Much of macroeconomics consists of establishing cause-and-effect relationships between various economic aggregates. It can be helpful to think about these relationships using a flowchart.

When we think there is some regular pattern linking two observable quantities, we say there is a *functional relationship* between them. Much of macroeconomics consists of describing and explaining the most important functional relationships between *economic aggregates* like output, inflation, and unemployment. It's important to distinguish statements about functional relationships among variables, from statements about the variables themselves. When I say that one variable tends to rise when another falls, I'm not saying that either one actually is rising or falling. Rather, I'm describing a pattern we can observe over an extended period in which the variables sometimes rise and sometimes fall.

For example, Okun's law says that an additional point of economic growth, sustained over one year, will probably be associated with a one-point decline in the unemployment rate:

$$\Delta U = -0.5(g - 2.5)$$

This equation doesn't say what the change in the unemployment rate (ΔU) or the growth rate (g) actually are. Rather, it describes a *function* linking the two. It says that *if* growth is high, unemployment is probably falling; and *if* growth is low or negative, unemployment is probably rising. So if you have an idea about what will happen to one of the variables, you can make a good guess about what must happen to the other. The numbers that appear in a function like this are called its *parameters*.

With most functional relationships, we have an idea about which variable is cause and which is effect. In the case of output and unemployment, we think that unemployed people get jobs because more stuff is being purchased and produced. The *direction of causality* is from output to unemployment. It can be helpful to present these causal links in a flowchart, so we can see at a glance how a change in one aggregate affects others, both directly or indirectly. You often find flowchart diagrams similar to the one here in the documentation of the macroeconomic models used by professional forecasters in government and business.

In this class, we will look at a number of flowcharts presenting the causal links between various macroeconomic aggregates. In these flowcharts, the *targets* of macroeconomic policy are in bold to help focus attention on the outcomes that normally guide policy decisions. Where an increase in one variable causes a decrease in another, I place a small minus sign (-) next to the line.

Many causal relationships have names. Here we see that the link from investment to output is called the *multiplier*, the link from output to investment is called the *accelerator*, and the link from output to unemployment is called *Okun's law*.[1] The *Phillips curve* is often used to refer to the link from output to inflation, which may take place via unemployment and wages, or by some other channel. Some of these links, like Okun's law, can be *quantified* – that is, we can make a definite prediction, based on statistical evidence, for how much one variable will change in response to a given change in the other. For other links, we have an idea of the direction of the resulting change but we can't put an exact number on it.

[1] Strictly speaking, the accelerator describes a link from the growth of output to investment, but we can ignore that detail here.

When a change in one variable produces changes in other variables that induce further change in the first variable, that is called a feedback loop. Feedback loops may be negative or positive.

When we see a loop on a flowchart, that means that a change in one variable will affect other variables in a way that results in a further change in the first variable. This is called a *feedback loop*. Positive feedbacks are cases when an increase in a variable leads, via other variables, to a further increase; negative feedbacks are cases where an initial increase leads, via other variables, to a decrease back toward the original variable. Another way of describing this is that when there is a positive feedback, a change in the variable is *amplified*, while when there is a negative feedback, a change in the variable is *dampened*.

A fundamental challenge in thinking about the economy is that, in reality, everything is connected to everything else. but to be able

to tell a coherent story or build a usable model, we need to focus on a few relationships and ignore the others. And this task is made harder by the fact that relative strength of the different relationships varies depending on the country and the historical period, and on the length of time we are interested in. So it is never a question of finding the "right" model, but only the best one for a partcular purpose. As Keynes wrote,

> Economics is a science of thinking in terms of models joined to the art of choosing models which are relevant to the contemporary world. It is compelled to be this, because, unlike the typical natural science, the material to which it is applied is, in too many respects, not homogeneous through time... Good economists are scarce because the gift for using "vigilant observation" to choose good models, although it does not require a highly specialised intellectual technique, appears to be a very rare one.

Orthodox macroeconomics focuses on one particular causal chain – from interest rates, to investment, to output, to unemployment, to wages, to inflation.

In recent years, macroeconomic policy has been conducted primarily by central banks. By law or in practice, central bankers' top concern in normal times is low and stable inflation. And while central banks have many tools with which to influence the financial system and the larger economy, their primary tool in recent decades has been changes in the short-term interest rate that they more or less directly control. As a result, macroeconomics textbooks have come to focus on one particular causal chain – from interest rates, to investment, to output, to unemployment, to wages, to inflation.

