BIEF

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B.LAB

HANDOUTS

MONETARY THEORY AND POLICY

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It is a useful tool for studying the subject, but it does not guarantee preparation that is as exhaustive and complete for passing the exam as the material recommended by the University.

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Monetary Theory and Policy

Comprehensive Guide

Table of Contents

Disclaimer: The course is not really heavy on graphs and those shown here are very similar to those required for take-home assignments or the quant part of the general exam. Please learn all models very well and do your homework! Also pay attention to the TA sessions, some juicy details are available there, especially if you want to take the non-attending general exam (not in this summary).

What is Money?

The first issue with monetary theory is defining what money is. Money is narrowly defined as **a stock of assets that is accepted as payment for goods and services, or as a means of settling debt**. Currency, deposits and checking accounts all count as money. Money is also distinct from **wealth**, or the stock of all resources owned by an individual (including immovable assets like land) and **income**, or the earnings per unit of time.

By this, money has three main usages. Firstly, **money is a medium of exchange** and that function differentiates it from other forms of wealth. We are confident that a shopkeeper will accept local currency as money and allow us to consume their goods and this has a **lower transaction cost than barter**, which requires a double coincidence of wants (a person selling a pound of milk needs to find a person selling a pound of leather for instance). Hence, as long as a commodity is easily divisible, carried and standardized, accepted and durable, it can be a candidate for money.

Secondly, **money is a unit of account** that allows for expressing prices in uniform and nominal terms. This has another massive improvement from barter: an economy with 1000 goods has almost 500000 prices if people rely on barter, but only 1000 prices if people rely on money. This further reduces confusion and transaction costs.

Thirdly, out of its durability, **money is a store of value**, or a means of deferring consumption to a future time. People hold money as it is the **most liquid[1] form of asset there is**, however, money is uniquely subject to purchasing power fluctuations. Inflation, for instance, reduces the real value of money and, by this, the buying power for people.

Payment Systems

A payment system is the way transactions are conducted in the economy and the money utilized for these purposes can take two main forms:

- Commodity money, or money that has **intrinsic value**.
- Fiat money, or money that has **no intrinsic value and that derives its value from a government backing it**.

Back in ancient times, gold was the main means of paying for things, but that required gold to be checked for purity, and it was dangerous to carry around. Gold coins were minted by governments ensuring a constant level of purity and weight. Then, since it was still dangerous to carry gold around, certificates of deposit were minted so that people could redeem gold at central banks with vouchers that then evolved into paper money.

Certificates became widely available and accepted and soon people lost interest in gold convertibility, thus gold backing became more irrelevant. Vouchers became fiat money declared legal tender by governments and backed by their credibility. Nowadays, checking accounts, checks and e-money are widely available, and gold backed currencies were fully abandoned post Bretton Woods.

[1] Liquidity defined as the ease of turning an asset into a medium of exchange.

Measuring Money

Changes in the money supply affect monetary metrics, primarily **interest rates and inflation**, hence knowing how much money is circulating in an economy is essential. In theory, since money is widely used for transactions, the **quantity of money must be equal to the stock of the asset's money can buy**, but in reality, due to financial innovation and complexity, no one form of money exists for the purpose of store and exchange. By this, central banks rely on the measurements of **monetary aggregates differentiated by liquidity levels**, and then assess which one is most relevant for whatever issue they have at hand:

- The ECB uses the following aggregates:
  - M1: currency + checking accounts (overnight).
  - M2: M1 + other short-term deposits.
  - M3: M2 + marketable securities + debt securities with maturity up to two years.
- The Federal Reserve uses the following aggregates:
  - M1: currency + checking accounts (demand).
  - M2: M1 + other short- and medium-term deposits + retail money market funds shares.

The Kiyotaki-Wright Model

How does money manage to become widely accepted in society if it doesn't have any intrinsic value? That's the question solved by the KW model, which **focuses on the equilibrium of many agents' strategic interactions**: people accept money as currency if they expect to be able to use it in further exchanges. Moreover, this model preserves the independence of all economic actors fully, as **each agent has to find a partner alone without the use of a clearinghouse**.

