The Dummies Guide to *The Final*

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Contents

0.1 Preliminaries

Pareto Efficiency An allocation is pareto efficient if theres no way to make anyone better off without making someone else worse off.

First Welfare Theorem The first welfare theorem states that every general competitive equilibrium is pareto efficient (ie in equilibrium with competitive markets, we cant make anyone better off without making someone else worse off).

Second Welfare Theorem The second fundamental theorem of welfare economics states that any pareto efficient outcome can be implemented by perfectly competitive markets with initial redistribution via lump sum taxes and transfers (i.e if we can engineer the "right" initial distribution, market forces will bring us to our desired pareto efficient allocation).

Rational Expectations Rational expectations is the hypothesis that people optimally use all available information to forecast the future and that people make correct forecasts on average.

1 Unemployment

The *labor force* is the total number of people available for employment. Members of the labor force who cannot find work are said to be *unemployed*. The *labor force participation rate* is the fraction of the population participating in the labor market. Structural unemployment/long term joblessness is due to market imperfections such as wage rigidities and skill mismatch (i.e workers are simply not skilled enough for the available jobs). It also encompasses frictional unemployment or those out of work due to the search process.

Definition 1 (Natural Rate of Unemployment) *The natural rate of unemployment or the $NAIRU$ is the* average *long run rate of unemployment around which the economy fluctuates.*

Its easily shown by that expression for the natural rate of unemployment is given by:

$$u^* = \frac{m}{m+f} \tag{1}$$

where m is the rate of *job separation* and f is the rate of *job finding*. This the natural rate is high in an environment of high job separation ($\frac{\partial u^*}{\partial m} > 0$) and low job finding ($\frac{\partial u^*}{\partial f} < 0$).
Anything that affects the rates of separation and job finding affects the natural rate. Principle structural factors affecting the natural rate are: sectoral changes (people moving between sectors, perhaps due to tech. change, leading to increased job search and separation), demographics (e.g an older workforce is more stable, a younger workforce leads to higher turnover and unemployment and *less* separation), union power (leads to unduly high real wages, reducing the availability of jobs), minimum wage and unemployment compensation (a big disincentive to work, a real big issue in Europe, this. People respond to incentives...) and search intensity (obviously affecting job finding rate). Finally any unemployment above the natural rate is said to be *cyclical* or induced by recessions. This is, however, a short run issue, people have lost jobs due to some recession; eventually equilibrium will be restored and the economy will revert back to the natural rate.

Definition 2 (Okun's Law) *For each % point by which the unemployment rate raises above the natural rate, real GDP declines by about 3% below potential. (Not a law, as such, but an empirical regularity).*

Unemployment below the natural rate is equivalent to output above potential and vice versa. Okun's Law enables us to simply quantify this relationship. Now when unemployment falls below the natural rate (or equivalently when output rises above the potential), we see an increase in inflation or "overheating" (since workers/unions now have more bargaining power and bid up wages leading to price rises). Unemployment above the natural rate leads to a fall in inflation. We can see this via the *Phillips curve* $\Delta\pi = \beta(lnY - lnY_p)$. In practice its very hard to tell the difference between cyclical unemployment and a change in the natural rate.

2 Potential Output and Inflation

Definition 3 (Nominal GDP**)** *Nominal GDP is the total* value *of goods and services produced in the economy by domestically located factors of production and regardless of nationality. However, we count only total* value added *and* final sales *and omit non-market activities. Purchases of old durables (such as cars) are not included.*

Definition 4 (Nominal GNP**)** *Nominal* GNP *is the value accruing to all factors of a given country both at home and abroad.*

Definition 5 (Real GDP) *Real GDP measures the physical volume of an economy's final production using the prices of some base year. In other words, it calculates the value of output alone, and filters out the effects of price changes.*

Definition 6 (Potential Output) *Potential output,* Y_p*, is the value of output when the economy is working at a normal pace and is neither in boom nor recession. At potential output there are no pressures on prices/inflation to change. The* output gap *is given by* $\log Y_p - \log Y$*. A positive output gap is a recession, a negative gap is an expansion. The "ideal" gap is zero and this is the level consistent with the natural rate of unemployment.*

Definition 7 (Price Index) *The price index measures the price of a market basket of goods. Inflation is the annual percentage change in this price index. The orthodoxy today is that the "ideal" level of inflation is about* $2.5 - 3\%$*. Anything above that should be forestalled at all costs.*

So whats with this inflation thing?

1. Shoeleather costs - the inconvenience of having go to the bank etc to reduce money holdings -yeah, one's shoes wear out quicker. (Hardly quantum physics, this).

2. Menu Costs - costs of having to change price lists etc.

3. Relative price distortions. Different firms change their prices at different times, leading to price distortions and inhibiting the allocation mechanism of the market. People simply can't deduce the true value of goods.

4. Adversely affects lenders, since their *real* return is less for a given nominal return. Affects retirees on fixed pensions.

5. Inflation variability engenders uncertainty and sends a decidedly negative signal to investors, who will demand an inflation *risk premium.*

6. It distorts the tax system. A person may get a rise of 20, say to compensate them for inflation, but their new wage may push them into a higher tax bracket. So they end up paying greater taxes on the *same* real wage. Also if I buy a share for 100 in an environment of 10% inflation the fair price of that share the following year is 110. But I'm charged *capital gains tax* on the $10, though I've made no *real* gain.

2.1 Why money is the root of all evil

Consider a muffin maker. Actually, a few identical muffin makers, who all work in Times Square on those dense summer days. He spends all day from 7*am* to 4*pm* making muffins - then he opens his stand on Times Square from 4*pm* to 11*pm*, selling his produce. Chocolate chip is his speciality, his *tour de force*. There are other guys too, just like him, specializing in other flavors and forms. What our friend makes on this "normal" working day is his maximum or *potential output*. Okay, he could get up a bit earlier at 5*am* say, an odd day, and make a extra 100 muffins or thereabouts. But that only leaves the poor guy with a mere 5 hours sleep.... and when he gets home he feels kinda wrecked and questioning why did even bother... Was it *really* worth it? So its certainly not something he would do *or physically could do* every morning. He just cannot do this indefinitely. Such is life.

Now suppose that the money supply has increased/interest rate has fallen, so people walking round Times Square have a bit more money in their pockets. In particular, they have more money to go to a muffin stand and indulge themselves, to go on a kind of muffin splurge. How does our friend respond to the increase in demand? He's naturally a bit reluctant to draw up a new price list and charge a bit more initially since the increase in demand could just be, well, merely temporary. And, in any case, he's afraid customers might deem him a little pricey and head across for a banana muffin instead. For the first few mornings, then, he gets up at 5*pm* so as to meet the increase in projected demand. The whole thing is a bit of novelty, really, for a couple of days, all those extra sales and *increase in real output*. After a few days, though, our friend has truly had it. Just look at him, he hasn't showered, he smells, his eyes are bloodshot etc. And this is, after all, New York, New York. This simply can't go on and he knows it. So what now, how does he cope with the fact that demand is greater than his "normal" potential supply. Yeah, *he raises his prices*. And he raises them till demand for muffins is just equal to his "normal" or potential output. And that will be in exact proportion to the increase in the money supply/demand.

- *Note that in the short run, we have a temporary boom, since prices are fixed. They are fixed due to a kind of* coordination failure - *agents are afraid to raise prices for fear of losing business. If agents could get together at the outset and coordinate a price increase, there would be no boom. Another factor is the* surprise *element. Agents simply don't know what's the story initially. Is this a July* 4 *kinda boom or what?.*

- *So note that the increase in money has had no real effects in the long run, this is the classical dichotomy. Nominal variables cannot, in the long run, affect real variables. The increase, however, did lead to a* <u>temporary</u> *increase in real output beyond potential, but this was unsustainable and led only to inflation. In the long run, his output/standard of living is determined by his factors of production ("real" factors); labor and his stoves etc.*

- *We would be better off without the increase in money supply and subsequent aggregate demand, since in the long run there are no real effects, just a higher price level. And we had distortionary inflation in the medium term. We really need a credible, independent central bank tied down by a rule, who can therefore commit not to driving the economy beyond potential in the first instance. A loony left wing central banker is a disaster waiting to happen.*

The above is *really* key and pivotal to macro. We can describe what happens mathematically via the *Phillips Curve*, which basically says that a fall in the output gap (which is expansionary) pushes up inflation. Conversely, when output falls below potential there is pressure on firms to *lower* prices.

$$\pi_{t+1} = \pi_t - \frac{1}{3}Gap_t \qquad (2)$$

3 Trade

In our setup, we have the production of two goods, bread (B) and wine (W), whose production functions are:

$$W = A_W L_W \qquad \text{and} \qquad B = A_B L_B \tag{3}$$

Analogous to the usual production function (but this time without capital), W denotes the number of bottles of wine produced and B the number of loaves of bread. We have the labor supply $L = L_B + L_W$ i.e each member of the labor force is either involved in production of bread or of wine. Note importantly, that $\frac{\partial W}{\partial L_W} = A_W$ and $\frac{\partial B}{\partial L_B} = A_B$ denote the *marginal products of labor* or equivalently the *productivity* of labor in each sector, indicating how many bottles of wine and loaves of bread each worker produces, respectively. This is the setup for the home country, *Home*. We have the exact same setup for the foreign country, conventionally called *Foreign*.

Definition 8 (Absolute Advantage) *Home has an absolute advantage in good i if $A_i > A_i^*$ i.e Home is simply more productive in the production of good i than Foreign. It is absolute advantage that determines the wage level and hence the standard of living.*

Now let us denote p_w and p_b the prices of wine and bread, respectively. This means that the value of a worker each period in the wine sector is $p_w A_W$ and the value of a worker each period in the bread sector is $p_b A_B$. These are just the values of their marginal products or the value of their produce. In this setup, we assume *perfect competition* and so *nominal/monetary wages* are given by the *value of marginal product* (workers earn the value of their produce):

$$w_W = p_w A_W \qquad \text{and} \qquad w_B = p_b A_B \tag{4}$$

However, *wages must be equal in each sector*, since otherwise our rational, homogeneous workers would abandon the low wage sector for the high wage sector. And in our initial state of autarky, where we *must* have production of both goods (for market clearing, $Q_D = Q_S$ in both the wine and bread markets and $Q_D > 0$ in both markets by assumption). Then we necessarily have, by equating our expressions for the wage in (4) above:

$$w_W = w_B \Rightarrow \frac{p_b}{p_w} = \frac{A_W}{A_B} \tag{5}$$

So, under our assumptions, the relative price, $\frac{p_b}{p_w}$, is equal to the opportunity cost, $\frac{A_W}{A_B}$. Suppose, say, that bread costs \$6 and wine costs \$3. Then $\frac{p_b}{p_w} = 2$ i.e the relative price of bread in terms of wine is 2 or bread is twice as valuable as wine. Hereafter, I will simply denote this relative price, $\frac{p_b}{p_w}$ by p_B so, in this case, for instance, we have $p_B = 2$ - this is our *conversion* factor from bread to wine. From now on, I'm going to put <u>everything in terms of wine</u> so will appeal to this result a lot. When I talk about the *price of bread* I mean this price *in terms of wine*, p_B, *not* the monetary price. *In this world, everything is paid for in terms of wine - wine is our new means of exchange/"money"-*, so don't be unsettled, then, when I say that p_B is the price of bread. So using this new notation we have the following important result *under autarky*:

$$p_B = \frac{A_W}{A_B} \qquad \text{and similarly} \qquad p_B^* = \frac{A_W^*}{A_B^*} \tag{6}$$

Before proceeding, please take this on board, since this result is key.