We will be exploring this chain in more detail later, but here is a summary.

1. The central bank takes actions (we'll talk later about what exactly) to change the *policy rate* of interest – in this case, the *Federal funds rate*, the interest rate banks charge each other for very short-term loans.

2. Changes to the Federal funds rate are passed on to other rates of interest, including the rates offered to nonfinancial businesses and households.

3. Changes in the rate of interest affect businesses' decisions about how much to borrow and invest. When interest rates fall, businesses borrow and invest more; when interest rates rise, they borrow and invest less.

4. Changes to business investment affect the total lev el of spending in the economy. An additional dollar of investment normally produces more than one additional dollar of total spending. The ratio between the increase in investment and the total resulting increase in GDP is called the *multiplier*.

5. Higher GDP reduces unemployment, as described by Okun's law. Lower GDP, similarly, increases unemployment.

6. Lower unemployment tends to raise wages, as workers have more bargaining power relative to employers. Higher unemployment tends to reduce wages.

7. Changes in wages tend to get passed on to other prices. In the simplest version of this story, businesses simply set their prices as a fixed *markup* over wages. So when wages rise faster, inflation will be higher; when wages rise more slowly, inflation will be lower.

This standard story captures several important facts about the world. First, it is true that there is often a close link between output, unemployment and inflation. *Expansionary* policy tends to raise output and inflation, and reduce unemployment. *Contractionary* policy does the opposite, reducing output and inflation and raising unemployment. Second, the component of output that varies most of the business cycle is investment. Booms and busts usually result from rises and falls in investment spending. Consumption and government spending tend to follow the overall state of the economy; they don't normally drive it. And in the US, net exports are too small to play a central role in the business cycle. (In other countries they are more important.) Third, credit conditions are one of the three main factors affecting business investment. And finally, macroeconomic policy is normally carried out by a central bank trying to make credit more or less available, as measured by the prevailing interest rate.

But while the standard story describes one important piece of the picture, in the real world things are more complicated. First, the central bank does not have perfect control over the actual terms on which businesses and households can borrow. There are many interest rates in the economy, and they do not all move in lockstep. And the interest rate is not the whole story – most businesses and households cannot borrow as much as they want at the prevailing interest rate, so the terms on which credit is available matter as well as its price. Second, monetary policy may work through other channels besides business borrowing. Households also borrow; in fact, mortgage borrowing may be more sensitive to monetary policy than is borrowing for investment. And as we'll see, changes in the policy interest

rate also can have important effects on *asset prices* and on the *exchange rate* with other currencies. Third, there are many other factors beside credit conditions that influence flows of spending in the economy. Investment often rises or falls for reasons that have nothing to do with monetary policy.

Nonetheless, it's important to understand the standard story, partly because of the important element of truth in it, and partly because it is how most macroeconomic policymakers, at central banks and elsewhere, talk about their decisions.

Investment is also strongly influenced by profits and by demand. Both these relationships create feedback loops, which may be important in business cycles.

Credit conditions are certainly important for business investment. But so are two other factors – profitability, and demand. In general, a business will expand only if it can sell profitably at current costs and prices, *and* if it is fully using its current plant and equipment, *and* if it can get the funds it needs to expand. While macroeconomic theory often focuses on the third factor, all three may be important in explaining the variation in investment that produces booms and busts in the economy.

The multiplier-accelerator theory explains macroeconomic fluctuations in terms of the positive feedback loop between investment and output growth.

The link from output to investment is called the *accelerator*. Strictly speaking, the accelerator relationship says that the level of investment tends to be determined by the increase in output, as opposed to the level – businesses are likely to expand only when demand for their products increases beyond the level they can meet with their existing capacity. As you can see, there is a positive feedback loop linking investment to output via the multiplier, and output to investment via the accelerator. In this story, a rise in investment spending by businesses increases incomes for their workers, and for other businesses they purchase inputs from. This leads to higher spending, and businesses increase investment to meet the new demand. Higher investment increases incomes in turn. This process continues until something interrupts the increase in investment – perhaps *supply constraints*, perhaps a fall in profitability or a shift toward more pessimistic *expectations* about future demand or profits. But when investment falls, the multiplier means that total spending falls more, leaving other businesses with excess capacity and causing investment to fall still further. This process continues until either new investment

drops to zero and cannot fall any further (as happened in the 1930s) or until something intervenes to boost demand – perhaps a shift toward more *expansionary* policy by the central bank. Then investment and output begin to rise again.

