Chapter 6
Exchange Rate Systems

Free Float, Fixed, Mixed & Central Bank Intervention

Review from Last Class

• **FX Market: A Huge Market**
Biggest financial market, with a daily volume: **USD 7.5T**.

Always "open" (wholesale) market, organized as an informal network of about **2,000 banks** and currency dealers (OTC format).

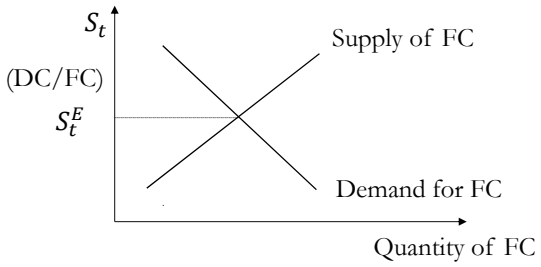
Divided in 3 segments – **Spot** $\Rightarrow S_t$
– **Forward** $\Rightarrow F_{t.T}$
– **FX Swap** (largest).

• Notation: We use **direct quotes**
The currency in the denominator is the FC.

S_t = **1.0903 USD/EUR** $\Rightarrow$ EUR 1 = USD 1.0903 (the DC)

Review from Last Class

- **S_t is a Price, determined by Supply and Demand**



- **Q: What moves Supply & Demand?**
  - International Investing: Foreign Investors investing in the US
    US Investors investing abroad
  - International Trade: Exports/Imports
  - International Tourism
  - Central Banks.

Review from Last Class

- **What moves Supply & Demand?**

– International Investing, International Trade, International Tourism, and other factors (Central Banks needs, international transfers, tariffs, etc.)

All these activities are reflected in the **Balance of Payments** (BOP).

- **Economic Variables ("*Fundamentals*") Affecting the BOP (S & D)**
  - – Interest rates ($i_d - i_f$)
  - – Inflation rates ($I_d - I_f$)
  - – Income growth rates ($y_d - y_f$)
  - – Others: Tariffs, quotas, other trade barriers, expectations, taxes, tastes, expected returns in financial assets/real estate, technology, etc.

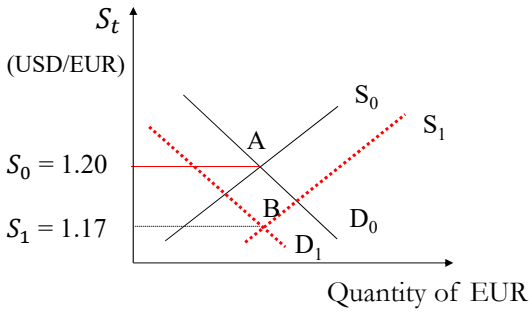
⇒ Changes in the fundamentals will affect S_t.

Review from Last Class

Example: **Changes in interest rate differentials**

The U.S. Fed increases interest rates ($i_{\text{USD}} \uparrow$) ⇒ ($i_{\text{USD}} - i_{EUR}$) ↑

Two effects: – European residents buy more U.S. T-bills (S of EUR ↑)
– U.S. residents buy less European T-bills (D for EUR ↓)
⇒ both Supply and Demand curves shift.



- S_t moves from A to B: $S_t \downarrow$ ⇒ EUR **depreciates** *against* the USD

Review from Last Class

• Summary of Effects

($i_{\text{USD}} - i_{EUR}$) ↑ ⇒ S_t ↓.	EUR **depreciates** against USD.
($i_{\text{USD}} - i_{EUR}$) ↓ ⇒ S_t ↑.	EUR **appreciates** against USD.
($I_{\text{USD}} - I_{EUR}$) ↑ ⇒ S_t ↑.	EUR **appreciates** against USD.
($I_{\text{USD}} - I_{EUR}$) ↓ ⇒ S_t ↓.	EUR **depreciates** against USD.
US tariffs on foreign goods ↑ (& no trade war) ⇒ S_t ↓	FC depreciates
US uncertainty ↑ ⇒ S_t ↑	Safe haven currencies appreciate
Negative wealth shock ⇒ S_t ↑	DC depreciates
($y_{\text{USD}} - y_{EUR}$) ↑ ⇒ S_t ↓	EUR depreciates (Monetary Approach)

Review from Last Class

• **FX Risk**

Example: Spec's imports wine from Europe. Spec's has to pay **EUR 5M** on **July 2**. Today, **June 4**, the exchange rate is S_t = **1.10 USD/EUR**.

Today, June 4, at $S_{t=June\ 4}$, Spec's total payment would be:

EUR 5M * **1.10 USD/EUR** = **USD 5.50M**.

On July 2 there are two potential scenarios, relative to June 4:

If $S_{July\ 2}\downarrow$ (USD appreciates) ⇒ Spec's will pay less USD.

If $S_{July\ 2}\uparrow$ (USD depreciates) ⇒ Spec's will pay more USD.

⇒ Second scenario introduces **FX (Currency) Risk.**

• We use derivatives (Futures/Forwards) and Options to manage FX Risk.

Review from Last Class

• **Forward & Futures FX Contract**

A forward contract is an agreement written today, between two parties to exchange a **given amount** (**size**) of currencies at a given **future date** (**maturity**) at a **pre-specified exchange rate**, $F_{t,T}$.

A futures contract standardizes size, maturity and collateral.

• **FX Hedging**

FX Hedger reduces the exposure of an **underlying position** to currency risk using (at least) another position (**hedging position**).

Basic Idea of a Hedger: A change in value of an underlying position is compensated with the change in value of a hedging position.

Goal: Make the overall position insensitive to changes in FX rates.

Review from Last Class

• Hedging with FX futures:

i. ***Long*** *hedger*: UP: *short* in the foreign currency.
HP: ***long*** in currency futures.

ii. ***Short*** *hedger*: UP: *long* in the foreign currency.
HP: ***short*** in currency futures.

Example: Iris Oil Inc. will transfer **CAD 300 million** to its USD account in 90 days. To avoid FX risk, Iris Oil *shorts* a USD/CAD Forward contract.

Data:

S_t = **.8451 USD/CAD**

$F_{t,T=90-day}$ = **.8493 USD/CAD** (Iris Oil sells/shorts CAD forward)

In 90-days, Iris Oil will receive with certainty:

CAD 300M * **.8493 USD/CAD** = **USD 254,790,000**.

Review from Last Class

• FX Option Contract

An option gives the holder the right to do something (buy/sell an asset at a given price) during a specific period of time:

- **calls** give the holder the right to buy the underlying asset
- **puts** give the holder the right to sell the underlying asset.

Terms of an option must specify:

- **Exercise** or **strike price** (**X**): Price at which the right is "exercised."
- **Expiration date** (T): Date when the right expires.
- **Type**. When the option can be exercised: Anytime (*American*)
  At expiration (*European*).

The right to buy/sell an asset has a price: The **premium**, paid upfront.

Review from Last Class

• **Hedging with FX options:**

Situation 1: Underlying position: **long** in foreign currency.
Hedging position: long in foreign currency ***puts***.

Situation 2: Underlying position: **short** in foreign currency.
Hedging position: long in foreign currency ***calls***.

