CHAPTER II

THE INTERNATIONAL MONETARY SYSTEM

This chapter studies the major features of the international monetary system, which represents a complex set of rules, mechanisms and agreements that determines the behavior of the foreign exchange market. First, this chapter starts by analyzing the different exchange rate regimes and their monetary policy implications. Then, this chapter briefly covers the history of the international monetary system.

I. Exchange Rate Systems

In chapter I we established that the exchange rate is just another price in the economy: the relative price of one currency in terms of another. Central banks around the world are the entities that create the different national currencies used in each country. Exchange rate systems are classified according to the role a central bank plays in the foreign exchange markets. There are two extreme, or pure, systems: the *flexible exchange rate* system and the *fixed exchange rate* system. Under a *flexible* exchange rate system, the central bank allows the supply of foreign currency and the demand for foreign currency to freely determine the exchange rate. On the other hand, under a *fixed* exchange rate system, the central bank determines the exchange rate and is willing to buy and sell foreign exchange at the determined exchange rate. The next sections study in great detail the different exchange rate systems.

1.A Central Banks: Brief Review

A central bank is a "bank." It holds assets and liabilities:

- Assets: Foreign (international reserves of foreign currency, mainly bonds denominated in foreign currency) + Domestic (mainly, loans to domestic institutions, government securities, and due to the Financial Crisis of 2008, other assets) + Liquidity Swaps + Gold
- Liabilities: Domestic currency outstanding + Deposits of banks.

Although a central bank generally holds government debt, in some countries the outstanding amount of government debt is smaller than the amount the central bank may wish to hold. In many countries, central banks hold significant amounts of assets denominated in foreign currency, rather than assets in their own national currency, particularly when the national currency is fixed to other currencies.

Any central bank purchase (sale) of assets automatically results in an increase (decrease) in liabilities, through an increase (decrease) in the domestic money supply (MS).

Table II.1 presents the Fed's balance sheet at the end of December 2017.

Table II.1
U.S. Federal Reserve Balance Sheet (December 2017)

Consolidated U.S. Fed Balance Sheet (in USD billions)			
Liabilities		***Assets***	
Federal Reserve Notes	1,569.1	U.S. Treasuries	2,454.2
Reverse Repurchase Agreements	386.8	Mortgage Backed Securities	1,764.9
Deposits	2,445.1	Gold	11.0
Other liabilities	6.3	SDR	5.2
Total	***4,407.3***	Foreign Currency Denominated Assets	21.2
		Central Bank Liquidity Swaps	12.0
Capital Account	***41.4***	Other assets	180.2
Capital paid in	31.4	***Total***	***4,448.7***
Surplus	10.0		

The difference between the Assets and Liabilities represents the Capital Account (USD 41.4 billion) –i.e., the earnings of the U.S. Fed. In the Capital Account, the surplus represents the retained earnings not paid to the Department of Treasury (USD 10 billion).

Around the world, CBs have different names: U.S. Federal Reserve System ("The Fed"), European Central Bank (ECB), Central Bank of UAE, Central Reserve Bank of Peru, Bank of Mexico, Swiss National Bank, Monetary Authority of Singapore, etc.

1.A.1 Central Banks: Monetary Policy

Originally, central banks were created as *lenders of last resort* ("bank of banks") and as supervisor of banks. This is the banking aspect of a central bank. But, later central bank were given other responsibilities: keep an eye on inflation (low) and the economy (full employment). This is the policy side of a modern central bank. Many times, both targets are conflicting targets.

Example II.1: Textbook effect of monetary policy:
Suppose the U.S. Fed decides to lower the Fed rate. As a result, other interest rates in the economy will fall ($i_d \downarrow$). The lower i_d stimulates spending (aggregate demand, AG, ↑), which makes businesses respond by increasing production (aggregate supply ↑). As a result, the economic grows (Y ↑).

Now, if the increase in AG is big enough it can increase domestic prices P_d (& I_d↑).

In general, all the above effects take time, on average between one to three years. Some estimates point that a 1% decrease in a CB rate, increases Y_d by 0.5% to 0.75% over 2 years and I_d by 0.25% over 2-3 years.

Note: What is the effect on S_t? On average, a 1% surprise increase in i_d increases S_t by 1.5% almost immediately. ¶

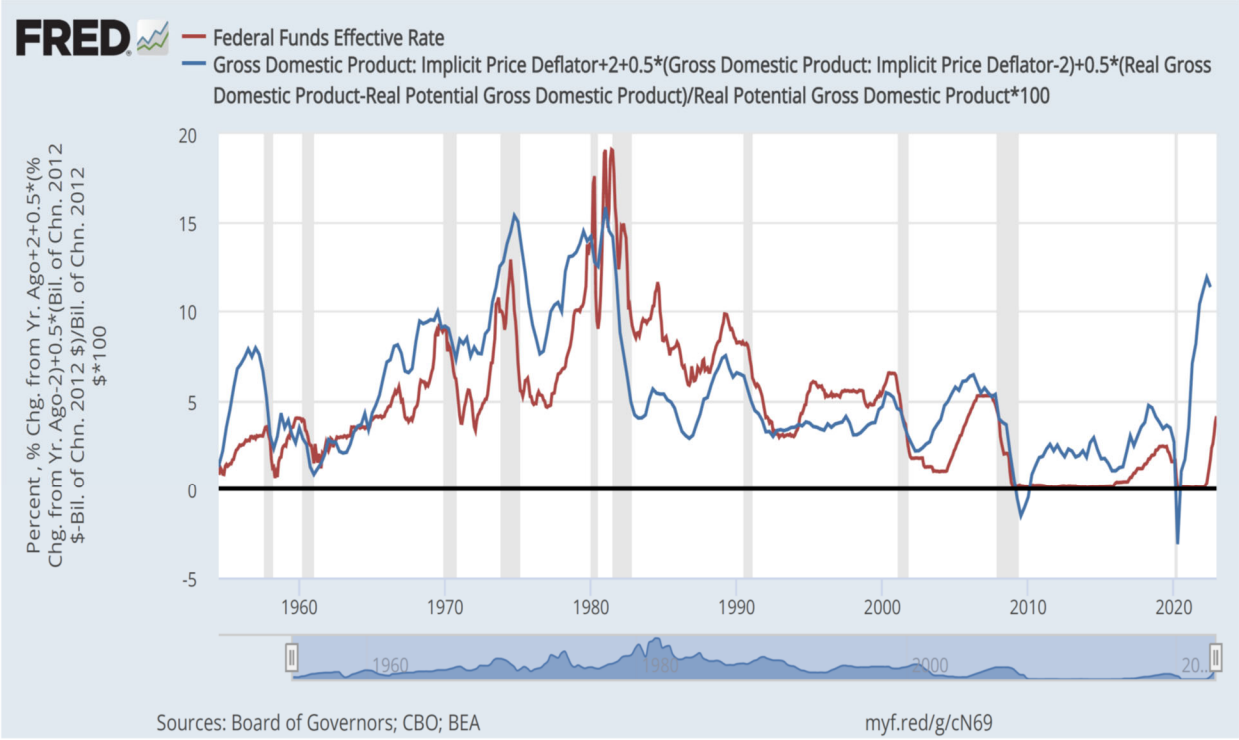
As Example II.1 illustrates, central banks walk a tight rope. They should balance Y_d and I_d. Studies show that central banks set monetary policy usually following a so-called *Taylor rule* (Taylor (1993)):

$$i_{d,TR} = r^* + I_d + \gamma\,(I_d - I_d^*) + \theta\; y\_gap$$

where r* is the real (equilibrium) CB interest rate, I_d^* is the desired CB inflation rate, *y_gap* is the difference between Y and potential GDP (or full employment GDP); and γ and θ are positive coefficients. For the U.S., the Taylor rule is usually parametrized with $r^*=2\%$, $I_d^*=2\%$, and $\gamma=\theta=0.5$.

Figure II.1 shows the actual Fed funds rate (i_d, in red) and the predicted by the Taylor rule Fed funds rate ($i_{d,TR}$, in blue). As shown below, the Federal Funds rate is too low (4.10%) relative to the prescribed Taylor rule rate (11.92%).

Figure II.1
Taylor Rule: U.S. Federal Fund Rate (1950 - 2022)



A popular variation to the Taylor rule is to allow for gradualism in interest rate policy, reflecting the usual Central Bank practice of gradual, small adjustments in interest rates. This *modified Taylor rule* is:

$$i_{d,t} = \rho\; i_{d,t-1} + (1 - \rho)\,[r_t^* + I_{d,t} + \gamma\,(I_{d,t} - I_{d,t}^*) + \theta\; y\_gap_t],$$

where ρ is the smoothing parameter. If there is no gradual adjustment ($\rho=0$), the modified Taylor rule, reverts to the original rule.

For many countries, whose Central Bank also monitors S_t closely, the Taylor rule is expanded to include the real exchange rate, R_t:

$$i_t = \mu + \lambda I_t + \gamma \text{ y-gap}_t + \delta R_t$$

Estimating this equation for the U.S. and a foreign country can give us a forecast for the interest rate differential, which can be used to forecast exchange rates.

1.A.2 Central Banks: Open Market Operations (OMO)

To achieve both targets, central banks have several monetary policy instruments. The most important ones are:

- Open market operation (OMO)
- Bank reserve requirement
- Interest rate policy

OMOs are the main policy tool of central banks to control the money supply. Through an OMO, a CB puts money in and takes money out of the banking system. This is done through the sale and purchase of government securities, in the U.S., U.S. Treasury bills. Each time the central bank buys securities, exchanging money for the security, the central bank raises the money supply. Conversely, selling of securities lowers the money supply. Buying of securities thus amounts to printing new money while lowering supply of the specific security.

The main OMOs are:

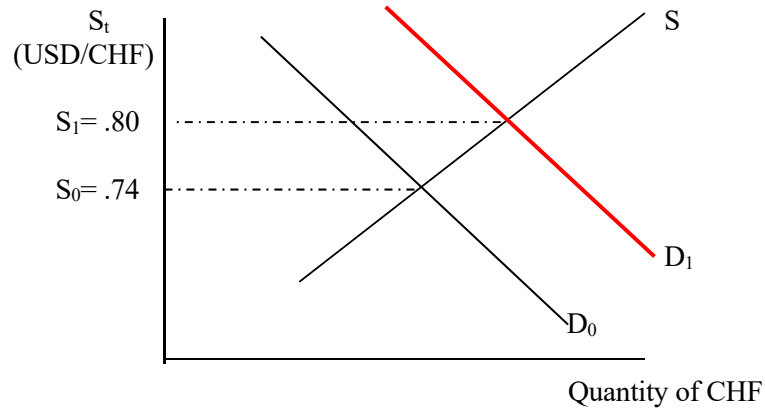
- Temporary lending/borrowing of money for collateral securities ("Reverse Operations" or "repurchase operations", otherwise known as the "*repo*" market). These operations are carried out on a regular basis, where fixed maturity loans are auctioned off.
- Buying or selling government securities ("direct operations") on ad-hoc basis.
- Foreign exchange operations such as FX swaps.

