Lecture 6: Exports, Imports, and Financial Markets

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What are we doing?

- Up until now we've been focusing on the macroeconomics of a single country that does not deal with the rest of the world
  - When exports and imports have shown up, they've been a footnote at best
  - No real theory of how changes in policy could affect them
- Now, we're adding the world back in
  - Add exports, imports, and international financial markets back into our standard macroeconomic model
  - Study how they're determined in an open economy
- As we move on to later weeks, we'll eventually be able to study how the economy changes in the short/long run, and the impacts of changes to exchange rate policy/monetary policy on the economy

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Key Assumptions

- We're going to assume that we're looking at a **small open economy**
  - An economy that trades with the rest of the world
  - but is not big enough to affect it in the aggregate

    This is a bit like assuming that a worker or firm is atomistic – nothing they do can affect aggregates
  - Everyone takes foreign prices/interest rates as given
- Three main markets:
  1. Goods markets – assume they are integrated

     Households and firms can trade freely across borders, but different countries produce differentiated goods
  2. Financial markets – assume they are integrated

     Everyone can borrow and lend across borders
  3. Labour markets – not integrated

     We assume that labour is entirely immobile
- Not a good assumption for the largest countries, but a good baseline to start with

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Section 1

The Real Exchange Rate

Differentiated Goods and their Prices

- We're assuming that goods can be traded across borders, but that different countries produce differentiated goods
  - Example: BMW (German) vs Volvo (Sweden)
  - Note: some foreign companies produce their cars in many different countries. (Toyota has factories in the UK)
  - Because goods are different, their prices don't have to be the same
  - The law of one price does not have to hold
- **Key Question:** How expensive are cars in the US vs. the UK?
  - Can you just use the nominal exchange rate? (i.e, £1 = \$1.2)
  - Need to account for the fact that cars have different prices in each country
  - The rate at which I can exchange cars in the US for cars in the UK will be *different* than the rate at which I can exchange dollars for pounds.

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The Real Exchange Rate

- We need a little bit of notation before we can proceed. Pick a good (like cars):
  - P is the price of the good produced at home in domestic currency
  - $P^\star$ is the price of the good produced abroad in foreign currency
  - e is the nominal exchange rate (price of domestic currency in terms of foreign currency)
  - ε is the real exchange rate (price of domestic goods in terms of goods produced abroad)
- How do you convert a car in the UK to a car in the US?
  - Step 1: Sell the car at price P (in GBP)
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- This means that the **real exchange rate** is

$$\varepsilon = \frac{eP}{P^\star} \tag{1}$$

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Problem #1: Countries trade many different goods

- If we want to think about *macroeconomics*, it would be useful to abstract away from needing to deal with all of these different types of goods
- We want a single measure of prices in the UK
- Average prices together into a single **price index**
- This will be our domestic price index P
- Weight roughly by share of consumption (exact details of price indices are *very complicated*)

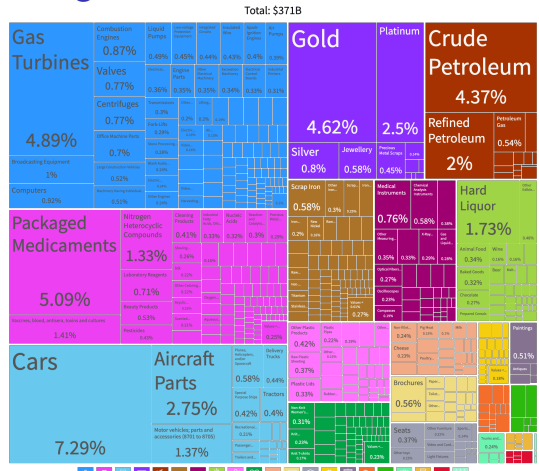

Figure: UK Exports by Product. Source: The Observatory of Economic Complexity (OEC)