Example: Iris Oil Inc. will transfer **CAD 300 million** to its USD account in 90 days. To avoid FX risk, Iris Oil *buys* USD/CAD put contracts.

Data:

S_t = **.8451 USD/CAD**

X = .84 USD/CAD, with P_{put}= **USD 0.0068** (Iris Oil buys CAD puts)

Cost = **CAD 300 M** * **USD 0.0068**/CAD = **USD 2.04 M**

Review from Last Class

At $T = t + 90$, there will be two scenarios:

Option is ITM (exercised –i.e., S_t < X=0.84)
Option is OTM (not exercised)

Position	**Initial CF**	S_{t+90} < **.84 USD/CAD**	S_{t+90} ≥ **.84 USD/CAD**
Option (HP)	**USD 2.04M**	(**.84** – S_{t+90}) * **CAD 300M**	0
Underlying (UP)	0	S_{t+90} * **CAD 300M**	S_{t+90} * **CAD 300M**
Total CF	**USD 2.04M**	USD 252M	S_{t+90} * CAD 300M

Net CF in 90 days:

USD 252M – **USD 2.04M** = USD 249.96M for S_{t+90} < .84 USD/CAD
S_{t+90} * **CAD 300M** – **USD 2.04M** for S_{t+90} ≥ .84 USD/CAD

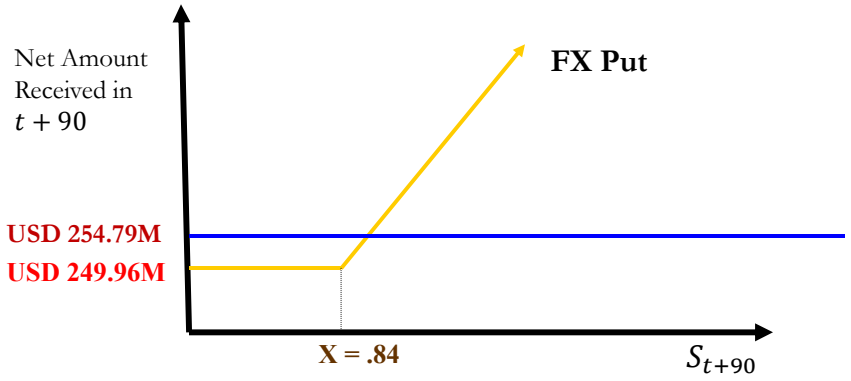
Worst case scenario (floor): **USD 249.96M** (when put is exercised.)

Remark: The final CFs depend on S_{t+90}!

Review from Last Class

• FX option limits FX risk, Iris Oil has established a floor: **USD 249.96M**.

But, FX options, unlike Futures/forwards, have an upside ⇒ At time t, the final outcome is unknown. There is still (some) uncertainty!



Exchange Rate Systems

• Pure FX Rate Systems

Defined by the role of the **Central Bank** (**CB**):

— **Free Float** or **Flexible**

— **Fixed**

• CB: Brief Review

A CB is a "bank." It holds:

◊ Assets: Foreign (FC Reserves, FC bonds)) + Gold + Domestic (**U.S. Treasuries**, **Mortgage Back Securities**)

◊ Liabilities: **DC outstanding** + **Deposits of banks**.

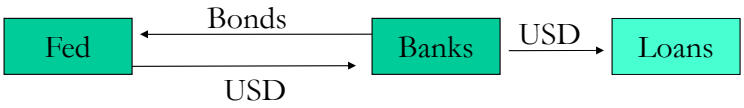
Remark: Change in assets = Change in liabilities

⇒ A purchase of an asset or FC results in an increase in the liabilities, usually through an increase in the MS.

• CB: Brief Review – Asset Purchases = Change in Liabilities

Example: During the 2008-09 Financial Crisis, the U.S. Fed launched the Quantitative Monetary Easing (QE) program.

Under QE, Fed buys bonds (assets ↑) & pays with USD (Money Supply ↑):



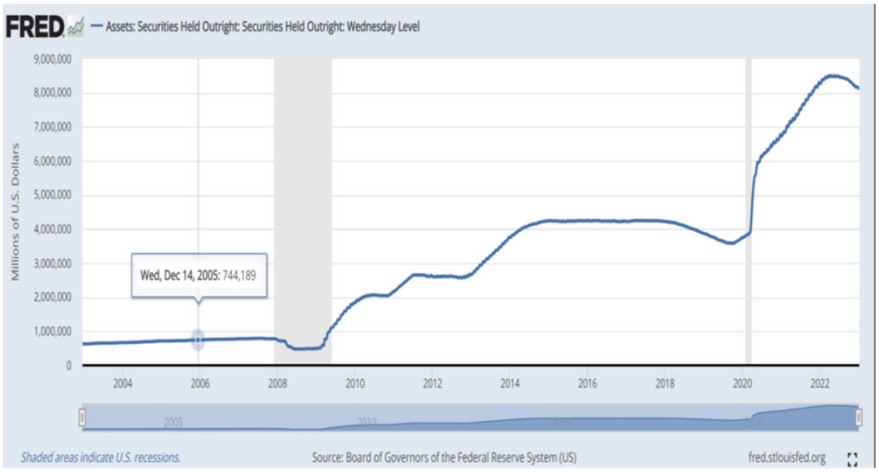
When QE finished, in Oct 2014, the Fed had bought USD 4.5 trillion worth of Treasuries, Mortgage-back securities, and Bank debt.

As a result, the Fed kept $i_{US} \approx 0$ (record low levels) for 6+ years.

Same QE program used for Covid crisis.

• CB: Brief Review – Asset Purchases = Change in Liabilities

Example: U.S. Fed QE program: QE1 (09-10), QE2 (11), QE3 (12-13), & QE-Covid (20-22)



Note: Japan has been on a QE situation since 2001! Bank of England, Swiss National Bank and ECB also had their QE programs.

• CB: Brief Review – Balance Sheet

Table II.1
U.S. Federal Reserve Balance Sheet (May 2025)

Consolidated U.S. Fed Balance Sheet (in USD billions)			
Liabilities		***Assets***	
Federal Reserve Notes	**2,335.4**	U.S. Treasuries	**4,213.4**
Reverse Repurchase Agreements	534.1	Mortgage Backed Securities	**2,171.9**
Deposits	**3,992.0**	Gold	11.0
Other liabilities	-218.3	SDR	15.2
Total	***6,643.2***	FC Denominated Assets	19.0
		Unamortized Premiums on Securities	239.7
Capital Account	***45.5***	Other assets	18.5
Capital paid in	38.7	***Total***	***6,688.7***
Surplus	6.8		

• Capital Account

Capital Account = Total Assets – Total Liabilities = **USD 45.5 B**

Surplus: Retained earnings not paid to the US Treasury (USD 6.8 B).

• CB: Brief Review – Roles

• Historical roles of a CB:
  – Lender of last resort ("*Bank of banks*")
  – Supervisor of financial institutions.

This is the banking side of a CB.