All of these interventions can also influence the FX market and, thus, S_t. For example the People's Bank of China and the Bank of Japan have on occasion bought several hundred billions of U.S. Treasuries, in order to stop the decline of the USD against the CNY and the JPY, respectively.

1.B Flexible Exchange Rate System

The first pure exchange rate system is the flexible exchange rate system. In a flexible exchange rate system the monetary authority –the central bank- allows the exchange rate to adjust to equate the supply and demand for foreign currency.

Example II.2: Suppose the USD/Swiss franc (CHF) exchange rate is .74 (USD .74 = CHF 1). Also suppose that U.S. residents start to buy more Swiss goods –i.e., Swiss exports to the U.S. increase. The demand for CHF by U.S. residents increases. The U.S. Federal Reserve can simply stand aside and let the exchange rate adjust.



In this particular example, the exchange rate moves from USD .74 per CHF to a new level, USD .80 per CHF, making Swiss goods more expensive in USD and thus reducing the demand for CHF by U.S. residents. ¶

As the above example illustrates, in a flexible exchange rate system, the central bank does not adjust the money supply to respond to changes in the foreign exchange market. Thus, under a flexible exchange rate, the central bank has an *independent* monetary policy. That is, the monetary policy of a country is not solely dictated by exchange rate concerns. Monetary policy, however, impacts exchange rates. For example, an expansive monetary policy will reduce domestic interest rates, and, then, affect the supply and the demand for foreign currency. Foreign investors will find the domestic interest rates not very attractive and capital will flow out of the country. That is, the capital outflows will reduce the supply of foreign currency and increase the demand for foreign currency in the domestic market. The foreign currency will increase in value. In general, an expansive domestic monetary policy increases the price of the foreign currency. On the other hand, a restrictive domestic monetary policy decreases the price of the foreign currency.

A currency *depreciates* (*appreciates*) when, under a flexible exchange rate system, it becomes less (more) expensive in terms of foreign currency. For example, if the USD/CHF exchange rate changes from .74 USD/CHF to .80 USD/CHF, the CHF is appreciating with respect to the USD. At the same time, we can also say that the USD is depreciating against the CHF.

Example II.3: Calculating the appreciation and depreciation of a foreign currency.
In Example II.1, the CHF appreciated against the USD. The exchange rate moved from .74 USD/CHF to .80 USD/CHF. The appreciation of the CHF against the USD is easily calculated:
$s_t = (S_t - S_{t-1})/S_{t-1} = (.80 - .74)/.74 = 0.0811$ (8.11%).

That is, the CHF appreciated against the USD by 8.11%. ¶

In order to calculate the depreciation of the USD against the CHF we have to reverse the direct quote into an indirect quote. Note that we usually think that the good in the denominator is the one changing in value (against the domestic currency).

Example II.4: Calculating the appreciation and depreciation of the currency.
Go back to Example II.3. Now, we want to calculate the change in value of the domestic currency (the USD) against the foreign currency (the CHF). First, we reverse the quotes. We go from the direct quote to

the indirect quote. Now, the exchange rate moved from 1.35 CHF/USD to 1.25 CHF/USD. The depreciation of the USD against the CHF is:

$s_t = (S_t - S_{t-1})/S_{t-1} = (1.25 - 1.35)/1.35 = -0.0741$ (-7.41%).

That is, the USD depreciated against the CHF by 7.41%. ¶

♦ **Reminder: The Exchange Rate is Just a Price**

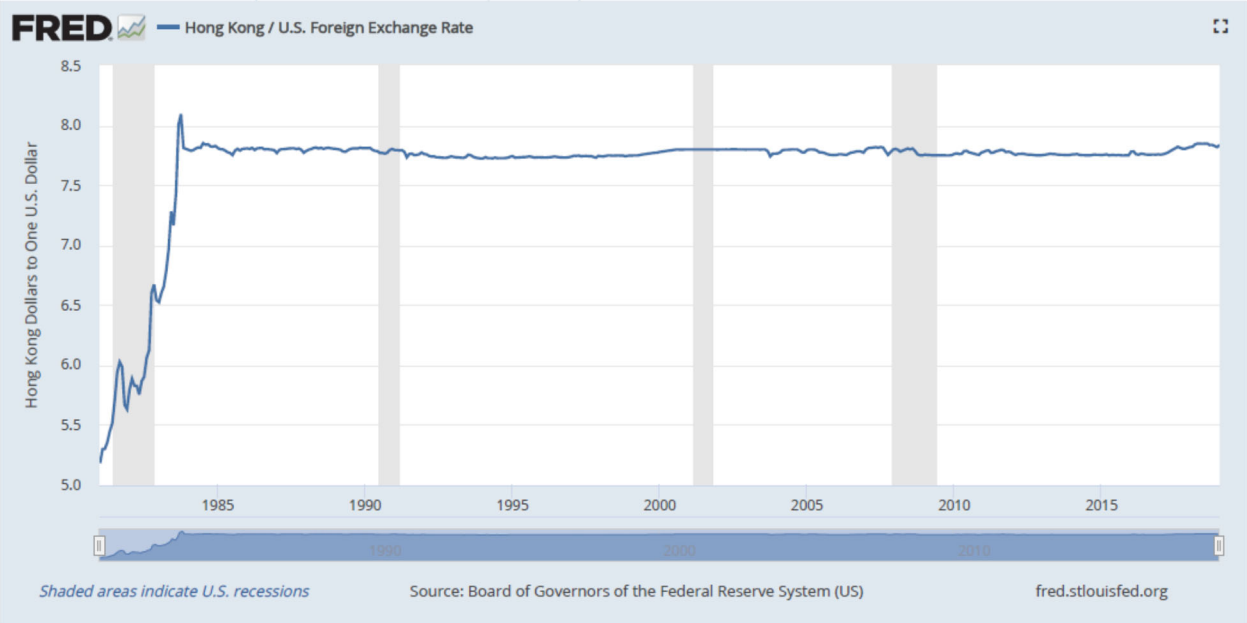
In chapter I, we pointed out that an exchange rate is just another price. When a foreign currency increases (decreases) in value against the domestic currency, we say the foreign currency has appreciated (depreciated) against the domestic currency. We can also think that goods appreciate or depreciate against the domestic currency. For example, if the price of one gallon of milk changes from USD 2.50 to USD 2.60, we can say that milk appreciates against the USD by 4%. ♦

Under flexible exchange rates, a country automatically adjusts to external imbalances. Suppose a country is having a balance of payment surplus, due to an increase in foreign demand (external shock). That is, there is an excess demand for the country's currency at the prevailing exchange rate in the foreign exchange market. Under a flexible exchange rate regime, the external value of the country's currency will appreciate to the level where the balance of payments imbalance disappears. The external balance is automatically achieved.

1.C Fixed Exchange Rate System

The second pure exchange rate system is the fixed exchange rate system. Under this system, the central bank is ready to buy and sell unlimited amounts of foreign currency at a *fixed* price, say S*= 3 DC/FC. Sometimes, the central bank pegs the value of the domestic currency, DC, to a *basket of currencies*, say S*= 1.273 DC/FC_{Basket}, where FC_{Basket} is the price of a basket of exchange rates, usually trade-weighted.

Example II.5: Hong Kong has a fixed exchange rate system since October 17, 1983. The exchange rate is 7.8052 HKD/USD (HKD: Hong Kong dollar).



Note: The HKD is not fixed against all currencies, only against the USD. When the USD moves, the HKD moves. From 2010 to 2015, the USD moved widely against the EUR, taking the HKD for a ride, going from 11.50 HKD/EUR (April 24, 2011) to 9.15 HKD/EUR (January 8, 2015). ¶

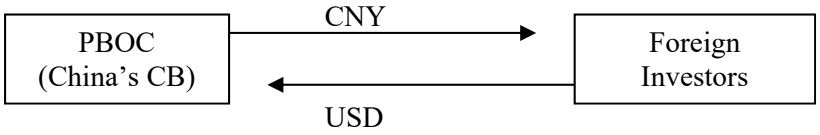
The major countries had fixed exchange rates against one another from the end of World War II until 1973. For example, during the 1960s the German Central Bank, the Bundesbank, would buy and sell any amount of USD at 4 deutsche marks (DEM) per USD. When the market for the USD showed upward pressures, the Bundesbank would sell USD. On the other hand, when the market for the USD showed downward pressures, the Bundesbank would buy USD.

In order to support the fixed parity, S*, a central bank needs two requirements:
(1) The central bank needs a large stock of the domestic currency to buy the foreign currency whenever there is a tendency for the market price of the foreign currency to go down. This is an easy requirement, since the central bank has the machine that prints domestic currency.
(2) The central bank needs a large stock of the foreign currency (*reserves*) to supply to the market whenever there is a tendency for the market price of the foreign currency to increase. Therefore, in a fixed exchange rate system a central bank needs to have enough reserves to purchase the total currency circulating in the public plus required bank's reserves at the central bank −i.e., monetary base− at the fixed exchange rate, S*.

Under a fixed rate system, central banks have to finance any balance of payments (BOP) surplus or deficit that arises at the official exchange rate. They do so by buying or selling all the foreign currency that is not supplied in private transactions. Every time a central bank sells (buys) foreign currency, the domestic money supply decreases (increases). Therefore, in a fixed exchange rate system the domestic money supply is endogenous to the system. That is, under a fixed exchange rate system, a central bank does not have an *independent* monetary policy (independent of the FX market!). The money supply is linked to the balance of payments. BOP surpluses imply automatic monetary expansion, while (BOP) deficits imply monetary contraction.

Example II.6: International capital inflows
For most of the past 30 years, China has maintained a fixed FX system and received vast amounts of capital inflows. Under this situation, the People's Bank of China (PBOC, China's central bank) exchanges yuans (CNY) for FC, say USD.

Capital Inflows



That is, international capital inflows increase not only the PBOC's international reserves of foreign currency, but also China's money supply.