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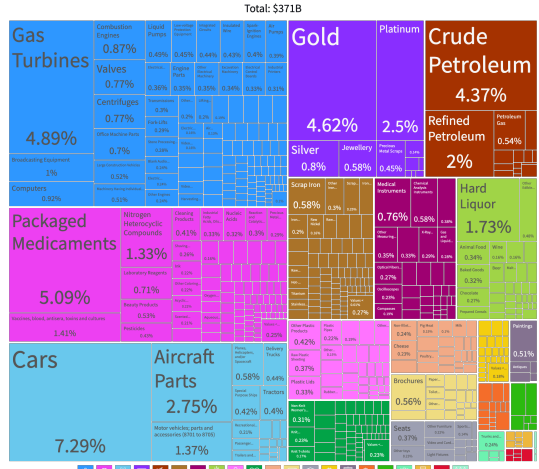

Figure: UK Exports by Product. Source: The Observatory of Economic Complexity (OEC)

Problem #2: Countries trade with many different countries

- How do we measure prices abroad, when there are so many different "abroads?"
- Again, we want to construct a weighted average of price levels in countries
- We weight by trade value (import/export shares)
- The relevant "abroad" depends on who you actually trade with (mostly your neighbors)
- This gives rise to **effective real exchange rates**

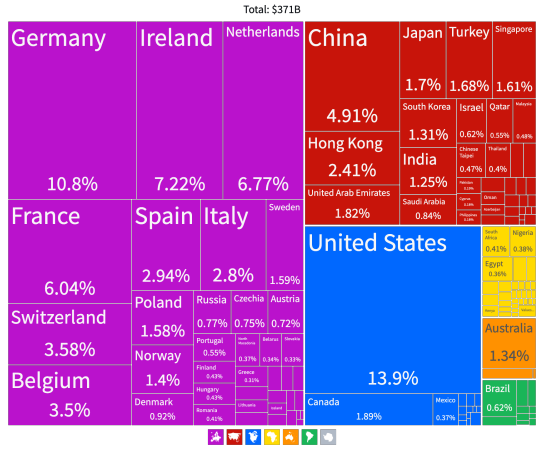

Figure: UK Exports by Destination. Source: The Observatory of Economic Complexity (OEC)

The Small Open Economy

The key insights here are:

1. We can abstract away from the specific goods:
   - Think of a few goods types: output, consumption, investment
   - This is just like what we did in closed economy macro
2. We can abstract away from the specific trading partners:
   - Small open economy vs. rest of the world
   - If the economy in question really is "small" then what happens there should not affect the macroeconomics of the rest of the world

As always, this assumption can fail. Need to pay attention when using a model

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Section 2

Imports, Exports, and Aggregate Demand

Small Open Economy: IS Equation

Recall the closed economy IS Equation:

$$Y = C(Y^d, Y^e - T^e, r, A) + I(Y^e, r, K) + G \tag{2}$$

To account for an open economy, we also want to include:

- Inflow of goods produced abroad: imports (IM)
- Outflow of goods sold abroad: exports (X)

We need to ensure that everything is measured in the same units:

- Split consumption by source:
  - domestic consumption C^d and
  - foreign consumption C^f
- Domestic goods output Y, domestic consumption C^d, investment I and government spending G are all denominated in our own currency
- What about imports?
- Need to divide by ε: IM/ε is the real value of imports

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Deriving IS Equation

- Start with the aggregate resource constraint:

$$\underbrace{Y + \frac{IM}{\varepsilon}}_{\text{Value of goods available}} = \underbrace{\overbrace{C^d + \frac{C^f}{\varepsilon}}^{\text{Private consumption } C} + I + G + X}_{\text{How those goods are allocated}} \tag{3}$$

- Define net exports (measured in the units of the domestic good):

$$NX := X - \frac{IM}{\varepsilon} \tag{4}$$

- We can rearrange eq. (3) as

$$Y = C + I + G + NX \tag{5}$$

- So far, this is just rearranging definitions of GDP.
- The theory comes when we start making assumptions about how these things are determined

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Deriving IS Equation: Key Assumptions