• But, a CB is also the Monetary Authority: It controls domestic money supply (MS), with responsibility over
  – **Inflation** (I_d low)
  – **Economic GDP** (Y_d close to full employment).

This is the economic policy side of a modern CB (today, the main role).

• Targets are conflicting: $i_d \uparrow \Rightarrow I_d \downarrow$, but $Y_d \downarrow$.
$i_d \downarrow \Rightarrow I_d \uparrow$, but $Y_d \uparrow$.

$\Rightarrow$ CBs set i_d, balancing I_d and Y_d.

• CB: Brief Review - Names

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

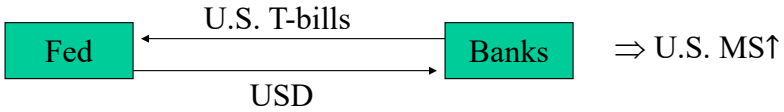
• CB: Brief Review - Open Market Operations

CBs have several monetary policy instruments. The most important:

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

OMO: Main policy tool. CB tool to put money in and take money out of banking system, by buying/selling government securities (U.S. Treasury bills):

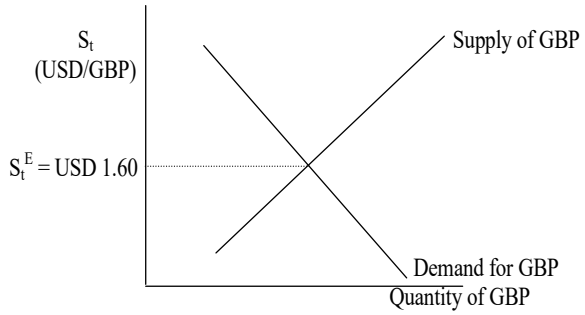
– MS Increase: CB buys securities from banks, paying with DC.



– MS Decrease: CB sells securities to banks, receiving DC.

1. Flexible Exchange Rate System (Free Float)

In a **flexible exchange rate system** the CB allows S & D to freely set S_t.



All the variables mentioned before ($i_d - i_f$; $I_d - I_f$, etc.) will affect S_t. In particular, international capital flows will change S_t.

Whatever S_t is, the CB is fine with it.

Features of a Free Float

- S_t reflects economic activity, through S & D.
- S_t is subject to volatility (FX risk!).
- Money supply is exogenous, independent of FX Market. Thus, the CB has an independent monetary policy.
- Under certain assumptions (IS-LM model, perfect capital mobility), fiscal policy does not work. But, monetary policy works.
- External shocks (say, oil shocks) can be quickly absorbed by changes in S_t.

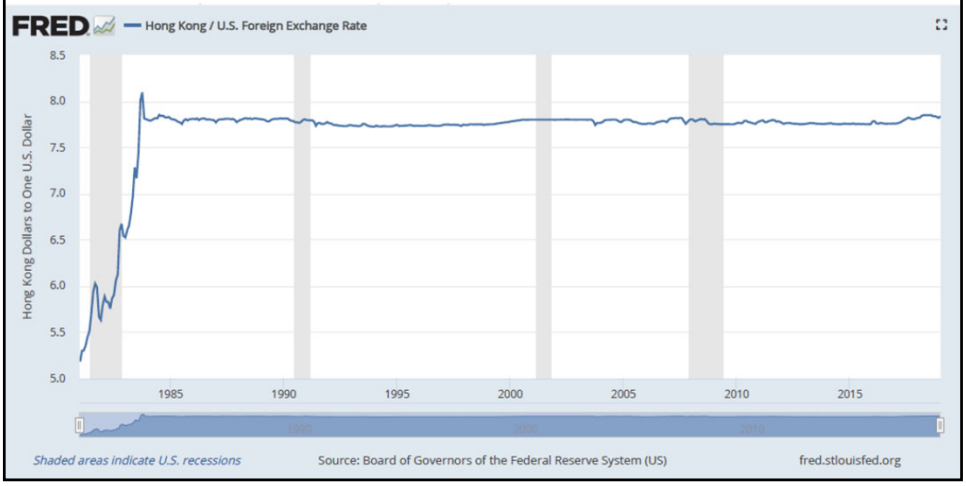
Terminology

A currency *depreciates* (*appreciates*) when, under a free float, it becomes less (more) expensive in terms of foreign currency.

2. Fixed Exchange Rate System

In a ***fixed exchange rate system*** the Central Bank is ready to buy and sell *unlimited* amounts of domestic currency at set (*fixed*) price, say **S***.

Example: Hong Kong has a fixed exchange rate (a *peg*) system since October 17, 1983. The exchange rate is **S*** = **7.8052 HKD/USD**.



Example (continuation):

Remark: The HKD is not fixed against all FCs, only against the USD:

USD moves against EUR ⇒ HKD moves against EUR.

From 2010 to 2015, USD moved widely against the EUR, HKD also moved: From 11.50 HKD/EUR (Apr 24, 2011) to 9.15 HKD/EUR (Jan 8, 2015). ¶

• Close to 50 countries follow a conventional fixed system. Africa has most of them: 19 countries -14 use the CFA franc, pegged to EUR, & 3 use the South African Rand (ZAR).

• In order to support the fixed parity **S***, a CB needs:
(a) Enough DC to buy "unlimited" amounts of FC.
(b) Enough reserves (FC) to buy "unlimited" amounts of DC.

Two observations:
(1) Element (a) is not a problem. CBs own the machines that print DC. Element (b) is the one that causes problems to CBs.

A CB may not have enough FC to buy all the DC in circulation. If there is not enough FC reserves and the demand for FC cannot be met, the CB has a problem: *A currency crisis*.

CB *credibility* plays a big role in currency crisis. A government may reach and use the CB reserves for other purposes, besides supporting the fixed parity.

Note: Element (b) can be addressed by placing enough FC reserves to buy the DC MS (keep 100% reserves) outside the reach of a CB/government. This arrangement is called **Currency Board**.

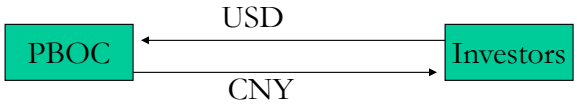
Small Caribbean countries (Grenada, Saint Lucia, Dominica, etc.) have a fixed exchange rate system (pegged to the USD) with a currency board.

(2) Every time somebody buys (sells) FC from (to) the CB, the domestic MS decreases (increases) $\Rightarrow$ A CB does not control the MS.

Thus, MS is *endogenous* to the FC demand/supply. Thus, international capital flows affect the domestic MS. Difficult to do monetary policy!

• MS is *endogenous* to the FC demand/supply. Thus, international capital flows affect the domestic MS. Difficult to do monetary policy!

Example: International capital inflows to China:



⇒ China's MS↑

Note: The People's Bank of China (PBOC, China's CB) may not like an increase in the MS (along with lower i_{CNY} & inflationary pressures) and take some counteraction to mitigate the increase in MS. ¶

• A CB gives up the control of MS. Only hope for independent monetary policy is to use indirect tools –usually, capital controls and/or change banking required reserve ratios (RRR).