Note: The PBOC may not like this increase in the money supply (along with lower interest rates and inflationary pressures) and may take some counteraction to nullify or mitigate the increase in China's money supply. A central bank counteraction is called *sterilization.* For example, the PBOC can increase the bank's reserve-requirement ratio. ¶

A *devaluation* (*revaluation*) takes places when the price of foreign currencies under a fixed exchange rate regime is increased (decreased) by official action. For example, until 1967 the official exchange rate set by the Bank of England was USD 2.80 per British pound (GBP). But in that year the GBP was devalued and the rate became 2.40 USD/GBP. In 1971 the GBP was revalued at 2.60 USD/GBP.

♦ **Fixed (Pegged) Exchange Rate System - Variations**

The fixed exchange rate system is sometimes referred as a *pegged exchange rate system* (or just, a *peg*). Some countries use a variation of the pure fixed exchange rate system: the value of their domestic currency is *pegged* to some unit of account. Under this system, the value of the domestic currency is fixed in terms of a selected unit of account (or foreign currency). The domestic currency moves in line with the unit of account to which is pegged against other currencies. Sometimes the exchange rate against the unit of account is allowed to fluctuate only within narrow limits (*target zone system*). Some central banks use a variation of the pegged exchange rate system called *crawling-peg*, where a central bank targets a value for the *real exchange rate.* Under a crawling-peg, a central bank periodically changes the pegged exchange rate through a system of mini-devaluations in response to supply and demand pressures that affect the value of its target.

Example II.7: In April 1972, the European Economic Community (EEC) established exchange rate bounds for the member's bilateral exchange rates. The exchange rate bounds, popularly known as the "snake," limited the fluctuations of EEC members' bilateral exchange rates to ± 1.125%. Later, in 1979, EEC members pegged the value of their domestic currency to a unit of account, the European Currency Unit.

From September 1985 to June 1994, Bolivia adopted a crawling-peg, using continuous mini-devaluations of the Bolivian sucre (BOS) to maintain a stable real exchange rate against the USD.

The Central Bank of Chile, in 1983 and later adjusted in 1984, adopted a crawling peg with a fluctuation band of ± 0.5. The value of the USD in terms of Chilean pesos (CLP) was adjusted according to the previous month's inflation minus an estimate of U.S. inflation (around 2% annually). ¶

1.C.1 Dual Exchange Rate System

In some countries, the government sets exchange rates, like in a fixed exchange rate system. But, the government will sell foreign exchange at the official rate, S*, only for some types of transactions (in general, officially recognized foreign imports). For all the other transactions, a *black market* is created. For example, in 2015, Venezuela had an official rate of 6.3 bolivares (VEF) per USD, while the black market rate was 172 VEF/USD.

A variation of the dual exchange rate system is the *multiple exchange rate system*. Under this system, the government sets different exchange rates for different official transactions. Usually, certain imported goods classified as *essential* to an economy -for example, oil, wheat, etc- have a lower exchange rate. Other imported goods –for example, luxury goods- have a higher, discouraging exchange rate. All other transactions are done at the black market rate.

Example II.8: In 2013, Argentina had three loosely recognized exchange rates. The official ("white") rate was 6.205 ARS/USD; the tourist rate (official + 35% tax) 9.377 ARS/USD and the black market rate ("blue") was 9.62 ARS/USD. ¶

1.C.2 Fixed Exchange Rate System: Importing Good Behavior

A fixed exchange rate is considered transparent and a simple anchor for monetary policy.
Countries with weak institutions, usually less developed/emerging markets, can "import" monetary credibility by anchoring to a currency with a credible central bank, say the Fed or the ECB.

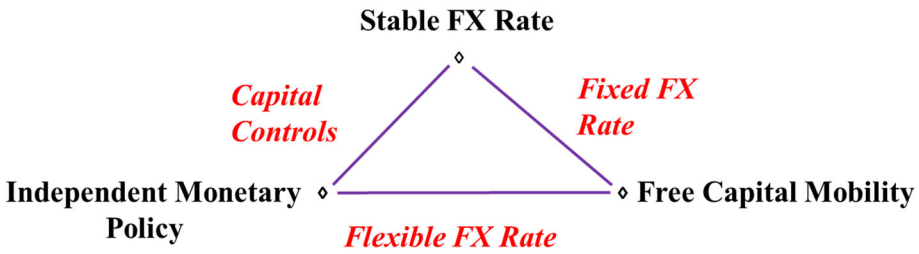
Another advantage for emerging markets: A fixed regime tends to reduce transaction costs and FX risk. In countries with less developed financial sectors, economic agents may not have the financial tools to hedge long-term currency risks. A fixed regime can help in this regard.

1.C.3 Fixed Exchange Rate System: Trilemma & Monetary Policy

Nobel Prize Winner Robert Mundell (1962) made the observation that it is impossible for a country to have at the same time:
- A fixed (stable) FX regime.
- Free international capital mobility -i.e., no capital controls.
- An independent monetary policy.

Mundell called this situation a Central Bank's *trilemma.* It is also called "*the impossible trinity*."

Figure II.1
The Impossible Trinity



That is, under free international capital mobility, the monetary policy of a central bank has to be consistent with the fixed exchange rate. Otherwise, market forces will force the central bank to change the official parity. For example, suppose a central bank suddenly increases the money supply. Under a fixed exchange rate system, such an expansive monetary policy will create devaluation pressures, since domestic interest rates will decrease and, thus, the interest rate differential moves in favor of the foreign currency. Then, the country will see international capital outflows with the corresponding loss of Central Bank's FX reserves. Fearing that this disequilibrium in the FX market will force the government to devalue, speculators will try to buy foreign currency from the central bank at the official rate. If a central bank does not have enough FX reserves, speculators can deplete official reserves. That is, a fixed exchange rate system disciplines the central bank.

Many countries, however, attempt to combine a fixed exchange rate system with an expansive, independent monetary policy. This puts a central bank in a trilemma. A typical trilemma situation arises when a local government substantially increases the domestic money supply (MS_d) to finance deficit spending or to mitigate an external shock. As a result of the expansion in the money supply, domestic interest rates go down (in a free float system, S_t would increase). This combination makes the foreign currency cheap relative to the domestic currency, a BOP deficit will ensue. Another typical trilemma situation occurs when foreign interest rates, say i_{USD}, substantially increase, but the Central Bank does not match the interest rate increase in the domestic market, due to the potential negative effects on the domestic economy.

It should be clear that under a free floating system, in both trilemma situations, a depreciation of the domestic currency occurs –i.e., S_t increases. But, under a fixed exchange rate system, S_t is fixed at S*. Now, domestic goods are relatively more expensive than domestic goods, the real exchange rate, R_t,goes down –i.e., R_t appreciates.

Note: If we think of the free float S_t as the "true equilibrium" (or "shadow") exchange rate, the divergence between S_t and the fixed S*signals a potential profit opportunity for speculators.

1.C.4 Fixed Exchange Rate System: Trilemma & Currency crisis

Eventually, faced with an increasing gap between the shadow S_t and S*, speculators realize that if the central bank abandons the fixed FX system, a sizable profit can be made from buying foreign currency at S* (usually, by borrowing domestic currency to buy foreign currency).

Since the central bank is losing reserves, policymakers consider the costs and benefits of defending the fixed parity and are willing to abandon the system if the costs of doing so exceed the benefits. there will be a moment that speculators will be concerned that the central bank will run out of reserves. Doubts about whether the central bank will defend the fixed S* can cause a "*currency run*" or "*speculative attack*," where speculators "run" to exchange domestic currency for foreign currency at the fixed exchange rate, S*.

In general, domestic residents and governments do not like devaluations of the domestic currency, since it increases inflation (pass-through to import prices), decreases real wages and has contractionary effects on the real economy, usually associated with balance sheet effects – i.e., a mismatch between currency of denomination of debt (mainly, in foreign) and income (mainly, in domestic currency)– in the corporate and government sectors. In addition, politicians are twice as likely to lose their jobs after a devaluation, as documented by Cooper (1971) and Frankel (2005).

Governments try hard to avoid a devaluation and very often impose restrictions on the demand for foreign currency and foreign currency transactions. The most common measure is the imposition of capital controls -in general, restrictions to the flight of capital from the domestic banks and to remittances of royalties and dividends. Other measures are import and foreign travel restrictions, taxes on foreign capital deposited in domestic banks, negotiation of longer maturities for short-term government debt denominated in foreign currency, and dual exchange rates –one exchange rate for some transactions and a more expensive exchange rate for other transactions.

Example II.9: Usual measures during currency crisis.
In January 2016, the Nigerian President, Muhammadu Buhari, rejected a devaluation of the naira (NGN). During the previous months, the Central Bank of Nigeria (CBN) restricted the supply of USD, banned the import of a long list of goods, from shovels and rice to toothpicks. In January 2016, the official exchange rate was 199 NGN/USD, while the black market rate was around 300 NGN/USD.

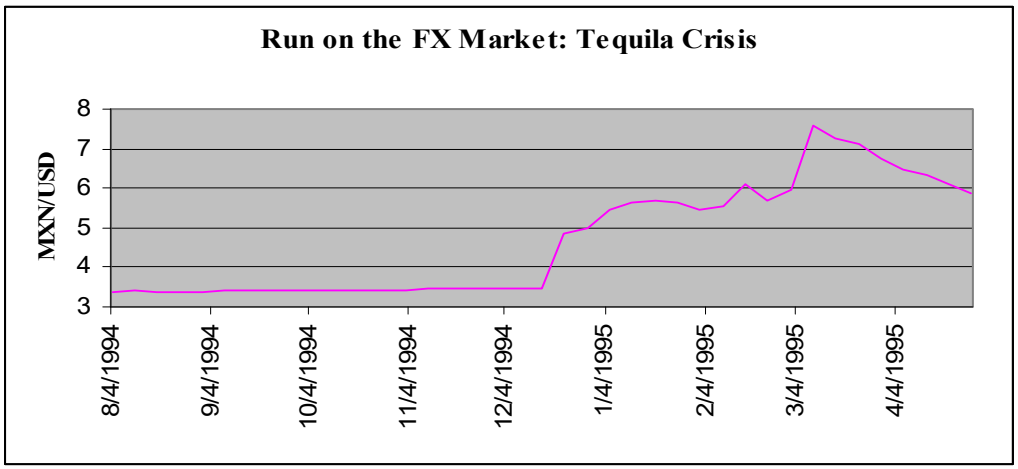
Finally, in June 2016, the CBN decided to float the currency, which quickly depreciated to 285 NGN/USD. ¶

Many countries that have a fixed exchange rate system do not have enough reserves to support the fixed parity. The survival of the fixed exchange rate system, however, is based on the good reputation of the government and investors' confidence on the government's promise to support the parity. As soon as the confidence of investors weakens, a run against the official reserves might force a government to devalue.

