Economics 1011B
Section 10: Open Economies

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Today's Outline

- New Ideas
  - Exports, Imports, Net Exports
  - Exchange Rates
- Law of One Price
- (Uncovered) Interest Parity
- The Monetary Trilemma
- Exchange Rate Overshooting
- Bonus Slides: Exchange Rate Forecasting

Motivation

- Until now, we have considered models of economies that do not engage in international trade.
- In the real world, trade across countries is hugely important!
  - US GDP in 2021: $23.92 trillion
  - US exports in 2021: $1.76 trillion
  - US imports in 2021: $3.39 trillion
- International trade is important for both long-run growth and business cycles in nearly all modern economies.
- We will need to develop some new terms and concepts in order to incorporate trade into our models.

Motivation

- The simplest way to incorporate international trade in our models is to consider a two-country model, where we only consider trade between a "home" country and "foreign" country (i.e. everywhere else).

- Of course, this is just a simplifying abstraction: nothing would prohibit us from extending our models to cover any number of countries.

- The two-country case will provide all the intuition we will need to think about net exports, exchange rates, capital flows, and other concepts that come up in open economies.

Exports and Imports

- Exports: The value (in local currency units, i.e. dollars) of all goods and services that are produced at home and sold abroad. In our models, denote exports as X_t.

- Imports: The value (in local currency units, i.e. dollars) of all goods and services that are produced abroad and purchased at home. In our models, denote imports as IM_t.

- Net Exports: Exports minus imports. The value (in local currency units, i.e. dollars) of dollars that flow into the country. Denote as $NX_t = X_t - IM_t$.

- In the presence of open economies, GDP can be written as the sum of consumption, investment, government expenditure, and net exports. This is an accounting identity - it is true by definition of its components. We have used this in several of our models.

$$Y = C + I + G + NX$$

Savings, Investment, Net Exports

- How do net exports interact with the rest of the components of GDP? One useful way to think about it is using what are called accounting identities.
- Domestic private savings is output minus taxes and consumption: $S_{\text{domestic}} = Y - T - C$.
- Domestic government savings as taxes minus government spending: $S_{\text{govt}} = T - G$.
- Define total domestic savings as private plus private savings: $S = S_{\text{domestic}} + S_{\text{govt}} = Y - C - G$.
- Recall GDP in an open economy is $Y = C + I + G + NX$.
- Rearrange, plugging in S: $S - I = NX$. In a closed economy, $S = I$.
- Interpretation: if $NX < 0$, home country buying more from abroad than it sells. $S - I$ must be negative, must be borrowing from abroad.

Nominal Exchange Rate

- Different countries often (not always) have distinct currency units that their goods are priced in. You probably have encountered this if you travel abroad.

- You are most used to the nominal exchange rate: what is the "going rate" by which I can trade units of one currency (i.e. US dollars) into another currency (i.e. Japanese yen)?

  Nominal exchange rate $= e =$ units of foreign currency per unit of local currency

- "How many euros can I get per US dollar?"

Real Exchange Rate

- The nominal exchange rate tells you about how the relative price of currencies varies, but does not tell you how purchasing power varies across countries.

- The real exchange rate is the nominal exchange rate times the relative price of goods across countries:

$$\text{Real exchange rate} = \epsilon = e \cdot \frac{P}{P^*}$$

"How many Big Macs does my dollar get in Paris vs. New York?"

- Nominal exchange rates measure the "relative price" of two different currencies. Real exchange rates measure the "relative price" of goods in two countries.

Exchange Rate Appreciation vs. Depreciation

- A (home) currency is appreciating (vis-a-vis some foreign currency) if e goes up.
- If the USD appreciates vs. the Japanese yen, you get more yen per dollar.
- Appreciation of the dollar is a good thing if you are a US traveler planning a trip abroad – you have higher purchasing powwer!
- Appreciation/depreciation can be confusing. If we defined e the opposite way - units of home currency per unit of foreign currency (which we will be careful NOT to do in this course, but you may see in real life), then appreciation of the dollar would be a decline in e.
- How do you keep this straight? My preferred way to think about it: an appreciating USD is *good for a US traveller planning a vacation abroad*.