Definition 9 (Comparative Advantage) *Home has a comparative advantage in bread if $\frac{A_B}{A_W} > \frac{A_B^*}{A_W^*}$. It is comparative (and not absolute) advantage that determines who produces what - countries specialize in things they are relatively good at. Further, in our setup each country has a comparative advantage at producing one good.*

In other words, countries should focus on activities in which their productivity advantage is greatest (or in which their productivity disadvantage is smallest). In this case, it just means that Home is relatively more productive/efficient in bread than in wine. Specifically, Home's *opportunity cost* of producing bread is less than in Foreign. Note that this implies that Foreign has a comparative advantage in wine. Note crucially that a country may have an absolute advantage in *both* goods, but *will* still have a *comparative advantage* in *one* good. This means that it though it is better at producing both, it would still be advantageous to specialize in just one, since it should specialize in what it is truly gifted at.[1] Note that (from (6)) under autarky the following obtains: $p_B = \frac{A_W}{A_B} < \frac{A_W^*}{A_B^*} = p_B^*$

3.0.1 Gains From Trade

Suppose that Home has an absolute advantage in *both* wine and bread, but that its *comparative advantage* vis-à-vis Foreign lies in bread . Now, I contend that both Home and Foreign can make mutual gains from trade. Without loss of generality, I will focus on Home, but the exact same reasoning applies to Foreign. So let's see. We know from (6) that under autarky $p_B^* = \frac{A_W^*}{A_B^*}$. Now recall that one of our Home workers can produce A_B units of bread. By producing and shipping abroad this guy can therefore earn $A_B p_B^*$ (i.e the number of loaves he produces multiplied by the foreign price) and then invoking (6) we have:

$$A_B p_B^* = A_B \frac{A_W^*}{A_B^*} \tag{7}$$

But note that $A_B p_B^*$ is the number of bottles of wine our Home worker can earn from this shipment business. If he produced wine at Home we would earn A_W. But since Home has a comparative advantage in bread, we have *by definition,* $\frac{A_B}{A_W} > \frac{A_B^*}{A_W^*} \Rightarrow \frac{A_W}{A_B} < \frac{A_W^*}{A_B^*} \Rightarrow A_W < A_B \frac{A_W^*}{A_B^*} = A_B p_B^*$. *So the country can in effect produce more wine by producing bread and shipping it. Note that this is really another (roundabout) means of producing wine. In other words, we should fire the guys producing wine, since they only produce* A_W *and get them producing bread to export, thereby earning* $A_B p_B^* > A_W$. *Note that Home can have an absolute advantage in* <u>*both*</u> *goods and this analysis still obtains i.e both can gain from trade.* Content yourself that the exact same argument holds for foreign, but with wine this time, since that is their *comparative advantage.* So we immediately see *potential gains from trade.* Now, note in equilibrium, that under trade that the *free trade price of bread,* p_{FT}, must (quite intuitively) satisfy:

$$p_B < p_{FT} < p_B^* \tag{8}$$

i.e by laws of supply and demand, the price of bread will fall in Foreign since it's importing cheaper bread from Home. But also, exporting bread from Home causes bread to become a little scarcer there, thereby pushing up its price.

3.0.2 An Example

Suppose $A_B = .9$, $A_W = .3$, $A_B^* = .3$ and $A_W^* = .9$. (Again, recall that these are all in terms of the respective produce). Clearly, Home has a *comparative advantage* in producing bread since $\frac{A_B^*}{A_W^*} < \frac{A_B}{A_W}$. Now suppose each country has $100,000$ workers. In the domestic market $60,000$ produce bread and $40,000$ produce wine. So from

[1] Think of Professor Jones and his secretary. Prof Jones is very smart and I know he's real good at administrative matters *as well* as research. In fact, I think he's much better than his secretary at *both* research *and* secretarial type work. And his secretary clearly doesn't even compare on the research front and as I said, is also, alas, inferior to Jones on the administrative front. In our new jargon, Jones has an *absolute advantage* at both research *and* secretarial work, but his *comparative advantage* is plain ol' research. The secretary's *comparative advantage* is administrative work. *However*, as we shall see, it is still optimal for Jones to concentrate on just his comparative advantage, research, and to let his secretary concentrate on administration. In that way, as we shall see, total production (of research and secretarial work) will increase and both Jones and his secretary will be better off.

our production functions in (1) we have $B = .9(60,000) = 54,000$ and $W = .3(40,000) = 12,000$. Analogously for Foreign $B^* = .3(30,000) = 9,000$ and $W^* = .9(70,000) = 63,000$. So under *autarky* the total production of bread is $63,000$ loaves and the production of wine is $75,000$.
Now consider free trade. If all the workers at Home produce bread and all those in Foreign produce wine we have $90,000$ loaves and $90,000$ bottles of wine.

3.0.3 Real wages and Specialization

Note that *under autarky* the *real wage* (*not* the money wage) in each sector is given by the actual marginal product of labor, $\frac{\partial B}{\partial L_B}$ and $\frac{\partial W}{\partial L_W}$ (and these of course must be equal in terms of wine (or bread) to ensure production of both goods). However, these are just A_B and A_W. In this formulation, workers are just paid their output. Note that the price of bread is $p_B = \frac{A_B}{A_W} = \frac{1}{3}$. Then, in autarky, our worker in the bread sector who gets his marginal productivity of .9 loaves of bread really gets $p_B A_B = \frac{1}{3}(.9) = .3$ bottles of wine, just like the wine worker getting $A_W = .3$. The Foreign worker receives his marginal product of $A_W^* = .9$.
We know from above that under free trade, $p_B < p_{FT} < p_B^*$ or by invoking (6) and substituting the figures above, $\frac{A_W}{A_B} = \frac{1}{3} < p_{FT} < 3 = \frac{A_W^*}{A_B^*}$. Suppose now that the free trade price settles at $p_{FT} = 1$ i.e a loaf of bread and a bottle of wine have the same value. In this case Home is *specializing* and a worker in the bread sector produces A_B loaves of bread and can get $A_B p_{FT} = .9$ bottles of wine (recall Home is specializing in bread and shipping it to Foreign earning p_{FT} and then importing wine). Similarly, Foreign specializes in wine and a worker earns $A_W^* = .9$. So the wage in Home has *apparently* increased whilst the wage in Foreign hasn't. This prompts us to consider the *purchasing power* of the wage. The reason for our peculiar result is that we haven't taken account of how many baskets of goods our wages can buy. And this is *really* what matters, not the purchasing power merely in terms of wine.

3.0.4 Cost of Living/Food Baskets

To examine the *cost of living* we must look at the price of a representative *basket* of goods, not just one good. It is no use having one cheap good, whilst all the rest are horrendously expensive etc. For our simple analysis our basket constitutes one bottle of wine and one loaf of bread. We will again seek the price of our basket, q, in terms of wine so $q = 1 + p_B$, $q^* = 1 + p_B^*$, $q_{FT} = 1 + p_{FT}$ i.e the price of a basket is the price of a bottle of wine and the price of bread, both in terms of wine.
Given that the autarky price of bread is $p_B = \frac{1}{3}$, the price of our Home basket, q, under autarky, is effectively the price of $q = 1 + p_B = \frac{4}{3}$ bottles of wine. The autarky price of a Foreign basket is $q^* = 1 + p_B^* = 1 + 3 = 4$ bottles of wine. Similarly the free trade price of a basket (obviously the same in Home *and* Foreign) is $q_{FT} = 1 + p_{FT} = 1 + 1 = 2$ or two bottles of wine.
Now our wage at Home under autarky (equal of course in *both* sectors) is $A_W = .3$ bottles of wine. But what we are *really* interested in is the *purchasing power* of this wage in terms of baskets. In other words, how many baskets of goods can we buy with it. Well, this is intuitively just the wage divided by the price of a basket. So in this case, we can buy $\frac{wage}{price} = \frac{wage}{q} = \frac{.3}{\frac{4}{3}} = \frac{.9}{4}$ baskets. Under *free trade/specialization*, however, the wage was $A_B p_{FT} = .9$ and so the number of baskets we can buy is $\frac{wage}{price} = \frac{wage}{q_{FT}} = \frac{.9}{2}$. Note that Home's wage has doubled. So the move to free trade leads do a doubling in the *purchasing power* (in terms of baskets) of the wage.
We can do the exact same for Foreign and show that *purchasing power* has increased there too. Therefore the number of baskets we could buy before trade was $\frac{wage}{price} = \frac{wage}{q^*} = \frac{A_W^*}{4} = \frac{.9}{4}$. After trade, however, we have $\frac{wage}{price} = \frac{A_W^*}{2} = \frac{.9}{2}$, so our *purchasing power* in Foreign has doubled too. So trade is good and the *invisible hand*

looks after us again.[2]

3.1 Trade in K and L

Firstly, we define *abundance* (or *scarcity*) of a factor in terms of *ratios*, not quantities. If Home has 10 workers and 10 machines ($\frac{L}{K} = 1$) while Foreign has 12 workers and 15 machines ($\frac{L^*}{K^*} = \frac{12}{15} < 1$), we still say that Home is *labor abundant*, though $L < L^*$.
Movements of capital and labor should in theory occur so as to equalize marginal products of labor and capital in Home and Foreign. Intuitively, factors such as labor should head to where their "usefulness" or marginal product is greatest. *Note importantly that that marginal product of a factor is decreasing in the supply of that factor already around and increasing in the supply of other, different factors.* For instance, if Home is labor abundant (i.e $\frac{L}{K} > \frac{L^*}{K^*}$) then labor in Home has a correspondingly lower marginal product than in Foreign, which is capital abundant (since $\frac{K^*}{L^*} > \frac{K}{L}$). So labor should leave and head to Foreign *where labor is less plentiful and capital is more plentiful (in relative terms)* so as to attain a higher marginal product. In other words, workers should head to Foreign since there will be more machines per worker there. (Just recall again that less labor and more capital is the ideal recipe for a high marginal product of labor).
In time this dynamic will raise the marginal product of labor (and wage) at Home and lower it in Foreign. And of course workers in Foreign won't be too happy by this rude intrusion having lowered their wages, but such is life. The same logic applies for capital, which should flow from the capital abundant country, Foreign, to the capital deficient country, Home. This dynamic will raise the marginal product of capital r at Foreign and lower it at Home. *Factor price equalization* for both countries will ensue, yielding a world wage rate $w_H < w^w < w_F$ and a world interest rate $r_H < r^w < r_F$. Ultimately, after this "trade in factors", GNP, the value of goods and services produced by Home and Foreign *factors* will rise for both countries. Note that given that the US is relatively abundant in skilled labor relative to Mexico, say, we should see an increase in unskilled Mexicans coming here to work (since unskilled labor is relatively scarce in the US). But those damn immigration controls at Rio Grande (or wherever) frustrate the market dynamic...But it's consoling to know that US capital *does* flow to Mexico, especially to the regions near the border. But why don't you or I head down south after graduation...? I think there's a lot else going on here (like social infrastructure), in actuality.