The Setup

Consider a very large population of **infinitely living agents and consumers** with many indivisible real commodities **coexisting with fiat money**. The latter has no intrinsic value beyond the paper it's made of. At the beginning, we have a proportion M of agents starting with a unit of money and the others having a unit of a good.

Assume all goods are **differentiated so to meet heterogeneous tastes**, captured by the parameter $x \in (0,1)$, or x amounts of agents consume that specific good. If an agent can consume a good, then **that consumer likes that goods and consuming it creates utility**. Consuming other goods or money grants no utility.

Money **cannot be produced by private agents** and those agents, when they consume a good, they **produce a different good they can only sell** in the same period. Consumers cannot self-consume and must consume to produce. Goods and money are costlessly storable and people that hold money are **money traders**, those who hold goods are **commodity traders**.

The following assumptions must be made:

- Traders meet randomly in pairs.
- No transaction costs.
- One meeting per agent per period.

- Fractions remain constant, people either hold goods or money at fixed proportions in equilibrium.

Money traders seek **people who sell a good they like** and will engage in exchanges if:

- They find a seller of a good they like.
- They find a seller that is willing to accept their money.

If they find an agreeable seller, then they will consume the good, receive utility and produce a good for next turn's exchanges. If no exchange happens, then they get to keep the money and will try again next period.

Commodity traders rely on the **double coincidence of wants** in a barter system to achieve the same exchange utility money traders will receive by finding an agreeable seller. Otherwise, they can accept money if they **find a money trader that likes their good**.

Strategies and Equilibrium

Goods and money differ in their acceptability. The former are **always accepted by some traders** because their consumption brings utility (x is the probability a random seller accepts a good, exogenously given). The latter will be accepted **only if agents expect to use it in future trades** (Π is the probability an agent accepts money, endogenous and result given at equilibrium).

By this, acceptance of either of the two can be framed as a **strategic decision that maximizes the payoffs of all agents** (given their previous choices) in a **stationary and symmetrical Nash Equilibrium**. The optimal strategy for an agent is such that:

- They accept a good if it is one that they like.
- They accept money with individual probability π given others will accept it with probability Π.

By this, an agent has to compare the utility of holding money at time t and of holding a commodity at time t, respectively:

$$V_M(t) = \frac{1}{1+r}[(1-M)x\Pi U + (1-M)x\Pi V_C(t+1) + 1 - (1-M)x\Pi V_M(t+1)]$$

$$V_C(t) = \frac{1}{1+r}[(1-M)x^2 U + Mx\pi V_M(t+1) + (1-Mx\pi)V_C(t+1)]$$

Which by the property of **stationarity and symmetry of strategies** become:

$$rV_M = (1-M)x\Pi U + (1-M)x\Pi(V_C - V_M)$$

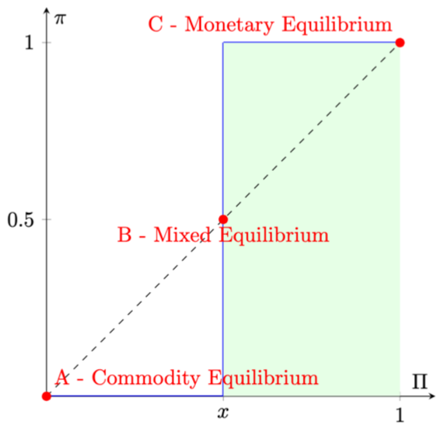
$$rV_C = (1-M)x^2 U + Mx\Pi(V_M - V_C)$$

And subtracting the payoffs:

$$V_C - V_M = \frac{(1-M)xU}{r+x\Pi}(x-\Pi)$$

With the sign of $V_C - V_M$ depending on the difference $x - \Pi$. Three possible equilibria are therefore possible:

- If $x > \Pi$, then $V_C > V_M$ and nobody will accept money for exchanges (commodity equilibrium).
- If $x < \Pi$, then $V_C < V_M$ and everybody will always accept money for exchanges (monetary equilibrium).
- If $x = \Pi$, then $V_C = V_M$ and money will be as useful for exchanges in exchanges as commodities (imperfect equilibrium).