A CB counteraction taken to mitigate the effect of some variable (say, capital inflows) on the domestic MS is called *sterilization.*

Fixed FX System: Variations

Some CBs have a fixed exchange rate system, but S_t is not really fixed:
- "**Target zone system**." S_t is kept within a band ("target zone").
- "**Crawling peg system**." S_t is regularly adjusted.

Example:

"**Target zone system**."

On July 21, 2005, the People's Bank of China (China's CB) announced that the CNY would trade within a narrow 0.3% band against the basket of currencies. The basket is dominated by the USD, EUR, JPY and KOW.

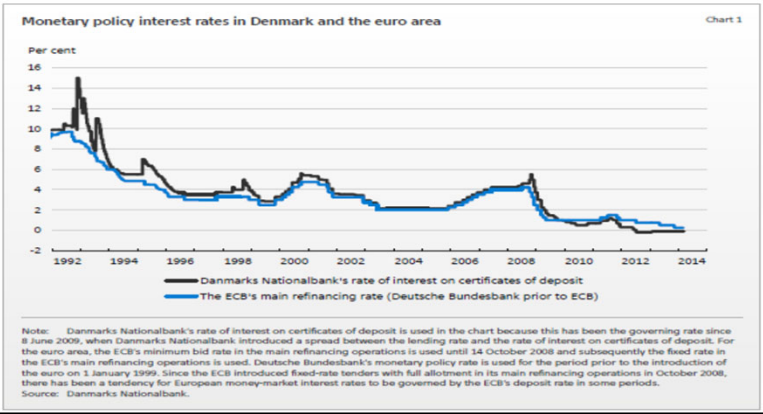
"**Crawling peg system**."

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

Example: Giving up Monetary Policy

Since 1982, Denmark adopted a target zone system, pegging against the DEM and, in 1999, to the EUR. Following the ERM II, S_t is fixed at **S***= **7.46038 DEK/EUR**, but it may fluctuate by ± 2.25%.

When the ECB changes its interest rates, Danmarks Nationalbank responds by making similar changes.



Features of Fixed System

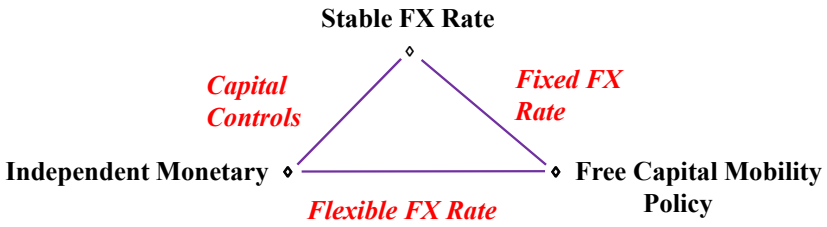
- Money supply is endogenous ⇒ No **independent** monetary policy!
- Exchange rate has no/low volatility. (Good for trade, investments.)
- If CB does not have enough FC reserves, **credibility** is crucial.
- Since S_t is fixed, external shocks have to be absorbed through prices, which tend to be rigid. (Slower adjustments to shocks/imbalances.)
- Under certain assumptions (Mundell-Fleming), fiscal policy works.

Trilemma –due to Robert Mundell (1962), Nobel Prize Winner.

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 autonomous (independent) monetary policy.

A country can have two, but not the three:



⇒ *Inconsistent* monetary policy = Attempt to have the three things.

Inconsistent monetary policy is the main cause of currency crisis.

Inconsistent Monetary Policy Problem: Example

Under a fixed system, $MS_d \uparrow$ to finance deficit spending or to mitigate an external shock:

$MS_d \uparrow \Rightarrow i_d \downarrow \Rightarrow (i_d - i_f) \downarrow$ ⇒ International capital outflows

⇒ CB's FC reserves ↓.

• Notice that under a free float,

$MS_d \uparrow \Rightarrow i_d \downarrow \Rightarrow (i_d - i_f) \downarrow$ ⇒ International capital outflows

$\Rightarrow S_t \uparrow$ (> S*). That's the adjustment.

• But, under a fixed system, S* does not change. This is a problem!

Inconsistent Monetary Policy Problems

• Usually, under a violation of Fixed FX system, under a free float, $S_t \uparrow$ (> **S***).

Notes:

- We think of free float S_t as the "*true equilibrium*" (or "*shadow*") rate.
- The size of (S_t – **S***) signals the magnitude of the inconsistency. It is also the size of the potential profit for speculators if CB abandons fixed parity.

Eventually, as inconsistency grows, a *speculative attack* on FC reserves occurs.

Speculators will attack the CB reserves when they have doubts that the CB will defend the parity. In these situations, we usually say a CB (or a country) faces a *currency crisis*.

• CB Dilemma: To Defend or Not To Defend parity?
A CB considers costs & benefits of defending fixed parity, **S***.

Usually, CBs defend **S***.

• Currency crisis

Usually, CBs defend **S***. Tools:

- Sell FC reserves
- Borrow FC
- Substantially raise i_d
- Impose capital controls.

These actions may be costly & cause (or make worse) a recession.

• Definite solution to a speculative attack: Float the currency (abandon **S***).

• When a CB abandons **S*** because it is running out of FC reserves, a devaluation/depreciation occurs. Speculators gain!

• Speculators questions: Will the CB be able to defend the parity **S***? Will the government bear the costs of defending it?

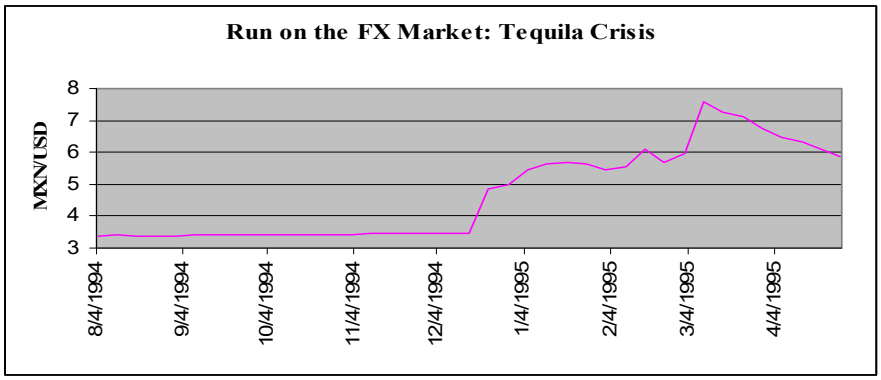
• *Currency Run*: Domestic residents *run* to banks to exchange DC for FC, before the devaluation occurs (or banks run out of FC!).

Currency Crisis

• Terminology
A *devaluation* (*revaluation*) occurs when the price of FC under a fixed exchange rate regime is increased (decreased) by the CB.

Note: The possibility of a currency crisis creates a risk: *devaluation risk*. The magnitude of this risk depends on the CB credibility –i.e., very credible CB, devaluation risk near zero.