- Assume that total consumption and total investment are determined as before:

$$C = C(Y^d, Y^e - T^e, r, A) \qquad I = I(r, Y^e, K) \tag{6}$$

- Demand for imported goods depends on the same factors as consumption, plus the the real exchange rate:

$$C^f = IM(\varepsilon, Y^d, Y^e - T^e, r, A) \tag{7}$$

- Exports are symmetric with imports (from the perspective of the rest of the world):

$$X = X(\varepsilon, Y^{d\star}, Y^{\star e} - T^{\star e}, r^\star, A^\star) \tag{8}$$

- We write net exports:

$$NX(\varepsilon, Y^\star, Y) = X(\varepsilon, Y^{d\star}, Y^{\star e} - T^{\star e}, r^\star, A^\star) - \frac{IM(\varepsilon, Y^d, Y^e - T^e, r, A)}{\varepsilon} \tag{9}$$

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$$C = C(Y^d, Y^e - T^e, r, A) \qquad I = I(r, Y^e, K) \tag{6}$$

- Demand for imported goods depends on the same factors as consumption, plus the the real exchange rate:

$$C^f = IM(\varepsilon, Y^d, Y^e - T^e, r, A) \tag{7}$$

- Exports are symmetric with imports (from the perspective of the rest of the world):

$$X = X(\varepsilon, Y^{d\star}, Y^{\star e} - T^{\star e}, r^\star, A^\star) \tag{8}$$

- We write net exports:

$$NX(\varepsilon, Y^\star, Y) = X(\varepsilon, Y^{d\star}, Y^{\star e} - T^{\star e}, r^\star, A^\star) - \frac{IM(\varepsilon, Y^d, Y^e - T^e, r, A)}{\varepsilon} \tag{9}$$

IS Equation

$$Y = C(Y^d, Y^e - T^e, r, A) + I(r, Y^e, K) + G + NX(\varepsilon, Y, Y^\star) \tag{10}$$

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Three channels:

1. Foreign consumers buy less of domestic goods (substitution) so $X \downarrow \implies NX \downarrow$
2. Domestic consumers buy more foreign goods (substitution) so $IM \uparrow \implies NX \downarrow$
3. Existing imports become cheaper, so $\frac{IM}{\varepsilon} \downarrow \implies NX \uparrow$

Which of these effects dominates?

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The Marshall-Lerner Condition: Derivation

$$NX = X(\varepsilon) - \frac{IM(\varepsilon)}{\varepsilon} \tag{11}$$

- Let's differentiate with respect to ε

$$\begin{aligned} \frac{\partial NX}{\partial \varepsilon} &= \frac{\partial X}{\partial \varepsilon} - \frac{\partial IM}{\partial \varepsilon}\frac{1}{\varepsilon} + \frac{IM}{\varepsilon^2} && \text{Applying product rule} \\ &= \frac{IM}{\varepsilon^2}\left[\frac{\partial X}{\partial \varepsilon}\frac{\varepsilon^2}{IM} - \frac{\partial IM}{\partial \varepsilon}\frac{\varepsilon}{IM} + 1\right] && \text{Factoring out the last term} \end{aligned} \tag{12}$$

- If trade is initially balanced, then $NX = 0 \implies \frac{IM}{\varepsilon} = X$. Substitute into eq. (12):

$$\frac{\partial NX}{\partial \varepsilon} = \frac{IM}{\varepsilon^2}\left[\underbrace{\frac{\partial X}{\partial \varepsilon}\frac{\varepsilon}{X}}_{\text{Price elasticity of X}} - \underbrace{\frac{\partial IM}{\partial \varepsilon}\frac{\varepsilon}{IM}}_{\text{Price elasticity of IM}} + 1\right] \tag{13}$$

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Marshall-Lerner Condition

When trade is initially balanced, an increase in the exchange rate decreases net exports if and only if

$$-\frac{\partial X}{\partial \varepsilon}\frac{\varepsilon}{X}+\frac{\partial IM}{\partial \varepsilon}\frac{\varepsilon}{IM}>1 \tag{14}$$

- Exports $\downarrow$ when $\varepsilon \uparrow$, so the first term is positive
- Imports $\uparrow$ when $\varepsilon \uparrow$ so the second term is positive
- Net exports are decreasing in the real exchange rate if the absolute values of the price elasticities of exports and imports sum to more than 1

