse than that, the things we do 'know' (for example that taxation pays for government expenditure) may be just plain wrong.

This is important, since it is largely on the basis of how they regulate or try to regulate these factors that governments seek to justify their existence, and we need to have a sufficient understanding of them to be able to assess their performance.

Economics is about the role of money in the creation and distribution of wealth. In very broad terms the part of economics that is about wealth creation is known as 'macro-economics', while the part that is concerned with its distribution comes mostly under the heading of 'micro-economics'. I mention this simply because all I will be considering in this note is the wealth-creation part of the story—macro-economics—for the simple reason that that is all I have researched so far.

'But,' you may protest, 'it's all very well understanding how wealth is generated, but what about poverty? Shouldn't the abolition of poverty be our primary concern?' I'll say more about this later, but essentially I would agree with you. There's no point whatever in generating more wealth for the already rich, and we need to understand micro-economics as much as macro-economics.

But there is also an interaction between the two. Suppose for example that a government decides, for macro-economic reasons that may or may not be sound, to embark on a radical programme of austerity. The worst that the rich will suffer in consequence will be a mild irritation. The poor by contrast will go hungry, may be obliged to live in sub-standard housing, and will have constant money worries and a host of attendant miseries.

But if we understand, and can demonstrate, that the proposed austerity programme is at best ill-informed and at worst economically illiterate, we may eventually be able to vote that government out of office and replace it with one that understands economics. This may not solve the poverty problem, but it is an important step in that direction and should at least avoid making things much worse.

1.2 Analysis

The study of economics is beset with complexity and uncertainty. Uncertainty as to the facts, and complexity in their analysis. It often seems that for every assertion made by an economist there is an opposite assertion made by another.

To break through this fog we need to identify what can be known 'for certain', and then to see whether there any useful facts that can be deduced while remaining within the realm of logic and avoiding as far as possible conjecture and speculation.

Wynne Godley and Marc Lavoie [3] pointed out that an economy of a (fiscally) sovereign country (specifically that of the USA) could be considered without loss of generality or consistency as comprising three 'sectors'. Each sector has at any given point in time, a 'sectoral balance', and these balances are changed over time by flows between them.

Given that in the real world such sectors can be clearly defined, that they will have measurable or countable balances, and that we can identify all trade as flows either within or between sectors, this representation is merely descriptive of what must logically be the case, and therefore can be accorded the status of 'fact'—it has to be true.

If there are any vestiges of doubt as to the validity of that assertion, they should be dispersed by figure 1.1 (from [3], which clearly shows that the balances of the government, private, and foreign sectors sum to zero at every point in time from 1990 to 2015. This not a curious coincidence—it is simply the inevitable effect of a system in which anything that leaves one of the sectors must end up in one of the others, or at least shared between them.

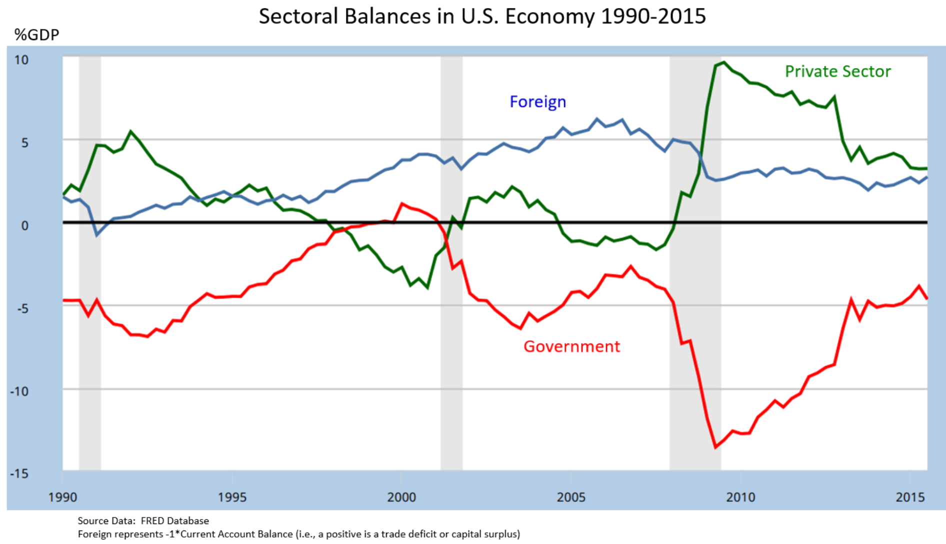

Figure 1.1: Sectoral balances in the US economy always sum to zero

Although simple, this model is surprisingly powerful.

1.2.1 Fiscal Sovereignty

But we do need to define what we mean by fiscally sovereign. A fiscally sovereign country is one in which currency creation and destruction is under the control of the government: creation by means of 'printing' money, and destruction by means of taxation. The former puts money into the economy, and the latter removes it.

It is important to realise that not all countries are sovereign in this sense. A country that is on the gold standard, for example, is not fiscally sovereign. It cannot create money; money is created by the poeple who mine the gold, and the government is dependent on taxes for its funds. Australia is fiscally sovereign; so are the USA, Japan and China. Although the USA is fiscally sovereign at the federal level, its individual states are not—they cannot create money and are dependent on taxation (or the government) for funds.

The EU is an interesting case. As a whole (like the USA at federal level) it has fiscal sovereignty as it can create money. It doesn't collect taxes directly, but the 'contributions' of member countries could be said to have the same effect. Member countries on the other hand are like American states. They are dependent for funds on the European Central Bank (effectively an arm of the European 'government') and national taxes, in the same way that

American states are dependent on the Federal Reserve and state taxes.

The UK is in a strange position. Nominally outside the Eurozone, it has nevertheless surrendered the right to control its own currency as a condition of membership of the European Union. It is interesting to note that since the decision was taken to leave the EU there has been more talk within the government of not 'balancing the books'—perhaps because we will no longer be subject to the constraints on government spending that go with EU membership.

1.2.2 Sectors

As a first approximation we can consider a sovereign economy as consisting of three 'sectors': households (H), government (G), and producers (P). Everything that goes on in the economy implies a transfer of funds between or within these sectors. As our main interest in the sectors will be to keep track of their financial (money) balances we can ignore the transactions that go on within them as they clearly leave the balances unchanged. Our concern will be solely with the transfers between them, and the resulting balances.

These three sectors describe a 'closed' economy—one that only trades internally and has no imports or exports. To allow for external trade we can add a fourth sector, which we will designate the 'foreign' sector (X).

A more detailed analysis could also include a financial sector, and others, but these four will be sufficient for our current purposes. (Incidentally, I use X to refer to the foreign sector simply in order to leave F free for possible use later for the financial sector.)

The next step is to decide what goes on between the sectors that will determine their balances—what their financial assets amount to.

The Household Sector

The households sector (H) is all of us. Although our individual (micro-economic) roles may differ widely, collectively (macro-economically) we have five functions. These are:

1. Domestic consumption. This simply means paying for goods and services from the producers sector.
2. Earning. This means receiving payments from the producers sector in return for work done, enabling it to sell goods and services for consumption by the household or other sectors.

3. Paying taxes to the government sector.
4. Buying goods and services (imports) from the foreign sector. This is of course also consumption, but we need to distinguish it from domestic consumption as transfers (payments) are made to a different sector.
5. Receiving welfare benefits from the government sector, including, as appropriate, basic income (if paid), unemployment, sickness, and disability benefit, and pensions.

We designate the amounts of these transfers as c (consumption), w (wages), t (taxes), m (imports) and b (benefits).

The Government Sector

The government sector (G) has four functions:

1. Levying and collecting taxes (t) from the households sector.
2. Providing funds to the producers sector for such things as public works and public services. We will call this primary government expenditure (g) to distinguish it from:
3. Provision of funds directly to the households sector for what may be roughly described as 'welfare benefits' (b), noting in passing that the term is somewhat politically loaded. Fortunately b can equally well stand for basic income, which I will argue in due course is an essential part of a well-functioning economy.
4. Payments to the foreign sector—often for major infra-structure projects where foreign companies may have expertise that indigenous companies cannot supply. This could also include foreign aid although the 'real' assets, if any, received in return are harder to quantify.

Note that, unlike the households sector, the government sector does not consist of people—the term refers only to the functional institution. The human beings that make it work remain members of the households sector, like the rest of us. This is an important distinctions that is often ignored, particularly by the popular press. The members of the government do not own its financial assets; *we* do. They merely manage those assets on our behalf.

The Producers Sector

The financial functions of the producers sector (P) are:

1. Paying wages (w) to the households sector for work done in producing goods and services. This will be in response to orders not only from the households sector but also the government and foreign sectors.
2. Receiving payments (c) from the households sector to pay for domestic consumption of goods and services.
3. Receiving payments (g) from the government sector for goods and services ordered by the government (i.e. primary government expenditure).
4. Receiving payments (x) from the foreign sector for goods and services produced for export.

It is important to note that this sector is assumed to pay out (principally as 'wages') all the funds it receives, so maintaining a zero financial balance. Wages in this context include payments to shareholders and other profit-takers or beneficiaries. In practice a business may retain some of its profits for future investment or for other purposes, but this is a secondary factor and we will ignore it for the time being.

