International Macroeconomics: Lecture Notes

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Associated videos and other content available at
bit.ly/2yO4GUS

Introduction

These notes summarize what I typically teach in a one-semester, college-level International Macroeconomics course (also known as "International Monetary Theory" or "International Finance"), which covers the intersection among *exchange rates*, *capital flows*, and *policy*. I recorded some video lectures for the course (available at bit.ly/2yO4GUS) that explain the mathematical and graphical concepts.

These notes are not a substitute for coming to class (I go into much more detail, particularly with regard to the international system, using the models, numerical examples, and applications) but, combined with outside readings and/or the videos, it is possible to use these to get a solid grasp of the topic. The course material lies somewhere between the principles level (which we review somewhat, but it is expected that students know what money, inflation, and GDP are) and intermediate macro (we do the DD-AA model, but not much more).

These notes follow my own structure to this course—other instructors will obviously do things differently. This is especially true for business-finance approaches to the topic, for example. I try to match real events in the world economy as much as possible.

Much of my lecture material has come from a variety of sources, but the equations and models are basically those of Krugman/Obstfeld(/Melitz)'s *International Economics*. I suggest you get a copy—any edition is fine for the models, although really old ones will have outdated examples and currencies.

The 12 topics covered here are:

1. Seven Main Macroeconomic Measurements
2. Review of Markets and Macroeconomic Models
3. The Current Account and Capital Flows
4. The Foreign Exchange Market and Exchange Rates
5. International Parity Conditions: PPP and IRP
6. The IRP Model of Exchange-Rate Determination
7. The Monetary Model of Exchange-Rate Determination
8. Exchange-Rate Regimes and Maintaining a Fixed E
9. International Policy Transmission
10. The DD-AA Model in the Short Run
11. The DD-AA Model in the Long(er) Run
12. Managing the International Monetary System

1. Seven Main Macroeconomic Measurements

While these concepts should have been covered in a prerequisite course (Principles of Macroeconomics), I cover these topics for three reasons. First, some students might need a refresher. Second, these topics can have a purely "international" application. These measurements can be used to assess a foreign country's economic performance, and the models in the next section can be used in the same way. Even Supply and Demand can be used to discuss the global oil market, for example. Finally, many of these variables are determined via the models introduced in this course.

The seven main variables are key to discussing a country's macroeconomic performance.. The first three are mainly *internal,* and are the main measures in a Principles course. The next two are measures of *borrowing* (one is internal, and one is external), and the final are more *financial* variables.

These variables are:

1) **Gross Domestic Product**. The *level* (often in dollars) can tell businesspeople the size of a country's market, while the *growth rate* of real GDP shows increases in income.
2) The **inflation** rate. Rising prices can hurt the real value of investments, and often signal weak economic conditions.
3) The **unemployment rate**. A high rate shows poor economic performance and might signal central bank action. Like all these numbers, "target" rates differ from country to country.
4) The Government **budget balance**. This is $(G - T)$, either in dollars or as a percentage of GDP. High deficits indicate a high risk to creditors. Sometimes deficits (where taxes exceed revenue) are presented as positive numbers, so be careful.
5) The **current account** balance, related to $(X - M)$. This is a measure of international borrowing; deficits are also a problem.
6) The **interest rate**. There are many versions, which depend on who issues the loan and for how long; higher risk and longer terms usually mean higher rates. Risk also raises interest rates.
7) The **exchange rate**—we will explain this in depth in this course. One main model determines E; the other does E and Y simultaneously.

The Economist, for example, gives a table in the back of the magazine every week that lists these measures.

These variables a are also important for macroeconomic policy. Each can affect each other, often in a complicated way. GDP growth should lead to higher interest rates, all else equal, which can cause an appreciation in the currency. But this might then reduce GDP. This is one reason why International Macroeconomics is often challenging.

Countries also face additional tradeoffs when integrated into the international economy. The interest rate is the key tool of monetary policy, but can only be used for domestic objectives or international objectives, but not both. Economists talk about "internal balance," meaning achieving goals such as low unemployment and inflation. But this forces them to sacrifice "external balance," such as a favorable trade balance or the exchange rate that policymakers want. A central bank can raise interest rates to fight inflation, but this can make the currency rise, hurting exports. A falling currency can also be bad for a country, particularly if it borrows in a different currency from its own (such as the dollar). It will take more of its own currency to pay the same dollar value of debt.

If any of these concepts seem unfamiliar, this is a good opportunity to review them. The class will make more sense if you do.

2. Review of Markets and Macroeconomic Models

It is also important to review the four economic models shown below at the end of these notes. Here, I am mainly outlining some international applications, but reviewing these models might take some time, depending on your Economics background. In fact, applying these models, as well as the main macroeconomic indicators, might take up an entire unit of a course that has principles as prerequisites.

The **supply and demand** model shows how **markets** function for a typical good or service. Shifts in supply and demand lead to changes in the price and quantity of the item. It is important to note the model's application to financial markets; you can even use this type of model for exchange rates, for example. One key concept is that of **arbitrage**. If the price of something differs across markets—either over space or over time—it is possible to make a profit by buying in the less-expensive market and selling in the more-expensive one. This price **differential** will disappear as a result, though, as the high price gets pushed down and the low price gets pushed up. In a perfectly efficient market, price differentials shouldn't even exist. The market model can be used for internationally-traded goods as an additional example.

The **Aggregate Expenditure** model links spending and output; as shown here, it is slightly different from the "closed-economy" version that I teach in principles because it includes $(X - M)$. In general, an **open economy** (which allows for trade and capital flows) has different policy results from a closed economy. While I don't spend too much time on this in class, I note that when imports are included, the Keynesian spending multiplier becomes smaller, so initial spending has a smaller effect as additional "rounds" go abroad. The AE curve can be drawn "flatter," but I generally draw it with a smaller slope than its correct value of close to 1, so I don't draw two versions. Mathematically, the multiplier becomes smaller because of the "Marginal Propensity to Import" is introduced; This is similar to the Marginal Propensity to Consume: $MPM = \frac{\Delta M}{\Delta Y}$. If $MPC + MPS + MPM = 1$, $\frac{1}{(1-MPC)}$ is smaller. The main result is the same: Increased spending leads to increased output, but the effect is weaker in an open economy.