Example II.10: Currency crisis: The 1994 Tequila currency crisis.
On December 20, 1994, the Mexican government under new president Zedillo announced a 14% devaluation of the Mexican peso (MXP) against the USD. This decision weakened the confidence of domestic and international investors, who started to change the composition of their portfolio, exchanging MXP denominated assets for USD denominated assets. Mexican USD reserves went from USD 18 billion in October 1994 to USD 5 billion in December 1994. By late December, the government, unable to support the fixed exchange rate system, decided to float the currency. The MXN fell against the USD by more than 40% and this fall started a severe recession in Mexico and other countries in Latin America.

This recession lasted until the second quarter of 1996. This currency run and its after-match are popularly known as the *Tequila crisis*. See Figure II.2 for the evolution of S_t around December 1994. ¶

Figure II.2
MXN/USD Exchange Rate Around the Tequila Currency Crisis



Currency crises are not rare. Laeven and Valencia (2012) report 218 currency crisis during the period 1970-2011. Relatively new examples are the above mentioned Tequila crisis, the 1991 Indian crisis, the 1992 U.K. sterling crisis ("Black Wednesday"), the 1997 Asian Financial ("Rice"), the 1998 Russian ("Vodka") crisis, the 2001 Argentinean ("Tango") crisis, the 2008 Icelandic crisis, the 2016 Nigerian crisis. 218

On average, a currency crisis is followed by a 30% drop of the value of the domestic currency. In many cases there is a temporary higher drop (say, 50%), before reverting to a value closer to the average. When a crisis is very serious, a 75% or higher drop is possible (Indonesia '97 and Argentina '01.)

Currency crisis are often related to a persistent "*inconsistent*" fixed exchange rate system. In these cases, the credibility of a central bank monetary policy weakens and the likelihood of a speculative attack increases. Understanding what may trigger a currency crisis can be very profitable.

There is an academic literature trying to predict currency crisis with so-called *early warning signals.* The usual signals are low FX reserves, high government deficits, low real exchange rate (domestic currency is overvalued, often due to high domestic inflation), weak financial system, and high short-term debt, asset/real estate bubbles financed by easy credit, etc.

♦ **Buying Credibility: Currency Boards**

Some countries have relied on an old mechanism to bring credibility to the fixed exchange rate system called *currency board agreement*. The currency board agreement is a system in which a

country pegs its money to a hard currency such as the U.S. dollar or the Euro in a consistent manner. That is, a currency board is the combination of a fixed exchange rate system and a very strict monetary rule, usually grounded in law or the constitution of the central bank. Under this system, the Currency Board can increase the money supply only when there is a corresponding increase in the foreign currency reserves held at the Currency Board. Thus, at all times, the Currency Board has foreign reserves that are at least equal to the monetary base of the country (100% reserves). The Currency Board holds no other assets -i.e., domestic government bonds. Because it requires severe conditions, a currency board raises political and financial credibility, as it gives a country a highly credible tool for defending a fixed exchange rate

Currency boards had been widely used in the British colonies in the 19th century, but almost vanished with the end of colonialism. Hong Kong, the ex-British colony, reintroduced a currency board in 1983. After that, many nations have introduced this system into their economy as Argentina in 1991 (lasted until 2002), Estonia in 1992 (abandoned in 2011, with the adoption of the euro), and Bulgaria in 1997. Bermuda, Brunei, the Cayman Islands and Lithuania are among the countries with currency boards agreements. ♦

1.C.5 Fixed Exchange Rate System: Twin Ds

In general, a currency crisis is a product of serious macro-economic problems. These macro-economic problems often lead to serious liquidity problems for the government and, in these situations, sovereign defaults –a government decides not to pay its debt, usually bond debt- are not rare. In general, sovereign defaults are accompanied by large devaluations. These are the "*twin Ds*": *Default* and *Devaluation*.

Reinhart (2002) reports that over the period 1970-1999 the probability of a devaluation, once a country had a default event, is 84%; while without a default even the probability of a devaluation is only 17%. A default is usually followed by a large devaluation: in 6 year window around a default event, the change in value of the domestic currency is 45% compared to no default events.

Using more data, Na, Schmitt-Grohe, Uribe and Yue (2017) estimate the probability of devaluation conditioned on a default event is lower: 48%.

Na et al. (2017) suggest that large devaluations around default events are needed to realign real wages to avoid widespread unemployment. In their simulations, if a country does not devalue its currency unemployment increases by 20%.

1.C.6 Different Policy Tools: A Comparison of Fixed and Flexible Exchange Rate Regimes

During the 1960s, the economics profession had a very interesting debate: should a country use a fixed or a flexible exchange rate regime? The debate is still open, which should be obvious, given that we observe different countries operating different exchange rate regimes.

Using a simple open macroeconomic model, called the Mundell-Fleming model, we can illustrate the main arguments for both exchange rate regimes. The Mundell-Fleming model extends the

standard IS-LM model to an open economy under the assumption of *perfect capital mobility*. We say that capital is perfectly mobile internationally when investors can purchase assets in any country they choose, quickly, with low transactions costs, and in unlimited amounts. That is, when capital is perfectly mobile, investors are willing and able to move large amounts of capital in search of the highest rate of return.

The policy arguments for flexible exchange rates are centered on monetary policy. Under a fixed exchange rate system, the money supply is endogenous and, thus, the central bank has no power to alter interest rates. Under a flexible exchange rate regime, however, a central bank can pursue independent monetary policies to stimulate the economy. For example, an expansive monetary policy tends to reduce interest rates. Under perfect capital mobility, this reduction in interest rate will create capital outflows, thus, depreciating the value of the domestic currency. The depreciation of the domestic currency increases foreign demand for domestic products and, as a result, domestic output increases.

On the other hand, the policy arguments for fixed exchange rates rest on fiscal policy. Under a fixed exchange rate regime, a fiscal expansion under conditions of capital mobility, might be effective in raising equilibrium output. For example, a fiscal expansion tends to increase both interest rates and the level of output. The higher interest rate, under perfect capital mobility, will attract capital inflows into the country, reducing the domestic interest rate. Under flexible exchange rates, by contrast, a fiscal expansion does not affect equilibrium output. The fiscal expansion tends to increase output and interest rates. The increase in interest rates produces an offsetting appreciation of the domestic currency and an increase in imports and a decrease in exports, thereby reducing output. That is, fiscal policies, under flexible exchange rates, shift the composition of domestic demand toward foreign goods away from domestic goods.

♦ **Comparison of Pure Exchange Rate Systems**

- Flexible System

- S_t reflects economic activity, through S & D for FC.
- Money supply is exogenous ⇒ The CB can have an independent monetary policy.
- The exchange rate is subject to volatility.
- Under certain assumptions (IS-LM model, perfect capital mobility) fiscal policy does not work.
- External shocks (say, oil shocks or sudden outflows of capital) can be quickly absorbed by changes in S_t.
- Quick(er) adjustments to shocks/disequilibrium.

- Fixed System

- Money supply is endogenous ⇒ A CB does not have an *independent* monetary policy!.
- Exchange rate has no/low volatility; actually, S_t inherits the volatility of the FC the CB fixes the DC against. (No or low volatility: Good for trade, investments and inflation control.)
- Under certain assumptions (same as above), fiscal policy works.
- If a CB does not have enough reserves, *credibility* is crucial.
- Since S_t is fixed, external shocks have to be absorbed through prices (including wages). ♦

1.C.7 Fixed or Floating?

Both regimes have pros and cons. There is no clear winner. Regime choices should reflect the individual characteristics of an economy. However, we do observe that large economies with sound monetary and fiscal policies and good institutions (say, an independent CB) prefer a flexible exchange rate regime. This is fine: a flexible exchange rate regime tends to insulate better a country from external shocks and/or imbalances.

On the other hand, we also observe that small or less developed countries with a history of poor institutions and/or credibility problems have relied on fixed regimes to fix problems. Some of these countries have had consistent monetary policies, since the adoption of the fixed system, and the fixed regime has served them well. For this reason, they have been reluctant to change the regime.

As Timothy Adams, Treasury Under Secretary for International Affairs, said in 2006, regarding the choice of an exchange rate regime: *"In particular, there is no substitute for sound fiscal and monetary policies and resilient institutions."*

The International Monetary Funds classifies the different currency arrangements of its members. In 2017, the IMF classified 54% of currencies as "*anchored*" (fixed FX rate), another 20% as "*stabilized*" (with an anchor, but allowed to vary in some way), and 26% as "*floating*" (occasional CB Intervention, see below, is acceptable).

1.D Managed Float

In practice, the exchange rate system in many countries is a mixture: *managed* floating (also called, *dirty floating*):

> A central bank allows the FX Market to determine S_t. But, from time to time, the central bank takes some actions with the intention to influence S_t. These actions are called *Central Bank intervention* in the FX Market. For example, the central bank can buy or sell foreign currency to change S_t.

This is the usual foreign exchange rate system in developed countries.

1.D.1 Central Bank Intervention

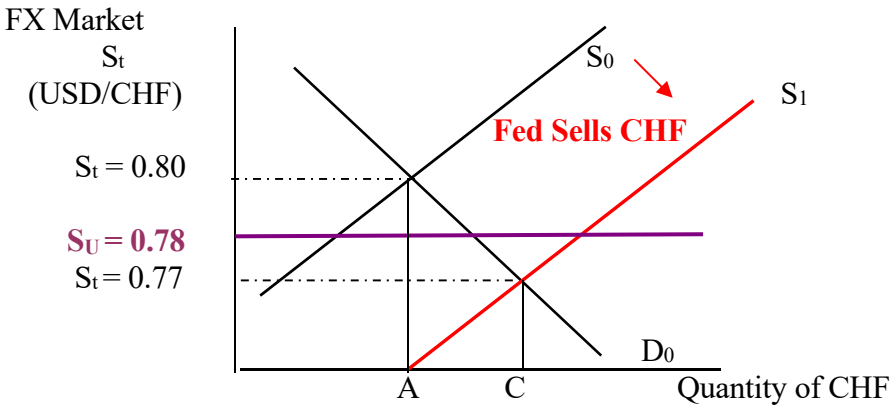
Central banks have economic models to determine what they believe is an equilibrium S_t. Using these models, a central bank determines a range for S_t, or a *trading band.* That is, if S_t moves within the band, say between $S_{t,L}$ and $S_{t,U}$, the central bank does nothing. But if S_t trades outside the band, the central bank intervenes in the FX Market. That is, there are three possible scenarios:

1. If S_t is within the range ($\mathbf{S_{t,L}} < S_t < \mathbf{S_{t,U}}$), the central bank does nothing.
2. If S_t is above $S_{t,U}$ ($S_t > \mathbf{S_{t,U}}$), CB determines that the foreign currency is overvalued, there is central bank intervention. Usually referred as "depreciating domestic currency" scenario.
3. If S_t is under $S_{t,L}$ ($S_t < \mathbf{S_{t,L}}$), CB determines that the foreign currency is undervalued, there is central bank intervention. Usually referred as "appreciating domestic currency" scenario.