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[2]The Grand Finale. Suppose $A_B = .9$, $A_W = .3$, $A^*_B = .3$ and $A^*_W = .2$. Clearly Home now has an *absolute advantage* in the production of both goods since $A_B > A^*_B$ and $A_W > A^*_W$. I'm going to show that *both countries can still be made better off from trade.* However, Home has a *comparative* advantage in producing bread since $\frac{A^*_B}{A^*_W} < \frac{A_B}{A_W}$, so it will specialize in bread. Similarly, Foreign will specialize in wine. The free trade/specialization price will satisfy $p_B = \frac{A_W}{A_B} = \frac{1}{3} < p_{FT} < \frac{A^*_W}{A^*_B} = \frac{2}{3} = p^*_B$. So suppose that $p_{FT} = \frac{1}{2}$. Without trade the price of a Home basket of goods was $q = 1 + p_B = 1 + \frac{A_W}{A_B} = 1 + \frac{1}{3} = \frac{4}{3}$. Similarly, the price of a Foreign basket was $q^* = 1 + p^*_B = 1 + \frac{A^*_W}{A^*_B} = 1 + \frac{2}{3} = \frac{5}{3}$. Under *free trade* the price of a basket (everywhere) is $q_{FT} = 1 + p_{FT} = 1 + \frac{1}{2} = \frac{3}{2}$.
Previously, the **Home** wage was $A_W = .3$ in both sectors (under autarky). So the purchasing power of the wage was $\frac{wage}{q} = \frac{.3}{\frac{4}{3}} = \frac{.9}{4}$.
Now, *under free trade* the wage is $A_B = .9$ units of bread or $A_B p_{FT} = .9(\frac{1}{2}) = \frac{.9}{2}$ bottles of wine. Hence the price in terms of a basket or its *purchasing power* is $\frac{wage}{q_{FT}} = \frac{\frac{.9}{2}}{\frac{3}{2}} = .3 > \frac{.9}{4}$ baskets. So Home is certainly better off under free trade.
Now in **Foreign** the purchasing power of the autarky wage (again, equal in both sectors) was $\frac{wage}{q^*} = \frac{A^*_W}{\frac{5}{3}} = \frac{.2}{\frac{5}{3}} = \frac{.6}{5}$. Under *free trade* the new *purchasing power* wage is $\frac{wage}{q_{FT}} = \frac{A^*_W}{\frac{3}{2}} = \frac{.2}{\frac{3}{2}} = \frac{.4}{3} > \frac{.6}{5}$.
So Foreign *and* Home are better off under trade, notwithstanding the fact the Foreign was *less* productive at both activities. (Note that their lack of productivity is reflected, however, in a *lower* overall wage than Home). I think this example is a *really* compelling argument for free trade. This is why almost all economists *abhor* protectionism and barriers to trade and why Benjamin Franklin famously remarked that, "*no nation was ever ruined by trade*"

4 Real Business Cycle Theory

We have $Y_t = A_t K_t^\alpha L_t^{1-\alpha}$, the accumulation of capital is given by $\dot{K} = sY_t$, $K_t > 0$ (no depreciation), $\hat{L}_t = n > 0$, $\hat{A}_t = g > 0$. Let's define a *perfectly competitive equilibrium* in this economy.
A competitive equilibrium consists of quantities $Y_t, K_t, L_t, K_t^d, L_t^d, A_t$ and prices w_t and r_t such that:

- Firms are price takers and solve:

$$\max_{K_t^d, L_t^d} Y_t - w_t L_t^d - r_t K_t^d, \quad \text{where} \quad Y_t = A_t K_t^\alpha L_t^{1-\alpha} \tag{9}$$

  where K_t^d and L_t^d denotes capital and labor *demanded* at time t. Firms maximize profits at each time t and take w_t and r_t as given (the *price taker* assumption, the essence of a *perfectly competitive* market).

- Households supply labor, L_t, inelastically and capital K_t. They save a constant portion s of their income $\dot{K}_t = s(w_t L_t + r_t K_t)$.

- At the interest rate r_t the capital market clears, $K_t^d = K_t$ i.e at r_t the capital supplied by households is exactly equal to the capital demanded by firms.

- At the wage rate w_t the labor market clears, $L_t^d = L$ i.e at w_t the labor supplied by households is exactly equal to the labor demanded by firms.

- $Y_t = A_t K_t^\alpha L_t^{1-\alpha}$

- $A_t = A_0 e^{gt}$

Advocates of *real business cycle theory*/the Chicago School believe that all economic fluctuations are propagate from fluctuations in A, productivity/technology. This causes endogenous responses of capital (higher investment) and labor (labor ought really to be elastic above.....but ah never mind). The main thing is that they believe that the world is described as depicted in the definition the hence, in accord with the *first welfare theorem* this equilibrium will be *pareto efficient*. RBC'ers contend that all fluctuations are thus, in some sense, efficient. Thus government intervention, and, in particular, Keynesian demand-side management and fine-tuning have no role and are in fact counterproductive and pernicious. So they believe that the unadulterated free market works best, no such thing as market failure, instant market clearing, flexible prices.

5 Interest Rates and Real Values

5.1 Interest Rates

The real ex post rate of return on something is given by $r = i - \pi$. This is my return after having realized my return on my bond or other financial instrument. The real ex ante rate of return is $r = i - \pi^e$. This is my expected real return upon purchasing a bond from you with nominal return i. In facts, lots of financiers lost out in the $70's$ since they bought bonds and only after did they witness a resurgence in inflation, thereby diminishing *real* returns. In other words, they lent money but the purchasing power of what they lent was much greater than what they got back. If I lent $10 to someone a hundred years ago and I got a mere $12 back today, then this has hardly any *purchasing value compared* to what I lent out, given the enormous price level increase in the interim. *Henceforth I assume perfect foresight,* $\pi = \pi^e$*, and that the real rate of interest is always thus* $r = i - \pi$. In the long run the real rate of interest is equal to the *natural rate* of interest or the marginal product of capital, ρ. If it were not and we had $\rho > r$, say, then it would be a great deal to get a loan at rate r and

invest the funds to get ρ. This cannot be a long run equilibrium, since it time, r will be driven up and ρ will be driven down, until $\rho = r$.
So what do I mean when I say I bought a bond from you and you offered me a rate of interest, i. Doesn't Greenspan control i. Not really. Greenspan controls what we call the *federal funds rate* the rate at which banks lend to each other (so as to satisfy their reserve requirements stipulated by the FED). However, the federal funds rate and all other interests rates generally *move together in sync.* If the banks have to pay more on loans from other banks, they'll surely pass that on to customers in the *prime rate*, though not necessarily. And if the interest rates in the banks are high, then corporate bonds will have to pay a higher return too. So plainly, all rates move together.

5.2 Real Values

In economics, we are typically interested in the *real value* of something, not the nominal or monetary value. To obtain the real value we simply deflate by a price level such as the CPI. (i.e the price of a normal basket of consumer goods). For instance, if the level of debt was \$1000 and the price level was \$100, then our real burden is ten basket of goods. If the price level was raised to \$1000, however, the real burden is now a mere one basket of goods. *And all that matters is the real burden in terms of purchasing power.* Countries often resort to a surprise inflation (an increase in P) so as to reduce their real debt burden, $\frac{D}{P}$ It's like me having taken a loan of \$10 from you fifty years ago. At that stage the purchasing power of the loan was pretty damn large, but given the substantial rise in the price level in the interim, the purchasing power of what I give back to you is pretty damn miserable, so I gain at your expense. So there.

6 Government Debt

Two big problems with government debt is that it can lead to inflationary expectations (since rational agents predict at some point the government will be forced to print money, but this is really only an issue in developing countries) and more significantly/relevantly, it leads to *crowding out.*

Definition 10 (Crowding out) *Crowding out occurs when the government runs up debt and takes funds from the capital markets that would otherwise have been used for private investment and capital formation.* Real *interest rates rise and we say private investment has been* crowded out*.*

Now, the evolution of government debt, in *real* terms, is given by:

$$B_t = (1 + r)B_{t-1} + G_t - Y_t \tag{10}$$

In *real* terms, the debt today is given by the previous debt plus interest payments, $(1 + r)B_{t-1}$ coupled with the today's imbalance or the *primary deficit*, $G_t - Y_t$.
Given that $e^r \approx 1 + r$, we can approximate 10 by:

$$B_t = e^r B_{t-1} + G_t - Y_t \tag{11}$$

However, our prime interest is in the debt/gdp ratio. This gives us indication of *sustainability* of the debt and whether a country can actually afford the to run up debt, given its income level. So to get this ratio, divide both sides by Y_t to get:

$$\frac{B_t}{Y_t} = e^r \frac{B_{t-1}}{Y_{t-1}} + \frac{G_t - Y_t}{Y_t} \tag{12}$$

Now this is just equivalent to:

$$\frac{B_t}{Y_t} = e^r \frac{B_{t-1}}{Y_t} \frac{Y_{t-1}}{Y_{t-1}} + \frac{G_t - Y_t}{Y_t} \tag{13}$$

And given that $\frac{Y_t}{Y_{t-1}} = 1 + g \approx e^g \Rightarrow \frac{Y_{t-1}}{Y_t} = e^{-g}$ this now reduces to:

$$\frac{B_t}{Y_t} = e^{r-g} \frac{B_{t-1}}{Y_{t-1}} + \frac{G_t - T_t}{Y_t} \tag{14}$$

and using the fact that $e^{r-g} = 1 + r - g$:

$$\frac{B_t}{Y_t} = (1 + r - g) \frac{B_{t-1}}{Y_{t-1}} + \frac{G_t - T_t}{Y_t} \tag{15}$$

implying that the evolution of *real debt* is given by:

$$\frac{B_t}{Y_t} - \frac{B_{t-1}}{Y_{t-1}} \equiv \Delta \frac{B_t}{Y_t} = (r - g) \frac{B_{t-1}}{Y_{t-1}} + \frac{G_t - T_t}{Y_t} \tag{16}$$

Now lets get nominal. Nominal GDP is given by $Y\$$. But nominal GDP is equal to the product of real GDP and the price level, by definition. So, $Y\$ = PY$ implying that $\hat{Y\$} = \pi + g \Rightarrow g = \hat{Y\$} - \pi$. And given that $r = i - \pi$, we can combine expressions to get $r - g = i - \pi - \hat{Y\$} + \pi = i - \hat{Y\$}$. And replacing our new expression for $r - g$ in (16) above gives:

$$\frac{B_t}{Y_t} = e^{i - \hat{Y\$}} \frac{B_{t-1}}{Y_{t-1}} + \frac{G_t - T_t}{Y_t} \tag{17}$$

Now we can get everything in nominal terms by multiplying the numerators and denominators by the same terms, P_t (for $\frac{B_t}{Y_t}$ and $\frac{G_t - T_t}{Y_t}$)) and P_{t-1} (for $\frac{B_{t-1}}{Y_{t-1}}$) thereby yielding:

$$\frac{B\$_t}{Y\$_t} = e^{i - \hat{Y\$}} \frac{B\$_{t-1}}{Y\$_{t-1}} + \frac{G\$_t - T\$_t}{Y\$_t} \tag{18}$$

A Note on Sustainability

Let's define sustainability as a position of a constant debt/GDP ratio over time. This is nothing inherently good about this, but let's derive a condition to ensure that this ratio doesn't get out of control. Also let the growth rate of nominal GDP, $\hat{Y\$} = g'$ and denote $\frac{B_t}{Y_t}$ by b_t. What conditions do we need for sustainability, a position where $b_t = b_{t-1} = b$ for some constant sustainable level, b. Also, lets assume that the primary balance/GDP ratio, $\frac{G\$_t - T\$_t}{Y\$_t}$ is constant at d or more realistically is *on average* equal to d over the long run. Substituting this into (18) and noting that $e^{i-g'} = 1 + i - g'$ gives:

$$b = e^{i-g'} b + d \Rightarrow b \approx (1 + i - g')b + d \tag{19}$$

using the approximation $e^{i-g'} \approx 1 + i - g'$. Now assuming equality and manipulating a little, this implies that:

$$d = (g' - i)b \tag{20}$$

Now, this *is* important. It gives the level of d necessary for sustainability of the debt/GDP ratio (in nominal terms) at b. Over the long run, *this means that to maintain a constant debt/GDP ratio, b, then if $g' > i$ i.e the growth rate of nominal income is greater than the nominal interest rate, then we can run deficits indefinitely. If however, $g' < i$, then we must run average run primary surpluses (i.e a negative d) to maintain a constant b.*

Otherwise the debt/gdp ratio will explode. In the data, we typically see $i > g'$ which means that the sustainability of the fiscal position requires that indebted governments cannot run persistent deficits in the long run. In other words, for sustainability, indebted governments must run primary surpluses on *average* (but not necessarily at all times). (Of course, we can do the same brute force on (16) to get a sustainability condition for real debt/GDP).