The AE model also serves as the foundation of the AD curve in the **Aggregate Demand/Aggregate Supply** model. The AS-AD model shows the effect of fiscal and monetary policy on a country's *output* and *price level*. You could use this model to show this policy in international

macroeconomics if you recognize the link between policy, interest rates, exchange rates, and net exports. Here, we use the DD-AA model; its *DD* curve is also derived from the AE model, only it focuses on the exchange rate instead of prices.

The most important of these models is the **money market**. The "price" of money is the interest rate, which is both the opportunity cost of holding money and the rate of return that attracts investors—both domestic and foreign. The real money supply (nominal Ms divided by the price level) is vertical because it is directly controlled by the central bank. Real money demand $L(r, Y)$ slopes downward with interest rates (people hold more money if the opportunity cost is lower), while income increases shift demand to the right (raising the interest rate). The three tools of monetary policy (the reserve ratio, the discount rate, and open-market operations) can be used to change money supply and the interest rate, which has an effect on Investment, aggregate demand, and the macroeconomy.

The three functions of money can be applied to an international context: The U.S. dollar is a *medium of exchange*; it is used in transactions by numerous countries worldwide. The dollar is also a *unit of account*, measuring wealth and even GDP for countries outside the United States. The dollar is a *store of value*, as it is held by central banks as the world's primary **reserve currency**. The dollar is often held by private individuals in countries whose currencies are depreciating and/or have high inflation.

Besides the four graphical models, two equations are useful in international macroeconomics. The **real interest rate** is the nominal rate minus inflation; sometimes countries have high nominal rates to compensate for rapid price increases. The **quantity theory of money** or **equation of exchange** links a country's money supply to its price level and output. It is useful when evaluating the consequences of exchange-rate policy. A country that buys foreign exchange reserves to keep its currency weak winds up increasing its money supply and fostering inflation. An international parallel to this model is the "Monetary Model" of exchange-rate determination.

3. The Current Account and Capital Flows

The **Current Account** is closely related to *net exports* as a GDP component: $Y = C + I + G + (X - M)$. In intermediate macroeconomics, we learn that the difference between the two is the *net factor payments* received and paid for production abroad. Sometimes this is assumed to be zero. The main determinants of *exports* are foreign income and the real exchange rate: $X = f(Y^F, q)$, while imports are determined by domestic income and the real rate: $M = f(Y^H, q)$.

The current account is a measure of *international borrowing* or lending. If a country has extra savings (it produces more than it consumes), it can export them abroad. Likewise, if it consumes more than it produces (or invests more than it saves), it can finance this through imports. Sometimes Government budget deficits (spending more than tax revenue) are included as well; this is known as the "twin deficits": $(S - I) + (T - G) = (X - M)$.

Exports receive *inpayments*, and imports require *outpayments*. If $X < M$, for example, more money must be going out than is coming in, This is "balanced" by an asset transfer. The **balance of payments** includes the current account, as well as the **capital account** and the **financial account.** The *KA* is relatively small, and often ignored. The *FA* should be equal in size to the CA, but opposite in sign. The naming can be confusing, since they used to be combined, but after they were split, the smaller component kept the name. Sometimes economists still refer to the "capital account," when they mean "financial account" or (the combined "capital and financial account" (*KFA*).

The balance of payments is generally arranged vertically, with all positive values. It is important, besides treating exports as inflows and imports as outflows, to know that financial-account **liabilities** are inflows (increased foreign ownership of domestic assets, which balance trade deficits). A**ssets** are outflows (domestic ownership of foreign assets, which balance trade surpluses). In other words, if a country has a trade deficit, it runs a capital/financial-account surplus, acquiring liabilities as other countries acquire its assets.

A country's changes in its stock of **foreign exchange reserves** can be split off from its capital/financial account; this shows that trade surpluses can lead to reserve accumulation, and deficits can be financed by spending down reserves. This is important for many developing countries, who often export oil or other commodities and build up large

reserves; others buy manufactured goods with foreign exchange, and running out can be a major problem.

The U.S. Bureau of Economic Analysis (*bea.gov*) provides detailed data on U.S. international transactions. Exports and imports can be subdivided by sector, for example.

The main categories of capital flows are **Foreign Direct Investment**, which can involve large (>10%) ownership of a firm, as well as building a new company. **Portfolio investment** involves smaller asset holdings. It is sometimes considered to be more volatile than FDI, since investors can buy or sell these assets more quickly in the face of changing economic or political conditions.

Capital flows have benefits to both the sending and the receiving country. In theory, a country with a low capital stock K will have a high marginal product MPK, and thus a high interest rate. Since the opposite is true for a country with a high K, investors on both sides can benefit if the high-K country sends capital to the low-K country. This is similar to the ideas discussed in international trade theory. A course on international trade might also cover the benefits that this type of investment brings to the receiving country, such as increased managerial skill or technology transfer.

Besides being directly tied to $(X - M)$ and thus GDP, capital flows have an effect on a country's exchange rate. Capital inflows can increase demand and cause an appreciation, while outflows might lead to a depreciation. Portfolio investment, in particular, might be responsible, as a piece of "bad news" might cause investors to flee a country.

To mitigate the effects of these appreciations and depreciations, a country might implement **capital controls**. These are taxes or other restrictions on asset purchases or sales. Tax increases in general raise the price of something and lower the quantity demanded; another type of capital control can be a direct quantity limitation (similar to a quota).

These can be directed towards domestic residents or foreigners, and can be on inward or outward investment. One example might be a mandatory "holding period" between buying and selling another country's stocks. Another might be a small tax on transactions. Or, foreigners might be barred from holding more than a certain percentage of a country's firms' stock.

In the reading list at the end of these notes, Neely (1999) goes into further detail regarding capital controls, and Edwards (1999) discusses their effectiveness in a more academic sense.

4. The Foreign Exchange Market and Exchange Rates

I usually introduce exchange rates in Principles of Macroeconomics, but usually a little review is worthwhile. Exchange rates are the price of one currency in terms of another; as we see in the models in this course, this is directly linked to the two countries' "price of money," as well as the price of goods. Exchange rates rise and fall with interest rates in the short run, and with price levels in the long run.

One major idea is there is no real reference currency—exchange rates can be "upside down" depending on whose currency you are looking at. I write it so that the reference currency is the *denominator*: $E_{¥/\$}$ depicts Japanese yen per U.S. dollar. If this value is 100, we can also say that $E_{\$/¥}$ = 0.0100. Sometimes you might read that the yen "fell to 0.0102," which seems backwards because the given number rose. $E_{H/F}$ is the generic Home currency in terms of one unit of Foreign currency, and equals $1/E_{F/H}$.