  Empirical studies have typically found they sum to around 3
- So we have added $NX(\varepsilon, Y, Y^{\star})$ which is:
  - Decreasing in ε
  - Decreasing in Y (smaller multipliers than in closed economy)

    Fiscal policy tends to "leak abroad" since consumers use extra income to purchase imports
  - Increasing in $Y^{\star}$ (income spillovers from rest of world)

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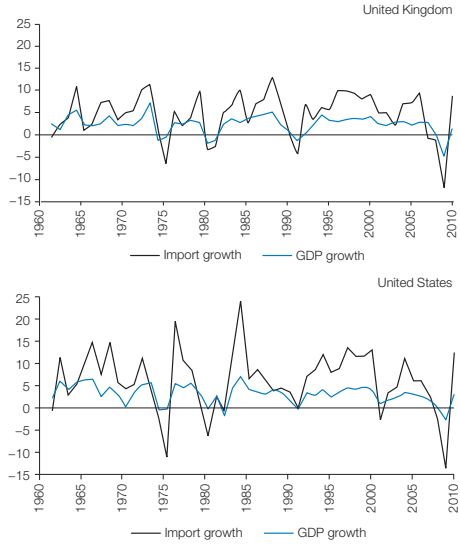
Section 3

Benchmarking to Data

Imports tend to follow GDP growth

- We assumed that demand for imports are driven by the same factors as domestic consumption
- This seems to be true in the data
- Note that demand for imports is much more volatile than GDP growth
- This is partly because a large part of imports are durable goods, rather than food or services
- It's easy to put off buying a new TV. Harder to decrease food consumption

Fig. 12.3 *Growth rates of GDP and imports, percentage changes*



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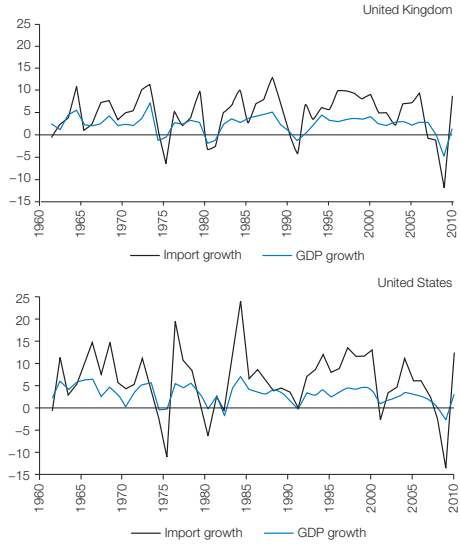

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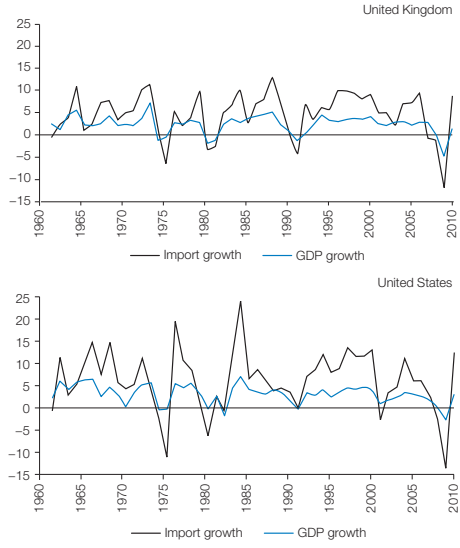
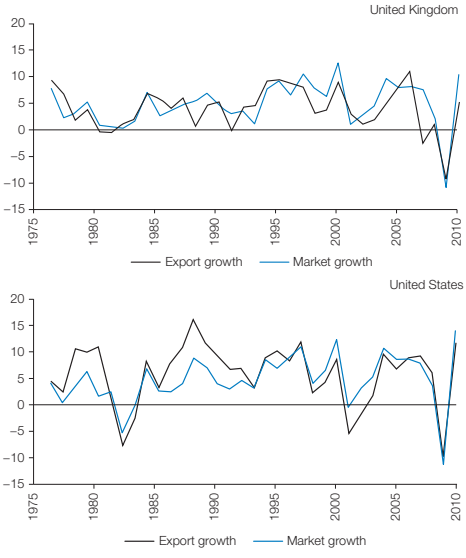