This model underlines the facts that:

- Money is adopted **strategically as medium of exchange**.
- Acceptability of money as medium is **endogenously determined by economic preferences**.
- Multiple equilibria can arise depending on money's level of substitutability in exchanges.
- Equilibria are **self-fulfilling and rely on the expectations of acceptability of either commodities or money** (stationarity of strategies). Actions allow for the realization of the degree of acceptability.

Tools of Monetary Policy

There are three main ways a central bank can use to control money supply and interest rates:

- Open Market Operations (OMOs).
- Standing facilities with interest rates.
- Reserve requirements.

And most CBs focus on short-term rates as the **policy instruments** and as primary indicators of monetary policy stance. To use any of these instruments, a CB's balance sheet must be modified:

- **Assets**

    - **Securities**: Depends on the CB (ECB holds European government bonds) and such assets pay interest. Since the Great Recession, CBs own multiple types of securities.
    - **Loans to Institutions**: CBs act as **lenders of last resort** to banks and other actors and charge interests to such loans. They are recorded as **borrowed reserves**.
- **Liabilities (Monetary Base)**
    - **Currency in Circulation** or the currency held by anyone outside the banking system.
    - **Reserves** are all cash not in circulation and deposited in the CB. They are split in required and excess reserves.

CBs can modify the monetary base and the reserves through:

- **Purchases in the Open Market** (buy or sell bonds from a bank, the bank pockets/pays the check and the CB increases/decreases the reserves it holds).
- **Loans to Institutions** (a bank borrows cash from the CB and the CB has both reserves and loans increase by the same amount).

In both cases, the monetary base is affected.

Interbank Interest Rate

Interbank Loans of Reserves are unsecured loans of reserve balances at the CB: they allow banks to redistribute excess reserve towards institutions in shortage situations. Their maturity is usually **overnight** or slightly more extended. The rate on those loans is the **Overnight Interbank Interest Rate** (in the ECB there was the Overnight Index Average (EONIA), replaced with the EUROSTR) and **CBs set targets on these rates as the official policy rate** (main policy tool): the actual rate is set by banks but the CB can influence the economic context to harmonize it.

How this rate is targeted depends on the CB: the Federal Reserve **explicitly targets a Fed Funds Rate Target**, while the ECB operates through **Main Refinancing Rate**. Other rates directly set by the CB are:

- **Deposit Rates** which allow banks to get interest from excess reserves overnight at the CB's deposit facility (that rate is the lowest possible rate).
- **Lending Rates**, which allow banks to borrow reserves overnight at the CB's lending facility (that rate is the highest possible rate).

Demand and Supply of Reserves

Total demand of reserves in the economy is split into **required and excess reserves**; we focus on the latter:

- More excess reserves above the statutory minimum are an insurance against outflows and allows for smooth interbank payments.
- However, excess reserves are **almost idle** and hold an opportunity cost equal to the **overnight rate minus the deposit rate** at the deposit facility.

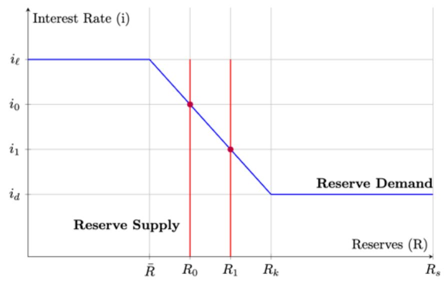
When the interbank rate i lies between the lending rate i_l and the deposit rate i_d, banks are willing to borrow and lend reserves at an intermediate rate. If the rate climbs up to i_l, then **there will be**

no incentive to borrow if not at the lending facility. The same happens to lending if rates fall to i_d.

The **supply of reserves in the economy is assumed to be perfectly inelastic**, as it's just the money stored in the CB.