7 The Current Account

In the international market, a country running a trade deficit exchanges goods for assets or claims. The country imports cars etc and in return gives the foreign country claims to stocks, bonds and other financial assets. The sum of a country's financial assets are called it's *net foreign assets* or international investment position. Clearly if a country is running continual trade deficits, it's also accumulating foreign liabilities, so its net foreign assets will soon turn negative.

The *current account* gives the change in the net foreign asset position of the country, $CA = \Delta NFA$ i.e if a country is running a current account deficit, say, in a given year, this means that its net foreign assets have declined. This is mathematically just what I said above. A current account surplus means a country is *lending* abroad and accumulating foreign credit. A current account deficit means a country is *borrowing* from abroad and accumulating foreign debt/liabilities or equivalently is running down its net foreign assets. The US which has been running persistent current account deficits for over twenty years has experienced a dramatic fall in its net foreign asset position, which is now negative. Crucially, note that *the counterpart to a capital flow is an exchange of goods.* But you retort that the $100 you pay for a Swiss watch is hardly some asset. It is, indirectly - the Swiss have to do something with those bucks, they don't just sit on them. Okay, the guy who sold you the watch plonks it in his bank account. But those dollars aren't staying there. Not at all. The bank or some investor will take them and *then* buy assets. So *now* we have the *goods for assets* thing. Right.[3]

So what determines the change in a country's net foreign asset position i.e how do we define the current account? As you've guessed the trade balance is the prime determinant but we also must account for other *flows.* The equation for the current account (abstracting from unilateral transfers/gifts) is[4]:

$$CA_t = NX_t + rNFA_{t-1} \tag{21}$$

i.e the current account is the sum of the trade balance/net exports, NX and the interest payments on its net foreign assets. So a country accumulates net foreign assets by running a positive trade balance and receiving interest payments on net foreign assets. A country's net foreign asset position deteriorates by running trade deficits having big interest payments on foreign liabilities.

7.0.1 NFA/GDP Position

Now, the evolution of the net foreign asset position is given by:

$$NFA_t = (1 + r)NFA_{t-1} + NX_t \tag{22}$$

or

$$\Delta NFA_t = rNFA_{t-1} + NX_t \tag{23}$$

[3]In rare circumstances it is possible for it to go one way. Say if a country runs a trade deficit, but nobody simply wants to hold its assets. Then the country pays for the deficit by running down its foreign reserves. But this obviously cant go on and is an anomalous scenario, that I shouldn't have even brought up.

[4]The equation sometimes given is $CA = NX + rNFA +$ Gifts, but this is a unconventional.

Then, completely analogously to how equation (10) morphed into equation (16) we have the evolution of the $\frac{NFA}{Y}$ position given by:

$$\frac{NFA_t}{Y_t} - \frac{NFA_{t-1}}{Y_{t-1}} \equiv \Delta\frac{NFA_t}{Y_t} = (r-g)\frac{NFA_{t-1}}{Y_{t-1}} + \frac{NX_t}{Y_t} \tag{24}$$

7.0.2 An Important Equation

The equation for GNP/national income, Y, by definition is:

$$Y = C + I + G + NX + rNFA = C + I + G + CA \tag{25}$$

Now introducing taxation, T, and manipulating (25) we have:

$$Y - C - T + T - G = I + CA$$

Noting that private savings are $S_p = Y - C - T$ and government savings are $S_g = T - G$, we have probably the most important equation in international finance:

$$S_p + S_g - I = CA \tag{28}$$

The says the the excess of national savings $S_g + S_p$ over investment I is equal to the current account. Note that this is an identity and must hold *at all times* (and is equilibrated by the real interest rate and the exchange rate). Intuitively this means the the excess of national savings over investment is sent abroad (the *net capital outflow*) and foreigners use this to finance their purchase of our imports (so we accordingly run a current account surplus). In other words, the counterpart of a current account surplus is a net capital outflow. Conversely, the counterpart of a current account deficit is a capital inflow. Again this reasoning is in accord with the “trade in goods in exchange for assets” that I detailed above.
Now lets write this taking account of the fact that the current account is a function of the real exchange rate, ϵ (a depreciation will *cet.par* make our goods cheaper, precipitating greater exports and an improvement in the trade balance). We now have:

$$S_p + S_g - I = CA(\epsilon) \tag{29}$$

Now recall how I said the US current account has now breached the dangerous 5% of GDP limit and how the US net foreign asset position is now the biggest imbalance in financial history. All countries that have approached this limit have suffered reversals, often quite sudden ones. The US situation is similarly unsustainable and as you know, if something is unsustainable, it doesn’t usually last.
But if we analyze the above in light of the present dynamics (lowest private saving rate ever and a fiscal crisis looming), we see that national savings $S_p + S_g$ are only getting inexorably worse. And I is already at rock bottom and can only increase. That means the left hand side is only *commencing* a bigger plunge. So, how is the long overdue US current account reversal (i.e a *positive* (yes positive) right hand side) going to materialize, if the *quantities* aren’t going to bail us out and in fact, are being exceedingly unhelpful. Clearly, the *prices* must move instead - in other words we need a sharp depreciation of the dollar to bring CA towards positive territory. The depreciation of the dollar would raise the CA on the right and increase S_p on the left (more exports$\Rightarrow$ more profits $\Rightarrow$ more private savings), thereby restoring balance. Note this is really the *only* way out. If I had a hedge fund on Wall St., I would bet a lot of money on a 15% or so depreciation of the dollar over the next year. I think this really is a one way bet, now thats the kind of advice a Wall St bank could only dream of...

8 Money and Prices

8.1 Money Supply and Demand

The prime conduit for increasing the *money supply* is via *open market operation*. The central bank prints money to buy bonds putting more money into circulation or it buys bonds thereby withdrawing money from circulation. It is important to keep in mind that the transactions are, in the main, done with *banks*. So the banks end up awash with reserves and are thus more willing and able to lend (and at lower interest rates). This is really the route through which the money ultimately enters Joe Blogg's pockets. So the FED really controls the money supply *indirectly* via the banks. This affects the interest rate and because the interest rate affects spending, it affects the economy as a whole. And it should be clear that increasing the quantity of money is equivalent to lowering the interest rate. Indeed this *is* how the Fed maintains the fed funds rate at a given target value.
The *money demand* function is given by:

$$m^d = PYL(i) \qquad L'(i) < 0 \tag{30}$$

This gives the demand for actual money (or *liquidity, hence the "L"*). When I say money, I mean currency and checkable deposits, what economists call $M1$. The latter are highly liquid (can be turned into cash easily) so we can regard them as money. Cash, stuck in some mutual fund in New York, however, is pretty illiquid and is not part of $M1$, but don't fret, they have a home too, $M3$. ($M2$ is basically $M1$ plus savings accounts).
Intuitively, this equation simply means that the greater is real output and the price level and the lower the nominal rate of interest the more money I wish to hold (this is often called the LM relationship). If output and the price level are higher, then I'll want more money since I'll be doing more spending. In particular, if the price level or the level of income doubles then my demand for money will double too. But if the interest rate is high, I'll want to buy bonds or some other asset, rather than have money in my back pocket (i is the *opportunity cost* of holding money).

8.1.1 Financial Market Equilibrium

In equilibrium $i = r + \pi$ adjusts so that money supply m is equal to money demand m^d. So equilibrium in the financial markets, $m = m^s = m^d$, dictates that:

$$m = m^d \Rightarrow m = PYL(i) = PYL(r + \pi) \tag{31}$$

In the short run P is taken to be fixed, as is Y, so i must adjust to clear market.
The money demand and money supply curves are depicted in figure 1. We assume money supply is initially fixed and as usual, the money demand function is a decreasing function of the nominal interest rate. *We always have money market equilibrium* and, in this case, we have equilibrium at interest rate i^*. I show what happens when money demand rises (due to say a rise in government expenditure, increasing Y). The equilibrium rate is pushed up (the idea behind *crowding out*). But then, assuming the FED keeps the rate set at i^*, it must increase the money supply, thus moving the supply curve to the right.

8.1.2 The Quantity Theory of Money

The value of total transactions in an economy in a given year is simply the value of nominal GDP, PY. Let the money stock during the year equal M. Then, we define the *velocity*, V, of money as:

$$V = \frac{PY}{M} \tag{32}$$

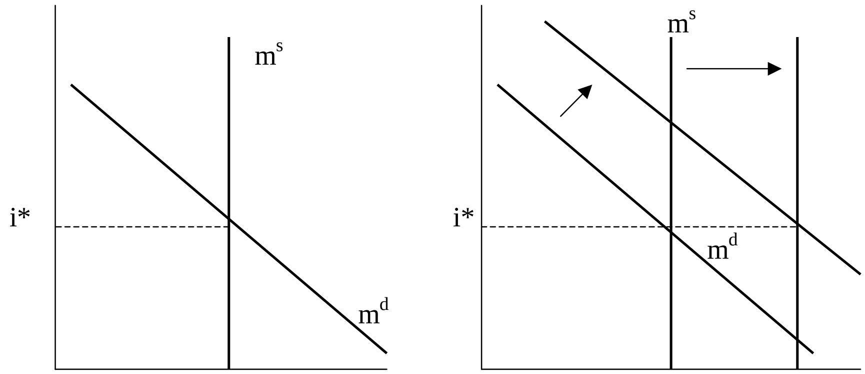

Figure 1: Interest Rate Targeting.

This is simply the rate at which money circulates. Manipulating it gives us the *identity*, $MV = PY$, often called the *quantity equation*. The *quantity theory of money* assumes that velocity, V is stable/constant.
Now recall the equilibrium condition from above:

$$M = PYL(i) \tag{33}$$

Combining these gives us $L(i) = \frac{1}{V}$. So, when money demand is high, velocity is low. For a given value of total transactions, when money holdings/demand is high, the money "gets around" less. Conversely, when money holdings/demand is low the money has to get around a lot (and do a lotta work), for the given value of transactions.
Finally, in the short run, money affects real variables through the route:

$$M \uparrow \Rightarrow i \downarrow \Rightarrow r = i - \pi \downarrow \Rightarrow I(r) \uparrow \Rightarrow Y \uparrow \tag{34}$$

Note first that investment depends on the *real* rate of interest i.e the *real* burden of payment. A high nominal rate has little *real* pain if inflation is eating away at the burden of your payments. Also, prices are fixed in the short run, so inflation is also constant. What the above says is a rise in the money supply, reduces the nominal rate, which reduces the real rate (since inflation is stuck) which increases investment and output, $Y = C + I(r) + G$.

8.1.3 The Long Run

Recall how, in the *long run*, a rise in the money supply is simply reflected in a proportional rise in the price level, the *classical dichotomy* or *monetary neutrality*. Money *cannot* have *real effects* in the long run.
Now in the *long run*, we assume that $i = r + \pi$ is *constant*. Prices are growing at a steady rate, π (a *balanced growth path*, indeed). And the real rate is constant at the marginal product of capital.
Taking logs and differentiating (33), noting L is constant (since $i = r + \pi$ is constant, gives the *long run relationship*.

$$\frac{\dot{m}}{m} = \frac{\dot{P}}{P} + \frac{\dot{Y}}{Y} \tag{35}$$

or

$$\pi = g_m - g_y \tag{36}$$

The intuition is that, *in the long run*, any increase in money growth beyond output growth manifests itself as inflation. For example suppose money growth is 12% and output growth is 10%. Then, clearly, we need 10% money growth just to be able to buy the new output, without inciting inflation. Any increase in money growth beyond 10%, though, *does* lead to a rise in prices. So in this case of the 12% output growth, 10% is used to buy the new goods (since they've increased by 10%) and the other "excess" 2% rears its ugly head as inflation.
Given that, in the long run, money growth, g_m, doesn't affect output growth, g_y, what effect does an increase in g_m have? Given that the increase in g_m doesn't affect g_y *an increase in* g_m *leads directly to an increase in* π, assuming g_y is constant. So in the long run when g_y is constant, $\frac{d\pi}{dg_m} = 1$ i.e there is a $1-1$ relationship between inflation and money growth - "*inflation is always and everywhere a monetary phenomenon*".
The monetarists believe the above analysis holds also in *the short run*. Monetarism was based on the fundamental tenet that, if you maintain constant money growth, that will will steady inflation and general economic stability. The argued that the FED should choose a specific monetary aggregate (such as $M1$ or $M2$) and keep it growing at a constant rate each year, effectively put the economy on auto-pilot. This was their *monetary rule*. Then via the equation below, this rule should yield a desired rate of inflation.

$$\pi = g_m - g_y \tag{37}$$

But this equation was derived under *long run* conditions assuming crucially that $L(i)$ is stable. However, in the short run, this part of the money demand varies quite a lot. And output growth is hardly constant in the short run either, so we can hardly aim for a given π simply via g_m given that g_y is varying as well. Monetarism has long since fallen out of favor but monetary restraint/rules are today very much *de rigueur*. Inflation targeting (aiming for around steady 3%) inflation is today's upcoming fad. In New Zealand the central banker is fired if his inflation target is not met.... Rough justice.