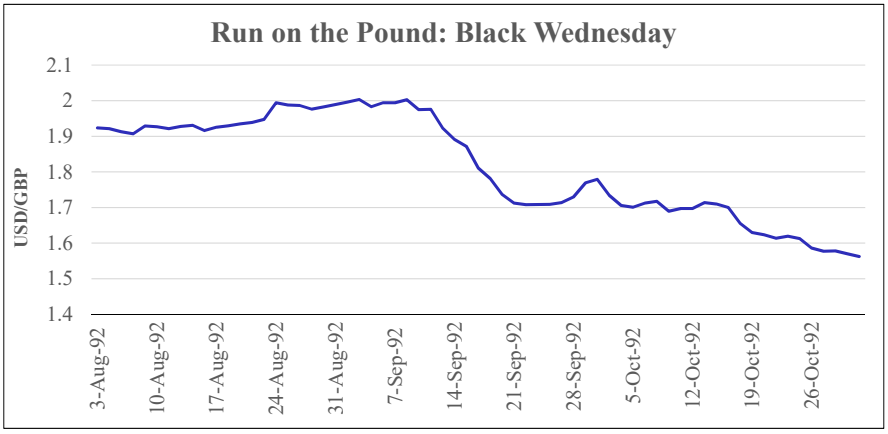
Currency Crisis: The "Tequila crisis" – Mexico Dec '94



Mexico had a crawling peg to the USD, but due to presidential elections, MS_d ↑. FC reserves went from **USD 18B** in October 1994 to **USD 5B** in December 1994, when CB abandoned the fixed system.

Overall, Mexico spent **USD 25B** in FC reserves to defend the peso & also borrowed **USD 25B** (bailout funds from the U.S. Fed).

Currency Crisis: "Black Wednesday" – U.K. Sep 16 '92



U.K. was part of the ERM, with the GBP tied, implicitly, to the DEM at S_t=2.95 DEM/GBP, with $\pm$6% band. But, when $i_{DEM} \uparrow$ to contain the spending due to German reunification, the BOE did not follow.

Overall, UK spent **GBP 30B** in FC reserves (and lost **GBP 3.3B**).

Currency Crisis: Devaluations

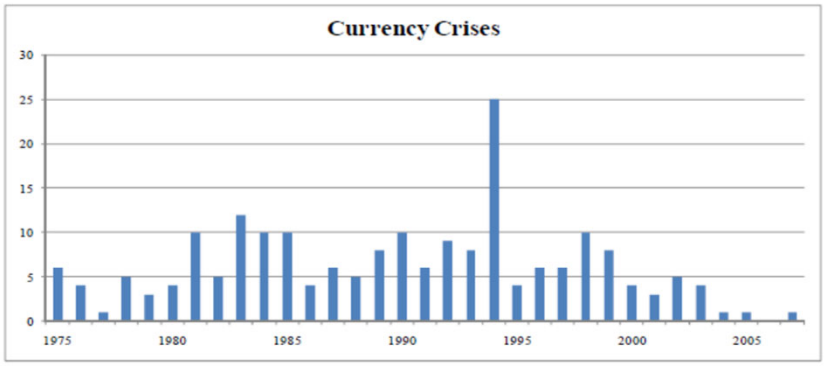
• On average, a currency crisis is followed by a **30%** devaluation of the DC. In many cases, there is a temporary higher drop (say, **50%**).

A very serious crisis: **75%+** (Indonesia '97, Argentina '01).

Examples: India '91, UK '92 (Black Wednesday), Mexico '94 (Tequila), Thailand '97 (Rice), Russia '98 (Vodka), Brazil '99 (Caipirinha), Argentina '01 (Tango), Uruguay '03, Iceland '08, Nigeria '16, Turkey '18, Lebanon '20 (ongoing).

Currency Crisis: Not Rare

Currency crisis are not rare. Figure below shows 208 *successful* currency crises –defined as a **30% depreciation of DC** that is also, at least, a 10% increase from previous year. (Period: 1975 – 2008.)

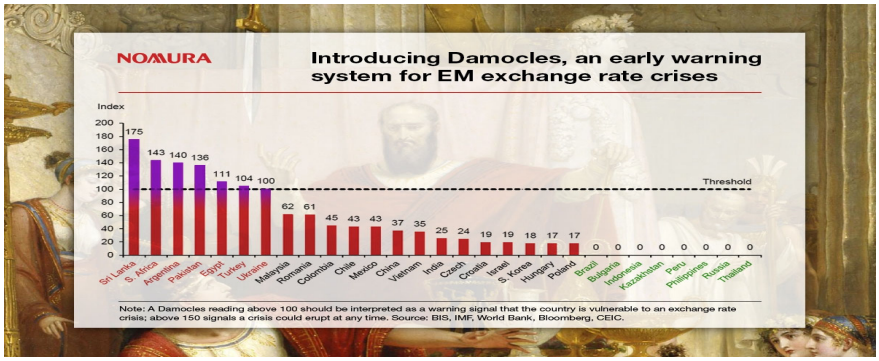


Note: Currency crisis is defined as a nominal depreciation of the currency of at least 30 percent that is also at least a 10 percent increase in the rate of depreciation compared to the year before. Five-year exclusion windows employed. The figure for 1994 is inflated by the devaluation of the 14 African members of the CFA zone against the French franc and the dollar.
Source: Laeven and Valencia (2008).

Currency Crisis: Predictors ("*Early warning signals*")

Predictors of a currency crisis: Low FX reserves, high government deficits, low real exchange rate (DC overvalued, often due to high domestic inflation), weak financial system, high short-term debt, etc.

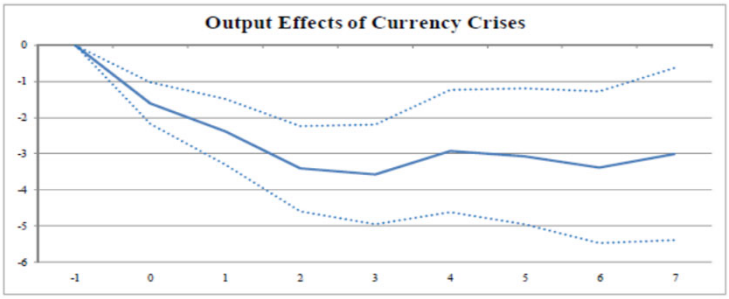
Many traders use an index to predict a currency crisis. A new one is the "*Damocles Index*," used by *Nomura*. (Nomura claims 67% of past 54 EM currency crisis were predicted 12 months in advanced.)



Devaluations Are Unpopular

• Economic Reasons:
– *Pass-through* to import prices (Domestic prices increase) ⇒ Inflation
– Real wages decrease
– Contractionary impact on the economy, especially in EM: **3%** average loss of GDP after 7 years!

The contraction is usually associated with balance sheet effects –i.e., a mismatch between currency of denomination of debt (mainly, in FC) and income (mainly, in DC)– in corporate and government sectors.



Devaluations Are Unpopular

• Politicians are run out of office.
– Cooper (1971) finds that heads of state lose their jobs twice as often within 1 year of devaluation:
30% as compared to 14% in a non-devaluation control group.

– Frankel (2005), updated sample 1971 – 2003 and measured exit 6 months after devaluation:
23% (=43/109) as compared to 12% in control group.