Euros per USD (nominal exchange rate) Over Time

Exchange Rates and Net Exports

- What happens when the US real exchange rate appreciates?
- Foreign goods become relatively cheap (which is why it is good to travel abroad when a currency has appreciated), which means US goods become relatively expensive.
- So domestic consumers substitute toward foreign goods $\implies$ imports go up.
- And foreign consumers substitute toward foreign goods $\implies$ exports go down.
- Hence $NX = X - IM$ unambiguously goes down.

Exchange Rate Determination

- What determines exchange rates? This depends somewhat on the particular currency.
- Virtually all currency these days is called fiat currency - value is implicit in that it is endorsed by the government as a medium of exchange.
- In the past, many countries explicitly tied the value of their currency to physical goods. Famous example is the gold standard: fixed ratio of gold / other precious metal per unit of currency, so value of currency fluctuates with value of gold.
- In my view (reflecting broad consensus among macroeconomists), shift away from the gold standard one of the great achievements and virtues of 20th century monetary economics.
- Much of the world operated on the gold standard $\implies$ fixed exchange rates across countries (why?)
- Nowadays, value determined by markets (floating exchange rates - with exceptions).

Exchange Rate Determination

- For a set of countries with fiat currencies, exchange rates largely determined by financial markets - unless governments/central banks intervene.

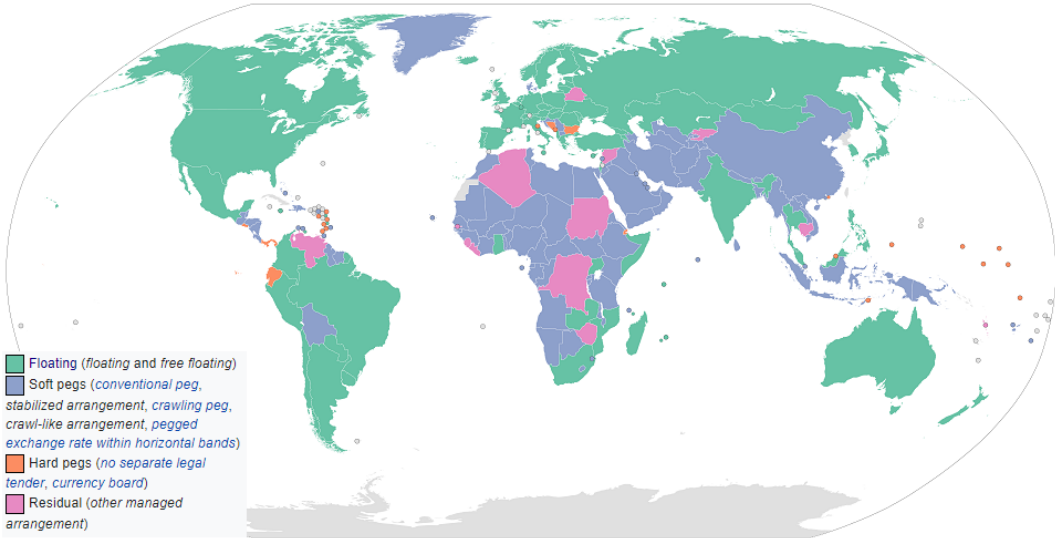
- Even though virtually all countries now use fiat currency rather than a gold standard, it is still possible for governments to intervene in financial markets to "fix" (sometimes called "peg") exchange rates.

- Suppose the US wants to make the dollar **depreciate** vs. Euro. U.S. Treasury mints new dollars, buys Euros through financial markets. Increases demand for Euros and supply of dollars available on markets. The Fed is said to have accumulated foreign reserves.

- Reserves can then be used by the central bank to "prop up" their currency if it devalues rapidly.

- Many countries operate "soft peg", i.e., intervene such that there is an approximately fixed exchange rate between their currency and the USD.