8.2 Seigniorage

The revenues the government can earn through printing money (ie through seigniorage) are Δm. The government "prints" money by *forcing* the central bank to buy its bonds.[5] The *central bank* then prints money so as to purchase the bonds and the money supply increases, just as with an open market operation. Pretty corrupt, this, really. Can the government "print" money and earn seigniorage revenues indefinitely? Not quite. The government's policy of printing money is only of use if people are actually going to *hold* the money. If the US government is printing toy money, no one will be willing to hold it, so they'd be pretty much wasting their time. Printing money is only of use if people physically use the money. But, seigniorage leads to inflation via (36) and inflation leads to a fall in money demand via (31). So, you can see the problem. And this can get real messy. Just think of a hyperinflation. So, how does the government collect this "tax" and who pays it? When the government "prints" money, it uses it to pay for goods and services, leading to inflation. *The tax is then paid by those holding money balances.*
Mathematically, we express seigniorage revenues as a fraction of nominal GDP. So we have:

$$\frac{\Delta m}{Y\$} = \frac{\Delta m}{m}\frac{m}{Y\$} \tag{38}$$

Now note how the government's seigniorage as a fraction of GDP, $\frac{\Delta m}{Y\$}$ is like a tax of rate $\frac{\Delta m}{m}$ on money held by the public (as a fraction of GDP), $\frac{m}{Y\$}$. As the government increases the "tax rate"/inflation tax, it gains revenue, but as will now see, it leads to a fall in $\frac{m}{Y\$}$, the "tax base".
The government's optimization problem is to just get the right balance, as it were, between these opposing forces. Now let's rewrite our equation above invoking (31), $m = Y\$L(i)$, above giving $\frac{m}{Y\$} = L(i)$. Now we have, noting that $i = r + \pi$,:

[5] Hence the importance of an independent central bank.

$$\frac{\Delta m}{Y\$} = \frac{\Delta m}{m}L(i) = \frac{\Delta m}{m}L(r+\pi) \tag{39}$$

And let's assume a constant money growth rate, g_m, and that $g_y = g$. And from (36) we have $\pi = g_m - g$. Hence $i = r + \pi = r + g_m - g$. So now (39) reduces to:

$$\frac{\Delta m}{Y\$} = \frac{\Delta m}{m}L(r+g_m-g) = g_m L(r+g_m-g) \tag{40}$$

So now we see explicitly the countervailing force on the governments efforts to earn seigniorage. As the "tax rate" increases, money demand, L, the "tax base", falls (recall $L' < 0$), since in an inflationary environment, money has a negative return (of $-\pi$) and people would rather have it in the bank earning i. Now the government wants to maximize $\frac{\Delta m}{Y\$} = g_m L(r+g_m-g)$. For exposition, let me assume $L(r+g_m-g) = -(r+g_m-g)$, a simple linear relationship satisfying of course $L' < 0$.
So the government's problem is to maximize:

$$\frac{\Delta m}{Y\$} = g_m(-r-g_m+g) = -rg_m - g_m^2 + gg_m \tag{41}$$

Solving (noting its concavity) gives:

$$\frac{\partial \frac{\Delta m}{Y\$}}{\partial g_m} = -r - 2g_m + g = 0 \tag{42}$$

implying

$$g_m^* = \frac{r-g}{2} \tag{43}$$

This money growth rate yields the maximum amount of revenue for the government. And the amount of seigniorage we can generate follows an inverted U shape, showing the the higher money growth rates lead to less seigniorage (since they simply encourage people to reduce money holdings).

9 Consumption

The typical Keynesian consumption function is given by $C = \gamma Y$ i.e consumption is a fixed fraction of income. Big shortcomings here are its failure to account for expectations of income, value of assets, uncertainty/savings motives. However, it may well be realistic for nonrational agents splurging all current income, and those faced with liquidity constraints who simply cant borrow so as to *smooth consumption.* Risk aversion is important here too, since I personally am unwilling to borrow a lot cos' you never know what might happen etc. Another manifestation of this kind of function is $C = \gamma Y_p$ i.e consumption is a function of *potential income.* Your potential income is your "average" income in normal times. In a boom, your income goes beyond potential, in a recession, below. This function is certainly a little more sophisticated than its Keynesian counterpart, since, in a downturn say, it dictates that consumption should remain the same as that in a boom. However, it dictates the consumption is dependent merely on *current* potential income and not future flows. If potential income doubles with certainty at some point in the future (the *new economy* and all that), this functions fails to incorporate such a development into *today's* consumption. To systematically embrace the future into our analysis, we consider the *permanent income hypothesis* (PIH).
PIH essentially states that consumption should depend on normal or *permanent* income where *permanent income* is the present discounted value of all lifetime income. It follows that savings will be high when disposable income is higher than permanent income and conversely. If people base consumption on lifetime income, then

a big bonus this year should have little effect on consumption this year. *But* it *does* affect consumption to a small extent, since it changes the present discounted value of all my income and hence *permanent income*. I will consume a little of the bonus this year, certainly, but will *smooth* the rest of it over my future lifetime. It makes a lot of sense, but it (strongly) assumes *perfect capital markets* (ie no borrowing constraints) and very forward looking behavior. I'll show this mathematically, in the simplest formulation possible.
Suppose $r = 0$ and $\beta = 1$ and there's no uncertainty. Then suppose you want to maximize utility over two periods, *young* period and *old* period, say.
Then I wanna maximize lifetime utility $U(C_1, C_2)$ subject to my intertemporal wealth constraint $C_1 + C_2 = W_1 + W_2$. Then the Lagrangian is:

$$L = U(C_1, C_2) + \lambda(W_1 + W_2 - C_1 - C_2) \tag{44}$$

Taking partial derivatives w.r.t C_1 and C_2, respectively:

$$\frac{\partial U}{\partial C_1} = \lambda \quad \text{and} \quad \frac{\partial U}{\partial C_2} = \lambda \tag{45}$$

So we have $\frac{\partial U}{\partial C_1} = \frac{\partial U}{\partial C_2} \Rightarrow C_1 = C_2$. This is intuitive. We equate marginal utilities of consumption in both periods. If we had a higher marginal utility (i.e *lower* consumption) in one period than another, then that would be suboptimal, since we can increase lifetime utility by taking increasing consumption in that period and decreasing it in the other. We should do this until marginal utilities are equated and no more "transferring" can occur.
Now subbing our result, $C_1 = C_2$ into the budget constraint gives:

$$C_1 = C_2 = \frac{W_1 + W_2}{2} \tag{46}$$

This is the very essence of the *permanent income hypothesis*. Consumption depends on lifetime income, not present income; the timing of receipts does not matter. If we have, quite realistically, no income in old age ($W_2 = 0$), then we perfectly smooth consumption and consume $\frac{W_1}{2}$ in both youth and old age. Now suppose we have to pay a *lump sum* tax of τ in old age, reducing income to $W_1 - \tau$. Now our consumption *each period* is reduced to $\frac{W_1+W_2-\tau}{2}$ and hence income in youth is reduced by $\frac{\tau}{2}$, so the pain starts to bite *today*. Get it. Good. Thats all there is to it. Now suppose the government administers a temporary lump sum tax cut of τ this year. Note that that consumption this year is now $C_1 = \frac{W_1+\tau+W_2}{2}$ i.e consumption only rises by $\frac{\tau}{2}$. If the tax rebate was to become a permanent fixture though, we'd have $C_1 = \frac{(W_1+\tau)+(W_2+\tau)}{2}$ and consumption would increase by τ. The moral is *according to the PIH temporary government policies will have little power to stimulate the economy*. The distinction between temporary and permanent is paramount.
If we derived this, assuming $r \neq 0$, $\beta \neq 1$, we would get a consumption function like $C_i = f(W, r, \beta)$, where again, consumption is increasing in lifetime wealth, W. C_1 is decreasing in β since β represents the "emphasis" placed on *future* consumption; the greater weight I put on future consumption the less Ill consume today. Equivalently, C_2 is *increasing* in β. Regarding the interest rate, it really depends on whether you are a lender or a borrow. If you are a lender, say, then a rise in r means you ought to lend more (the *substitution effect*) and consume *less* today, since lending is now more lucrative (this will of course raise consumption, *next (i.e the final) period*, though). But it also means you are richer, (*the income effect*), so you should consume *more* today (*and* next period). Next period's consumption will thus *rise* since both effects go the same way for C_2. But this period's can clearly go either way since effect go in opposite directions. But relax. We *can* actually tell which way things go from the agent's utility function; in particular, from the *elasticity of substitution,* σ. This indicates how strong the substitution effect is (i.e who willing the agent is to "transfer" consumption from this period to the next) and if $\sigma > 1$, the substitution effect will dominate the income effect and we'll have a *fall* in C_1. Other way round for $\sigma < 1$ and effects just balance if $\sigma = 1$.

10 The IS-Curve and All That

Now taking time derivatives of our usual aggregate demand equation yields;

$$Y = C + I + G \qquad \Rightarrow \quad \dot{Y} = \dot{C} + \dot{I} + \dot{G} \tag{47}$$

Then, dividing across by Y to get this in terms of growth rates:

$$\frac{\dot{Y}}{Y} = \frac{C}{Y}\frac{\dot{C}}{C} + \frac{I}{Y}\frac{\dot{I}}{I} + \frac{G}{Y}\frac{\dot{G}}{G} \tag{48}$$

or equivalently:

$$\hat{Y} = \frac{C}{Y}\hat{C} + \frac{I}{Y}\hat{I} + \frac{G}{Y}\hat{G} \tag{49}$$

Then subbing in the equation for $\hat{I}$ gives *the* IS curve and adding and subtracting $\hat{Y_p} = (\frac{C}{Y} + \frac{I}{Y} + \frac{G}{Y})\hat{Y_p}$ gives

$$\hat{Y} = \frac{C}{Y}\hat{C} + \frac{I}{Y}\hat{I} + \frac{G}{Y}\hat{G} \quad \Rightarrow \quad \hat{Y} = \hat{Y_p} + \frac{C}{Y}(\hat{C} - \hat{Y_p}) + \frac{I}{Y}(\hat{I} - \hat{Y_p}) + \frac{G}{Y}(\hat{G} - \hat{Y_p}) \tag{50}$$

The above is the true, raw, rugged, no frills IS curve. We can see explicitly that anything that affects the growth of the components of aggregate demand - C, I, G - shifts the curve. Period. When I refer to the IS curve, this is what is what I'm referring to. Keep *this* version in mind, its nice and intuitive.
Now let's make *assumption* that $C = \gamma Y_p \Rightarrow \hat{C} = \hat{Y_p}$ and $\hat{I} = \hat{Y_p} + a(\rho - r)$. Basically, just note that investment growth is a negative function of the real interest rate. Now subbing these into (49) gives:

$$\hat{Y} = \frac{C}{Y}\hat{Y_p} + \frac{I}{Y}(\hat{Y_p} + a(\rho - r)) + \frac{G}{Y}\hat{G} \tag{51}$$