Other FX Regimes:
Managed Float

In practice, the FX rate system is a mixture: *Managed floating* or *dirty float*.
We see a free float, but the CB *intervenes* to buy & sell FC with the *intent* of changing the market determined S_t, every time the CB does not like S_t. CBs from EM countries tend to intervene much more than others.

Dual Systems

In some markets, S_t is fixed by the government. But, the government sells FC at the official S_t only for some transactions. For all the other transactions, a *black market* is created.

Example: By the end of 2022, Argentina had 10 (yes, "ten!") FX rates:
1) "Official": **192 ARS/USD**, for official imports & some exports.
2) Black market ("Blue"): of **385 ARS/USD**.
3) Burse (MEP): **356 ARS/USD**, for buying/selling government debt.
4) Tourist: 30% tax on official rate + 70% extra as advanced income tax.
5) Cultural ("Coldplay"): 30% tax on official rate, for foreign artists.

Example (continuation): Argentina's multiple FX rates:

Range of Exchange Rate Regimes

Ranked in terms of (decreasing) flexibility for the CB:

- Free Float or Flexible
- Managed "*Dirty*" Float
- Crawling Peg
- Fixed
- Currency Board (Fixed + 100% FC reserves)
- Adopting a FC as legal tender, for example, "*dollarization*" (Panama, British Virgin Islands, El Salvador, Ecuador, Zimbabwe).

• In 2017, the IMF classifies:
  - 54% of currencies as "*anchored*" (fixed FX rate)
  - 20% as "*stabilized*" (anchored, but allowed to vary in some way)
  - 26% as "floating" (occasional CB Intervention OK).

Exchange Rate Regimes: Fixed or Flexible?

Feature	Fixed	Flexible
	Cons	**Pros**
Adjustment to imbalances	Difficult	Easy
External shocks	Vulnerable	Less vulnerable
Support S_t	May need to raise i_d (or cause recession)	No need to do anything
Monetary policy	Ineffective	Effective
	Pros	**Cons**
FX Volatility	Stable S_t (good for trade & investments)	Volatile (P_d also volatile)
I_d: Control/Reduce	Good (with credibility)	Harder
Fiscal policy	Effective	Ineffective

Exchange Rate Regimes: Fixed or Flexible?

• Both regimes have pros and cons: No clear winner.

• We observe:

– Large economies with sound economic policies, good institutions & high credibility prefer a flexible regime.

– Developed economies with bad economic policies, bad institutions & low credibility rely on a fixed regime.

• Aside Q: If a CB decides to fix, which currency should be the anchor?

Stable trade & investments advantage: Fix against currency of a large trading partner:

– In Latin America, the USD is a good choice.

– In Andorra (between Spain and France), the EUR should be the anchor.

Central Bank FX Intervention

• Definition

FX Intervention: CBs buys & sells FC with the *intent* to change S_t to a different S_t^E.

• CBs use models to determine S_t^E. Then, CB determines a range for S_t

$\Rightarrow S_t$ should move between $\boldsymbol{S_t^L}$ and $\boldsymbol{S_t^U}$.

If S_t is within the range ($\boldsymbol{S_t^L} < S_t < \boldsymbol{S_t^U}$), CB does nothing (Free float!)

If $S_t > \boldsymbol{S_t^U}$, CB determines FC is overvalued $\Rightarrow$ CB intervention

If $S_t < \boldsymbol{S_t^L}$, CB determines FC is undervalued $\Rightarrow$ CB intervention

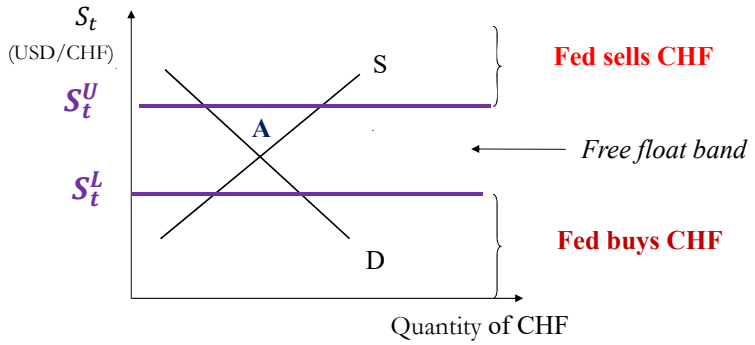
$S_t > \boldsymbol{S_t^U}$: Appreciating FC $\Rightarrow$ CB sells FC.

$S_t < \boldsymbol{S_t^L}$: Depreciating FC $\Rightarrow$ CB buys FC.

Situation: Suppose the US Fed follows the value of the CHF.

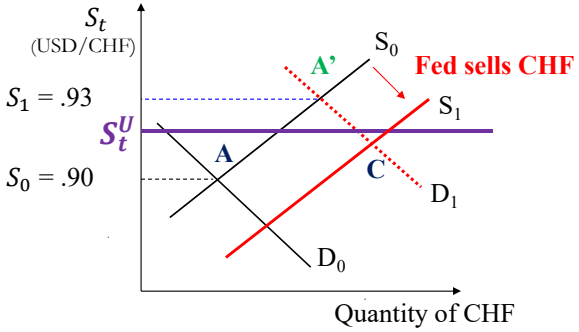
If **A** is within the range ($S_t^L < S_t < S_t^U$), Fed does nothing (*Free float*)
If $S_t > S_t^U$, Fed determines FC is overvalued ⇒ **Fed sells CHF**
If $S_t < S_t^L$, Fed determines FC is undervalued ⇒ **Fed buys CHF**

⇒ The Fed acts like an FX speculator.

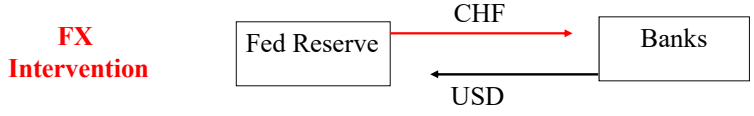


Example 1: USD depreciates against CHF (**A** to **A'**).

At S_t = .93 USD/CHF, the Fed determines CHF too expensive: $S_t > S_t^U$
⇒ CB *intervention:* **Fed sells CHF**



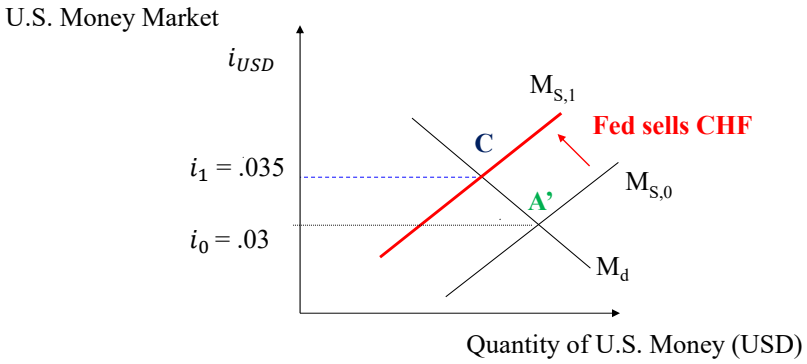
⇒ Fed sells CHF to bring S_t under S_t^U (**A'** to **C**).