Limited Reserves Regime

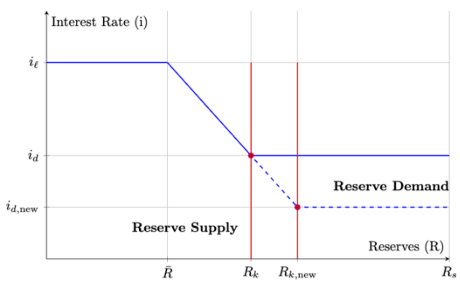
Before the Great Recession and Quantitative Easing (QE) banks held **only slightly more than the required reserves as excess** and the main policy tools were OMOs. By that, equilibrium occurred in the downward-sloping part of the demand curve of reserves. By this, there was almost no use for cutting or increasing the deposit or lending rates, as interbank borrowing happened at intermediate interbank rates. Other ways of changing the interbank rates were **modifications to reserve requirements**, which shifted forward (in case mandatory requirements increased) or backward (in the opposite case) the reserve demand curve.



That changed in the Great Recession, when the CBs across the world **drastically increased their balance sheets** through QE.

Ample Reserves Regime

Quantitative Easing refers to **enormous asset purchases by CBs** in order to shore up mass deleveraging during 2008 and onwards. The injection of reserves was so significant that **classical monetary policy disappeared** and now the main policy instrument is the **interest rates on reserves** (deposit rate).



Indeed, now monetary policy is conducted at the lower floor of the reserves demand curve: if a monetary expansion has to take place, there must be a **lowering of the rate floor first, followed by an OMO later** if needed. Usually, CBs choose to maintain the spread between lending and deposit rates constant, so a lowering of one leads to an equal lowering of the other (*stable* *corridor policy*). Simple OMOs are completely ineffective, as any further liquidity would just be circled back to the CB overnight deposit facility.

Reserve Requirements

Reserve requirements are more complex. They don't just force CBs to move the discount or deposit rates, rather they have legal implications:

- **Limited Reserves Regimes** cause the overnight rate to change upon changing the required reserves rate (if it increases, the demand for reserves shifts upward). On the other hand, it has drawbacks:
    - **It can be ineffective** if the requirements are not binding or not enforced.
    - **It can create liquidity problems for banks** if implemented suddenly.
    - **Frequent changes increase uncertainty** and complicate liquidity management for banks.
- **Ample Reserves Regimes** transform requirements in formalities; they remain in place but are not used in policy implementation and are *not binding*. Currently, the Federal Reserve has **no reserve requirements** (up to March 2020, they were at 10%), whilst the ECB has them at 1% for checking accounts and S.T. deposits.

Open Market Operations

Similar considerations have to be made in the case of OMOs:

- Under a **Limited Reserves Regime,** they are the main tool to steer interbank rates and work as previously stated.
- Under an **Ample Reserves Regime,** they are no longer policy tools but are still used to *maintain the reserves ample*.

In both cases, OMOs are *initiated at will by the CB*, and can be of two types:

- **Temporary OMOs** rely on *Repurchase Agreements*, money market instruments that mandate a seller will repurchase an asset the CB buys at a set price and date (or the opposite in the case of a **reverse Repo**). Transactions are reversed and *effects are temporary*.
- **Outright OMOs** are permanent purchases/sales and have lasting effects on the CB's reserves.

In Europe, the ECB operates through *three main type of refinancing operations* and OMOs are **executed by national CBs**:

- **Main Refinancing Operations** (MROs) happen weekly and are temporary trades of assets (through repos or collateralized loans) with *one-two week maturity*.
- **Long Term Refinancing Operations** (LTROs) are monthly and the underlying trades have a three-months maturity.
- **Fine Tuning and Structural Operations** happen when need be and have unspecified maturity/frequency.

The Federal Reserve in the US operates through repos and reverse repos, utilizes **outright purchases rarely** and OMOs are **centralized at the NY-Fed Trading Desk**. During limited-reserves regimes, OMOs were *conducted daily through US Treasury bills*.

The ECB's refinancing operations function broadly like the Fed's OMOs:

- The ECB acts decentralized and functions are conducted simultaneously by national CBs.
- The ECB runs auctions with **hundreds of participants**, whilst the Fed lets 20 primary dealers participate.
- The ECB uses a **very wide array of securities for ROs**, the Fed uses US Government Securities only.
- OMOs are institutionally more complex in Europe.

