1 Internal and External Balance[1]

Section 19.1 of Chapter 19 in the textbook has a good discussion of internal vs external balance. If you have not yet read that section, you may want to do so before reading the rest of this note (even though this note is self-contained and should be understandable without having read Chapter 8).

Our initial understanding of internal vs external balance will require very few assumptions. In some sense, that is great: the fewer the assumptions, the more general we hope our model can be. On the other hand, we will be able to understand fewer things than if we had a more comprehensive model. After this first pass that requires few assumptions, we will return to the AA-DD and use it to reach sharper conclusions that have the same overall message.

Therefore, we now work under the following assumptions:

- There is a long-run level of output that coincides with the full-employment level Y^f. This means that, absent any changes, output Y will approach its full-employment level Y^f. Government policy can make the convergence of Y toward Y^f faster or slower, but it cannot change Y^f. In addition, given that Y^f is the "full-employment level" (whatever that means!), any deviations of Y from Y^f are undesirable for the people who live in this economy.
- There is a long-run level of the current account that is "sustainable", which we denote by XX^b. Sustainable means that, absent any changes, the current account CA:
  - will approach XX^b over time,
  - remains at XX^b once it gets there, and
  - has XX^b as a desirable value for reasons that we leave unspecified; perhaps sustainability itself is a worthy goal, or perhaps there is a good economic reason why people may prefer XX^b to other levels.

[1]This chapter is based on: Roberto Rigobon, "15.014 Applied Macro- and International Economics II", Spring 2016. License: Creative Commons BY-NC-SA.

Given these three assumptions, an economy that has $Y = Y^f$ and $CA = XX^b$ is in its happy place. Our next task is to understand what combinations of output and exchange rates (Y, E) are compatible with $Y = Y^f$ and $CA = XX^b$ in the short run, that is, when the price level P is fixed.

1.1 The II Curve

In this section, we introduce the II curve. The II curve is the set of points (Y, E) that are consistent with full employment in the short run, i.e., the set of points that have $Y = Y^f$ and any E. As Figure 1.1 shows, the II curve is vertical.

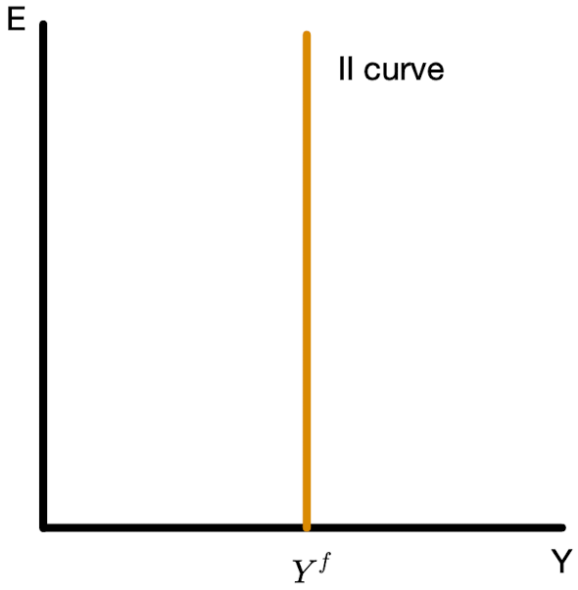

Figure 1.1:

1.2 Internal Balance

When the economy is at $Y = Y^f$, we say it is in "internal balance". At $Y = Y^f$, there is no reason for a policymaker to try to stimulate or cool down the economy in the short run. We have been referring to Y^f as the full-employment level, but there are closely related terms that describe the same idea: the "natural level of output", the "non-accelerating-inflation level of output", the "potential level of output". At $Y = Y^f$, the economy is operating at an efficient and non-inflationary level. Associated with this full-employment level of output is a

"natural rate of unemployment", u^n, defined as the rate of unemployment that is consistent with $Y = Y^f$ and a constant price level P^f. Let L be the economy's workforce and N be the number of people in the workforce that are employed. Then the unemployment rate is defined by

$$u = \frac{L - N}{L}. \tag{1.1}$$

If we assume that the only factor of production is labor[2] and that the economy's aggregate production function is

$$Y = N,$$

then the natural rate of unemployment and the "full-employment" level of output are related by

$$u^n = 1 - \frac{Y^f}{L}.$$

Figure 1.2 shows a representation of the adjustment dynamics for the economy as time goes by. The arrows point toward the II line to signify that there is an economic force (as of now unspecified) that tends to move the economy toward Y^f.

When $Y > Y^f$, we describe the situation as one of "overheating". Compared to the more desirable state in which $Y = Y^f$, people are working overtime, inflation is too high, and other resources are being used "above capacity", which can result in higher overall output but with lower productivity and faster capital depreciation.

When $Y < Y^f$, we describe the situation as "unemployment". People would like to work more, there is idle capacity or underutilization of resources, and inflation is too low.

[2]This is not as restrictive as it sounds: we are assuming that labor is the only factor of production that adjusts within the time horizons we are considering and ignoring the other factors because they remain unchanged.

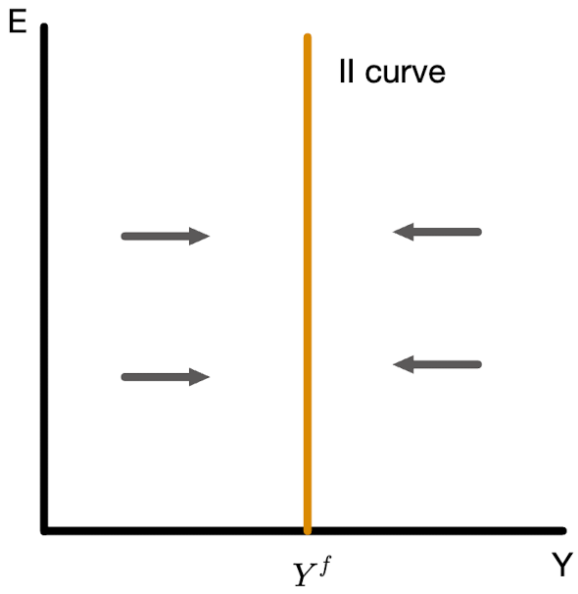

Figure 1.2:

1.3 The XX Curve

The XX curve is the set of points (Y, E) that keep the current account constant and equal to a given value XX in the short run (with P fixed):

$$XX = CA\left(\frac{EP^*}{P}, Y, Y^*\right) \tag{1.2}$$

We already encountered the XX curve in the context of the AA-DD model. When plotted in a diagram with Y in the horizontal axis and E on the vertical axis, it is increasing. We know it is increasing because CA is increasing in E and decreasing in Y (keeping P, P^*, Y^* constant).

We now want to have deeper economic understanding of why the XX is increasing. Figure 1.3 shows an arbitrary starting point (Y_0, E_0).

The value of CA at that point is XX_0, so we have that:

$$XX_0 = CA\left(\frac{E_0P^*}{P}, Y_0, Y^*\right)$$

Imagine that there is a nominal depreciation that keeps output fixed: from (Y_0, E_0) we move to (Y_0, E_1) with $E_1 > E_0$. In the short run, P and P^* are fixed, so the nominal depreciation

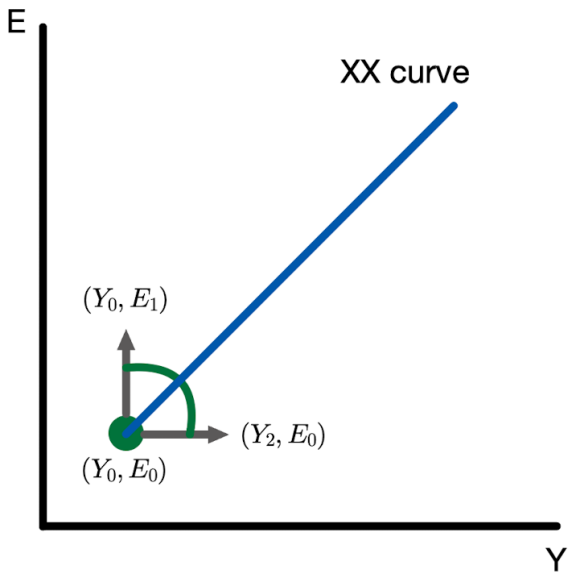

Figure 1.3:

is also a real depreciation. Domestic goods have become cheaper relative to foreign goods. Imports go down, exports go up, and the current account improves (goes up). So when we start at (Y_0, E_0) and move north in the Figure 1.3, CA goes up.

Now imagine a different change that keeps the exchange rate fixed but increases output: from (Y_0, E_0) we move to (Y_2, E_0) with $Y_2 > Y_0$. Higher Y implies that there is a higher demand for foreign goods. Imports go up and the current account deteriorates (goes down). So when we start at (Y_0, E_0) and move east in Figure 1.3, CA goes down.

Going north we have a situation of higher CA, while going east leads to a lower CA. If we move from the point (Y_0, E_1) to the point (Y_2, E_0), we must cross a point of zero change in CA. Said differently, you can always find a combination of movements to the north and to the east that lead to no change in CA. This point of no change in CA to the northeast of (Y_0, E_0) must therefore be on the same XX curve as (Y_0, E_0), which in this case is the one that has $CA = XX_0$.

If we connect all the points that give us a zero change in CA, we trace the entire XX curve. We have found that movements along the XX curve keep CA unchanged because the improvement in CA due to a real depreciation (the movement to the north) is exactly

offset by a deterioration in CA due to increased imports that were caused by higher income[3].