A few terms are important: **Spot exchange rates** are quoted now for immediate delivery, while **forward rates** are negotiated in the present at a *future* price. If you think the dollar will be weak in 90 days, you might want to lock in a higher price now. Speculators can try to make money on these predictions, either upward or downward.

Nominal exchange rates (*E*) are the given value, while **real exchange rates** (here given the letter *q*), are adjusted for both countries' price levels. A **bilateral exchange rate** is a two-way price, such as dollars per yen. An **effective exchange rate** is a multilateral price index, with a basket of currencies similar to the one that makes up the CPI. The basket components are often major trade partners, and differ by the company or organization who is creating the index. It is often called a "trade-weighted index," and the weights are often related to trade shares. Major partners get larger weight.

Finally, **cross rates** can be a third exchange rate in terms of another. If \$1 = 20 Mexican pesos and \$0.80 Euros, we can say that 1 Euro equals 25 pesos. Speculators can make money off of **arbitrage**, finding price differences and buying and selling accordingly. If I found that 1 Euro was selling for 24 pesos in a different market, I could buy low, sell high at 25, and make a profit. But this should force the markets to equalize at the same price. Obviously, banks and large enterprises make up most of the private foreign exchange market, though, so I myself would have little effect on these rates.

5. International Parity Conditions: PPP and IRP

Exchange rates are driven by two **parity conditions**, where **arbitrage** leads to price equalization between markets. In the long run, where all prices are flexible, goods prices should be equal. Otherwise, I should be able to buy a good cheaply in one country and sell it for a profit in a more-expensive country. This gap should close as a result, though, as demand increases in the low-price country and falls in the high-price country. In the short run, where goods prices are "sticky," the interest rate is the price that represents the **rate of return** on an investment. Just like with goods, I should not be able to profit off of an investment that pays "too much."

While interest rates and prices can and do move in both of these models, we focus on the *exchange rate* as the variable that adjusts based on these factors. If one country's goods are relatively inexpensive, my demand for them pushes up the exchange rate; the same thing is true for an attractive interest rate.

Purchasing Power Parity (PPP) states that two countries' exchange rate should be equal to the ratio of their price levels. Price increases in a country will weaken its currency in the long run. PPP also gives a relative idea of what a currency "should be" worth. *The Economist*'s "Big Mac Index" gives an example of this.

The three variables can be rearranged to be in terms of the price: One country's P should equal the other country's—but only after one currency is exchanged. Further rearranging can give the **real exchange rate**. If the currency is appropriately valued, $q = 1$. If it is greater or less than this value (depending on the "point of view"), the currency can be **overvalued** or **undervalued**. An overvalued currency is too expensive, so it hurts exports and helps imports, while an undervalued currency does the opposite. I tend to think of q as the ratio between the *actual* exchange rate E and the *theoretical* PPP-based rate P^*/P. If actual ≠ theoretical, the currency is incorrectly valued.

PPP is not really shown to be very valid in real life, so the assumptions of **absolute** PPP can be relaxed (known as **relative PPP**). Here, the equation is given in terms of percentage changes in the exchange rate and price levels, so high inflation leads to a depreciation. Still, evidence supporting PPP is weak. Persistent differences between theory and reality can be blamed on transport costs, taxes, productivity differentials, and non-traded goods.

Interest-Rate Parity (IRP) is based on *perfect capital mobility*, which is a very strong assumption in real life. If capital can move freely, investors will seek the highest rate of return. Besides official capital controls, asymmetric information and people's "home bias" against sending money abroad might help reduce capital mobility. But IRP assumes that there are no barriers.

Under IRP, the (expected) rates of return should be equal between two countries: $r^H = r^F + \%\Delta E$. In the Home country, a Home investor simply earns the Home interest rate. But if they invest in the Foreign country, they hold Foreign currency over time to do so, so they earn the Foreign interest rate as well as *money from any appreciation in that currency*. The IRP equation can be rewritten to show that currency movements are based on **interest-rate differentials**: If Home raises interest rates relative to Foreign, Home's currency should appreciate (and Foreign's should depreciate).

The **IRP Model** of exchange rate determination shows how these rates of return determine the equilibrium exchange rate.

6. The IRP Model of Exchange-Rate Determination

The **IRP Model** of exchange rate determination shows the equality of these rates of return as the intersection between the Home expected rate of return, which is fixed at the Home interest rate, and the Foreign ERR, which depends on the expected appreciation of the currency as well as Foreign *r*. One tricky point is that the *future exchange rate is fixed*: It could be based on PPP or some other expected value. What moves is *today's exchange rate*. If r^F is high, the Foreign currency must depreciate over time—so it needs to be *strong now* so that it has room to fall! That is why, in real life, if the Fed raises rates, the dollar should rise immediately. If investors expect a rate hike tomorrow, the dollar might rise even before anything happens. This is a form of "intertemporal" arbitrage, treating present and future as separate markets, and buying "low" before prices actually change.

This model, which is drawn from the Krugman/Obstfeld/Melitz text, is drawn so that "up" represents a *Home depreciation*. That sort of seems backwards, but it makes sense as long as you keep it in mind and don't confuse "up in value" with "up on the graph."

Increases in the Home interest rate shift ERR^H to the right, so the Home currency appreciates. Increases in the Foreign interest rate shift ERR^F to the right as well, causing the Foreign currency to appreciate, but this curve also incorporates *expectations*. Anything that is "good news" for investments in the Foreign country, or relatively "bad news" for investments in Home, also shift ERR^F to the right and cause the Foreign currency to appreciate.

The Home money market can be added below the main graph by rotating it so that *r*, which is also ERR^H, is shared on the horizontal axis. This shows that the factors that change Home *r*—Money supply and income—also affect the exchange rate. Similar factors are not shown for Foreign, though; they just need to be assumed.

This model shows that increases in Home income, Home *r*, or Foreign Ms, or decreases in Foreign income, Foreign *r*, or Home Ms, cause the Home currency to appreciate (and the Foreign currency to depreciate). So does "good news" at Home or "bad news" in Foreign. Remember that these can be relative though. If Home does well, but Foreign does better, Home's currency might still fall.