The Foreign Sector

1. Exports (x) are payments by the foreign sector to the producers sector. For the time being we ignore the question of exchange rates as we are not concerned with the economics of the foreign sector itself. Payments may be made in the home currency (if the purchaser has access to them) or in the foreign currency at the going exchange rate—which for the sake of this exercise we assume to be unchanging. This is not, in general, a safe assumption, and would need to be accounted for in a more complete analysis.
2. Imports (m) are payments from the households sector for goods and services provided by the foreign sector. As with exports, we are not concerned with the exchange rate and assume payments are made in the home (not the foreign) currency.
3. The foreign sector receives payments (f) from the Government both as foreign aid and in payment for goods and services supplied directly to the government for goods and services—for example military hardware.

1.2.3 Stocks, Flows and an Equation or Two

All this can be summed up in the following diagram, which shows the four sectors we have defined and the transfers (or in economics-speak, 'flows') between them. We immediately begin to see the power of this sort of analysis (known as 'sectoral analysis') as some of the relationships quickly become apparent.

Looking at sector P, for example, we can see that there are three sources of incoming funds: g, c, and x, and one outgoing: w. But we have already said that the producers sector maintains a zero balance, from which it immediately follows that

$$w = c + g + x \tag{1.1}$$

An English translation of this would be, 'Wages paid are equal to the total of all money received from sales.' As indeed (given our loose definition of wages and the constraint that the sector is not to retain any funds) they have to be—where else would the money go?

G, on the other hand, is allowed a non-zero balance, which is evidently $t - g - b - f$, and which we call a deficit if it's negative and a surplus if it's positive—another couple of highly loaded terms.

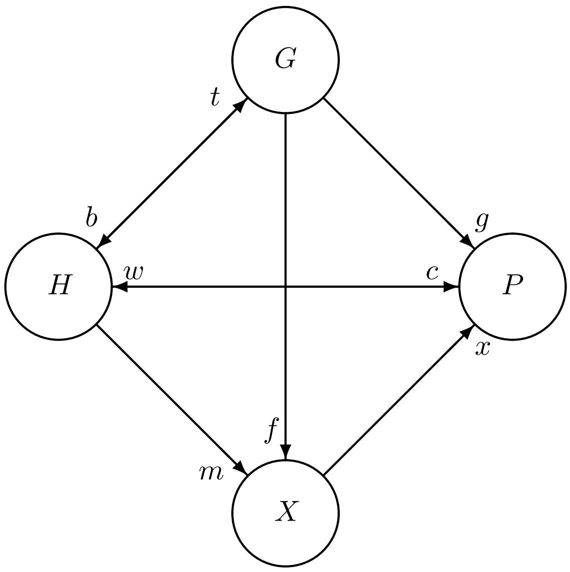

Figure 1.2: Four sectors of an open economy

1.2.4 The Basic Model

Let's put our definitions of inter-sector transfers on a more formal footing. We'll continue to follow the convention that sectors are represented by upper-case letters (or words beginning with a capital letter). Thus G, H, P and X are sectors. Next, we'll define transfers by writing the name of the transfer (lower case), followed by a colon, followed by the source and destination sectors separated by an arrow ('$\rightarrow$'). Thus we have eight transfers as follows:

$$
\begin{aligned}
g &: G \rightarrow P \\
b &: G \rightarrow H \\
t &: H \rightarrow G \\
w &: P \rightarrow H \\
c &: H \rightarrow P \\
x &: X \rightarrow P \\
m &: H \rightarrow X \\
f &: G \rightarrow X
\end{aligned}
$$

Of course, this merely restates what we have already said less formally. The benefit of using this notation is that it is relatively easy to construct a parsing algorithm that will accept it as input to our computer-based model.

Now it's time to pin down the relationships between the transfers. We have already noted that $w = c + g + x$ (equation 1.1). Next we look at each of the terms on the left-hand side and see what we can say about them.

Consumption

First c, consumption. The question is, how, typically, does anyone decide how much to spend? Our answer to this thorny question doesn't have to be right—we can modify it later—it just has to be plausible.

Clearly, this must depend on two things (possibly among many others): disposable income, and accumulated money (or 'savings'). The latter may be money in the bank, notes under the mattress or in the cookie jar, whatever—we'll call it the 'money stock'. It's basically any money that has been left over from earlier spending. Let's say, for the sake of argument that a person typically spends a certain fraction of disposable income (we'll call the fraction a_1) plus a different fraction (a_2) of the money stock. Then we have:

$$c = (a1 \times \text{disposable income}) + (a2 \times \text{money stock})$$

Looking down our list of transfers we see there's nothing corresponding to disposable income, so for now we'll just call it d. As for money stock, this is the same thing as the balance for the sector—i.e. H. So it looks as though we can simply write this as:

$$c = a_1 d + a_2 H$$

This is a big improvement, certainly, but it's not quite right. Consumption cannot depend on the sectoral balance because the sectoral balance depends on consumption! If we put this into the computer it will complain bitterly. It really is a classic 'chicken-and-egg situation'.

Fortunately there's a way around it.

In real life we avoid this problem because when deciding how much we're going to spend we're not going to look at the balance that we will have at the end of the month, but the balance that's left over from the previous month (or week, or year, or, in general, period). So instead of writing H, we simply write H', pronounced 'H dashed', 'H prime,' or if you prefer, 'H previous'.

And now we can write the correct version of the equation:

$$c = a_1 d + a_2 H' \tag{1.2}$$

That's fair enough, but we still don't know what the values of a_1, a_2 and d are. Well, we have said that a_1 and a_2 are fractions. They don't depend on anything—they can be anything you like as long as they are positive and not more than 1. In other words they are 'parameters' of the system, and what we generally do with parameters is just give them arbitrary (but plausible) values, and try adjusting them to see what happens.

OK, let's say that a_1 is 0.6 and a_2 is 0.4. In other words in each period a typical householder might spend 60% of his or her disposable income, and 40% of other available cash. Plausible, if arbitrary. So,

$$a_1 = 0.6 \tag{1.3}$$

$$a_2 = 0.4 \tag{1.4}$$

When we come to examine the system more carefully we can try out other values and see what difference it makes. We could even carry out research to find out how people really decide how much to spend—or look for research that has no doubt already been done on the subject.

Disposable Income

That still leaves us with d to define. Simple—it's disposable income, which must be wages less taxation. But not $w - t$, since we must assume (as we haven't built in any provision for banking or credit) that people can only spend money they already have, not money they expect to have by the end of the month. We therefore use income and expenditure figures from the previous period:

$$d = w' - t' \tag{1.5}$$

So now we've taken our analysis of domestic consumption as far as we can. The next value to look at is g—which like a_1 and a_2 doesn't depend on anything. It's the amount the government decides to spend, and the government can decide whatever it likes. Economists refer to it as 'exogenous', in contrast to quantities like wages and consumption which are dependent on whatever else is going on in the economy and are described as 'endogenous'.

We'll assign an arbitrary value of 100 to g, noting that this still leaves the possibilities wide open because we haven't defined the units. It could be £100 or £100bn. But whatever we take it to mean, we must use the same scale for everything else as well.

$$g = 100 \tag{1.6}$$

Taxation

Taxation, t, is another endogenous quantity. The government can fix the tax rate, or rates, but as we will see, it cannot fix the amount of tax—not directly, anyway.

To a first approximation tax paid will typically be a percentage r_1 of wages (i.e income tax), plus a percentage r_2 of consumption (i.e. purchase tax). In practice it is likely to be much more complicated than that, but it will do for our current purposes.

This gives us the equation

$$t = r_1 w + r_2 c \tag{1.7}$$

r_1 and r_2 are exogenous parameters, to which we will assign default values of 10 (percent) and 0 (percent), representing an economy that imposes income tax but no purchase tax. What happens for different combinations of the two tax systems is something we can investigate.

This leaves benefits (b), imports (m), exports (x), and government foreign expenditure. We'll set these all to zero in the first instance, thus modelling a closed economy in which all government spending is on public works and public services (provided by indigenous businesses), with none on welfare and where there is no external trade.

$$b = 0 \tag{1.8}$$
$$m = 0 \tag{1.9}$$
$$x = 0 \tag{1.10}$$
$$f = 0 \tag{1.11}$$

So that's it. We have now defined a model of a simple closed economy at a macro level.

1.2.5 A Computer Representation

The next step is to feed this information into a program that is designed to work out how the system will evolve through time—a computer model.

It will do this simply by applying each of the transfers we defined at the outset, calculating the values of the variables that result, and plotting the results on a graph. It will do this repeatedly, for a configurable number of iterations, each iteration representing a 'period'. What a period is, exactly, is rather difficult to pin down, particularly as the different agents in a real-world economy would work to periods of different lengths, ranging from a day for some 'casual' workers to a quarter of a year for a government or large corporation.

These caveats imply that we shouldn't look to our model for precise timely predictions. Rather, what we can expect it to reveal are general principles, such as that increasing certain parameter in a certain situation causes an increase, or reduction, in some other variable. It may, for example indicate that the tax take will increase or reduce to a certain point and no further, but it will probably not be able to tell us accurately how long this will take.

The program I used (and wrote) is implemented in C++ on 64 bit Linux Ubuntu, using the CodeBlocks IDE for development, and wxSmith for the user interface and graphics. A basic model can be defined using the notation of section 1.2.4, and runs and extension runs are then set up by selecting parameters and adding equations. The program stores each model in the same notation so that it can be rerun later if required.

The executable runs on Linux Ubuntu but the source is freely available to anyone who is interested in either extending it or compiling it for another platform. The executable is also available, but only for 64 bit Linux Ubuntu.[1]

[1] For a copy of the source or an executable (64-bit Linux only), or for more information, email me at david@cowlstreetpress.co.uk.