Exchange Rate Regimes Across the World



International Arbitrage

- When we consider an open economy, it is important to keep in mind that even if the two countries produce and consume exactly the same basket of goods, those countries might differ in at least three important respects:
  1. Their nominal interest rates might differ.
  2. Their price levels might differ.
  3. Their currencies might differ (and $e \neq 1$).

- Note that even if $e = 1$, we might have $\epsilon \neq 1$ if $P \neq P^*$. (Lots of jargon in this sentence: try to think about what it means!)

- We will keep in mind two types of "arbitrage" strategies that will link up these quantities across countries if people are smart. When we say "arbitrage", think of an opportunity to make free money.

Law of One Price (LOOP)

- Consider a good that is produced and sold in many countries, like Big Macs. Suppose it is costless to hold on to them and ship them anywhere to sell.

- Big Macs costs 5 Euros in Berlin and \$4 in Central Square. Suppose that the nominal Euro-USD exchange rate $= 1$. Then an arbitrage opportunity exists: people should buy Big Macs in Central Square and sell in Berlin, earn 1 euro $= 1$ USD free money per burger sold, not producing anything.

- This "arbitrage opportunity" should compel people to do this until they disappear: increased demand for Big Macs in Central Square and increased supply in Berlin.

- This is the so-called "strong form" of the law of one price. In the real world, costs associated with shipping and storage can allow for a wedge to exist between the real price of a given good when measured in common currency units.

Interest Parity

- Suppose you're a risk-neutral investor who is deciding whether to invest 1 USD bonds from one of two countries (say, US and German bonds).
- Strategy #1: Invest in US bonds at date $t = 0$.
  - Return of $1 + i_{0,1}$ dollars
- Strategy #2: Invest in German bonds at date $t = 0$.
  - Return of $e_0(1 + i^*_{0,1})/e_1$ dollars.
  - Why? Each euro invested yields return of $1 + i^*_{0,1}$... but you start with one dollar!
  - Need to convert US dollars in period 0 into euros, and then convert $t = 1$ return back into dollars.
- At an optimum, household is indifferent (otherwise, they are not doing the right thing):

$$(1 + i_{0,1}) = (1 + i^*_{0,1})\frac{e_0}{e_1}$$

- Rearranging, taking logs, defining $\%\Delta e = ln(e_1/e_0)$: $i_{0,1} \approx i^*_{0,1} - \%\Delta e$

Interest Parity and the Monetary Trilemma

- Interest rate parity is an important idea because it suggests that arbitrage in bond markets might link up the two seemingly unrelated concepts of interest rates and exchange rates.

- The idea of interest parity is itself a deep idea for a number of reasons (and Harvard PHDs have recently been thinking a lot about it empirically - for instance, this paper). If investors can freely invest in bond markets at home and abroad, we say that there is perfect capital mobility (why?)

- The idea of interest parity is also useful in motivating what is sometimes called the **monetary trilemma**, which states that a country cannot accomplish all three of the following at once:
  - Fixed exchange rates ($\%\Delta e = 0$)
  - Independent monetary policy ($i \neq i^*$)
  - Perfect capital mobility (interest parity holds)

- The monetary trilemma is a consequence of interest parity.

Dornbusch Overshooting Model

- Dornsbusch 'overshooting' model: beautiful insight, hugely influential in international finance. Follows from law of one price, sticky prices, and interest parity.

- Motivating question: why are exchange rates *so darned volatile* in the short-run?

- Dornbusch's answer: law of one price, interest parity tell us that nominal exchange rates may 'overshoot' in the short-run in response to changes in fundamental shifters of the economy.

- We will consider a simple case. Suppose the Fed decides to engage in temporary expansionary monetary policy by suddenly reducing the interest rate. This boosts output (e.g. in IS-MP or in our NK model), and through Phillips curve logic eventually results in inflation and a rise in the price level.

- Now how does this impact exchange rates?