The first scenario is the free float part of the mixed regime, the second and third scenarios represent the fixed part of the mixed regime.

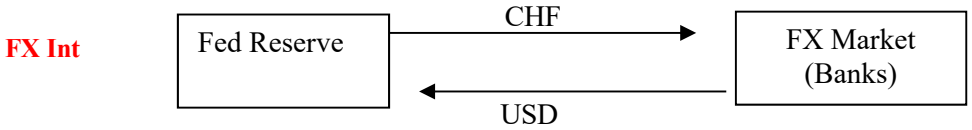
In the case of an appreciating domestic currency, central banks usually buy foreign currency, raising the price of the foreign currency in terms of the domestic currency. Exhibit II.1 illustrates the opposite intervention, where the domestic central bank sells foreign currency (and buys domestic currency!). Suppose that due to an increase demand for Swiss goods, the demand for CHF increases and sends the exchange rate to 0.80 USD/CHF, which is outside the trading band with an upper limit of 0.78 USD/CHF. The Federal Reserve decides to intervene to stop the depreciation and bring the value of the CHF under USD 0.78. The Federal Reserve sells CHF (usually, CHF bonds), moving the supply of CHF from S_0 to S_1.

Exhibit II.1-A
Central Bank Intervention to Halt Depreciation of Domestic Currency



As a final result, the equilibrium changes to 0.77 USD/CHF level. As Exhibit II.1-B shows, the Federal Reserve sold an amount of CHF equal to AC, receiving an equivalent amount in USD. This is needed to support the 0.77 USD/CHF exchange rate.

Exhibit II.1-B
Central Bank Intervention: Exchange of Cash Flows



Note: The arrows above are a simplification of three transactions. Technically speaking, the Fed sells Swiss government securities (in CHF) to a Swiss commercial bank, which pays the Fed through a deposit in a U.S. commercial bank. Then, the Fed debits the reserves of the U.S. commercial bank.

Usually, central banks do not have enough foreign reserves in stock to effectively affect exchange rates. To this purpose, central banks have reciprocal currency (swap) arrangements. For example, the Federal Reserve of the U.S. has established with the Swiss National Bank a swap arrangement of up to USD 4,000 million that may be drawn upon when needed. Any large central bank intervention in the FX market involves either the Federal Reserve or a foreign bank drawing from the swap facility currency balances, which are repaid at a later date.

1.D.2 Central Bank Intervention: Details

Central bank interventions transactions almost always are conducted at least partially in spot markets according to a 1999 BIS survey. More than 95.2% of central banks report that their official intervention activities "always include" spot market transactions and the other 4.8% "sometimes include" spot transactions. A total of 53% of central banks mention using the forward market, perhaps in conjunction with the spot market to create a swap transaction. But, there is no central bank that reports "always using" the forward market.

During intervention, central banks tend to deal with major domestic banks, but will also transact with major foreign banks. This is not unexpected, given that central bankers have frequent interactions with local banks.

Some countries have large FX reserves, which can be used to influence the value of exchange rates. For example, by the end of 2011, China and Japan had the largest FX reserves in the world, USD 3.2 trillion and USD 1.2 trillion, respectively. But, large FX reserves are not necessary in many markets. In emerging markets, central banks have an overwhelming potential "firepower," since the ratio of official reserves to average daily turnover is vastly higher in emerging markets than in industrial countries. On average, official reserves were 15 times the size of daily turnover in emerging market currencies, compared with less than half in smaller industrial countries.

When a central bank has considerable firepower, sometimes just a rumor or the threat of central bank intervention may bring the FX market in line with the central bank's desired valuation. It is common to hear central bankers talk about possible FX intervention or just talk about the overvaluation or undervaluation of the domestic currency. They hope that by talking they are sending a signal to the market. This type of verbal intervention is referred as *jawboning*. It is cheap and, sometimes, effective. For example, on September 6, 2011, the Swiss National Bank (SNB) announced a "minimum" exchange rate of 1.20 CHF/EUR, saying that the SNB would buy "unlimited quantities of foreign currency." The CHF fell from 1.11 CHF/EUR to 1.20 CHF/EUR almost immediately.

The actual size of central bank intervention depends on the reaction of the FX market. In general, if the central bank finds the initial response to be positive, the planned size of the intervention

will be cut. That is, the final size is endogenous, since it depends on the FX market reaction. The FX market can quickly align its prices to the central bank's targets. For example, Neely (2001) found, in a sample of 13 industrial countries and 9 developing economies, that in 39% of cases it took just a few minutes to observe the desired effect of intervention on exchange rates –but, in 49% it took a few days or more!. On average, during the 2002-2004 period, the size of an FX intervention, as a percentage of average daily FX market turnover- was between 5% to 12%.

Most central banks intervene secretly, releasing actual intervention data with a lag, if at all. Some authorities, like the SNB, always publicize interventions at the time they occur. Given that central banks want the market to know that a currency is "overvalued" or "undervalued" in the FX market, it is not clear why central bankers like secrecy. That is, if a central bank intervenes to convey information to the FX market, why do they conceal these transactions? Dominguez and Frankel (1993) consider several possibilities. First, if the fundamentals are inconsistent with the intervention, a central bank may prefer not to draw attention to the intervention. Second, the central bank may have very poor credibility. Third, the central bank monetary authority may wish to simply adjust the currency holdings of its portfolio.

1.D.3 Central Bank Intervention: Some Issues

Behind exchange rate stabilization, we have the implicit notion of "overvalued" or "undervalued" market exchange rates. This argument implies that central banks will realize a profit from foreign exchange intervention. But if the central bank can earn a speculative profit this way, why can't private market speculators perform the same role? To justify central bank intervention, we have to assume that there is insufficient speculation or that the central bank has "superior" information.

Intervention also presents a philosophical issue for central bankers. Note that when central banks allow exchange rates to float, it is assumed that they believe that rates determined in the market are better than fixed exchange rates. A freely floating exchange rate has the property that it is the price at which the foreign exchange market clears –point A, in Exhibit I.2. What we observe in the real world, however, is a *dirty floating* system. Therefore, if central bankers intervene in the market, the resulting equilibrium price is a signal whose interpretation is, sometimes, uncertain. This uncertainty comes from the fact that the central bank's actions may not be predictable or consistent. The uncertainty over central bank actions could increase exchange rate uncertainty, volatility, and risk. Precisely, what a central bank wants to avoid.

Despite these issues and the overwhelming academic sentiment that FX intervention is not worth it, central banks do intervene in foreign exchange markets. In a 1999 BIS survey of CBs, the percentage of business days on which CB report intervening from 0.5% to 40% percent, with a 4.5% median. The largest player is Japan. For example, between April 1991 and December 2000, the Bank of Japan (acting as the agent of the Ministry of Finance) bought USD on 168 occasions for a cumulative amount of USD 304 billion and sold USD on 33 occasions for a cumulative amount of USD 38 billion. A specific example happened on Monday, April 3, 2000. During this day, the Bank of Japan purchased USD 13.2 billion of dollars in the foreign exchange market in an attempt to stop the more than 4% depreciation of the USD against the JPY that had occurred during the previous week. These magnitudes dwarf all other countries' official intervention in the

foreign exchange market; for example, it exceeds U.S. intervention over the same period by a factor of more than 30.

There is always a potential for conflict after a central bank decides to intervene in the FX market. When a central bank intervenes in the FX market to depreciate the domestic currency with the purpose of increasing domestic exports, trading partners will be affected. This kind of central bank intervention is called *beggar-they-neighbor* devaluation. They were very common in the 1930s.

♦**Central Bank Intervention, stabilization and profit maximization.**
Probably, the main reason central banks intervene is to pursue a policy of exchange rate *stabilization*. That is, central banks intervene to minimize deviation of the exchange rates from a target level and thus, reduce uncertainty. This policy is referred as *leaning against the wind*, since the central bank sells foreign exchange rate when it is appreciating and buys foreign currency when it is depreciating. The target level is supposed to represent an equilibrium exchange rate set by the central bank. Central banks routinely intervene in the FX market with a stabilization objective. Frequently, speculators are on the other side of interventions. Profit maximization is not the objective behind this kind of central bank intervention. On the other hand, speculators are profit maximizing agents. A priori we expect central banks to show negative profits in the intervention business. If central banks, however, have privileged information about what the equilibrium exchange rate should be, central banks should profit from stabilization policies. In a paper published in the Journal of Political Economy, in 1982, Dean Taylor finds that the major central banks (with the exception of the Bank of France) have lost billions in the process of intervention. Other economists, however, studying different periods and more currencies, have found that central banks have made some profits from intervention.

There is also mixed evidence regarding the success of central bank intervention. Some empirical work find that intervention has a significant impact on exchange rates –see, Dominguez and Frankel (1993)--, while other papers find no evidence for successful central bank intervention –see Baillie and Osterberg (1997).