1.3 Investigation

Even with a simple model like ours the number of interacting variables can be confusing. The approach we adopt initially is to keep the model (as defined by its equations) constant and to note the effect of varying the parameters one at a time. Once we have gained an understanding of how that model behaves we can try changing the model itself (i.e. its equations) to determine whether the changed model behaves similarly.

The model, then, is defined by equations 1.1, 1.2, 1.5 and 1.7, which describe the relations between wages, consumption, disposable income, and taxation. The remaining equations give the default values of the parameters For ease of reference, I've included a summary in figure 1.3 below.

$w = c + g + x$	Wages
$c = a_1 d + a_2 H'$	Consumption
$d = w' + t'$	Disposable income
$t = r_1 w + r_2 c$	Taxation
$a_1 = 60$	Proportion of wages spent on consumption
$a_2 = 40$	Proportion of money stock spent on consumption
$g = 100$	Primary government expenditure
$r_1 = 10$	Income tax rate
$r_2 = 0$	Purchase tax rate
$b = 0$	Government expenditure on direct payments
$m = 0$	Cost of imports
$x = 0$	Receipts for exports
$f = 0$	Government foreign expenditure

Figure 1.3: Equations and default parameters of the Basic Model

If we ignore for now the last five parameters (which are all set to zero) we see that we have a very simple model indeed: four equations and four parameters. By zeroing the m, x and f parameters we have also eliminated foreign trade so sector X will have no bearing on proceedings and we have effectively reduced the model to just three sectors. This is all to the good—the simpler the better at this stage—but we must be sure to re-introduce these extra factors later. For the time being we just have to be aware that we are now dealing with a closed economy, and that the results may be changed in as yet unknown ways once foreign trade is accounted for.

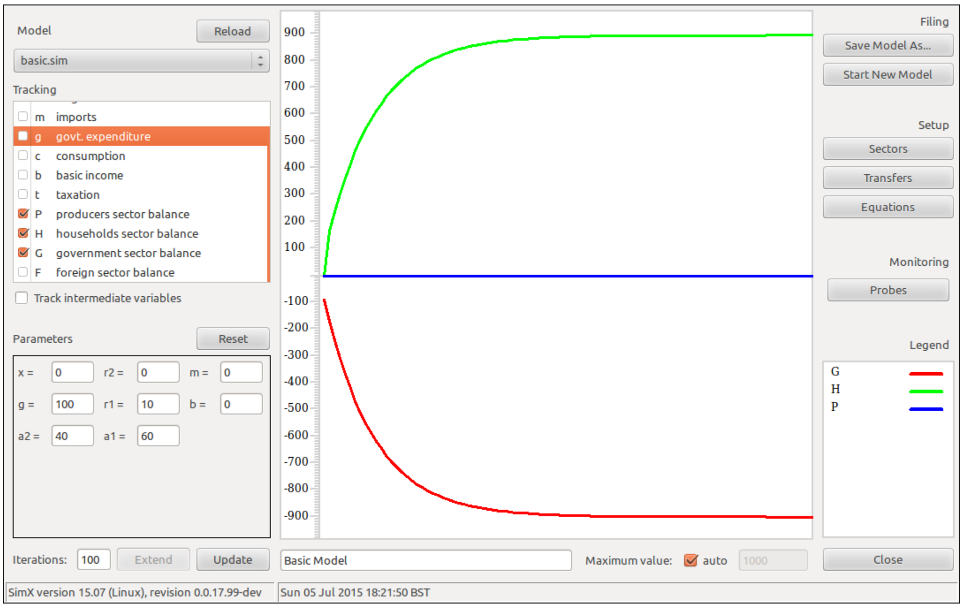

Figure 1.4: Sectoral balances of the Basic Model

1.3.1 Overview of Sectoral Balances

As a preliminary experiment, after setting up the Basic Model as described[2] we simply get it to display the sectoral balances for a hundred iterations, or periods (see figure 1.4).

Stocks are not Flows

Before going any further, let's reiterate what we mean by a 'sectoral balance'. We have already noted that a transfer (between sectors) is a 'flow'. Wages, for example, are a flow. They are paid every period, and only have meaning 'during' the period to which they apply. A balance, on the other hand is a 'stock' and amounts to the cumulative result of transfers into a sector up to and including a given period. And note that although stocks and flows can can be represented on the same graph this can easily cause confusion because they do not actually have the same units. In financial terms a stock is an amount of money, while a flow is an amount of money per period—i.e. the rate of change (of a stock) with respect to time.

In figure 1.4 we see the change, or evolution, of our three sectoral balances over 100 time periods. As expected, the producers sector remains at zero

[2] With the exception that, rather than setting it to zero, we omit f from the model altogether, which means it does not appear in the arguments shown in the illustrations.

throughout—everything that comes in from sales goes out again immediately as wages, so this is not surprising, and helps to confirm that we have set the model up correctly.

The government and households balances are more interesting though, and reveal some very important aspects of economic behaviour. They start at zero, of course, because we start all sectoral balances at zero. But once the system gets under way each is an exact mirror image of the other—one positive, the other negative. When (after 74 iterations) $H = 899.589$, $G = -899.589$. This is clearly not just a coincidence!

In fact there's nothing mysterious about it. No money comes into the system and no money leaves it. We start off with all the sectors having zero balances, so the total of all the balances must always be zero. From which it follows immediately that if one sector has a balance of £x, and one has a balance of £0, the remaining sector must have a balance of £$(-x)$.

Some Observations on Negative and Zero Balances

It might be interesting to explore the notion of negative and zero balances a little further at this point.

We have already noted that the producers sector P is assumed always to be zero. This is effectively an idealisation of the real world situation—where businesses typically do have non-zero balances. However where a business has a negative balance it will generally be because it has obtained finance on credit, with a view to making investments that will bring in sufficient funds to cover the loan. If this is not the case the business is in trouble.

Where, on the other hand, a business has a significant positive balance this will generally be seen either as a buffer agains a 'rainy day' or as a temporary blip. Ideally a business will aim to use all its funds in pursuit of its activities, not to have them lying idle in a bank account.

But in any case, our simple model rules out negative balances for the producers and householders sectors as we have no mechanism for banking or credit. This allows us to postulate the simplification that businesses do in fact pay out all their income (and no more than all their income), be it in the form of wages, dividends to shareholders, or other kinds of remuneration.

The government sector G is different. As we have already noted, it is the source of all money. Its only income is taxation, but it has expenditures which may be greater than its tax receipts. They certainly cannot, overall, be less than its tax receipts because the funds that make up those receipts came originally from government expenditure (there being, as we keep saying, no other source of money).[3]

If, as seems likely therefore, a government's aggregate expenditures exceed its aggregate tax receipts, there will be two inevitable consequences: (1) the government sectoral balance will be negative, and (2) the households sectoral balance will be positive.

But if we are not allowing for banking or credit, how can a sectoral balance, even the government's, be negative?

The answer to this conundrum is simple but crucial. *The negative balance is no more than an accounting record of the funds the government has created.* To use a mining analogy, it is the conceptual hole in the ground from which it has dug out the notional gold. Many commentators, including government spokespeople, fail to recognise this distinction, and regard the 'hole' as a debt. In fact some pundits even go so far as to call it a 'black hole in the government's finances'. This is nonsense.

The situation is confused still further by the routine practice of actually creating real debts (i.e. government bonds) whose value matches the negative balance (referred to in this context as the PSBR, or Public Sector Borrowing Requirement). While this might be a convenient way to fund financial institutions (through interest payments) and at the same time to maintain control over interest rates and hence inflation, it is logically unnecessary. It is also worth noting in passing that when and if a government decides to repay the debt the only mechanisms at its disposal for doing so are (1) further borrowing, and (2) creating more funds.

It is also important to note that the counterpart of the negative value of G is the positive value of H, P being zero. And P is 'our' balance, the funds held by households. Were the government's balance to be positive this would have to be negative, impossible in our model as we have no banking mechansim, and hardly a desirable state of affairs in the real world either.[4]

Convergence

The other interesting thing about the H and G curves is that they appear to flatten off at about 900. Actually they have only reached 899.973 after 100 iterations, but they do eventually—after another 39 iterations—reach 900

[3]This may not necessarily apply *in the short term* if expenditure has already exceeded tax receipts for a while, creating a so-called 'deficit'. But aggregate tax receipts can never exceed aggregate government expenditure.

[4]In fact we see this in the real world too, where governments have striven to maintain a surplus—thus starving households and businesses of funds and consequently increasing the indebtedness of the private sector (i.e. us) to unsustainable levels.

and remain there. Again, 900 is a surprisingly round number. But checking out other rates confirms that in the limit, as the number of iterations increases,

$$H \to \left(\frac{1}{r_1} - 1\right)g \tag{1.12}$$

if $0 < r_1 < 1$ and $r_2 = 0$, and

$$H \to \frac{1}{r_2}g \tag{1.13}$$

if $0 < r_2 \leqslant 1$ and $r_1 = 0$.

This is an important result as it shows, perhaps a little surprisingly at first sight, that (for our simple model at least) the households' sectoral balance is completely determined by government expenditure and taxation. A little careful thought will show that indeed this must be so, since the source of all money is ultimately the government, and the only agency that can remove money is also the government.

It is interesting to note also that the balance is *directly* related to government expenditure, and *inversely* related to taxation. The implications for government fiscal policy ought to be be profound, and no doubt would be if governments were not perversely concerned with the 'deficit'—its negative mirror image of the households' sectoral balance. We will consider these issues more fully in due course.