The Fed sells CHF and receives ("buys") USD.

• CB FX intervention affects money supply:
When CB sells (buys) FC ⇒ Money supply decreases (increases)
(This is the Fixed Regime characteristic of the managed float.)

Example 1 (continuation): Fed intervenes to halt appreciation of CHF.

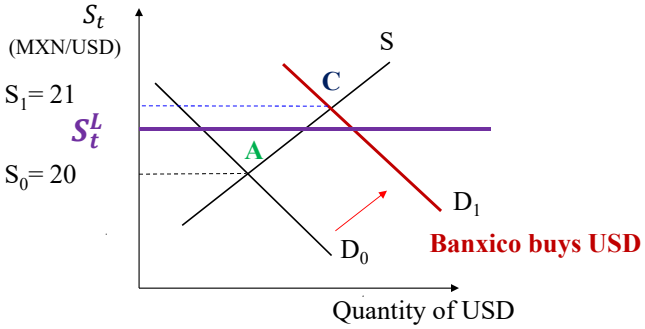


Process: **Fed sells CHF** ⇒ $M_S \downarrow$ ⇒ interest rates (i_{USD}) ↑

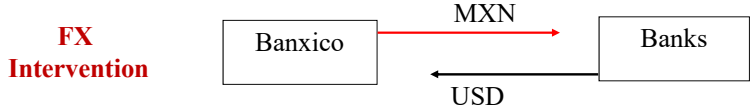
Example 2: Banco de Mexico (Banxico, Mexico's CB) FX Intervention

At **A**, Banxico considers the USD too inexpensive (*Undervalued*: $S_t < S_t^L$).

⇒ CB *intervenes*: **Banxico buys USD**



⇒ Banxico buys USD to bring S_t over S_t^L (**A** to **C**).



Banxico buys USD and pays with MXN ⇒ $M_S \uparrow$ ⇒ $i_{MXN} \downarrow$

• CB General Policy Objective for FX Intervention: Stabilization

Lean against the Wind:

- CB sells FC when it is appreciating.
- CB buys FC when it is depreciating.

• CB Intervention: Issues

(1) Implicit notion of "overvaluation/undervaluation" in FX market.

⇒ Q: Do CBs have "superior" information?

A: Mixed evidence: Some CBs have big losses; others profits.

(2) CB generates FX stability?

⇒ Uncertainty over CB actions increase FX volatility & risk. Precisely, what a CB dislikes.

⇒ Q: But, do CBs succeed to reduce FX volatility? Not clear.

(3) Potential conflict with other countries. When a CB intervenes in the FX market ($S_t \uparrow$) to boost exports, trading partners will be affected.

⇒ *beggar-they-neighbor* devaluation. Popular in the 1930s.

• CB Intervention: Details

• CBs tend to deal with major domestic banks, but will also transact with major foreign banks.

• Size of intervention. The final size depends on the initial FX market reaction.

• How often do CBs intervene? In a 1999 BIS survey of CBs, CBs report intervening from **0.5%** to **40%** of business days (**4.5% median**).

• Disclosure of intervention? Most CBs intervene secretly. Why secrecy? Poor credibility, bad fundamentals.

• CB Intervention: Data

CB **do** intervene in FX markets.

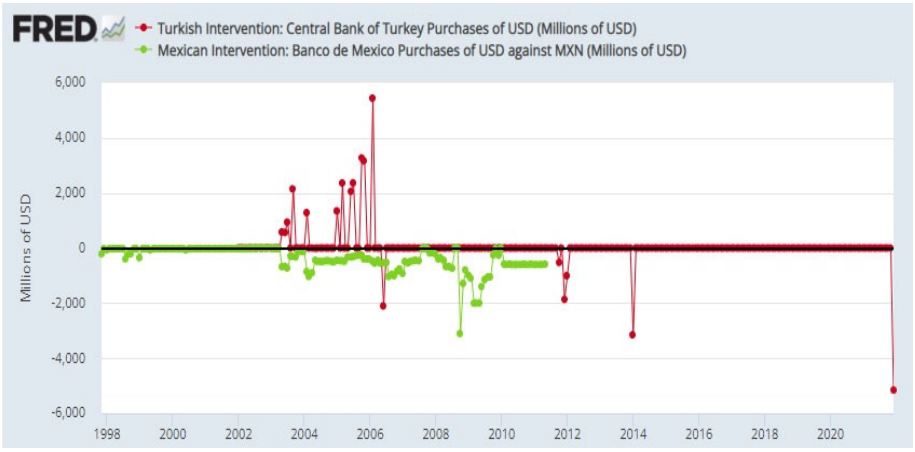
Historically, the largest player by far is **Japan**. For example, between April 1991 and October 2021, the BOJ intervened in the FX Market:

- Buying USD on 319 occasions for a total amount of USD 798B.
- Selling USD on 32 occasions for a total amount of USD 48B.

BOJ interventions exceeded U.S. interventions by a factor of more than 30.

• CB Intervention: Data

Example: Turkey and Mexico do CB intervention, in general to support their currency.



• Other CB Interventions in the FX Market

• CBs can buy foreign assets, instead of FC.

Example: The PBOC and the Bank of Japan may buy U.S. Treasuries to stop the decline of the USD against the CNY & the JPY, respectively.

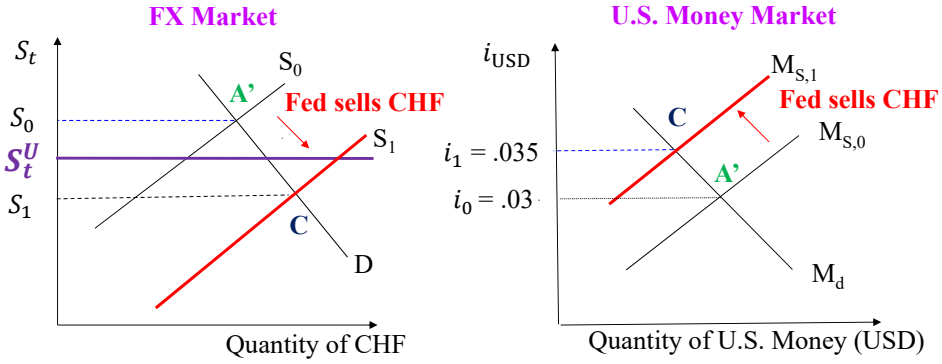
• Other tools CBs can use:
- Forward/option market, instead of the spot market.
- Use taxes, capital controls, banking regulations, etc.
- Coordinate with other CBs (*Concerted Intervention*).
- Coordinate with other state agencies (sovereign funds, SOEs, etc.)
- CB officials "Talk of under/overvaluation."

• The last one is the most popular form of intervention, usually referred as *jawboning*. Here, the credibility of CBs plays a big role.

• Sterilization

CB actions taken to neutralize the effects of intervention in Money Markets: Change in domestic interest rates.

Back to **Example 1**: Fed sells CHF (move from **A'** to **C**: MS↓ & i_{USD} ↑.)