7. The Monetary Model of Exchange-Rate Determination

The **monetary model** shows how macroeconomic fundamentals in both countries determine the bilateral exchange rate. It is also useful in showing how monetary policy can be transmitted between countries. It is similar to the *equation of exchange* in that it tells the same story as a more complicated graphical model, but in a simpler way. But this simplicity comes at a cost—the monetary model does not incorporate expectations like the IRP model does.

The monetary model is derived by combining the money market and the PPP equation. Where $Ms = Md$, the equation is rewritten to show each country's price level P. These are placed into the PPP equation to solve for E. (If the two countries' Velocities were the same, you could get a similar result using $P = MsV/Y$.)

This model shows how increases in one country's money supply, relative to the other, causes its currency to depreciate. Relative income growth leads to an appreciation. These changes are relative: If the Home country increases Ms by 3%, but the Foreign country increases in by 5%, this still should lead to a Home appreciation.

8. Exchange-Rate Regimes and Maintaining a Fixed *E*

Textbooks often focus mainly on **floating exchange rates** (which move entirely based on market forces, with no intervention) and **fixed exchange rates** (with no deviation from the central bank's set peg). In reality, between the two lie the **managed float**, under which the central bank intervenes somewhat; and a **peg-and-band**, which allows for some deviation from the target. The "band" might be a certain percentage above and below the peg; sometimes this is widened if the currency keeps moving too far. If the peg is raised to a stronger rate, the currency is **revalued**; if a weaker target is chosen, the currency is **devalued**. Some countries with high inflation or weak fundamentals have constantly depreciating currencies, so their monetary authority might choose a **crawling peg**; this devalues the currency in a way that investors can predict.

It is often difficult to tell the difference between the intermediate regimes between fixed and floating. The IMF and other economists analyze countries' true regimes. As Calvo and Reinhart (2002) note, some countries *say* they float their currencies—putting them more in line with market forces—but in reality they do not.

Even more fixed than "fixed rates" are a **currency board**, where a country issues its own currency but backs it up on its balance sheet with another country's currency. This might allow a developing country, which would otherwise suffer from high inflation, to "import" another country's monetary policy. A country could also directly circulate another country's currency in place of its own, which is known as **dollarization**. Panama and Ecuador do this, for example, but they do not coordinate with the United States. The Eurozone, however, has a **common currency** and a common central bank.

Because weak pegs can eventually be broken—particularly by speculators who stand to profit—economists (as explained by Fischer, 2001) often think that two extremes are preferred: free float and hard peg. Each exchange-rate regime has its own costs and benefits. Calvo and Reinhart (2002) and Bernanke (2005) discuss the tradeoffs faced by emerging markets. Fixed exchange rates allow for less uncertainty regarding export revenue or the cost of debt. Floating exchange rates can be highly **volatile**, this represents a type of risk that might deter

international trade. Fixed exchange rates allow for the transmission of economic shocks that floating rates might better absorb. In general, large countries with large, diverse economies such as the U.S. and Japan have floating rates. Many economists (such as Obstfeld and Rogoff, 1995; or Bernanke, 2005) advocate for floating rates. An important cost is that fixed rates also require that reserves be accumulated or spent to maintain them.

One key concept in international finance is the mechanism by which fixed exchange rates are maintained. The "textbook" method is through foreign exchange reserves (in real life, central banks can also use open-market operations). To keep its currency from appreciating, the central bank will **buy reserves**. On the balance sheet, domestic money supply will increase (unless the central bank *sterilizes* the purchase by selling domestic assets), which causes inflation. To stop a depreciation, the central bank **sells reserves**. This lowers *Ms*, which raises *r*—according to IRP, this should keep the exchange rate strong.

This can be shown in the IRP model. If Home's currency "wants" to fall (say, because ERR^F increase), the reserve sale reduces *Ms*, which raises r and ERR^H. E^* is unchanged. The drawback of maintaining this fixed rate, though, is that this is contractionary.

This brings up another concept that drives international macroeconomics is the **Open-Economy Trilemma**. A country can choose two of the three: 1) a fixed exchange rate; 2) free capital movements; and 3) an independent monetary policy. Choosing $\bar{E}$ meant that the country suffered an unwanted contraction—policy could only be used for one goal.

The Trilemma can also be shown by the IRP equation: $\%\Delta E = r^H - r^H$. Without free capital movement, this equation doesn't even exist; r can differ across countries because there is no way to arbitrage. If exchange rates are fixed, $\%\Delta E = 0$, so Home can't raise rates independently. If Foreign raises rates, Home must follow. If Home does raise interest rates to fight inflation, its currency must appreciate.

9. International Policy Transmission

The main international macroeconomic equations—PPP, IRP, and the Monetary model—can be used to show the **transmission** of macroeconomic policy from one country to another. This depends on the exchange-rate regime; we get different results depending on whether the exchange rate is fixed or is allowed to float.

If the exchange rate floats, changes in one country's money supply, interest rate, or price level (and output, as well) can cause its currency to appreciate or depreciate. This will have an effect on the other country's exports and imports. A Home monetary expansion, for example, will depreciate Home's currency—which is an appreciation from the Foreign point of view. This will hurt Foreign's trade balance and contract its economy. Home, then, is expanding its economy at the expense of Foreign's.

If the exchange rate is fixed, we can set $\%\Delta E = 0$ or $\bar{E}$ as unchanging on the left-hand side. Any changes on the right-hand side of an equation need to be balanced on the right-hand side, so that there is no change overall. In the monetary model, an increase in Home *Ms* will be matched by an increase in Foreign *Ms*. Foreign's policy is dictated by Home. Inflation and interest-rate hikes can be shown to spill over in the IRP and PPP equations. It is important to note that a flexible exchange rate *restores equilibrium*, and if it does not, *something else will*. If a country's ($X < M$) for example, its exchange rate should depreciate. But if E is fixed, *goods prices might adjust instead*. Deflation will adjust q (and competitiveness), but this adjustment can be uneven and painful.

Exchange markets can experience **contagion**—comovements in excess of what is predicted by the fundamentals. Economists debate what exactly determines such an event, but one well-known example is the spillovers from Asia to Russia and Brazil following the 1997 Asian Crisis. One cause could be investors having to pull funds from still-well-performing markets to cover losses in other markets; others could involve trade and financial linkages among countries. I tend to focus on investor behavior and psychological factors. For example, investors might treat all "emerging markets" the same and pull funds from all of them at once due to a lack of detailed information. Or, panic or "herding" behavior might cause a sell-off to spread for non-economic reasons. One interesting academic article is by Kaminsky *et al.* (2003), who discuss some earlier contagion episodes and their possible causes.