Expanding a bit noting that $Y = C + I + G \Rightarrow \frac{C}{Y} = 1 - \frac{I}{Y} - \frac{G}{Y}$

$$\hat{Y} = (1 - \frac{I}{Y} - \frac{G}{Y})\hat{Y_p} + \frac{I}{Y}(\hat{Y_p} + a(\rho - r)) + \frac{G}{Y}\hat{G} \tag{52}$$

yielding another permutation of the original IS curve:

$$\hat{Y} = \hat{Y_p} + a\frac{I}{Y}(\rho - r) + \frac{G}{Y}(\hat{G} - \hat{Y_p}) \tag{53}$$

I'll stick with this version from now on, since its easier to handle. Again, main thing to note with this is the negative relationship between the interest rate and output growth. Also, note that in the long run we have $r = \rho$, $\hat{G} = \hat{Y_p}$ and hence $\hat{Y} = \hat{Y_p}$ i.e the economy grows at its potential...along the yellow brick road. Consumption doesn't explicitly appear since thats just a function of Y_p, so thats how its taken care of here.[6] Now, when investment is given by $\hat{I} = \hat{Y_p} + a\frac{I}{Y}(\rho - r) + f(\hat{Y} - \hat{Y_p})$, we have a *multiplier effect* in the the IS curve since an increase in investment growth leads to an increase in output growth and, in this formulation of investment, the increase in output growth leads to another increase in output growth, and so forth. So the effect is "multiplied". This multiplier effect will determine the *extent* of the ultimate expansion/contraction. With the multiplier, all effects are *accentuated* via these backward linkages to investment. If you subbed this expression for $\hat{I}$ into the raw IS curve and manipulate, all terms will now be "blown" up by some factor μ due to these multiplier

[6] Thats way its more constructive to think of this analysis via the "raw" IS curve above, since everything is explicit.

effects.[7] Again, no big deal. Finally, when we have an open economy with $Y = C + I + G + X - M$ the curve now reduces to:

$$\hat{Y} = \hat{Y_p} + a\frac{I}{Y}(\rho - r) + \frac{G}{Y}(\hat{G} - \hat{Y_p}) + \frac{TB}{Y}(\hat{TB} - \hat{Y_p}) \tag{55}$$

where $TB = X - M$.[8]. No big deal. Just note how a change in the trade balance can shift the IS curve.
Now what follows *is* important - *anything expansionary (aside from money) shifts the IS curve outwards* since it raises growth for a given real interest rate e.g an investment tax credit, esp a temporary one. Similarly, *anything contractionary (aside from money) shifts the IS curve inwards* e.g an increase in corporate tax rates, depressing investment. Initial conditions matter an awful lot in this framework i.e is the shift pushing us below, towards or beyond potential. Pushes beyond potential are inflationary and *bad.* Pushes to potential are *good.*
In the IS framework we have our downward sloping IS curve (*the demand side*) and the real interest rate rule (*the monetary side*).[9]. A movement to the left of this curve represents a fall in the interest rate and hence is a monetary *expansion.* A shift to the right is an interest rate rise and hence a monetary *contraction.* We generally use this framework only for *short run* analysis. But keep in mind that *supply side factors* such as an increase in the labor force (or a marked change in tax rates/productivity) *can* change potential growth, $\hat{Y_p}$

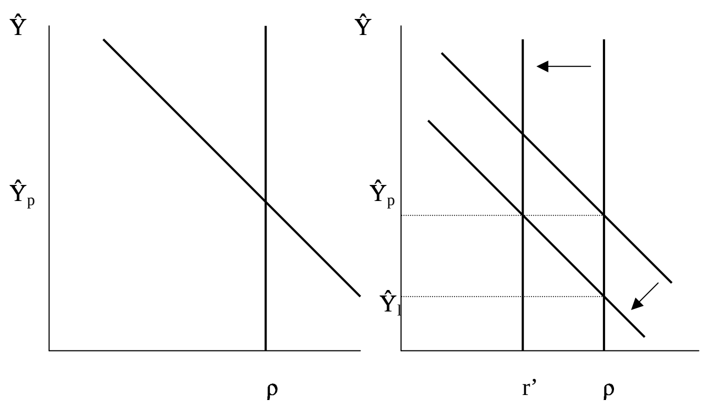

Figure 2: The Clinton/Greenspan "Deal". The left figure shows the initial long run equilibrium at potential growth and the natural rate of interest ρ (or marginal product of capital). The intersection of the IS curve and the interest rate rule determine growth. The right figure shows the fiscal contraction of the 90's shifting the IS curve inwards to below potential growth. Greenspan dutifully lowers interest rates, bringing the economy back to potential.

[7]If investment takes this "multiplier" form in 53 for instance, we will our IS curve will be:

$$\hat{Y} = \hat{Y_p} + \mu a\frac{I}{Y}(\rho - r) + \mu\frac{G}{Y}(\hat{G} - \hat{Y_p}) \tag{54}$$

[8]The *trade balance*, $X - M$, depends postitively on world income (more exports) and negatively on our income (more imports) and the real exchange rate (falling competitiveness)

[9]Note that *monetary policy* is *the* tool generally deployed to fight recessions (fiscal policy too politicized, we have delays/implementation lags etc)

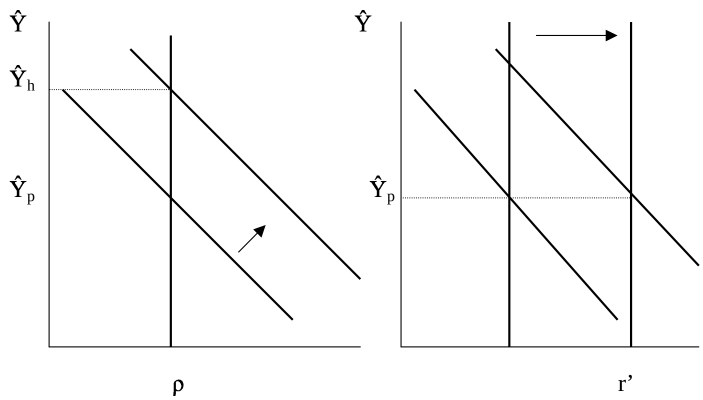

Figure 3: German Reunification. Big German expansion after reunification, shifting IS curve out, beyond potential. The Bundesbank, notoriously hawkish on inflation, raised interest rates, slowing down economy and reining it back to potential.

11 Three Key Equations

Our IS curve is:

$$\hat{Y} = \hat{Y_p} + a\frac{I}{Y}(\rho - r) + \frac{G}{Y}(\hat{G} - \hat{Y_p}) \tag{56}$$

Assuming that $a\frac{I}{Y} = 1$, and $\hat{G} = \hat{Y_p}$, this reduces to:

$$\hat{Y_t} = \hat{Y_p} + \rho - r \tag{57}$$

By definition of the output gap, we have:

$$Gap_t = \log Y_p - \log Y_t \tag{58}$$

Then:

$$\begin{aligned} \Delta Gap_t &= \Delta \log Y_p - \Delta Y_t & (59)\\ &= \hat{Y_p} - \hat{Y_t} & (60)\\ & & (61) \end{aligned}$$

This then implies that:

$$\hat{Y_t} = \hat{Y_p} - \Delta Gap_t \tag{62}$$

Then comparing this to 57 above, we have:

$$-\Delta Gap_t = \rho - r \quad \Rightarrow \quad \Delta Gap_t = r - \rho \tag{63}$$

So our <u>first key equation</u> is

$$\Delta Gap_t = r - \rho \tag{64}$$

Intuitively, an increase in the real interest rate above the marginal product of capital leads to a fall in investment and an increase in the output gap. *An increase in the output gap is recessionary.*
Our second key equation is the Taylor Rule;

$$r_t = \rho + \frac{1}{2}(\pi_{t-1} - \pi^*) - \frac{1}{2}Gap_{t-1} \tag{65}$$

All else equal, Greenspan *raises* the real rate of interest[10] in response to an increase in inflation/a negative output gap so as to depress the economy so as to avert further inflationary forces - *he takes the punch bowl away.* All else equal, he *lowers* the real rate in response to a rise in the output gap/fall in inflation - *he adds more punch.* He does so to stimulate the economy, since a positive output gap is recessionary.
Combining 64 and 65 gives:

$$\Delta Gap_t = \frac{1}{2}(\pi_{t-1} - \pi^*) - \frac{1}{2}Gap_{t-1} \tag{66}$$

This simple substitution now simply restates the Taylor rule, saying that Greenspan effectively controls the output gap (which he does, of course, through raising/lowering interest rates). It's just another way of saying the same thing.
Our third key equation is the Phillips curve relationship given by:[11]

$$\pi_{t+1} = \pi_t - \frac{1}{3}Gap_t \tag{67}$$

Basically, a rise in the output gap leads to a fall in the rate of inflation. A large positive output gap is recessionary, leading to deflationary pressures on the price level. Conversely, a negative output gap, leads to a rise in inflation. Think of the guy in Times Square. Note too that inflation betrays *inertia.* Inflation yesterday contributes to inflation today. The coefficient on the output gap, here $\frac{1}{3}$, represents the *sensitivity* of inflation to the output gap. If the coefficient is very large, then inflation falls quickly when we have a recession. So if the government is embarking on *cold turkey* to purge the economy of inflation, all it need do is embark on a *small* recession. Now lagging this one period gives us:

$$\pi_t = \pi_{t-1} - \frac{1}{3}Gap_{t-1} \tag{68}$$

giving us our *two equation* system:

$$\Delta\pi_t = \frac{1}{3}Gap_{t-1} \tag{69}$$

$$\Delta Gap_t = \frac{1}{2}(\pi_{t-1} - \pi^*) - \frac{1}{2}Gap_{t-1} \tag{70}$$

[10] In practice, Greenspan sets the *nominal rate of interest*, but content yourself that, if he knows the rate of inflation, by changing i, he can effectively set the real rate, $r = i - \pi$.

[11] Important note. The conventional way of writing this is $\pi_{t+1} = \pi^e_{t+1} - \frac{1}{3}Gap_t$ i.e inflation next period is dependent on *expectations* of inflation next period and the output gap. In our formulation, we assume $\pi^e_{t+1} = \pi_t$, expectations of next periods inflation are equal to *today's* inflation - *adaptive* expectations. (In contrast, *rational expectations* would be much more forward looking.) If we have a zero output gap and wanna purge the system of inflation, we have to clearly manipulate expectations, π^e_{t+1}, since its these alone that are now driving inflation. We can do this through a recession, thereby creating disinflation i.e through so-called *cold turkey*, which will ultimately alter the way agents think and bring down π^e_{t+1} permanently. *But* if the central bank/gov can *credibly* promise that inflation will be lower next period (through not printing money) then that's a much better and *painless* way of bringing down π^e_{t+1}. Credibility is obviously *essential* here.

We have now reduced our system to just two equations. *The first equation, the Phillips curve, gives the natural dynamics of the economy - the Mother Nature equation. The second equation gives the rule imposed by the central bank - this is the Father Greenspan equation.*

If you look at the figure below you can see the dynamics. Anything to the right of the 0 gap is a *recession*; anything to the left is a *boom*. The *Mother Nature* dynamics go up and down. When we have a positive output gap (recession), inflation is falling. When we have a negative output gap (boom), inflation is rising.