1.4 External Balance

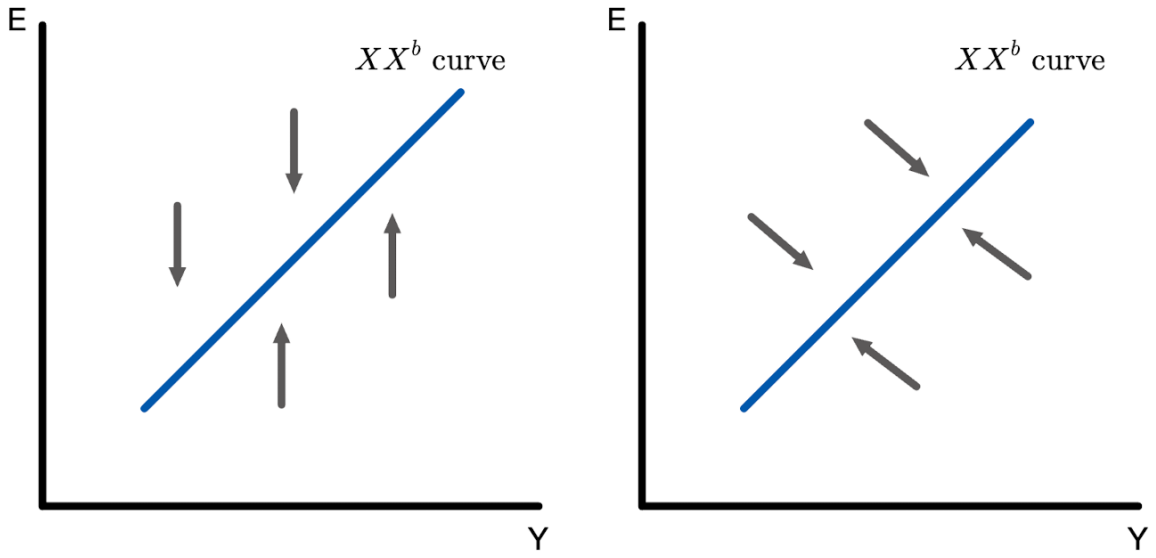

Figure 1.4:

We define external balance as the situation in which the current account is at its sustainable level XX^b. Figure 1.4 depicts the dynamics of convergence toward XX^b. First, the figure shows the XX curve with an associated value of the current account equal to XX^b. For any combination of points (Y, E) above this XX^b, the current account is higher than XX^b. In this case, the figure shows arrows that point down and toward the curve to signify dynamics that, over time, make the current account decrease toward XX^b. Similarly, for points below the XX^b curve that have a current account lower than XX^b, the left panel of the figure shows arrows pointing up and toward the curve, to signify dynamics that make the current account increase toward XX^b. Arrows that point straight up and straight down are not the only possibility. Indeed, the adjustment toward XX^b does not have to occur only through the exchange rate and can occur through combinations of E and Y. The right panel of Figure 1.4 shows an example in which E and Y are both changing as the adjustment takes place. The arrows point toward the XX^b curve at some angle rather than vertically up and

[3]Remember that Y is both aggregate output and aggregate income. That aggregate output equals aggregate income is an accounting identity. If you don't recall this relation, go back to your notes from intermediate macro or our quick review of this issue in the lecture slides on National Accounts.

down, as in the right panel of the figure.

The lack of specificity about how the adjustment toward XX^b is one of the drawbacks of this simple model vis-a-vis a model with more structure such as the AA-DD.

When the current account is above XX^b, we say that the economy is in a situation of "surplus", while when the current account is lower than XX^b, we say that the economy is in a situation of "deficit". Here the word deficit refers to a *current account* deficit (relative to the level XX^b) and not a *fiscal* deficit. A fiscal deficit is characterized by government purchases larger than taxes, $G > T$, while the current account deficit is characterized by $CA < XX^b$. While current account and fiscal deficits are not the same thing, we do see in the real world that persistent domestic fiscal deficits are often sustained, at least in part, by borrowing from the rest of the world, which brings the current account down.[4]

1.5 The Four Zones of Economic Discomfort

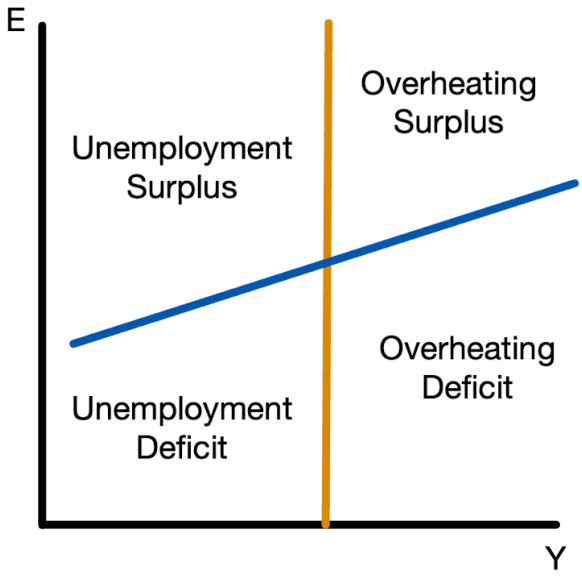

Figure 1.5:

Figure 1.5 shows the result of putting Figures 1.2 and 1.4 together. We can use this figure to diagnose the state of the economy belonging to one of the four "zones of economic dis-

[4]Recall that if S^p is private saving, $S^g \equiv T - G$ is public saving, and I is investment, then $S^p + S^g = I + CA$. For given S^p and I, higher public saving (equivalently, lower public deficit) is associated with a lower current account.

comfort". In each of these zones, we have an absence of internal of external balance of a different kind. For example, the south-east zone represents an overheating economy with current account deficits, while the north-east zone has overheating and surplus.

We can also combine the dynamics from Figures 1.2 and 1.4, as is done in Figure 1.6. An important question is how long it takes for an economy to trace the whole path in the real world.

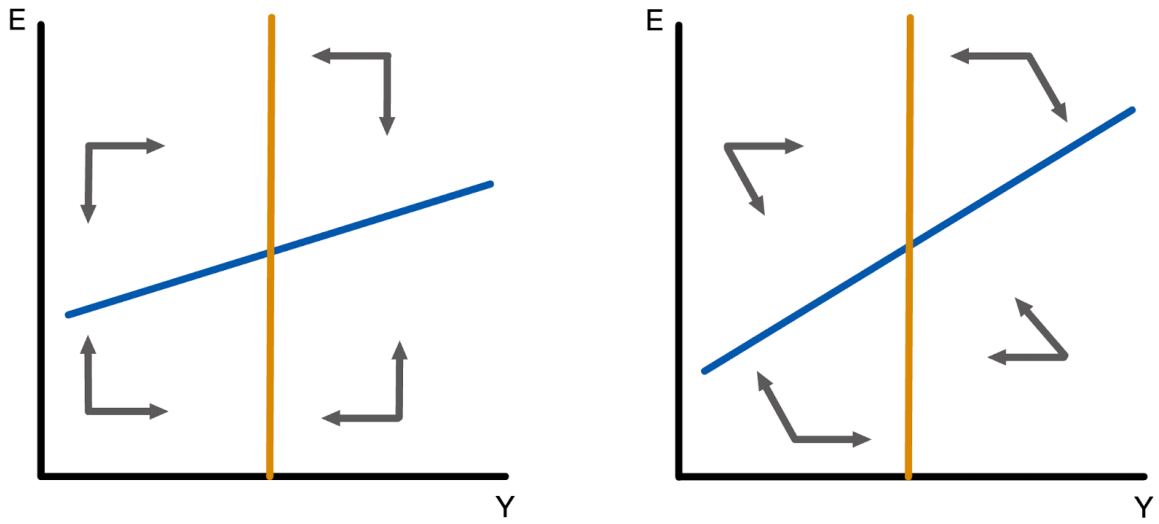

Figure 1.6:

Without any policy intervention, the answer is that it can take many years. Policy intervention, if appropriate, can speed up the convergence toward the long-run equilibrium. However, the effects of policy also take time to be felt in the economy. In the United States, monetary policy actions usually start to have an effect on output and the current account after a few months, and have their largest effect between one and two years after the actions are taken. Fiscal policy can be faster or slower, depending on the nature of the policy. For example, one would expect that mailing stimulus checks to households would have a faster effect than increasing spending on education. The *nominal* exchange rate usually adjusts more rapidly. In the context of the AA-DD model, the convergence to the long-run was assumed to happen "monotonically", that is, with Y and E always moving in one direction between the short run and the long run. With a slower adjustment along the Y or the E directions, or with different ways to converge to XX^b, the resulting dynamics can

be very different. Figure 2.1 shows three possible cases. On the left panel, we have the type of monotonic adjustment that was commonplace in the AA-DD framework. The middle panel shows a transition from overheating to unemployment, and the right panel shows a transition from deficit to surplus.

2 The Latin Triangle

We can extend our framework to include social constraints. We will model these social constraints by assuming that there is a level of the real wage above which there is "social peace" and below which there is "social unrest". When there is social peace, there is little social pressure exerted on the government to enact reform or significantly change course. Social unrest, on the other hand, is a situation in which people's standard of living is not acceptable, prompting society to make demands on the government. There are many levels of social unrest: from just complaining, to demonstrations, to riots, to revolution. Our way to capture social constraints is, of course, an extreme simplification of much more multidimensional and complicated issues. But even with its simplicity, we will gain what I think is valuable insight.