1.3.2 Taxation and Spending

I said earlier that tax—but not tax rates—is endogenous. This may seem a little counter-intuitive since a government can, in principle, levy whatever taxes it wishes. Suppose a country has a population of 10 million and the government wishes to raise a billion pounds in taxes. It could simply say everyone had to pay £100 (10m x £100 = £1bn). One problem would be in collecting the taxes. Not everyone would have £100 to spare, and some would feel that the enterprise was so unfair that they would refuse to pay on principle. The upshot would be that the government might not be able to collect all the tax it demanded.

More importantly though, even if the government could collect all the tax it wanted to, in doing so it would have a significant effect on the economy itself, and this could result in there being fewer funds for it to collect. Everything is related, and we (and particularly the government) need to understand the nature of the relationships.

In general terms, for tax to be collectible, it must have the payers' consent, even if that consent is grudging. This means it has to be related in some way to each payer's ability to pay, and will be at least partly dependent on the payer's circumstances, which in turn will depend on the economic situation. In other words although the government can create the rules which determine tax liability, it cannot simply determine how much tax it will take, as this will be influenced by a number of other factors.

So our next experiment is a very simple one: to get an idea what the relationship (if any) is between taxation and government spending we ask the model to plot these two quantities over a timescale of 100 periods. The result is shown in figure 1.5, below.

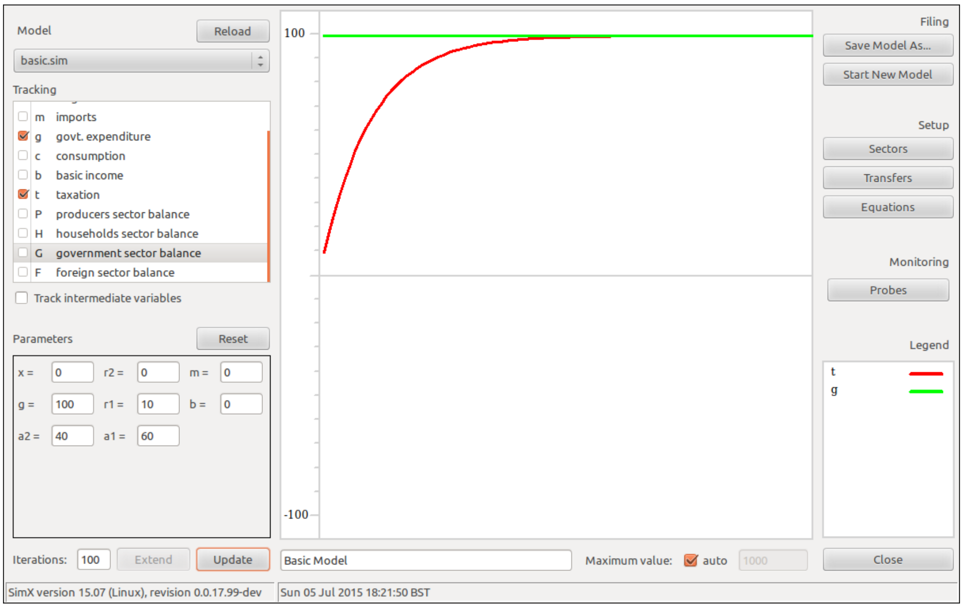

Figure 1.5: Government expenditure and taxation

Here taxation, like everything else, is initially zero, and in the course of about 50 iterations it rises to be equal to government expenditure. Having reached that point it stays there.

The default value for government expenditure is 100. We would not expect the shape of the graph to change if we changed it to, say 200, or 10,000, or anything else since government expenditure is the only absolute quantity in our model—everything else is a proportion of something else, and so, ultimately a proportion of government expenditure. Double government expenditure then, and you will automatically double the tax take. The only thing that changes on the graph is its scale.

This simple fact has important implications. Suppose, in a real economy, the government decides it should run a 'budget surplus'—in other words try to arrange things such that revenue (i.e. taxation) exceeds expenditure.

We have already noted that, except in the short term, this is impossible as a matter of simple arithmetic, but nevertheless governments have often adopted it as a policy objective.[5] They can try to do it either by raising taxation or by reducing expenditure, but it is doomed to failure either way since (subject to a small caveat—see Oops! below) everything will adjust automatically, to keep them in sync.

1.3.3 Changing the Tax Rate

If that last statement sounded a bit rash, take a look at figure 1.6, which shows the effect of increasing the tax rate r_1 from 10% to 25%. The only effect is to make the amount of tax taken rise more quickly, but it doesn't rise any further than government expenditure. Conversely, if we reduce the tax rate the slope gets shallower. At 1% it takes about 500 iterations to more-or-less reach government expenditure, and at 1000 iterations it is still 0.0043% short.

This holds as long as r_1, however small, is greater than zero. When it's zero the tax take is also zero and the curve lies flat along the time axis. You could say that it takes an infinite amount of time in this case to reach 100—the question is academic. And if you go beyond zero into negative territory the model breaks down completely since each time the system adjusts the tax becomes more negative, and at an ever increasing rate.

Oops!

Having asserted that tax will always track government spending we now have to backtrack a little. Godley and Lavoie [3] relate what classical economists call the multiplier effect to the fact that households use some of their 'savings' (H', in our system) as part of their payment for consumption, which influences the relationships between tax, consumption and government expenditure.

The default parameters of our Basic Model stipulate that as well as 60% of their disposable income (d) households will spend 40% of their accumulated wealth (i.e. 'savings') H' on consumption. To see whether, as Godley and Lavoie seem to suggest, this could have a bearing on the question whether, and how, tax follows government spending, We changed parameter a_2, the fraction of H' that is employed, to zero. The immediate consequence was that tax no longer followed government expenditure exactly, whatever the

[5] In 2015 George Osborne, UK Chancellor of the Exchequer actually claimed that he would enshrine the policy in law [1], but it was nevertheless unceremoniously ditched by his successor.

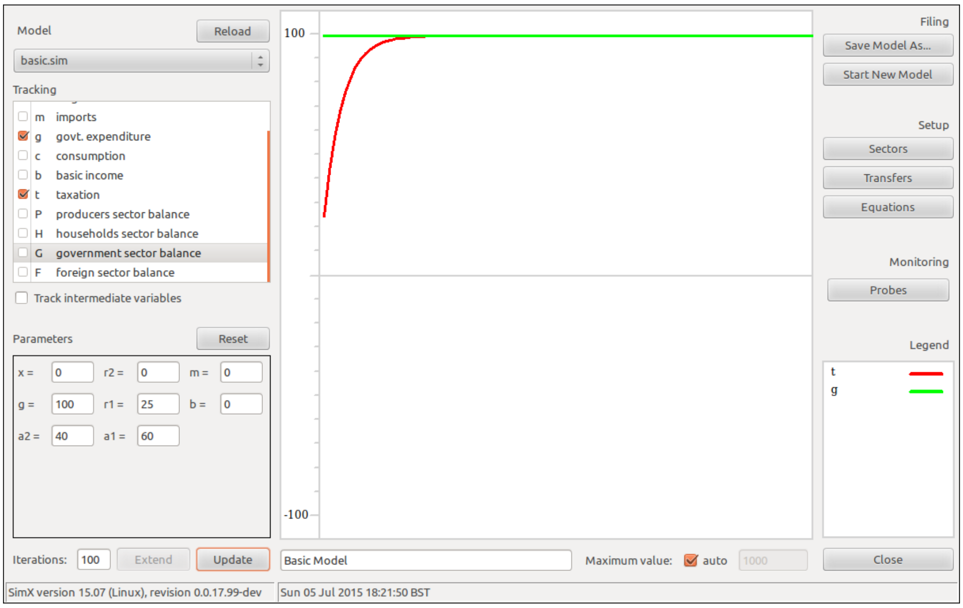

Figure 1.6: Changing the tax rate

value of a_1. It continued to reach a ‘steady state’ but at a fraction of g that was much smaller than a_1.

The proportion (a_2) of H' that was employed was more-or-less immaterial: t reliably tracked g for all values of a_2 greater than zero, though as with the tax rate itself the speed of adjustment was higher for higher values. In fact for values close to 100% it would very slightly overshoot the target and then drop back down.

This weakens our assertion that tax follows follows government expenditure (i.e. that $t \to g$) but not that it is endogenous. The extent to which it follows expenditure will depend on the extent to which households spend either (a) 100% of their income or (b) at least some of their accumulated wealth, on consumption. But where neither of these conditions apply we can still say that taxation never exceeds expenditure, and is generally much less. Further, that an attempt to ‘remedy’ this by increasing the tax rate will always be unsuccessful.

And in practice, the assumption that part of the households sector’s spending will be a fairly consistent proportion of its accumulated wealth, still seems reasonable.