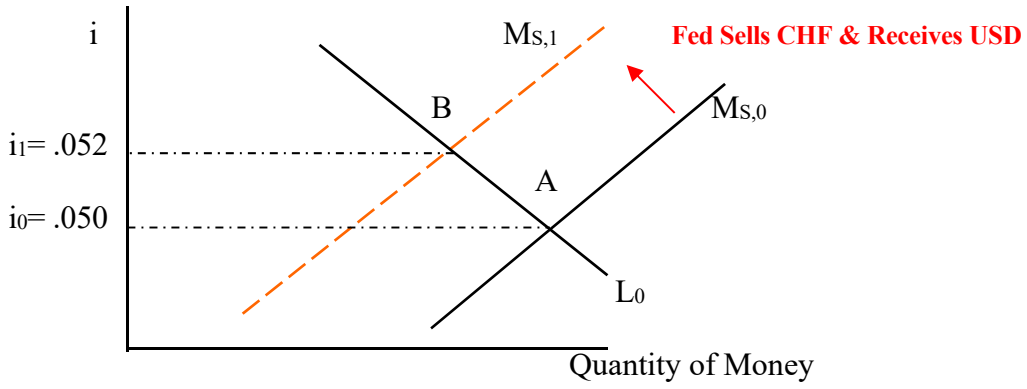
More recent academic papers look at the effect of central bank intervention on exchange rate volatility. It has been found that central bank intervention often increases exchange rate volatility.♦

1.D.4 Central Bank Intervention: Sterilization

As shown above, when a central bank buys foreign currency, it gives domestic currency to the FX sellers, thereby increasing the domestic money supply. On the hand, when a central bank sells foreign currency, the domestic money supply shrinks. Central bank intervention affects money markets. Thus, interest rates will be affected by central bank intervention in the FX market. In Exhibit II.2, we present the effects of the central bank intervention, *ceteris paribus*, on money markets illustrated in Exhibit I.2. That is, Exhibit II.2 shows the money supply (M_S) shrinking from $M_{S,0}$ to $M_{S,1}$. As a result, interest rates, i, increase from 5% to 5.20%.

Exhibit II.2

Central Bank Sells CHF and Decreases Money Supply

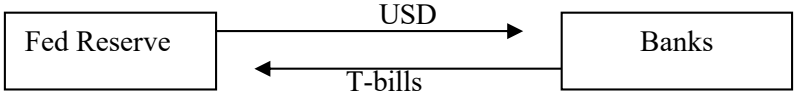


Many central banks want to have an independent monetary policy. Therefore, central banks need to take some offsetting actions to avoid the indirect effects of intervention in the FX market. *Sterilization* refers to the actions taken by a central bank to neutralize the effects of international reserve flows in money markets. For example, take the case of Exhibit II.1, where the Federal Reserve sells CHF to halt the appreciation of the CHF against the USD. To neutralize the increase in interest rates –seen in Exhibit II.2--, the Federal Reserve uses an open market operation (OMO). Through the OMO, the Federal Reserve buys Treasury Bills in the U.S. to increase money supply.

Exhibit II.3

Central Bank: Open Market Operation (OMO) to increase Money Supply

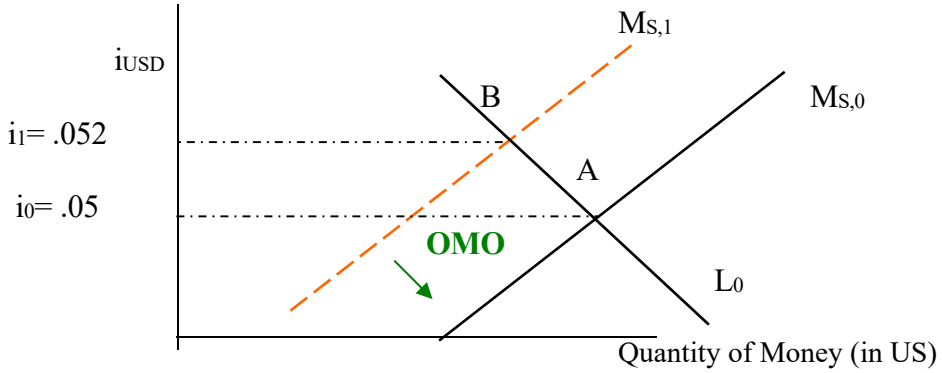
OMO



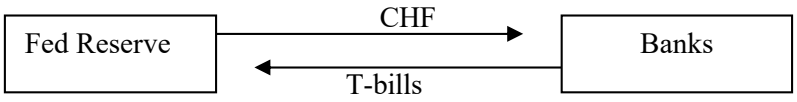
If the Federal Reserve coordinates both operations perfectly, the U.S. money supply will not be affected by the central bank intervention. This kind of intervention is called *sterilized intervention*.

Example II.11: The Federal Reserve uses an OMO to counteract the effect of FX intervention in Money Markets.

U.S. Money Market

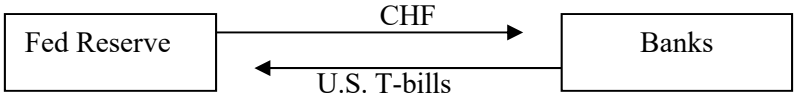


The Federal Reserve buys T-Bills to increase the U.S. M_S. The effect of both coordinated operations (*sterilized intervention*) results in the following net exchange of cash flows:



As a result, the CHF depreciates (S_t goes to .74 USD/CHF) and U.S. money markets are unaffected (U.S. interest rates stay at go back to i_0= .05).

Net effect: OMO + Fed FX Intervention



Note: Instead of using an OMO, the Fed can decrease the bank reserve-requirement ratio. This will also increase the U.S. money supply. ¶

1.D.4.i Sterilization: Side Effects

Although sterilized intervention does not change the domestic money supply (MS), it does change the composition of the Fed's (and, in equilibrium, the public's) mix of domestic and foreign assets. This creates a *balance sheet effect.* Depending on the rates of return of the assets involved, this effect can be positive or negative for the central bank. In general, for major currencies, this effect is very small. But for minor currencies, the balance sheet effect can be substantial.

Another side effect may materialize if the central bank can successfully maintain for a while S_t artificially high/low and, then, keep money markets out of sync with the FX Market. For example, suppose a central bank keeps sterilizing to keep S_t low (domestic currency is overvalued). Then, the central bank is forcing the economy, as whole, to subsidize the import sector (and domestic consumption) and leaving its domestic producers in a tough competitive situation.

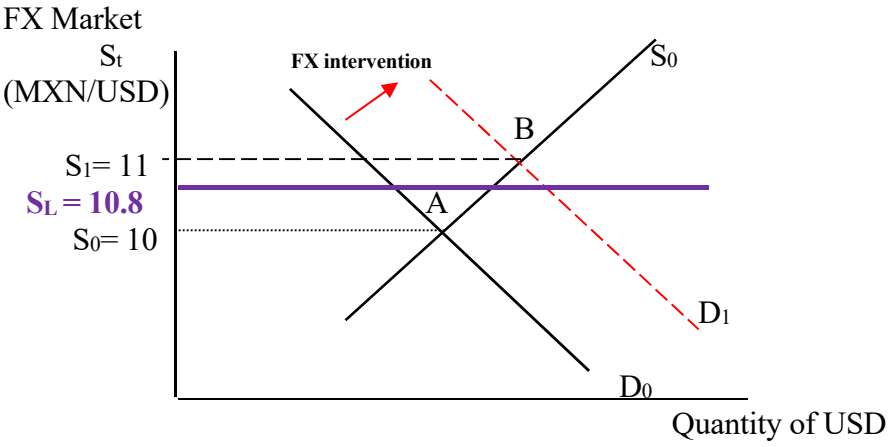
For a short time, the side effects can be tolerated; for a long time, they can lead to resource allocation problems.

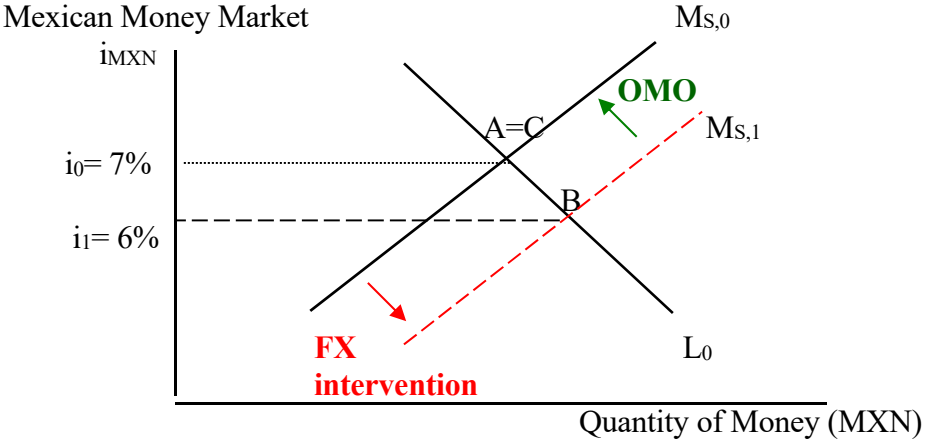
In addition, banks may not like the situation of having to hold large amounts of government bills (T-bills) and/or having high reserve-requirement ratios. Both situations will reduce bank's profits.

Example II.12: The Banco de México (Banxico, México's CB) considers the USD undervalued, say $S_t < S_L$, with $S_L = 10.8$ MXN/USD

⇒ Banxico decides to intervene, but does not want to affect local interest rates. Thus, it will use an OMO (CETES: Mexican T-bills).

Original Situation:	Point A (S_0= 10 USD/MXN and i_0=7%)
Banxico intervention in FX market (Buy USD/Sell MXN)	Point B (S_1= 11 USD/MXN and i_1=6%)
Sterilization intervention (OMO: Buy MXN/Sell CETES)	Point C (S_1= 11 USD/MXN and i_0=7%)





Banxico will invest the USD in U.S. T-bills, which have a lower effective yield than the CETES (now, with even a greater yield: 7%!) creating a negative balance sheet effect (if sterilization works the change in S_t is zero).

Note: If Banxico keeps sterilizing for a long time, keeping $S_t > S_t^E$, Mexico subsidizes its export sector (and protects its domestic sector from foreign competition). In addition, for the given S_t, Mexican interest rates will be higher, affecting consumption and investments. ¶

1.D.4.ii Sterilization: Durable Effects on S_t?

There are two main channels through which sterilization can have a more durable effect on S_t: (1) the *portfolio balance channel* and (2) the *signaling channel*.
(1) *Portfolio balance channel*: Suppose Banxico intervenes to support the USD. Then, banks buy CETES and sell USD, which used to be held in T-bills. Then, the relative supply of domestic to foreign bonds increases. If domestic and foreign bonds are *imperfect substitutes*, then, their relative prices would change in favor of the foreign bonds, increasing S_t.
(2) *Signaling channel*: Agents perceive a CB intervention as signaling a CB's intentions, regarding its future monetary policy.

1.D.4.iii Sterilization: Do They Work?

In the short-run, sterilizations tend to work, affecting S_t in the direction the CB wanted. But the evidence regarding lasting effects on S_t is mixed and it tends to be on the negative side, especially for major currencies.