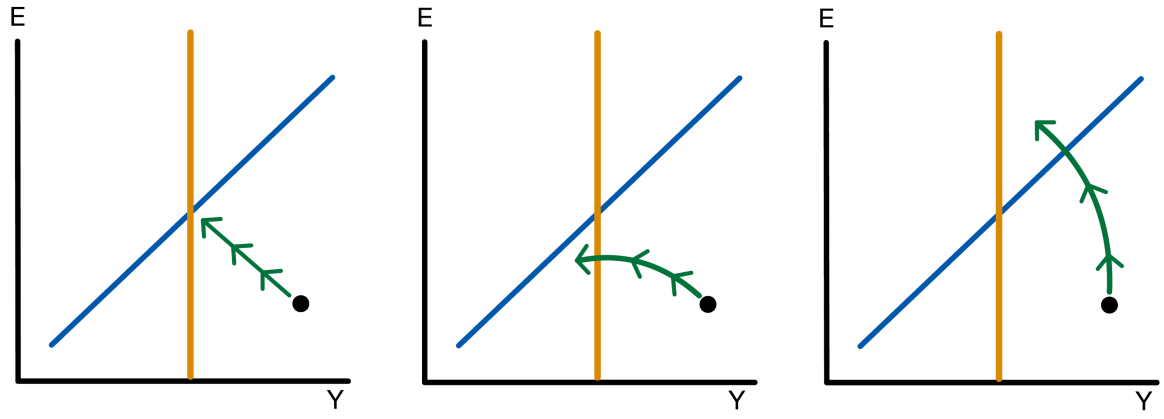

Figure 2.1:

2.1 Social Peace Line

Figure 2.2 plots the social peace curve SP as a function of output Y and the real exchange rate q. To interpret this SP curve, we first note that the real wage and the real exchange

rate are inversely related[5], so moving north in the figure implies lower real wages. Social peace occurs when the economy is below the SP curve, and social unrest when the economy is above the SP curve. If social peace is achieved at a high enough real wage independent of the level of Y, the SP curve is flat.

In general, however, we can easily imagine an upward sloping SP curve. It is reasonable to assume that people may be equally happy with a lower real wage if Y is higher. For example, people may be equally happy if they have a lower real wage but the government provides better healthcare (which makes Y go up through higher G). Of course, there is a question about how to finance such change, but the social peace line is not about financing; that is what the XX is for. Here we are mostly interested in happiness. Another reason for an increasing SP curve is that people dislike to live in an economy with higher unemployment (which in our framework means low Y) for a given level of the real wage. Nevertheless, a flat SP curve suffices to make the points we want to make, and makes everything simple, so we assume the SP is flat. In addition, any aspects that we have explicitly omitted can be incorporated as "shifters" of the SP curve. Therefore, even though the schedule only depends on real wages, changes in inequality, quality of democracy, legitimacy of the government, corruption, crime, freedom of speech, etc., can be analyzed by shifting the SP curve.

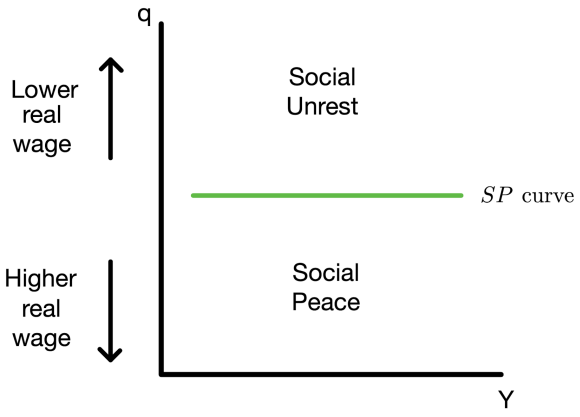

Figure 2.2:

The next step is to put the SP curve together with the II-XX framework. Where does the

[5]Technically, the *expected* real wage is inversely proportional to the real exchange rate. See Appendix 1 for details.

SP curve lie? Above, below, or through the intersection of the II and XX curves? Nothing forces the SP curve to cross at exactly the same point at which II and XX intersect.

The most interesting case is when the SP curve is below the long-run equilibrium. In Figure 2.3, we show the three curves together. Although we now have q rather than E on the vertical axis, the shapes of the II and XX curves remain unchanged since we keep P fixed (and P^* is exogenous). There are three points of intersection. At point A, the economy has internal and external balance, but real wages are too low and citizens are rioting. At point B, wages are high enough for social peace, external balance is achieved, but the economy is not in internal balance and has unemployment. Finally, at point C, wages are high enough to achieve social peace, the economy achieves internal balance, but there is external imbalance with a current account deficit.

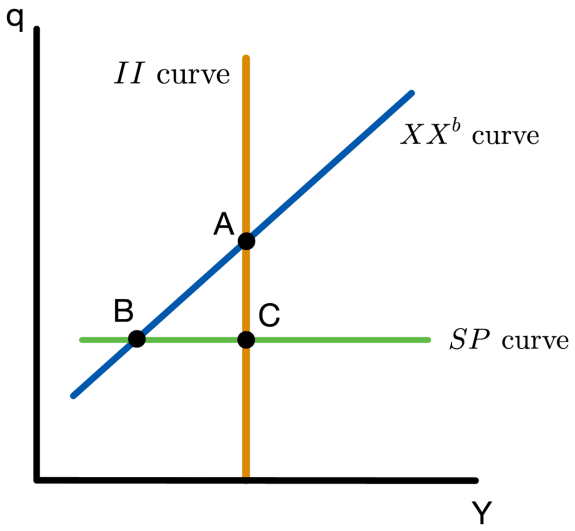

Figure 2.3:

These three points highlight the conflict between social and economic objectives. We can give some more evocative labels to the three points: point A is the *IMF equilibrium*, point B is *Europe*, and point C is *Populism*. Each of the three options has a problem. In the IMF equilibrium, the economic equilibrium has been achieved, but socially and politically, the situation is unsustainable. In Europe, even though salaries are high, standards of living are high, and the current account is in balance, the labor market exhibits significant unemployment. So, wages are high, but only for the those who actually have a job. Finally, in

Populism, wages are high and unemployment is low, but this is at the expense of a significant current account deficit. Borrowing from the rest of the world is needed to keep the economy at this level of demand and exchange rates, and borrowing that much forever is not sustainable.

Because none of these options are sustainable in the long run, the economy cannot stay on any one of the three options forever. Figure 2.4 shows that, instead, the economy cycles over the options.

Assume the economy starts with a relatively conservative government at point A (IMF). Of course wages are low, but everybody is working and the current account is at a sustainable level. The low standards of living slowly lead citizens to some complaints. Later the complaints increase enough to reach levels where public demonstrations and even riots occur. The complaining takes a toll on the political landscape. The government responds by increasing wages. Because the government is relatively conservative, it does not want to increase foreign debt. Or perhaps it cannot borrow more from abroad due to prior agreements with the IMF, or other constraints arising from foreign creditors. To keep the current account at its sustainable level while increasing wages, the economy moves along the XX^b schedule from point A to point B.

As the economy is moving from A to B, unemployment starts to increase. However, at the beginning, the unemployed are few and disorganized. Politically speaking, it is relatively easy to increase wages and make the small yet increasing number of unemployed people pay the cost of the adjustment. However, when the economy reaches point B, the unemployment rate is large enough that workers get organized, and they start applying political pressure. Elections are approaching, so the government decides it is time to respond to people's demands. The government decides to keep salaries high, but implements expansionary fiscal and monetary policy to stimulate the economy and reduce unemployment. Interest rates drop, taxes are cut, highways are built.

The incumbent government moves to C and makes all citizens happy. Of course, the government is financing all the expansion through a massive current account deficit, borrowing internationally. After the elections, the government finds itself with large fiscal and current

account deficits. The "country risk" increases as it becomes increasingly obvious that the creditworthiness of the country is becoming questionable. The government cuts spending somewhat, but the reduction in government spending is small relative to the already large interest payments on all the accumulated debt. Refinancing the government's debt is becoming more expensive, as creditors demand higher and higher interest rates in compensation for the increased country risk. Soon, the government starts having difficulty borrowing from abroad at ever-increasing interest rates. Eventually, the country defaults, faces a balance of payments crisis, or becomes unable to borrow a sufficient amount to keep the economy at full employment with high wages. There is a crisis. The country calls the IMF for help. Of course the IMF is willing to help, but the assessment of the situation reveals that the economy is not competitive, that wages are too high, and that the economy needs and adjustment program that reduces fiscal and current account deficits. The economy needs to return to conservativeness. The government cuts expenses drastically, increases taxes, and devalues the currency to stimulate exports and improve the current account. And the cycle starts again.

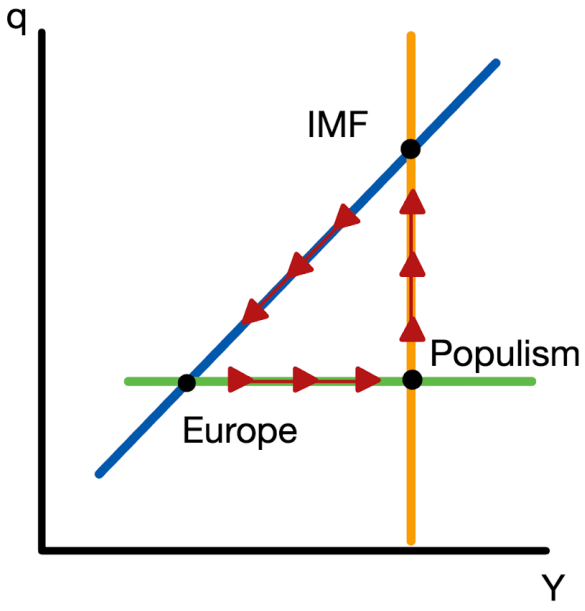

Figure 2.4:

This cycle is remarkably and scarily realistic, especially in many Latin American countries – hence the name "Latin Triangle". We have made some very minimal assumptions thus far,

yet captured a deep-rooted cycle that comes from the fact that economic objectives sometimes collide with political and social aspirations. The cycle acknowledges that there are no simple answers and that, over time, there will inevitably be periods of painful adjustment – social, political, economic. It is easy to blame incompetent politicians, greedy foreign institutions, or our corrupt political rivals for these episodes. The Latin Triangle gives us a way to more deeply understand the ultimate forces behind some of the more immediate causes of bad outcomes.

The model can help us conceptualize the social narratives that shape social sentiment in different economic environments. Let's now revisit the cycle from from the perspective of how society sees itself. A country in the populist phase is financing its standard of living with borrowing. Unemployment is at a record low, salaries are high, aggregate demand is booming, and the economy has been doing "well" for quite a while. The only bad indicator in the economy is that it is running a current account deficit. So, yes, the economy is not competitive (since wages are "too high"), but if the future is as bright as the past, this is transitory. This false sense of invincibility, mostly driven by a sequence of previous "good economic times", masks the underlying lack of economic sustainability. This is a time of excess optimism. The future and present are perceived to be much better than what they truly are. Elections take place and the incumbent government wins.