The *Father Greenspan* equation gives us the dynamics imposed by the central bank, he looks cross...and controls the *cross* dynamics. If inflation is above the target, π^*, Greenspan tries to create a recession, striving to lead us to recession, to a positive output gap *to the right*. If inflation is below the target, Greenspan still has the luxury of stimulating the economy and moving it to a negative output gap, *to the left*. The arrows and corresponding spiral are shown in figure 4. The economy spins round and round (forever). In theory, once the economy leaves the midpoint, it never returns; it's literally swept off its feet, and carried away by the deadly spirals. It's almost like a hurricane, a tornado, if you like. The economy's here one minute, gone the next.

Ok, enough. For the purposes of basic analysis, its fine to assume rapid convergence i.e convergence after, say, a 270 degrees loop. I depict two simple examples in figure 5.

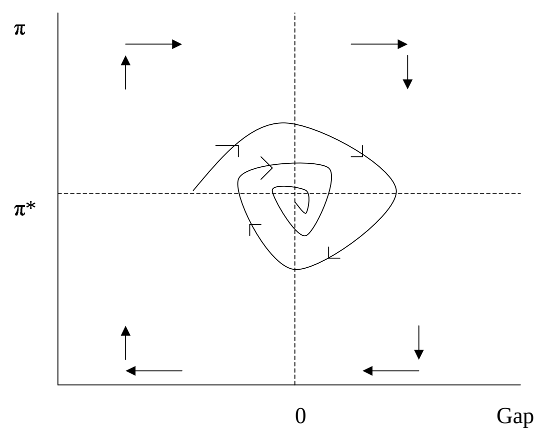

Figure 4: Inflation-Output Gap Spirals

12 The Open Economy

We define the *nominal exchange rate*, E, as the number of units of foreign currency per unit of domestic currency e.g 1\$ $=100Yen$.

Thus the price I pay for a foreign good that I import is $p^* = \frac{P^w}{E}$. Taking logs and differentiating gives $\frac{\dot{p^*}}{p} = \frac{\dot{P^w}}{P^w} - \frac{\dot{E}}{E} = \pi^w - \hat{E}$. For an open economy it follows that the rate of inflation is:

$$\pi = b\pi^d + (1-b)(\pi^w - \hat{E}) \tag{71}$$

where b is the share of expenditure on domestic goods and thus $1-b$ is the share spent on foreign goods.[12] We

[12]So we can formulate a new kinda Phillips curve subbing in our usual expression for π_t;

$$\pi_t = b\pi^d + (1-b)(\pi^w - \hat{E}) = b(\pi_{t-1} - \alpha Gap_{t-1}) + (1-b)(\pi^w_t - \hat{E})$$

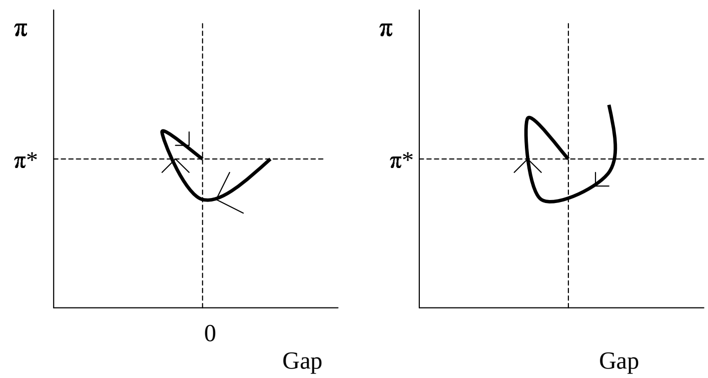

Figure 5: The left figure shows the effect of a contraction such as a rise in tax rates. This leads to a sudden positive output gap. Over time, inflation falls by the Phillips curve and Greenspan adds punch. The economy then goes into boom, with Greenspan still adding punch since inflation is below target. But inflation now rises and Greenspan starts to take punchbowl away by raising real rates. Inflation falls and the economy returns to potential. The second figure shows the effect of an oil shock, which leads both to sudden inflation and a positive output gap (*stagflation*). Same kind of story as before.

simply get a weighted average of price rises of domestic goods and price rises of imported goods. Thus, say, it's clear that an exchange rate *appreciation* leads to lower domestic inflation, with the sensitivity depending on the level of openness, $1-b$, of the economy.

Definition 11 (Law of one price (LOOP)) *In competitive markets free of transportation costs and barriers to trade, identical goods should be priced the same when converted into the same currency. Mathematically,* $EP^i_{US} = P^i_{Jap}$*, the US price in Yen is equal to the Yen price.*

Definition 12 (Purchasing Power Parity (or Pretty Poor Predictor)) *Basically, this is just the LOOP applied to consumption baskets (as opposed to specific goods) in the respective countries. Mathematically,* $EP_{US} = P_{Jap}$*, the US basket price in Yen (say) is equal to the Yen basket price. It posits that the nominal exchange rate adjusts so as to equate the price of the same basket of goods across countries.*

Henceforth let's adopt the notation P for the US and P^W for the foreign country. Now taking logs and derivatives of our PPP result above, $EP = P_W$ gives:

$$\frac{\dot{E}}{E} + \frac{\dot{P}}{P} = \frac{\dot{P_W}}{P_W} \tag{72}$$

or manipulating a bit,

$$\hat{E} = \pi^W - \pi \tag{73}$$

i.e if we have inflation at home, then we should (*cet. par*) see a depreciation of the dollar. Intuitively, if our goods are rising in price via inflation, then to preserve PPP above, there has to be an offsetting depreciation of the dollar to make our goods cheaper to foreigners. This version of PPP in *changes* is called *relative* PPP. Generally only holds for large depreciations of a currency.

Definition 13 (Real Exchange Rate) *The real exchange rate (or terms of trade),* ϵ*, is the relative price of a basket of goods in the US relative to that in the foreign country. Mathematically,* $\epsilon = \frac{EP}{P^W}$*. If* PPP *holds then clearly* $\epsilon = 1$*.*

The real exchange rate is the true measure of *competitiveness* of a country and we typically write, $CA(\epsilon)$ i.e the current account is a (decreasing) function of the real exchange rate. If the real exchange rate is high foreign goods are relatively cheap and domestic goods are relatively expensive. A rise, reflecting either a rise in US prices or the dollar, represents a decline in competitiveness e.g an increase in domestic demand will, *cet. par*, induce a rise in P and hence ϵ.

12.1 The UIP Condition

On the foreign exchange markets *arbitrage* will ensure that:

$$\hat{E^e} = -(i - i^W) \tag{74}$$

i.e if the US offers higher interest rates, say, then we should expect a dollar depreciation. This offsets the higher return in the US and makes the US *equally* attractive as the foreign country. This equality of gains in equilibrium is called the *uncovered interest rate parity condition* or UIP, for short.
Taking logs and differentiating the definition of the *real exchange rate* gives:

$$\hat{\epsilon} = \hat{E^e} + \pi - \pi^w \tag{75}$$

Then substituting from the UIP condition and recalling that $r = i - \pi$ gives:

$$\hat{\epsilon} = -(i - i^W) + \pi - \pi^w = -(r - r^w) \tag{76}$$

This is the *real interest rate parity condition.* No big deal. Same intuition as UIP.

12.2 Overshooting

First, note the following crucial result: *in the long run an increase in the US money supply will cause a proportional rise in the price level and a proportional depreciation of the nominal exchange rate i.e* $\uparrow M \Rightarrow \uparrow P \Rightarrow \downarrow E$. Intuitively, more money leads to greater pressure on prices and the increase in dollars leads to a fall in the price of the dollar (of course, this means a *rise* in the price of foreign goods, so we ultimately have a rise in the price of *all* goods). *The opposite holds for a monetary contraction i.e* $\downarrow M \Rightarrow \downarrow P \Rightarrow \uparrow E$. Note that this implies that the real exchange rate $\epsilon = \frac{EP}{P^*}$ remains constant, due to the opposite movements in E ($\downarrow$) and P ($\uparrow$). *Also, in the long run, output and interest rates remain unchanged.*
But what happens in the short/medium-run as a result of a *monetary expansion.*

1. At the instant of the expansion, the price level is *fixed.* The increase in the money supply moves the m^S curve to the right, leading to a *fall* in the interest rate.

2. The lower interest rate must by UIP lead to an *expected appreciation of the dollar.*

3. But the long run dynamics outlined above indicate that eventually, we will have a *depreciation of the dollar.* So what's up?

4. There is only one way to reconcile these stories - the exchange rate must *overshoot* beyond its long run lower equilibrium value to a point at which it is *expected to appreciate.* This is the only way to get a long run depreciation and a short run expected appreciation. This is illustrated on the figure. Intuitively, the sudden fall in interest rates leads investors to quickly sell dollars and go elsewhere. Then a point comes where the exchange rate has plunged so low that dollars become attractive again since the expected appreciation from this rock-bottom position is sufficient to lure people back to dollars. And the quick sell-off ends and we are in equilibrium with *equal expected returns* on US and foreign assets.

5. At the time of the shock, the real exchange rate depreciates along with the nominal rate since $\epsilon = \frac{eP}{P^W}$ and P and P^W are initially *fixed*. In the subsequent adjustment process, the price level and E rise, ultimately bringing back the real exchange rate to its initial value.

6. We assume that output suddenly increases (okay, in reality it would take a few months) at the moment of the shock due to both the stimulus from lower interest rates and increase in exports due to the *real* exchange rate depreciation.[13] It is this movement of output beyond potential that causes the price level to rise. Output falls over time, since the price level is rising (making domestic goods more expensive and leading to a decline in competitiveness via the rise in $\epsilon = \frac{eP}{P^W}$).

7. Over time the nominal and real rates of interest rise back to their initial values as the money market equilibrium condition, $M = PYL(i)$ is restored, reducing investment and GDP via the multiplier. Over time P rise and takes takes on the burden of adjustment. Ultimately, P does *all* the adjustment and Y and i revert to initial values.

Of course the exact opposite happens for a monetary *contraction*; sudden rise in interest rate, drop in output, sudden exchange rate appreciation (overshoots so as to get *expected depreciation*), subsequent depreciation (but to higher level than initially) and fall in prices (to lower level), rise in output (back to initial level).

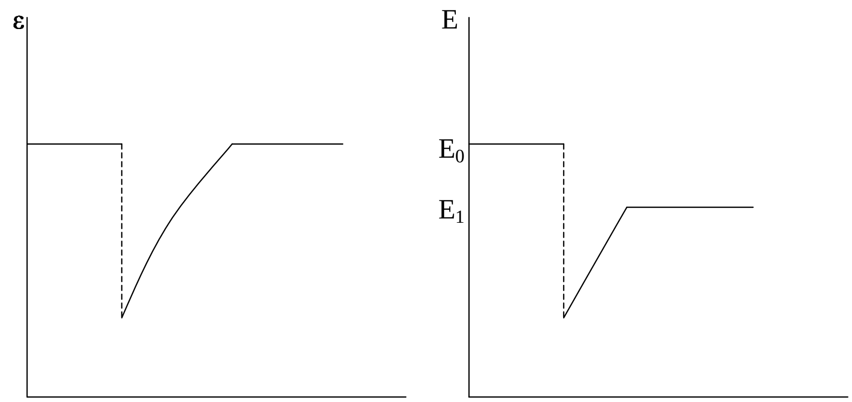

Figure 6: Exchange Rate Overshooting

12.3 Fixed Exchange Rates

In a *fixed exchange rate system* the central bank promises to maintain the exchange rate fixed against some other currency. Specifically, the central bank promises to make the conversion on market demand e.g the FED pegs to the yen at \$1=100 Yen and is willing to make this exchange at any time. Now, invoking the UIP condition, this implies that:

$$\hat{E}^e = -(i - i^W) = 0 \Rightarrow i = i^W \tag{77}$$

Pegging the exchange rate is equivalent to pegging the interest rate, since changes in interest rates lead to changes in exchange rates. Its impossible to concurrently have a fixed exchange rate and maintain vastly different interest rates. So we effectively a new *interest rate rule* for the monetary authority, which must set its money supply