Exports depend mostly on foreign income and the real exchange rate

- Market growth is a measure of import demand in the main trading partners (weighted average using previous year's trade as weights)
- Exports seem mostly demand driven and very volatile
- Why isn't export demand growth exactly foreign import demand growth?
  - This would be true if export market shares were constant

Fig. 12.4 *Growth rates of export market demand and exports*



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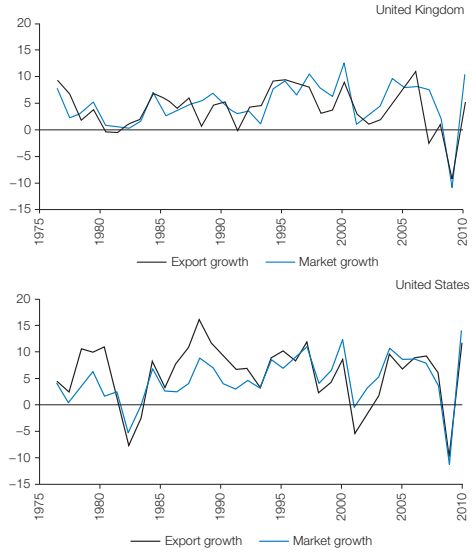
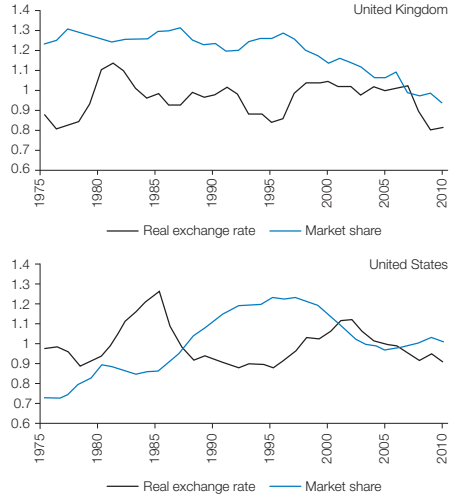


Export market shares move slowly, and may be related to exchange rates

- Export market shares move slowly
  - Many long-term supplier relationships
  - Hard to re-route supply chains on short notice
  - Brand loyalty for some durable goods
- They seem broadly related to the exchange rates in the short term, but you can't explain the long term movements with just exchange rates

  See more details on this in your textbook

Fig. 12.5 *The real exchange rate and the export market share*



Section 4

Savings, investment, and the current account

Bringing back financial markets

- So far, we have been focusing on just one type of market: goods market

  Think cars, haircuts, iPhones, oil, etc...

- We want to pivot to thinking about **financial markets**
- The key difference between money and goods is that money is *even more* mobile and *even more* fungible
  - Not a differentiated product
  - Law of one price should hold (we'll see the exact form it takes)
  - Far fewer frictions when moving it

    No supplier relations, no waiting time at the port, no supply-chain bottlenecks, etc...
- There are two main drivers in international financial markets:
  - Where the money comes from (supply side)
  - Where you want to put it (demand side)

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Savings and Net Foreign Claims

- In an open economy, it's no longer true that your debt is my savings and vice versa
- There is a third option: we can both owe money to creditors abroad

  Or, we can both own claims on foreign debt as an asset
- We're adding a new type of asset to the economy:

$$A = K + D + F \tag{15}$$

where:

  - A denotes net assets
  - K denotes capital
  - D denotes government debt. To make things easy (but w.l.o.g.), assume that all government debt is owned domestically
  - F denotes **net claims on foreign households**
- F can be positive or negative, depending on whether households are *lending to* or *borrowing from* their counterparts abroad on net
- **Question:** What determines changes in F? How is it related to NX?

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Follow the money

To see why these two must be related, we want to start with the national accounts.