Of course, just after the elections, the continuing borrowing puts pressure on the exchange rate, taking a toll on the central bank balance sheet. Reserves plummet to dangerous levels and the country's currency suffers a balance of payments crisis. How is that possible? How is it possible that such a successful country with only some minor weaknesses is being so unfairly treated? Financial speculation is blamed for the unwarranted attack on the currency and on the central bank. The country has no option but to devalue, cut aggregate demand, and call international institutions to repair the damaged financial situation. In fact, in some cases, the country needs to restructure or outright default on its debt. When this happens, the country is excluded from international financial markets, the interest rate increases to unthinkable levels, and a massive credit drought takes place. The government claims that the unfair adjustment is being imposed by these evil international financial

institutions, amplified by speculators and vulture funds. The country has "no other option"; it is almost as if the country has lost part of its sovereignty.

At the IMF equilibrium, economic balance is reestablished, but at the cost of a significant drop in standards of living. On the economic side, the government runs a tight fiscal ship. There is neither a fiscal nor a current account deficit. There is no excess unemployment. On the social side, however, real wages are significantly lower. With depreciation comes domestic inflation. Slowly but surely, the purchasing power of consumers declines. Even though the economics is sound, the social contract is not. Poverty increases, inequality deteriorates, consumers start expressing their discontent privately and, later on, publicly. This is a time in which consumption is depressed. The bright future is now gone. The unrest prompts the government to deal with the low standards of living by compensating workers with salary increases, subsidies, a better social safety net, etc. The outcome is that the cost of the workers goes up, but because the country has been excluded from borrowing they cannot run a current account deficit. Hence, the only option is increase wages by cutting aggregate demand. The expenses by the government are increasing but, at the same time, taxes are increasing as well. The economy is now on its way to the Europe equilibrium.

Wages are high, but unemployment starts to increase. At the IMF equilibrium, everybody was employed but upset at the low wages. As wages start improving, the majority becomes happier. Only a few unemployed are disgruntled but by and large people see an improvement in their standard of living. Politically, this is palatable situation. The problem of rising unemployment can be addressed by a more generous unemployment insurance and a strengthening the social safety net. In the meantime, because the country has been running relatively good economic policy, it can, and does, re-enter international financial markets. After some time, the number of unemployed has increased so much that it is clear that the situation is no longer sustainable.

The more open financial markets and the high unemployment makes political rhetoric shift toward a more populist stance. Impositions by foreigners cannot determine the fate of millions of citizens; it is unfair that a country that was once so successful on its own is now at the mercy of heartless financial speculators. In response, government spending

increases, taxes are cut, interest rates are cut, and all is financed with borrowing (mostly from abroad). At the beginning, the borrowing is manageable. The low initial fiscal debt levels allow the government to borrow at a low rate. The situation improves, unemployment declines, and wages start to go up. The government believes it has found the right policy. Why not do more of the same? And they do. The economy is now moving toward populism. The only way to sustain the economy and fulfill campaign promises is to keep borrowing more, increasing aggregate demand, and keeping wages high. Citizens feel better, and their contentment is reflected in the polls. Elections are nearby and there is no incentive to go back to orthodoxy. This is the time to concentrate on what is important: the welfare of our citizens – and their votes. And just like that, we are back to populism, and the cycle repeats itself.

2.2 Dynamics

Figure 2.4 shows a counter-clockwise spiral. If we compare these counter-clockwise dynamics with those in Figure 1.6, we see that the movements from the Europe point to Populism, and from Populism to IMF, are consistent with the "natural" adjustment dynamics of the economy. In other words, even if the government kept policy unchanged, the tendency of the economy to approach internal and external balance is compatible with the Europe-to-Populism-to-IMF dynamics. Of course, our narrative of the Latin Triangle makes clear that governments do change policies along the way, which can speed up, slow down, or change the "natural" dynamics. The point is that on this part of the Triangle, the government will find it generally easier to steer the economy since it is not going against the built-in adjustment mechanisms of the economy.

In contrast, the transition from IMF to Europe does imply an active government policy that goes against (and overcomes) the tendency of the economy to converge toward internal balance.

3 The II-XX with Domestic Demand and Real Exchange Rates

We now put more structure on the model by making stronger assumptions on how the economy adjusts over time toward internal and external balance. As anticipated, the stronger assumptions will allow us to have a sharper characterization of the dynamics that the economy follows.

To incorporate these two adjustment mechanisms into our model, it will be convenient to look at diagrams with domestic demand A and the real exchange rate q in the axes rather than output Y and the nominal exchange rate E as we had done before (we already took some steps in this direction during the Latin Triangle discussion, where we plotted q rather than E on the vertical axis). With A on the horizontal axis and q on the vertical axis, the adjustments toward internal and external balance will be very simple. Internal balance will be achieved through vertical movements (changes in q) while external balance will be achieved through horizontal movements (changes in A). The switch from Y and E to A and q also has the conceptual advantage of separating domestic policy (changes in A) from external policy (changes in q).

Therefore, our first job is to express all the equations we will need as functions of A and q. After that, we study the adjustment dynamics.

3.1 Domestic Demand

Let's recall that demand for domestic goods is not the same as domestic demand, since domestic demand includes demand for all goods, both domestic and foreign. Demand for domestic goods is

$$Z = C + I + G + CA,$$

while domestic demand is

$$A = C + I + G. \tag{3.1}$$

In the present context, domestic demand is sometimes referred to as "domestic *a*bsorption", which is why I have denoted it with an A. The term absorption is supposed to evoke the idea that when demand for domestic goods goes up, some of that demand is "absorbed" by A, while the rest is "lost" to imports. Domestic demand is also referred to as "aggregate demand", since it is the total demand for all goods, foreign and domestic.

As usual, we maintain the assumption that consumption is an increasing function of disposable income: $C = C(Y - T)$. Using $C = C(Y - T)$ in equation (3.1) gives:

$$A = C(Y - T) + I + G \tag{3.2}$$

so A is an increasing function of Y. In addition, since marginal propensity to consume out of disposable income is less than one (consumers on aggregate save at least some part of their income), an increase in Y is associated to a less than one-for-one increase in A.

The current account is also modeled just as before:

$$CA = CA(EP^*/P, Y, Y^*),$$

where CA is a function that is increasing in the real exchange rate EP^*/P, decreasing in domestic income Y, and increasing in foreign demand Y^*.

With a supply of goods given by Y, the equilibrium condition in the market for domestic goods is

$$Y = C + I + G + CA. \tag{3.3}$$

To write our model in terms of A, we combine equations (3.1) and (3.3) to get

$$A = Y - CA(EP^*/P, Y, Y^*)$$

Now use that $q = EP^*/P$ to write

$$A = Y - CA(q, Y, Y^*) \tag{3.4}$$

3.2 The *II* Curve in Terms of *A* and *q*

In this context, we define the II curve as the set of points (A, q) compatible with a goods market equilibrium that has $Y = Y^f$ in the short run (i.e., with P fixed). Using $Y = Y^f$ in equation (3.4) gives the II curve:

$$A = Y^f - CA(q, Y^f, Y^*). \tag{3.5}$$

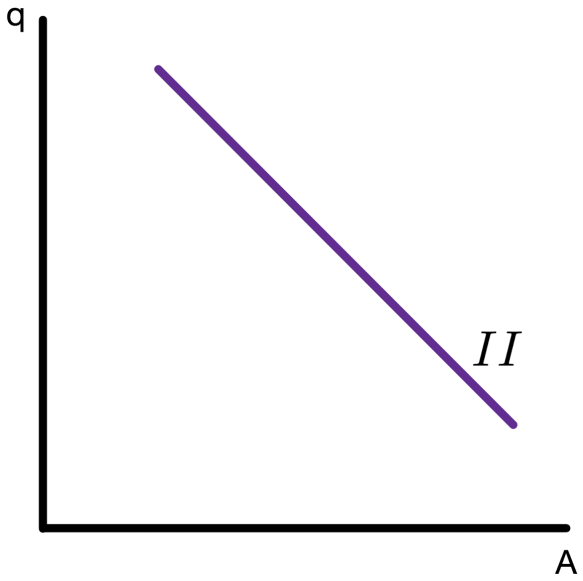

Figure 3.1:

Figure 3.1 plots the II curve from equation (3.5) with A on the horizontal axis and q on the vertical axis. The II curve gives the combination of domestic demand levels and real exchange rates that, keeping prices fixed, gives a short-run equilibrium in the goods market that has output equal to its full-employment level.

In this model, A and q are both endogenous. We can take q as given and see what happens to A, or we can take A as given and see what happens to q. In the end, the model determines the joint behavior of A and q. Taking q as given, the II curve provides the answer to the following question: For a given value of q, what is the level of domestic demand (or absorption A) required to make output equal to the full-employment level of output? Now let's assume that A is given. First, consider a given A that is much smaller than Y^f. In order for output to equal Y^f, there has to be a large current account surplus. The only way to

achieve a large current account surplus is to have a real exchange rate that is sufficiently high (a large enough depreciation). Consider now a given A that is above Y^f. If $CA = 0$, then we must have $Y > Y^f$. In order to have $Y = Y^f$, we need a current account deficit. The only way to achieve a deficit in the short run is if q is low enough (a large enough apreciation).

We note that this II curve is conceptually similar to the II curve that we introduced in Section 1, but not exactly the same. The earlier version of the II curve was defined as the set of points (Y, E) that are consistent with $Y = Y^f$ in the short run. The new II curve in equation (3.5) gives the set of points (A, q) that are consistent with a short-run goods market equilibrium that has $Y = Y^f$. In addition to considering (A, q) instead of (Y, E), the new II introduces the requirement that (A, q) can *support an equilibrium* with $Y = Y^f$. The earlier II curve, in contrast, just required $Y = Y^f$ without any reference to equilibria.