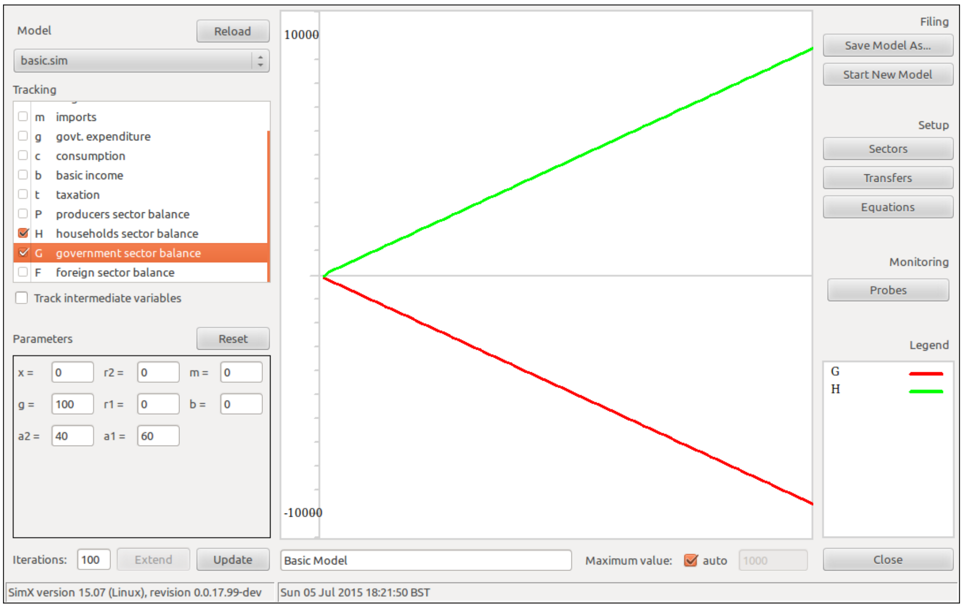

Figure 1.7: Household sector balance increases without limit if tax is zero

1.3.4 Steady States

All the experiments so far have given rise to what we might call a 'steady state'. The rough meaning of this term is fairly obvious, but it will be helpful to pin it down it bit more firmly. First, let's look at a situation that doesn't reach a steady state.

Suppose we reduce tax to zero. We have seen what happens when either r_1 or r_2 (or both) is non-zero; now we will see (figure 1.7) what happens to domestic wealth (H) if government expenditure (g) is non zero but no tax is recovered.

Unsurprisingly, the graph shows the households sector's balance (the green line) increasing without limit. This is hardly surprising—the government is spending money into the economy at a constant rate (100 units per period) but it's a closed system and the money is never taken out again, so it simply accumulates as an ever-increasing balance in the household sector.

I have also included the government sector's balance (the red line) as a reminder that a positive domestic balance inevitably requires an equal but negative balance in the government sector. This isn't, of itself, a problem; but it is an inevitable fact—unavoidable and non-negotiable, despite the fact that the policy of most governments (supported by most of the media) has been to try to 'fix' it.

But all we are really concerned about here is to note that in no sense is this a steady state, because something (lots of things, in fact) is changing. At any point in time we would find that $H > H'$ and $G < G'$. Similar things would also be happening to the variables we have not plotted. If we compare this with, say, figure 1.5 and previous examples, we can see that when the steady state has been reached everything remains the same. In particular, in figure 1.5 it is clear the after the initial rise all subsequent values of t satisfy the equation $t = t'$. If the whole system is in a steady state (which is likely to be the case, if any part of it it is) then for any variable β of the system, $\beta = \beta'$.

This means that we will sometimes be able to write down simultaneous equations that we can solve to find the values variables must have in a steady state. It is important to recognise however that solving such equations does not on its own prove that a steady state exists.

For example, equipped with equation 1.13 we could now rewrite our four Basic Model equations in their equivalent 'steady state' versions, as follows.

Dropping the x term from equation 1.1 as it is always zero we have

$$w = c + g \tag{1.14}$$

Substituting H for H' in equation 1.2 we have

$$c = a_1 d + a_2 H \tag{1.15}$$

Substituting w for w' and t for t' in equation 1.5 we have

$$d = w - t \tag{1.16}$$

and

$$t = r_1 w + r_2 c \tag{1.17}$$

We could then supplement the list with equation 1.12 or 1.13 to enable us to get rid of the H term in equation 1.15 and solve the equations simultaneously to obtain t, w and c in terms of g. We could, but it's less hassle just to run the model and see what comes out.

Referring back now to figure 1.7, a question that comes to mind concerns the slope, or 'rate of change' of the sector balances. Clearly it has to be $t - g$ for sector G, and therefore $g - t$ for sector H. Each period the government sector reduces its balance by g units and recovers t units, and produces the opposite effect in the households sector.

Expressing this mathematically we have

$$\frac{\delta H}{\delta T} = H - H' = g - t \tag{1.18}$$

where T represents time, counted in periods.

Now in a steady state the line representing H, or any other sectoral balance, is flat: there is no change. In other words $H = H'$ (and $G = G'$ and $P = P'$), so $g-t$ must be zero—i.e. $g = t$, or in other words *tax must equal government expenditure.*

More generally the relationship between H and H' is

$$\begin{aligned} H &= H'(1 - a_2) + d(1 - a_1) && (1.19) \\ &= H'(1 - a_2) + (w' - t')(1 - a_1) && (1.20) \end{aligned}$$

from the definitions of a_1, a_2, and d. For a steady state to be achieved time-successive values of this expression must converge on a limit, which the model clearly shows is the case for most of the situations we have examined.[6] Figure 1.7 Is an obvious example of non-convergence but could only occur in real life if tax were reduced to zero.

Balancing the Books

A non-zero value for $g-t$ tends to be viewed with concern by government and the media. The cry goes up, 'Balance the books!' and there are calls, if $g > t$, to increase taxation or to reduce expenditure in order to bring them into line. But, as we have seen, in a closed economy, at least one of the simple kind we are considering, this will not work. The tax take is endogenous. More than that it will automatically track government expenditure (eventually) without any intervention from the government.

If it fails to do this there are essentially two possible explanations. Either (somewhat improbably) the household sector is spending significantly less than 100% of its income and none of its accumulated wealth, or (much more realistically) the economy is not closed and exports and imports do not match. Increasing taxes and reducing expenditure will not affect this in any direct way.

However, we have not yet included imports and exports so I'll say no more about it for now.

1.3.5 Tax and Wealth

Wealth is a tricky concept. We tend to see it as obvious that someone who has more money is necessarily wealthier than someone who has less. We get

[6] For a more thorough treatment we would have to show algebraically what were the limits of this convergence.

a different perspective however if we ask ourselves the following question. If Fred has £10,000 in the bank, and leaves it there, while his friend Jim has nothing in the bank because he has just spent it on something he has always wanted, who is the richer of the two?

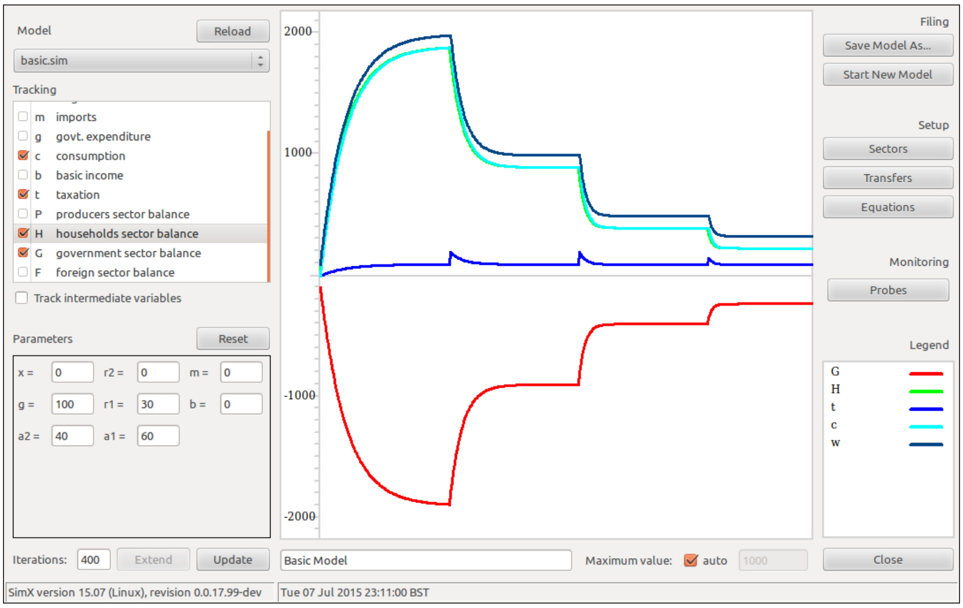

Figure 1.8: Effect on wealth of changing tax rate

Money in the bank is potential wealth; money spent is realised wealth—always assuming, of course that it was spent on something worthwhile. Economists sometimes make a similar distinction by referring to financial assets (money in the bank) and real assets (stuff that the money was spent on). The notion of real assets as real wealth is difficult to quantify, unfortunately, because we still tend to set its value according to what it cost or what we could sell it for. In the end we always invoke 'the market' to decide, for example, whether a Monet is more valuable than a Degas, with the consequence that the work of artists who themselves lived lives of penury, can only be afforded by the super-rich.

This question is relevant if we want to examine the effect of tax on wealth. Would we consider a tax rate optimal if it maximised the money that households held in reserve, or their wages, or their consumption? Perhaps we would look at none of these but instead try to maximise government spending on public services as the best way to ensure a good quality of life for everyone.

These are of course political and moral rather than economic questions, but they suggest that to make such decisions we, and our politicians, need to be aware of the effect tax has on all these factors.

To my mind figure 1.8 is the most interesting graph so far. It clearly illustrates two points we have already made in a different context: (1) changing the tax rate does not, apart from an initial blip, change the amount of tax recovered, but (2) it very clearly does drastically affect wealth (here considered to be a product of consumption or wages).

The cyan curve represents consumption, the grey curve wages, and the blue curve income tax take. In the first section of the graph, before the blip, weI set the tax rate (r_1) to 5%. The corresponding steady state wage level (w) was 2000, i.e. government expenditure ($g = 100$) divided by tax rate ($r_1 = \frac{1}{20}$). Consumption (c) is always going to be $w - g$, which here is 1900.