As long as a limited-reserves regime holds, OMOs are very flexible and precise tools of monetary policy and can be easily and quickly implemented or reversed.

Standing Facilities

They **provide or absorb reserves overnight** and have no limit to their access at both rates (discount and deposit). In a Limited Reserves Regime, they establish a **policy corridor system** where the rate will oscillate between the discount and deposit rate. In an Ample Reserves Regime, the **administered rates are the main tools of monetary policy**, primarily the deposit rate.

Focusing on the Federal Reserve, the lending to banks happens in the **Lending Facility** at three types of *discount rate*:

- **Primary Credit** which is a liquidity backstop for healthy banks available at the overnight discount rate.
- **Secondary Credit** which is 50bps higher than primary and is reserved to distressed banks.
- **Seasonal Credit** which has a rate pegged to the current market rate and is administered for banks with seasonal deposit patterns.

This facility allows the Fed to operate as a **Lender of Last Resort** to prevent financial of banking panics from spreading and causing mass deleveraging and debt deflation. This, however, is countered by the fact that **moral hazard is a major issue in banking**, with the *Too Big to Fail* conundrum still being unaddressed.

The **Deposit Facility** allows banks to hold reserves at the Fed for two main types of interest rates:

- The **Interest on Required Reserves** (IORR) removes the opportunity cost of having idle cash at the CB.
- The **Interest on Excess Reserves** (IOER) is set *higher than IORR* and is a QE-era tool:
  - It facilitated normalization **without need for massive OMOs**.
  - Allowed QE to be enacted since 2008.

Today IORR is irrelevant as reserve requirements are null and the Fed uses the **Interest on Reserve Balance** (IORB) and **Overnight Reserve Repurchase Agreement Rate** (ON RRP – Ample Reserves Regime Tool), which is *open to many more types of institutions than IORB*, allowing them to be **rewarded for keeping reserves and anchoring the lower bound of overnight rates**.

In practice, in the Ample Reserves Regime, the FFR lays between the IORB and ON RRP. In addition to that, better information systems and Fed procedural changes made effective rates stray less from policy rates.

In Europe, the ECB Facilities are the **Marginal Lending Facility** and the **Deposit Facility** and offer *marginal lending rates and deposit rates* respectively. They are accessible at will by banks and have overnight maturity. The ECB tends to maintain a constant spread (or corridor) between the rates.

The Great Recession and Monetary Policy

From an American Perspective, the 2008 Crisis broke the old conduct of monetary policy. Post-QE until 2019 tried to **retire the money created during the mass purchases of distressed assets**, but this proved impossible due to **banks actively seeking larger reserve and High-Quality Liquid Asset** (HQLA) **pools** to comply with the Liquidity Coverage Ratio (LCR) requirements. The FOMC had to adapt to a *de-facto permanent Ample Reserves Regime* and started operating through administered rates only.

Moreover, this permanent Ample Reserve Regime of mass HQLA accumulation avoids the **stigma of mass-selling assets during distress**: if reserves are used to cover for liquidity shortfalls, only the CB will know, whilst if the mass-selling of Treasuries ensues, the stigma could cause a further bank run (Cecchetti & Schoenholtz, 2019).

In the EU, before 2008 the minimum bid rate on weekly on MROs was considered the **main policy rate** as the ECB set total liquidity and funds went to the highest bidders. However, due to funding failure and euro-exit fears, the **interbank markets were frozen in late 2008** and the ECB itself became the main source of liquidity: **LTROs substituted MROs** and since October 2008, MROs were conducted at a fixed rate and collateralized unlimited funds. Collateral requirements were relaxed in 2012 allowing banks to post **credit claims as collateral**.

Before 2008, EONIA/€STR stayed close to the MRO rate, *reflecting substitutability between the two* but now the main policy rate is the **deposit rate**, which has turned negative and so EONIA/€STR has turned negative as well.