- Consider net private savings:

$$\underbrace{Y^d - C}_{\text{Net private savings}} = \underbrace{I + \Delta D + \Delta F}_{\text{Possible investments}} \tag{16}$$

- We also know that households real disposable income is equal to production plus net income, minus taxes

$$Y^d = Y + r(D + F) - T \tag{17}$$

- Finally, we know from a few weeks ago that

$$\Delta D = G - T + rD \tag{18}$$

- Put it all together:

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Current Account as Aggregate Savings

$$\Delta F = \underbrace{Y + rF - C(Y^d, Y^e - T^e, r, A) - G}_{\text{Aggregate Savings}} - I(r, Y^e, K) \tag{20}$$

- Changes in net foreign claims look like net saving from the country's perspective
- If you save more than you invest, the money has to go somewhere
  - It can't go to government bonds (since those net out of national savings if the debt is owned by domestic households)
  - So it must be loaned to foreign households in exchange for a promise of future repayment (a foreign claim)
- Equation (20) is a theory of the current account as a phenomenon of **savings**
- The only price here is the interest rate

Current Account as Flows from Trade

$$\Delta F = NX(\varepsilon, Y^{\star}, Y) + rF \tag{21}$$

- Changes in net foreign claims look like net exports plus interest income from abroad
- Consider buying a German car:
  - BMW wants to be paid in Euros, not Pounds (they need to pay their workers Euros)
  - So you (or rather, the import firm) sells GBP and buys EUR so that they can pay BMW
  - But someone is on the other side of the transaction, *selling* EUR and buying GBP. Why?
  - If we hold the supply of both GBP and EUR constant, there are two possibilities:
    1. They want the GBP to buy something from the UK themselves (pure exchange). But then NX doesn't change...
    2. They want to invest in the UK (i.e., purchase a claim on future payments from a UK household)

    Note: Holding the money in a bank that lends to households is the same thing
  - So if *net* exports are increasing, it must mean that there are foreigners who are investing money in the UK
- Two prices that show up here: ε and r

Current Account as Flows from Trade

$$\Delta F = NX(\varepsilon, Y^{\star}, Y) + rF \tag{21}$$

- Changes in net foreign claims look like net exports plus interest income from abroad
- Consider buying a German car:
  - BMW wants to be paid in Euros, not Pounds (they need to pay their workers Euros)
  - So you (or rather, the import firm) sells GBP and buys EUR so that they can pay BMW
  - But someone is on the other side of the transaction, *selling* EUR and buying GBP. Why?
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Current Account Two Ways

- We now have two ways of thinking about the current account:
  1. As aggregate savings:

$$\Delta F = Y + rF - C(Y^d, Y^e - T^e, r, A) - G - I(r, Y^e, K) \tag{20}$$

  2. As determined by net exports:

$$\Delta F = NX(\varepsilon, Y^\star, Y) + rF \tag{21}$$

- For these to both be true, prices must be adjusting in equilibrium to **clear the market**
- This suggests a deep relationship between exchange rates and interest rates
- But we need some additional structure to our model in order to say more

Section 5

The interest parity condition

Where do you put your money?

- Suppose you're saving for retirement and there are two options:
  1. A UK government bond, which pays a 4% interest rate and is denominated in GBP
  2. A German bond, which also pays 4% but is denominated in EUR
- Are you indifferent between the two?
- Consider how buying the German bond works:
  - Step 1: Sell GBP and buy EUR
  - Step 2: Use the EUR to buy the bond
  - Step 3: Collect the interest payments for one year, and then
  - Step 4: Sell the bond, and convert the EUR back to GBP
- What happens if the Euro appreciates relative to the pound while you're holding the bond?
- You have to care about the **expected change in the exchange rate**

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Investor Problem

- Consider a foreign investor who is choosing between:
  - Lending in their own currency
  - Lending in the currency of our small open economy
- If money can move freely, the investor must be indifferent between the two choices
- **Assumption:** Investors are risk neutral