[13] But note that since income has risen, imports will rise. In theory, the trade balance can really go either way.

so as $M = PYL(i^W)$, so it's also a money supply rule. Countries that peg to the dollar effectively have Alan Greenspan controlling their interest rates. They peg rates just as depicted back in figure 1. In reality, however, interest rates may vary a little and the peg is never totally strict.[14]. For example, after German reunification, the Bundesbank raised interest rates to offset inflation. Then other European countries, who had pegged themselves to the Deutschmark, had to do likewise (under the "interest rate rule"), precipitating major recessions in European countries, causing many countries to withdraw from the fixed exchange rate system.
Suppose a fall in output lowers the demand for domestic money. Such a development would normally push down the domestic interest rate. To prevent the depreciation of the home currency that would ensue, the central bank must intervene in the foreign exchange market by selling foreign reserves, and buying domestic currency. This foreign asset sale eliminates the excess supply of domestic money because the central bank receives domestic money for the foreign assets it sells. The bank automatically decreases the money supply in this way until asset markets again clear at the pegged interest rate. If it did not sell foreign reserves the domestic interest rate would fall, leading to a currency depreciation, and a deviation from the pegged exchange rate. There are two important points:

- *The monetary authority must intervene with foreign exchange sales/purchases when, for any reason, the exchange rate starts deviating from the pegged rate.* [15]
- *There is no role for stabilizing monetary policy here, since via the rule above, all monetary policy is subordinated to defending the peg. If a country wishes to increase the money supply, the home country must devalue (set a lower peg).*
- *If a country runs out of foreign exchange reserves, it cannot meet it's pledge to maintain the pegged rate. The central bank always needs a stock of reserves to be able to buy domestic currency so as to protect its value.*

12.3.1 Costs and Benefits

The main drawback of a fixed exchange rate is the effective loss of monetary policy (or *"monetary sovereignity"*). Seigniorage revenues are now also severely constricted. However, domestic inflation can lead to a lack of competitiveness if the exchange rate is fixed since the true measure of competitiveness, the real exchange rate, $\epsilon = \frac{EP}{P^*}$ rises and we have an *overvaluation.* Given that E is fixed, there can be no offsetting depreciation of the currency (as PPP would dictate) The *real* appreciation leads to trade/current account deficits and a deteriorating net foreign asset position. [16]
The overriding gain is *credibility.* If the central bank is following the monetary rule, then its flexibility is severely restrained and it cannot resort to printing grand sums of money to finance excessive deficits. So it should also lead to fiscal prudence. Not surprisingly, many countries who do peg their exchange rates are those who have a history of financial profligacy and who have lost the trust of the financial markets. Also, a stable exchange rate can promote trade, investment and financial stability, in general.

12.4 Currency Crises

Fixed exchange rate regimes are invariably fickle and are highly prone to collapse and *speculative attack. The main idea is the is that a country must maintain sufficient reserves to be able to defend the peg. A government must be pursuing policies consistent with the discipline imposed by the peg and the peg must be suited to the*

[14]This does permit some seigniorage revenues under *fixed exchange rate regimes*, but only very small amounts. Large seigniorage revenues are simply inconsistent with the peg, since they lead to lower interest rates and a depreciation of the exchange rate away from the peg.

[15]Suppose investors are withdrawing funds from the home country (due to greater perceived riskiness on assets) and selling its currency on the foreign exchange markets so as to buy other currencies. By basic supply and demand, this puts downward pressure on the exchange rate. Then to maintain the exchange rate the central bank must sell foreign exchange and buy up dollars, to strengthen it on the forex markets. This cannot go on forever since the central bank has only a limited supply of reserves.

[16]However, note that if PPP held (unlikely) then, by arbitrage, we couldnt have different inflation rates in both countries. Mathematically:

$$0 = \hat{E} = \pi^W - \pi \Rightarrow \pi = \pi^W \tag{78}$$

country. The rigidity imposed by the peg, then, must not be *too* severe. If the country to which it is pegged has an exchange rate appreciation, then to maintain the peg the pegging country will have to buy domestic currency with foreign exchange reserves to strengthen its currency too. However a strong currency may well cripple its export industry, especially if the country is relatively open to trade. Investors will rightly discern that such a situation cannot last and will simply bailout. On a similar theme, if the monetary constraint is overly burdensome, then the government will have to run excessive fiscal deficits. These, too, cannot be maintained and signify that the peg is unsustainable. Investors will quickly start to bailout of the country and sell its assets for fear of default etc. They will see that the policies are unsustainable and will rightly predict that, at some stage, the country will have to leave the peg and subsequently devalue. In bailing out of the country, investors go to the central bank, sell the domestic currency and receive the now "safer" foreign currency and then flee - so-called *capital flight. But in the process the central bank's foreign exchange reserves are being depleted.* This is the the dynamic behind a *currency crisis.* In essence, *crisis is simply the market's way of telling a government that it's policies aren't sustainable.* In other words, if the financial market smell trouble, there *will* be trouble. However, in the Asian crisis in 1997, it didn't play out exactly like this. That crisis was, in the main, self-fulfilling and prompted by *investor herding.* In many countries, for hardly no substantive reasons at all, investors started bailing out, leading the currency pegs to collapse, one after the other. Thailand was the first to go, and was attacked merely for a fall in its stockmarket and the perception that many banks had made suspect, dud loans, thereby eroding confidence in the banking system. Then investors deemed other Asian countries to be equally vulnerable (since they had similar suspect banking systems) and the crisis spread -"contagian", as it's called. All countries subsequently experienced large devaluations but had export-led V-shaped recoveries. In Mexico, the so-called "*Tequila crisis*" was caused by a sequence of political assassinations, which naturally led investors to flee and to an attendant collapse in foreign exchange reserves.

Currency Mismatch exacerbates currency crises, and this was a notable feature of the Asian crisis. Crises usually end with substantial depreciations of the exchange rate after the peg is broken. This proves fatal for a country that has its liabilities (borrowing) in dollars, since their value in the depreciated domestic currency soars. To make matters worse, the country may have its assets (loans) all in the depreciated domestic currency. This leads to enormous problems for the banking system (many becoming insolvent) and firms and this was a big issue in the Asian crisis. Also there is a problem of *maturity mismatch* in that many firms had borrowed short-term and had to repay loans just after the domestic currency depreciation. However, many of the same firms had lent money with long term maturities, so they weren't able to obtain any money immediately to pay their soaring debts. Mismatch leads to *financial fragility*, since the banking system remains very vulnerable and fragile. Another factor is *currency mismatch.* Suppose a country has a stock of assets denominated in the domestic currency and a stock of liabilities denominated in a foreign currency. In many cases, countries tried to defend their currencies by temporarily raising interest rates to attract investors back, but this typically only led to deep, contractions within the countries and only temporary respite from the *capital flight.*

A *currency board* backs the domestic money supply $1-1$ with the currency to which it is pegging, usually the dollar. The central bank strictly cannot print money since everything must be backed (by law) $1-1$ by the foreign currency, so it *must* renounce seigniorage. Hence the central bank cannot print money so as to act as *lender of last resort* (i.e to bail out banks). A board by definition always has sufficient reserves to meet market demands, so it immunized against the kind of speculative (and otherwise) attacks outlined above. A currency board collapses if its maintenance proves unduly difficult and onerous for the country in question. Argentina (which has a history of hyperinflation) had a currency board up until last year, when it collapsed. The prime reason for its failure was an excessive budget deficit and the strong dollar to which it was pegged, which wreaked havoc with its trade balance. This scenario was clearly untenable and the board invariably collapsed. Finally, dollarization is just complete, irrevocable conversion to dollars. Can't really "collapse" like a currency board, so highly credible.

13 Epilogue

Economists are not like normal people. For many years now, I've studied and observed them, their little idiosyncracies and mores, much like the way they study animals on nature programs. Its not that they don't eat, sleep or do any of the things normal people do, its the way economists *think* that sets them aside. For instance, a normal Californian might react to a cut in the interest rate by exclaiming that its "pretty cool (dood)". An economist would never perceive it like that, retorting that it all really depends on whether we are above or below potential growth and whether the Taylor rule has been invoked with due expedience. The economist lives by his Phillips curve and he knows well the damage wrought by stimulating an economy beyond its means. In this vein, I've noticed that the economist is a congenital pessimist, always circumspect vis à vis good news and booms in general; its just the way he's made. He cant help it, its in his blood. While most normal people regarded all the "new economy" talk of the nineties as "pretty hip", your average economist again saw it in a wholly different light. To him, this was a shock that would yield a level effect *and* a *permanent* growth effect. A permanent growth effect is like cocaine to your typical economist; *manna from heaven* is enough to give him highs for weeks. Your ordinary American would regard a fiscal contraction as something that "sucks". The economist of course construes it quite differently. He sees first an instant inward shift of the *IS* curve, but (and here's the punch) he also discerns a contemporaneous shift back out (but of indeterminate magnitude.) Here, too, the economist takes a completely contrarian view. For the economist, a fiscal contraction, *ceterus paribus*, heralds in general lower future tax rates. And he quickly discerns mighty expansionary effects here, as he contemplates the mother of all his theories kicking in; the *permanent income hypothesis.* I don't think normal people construe contractions in this light, I just don't think, in normal circumstances, they spot the attendant rise in the presented discounted value of wealth. But who am I to say?

Economists are a most heterogenous group. Just like animals, there are various breeds and species. Growth economists are a fairly sedate bunch, seeing the economy permanently tracking a *balanced growth path* (with y growing at exponential rate g); his *bgp* is sacrosanct - sacred and inviolable. A business cycle economist quails at this; he's a different creature altogether, much more dynamic, instead seeing the economy as whirling around permanently, tracking an endless π-Gap spiral curve (with infinitely many loops). His beloved π-Gap spirals are his heart's darling, his *raison d'etre*; he'd be nothing were it not for those loops. But these are surely decidedly *unbalanced* and herein lies a stark bone of contention. Such profoundly dissimilar and (apparently) irreconcilable viewpoints are obviously a source of enmity and bitter tension between both sects. Some time back, trying to reconcile both stories, I surmised to to a normal person that perhaps the US economy is just like the earth spinning round the sun. It's possible surely for the economy to simultaneously whirl *and* proceed along a stable trajectory at the same time. Though he opined my views of the world were certainly "unique", I was sure I heard him mumble the words "pretty screwed up". Though we haven't met since, I don't think he got it, but, neither, really, did I. Don't get me wrong, though, there are other obscure subspecies of these species too. Within the growth sect, those disposed to the standard *Romer* type framework believe, for instance, that long run growth of y is *increasing* in n, population growth. Those more disposed to the *Solow* model with natural resources just can't take this; they see long run growth as *decreasing* in n. And those with a penchant for the plain ol' *Solow* model believe that long run growth is *independent* of n. It's confused and blurred. It's weird. It's anything but clarity. Real business cycle economists in the Chicago freshwater tradition, for instance, maintain the conviction that the business cycle is attributable to fluctuations in potential. Those with more Keynesian, aquatic tendencies see the business cycle as fluctuations of demand around a *fixed* potential. This, too, hardly smacks of consensus. Man, oh man, I was a math major and never recall things ever being like this. While mathematicians are hardly normal themselves, at least they're homogeneous in their abnormality. I mean, when normal people ask questions on matters, they generally (I think) seek one definitive, plain answer, something that offers some guidance, some direction. They generally don't get it when economists offer *all* possible answers. There, too, is where I just lose it. Incidentally, they say, you know, the only thing we know for sure in macro is how to create a hyperinflation... and they'd be right.

Through these notes, I've sought was to make your descension into abnormality a little easier, to facilitate the transition, as it were, to open a window to this bizarre, perverted, surreal world. To help you *think* like an economist, to help you see this place for what it really is, to help you see what I see. I was out to corrupt and destroy you. Plain and simple.