Structure of Central Banks

The Federal Reserve System

The Federal Reserve System was created in 1913 with the *Federal Reserve Act* with the goal of opening an accountable and decentralized central bank system. In practice, power was **split between a Board of Governors** and **12 Federal Reserve Banks** in other cities. This mirrored the division of power between the **Federal Government, the Banking System and the Broader nonbank and public interests**.

By this, the Federal Reserve System has:

- A **Board of Governors**.
- 12 **Federal Reserve Banks** and as many districts, with the NY Fed being the most prominent one.
- One **Federal Open Market Committee**.

The Feds are quasi-public and owned by **district member banks** and hold the reserves of the member banks. Each Fed has **9 directors**:

- 3 Class A Bankers, elected by the member banks.
- 3 Class B Industry appointees, elected by the member banks.
- 3 Class C nonbank reps, elected by the Board of Governors.

The directors **appoint the Bank President** contingent on the approval of the Board of Governors.

The Feds have differing functions. *Only 5 Feds vote on the FOMC* and the NY Fed has a permanent seat, with the others rotated annually. Nonvoting members can participate more passively. Additionally, the NY Fed hosts the *Open Market Desk* which executes the OMOs. Directors propose the **discount rate and the Board approves them** and decide eligibility for discount loans in their districts. Other functions include check clearing, removal of damaged currency, collect data (i.e., FRED by the St. Louis Fed), staff economists and help in drafting regulation.

The Board resides in Washington DC's Federal Reserve Board and it's **composed of seven governors** and a **Chair**: each governor serves for a non-renewable mandate of 14 years, is appointed by the US President and confirmed by the Senate. The Chair serves a renewable 5-year mandate. All Governors:

- Vote in the FOMC.
- Set reserve requirements within congressional limits.
- Sets banking regulations.

The Chair in particular advises the US President and testifies before Congress representing the Fed System at large and it may represent the US in international economic forums. Both the Chair and the Governors are directly advised by a staff of economists.

The FOMC convenes **eight times per year** and its Chair is also the Chair of the Board of Governors (who all participate). Its primary role is setting the stance of monetary policy with its statutory tools.

The Federal Reserve System has **both instrumental and goal independence** from the broader state machine: it has control over its budget, its decisions are final and **no Fed Chairperson is directly appointed by a sole politician**. The Fed's independence is controversial: many believe that monetary policy stewards should be hold to the same accountability politicians are, and therefore electable to some extent. However, **monetary policy is radically different than any other policymaking**: the ideal goals (i.e., price stability) are *very long-term* and introducing day-to-day politics to a CB can lead **inflationary biases** if the tools are used to, say, bolster demand or employment.

The European Central Bank and the Euro Area

On January 1st, 1999, the ECB assumed responsibility of the monetary policy of the Euro Area, including **20 countries today** and in 2002, the Euro became the legal tender in its constituent states. In particular, the Treaty of Maastricht formalized the construction of the **European Monetary Union**, paving the way towards the **European System of Central Banks** (for all member states) and the **Eurosystem** (for all Euro Area states) with the head in the ECB in Frankfurt and subdivided among National Central Banks (NCBs), which mirrors the Fed in the US.

Three bodies are responsible for the conduct of monetary policy in Europe:

- The **Governing Council**, which is analogous to the FOMC.
- The **Board**, which is analogous to the Board of Governors.
- The **General Council** at the ECB.

Monetary policy is applied at the national level via NCBs that take in orders decided centrally at the ECB.

The Governing Council is chaired by the **ECB President** and formed of NCB governors and six members of the Executive Board, **operates by qualified majority** (post-EU Enlargement, before operated by consensus) and meets **twice-monthly** with the responsibility to set monetary policy (first meeting of the month) and then **discuss the implementation guidelines and set further tasks** (second meeting of the month). Executive Board members have permanent voting rights, but NCB governors are rotated, with larger countries having precedence. All governors are free to attend and participate, voting or not.

The Executive Board is composed by a President and Vice-President, four members appointed by the euro-area Heads of State and the ECB President as chairperson. It has **regulatory powers** and **runs the ECB's monetary policy agenda**, issuing instructions to the governors of the NCBs.