3.3 The *XX* Curve in Terms of *A* and *q*

Let's now write the XX^b curve as a function of A and q. Equation (1.2) with $XX = XX^b$ and $q = EP^*/P$ gives the XX^b curve:

$$XX^b = CA(q, Y, Y^*). \tag{3.6}$$

To write CA as a function of A instead of Y, we solve equation (3.2) for Y to get:

$$Y = C^{-1}(A - I - G) + T, \tag{3.7}$$

where $C^{-1}(\cdot)$ is the inverse function of the increasing function $C(\cdot)$. For example, if

$$C(x) = 1 + \frac{3}{4}x \tag{3.8}$$

then

$$C^{-1}(x) = \frac{4}{3}(x - 1). \tag{3.9}$$

Plugging equation (3.7) into equation (3.6) gives:

$$XX^b = CA\left(q, C^{-1}(A - I - G) + T, Y^*\right).$$

We can write this equation as

$$XX^b = \widetilde{CA}(q, A, Y^*) \tag{3.10}$$

where the function $\widetilde{CA}$ is defined by

$$\widetilde{CA}(q, A, Y^*) \equiv CA\left(q, C^{-1}(A - I - G) + T, Y^*\right).$$

Since $C(\cdot)$ is increasing and $CA(\cdot, \cdot, \cdot)$ is decreasing in its second argument, $\widetilde{CA}$ is also decreasing in its second argument. It is good to keep in mind that sometimes, with some abuse of notation, we write $XX^b = CA(q, A, Y^*)$ instead of the more correct but cumbersome $\widetilde{CA}(q, A, Y^*)$.

Example 3.1. We keep using equation (3.8). We additionally assume that

$$CA(q, Y, Y^*) = 2q - 0.5Y + 0.1Y^*.$$

Using (3.9), we have

$$\begin{aligned}
CA(q, Y, Y^*) &= 2q - 0.5Y + 0.1Y^*, \\
&= 2q - 0.5[C^{-1}(A - I - G) + T] + 0.1Y^*, \\
&= 2q - 0.5\left[\frac{4}{3}(A - I - G - 1) + T\right] + 0.1Y^*, \\
&= 2q - \frac{2}{3}A + \frac{2}{3}(I + G + 1) - 0.5T + 0.1Y^*.
\end{aligned}$$

So, in this case

$$\widetilde{CA}(q, A, Y^*) = 2q - \frac{2}{3}A + \frac{2}{3}(I + G + 1) - 0.5T + 0.1Y^*.$$

□

Figure 3.2 plots the XX^b curve from equation (3.10) with A on the horizontal axis and q on the vertical axis. This is the same curve as the upward sloping curve from Figures 1.3, 1.5 and 1.6, but plotted in a different axis. The XX^b curve is the set of points (A, q) that are consistent with a current account equal to XX^b in the short run. It answers the following question: For a given value of q, what is the level of domestic demand (or absorption A) required to make the current account equal to its sustainable level XX^b? Just as for the II curve, we can also take A as given and ask what happens to q. The XX^b curve therefore

also answers the question: For a given value of A, what is the level of q required to make the current account equal to its sustainable level XX^b?

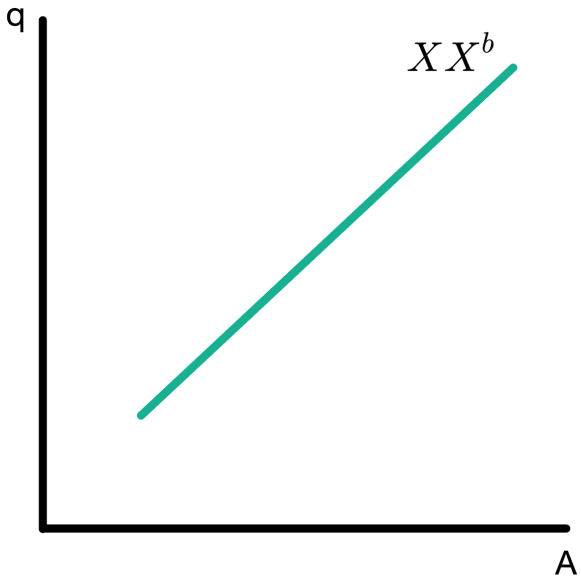

Figure 3.2:

3.4 The Four Zones of Economic Discomfort

The left panel of Figure 3.3 shows the II and XX^b curves in the same plot, with A and q in the axes. Similar to Figure 1.5, we can characterize the four regions of economic discomfort based on the combinations of internal and external imbalances that prevail.

The points above the II curve have $Y > Y^f$ and, conversely, the points below the II curve have $Y < Y^f$.[6] For the XX^b curve, we have that points above it have $CA > XX^b$ while points below it have $CA < XX^b$. Points exactly on II have $Y = Y^f$ and correspond to points in which there is internal balance. Points exactly on XX^b have $CA = XX^b$ and correspond to points in which there is external balance.

[6]To see that $Y > Y^f$ is the same as being above the II curve, use equations (3.5), (3.4), and that domestic demand A is increasing in Y.

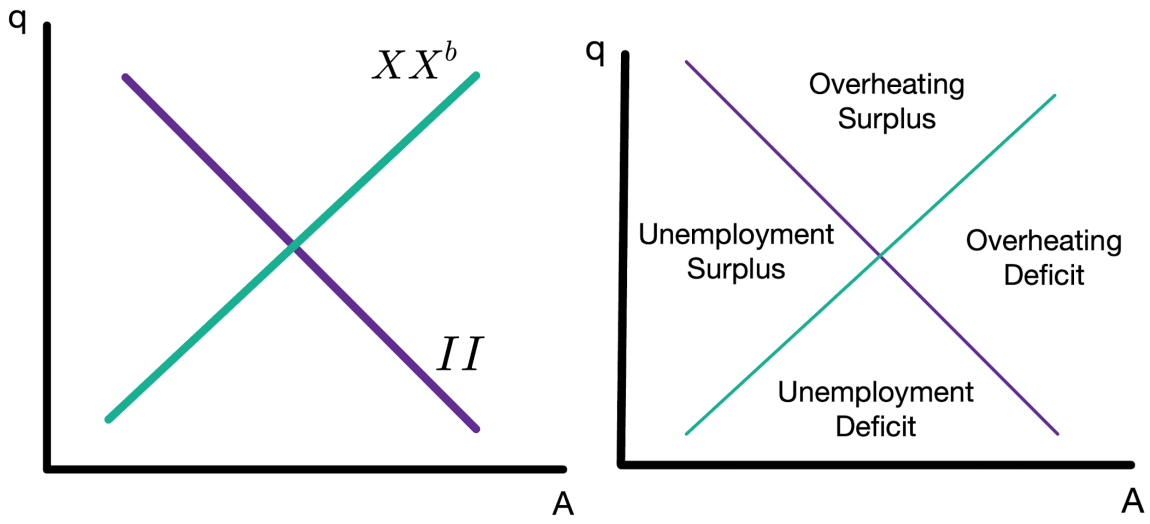

Figure 3.3:

3.5 Adjustment Mechanisms

We are finally ready to make the stronger assumptions regarding how the economy adjusts over time toward internal and external balance.

Adjustment Mechanism Toward Internal Balance

- The economy tends toward internal balance through adjustments in the price level P. When $Y > Y^f$, P is increasing. When $Y < Y^f$, P is decreasing. As time goes by, absent any changes in exogenous variables or parameters, the changes in P will make Y approach Y^f.

What does this adjustment mechanism imply for the dynamics of A and q? The left panel of Figure 3.4 shows the dynamics that arise from adjustments in P. All the points above the II curve have $Y > Y^f$. For these points, P is increasing over time. When P is increasing over time, q is decreasing over time (since $q = EP^*/P$). Conversely, for points below the II curve we have $Y < Y^f$, P decreasing and q increasing. Thus, internal balance is achieved by movements in the real exchange rate q, which are movements in the north-south direction.

In the AA-DD model, we had already encountered an adjustment mechanism driven by changes in P. In fact, for the AA-DD model, it was the *only* endogenous adjustment mech-

anism. When P changed, it induced shifts in both the AA and the DD. The shifting of the curves stopped when their intersection gave an equilibrium with $Y = Y^f$. Thus, starting from any short-run equilibrium, the adjustments in P pushed the economy toward a long-run equilibrium. One aspect that is different in the current model compared to the AA-DD model is that we now assume that adjustments in P serve as an adjustment mechanism for internal balance only. In the AA-DD, changes in P induced changes in Y, q and E, moving all of them toward their long-run equilibrium levels. As a consequence, changes in P also induced changes in A in the AA-DD model (although we never looked at that directly when we studied the AA-DD). In contrast, in the present II-XX model, changes in P induce changes in q only; neither Y nor E change with P.