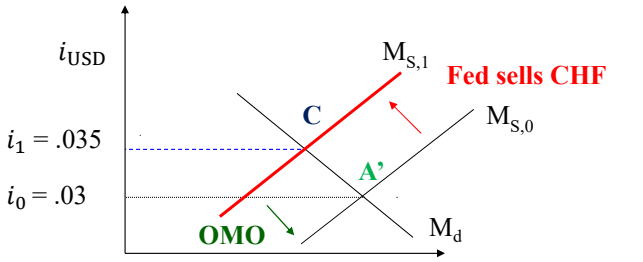
• Suppose the Fed does not want a higher i_{USD} .

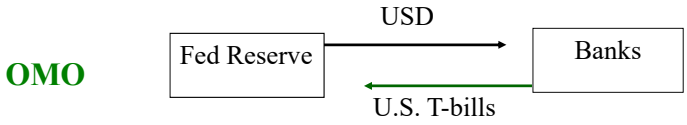
• CB tools to change MS: Open Market Operation (OMO), bank's RRR.

• **Sterilization in the U.S. with OMO**

- When the Fed buys T-bills, exchanging USD for T-bills ⇒ US MS ↑
- When the Fed sells T-bills, exchanging USD for T-bills ⇒ US MS ↓

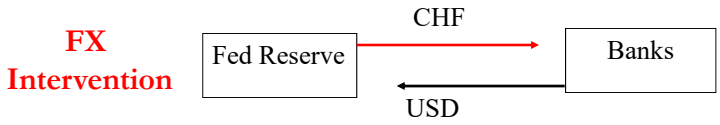
Example 1 (continuation): Back to previous example.
The Fed uses an OMO: Fed buys T-Bills to increase MS.

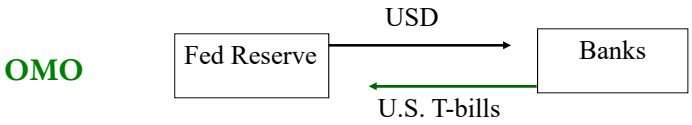




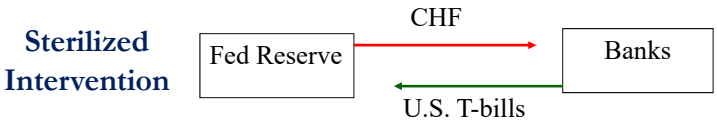
This CB intervention will be classified as *sterilized intervention*.

CB Intervention + Sterilization: Cash flows exchange:





Net effect: OMO + Fed Intervention

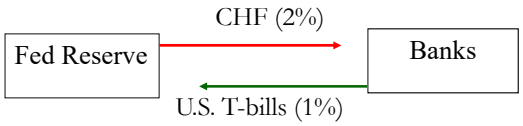


• Sterilized Interventions: Side Effects

• Sterilization changes the composition of the Fed's (and, in equilibrium, the public's) mix of DC & FC 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 CB.

Example: If CHF T-bills pay 2% and U.S. T-bills pay 1%, the previous change in the Fed's mix has a negative effect.



• Sterilized Interventions: Side Effects

• Suppose the CB can keep for a while S_t artificially high/low and money markets out of sync with the FX Market.

Example: CB keeps S_t low (DC overvalued) to keep I_d low. Then, the CB forces the economy to subsidize the import sector (& domestic consumption) and leaves domestic producers in a tough situation.

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

• Banks do not like holding large amounts of government bonds and/or having high reserve-requirement ratios

$\Rightarrow$ A squeeze in bank's profits.

Example 2 (continuation): At **A**, Banxico considers the USD *undervalued* (S_t < S_L), with:

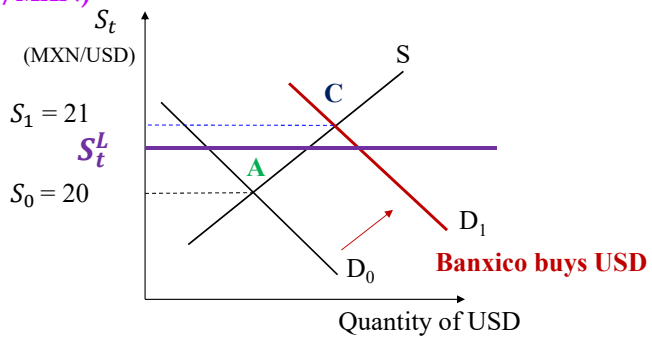
S_0 = 20 MXN/USD & S_t^L = **20.6 MXN/USD**

Banxico decides to intervene, but does not want to affect i_{MXN}.

Original Situation: S_0 = 20 USD/MXN & i_0 = 7%

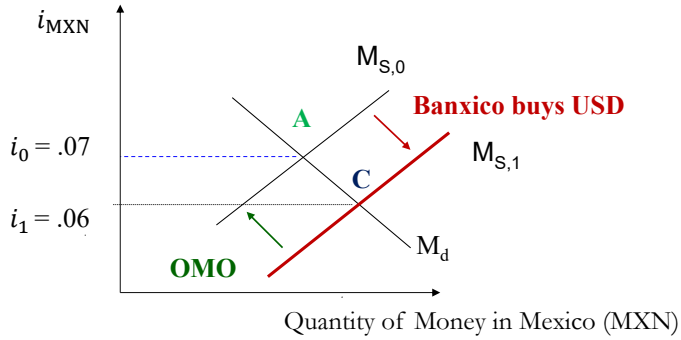
Banxico FX intervention (Buy USD): S_1 = 21 USD/MXN & i_1 = 6%

FX Market (USD/MXN)



OMO: Buy MXN - Sell CETES: S_1 = 21 USD/MXN & i_0 =7%

Mexican Money Market



Process:

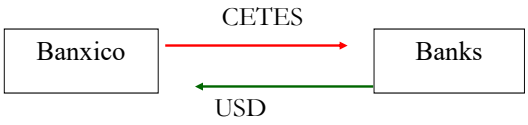
(1) Banxico buys USD ⇒ M_S ↑ ⇒ interest rates (i_{MXN}) ↓

(2) Banxico sells CETES ⇒ M_S ↓ ⇒ interest rates (i_{MXN}) ↑

Net Effect: (1) + (2) ⇒ M_S (& i_{MXN}) unaffected!

Net Effect: (1) + (2) $\Rightarrow M_S$ (& i_{MXN}) unaffected!

Sterilized Intervention



Banxico will invest the USD in U.S. T-bills, which have a lower effective yield than the CETES (now, paying 7%!)

$\Rightarrow$ Negative balance sheet effect (if sterilization works the change in S_t is zero).

• Sterilized Interventions: 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. 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.

$\Rightarrow$ Interest payments, when domestic interest rates go up, render sterilization operations too costly to last.

FX Curiosity: Zimbabwe's $50 Billion Dollar Note (January, 2009)

Because of its huge inflation, Zimbabwe's Central Bank, which is rapidly running our of paper, introduced the ZWD 50 billion dollar note. The new note is equivalent to about USD 1.25.

What will ZWD 50 billion buy you? Two loaves of bread and no change.