10. The DD-AA Model in the Short Run

The **DD-AA Model** shows simultaneous equilibrium in the *goods market* and the *asset market*, and depicts equilibrium combinations of output and the exchange rate. Shifts in policy (both fiscal and monetary) can cause GDP to increase or decrease, and the exchange rate to appreciate or to depreciate.

The *DD* curve represents goo**D**s market equilibrium; it is derived from the AE model. As E rises (the currency depreciates), net exports increase, and aggregate expenditure increase. All subsequent (E, Y) combinations are represented on this upward-sloping graph. Shifts in real spending (including *C*, *T*, autonomous *I*, or *G*) shift the DD curve. I focus mostly on *temporary* shifts (but discuss *permanent* shifts next); in the graphs below, a temporary fiscal expansion shifts *DD* to the right, leading to output growth and a currency appreciation.

The *AA* curve represents **A**sset market equilibrium; it is derived from the IRP model. If income increases, $L(r, Y)$ increases in the money market. As a result, r rises and E appreciates. This downward-sloping graph has all the (E, Y) combinations that capture the equilibrium between ERR^H and ERR^F. Shifts in the money supply shift the *AA* curve; the graph below shows how an increase in *Ms* leads to an increase in Y and a weaker E.

An additional relationship that can be added, but that I don't focus too much on, is maintaining a fixed trade balance through the *XX* curve. This slopes upward, but is flatter than *DD* because a small depreciation will have a large effect on $(X - M)$. A relatively large increase in Y is needed to balance this out and restore equilibrium.

With fixed exchange rates, reserve purchases and sales affect *Ms*, which moves *AA*. Following a policy that affects GDP (expansionary or contractionary), this additional movement can *counteract* or *augment* the intended policy. On the graphs below, a fiscal expansion with a fixed E would cause an appreciation, but the central bank buys reserves, pushing *AA* to the right. Output expands more than intended (which can be inflationary). A monetary expansion with a fixed exchange rate is impossible: Increasing *Ms* leads to a depreciation, with is fought by reserve sales—and a reduction in *Ms*. The *AA* curve doesn't move at all. This matches the Open Economy Trilemma—the country chooses international policy over domestic policy.

11. The DD-AA Model in the Long(er) Run

The *DD-AA* model can be expanded to include **expectations** as well as economic **adjustment**. This is essentially a two-period model, with fiscal or monetary policy implemented *now*, and adjustment accruing over time; when we get to *later*, the curves look very different than they would if the shift were only temporary. Plus, even knowing that there *is* a "later" changes "now." Permanent policy changes have more shifts in the curves than do temporary changes.

Changes in expectations occur in the ERR^F, which shifts *AA* immediately. The main variable that adjusts over time is the price level, which is also part of *AA*. As a result, a policy change can cause additional shifts in *AA* both *now* and *later*.

A permanent fiscal expansion is more straightforward, and matches the predictions of Classical economics. *DD* shifts right, which causes the currency to appreciate. But investors know this, so expectations change immediately, and this appreciation is "factored in." This lowers ERR^F and moves *AA* to the left. With these two shifts combined, output is unchanged, while the currency has appreciated strongly.

A permanent increase in Home *Ms* is more complicated. This shifts ERR^H and *AA* to the right as expected, but investors know the currency is depreciating—so ERR^F shifts to the right because Foreign investments look better. This causes an extra-large currency depreciation for Home. Over time, though, *P* increases. This cancels out in the money market, returning ERR^H to its original position, but things are never really "back to normal." Expectations are permanently better for Foreign—ERR^F does not shift back—so *AA* only shifts partway back. At the same time, *DD* shifts left, because real spending declines due to inflation. The end result is no change in *Y* and a weaker *E*.

The large depreciation followed by partial reversion follows Dornbusch's "Overshooting" model, where expectations and sticky prices combine to cause the exchange rate to overcompensate following a shift. Since *E* must do all the adjusting, it moves extra until *P* catches up.

Included below is a graph with the "full system" of markets in the DD-AA model. The Goods market is shown in the AE model above the main graph, while the Asset and Money markets are shown to the right. This is useful when visualizing the causes behind shifts in *DD* and *AA*.

12. Managing the International Monetary System

There is no single world currency, or organization that coordinates currencies—in fact, monetary policy works better for small areas with unique macroeconomic conditions. There have been a number of formal and informal currency arrangements, however.

In the pre-modern period, currencies competed with one another and did not correspond to national territories like they do today. Trusted coins could drive others from the market, although inflation could be a problem if people shaved off coins to make them contain less precious metal. In that case, people might hold trusted coins and remove them from circulation. Money eventually began to be controlled by governments, for political symbolism and because of **seigniorage**, the benefits that countries get from issuing currency. While central banks originally did little in the way of macroeconomic management, today money is an important tool in controlling inflation and unemployment.

I divide the modern period into four key periods. Each chose its own two elements of the *Open-Economy Trilemma*. These are:

1) The pre-WWI **Gold standard**. Major countries such as Britain and the United States made their currencies convertible to gold at a fixed price; this promoted economic stability. Money could not be issued as a liability on the balance sheet unless gold was held as an asset. Sterling, for example, was convertible at £1 = 113 grains of gold; $1 was worth 23. With 480 grains per ounce of gold, 1oz = £4.25 = $20.67. Pounds could therefore be exchanged for dollars at £1= $4.85. Gold was able to flow between countries; if the exchange rate appreciated above shipping costs, gold flows would bring the exchange rate back in line through arbitrage. The mechanism is also self-correcting in a Classical sense: IF M > X, gold flows out to pay for imports, which reduces Ms; this contraction lowers imports, and deflation might maxe exports more competitive.

   Having chosen fixed exchange rates and free capital movements, countries under a gold standard had no independent monetary policy. The Gold Standard ended with WWI. In general, wars are inflationary, as countries need to pay soldiers and fund the war effort. They can't increase *Ms* without issuing some sort of paper currency.