Next I extended the graph by another 100 iterations at 10% tax, which reduced wages to 1000 (and consumption to 900). Essentially by doubling the tax rate we have halved the wage level showing that taxation has a powerful inverse multiplying effect. The pattern continues, wages and consumption plummeting as taxation is increased to 20% and then to 30%.

Although we should expect it by now, I think it's quite striking to see the consistency of the blue line representing taxation (t). Whatever we do to the tax rate the tax take remains doggedly the same—apart from the blips, which are caused by the fact that it takes a while to establish the new steady state after each change.

The red curve is the government sector balance (G). I've included it not because it is interesting in itself, but because it is the mirror image of the household sector balance (H)—households' 'money in the bank', which we might want to use as an indicator of wealth. As you may be able to see (try imagining the red curve the other way up), it's more-or less identical to the consumption curve, not the wages curve. It adjusts at a slightly different rate (consumption lags by one period) but apart from that it's the same.

It's worth reminding ourselves that these results are all built on the default parameters of the basic model, and could be significantly different if we changed them. To be completely rigorous we should try every combination of parameters, but given that we have limited time and space we must be content to trade some rigour for comprehensibility.

On the question of which indicator of wealth to base policy on we see that wages, consumption and money stock all move together. At least until the tax rate is high enough to bring them all down to a level close to that of government expenditure (significantly affecting their relative values), it makes little difference which we choose. And since government expenditure equals tax take (in the long run), which doesn't vary, tax rate has no *direct* bearing on the question. If we want to increase government expenditure the way to do it is to increase government expenditure—not mess about with tax rates!

On the other hand if we want to increase economic activity because by causing the economy to expand it will *indirectly* help to pay for things of public value, the way to do it is by reducing tax rates. Counter-intuitive, perhaps, but you can't argue with the numbers.

One further point worth mentioning: we noted that doubling the tax rate halves wages—that is,

$$r_2 = 0 \Rightarrow w \propto \frac{1}{r_1} \tag{1.21}$$

but remember that this refers to *gross* wages. The effect on net wages is much greater, because tax is subsequently deducted from the already reduced figure. On reflection it is evident that equation 1.21 holds by definition. What is perhaps unexpected about it though is the fact that wages are determined by tax rate not the other way around!

1.3.6 Government Expenditure and Wealth

Figure 1.9: Effect on wealth of changing government expenditure

We are beginning to see that there is a clear symmetry between taxation and government expenditure, and this is confirmed in the next experiment (figure 1.9).

It would be reasonable to see taxation as negative government expenditure and vice versa: one or other of the concepts is logically redundant. So just as wealth is inversely proportional to tax rate, as in equation 1.21, so wealth is directly proportional to government expenditure, giving us:

$$r_2 = 0 \Rightarrow w \propto g \tag{1.22}$$

The constant of proportionality would be different, of course, because tax is defined relative to wages (as it has to be, being endogenous), while government expenditure is given as an absolute value. No surprises then, in figure 1.9, which simply confirms what we already know. The first section of the graph shows wages increasing from zero to to ten times the default government expenditure (tax rate $r_1 = 0.1$) of 100. In the second section g is suddenly increased to 200, and wages double to a new steady state value of 2000. Consumption remains at 90% of wages throughout, reflecting the fact that households' consumption is only 90% of the total, the other 10% being absorbed by government expenditure, which, like taxation, remains at 10% of wages.

1.3.7 Welfare and Taxation

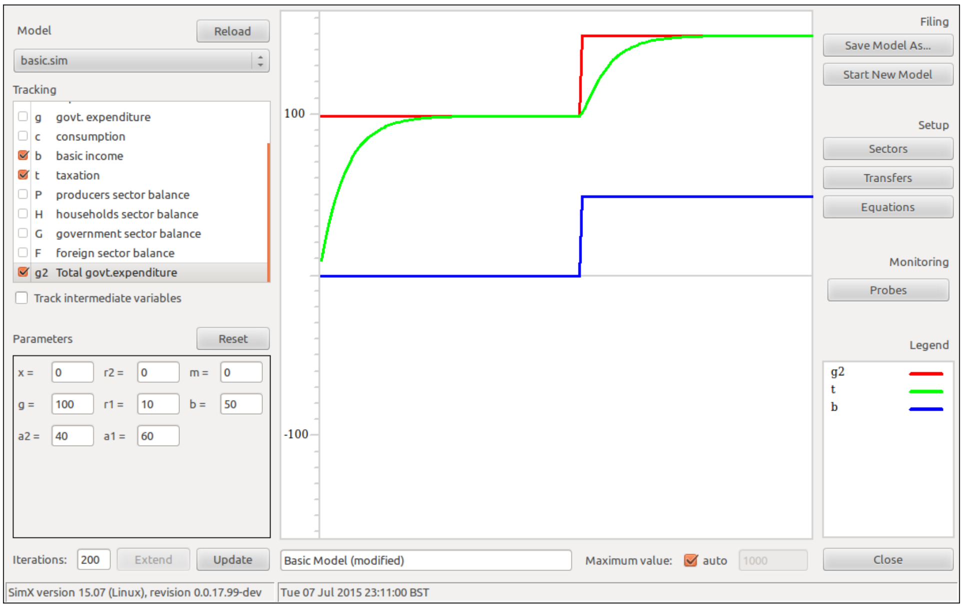

Figure 1.10: Effect of welfare payments on taxation

Our default value for welfare benefits (or basic income), b, is zero—in other words everything we have examined so far has assumed that there are no unemployment benefits, tax credits, disability benefits or basic income payments. Whenever 'benefits' are discussed one of the first issues raised is inevitably how to pay for them, which generally means whether taxes will need to be raised. The next question is likely to be whether they are 'affordable', the assumption being that there will be a significant cost to taxpayers. This experiment addresses the first of these questions and the next experiment addresses the second.

In figure 1.10 we start off with the usual default values: 100 for government expenditure, 10% for income tax rate, and zero welfare benefits. We plot total government expenditure (the red line), which now includes both primary expenditure and welfare costs, the tax take (the green line), and the level of benefits payments (the blue line). As we have already seen, the tax take rises from zero and levels off at 100, equal to government expenditure.

After 100 iterations we suddenly increase welfare spending to 50—half of primary government expenditure. The effect on the tax take is exactly the same as if we had just increased *primary* expenditure by the same amount. Total government expenditure ($g + b$) is now 150, and the tax take increases to exactly 150. But is is important to note that we did not have to adjust the tax rate at all. The mere fact that 50% more money is being injected into the economy causes the tax take to rise by 50% automatically. Contrary to what many people would expect, *the affordability of welfare payments is not limited by taxation* (even if we feel a need to 'balance the books').

It should also be clear that since the same proportion of taxes is being taken but taxes have increased, it must be the case that wages have increased in the same proportion. How can this happen? If nothing else changes (which, of course, it might) as a result of the welfare payments, there will inevitably be an increase in economic activity arising from the spending of the benefits, and this, on the assumption that all the money is transferred by producers to households will cause an exactly equal increase in wages.

Where this system can break down, of course, is in the distribution of wages. If they are retained by the owners of the businesses where the benefits are spent, then although aggregate wages will be increased by 50% those at the lower end of the pay scales may see little of the additional money. In a very real sense, without fair distribution mechanisms the moderately poor will find themselves paying for the very poor, while at the same the same time subsidising the rich. But this is not an argument against welfare—it is an argument for fairer distribution or greater equality.

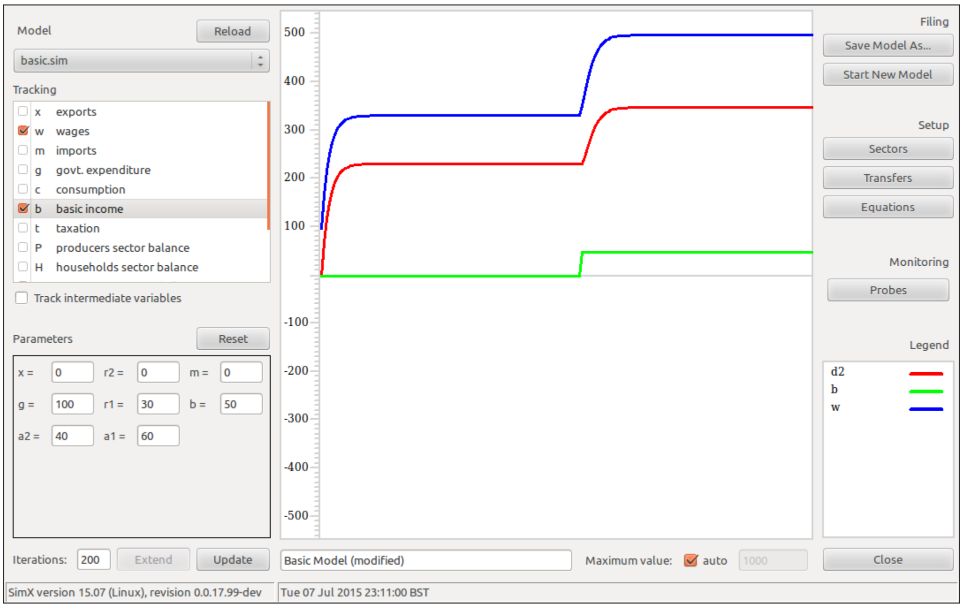

Figure 1.11: Effect of welfare payments on aggregate wealth

1.3.8 Welfare and Aggregate Wealth

In figure 1.11 I have plotted gross wages and disposable income (aggregated, of course, for the whole of the households sector). The plot is a bit different from all the previous ones, in that I have pushed tax up, from the outset, from 10% to 30%. The only reason for doing this is to make the graph clearer: by reducing the level of wages (which increasing tax does, as we have already shown) it's possible to get benefits and wages on the same graph without wages completely overwhelming benefits. It makes it easier to see what's going on, that's all.