Sustaining sterilizations can be costly, due to the balance sheet effects. In Banxico's example, CETES yield 7%, while US T-bills have a substantial lower yield. Over time, these costs can be difficult to bear.

Mohanty and Turner (2005) report that, between 2000 and 2004, the CBs of Korea, the Czech Republic, and Israel issued currency-stabilizing bonds of values equivalent to 300%, 200% and, 150% of their respective reserve money for the purpose of sterilization operations. Interest payments, when domestic interest rates go up, render sterilization operations too costly to last.

II. An Overview of the Modern International Monetary System

Many students will imagine that an international monetary system is a set of rules set by officials and experts at an international conference. The Bretton Woods Agreement to manage exchange rates and balance of payments, which emerged from an international conference in 1944, might be considered a typical example. Monetary rules established by international agreements, however, are the exception, not the rule. More commonly, international rules have arisen out of the individual choices of countries constrained by the prior decisions of their neighbors and by other historical events.

The emergence of the classical gold standard before World War I is an example of this spontaneous process. The gold standard evolved out of the variety of commodity-money standards that emerged before the development of paper money. Its development was one of the accidents of

modern times. It owed much to Great Britain's accidental adoption of a de facto gold standard in 1717, when Sir Isaac Newton, as master of the mint, set too low a gold price for silver, causing silver coins to disappear from circulation. With Britain's emergence in the nineteenth century as the world's leading financial and commercial power, British monetary practices became an attractive alternative to silver-based money for countries seeking to trade and borrow from the British Union. Out of these independent decisions of national governments an international system of fixed exchange rates, based on gold, was born.

2.A The Gold Standard

Silver was the dominant money during medieval times and into the modern era. Other metals were too heavy (copper) or too light (gold) when cast into coins of a value convenient for transactions. Gold coins were used to settle large transactions. This mixture of silver and gold (and copper in Sweden in 1625) was the basis for international settlements. When the residents of a country purchased abroad more than they sold, or lent more than they borrowed, they settled the difference with money acceptable to their creditors.

In the early nineteenth century, the monetary system of many countries permitted the simultaneous minting and circulation of both gold and silver coins. The U.S., The Netherlands and France had a bimetallic standard. These countries were on a *bimetallic standard*. Only Britain was fully on the gold standard from the start of the century. The German states, the Austro-Hungarian Empire, Scandinavia, Russia, and the Far East operated silver standards. Countries with bimetallic standards provided the link between the gold and silver blocs.

The French law of 1803 was representative of their bimetallic statutes: it required the mint to supply coins with legal-tender status to individuals presenting specified quantities of silver or gold. The mint ratio of the two metals was 15½ to 1 (one could obtain from the government's mint coins of equal value containing a certain amount of gold or 15½ times as much silver). Maintaining the circulation of both metals was difficult. If the market price was higher than the mint ratio, say 17 to 1, then there was an incentive for arbitrage. The arbitrageur could import 15½ ounces of silver and have it coined at the mint. She could exchange at the mint that silver coin for one containing an ounce of gold. She could export the gold and trade it for 17 ounces of silver on foreign markets, leaving the arbitrageur a profit of 1½ ounces of silver.

Gold discoveries in California in 1848 and Australia in 1851 increased the production of gold by 1,000%. The price of gold dropped substantially and gold was shipped to bimetallic countries, where the mint stood ready to purchase it at a fixed price. For example, French silver, which was undervalued, left France for the Far East and other silver standard countries. When silver deposits were discovered in Nevada, the opposite happened. Silver invaded bimetallic countries and French gold left for Britain.

At the beginning of the second half of the 1800s, countries with commercial and financial ties with Britain started to adopt the gold standard. Portugal adopted the gold standard in 1854. Germany followed in 1871. Soon, the majority of the entire European continent was in the gold standard. By the end of the nineteenth century, Spain was the only European country still on inconvertible

paper. The U.S. omitted reference to silver in the Coinage Act of 1873; when the greenback rose to par and convertibility was restored in 1879, the U.S. was effectively on gold. The system was adopted in Asia and in Latin America. Silver remained the monetary standard only in China and a few Central American countries.

During this time and until World War I, each nation defined the gold content of its currency and passively stood ready to buy and sell any amount of gold at that price. Since the gold content in one unit of each currency was fixed, exchange rates were also fixed. This was called the *mint parity*. The exchange rate could then fluctuate above and below the mint parity by the cost of shipping an amount of gold equal to one unit of the foreign currency between the two monetary centers. We can think of exchange rates being determined by a country's stock of gold. After World War I, several attempts were made to reestablish the gold standard in several countries, but they failed because of either overvaluation (Great Britain in 1925) or undervaluation (France in 1926). By 1933 the only currency that was officially convertible into gold was the U.S. dollar.

♦ The Gold Standard at Work

In its simplest form, as described by English economist David Hume more than two centuries ago, flows of gold would automatically keep economies and trade in balance. A surplus in trade would attract gold, producing an expansion of money supply. Spending would rise, along with prices, which in turn would attract imports. On the other hand, a trade deficit would then lead to an outflow of gold, contracting money stock, deflating prices, which would make the nation's exports more competitive, until a trade surplus emerged and the cycle started anew.

David Hume's version of the gold standard involved no central bank or government involvement. During the classic gold period, from 1880 until 1914, the Bank of England assisted the process. It would react to outflows of gold by raising the bank rate, which would deflate prices, making British goods more competitive and reducing demand for imports. Higher interest rates would also attract gold (capital) to the London money market.

The price adjustment mechanism is given by the Quantitative Theory of Money (QTM). Formally,

$$M_S\, V = P\, Y,$$

where M_S represents the quantity of gold (money) supplied in a given economy, V represents money's velocity, Y represents real output, and P represents nominal prices. In the short run, the velocity of money, and real output are considered stable. Therefore, in the short-run, any changes in M_s will be reflected in P. For example, a 10% increase in the quantity of gold in England will cause a 10% increase in English prices.

War disrupted financial affairs. To raise armies and pay for weapons and munitions kings and governments are forced to spend more than they have. A gold standard was usually abandoned in favor of printed money. By printing money, kings and governments were raising revenue through inflationary taxation. Such was the case in Britain during the Napoleonic Wars and in the U.S. with the Civil War. Inflation would be the by-product of war, and deflation and depression its aftermath.

Prices in England and the U.S., however, were roughly the same at the beginning of the 20th century as they were early in the 19th century. ♦

2.B Bretton Woods Agreements (1944-1973)

The leaders of the Allied countries met at Bretton Woods, New Hampshire in July 1944. They agreed to support a new international monetary system. To help to implement this system, the Bretton Woods Agreements created two institutions: the International Monetary Fund (IMF) and the World Bank. The agreement established regulation of foreign exchange rates that worked as follows:

(1) The central banks of all IMF member countries would keep their foreign exchange reserve in USD or GBP.
(2) Each member country would establish its currency's par value against the U.S. dollar. Thereafter, it would be responsible for maintaining its currency against the dollar within a band of plus or minus 1 percent. The IMF would help countries with temporary balance account problems.
(3) The U.S. agreed to maintain the dollar value by purchasing and selling gold at USD 35 per ounce.

The Bretton Woods Agreements needed a player with a large stock of gold to supply to the market whenever there was a tendency for the market price of gold to increase, and a large stock USD with which to purchase gold whenever there is a tendency for the market price of gold to go down. The U.S. had plenty of gold (nearly 60% of the world's stock) and, obviously, plenty of USD. Thus, the Bretton Woods system would have the U.S. remain the ultimate bulwark, maintaining the value of the dollar stable versus gold. The USD became the main reserve currency held by central banks and was the currency used for international transactions. Other nations would keep a stable, but flexible exchange rate mechanism.

By the late 1960s, the cost of the Vietnam War, plus the cost of the new domestic programs of the Great Society, began to put pressure on the USD. The U.S. was spending more than it produced. As a consequence, in 1958 the U.S. began to have large balance of payment deficits, which were partially financed with the creation of USD. High U.S. inflation caused the (private) market price of gold to rise above the Bretton Woods Agreements price of USD 35 per ounce. That is, the market value of the USD was below the official rate, relative to foreign currencies. A run on the USD followed as speculators (including investors, banks, and governments) rushed to buy gold from the U.S. at the official rate of USD 35 per ounce.

In March 1968, the effort to control the private market of gold was abandoned. A *dual* system was established. Official transactions (i.e., transactions among Central Banks) in gold would be carried out at the official rate of USD 35 per ounce. The private market could trade at the equilibrium market price. The private price of gold immediately increased to USD 43 per ounce. By the end of 1969, the price of gold went back to USD 35 per ounce.

The "dollar crisis of 1971" led President Nixon to suspend, in August 15, 1971, the dollar's convertibility into gold (due to expansive monetary policies). In the meantime, exchange rates of

most of the leading countries were allowed to float in relation to the USD. By the end of 1971, most of the major trading currencies had appreciated vis-a-vis the USD. In December 1971, a major modification to Bretton Woods was declared (The Smithsonian Agreement). The price of gold was raised to USD 38 and the band of fluctuation was widened to plus or minus 2.25 percent. In early 1973 the U.S. dollar came under attack once again, forcing a second devaluation on February 12, 1973, this time the prices of gold was raised to USD 42.22. By late February 1973 the system totally collapsed. The major exchange markets were actually closed for several weeks in March 1973, and when they reopened, most currencies were allowed to float. The dual system that started in March 1968 was abandoned in November 1973. By then, the price of gold had reached USD 100 per ounce. Since that time (dirty) floating exchange rates have prevailed for the major countries.

Several economists argue that the Bretton Woods system worked acceptably well until the late 1960s. The market periodically forced countries to devalue their currencies, but the system helped to facilitate cross-border trade and stimulated economic development.

♦ **The Collapse of Bretton Woods: An Application of Hume's QTM**
The collapse of the Bretton Woods Agreements can be explained by Hume's QTM. Annual U.S. money supply (M1) growth averaged 2.2% during the 1950s. During the Kennedy administration, the annual M1 growth rate increased to 2.9%. During the Johnson administration, the annual M1 growth rate increased substantially: 4.6% over 1964-1967 and 7.7% in 1968. During the Nixon administration, the annual M1 growth rate initially decreased to 3.2% in 1969, increased to 5.2% in 1970, and then jumped to 7.1% over 1971-1973. An inconsistent monetary policy caused the fixed exchange rate system to collapse. ♦

2.C Managed floating system and the G-7 Council

After the collapse of the Bretton Woods Agreements, the world observed a period of high risk in financial markets. High government deficits, high inflation and the OPEC oil embargo increased financial price volatility. Whether floating rates was the cause or the effect of monetary instability is the subject of continuing debate. Exchange rate volatility has been considered too high many times during the past 25 years. Overall, the world has had a managed (by central banks) floating exchange rate system.