2) The **interwar period** that lasted until WWII was known for instability, including economic conflicts, such as trade wars, that preceded military conflict. Many countries went back on the gold standard, but at overvalued currencies that didn't reflect the fact that wars weaken

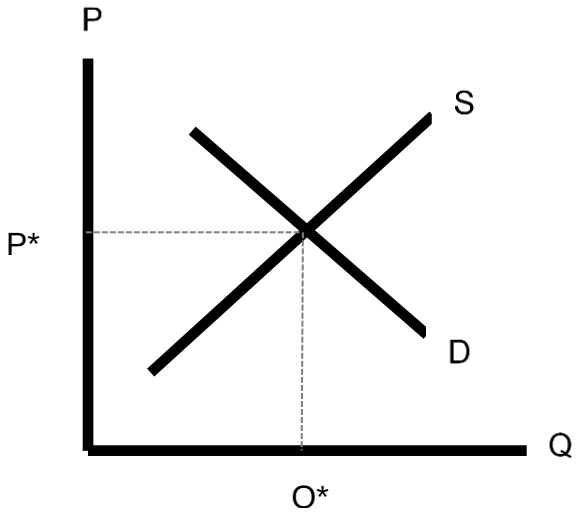
currencies. This hurt their trade balances, so countries implemented **competitive devaluations** that made their trade partners' currencies appreciate. Some economists believe that the Great Depression lasted longer for countries on the gold standard. Capital mobility was often limited; countries made different choices regarding the Trilemma at different times.

3) Toward the end of WWII, the future victors met in New Hampshire to devise a system that would be more stable than the post-WWI chaos. The **Bretton Woods** system was centered around the dollar, which was pegged to gold at $35 per ounce. Other currencies pegged to the dollar. They could have independent monetary policies because capital flows were relatively limited. The system also instituted the **International Monetary Fund**, which was originally intended to support fixed exchange rates, as well as the **World Bank.** Bretton Woods lasted until 1973; the U.S., as the center of the system, could not fund the Vietnam War and social policy under a Gold gtandard, so President Nixon ended the convertibility of dollars for gold.
4) The current system is dominated by floating exchange rates with no set value. The dollar is still the dominant currency, although people often ask which currency might replace it (the Euro, the renminbi, virtual currencies, etc.), like the dollar supplanted sterling in the past. Some developing countries might peg their currencies, but as Bernanke (2005) notes, capital mobility and floating rates are preferred. In the Trilemma, then, independent monetary policy is chosen. But currencies are much more volatile than in the past.

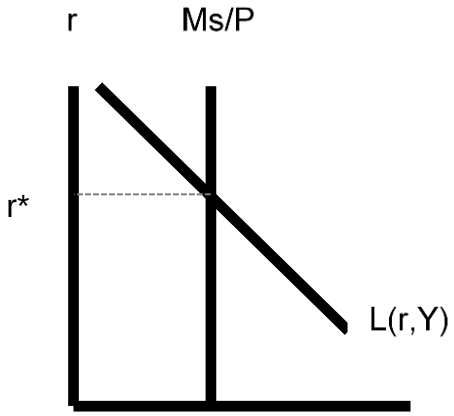
   There are some examples of international policy coordination and transmission in recent decades. A classic is the 1985 Plaza Accord, where world central bankers agreed to intervene in currency markets and weaken the dollar. I focus on the pre-Euro European Monetary System (EMS), and how Germany's contractionary policy following reunification spilled over to Britain.

   I also talk about the European Union as a political, rather than an economic, institution. In fact, Mundell (1961) predicted that such a bloc might be too large to function effectively. If some areas suffer from inflation and others from unemployment, a single monetary policy cannot solve both. Other means, such as fiscal transfers, price-level adjustment, or interstate labor mobility would have to do the job of adjustment. The 50 United States, which share the dollar, better fit the description of an Optimal Currency Area.

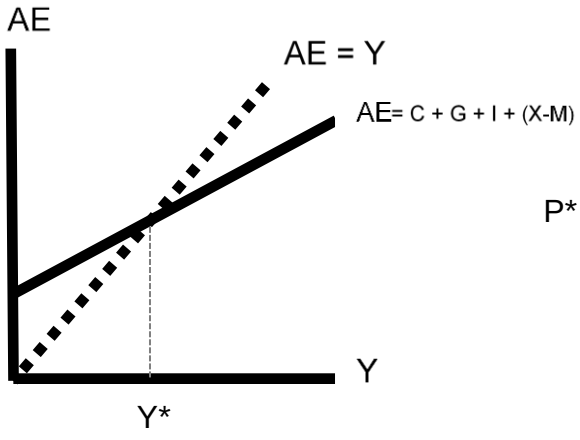
ECON 321 NEIU Macroeconomic Models (Principles)



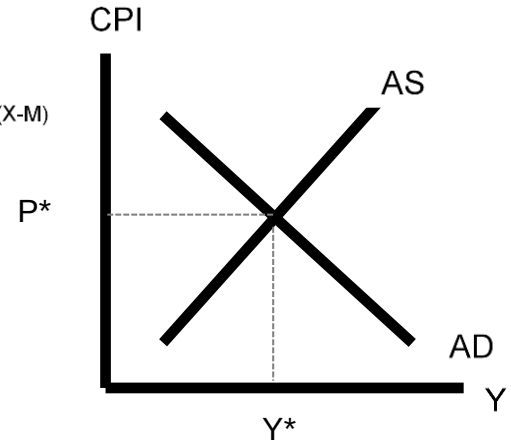
Basic Market



Money Market



Aggregate Expenditure
("Keynesian Cross")



Aggregate Supply/Aggregate Demand

Equation of Exchange: $M_sV = PY$

Real interest rate = Nominal r — π

ECON 321 Formulas and Graphs NEIU Hegerty

Balance of Payments:

$CA + KFA = 0$ or $\Delta RES = CA + KFA$ $\qquad (S - I) = (X - M)$

Purchasing Power Parity

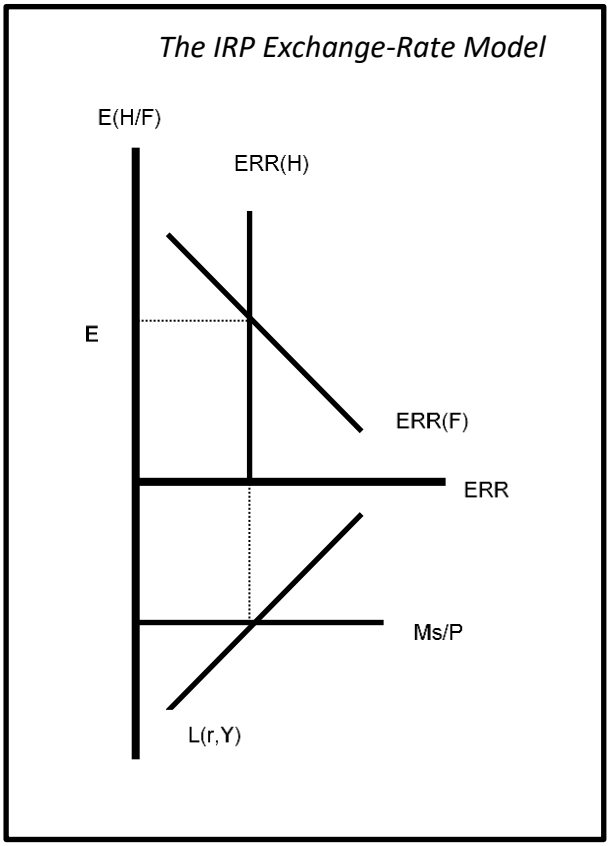
$$E_{H/F} = \frac{P^H}{P^F} \qquad \%\Delta E = \pi^H - \pi^F \qquad q_{H/F} = E_{H/F}\frac{P^F}{P^H}$$

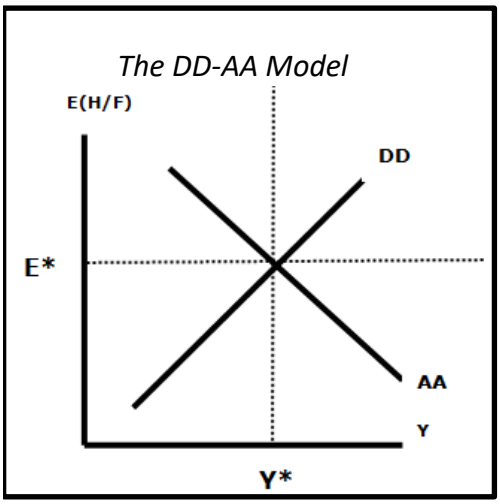
Interest-Rate Parity

$$\%\Delta E = r^H - r^F$$

The Monetary Model

$$E_{H/F} = \frac{Ms^H}{Ms^F}\frac{L(r^F, Y^F)}{L(r^H, Y^H)}$$





Fixed Exchange Rates and Monetary Policy

Central Bank Balance Sheet

Assets	Liabilities	
Bonds	Currency	(Ms)
Forex	Reserves	

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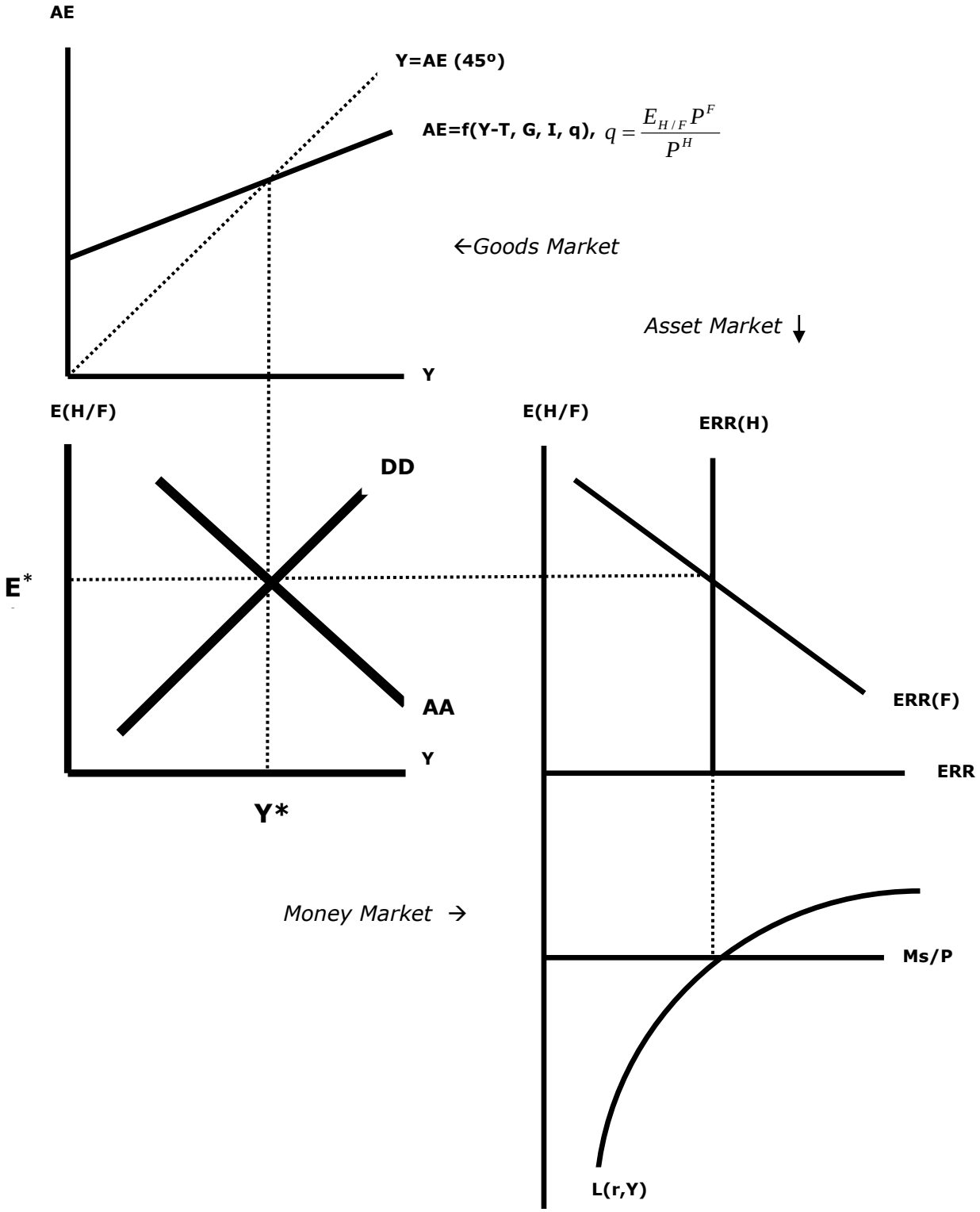
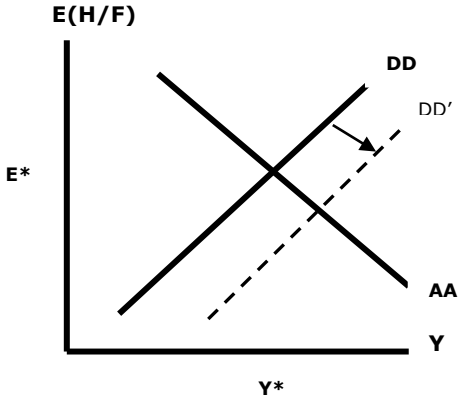
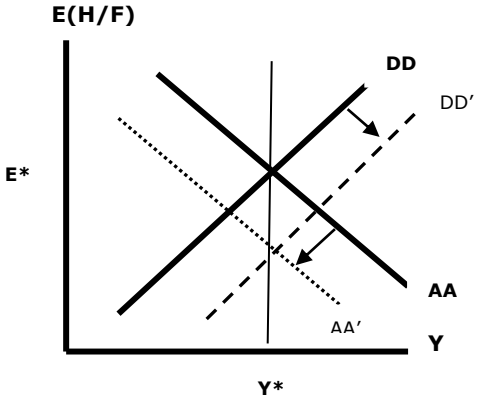
The DD-AA Model: Output and the Exchange Rate in the Short Run