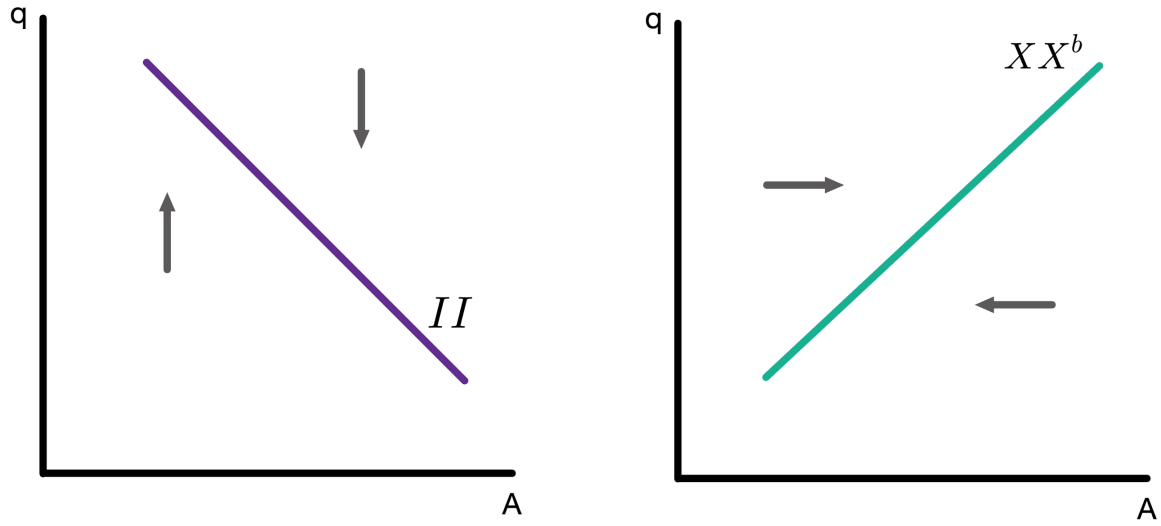

Figure 3.4:

Adjustment Mechanism Toward External Balance

The adjustment mechanism we consider now is a new mechanism that is absent in the AA-DD framework and that we have not encountered (in this course) until now.

- The economy tends toward external balance through adjustments in aggregate consumption C. When the current account is below its sustainable level XX^b, consumption is decreasing over time. Lower consumption leads to lower aggregate demand A, lower output and lower income. Lower income makes imports go down, which

makes the current account increase and get closer to XX^b. Conversely, when the current account is above its sustainable level XX^b, consumption, output and income are increasing over time. The current account is deteriorating and moving toward XX^b.

The right panel of Figure 3.4 shows the dynamics that are brought about by this adjustment mechanism.

Let's now understand the economic logic behind it. At the deepest level, the adjustment mechanism of the current account through consumption and aggregate demand comes from two sources. The first is the existence of an aggregate budget constraint for the entire economy that says that we cannot finance too high a level of consumption with ever-increasing borrowing. The second is that people value consumption and will not choose to consume less in every period if it can consume more in every period with the same resources.

The existence of a budget constraint provides the adjustment mechanism of CA toward XX^b when $CA < XX^b$. The preference for higher consumption provides the adjustment mechanism of CA toward XX^b when $CA > XX^b$.

Imagine the economy has an unsustainable current account deficit, which in this context means $CA < XX^b$. In the right panel of Figure 3.4, points with $CA < XX^b$ correspond to points below the XX^b line. When $CA < XX^b$, the country is consuming more than what is sustainable in the long run and financing this consumption by borrowing from the rest of the world. As time goes by, the country's debt to foreigners keeps increasing. The borrowing being unsustainable means that, eventually, the borrowing must go down, and the debt levels must stabilize (or else the budget constraint is violated). When the borrowing goes down, consumption levels cannot be sustained and must go down as well. Lower consumption leads to lower domestic demand. In a goods market equilibrium, lower demand implies lower output. Since aggregate output equals aggregate income[7], aggregate income goes down. Lower aggregate income implies that demand for imports is lower, so equilibrium imports go down. Lower imports make CA go up, which is an adjustment toward XX^b.

[7] See footnote 3.

In the chain of events described in the last paragraph, the unsustainably high borrowing must *eventually* go down. There is in principle no reason why we can't keep an unsustainable deficit, or even increase the deficit, for some time before having to reduce consumption. After all, whether a current account level is sustainable is a long-run issue. Short-run movements away from sustainability may be consistent with long-run sustainability if they are reversed quickly enough. However, in our model we do assume that the adjustment toward long-run sustainability and toward external balance begins immediately. This does not rule out all temporary movements away from sustainability. There can be movements away from sustainability brought about by changes in exogenous variables or parameters. However, it is good to keep in mind that, in the real world, endogenous movements away from sustainability can occur, do occur, and are sometimes quite persistent.

Imagine now that the economy has an unsustainable current account surplus, $CA > XX^b$. When $CA > XX^b$, the country's income is higher than its aggregate demand. The difference between income and demand is lent out to the rest of the world. As time goes by, the domestic economy accumulates wealth in the form of foreign assets – the IOUs that entitle the domestic economy to future repayments from the rest of the world. This accumulation of wealth is a form of saving, as it foregoes consumption today (by lending to foreigners) in exchange for consumption in the future (when we use the IOU repayments to increase consumption). The accumulation of saving becomes unsustainable when it is not desirable for consumers to keep lending forever at the current level, as that would imply that, for all future periods, wealth is being accumulated faster than it is consumed. And if wealth is forever being accumulated faster than it is consumed, it is possible to consume some of the wealth today and also keep all future consumption unchanged. Therefore, when the current account surplus becomes unsustainable, it is optimal for consumers to consume more and lend less. The reduced lending to the rest of the world lowers the current account toward its sustainable level, while the higher consumption increases domestic demand.

In sum, countries cannot borrow at an unsustainable level forever, and do not want to save at an unsustainable level forever. In either case, the external imbalances are corrected over time by changes in aggregate demand A. In the right panel of Figure 3.4, this corresponds

to movements in the east-west direction. When the external imbalance is in the form of a surplus, the economy is above the XX^b line and the adjustment toward external balance happens by increasing A over time. When the external imbalance is in the form of deficits, the economy is below the XX^b line and the adjustment toward external balance happens by lowering A over time.

3.6 Adjustment Dynamics

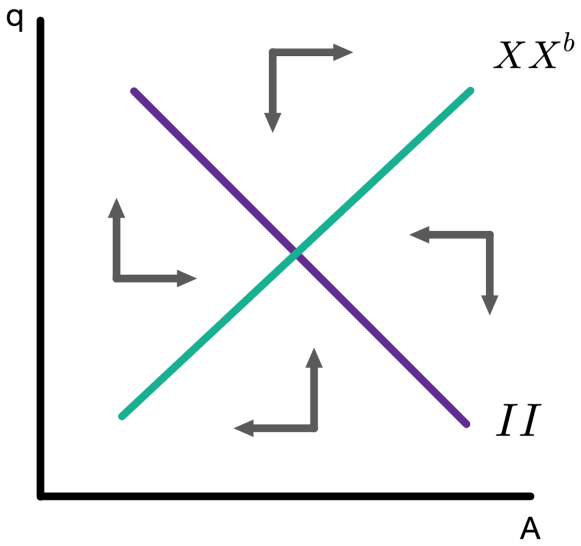

Figure 3.5:

Combining the dynamics from the two panels of Figure 3.4 gives Figure 3.5. Each of the four zones of economic discomfort have their own dynamics. For example, the top quadrant has overheating and surplus. Because it has overheating, the price level is increasing, which pushes q down. Because it has surpluses, consumption is increasing, which pushes A to the right (toward higher values).

Figure 3.6 places the economy at a starting point in the top quadrant and traces the path that results from following the adjustment dynamics from Figure 3.5. The result is a clockwise spiral.

We can get some further insight by looking at the strength of each of the two adjustment mechanisms for different combinations of A and q. Figure 3.7 illustrates the strength of the adjustment mechanisms with arrows attached to the path traversed by the economy

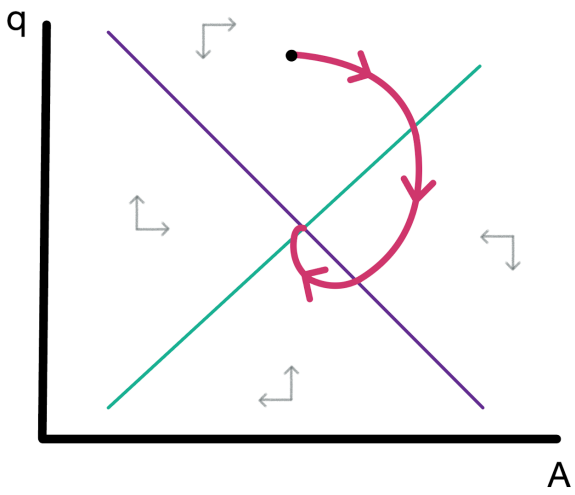

Figure 3.6:

over time. Longer arrows denote a "stronger" adjustment. We equate stronger adjustments with faster adjustments; we can think of the length of an arrow as indicating the speed at which the economy is moving in the direction of the arrow. The arrows pointing up or down correspond to adjustments in q that move the economy toward internal balance while the arrows pointing east or west correspond to adjustments in A that move the economy toward external balance. A natural assumption, which we make from now on, is to have adjustments be faster when the economy is far away from balance, and slower when the economy is closer to balance.

In Figure 3.7 the red path starts with two arrows that are relatively large and of similar size. The arrows are large because the economy is far from the lines. The arrows are of similar size because the distance to the purple II curve is similar to the distance to the green XX^b curve. We expect the economy to move down and to the right at approximately similar speeds. As the economy moves down and to the right, it gets closer to the green XX^b curve of external balance. As it gets closer to XX^b, the arrow pointing to the right becomes shorter. For example, the arrow pointing to the right at the midpoint of the red path is shorter than the arrow pointing to the right at the beginning of the red path.

At the midpoint of the red path, we also see that the arrow pointing to the right is shorter than the arrow pointing down. The arrow pointing right is shorter because the economy is closer to the green external balance XX^b curve than to the purple internal balance II

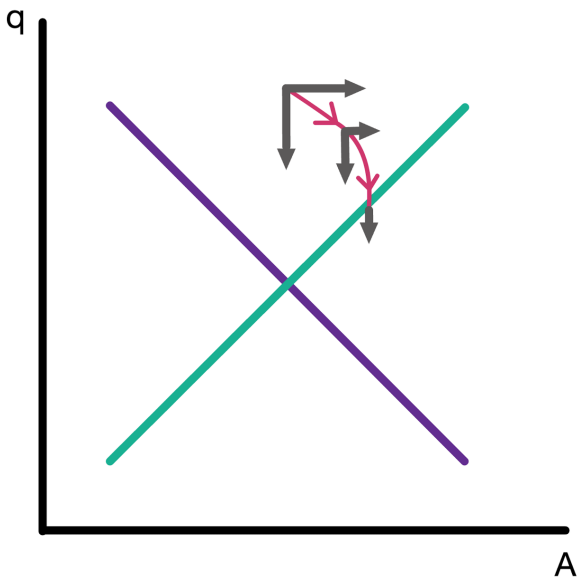

Figure 3.7:

curve. Adjustment toward external balance (moving to the right) is happening at a slower pace than the adjustment toward internal balance (moving down).