Gross wages are shown by the blue line, net (i.e. after tax) by the red line, and benefits payments by the green line. If we spend more on benefits there will be less left for everyone else, right? Wrong! What the graph shows is that is that both gross and net wages are dramatically increased by increasing benefits, which I increased from zero to 50 against the default primary government expenditure of 100.

Of course, one would expect there to be some increase, because those on benefits are now receiving, and spending, money, and they weren't before. But compare the height of the step in the green line, 50 units, with the corresponding increase in the height of the red line, 267 units. Subtract 50 from 267 and you still have an additional increase, beyond the extra funds injected, of 217 units. And this would have been very much more if we had held tax at its default level of 10%.

Evidently benefits, far from being a cost to the household sector result in a major overall benefit. But I'm going to leave the maths as an exercise to the reader this time. It's not very complicated if you keep all the relationships clearly in focus!

Throughout this series of experiments the parameters a_1 and a_2 have been kept at their default values of 60% and 40%. Together they define 'propensity to consume'. The first indicates the proportion of the household sector's disposable income (i.e. after tax) that is assumed to be spent on consumption, and the second is the proportion of the sector's balance that is assumed to be used. To avoid computational circularity—and to reflect the real world a little more accurately—the figures from the previous period are used (see equations 1.2 and 1.5). This conveniently provides an approximating mechanism and allows the system to adjust asymptotically to changes.

For completeness I ran a couple of tests to get some sense of the kind of effect that varying a_1 and a_2 is likely to have. The results were complex but for the most part unsurprising.

1.3.9 Varying Propensity to Consume

Consumption out of Income

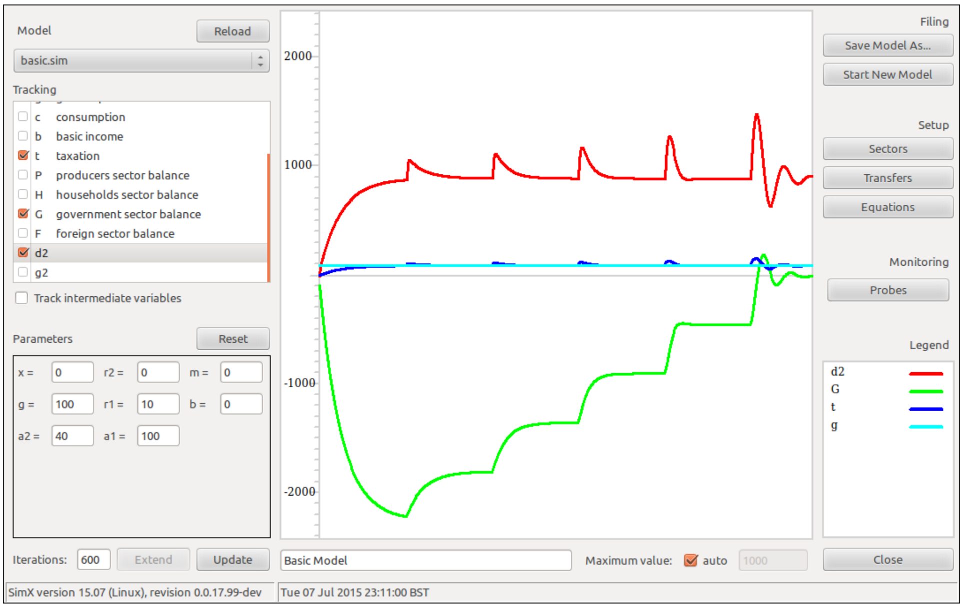

Figure 1.12: Varying propensity to consume out of income

In figure 1.12 I kept a_2 at 40% and varied a_1 in steps, from zero to 100%.

The red line representing disposable income remained constant throughout, apart from increasingly wild blips at change-over points. Similarly for tax, the dark-blue line largely obscured by the cyan line representing government expenditure. The green line representing government sector balance and therefore the negative of the household sector balance diminished at each step as income was increasingly used for consumption rather than being saved. This all seems intuitively predictable, though the constancy of everything apart from government and household sector balances is notable.

Consumption out of Savings

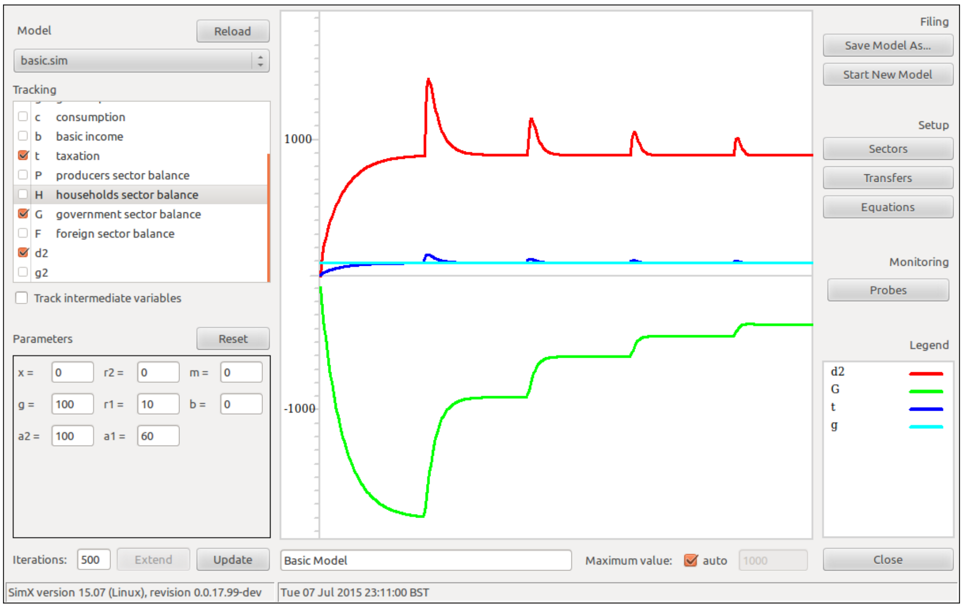

Figure 1.13: Varying propensity to consume out of savings

I then varied a_2 keeping a_1 constant at 60% The results were very similar (figure 1.13), except that the sector balances did not reduce to zero as the were always topped up by the 40% remaining from disposable income after spending on consumption. The system broke down if a_2 was zero (as discussed earlier) only in the sense that the H and G balances increased without limit (H negatively), but everything else continued as normal. In the real world of course a steadily increasing sectoral balance would not be acceptable.

1.3.10 Imports and Exports

The defining characteristic of a closed economy is that it does not involve imports or exports, so strictly speaking this experiment is outside our remit. However, a few preliminary results will enable us to see the kinds of effects opening the economy up might have.

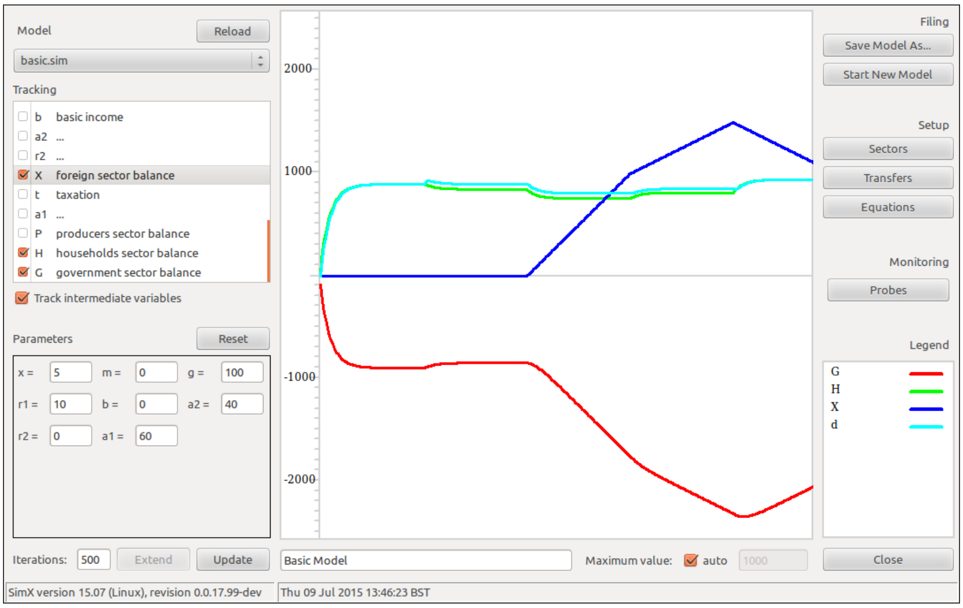

Figure 1.14: Unbalanced trade without exchange rate adjustment

The important feature of imports and exports that distinguishes them from transactions within the economy is that they require transactions in a different currency. Imports, for example, cannot, by definition, be paid for using the home currency, so we first have to obtain the necessary funds in the foreign currency. If we do not already hold any we must find someone—in principle an agent in the external economy—who is willing to exchange some of our currency for the required amount of theirs, which we can then use to make the purchase. We end up with a real asset; they end up with a holding in what, to them, is a foreign currency. They can use this to pay for imports (exports, from our point of view), or they can hold them in anticipation of someone else being willing to exchange them for, possibly, yet another currency.