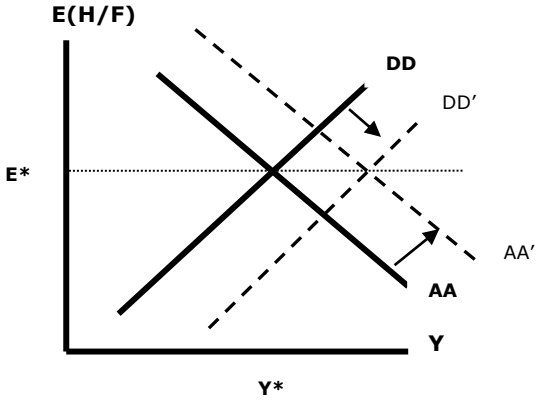
ECON 321 NEIU Summary of Policy Results With the DD-AA Model



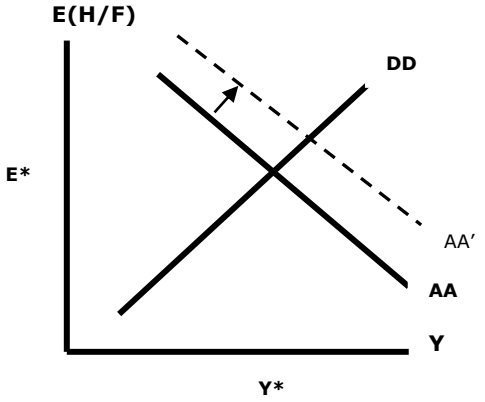
Temporary Fiscal Expansion



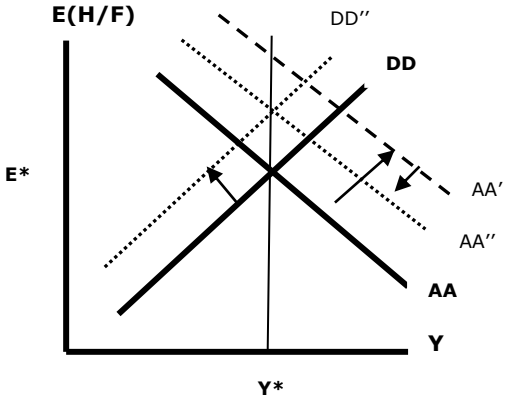
Permanent Fiscal Expansion



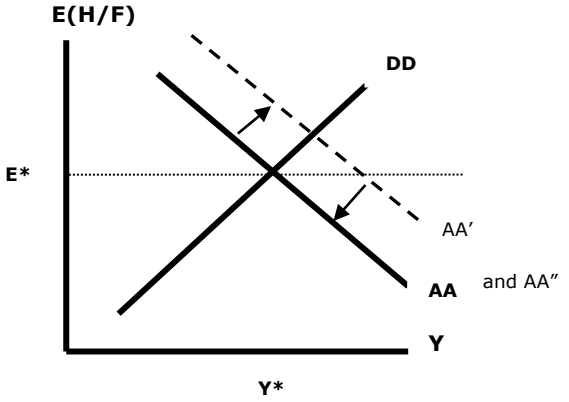
Fiscal Expansion With Fixed Rate



Temporary Monetary Expansion



Permanent Monetary Expansion



Monetary Expansion With Fixed Rate

Additional course topics include: **Understanding a bank report**, which gives an analysis of a country's economic performance, global trends, and monetary policy; and a **data exercise**, which allows students to gather and analyze statistics to test some of the theories outlined in class. I usually include some examples that use the software R to examine concepts such as PPP. In-depth discussion of the **article readings** is also beneficial for a face-to-face class.

Additional Readings:

Krugman, P., M. Obstfeld, and M. Melitz (2018) *International Economics: Theory and Policy*, Pearson. This is the 11th edition, but I think even I use an older one! Usually I allow previous versions published after 2009.

Bernanke, B.S. (2005), "Monetary Policy in a World of Mobile Capital," *Cato Journal* 25(1), 1-12, Winter.

Calvo, G.A. and C.M. Reinhart (2002), "Fear of Floating," *The Quarterly Journal of Economics* 117(2), 379-408.

Edwards, S. (1999), "How Effective are Capital Controls?" *Journal of Economic Perspectives* 13(4), 65-84.

Fischer, S. (2001), "Exchange Rate Regimes: Is the Bipolar View Correct?" *Journal of Economic Perspectives* 15(2), 3-24.

Kaminsky, G.L., C.M. Reinhart, and C.A. Vegh (2003), "The Unholy Trinity of Financial Contagion," *The Journal of Economic Perspectives* 17(4), 51-74.

Mundell, R. (1961), "A Theory of Optimal Currency Areas," *American Economic Review* 51(4) 657-665.

Neely, C.J. (1999), "An Introduction to Capital Controls," *Federal Reserve Bank of St. Louis Review*,13-30.

Obstfeld, M. and K. Rogoff, (1995), "The Mirage of Fixed Exchange Rates*" Journal of Economic Perspectives* 9, 73-16.