When the economy is at the end of the red path, it is on the green XX^b line, so it is in external balance. When the economy is in external balance, there is no force pushing the economy toward higher or lower A, which is why there is no horizontal arrow at that point (equivalently, the arrow has zero length). On the other hand, there still is internal imbalance in the form of overheating, which pushes q down. The economy is therefore moving straight down. The length of the arrow pointing down at the end of the red path is smaller than the two other arrows pointing down in the red path because the economy is closer to internal balance at the end of the red path than at any other point in the path.

The same reasoning applies when the economy finds itself on the purple II line. In this case, there would be no north-south adjustment and the economy would be moving only in the east-west direction toward the green XX^b line. You can try starting the economy in different places and trace the path it follows. The result will always be adjustment dynamics that trace a clockwise spiral path that converges toward the intersection of the II and XX^b curves.

4 Environmental Sustainability

We now look at how to incorporate environmental concerns to the framework. As usual, we simplify the problem, not with the intention of trivializing it, but to have a manageable model that, despite its simplicity, is still useful.

With environmental concerns, we do not see cycles like the ones that arise in the Latin Triangle. The reason is that the environment moves much slower than economic and social events. The slow-moving nature of the environment makes some of the tensions between environmental sustainability and all other goals more dangerous. If the environment were already deteriorating at a fast enough pace, we probably would have taken corrective actions already. Instead, social choices are more focused on the economic and social cycles.

At the end of this section, we discuss the type of technological progress that can help resolve the tension between economic and environmental goals.

4.1 Environment Schedule

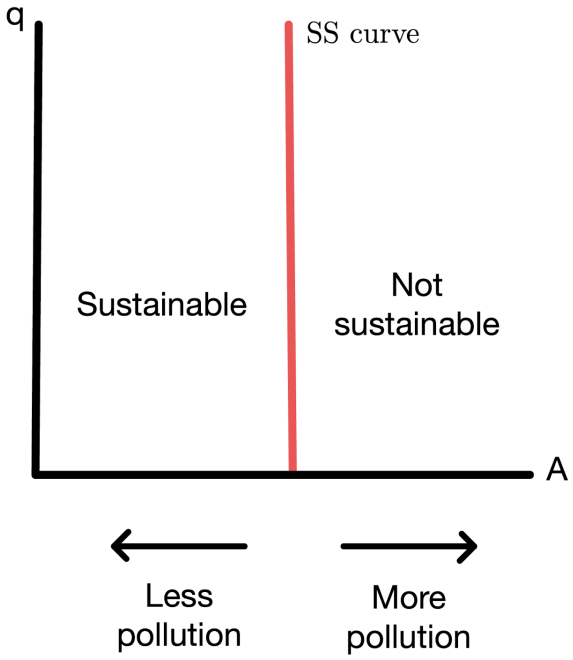

Figure 4.1:

We assume that there exists a level of aggregate demand A below which the impact on

the environment is sustainable. This assumption is meant to capture that some of the environmental problems of excessive consumption of natural resources (renewables or not), excessive production and pollution, congestion, and many others, require a large enough level of consumption and investment. We do not assume that sustainability depends on exchange rates – which sounds like a reasonable assumption, especially in the long run. Figure 4.1 shows a diagram that represents the idea of an aggregate level of A below which we have environmental sustainability. We refer to the vertical line that determines this cut-off level of A as the SS curve. To the right of SS, the environment suffers. The more to the right, the more it suffers. To the left of the SS curve, the environment is protected and consumption is sustainable. We have once again simplified and labeled the complex effects that lead to a less sustainable environment as "more pollution", and those that improve the environmental sustainability as "less pollution".

4.2 Kyoto's Triangle

Given the slow-moving nature of the environment, the uncertainty in the speed and type of future technological progress, the scientific disagreements in long-run environmental predictions, and the likelihood and variety of potential policies that may or may not be implemented, it is difficult to know where to place the SS relative to the other curves we have been studying. We will look at the case in which the level of consumption implied by having internal and external balance (the IMF equilibrium) is already too high to be consistent with a sustainable environment. Even if other placements of the SS curve are possible and interesting, the case we look at presents a number of challenges that, to me, seem relevant in today's world and will become even more relevant as time goes by.

Figure 4.2 adds the SS curve to Figure 2.3, with the SS to the left of the IMF equilibrium. The SS goes exactly through the Europe point, but this is not so important. If we move the SS slightly to the left or to the right, other points of intersection would arise among the curves. However, not much would change in terms of the insights we are interested in.

In Figure 4.2, the intersection of the red environmental sustainability SS curve with the purple internal balance II curve is labeled "Kyoto". Now we have four locations to think

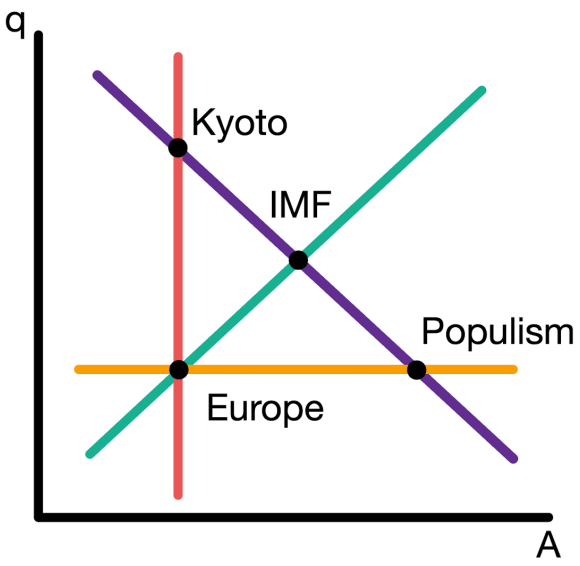

Figure 4.2:

about, each of which has its own challenges. Table 4.1 summarizes them.

At the IMF equilibrium, the economy is in internal and external balance, but it exhibits social tensions and the demand implies the environmental sustainability – polluting, for simplicity – is not attained. In other words, we have economic balance, but neither social nor environmental balance. Even though there is full employment and there are no current account pressures, the economy is unsustainable.

In the point labeled Europe, the country has external balance, the standard of living is relatively high – given the high real wage – and the demand is low enough that the impact in the environment is low enough for sustainability. The only problem is that the country has a relatively large level of unemployment. So, even though the economy is sustainable along the social, environmental, and external balance dimensions, labor markets are in significant disarray. This is sustainable for a while, but the social safety net required to keep the unemployed content is a large burden for the economy.

At the point labeled Populism, political and social concerns are minimal. Real wages are high and employment is at the natural rate. People are very happy regarding economic matters. However, the country is running an unsustainable current account deficit that requires borrowing from foreigners – the equivalent of running down savings. In addition,

aggregate demand is so high that the environmental impact is the worse out of the five options we are considering. This is clearly an unsustainable situation. In general, however, the escape valve is the current account. In most cases, a sharp reduction in (or outright shutdown of) foreign lending is what forces the economy to adjust – not the environmental impact.

Finally, the point labeled Kyoto is in many ways similar to Europe. Aggregate demand is low enough that the environmental impact is sustainable. However, instead of workers having to suffer from unemployment, it is real wages that are too low. At the Kyoto point, because wages are depressed, the costs of production are low by international standards, the export sector is very competitive and the current account has a large surplus. The label "Kyoto" is evocative not only of Japan, which is arguably in a low-demand, depressed-wage situation (or used to be until recently), but also of the Kyoto Protocol, one of the first international treaties to reduce greenhouse gas emissions. Saying that wages in Japan are depressed does not mean that wages in Japan are lower than their counterpart in other less developed countries. Wages in Japan are depressed relative to the wages that would prevail at the IMF equilibrium. In other words, wages are below the level required to achieve external balance. Because wages are low, the economy has a current account surplus. This is also an unsustainable situation. First, there is tension in the political system. Second, not all countries in the world can run surpluses – by definition, every surplus must be balanced by a deficit.

	Internal Balance	External Balance	Social Peace	Environment
IMF	✓	✓	Conflict	Pollution
Europe	Unemployment	✓	✓	✓
Populism	✓	Deficit	✓	High Pollution
Kyoto	✓	Surplus	Conflict	✓

Table 4.1:

4.3 Productivity Improvements

Technological improvements can increase production without increasing the use of resources. This is one of the "solutions" to environmental sustainability issues that has received a lot of attention in the public discussion. However, technological improvements have two implications. First, if production increases without using additional resources, the SS shifts to the right, which allows the economy to sustain a larger demand with a smaller impact on the environment. Second, if technological improvements come with an increase in productivity, the full-employment level of output Y^f also increases – the same labor force can now produce more output. Changes in Y^f shift the II curve.

The overall effect of technological improvements depends crucially on how much the SS and II curves shift. Figure 4.3 shows three possibilities. On the left panel, the technological improvement has a relatively large impact on production and a relatively small impact on environmental sustainability. In this case, the IMF equilibrium has higher demand and a lower wage than before, making social unrest more severe. If the change in SS is small enough, even the original IMF equilibrium (at the intersection of the dashed purple initial II curve and the green XX^b) remains unsustainable.

The center panel of Figure 4.3 shows a productivity increase that makes both the SS and the II shift more than in the left panel. If the II did not shift, then the IMF equilibrium would be sustainable. However, the technological improvements have made much more production feasible. The new IMF equilibrium can support a level of demand that is too high to be environmentally sustainable, even after the large shift in the SS.