In January 1976, the IMF convened a monetary summit in Jamaica to reach some agreement on a new monetary system. The Jamaica Accords formally recognized the managed floating system and allowed nations the choice of a foreign exchange regime as long as their actions did not prove disruptive to trade partners and the world economy. Gold was demonetized as a reserve asset. The Jamaica Accords were ratified in April 1978.

World leaders, however, still attempt to coordinate exchange rate policies. The most recent manifestation is so-called the "G-7" council of economic ministers. The exact goals of the council seem to change with economic conditions. In two of these meeting, the G-7 council of economic ministers agreed on a set of policies with regard to exchange rates. The Plaza Accord (September 1985), signed in the Plaza Hotel in New York City, agreed to coordinate an intervention aimed at

lowering the value of the U.S. dollar. The dollar had already started to weaken in value during the summer of 1985 and the announcement of the Plaza Accord accelerated the U.S. dollar's decline. In fact, after this announcement, the dollar fell 4 percent in 24 hours. By the end of 1986, the G-7 council considered that the U.S. had depreciated "too much." The Louvre Accord (February 1987) agreed to stabilized exchange rates. This meant limiting the size of exchange rate fluctuations with the use of coordinated central bank intervention. This accord lasted until April 1990.

2.D Europe's Exchange Rate Mechanism and the Euro

Following the Smithsonian Agreements in April 1972, the European Economic Community -now, European Union (EU)- suggested that its members' countries limit the movement of their bilateral exchange rate to a 1.125 percent band. It became known as the "snake in the tunnel" or "snake." Expansive monetary policies forced the GBP out of the "snake" in two months. The "snake" lasted one year, but it was the basis for the European Monetary System, EMS, (March 1979) and its Exchange Rate Mechanism (ERM). The EMS called for the creation of a new currency, the European Currency Unit (XEU), or "ecu." The XEU was a GDP weighted average of the EMS currencies. Each member of the ERM had an assigned "XEU central rate" which was its targeted rate of exchange for the XEU, measured as the number of currency equal to one XEU. The ratio of any two currencies' XEU central rates was defined as their "bilateral central rate." The crux of the ERM was the requirement that each member must keep its currency's exchange rate around the bilateral parity rates. Originally, the margin was plus or minus 2.25 percent. The U.K. was admitted with a 6 percent band. Occasionally, inconsistent national monetary policies and market forces forced countries out of the ERM. Reentry into the system was usually at a much lower exchange rate than the parity the country had before, resulting in a currency devaluation. By September 1992, with the exception of Greece and Portugal, all EU members belonged to the ERM. Several European central banks, although not officially part of the EU, were voluntarily attaching their currencies to the ERM.

In December 1991, the then twelve members of the EU signed the Maastricht Treaty. The Treaty specified a plan to establish a full European Monetary Union (EMU), with single currency, the euro (EUR), and central bank, by January 1, 1999. The idea behind a single currency for the EU is that exchange rate fluctuations disrupt trade and market integration. Multiple currencies complicate price comparisons requiring importers and exporters to hedge, and reduces the volume of intra-regional trade. The single currency created a new European monetary authority, the European Central Bank (ECB), which is now located in Frankfurt. The ECB and the National Central Banks (NCB) of the EU members formed the European System of Central Banks (ESCB). The ESCB is based on the concept of a dual-layer central bank system. The decision-making is fully centralized at the ECB, while the implementation of the monetary policy is carried out by the NCBs. The highest decision-making body is the ECB Governing Council. The Council is composed of the six members of the ECB Executive Board and the Governors of the eleven NCBs of the participating members. The ECB Governing Council controls the overall monetary policy, which has a stated goal of "price stability."

The Maastricht Treaty also called for the integration and coordination of the member countries' monetary and fiscal policies. The idea was that, by the time the EMU started, the financial

conditions of all the members had to be similar. Before becoming a full member of the EMU, each member had to meet the following criteria:

(1) Nominal inflation should be no more than 1.5% above the average for the three members of the EU with the lowest inflation rates during the previous year.

(2) Long-term deficit should be no more than 3% of GDP.

(3) Long-term interest rates should be no more than 2% above the average for the three members with the lowest interest rates.

(4) Government debt should have a continuous and significant movement towards a cap of 60% of GDP.

On January 1, 1999, eleven EU members joined the EMU: Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Portugal and Sweden. Permanent exchange rates -Austrian schilling (ATS) against EUR, French Franc (FRF) against EUR, and so on- for these eleven EMU members were set by the ECB on January 1, 1999. For example, a EUR was set to be equal to ATS 13.7603, and FRF 6.55957. The value of the EUR against the USD and other currencies fluctuates from January 1, 1999. Great Britain, Denmark and Sweden will decide later whether to join the EMU. Greece hopes to qualify early in the next decade.

♦ **The Euro: Politics behind a Currency**

The period from February 1992 to December 1998 was needed to decide on a name and a design for the new European currency. It was thought, all along, that the name of the new currency would be ecu. This stood for European Currency Unit and if spelled écu it represents the name of a medieval French coin. The German government, in 1995, demanded to drop the name ecu: *ein ecu* sounded too much like *eine Kuh* -in Germany, the new coin would be confused with a cow. The Spanish government suggested "euro." The Greeks did not approve of the name euro: it sounded like the Greek word for "urine." But Greece is not Germany in the EU, and the name euro was chosen.

For the composition of the coins, the European mint had decided on using nickel, which is abundant in France. The Swedes demanded a change: in Sweden nickel coins are banned, since it is believed they produce an allergic skin reaction. (Never mind that the Swedes produce copper.) Now, the lowest denomination euro coins -the 1-, 2-, and 5-cent coins) will be copper-platted steel. The 10-, 20-, and 50-cent coins will be made from a new yellowish alloy, invented in Finland. The 1- and 2-euro coins will contain nickel and most of it will be sandwiched inside a copper alloy, patented by the German company Krupp.

Source: *Discover*, October 1998. ♦

The transition to the euro was done in different stages. Starting on January 1, 1999, the euro was used by business conducting electronic and other noncash transactions. Euronotes and coins began circulating until January 1, 2002. That is, during the three-year transition period, the euro was the legal currency for use in financial markets and other business activities. But the national

currencies were still used for cash transactions. From January 1, 2002 to June 30, 2002, prices were displayed in both old and new currencies. From July 1, 2002, the euro was the only legal tender in member countries.

The creation of a single currency eliminates foreign exchange charges for cross-border European trade -the commission that banks now charge for changing GBP to DEM, FRF to ATS. It is estimated that the euro saves USD 75 billion a year in costs involved in exchanging currencies in the EU. Making Europe's currencies one creates a vast pool of capital that is far more mobile than before.

The nineteen separate government bond markets have created a single, USD 2.5 trillion giant market. Europe's illiquid corporate bond market has the potential to grow into an active USD 1 trillion market, more than four times its size in 1997.

The common currency creates problems and costs. EMU members have lost their independent monetary policies. The ECB decides the monetary policy for all the EMU members. It is natural to suppose that not all the EMU members will necessarily agree on a common monetary policy For example, during the recent Greek crisis, the Greek and the German governments have no agreements on a common policy. The lack of flexibility that a common currency creates has been a drag in the recovery of the Greek economy.

For example, before January 1, 1999, the Central Bank of Greece would allow the depreciation of the Greek drachma to increase foreign demand for Greek products and/or decrease interest rates to stimulate domestic consumption. After the monetary union, the Central Bank of Greece is unable to modify exchange rates or lower interest rates. Since labor markets are very rigid in Europe, Greek firms are not able to adjust salaries to reduce prices and increase demand for their products. Thus, Greek unemployment can increase.

III. Looking Ahead

In the first two chapters we have discussed the general features of the foreign exchange market. Chapter I presented the concept of equilibrium exchange rates, the organization of the foreign exchange market and the major instruments traded in foreign exchange markets. This chapter introduced the different exchange rate systems, the mechanisms of central bank intervention, and a brief history of the international monetary system. In the first two chapters we have used the simple intuition of supply and demand to determine the equilibrium exchange rate. The next chapters will introduce us to different models of exchange rate determination. To derive an equilibrium exchange rate, some of the models will rely on simple arbitrage concepts, while other models will rely on very complex general equilibrium models.

Related readings:

For a journalist perspective on the problems associated with fixed-exchange rates, see the first chapter of **Lost Prophets: An Insider's History of the Modern Economists**, by Alfred J. Malabre, Jr.

Parts of Chapter I were based on the following books:

International Financial Markets, by J. Orlin Grabbe, published by McGraw-Hill.
International Financial Markets and The Firm, by Piet Sercu and Raman Uppal, published by South Western.
International Investments, by Bruno Solnik, published by Addison Wesley.

Exercises:

1. You work for the President of the U.S. Federal Reserve. Your priority is to maintain a stable USD. You have a USD 40 billion intervention fund to directly affect supply or demand of foreign exchange. How would you use the intervention fund in the following situations:

i.- Japanese interest rates are suddenly reduced.
ii.- U.S. inflation suddenly increase relative to British inflation.
iii.- German GNP grows at a faster pace, relative to the U.S. GNP.

2. South Africa has a floating exchange rate system. The rand –South African's currency- is depreciating against the USD. The Central Bank of South Africa decides to intervene to stop the depreciation of the Guild. The Central Bank of Africa does not want to affect local interest rates. With the help of a graph, describe what the Central Bank authorities can do.

3. During the first quarter of 2000, the Brazilian real plunged quickly from 1.20 BRR/USD to 2 BRR/USD. Calculate the appreciation of the USD against the BRR and the depreciation of the BRR against the USD.

4. On September 19, 2000, the *Wall Street Journal* reported that the ECB Vice President Christian Noyer said "the euro is dangerously undervalued." How can the ECB intervene to increase the value of the euro? Draw a graph. Describe the effect of ECB intervention on European money markets.

5. On September 6, 2011, the Swiss National Bank (SNB) announced a "minimum" exchange rate of 1.20 CHF/EUR, saying that the SNB would buy "unlimited quantities of foreign currency." In a famous central bank intervention, on September 16, 1992, the Bank of England was trying to stay within the ERM limits, by pushing the value of the GBP above 2.78 DEM/GBP. Which central bank intervention was easier?