Dornbusch Overshooting Model: Long-Run

- Recall the definition of the real exchange rate: $\epsilon = e \cdot \frac{P}{P^*}$
- Suppose the *real* exchange rate was initially 1 (could be any constant, convenient to normalize): $\epsilon_0 = 1$.
- If the law of one price holds, we should expect that the nominal interest rate will adjust in the long-run so that the real exchange rate eventually returns to 1: $\lim_{t \to \infty} \epsilon_t = 1$.
- Why? If the real exchange rate did not return to ϵ_0, an arbitrage opportunity exists: import/export goods from abroad to sell at a higher price.
- If the price level abroad does not adjust, this implies (by the definition of the real exchange rate) that the nominal exchange rate will be permanently **lower** in the long-run.

Dornbusch Overshooting Model: Short-Run

- Now recall interest parity:

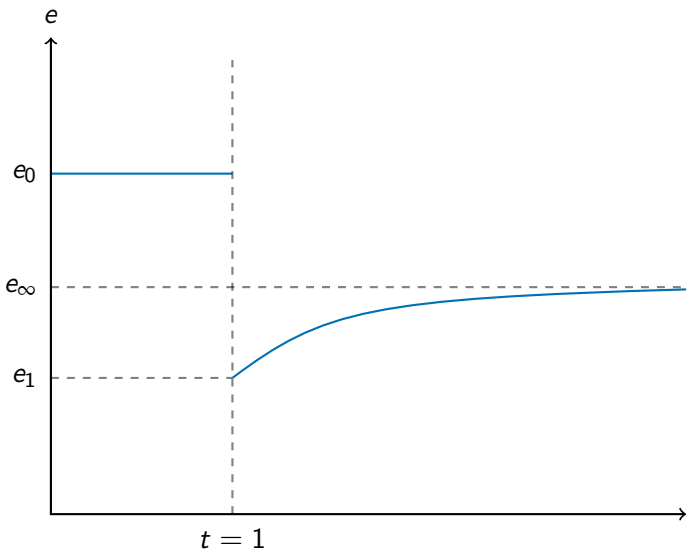
$$i_{0,1} \approx i^*_{0,1} - \%\Delta e$$

- If $i_{0,1}$ goes down and $i^*0,1$ stays fixed, we must have $\%\Delta e > 0$ for uncovered interest parity to hold.

- Thus, on the transition to the new steady state (long run), the home currency must be appreciating.

- The only way for dollar to be appreciating in the transition to a new, *lower* e is for the nominal exchange rate to *overshoot* in response to the initial shock to i: that is, the nominal exchange rate must initially fall *below* its long-run level.!

Dornbusch Overshooting Model



Start with some initial e_0 and $i = i^*$.

$t = 1$: $i \downarrow$ causes $\pi \uparrow$ and thus $P \uparrow$.

By LOOP, ϵ will return back to initial value in the long-run. Since prices rose permanently, definition of ϵ implies that long-run $e \downarrow$, $e_\infty < e_0$.

By UIP: e must appreciate for $t > 1$.

Only way to get appreciation is if $e_1 < e_\infty$: "overshooting"

Bonus Slides

Bonus Slides: Exchange Rate Forecasting

- Wouldn't it be nice to forecast exchange rates, so that you could plan out your fancy vacations in advance and get the most bang for your buck abroad?

- The Federal Reserve thought so, too. Back in the early 1980s, they assigned a young staff economist at the Fed, Ken Rogoff, to come up with an exchange rate forecasting model.

- Meese and Rogoff (1983, link): a "random walk" model of the exchange rates - where the guess for the exchange rate tomorrow iw simply the exchange rate today - fits just as well as any economic (or time series) model for short horizons (< 1 year).

- Clearly implies that exchange rates are difficult to forecast. It also suggests that our models (at least, the models in 1983) are missing something important about explaining how exchange rates fluctuate over the short-run (i.e. month-to-month changes).

Bonus Slides: Exchange Rate Forecasting

- This paper made Ken Rogoff (now at Harvard) famous overnight and he wound up writing a ton of papers thinking about factors that influence exchange rates.

- This literature is more voluminous than can possibly be summarized on a single slide, and historically has been about half of the field of international finance (the College offers courses in this if you are interested).

- Determining exchange rates hugely important for government agencies (who can use this information to conduct better monetary policy) and for private industry (banks can use this information to make a lot of money in financial markets).