  This means they only care about the *expected return*, and will invest wherever it is highest
- If they lend in their own currency, their return is straightforward:

$$1 + i_t^\star$$

- If they lend in the small open economy's currency, then they get

$$\frac{1}{e_t}(1 + i_t)e_{t+1}$$

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Interest Parity Condition

- Since the investor has to be indifferent between the two choices (in expectation), this means that interest rates and exchange rates must be related by the following **interest parity condition**:

$$1 + i_t^\star = (1 + i_t)\frac{e_{t+1}^e}{e_t} \tag{22}$$

  - If the currency of the small open economy is expected to depreciate ($e_{t+1}^e/e_t < 1$) then i_t must be higher than $i_t^\star$ to compensate

- We can write this in terms of the percentage change in e if we start with eq. (22):

$$\begin{aligned}
1 + i_t^\star &= (1 + i_t)\left(\frac{e_t + e_{t+1}^e - e_t}{e_t}\right) && \text{Add and subtract } e_t \\
&= (1 + i_t)\left(1 + \frac{\Delta e_{t+1}^e}{e_t}\right) && \text{Rewrite as \% change} \\
&\approx 1 + i_t + \frac{\Delta e_{t+1}^e}{e_t} && \text{Since both rates are small}
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$$\implies \underbrace{i_t - i_t^\star}_{\text{Interest differential}} \approx \underbrace{-\frac{\Delta e_{t+1}^e}{e_t}}_{\text{Expected \% depreciation}}$$

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Exchange Rate Regimes

Central banks have several approaches to dealing with exchange rates

- **Fixed Exchange Rate:** Central bank announces official target level for the exchange rate
  - Backed by a promise to buy/sell currency as needed
  - Also called an exchange rate peg
  - Interest parity means that the central bank is limited in how it conducts monetary policy
- **Floating exchange rate**: Central bank does not target exchange rate, or currency markets
  - Allows exchange rates to adjust freely ("float")
  - More control over setting interest rates
- What do these mean for monetary policy?

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Fixed Exchange Rate

- Suppose the central bank promises that

$$e_{t+1} = e_t = \bar{e}$$

- If the promise is credible, then $e^e_{t+1} = \bar{e}$ as well
- Interest parity requires that:

$$(1 + i^\star_t) = (1 + i_t)\left(\frac{e^e_{t+1}}{e_t}\right) = (1 + i_t)\left(\frac{\bar{e}}{\bar{e}}\right) = (1 + i_t)$$

In other words $i^\star_t = i_t$!

Note: this abstracts from credit risk, which is another source of interest rate spreads between sovereign bonds.

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How does a peg work?

- Suppose $i_t < i_t^\star$
  - Foreign investors can make a profit by borrowing in small open economy, and lending at home
  - Money flows *out* of the economy, which causes exchange rate to fall
  - Central bank has to buy its own currency (using foreign reserves) to stop the exchange rate from falling but then this decreases the money supply (since they are now holding their own currency instead of having it in circulation) and this tends to raise interest rates
  - Eventually since they have a finite supply of foreign reserves, eventually they can run out
- Suppose $i_t > i_t^\star$
  - Investors attempt to do the reverse: borrow and home and lend in the small open economy
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- With freely mobile capital and a fixed exchange rate, a central bank cannot control the nominal interest rate (sovereign monetary policy)

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The Trilemma of International Finance

You cannot have all three:

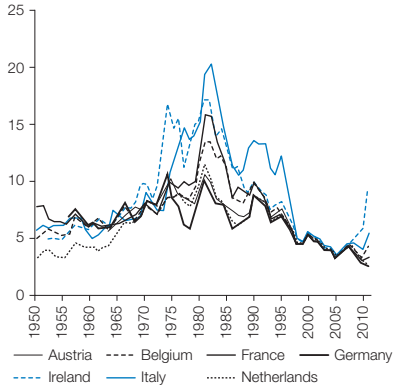
1. Freely mobile capital
2. Sovereign monetary policy
3. Fixed exchange rates

This is also called the **Impossible Trinity**

Eurozone Rates

- In the 50s and 60s most countries maintained a fixed interest rate regime (Bretton Woods System)
- After, capital controls relaxed, countries could no longer maintain the fixed exchange rates
- Large differences in inflation between countries in this period
- In the 2000s, interest rates compressed again (because of the Euro)

Fig. 12.6 *Interest rates in some countries that now have the euro*



Note: Interest rates are rates on government securities in percentage points per year, but the maturities may differ.
Source: International Financial Statistics, IMF, 11 July 2012.