A person who exchanges currency in this way is a currency trader, and will endeavour to make a profit on each trade. However this is organised it results in the holding of our currency by an agent of an economy that trades in a different currency.

A foreign importer (someone to whom we export) will have to obtain funds in our currency. In principle this will result in an agent of our economy holding funds in a foreign currency.

Clearly these shenanigans are liable to be a complicating factor in our hitherto simple and smooth-running system. What happens if we wish to import something but cannot find anyone who wants our currency enough to be willing to exchange it for the currency we need? Conversely, what happens if we have goods to export but the only people who wish to import them use a currency that is of no use either to us or to anyone who wishes to trade in our currency?

This is new territory and well beyond the scope of this chapter. However, we will have a preliminary look at the effect of imports and exports on our sector balances and aggregate disposable income, ignoring the complications implicit in the need to exchange one currency for another in order to carry out any transaction.

In figure 1.14 we start with the closed economy of our Basic Model. The cyan line indicates aggregate disposable income, the green line the households sector balance (in case it's not clear, it's the lower of the two more-or-less parallel curves); the red line shows the government sector balance, and the blue line indicates the foreign sector balance. It?s important to note that the blue line only accounts for that part of the foreign economy that is actively engaged in trade with us—it is not their government sector balance, although it contributes to it. It is what the government refers to as our 'current account'—with the proviso that where we show a positive amount (i.e. from the foreign sector's viewpoint), our government would register a negative amount and call it a 'trade deficit'.

The second section of the graph introduces balanced imports and exports of 20 units each. This doesn't make a lot of difference to anything. The government sector balance is slightly increased and the households sector balance reduced by the same amount. Aggregate disposable income is also slightly reduced (from 927 to 900).

For the third section we keep imports at 20 and reduce exports to 10. This reduces the households sector balance still further, though not dramatically, and reduces aggregate disposable income to about 810. The most important changes though are the steep rise in foreign sector balance (the trade deficit) and the correspondingly steep fall in government sector balance. The latter is slightly less steep than the former to start with as some of the change is absorbed by the household sector, but essentially both of these changes are 'straight line' effects and will continue as long as the imbalance continues.

For the next section I reduced the trade imbalance by increasing exports to

15, halving the trade deficit and (equivalently) the (negative) rate of increase in the account. And lastly I reversed the situation by changing imports from 20 to 15 and exports from 15 to 20.

Clearly these straight line sections are not sustainable and something must happen to level them off. Essentially what happens is that exchange rates change. Ideally they will change in such a way as to bring the 'values' (i.e. prices) of imports and exports into line, but this is often impossible. A country may have so much of an exportable commodity (such as oil) that it can attract vast quantities of foreign currencies which it can use for imports without having to worry about the value of its domestic currency. Or it may have nothing to export so its domestic currency is worthless to the outside world. If it has no domestic economy to speak of (think Zimbabwe) it will be dependent on imports that it has no means to obtain.

We will consider these issues further in Chapter 2.

1.4 Comments, Conclusions and Caveats

I have to acknowledge that I am neither a mathematician nor an economist, and can claim no great expertise in either area. My objective has simply been to try to pin down the key logical features of any economy that is based on money created by a sovereign currency-issuer—of which the UK is one[7]—and by means of a simple computer model incorporating those features to draw some conclusions about the way it will behave. To the best of my knowledge and belief, the model works and the principles are valid, from which it follows that the conclusions should be sound. But I could be wrong on any of these points!

The principal conclusions *for a closed economy* are these:

1. An economy automatically adjusts, after changes, to a steady state in which tax recovered is equal to government expenditure.
2. Tax rates determine the relationship between government expenditure and aggregate income.
3. Aggregate income is inversely proportional to tax rate.
4. Attempting to increase tax receipts by increasing tax rates is likely to depress economic activity and reduce aggregate wealth.[8]

[7]Albeit one whose ability to control its own currency is significantly limited by its adherence to Eurozone rules, a situation that may change in the fairly near future.

[8]A persistent deficit or surplus could have more to do with foreign trade than with domestic issues.

5. Aggregate income is directly proportional to government expenditure.
6. Household and government sector balances are accumulated (and dissipated) during the periods of adjustment from one set of conditions (tax rates and government expenditure) to another. When no change is taking place net government expenditure (defined as the amount by which government expenditure exceeds tax receipts) is zero.

These findings confirm, as MMT [5] claims, that tax receipts do not pay for government expenditure, nor does lack of tax receipts limit it.

The age-old intuition that the government must receive money in the form of tax receipts before it can spend it, and that failing to do so creates a debt that has to be paid off, is no more than an intuition. The intuition breaks down because government—unlike households—really does 'make money'. In fact government must spend money *before* taxes can be paid, since it provides the money to pay the taxes.

So why do we need taxes at all? See section 1.3.4.

I am aware that these conclusions ignore other candidates for exogenous parameters that could be used in regulating the behaviour of the economy—notably interest rates. These cannot be modelled without an explicit financial or banking sector, and I hope to include them in subsequent investigations.

A further possible weakness of the model adopted is that lack of any empirical or statistical basis for the 'propensity to consume' functions. I have endeavoured to minimise the effect of this problem by experimenting with different values of the a_1 and a_2 parameters, but the approach is still open to the criticism that real-world propensity to consume is probably not linear and may not even be consistent through time. Further research on this topic would be helpful.

A critic will also draw attention to the assumption throughout that economic activity will always expand and contract in response to demand. Clearly this is an approximation. In particular an economy can only expand within the limits of its productive capacity. At the same time it needs to be recognised that the UK, or any economy with moderate to high levels of unemployment, is nowhere these limits.

A more serious issue is our implicit assumption that increasing aggregate wealth is necessarily good for everyone. Clearly this is untrue. Our socio-economic structures are organised so as to ensure that the principal beneficiaries of increased aggregate wealth are the already wealthy, and the principal sufferers from reduced aggregate wealth are the already poor. It is also true that capitalism is inherently conservative, in that it confers most power on the rich. These are serious issues that need to be recognised, but they can only be dealt with politically.

1.4.1 National Debt

One more observation: we have consistently shown a substantial level of government 'debt' in every case we have considered. It is commonplace to argue that this is a bad thing and should be avoided, that the 'debt' will have to be 'paid down'.

This is one of the commonest and most pernicious of mainstream misrepresentations of economic fact. Government 'debt' (so-called, rather misleadingly) is the precise counterpart of domestic wealth (the G sectoral balance is the counterpart of the H sectoral balance, apart from the effect of foreign trade). Get rid of one and you get rid of the other—it's as simple as that. Our grandchildren will not 'inherit' it, in the sense of a liability that they will somehow have to pay off out of their hard-earned wages. This whole scenario is nonsense. It's not what 'debt', in this context, means, or how it works. For a full discussion of this issue see (for example) Mitchell [5] or Mitchell, Wray and Watts [6].

1.4.2 A Brief Reflection on Government Policy

The principal, and obvious implication is summed up by the adage 'When you are in a hole, stop digging'. More specifically that you cannot fix a recession through austerity, since austerity tends inevitably to worsen and prolong the recession. The fact that this has been known since Keynes' work in the 1920s cannot but throw serious doubt over the motives, goodwill, economic literacy and competence of the present government—or over at least one of those factors.

1.4.3 The Left's Unrecognised Problem

One of the most important insights of MMT (borne out by our investigations here), and one that has potentially far-reaching implications, is that *tax does not fund government expenditure.* There are of course other constraints on government spending, but the amount of tax received is not one of them.

The failure of the public, the media, and Government to recognise this simple fact means that every proposal for expenditure on public services and public provision is met with the misguided objection that we cannot afford it unless we raise taxes to pay for it. Actually, as we have seen, increasing tax rates is the very thing we should *not* do. Far from releasing funds for public provision, it actually causes the economy to contract—inevitably putting people out of work, reducing tax receipts, and increasing demands on welfare and other forms of public provision.

This puts the Left in a difficult situation. In order to argue for improved funding for public provision it also has to argue for increased taxation—which is unpopular and would anyway be counter-productive. On the other hand were they to argue that funding could be increased *without* increasing taxation they would be laughed out of court.

Sadly, I have no solution to offer for this, public education being outside my scope, competence, and remit, but a solution is desperately needed.

Let's call it an exercise for the reader.

What's Next?

Who knows! Possibly some stuff on micro-economics, possibly on foreign trade. Eventually both, I hope,

Bibliography

[1] Osborne confirms budget surplus law (BBC News). http://www.bbc.co.uk/news/business-33074500, 2015. [Online; accessed 15 January 2017].

[2] J. K. Galbraith. *Money: Whence it Came, Where it Went.* Houghton Miffin, 2001.

[3] W. Godley and M. Lavoie. *Monetary Economics: An Integrated Approach to Credit, Money, Production and Wealth.* Palgrave and MacMillan, 2007.

[4] C. E. B. Melville. *Notes On The Model SIM.* Unpublished, 2007.

[5] W. Mitchell. Billy blog: Modern monetary theory. http://bilbo.economicoutlook.net/blog/. [Online; accessed 9 January 2017].

[6] W. Mitchell, L. R. Wray, and M. Watts. *Modern Monetary Theory and Practice: An Introductory Text.* Centre of Full Employment and Equity, 2016.