This loop was first described by the British economist Roy Harrod in the 1940s, and was the most important theory of business cycles in the 1950s and 1960s. Harrod pointed out that there will be some combination of investment output growth that can remain constant, but if the economy moves away from that stable point, the multiplier-accelerator feedback loop tends to carry it even further away. Harrod described this problem of instability as the *knife edge*. While the multiplier-accelerator feedback loops is not as central in macroeconomic thought, as it once was, it can still be a useful way of thinking about why modern economies tend to go through recurring booms and busts rather than growing steadily.

The Goodwin cycle describes macroeconomic fluctuations in terms of the feedback between investment, on the one hand, and the distribution of output between workers and capital-owners, on the other.

The third important factor affecting investment, in addition to credit conditions and demand, is profitability. This is the focus of a third story about macroeconomic instability. Now we are interested in the feedback loop from investment, to output, to unemployment, to the distribution between wages and profits, and back to investment. The story here is that a rise in investment leads to higher investment, which in turn brings down unemployment and, by improving workers' bargaining position, raises wages. So far this is the same as the standard story. But here, instead of assuming that higher nominal wages just lead to higher inflation, leaving real wages and the *wage share* unchanged, we think that higher wages increase workers' share of the total product at the expense of capital-owners'. A lower share of output going to owners normally means a lower profit rate. And if profits fall enough, that will discourage further investment, bringing output back down and unemployment back up. Here, we are looking at a negative feedback loop, but that does not guarantee that the system will reach a stable *equilibrium*; instead, it may show repeated cycles.

This type of feedback loop is called a *Goodwin cycle*, after Richard Goodwin. Goodwin cycles are primarily discussed by Marxist economists, since they focus more on the conflict between workers and owners than most other economists do. But there is good reason to think that these type of cycles play an important role in real economies. It is a statistical fact that profit rates almost always decline late in

expansion, and investment spending then follows them down.

"The Phillips curve" normally refers to the relationship between output and inflation, but it is also sometimes used to mean just part of that relationship.

The *Phillips curve* usually refers to the link from output to inflation, which may take place via but it is also often used to mean the link from unemployment to inflation. When the Phillips curve is drawn on a graph, it is drawn with the inflation rate (or price level) on the vertical axis, and either output (GDP) or unemployment on the horizontal axis. If output is on the horizontal axis, the curve slopes upward, to show that inflation tends to rise with output; if unemployment is on the horizontal axis, the curve slopes downward, to show that inflation tends to fall when unemployment rises.[2] A steep Phillips curve means that inflation will change a lot in response to a small change in output or unemployment; a flat or shallow Phillips curve means that inflation changes on a little in response to output or unemployment.

    Unlike Okun's law, the Phillips curve there does not seem to have stable parameters. How much additional inflation you get for a one point acceleration in GDP growth, or a one point fall in unemployment, depends on the current values of the variables, as well as on the country and historical period we are looking at, and how long a time period we are interested in. Many economists believe that the curve is steeper over long periods. That is, one year of high GDP growth may not raise inflation very much at all, but if the high growth rate is sustained year after year, eventually inflation will rise. Some economists believe that the Phillips curve is vertical in the very long run – that is, there is only one level of unemployment that is consistent with constant inflation. This unique unemployment rate is called the *natural rate of unemployment* or *Non Accelerating Inflation Rate of Unemployment* (NAIRU). In the 1990s, economists and policymakers put a lot of energy into trying to determine the NAIRU so that central banks could try to hold unemployment at that level. But the concept has become less popular since then – most economists no longer believe that there is one unique level of unemployment at which inflation is stable. But the more general idea of the Phillips curve – that lower unemployment tends to lead to higher inflation, and high unemployment to low inflation or deflation – continues to be widely accepted.

[2] When the curve was first drawn by New Zealand economist A. W. Phillips in the 1950s, he was looking only at the link from unemployment to nominal wage growth. Today, the link from unemployment to wages is sometimes called the *wage curve*.