Floating Exchange Rates

- Government does not target exchange rates or interfere in currency markets
- Now we can re-write the interest parity condition to back out exchange rate:

$$e_t = \left(\frac{1 + i_t}{1 + i_t^\star} \right) e_{t+1}^e$$

- Exchange rate is determined by three variables:
  1. Domestic interest rate
  2. Foreign interest rate
  3. Expected future exchange rate
- One of the key ways that monetary policy operates is **through the exchange rate**
  - If the central bank cuts interest rates, e_t falls, and so does ε
  - We know that this tends to **increase** net exports, so aggregate demands rises

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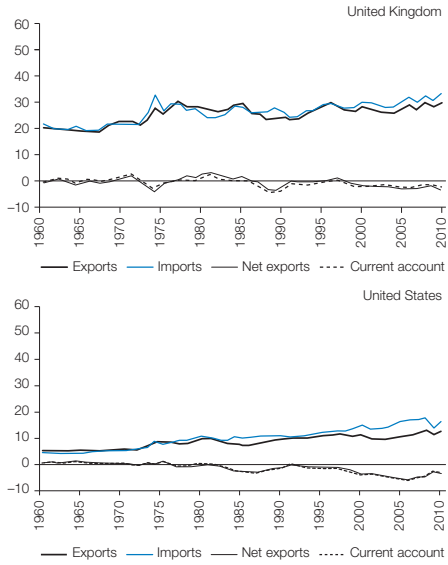
Putting this all in context

Why do we care?

- In the 50s and 60s, capital flows were highly restricted and it was hard to borrow money from abroad
- Our analysis of the current account tells us this means (almost by definition) that net exports must have been low
- Since the 70s/80s, financial capital flows were deregulated: more countries have run current account deficits/surpluses
- This means **net exports** are a larger share of GDP than they used to be
- Moreover, globalization means higher trade volumes overall

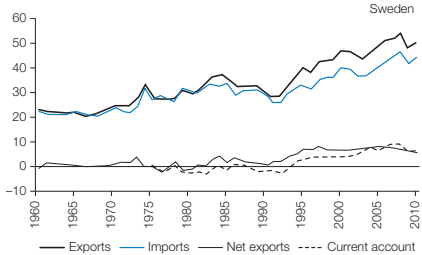
Fig. 12.7 *Exports, imports, net exports, and the current account, percent of GDP*

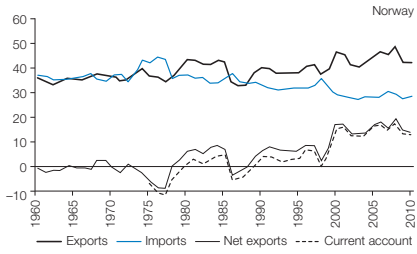


Putting this all in context

Why do we care?

- This means that aggregate demand is more exposed to spillovers from your neighbors than it used to be
- Countries who trade a lot with their neighbors may be vulnerable to shocks from abroad, if their trading partners enter a recession
- Recessions have become contagious, as the global economy is linked more and more tightly together
- We have to pay attention to these international linkages, or we can miss a big part of the story





Source: *OECD Economic Outlook*, OECD, 12 October 2011, http://www.oecd-ilibrary.org/statistics.

What's next?

- This week, we developed an extension of our baseline macroeconomic model for closed economies to accommodate:
  - International trade in goods
  - Financial flows across borders
- We've talked about the tight connection between interest rates and exchange rates, and what that means for how central banks think about managing the exchange rate
- Next week, we will focus on the small open economy in the long run
- The key question: what is the relationship between economic growth and foreign debt?

  In other words: should we care about the current account?