Last, the right panel of Figure 4.3 shows the kind of technological progress that solves the environmental problems. This kind of "green" technology increases the level of production that is environmentally sustainable without simultaneously increasing demand beyond that new environmentally sustainable point.

The bad news is that social unrest remains in all panels of Figure 4.3. To address social peace and environmental sustainability together, we must consider shifts in the XX^b curve.

Figure 4.4 shows three possibilities when the XX^b curve shifts. These shifts can come from

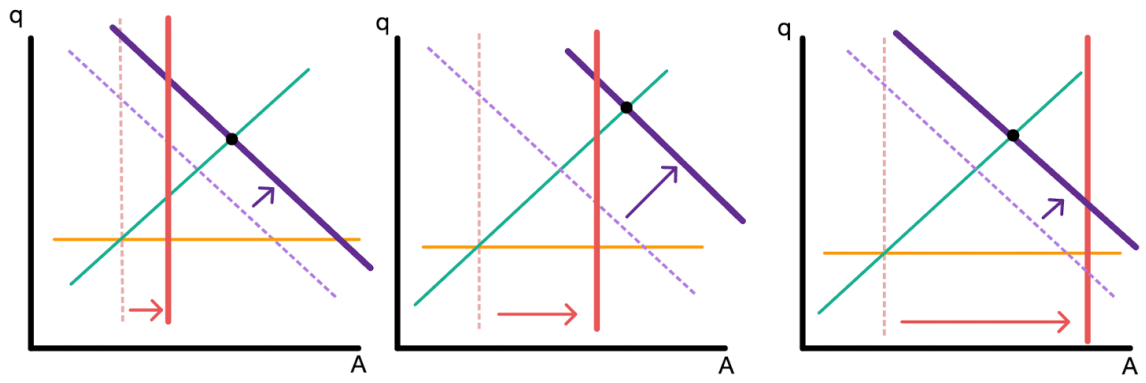

Figure 4.3:

many sources. Here we still consider technological changes, which can induce changes in the level XX^b that is sustainable for the current account, or in foreign demand Y^* if technology diffuses globally.

On the left panel, the technological improvement has a large impact on the XX^b curve but a small impact on environmental sustainability. In this case, the IMF equilibrium implies a much higher standard of living, a higher demand, and, if the improvements are large enough, social peace. On the other hand, the environmental impact, measured by the horizontal distance between the SS curve and the IMF equilibrium, is now larger.

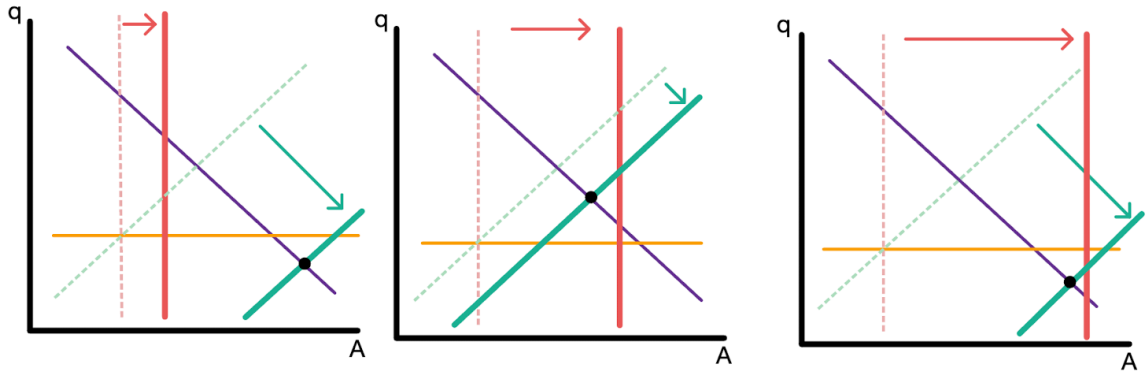

Figure 4.4:

The center panel of Figure 4.4 shows a technological change that makes the SS shift significantly, and the XX^b shift little. The improvement in environmental sustainability is so large that the IMF equilibrium is to the left of the SS. There is no negative environmental outcome associated with this type of technological progress. On the other hand, the Latin

Triangle and its implied cycles are a concern. Even though the environment is sustainable, the economy and the politics are not.

Last, the right panel of Figure 4.4 shows the kind of technological progress that solves both the Latin Triangle and the environmental problems.

1 Appendix

1.1 Labor Market

In this Appendix, we develop a small model of the labor market, taken straight from intermediate macro. You do not need to know this model of the labor market, I will not ask you about it in exams.

In our labor market model, labor is the only factor of production and $Y = N$, as we had assumed above. Since the only factor of production is labor, the marginal cost for firms producing goods and services is the wage W. If markets were perfectly competitive, firms would set the price P equal to marginal cost W and make zero profits. In the real world, there is market power and firms tend to set prices above marginal cost. We capture this idea by the following price-setting relation:

$$P = (1 + m)W. \tag{1.1}$$

where m is the markup. This price setting relation says that firms set the price of their goods based with a markup above their marginal cost W.

Wages are set according to the following wage setting relation:

$$W = P^e F(\underset{(-)}{u}, \underset{(+)}{z}). \tag{1.2}$$

In this wage setting relation, P^e is the expected price level (the price level we expect to hold in the future), u is the unemployment rate, z is a catch-all variable that captures all other elements that influence wages, and F is a function that is decreasing in u and increasing in z (as represented by the plus and minus signs in the formula). There are therefore three elements that determine the wage: P^e, u and z. We briefly explain why they matter for

wages:

- Expected price level. The expected price level P^e is an important determinant of the nominal wage because what people and firms really care about is not the nominal wage but the real wage. Workers value money because of the goods and services they can buy with it, not for its own sake. If my nominal wage is \$1,000,000 but the price of one apple is \$10,000,000, I am not so happy with my gigantic nominal wage. We use P^e rather than P because after wages are set, they usually remain fixed (or closed to fixed) for some time, with wage contracts renegotiated only infrequently. So the relevant price level is the one that will prevail between now and the future time when the wage is renegotiated rather than just the current price level. goods and services that one can afford after W is set are better captured by W/P^e.
- Unemployment. The wage setting equation says that when unemployment is high, wages are low. The reasoning is that when unemployment is high, employers have more bargaining power, since someone seeking a job must compete with a larger pool of unemployed workers. Conversely, when the unemployment rate is low, it is workers who have higher bargaining power, as many firms have to compete to hire among the smaller pool of unemployed people.
- Other factors. The other factors are defined so that when z goes up, wages go up. That F is increasing in z is arbitrary, we could have just as well assumed the opposite and change the meaning of z. One example of a factor that enters z are unemployment benefits. For given u and P^e, higher unemployment benefits make unemployment less painful, so employers must offer a higher wage to attract workers (in this case higher unemployment benefits were associated with a higher z).

Combining (1.1) and (1.2) gives

$$P = (1 + m)P^e F(u, z). \tag{1.3}$$

In the long-run, $P = P^e$. Using $P = P^e$ in (1.3) defines the natural rate of unemployment

u^n:

$$1 = (1+m)F(u^n, z).$$

Given u^n, we can find the full-employment level of output Y^f using equation (1.1).

Equation (1.1) implies that the expected real wage is:

$$\frac{W}{P^e} = \frac{1}{1+m}\frac{P}{P^e} \tag{1.4}$$

$$= \frac{1}{(1+m)(1+\pi^e)} \tag{1.5}$$

where I have used the definition of expected inflation $\pi^e \equiv P^e/P - 1$.

1.2 Real uncovered interest parity

Using the definitions of the real exchange rate

$$q \equiv EP^*/P \tag{1.6}$$

and of expected inflation

$$\pi^e \equiv P^e/P - 1, \tag{1.7}$$

we have that

$$\begin{aligned}
\frac{E^e}{E} &= \frac{q^e \frac{P^e}{P^{*e}}}{q\frac{P}{P^*}} \\
&= \frac{q^e}{q}\frac{1}{P^{*e}/P^*}\frac{P^e}{P} \\
&= \frac{q^e}{q}\frac{(1+\pi^e)}{(1+\pi^{e*})} \\
&= \left(1 + \left[\frac{q^e}{q} - 1\right]\right)\frac{(1+\pi^e)}{(1+\pi^{e*})}
\end{aligned}$$

A linear approximation gives

$$\frac{E^e}{E} \approx 1 + \left(\frac{q^e}{q} - 1\right) + \pi^e - \pi^{e*}$$

Using this linear approximation in the uncovered interest parity condition

$$R - R^* = \frac{E^e}{E} - 1$$

gives

$$R - R^* = \left(\frac{q^e}{q} - 1\right) + \pi^e - \pi^{e*}$$

Using the definition of the real interest rate

$$r^e = R - \pi^e, \tag{1.8}$$

we get the real uncovered interest parity condition

$$r^e - r^{e*} = \left(\frac{q^e}{q} - 1\right) \tag{1.9}$$

1.3 Real Wages and Real Exchange Rates

Using (1.8) and (1.9) in (1.5) gives

$$\begin{aligned}\frac{W}{P^e} &= \frac{1}{(1+m)(1+\pi^e)} \\ &= \frac{1}{(1+m)(1+R-r^e)} \\ &= \frac{1}{(1+m)\left(1+R-r^{e*}-\left[\frac{q^e}{q}-1\right]\right)}\end{aligned}$$

A linear approximation gives

$$\begin{aligned}\frac{W}{P^e} &\approx 1 - m - \left(R - r^{e*} - \left[\frac{q^e}{q} - 1\right]\right) \\ &= 1 - m + r^{e*} - R + \left(\frac{q^e}{q} - 1\right)\end{aligned}$$

which shows that, for a given domestic interest rate R, the expected real wage W/P^e is proportional to real expected depreciation $q^e/q - 1$. In turn, for a given expected real exchange rate q^e, real expected depreciation is inversely related to the current real exchange rate q. It follows that, for given R and q^e, the expected real wage W/P^e and the real exchange rate q are inversely related.