The General Council is staffed in a similar way (President, Vice-President, Chairperson, One Governor per EU Member State) and manages **EU Monetary Coordination in the ESCB** and prepares countries for **euro adoption**.

The Maastricht Treaty establishes that the ECB is **independent from political influence** and this is maintained through:

- **Instrument Independence**, as all decisions are final.
- **Goal Independence**, with the mandate being price stability and the ECB choosing indexes and numerical definitions.
- **Separate Finances**.
- **Long Terms for Governors/Executives**.

Business Cycles

A business cycle is a **fluctuation in output around the trend of real GDP**, or the real value of all items outputted by an economy in a year. GDP can be thought of as a composition of the following:

$$\text{GDP} = \text{Consumption} + \text{Investment} + \text{Government Spending} - \text{Imports} + \text{Exports}$$

In the topic of business cycles, we also have to point out that **short-run output fluctuations hover around the *Natural Output Level***, whilst **unemployment fluctuations hover around the *Natural Rate of Unemployment***. We define variables that *comove positively with cyclical output as procyclical*, otherwise they are *countercyclical*.

Potential Output

According to the Congressional Budget Office, potential output is the "*trend growth of the economy's productive capacity, determined by labor, capital, and technology*", hence the expected GDP level following intensive resource utilization: it's not a ceiling, rather a **maximum**

sustainable output given stable inflation. If actual output surpasses the potential, the resource constraint will lead to higher prices (i.e., inflationary pressure).

The CBO estimates the potential output as:

$$Y_t = A_t L_t^{\alpha} K^{1-\alpha}$$

Which relates in time t **total factor productivity** A_t, **hours worked** L_t^{α}, and **capital stock** $K^{1-\alpha}$. This is a variant of the **Okun Law**: output will be at a higher potential if unemployment is lower than its noncyclical rate. By this, **the actual-natural unemployment gap is the key driver**. We also estimate the *output gap*, or the difference of actual and potential output as a hare of potential:

$$\text{Output Gap} = \frac{y - y_p}{y_p}$$

Natural Rate of Unemployment

Policymakers utilize two main rates to estimate the natural rate of unemployment:

- The **Long-Run Rate** is the main indicator of normal economic activity once shocks dissipate (10 or more years in the future).
- The **Noninflationary Rate** is the rate associated with *price stability* and assesses slack and inflationary pressures in the short and medium run.

The CBO historically used to publish both short- and long-term natural rates of unemployment: they were effectively the same until 2008 and later the short-term rate was discontinued in July 2021. Right now, it holds that:

$$\text{Unemployment} = \text{Natural Unemployment} \Leftrightarrow \text{Output} = \text{Potential Output}$$

We can also analyze the *unemployment gap*, defined as the difference between the actual and natural rates of unemployment:

$$\text{Unemployment Gap} = u - u_p$$

If it is positive, there is *slack* in the labor market, otherwise there is *tightness*.

Recessions and Expansions

A **Recession** is the **period between the peak and the trough of economic growth**, between trough and peak it's called **expansion** and that is considered to be the *normal state of the economy*. Recessions tend to involve **lasting and broad declines in activity** and even if they tend to be brief, it can take years to recover and expand back to a peak. Indeed, the 2008 Recession lasted for a few months, but the ensuing clawback to potential output took *a decade*.

In general, business cycles have the following characteristics regarding fluctuations:

- Deviations from trends are **persistent and significative**.
- Peaks and troughs **vary in amplitude** and there is no foreseeing their size.
- The peak and trough timing **is variable: recessions happen at irregular frequencies**.

Moreover, analyzing real GDP, we see how it is very strongly comoving with consumption and investment, *but the latter is significantly more volatile*.

Transmission Channels of Monetary Policy

The link from a policy change to real activities has two main elements:

- An impact on **aggregate demand**.
- An impact of aggregate demand on **output, investment, employment and prices**.

The former is the *academically defined monetary policy transmission channel*. The basic mechanism **acts on borrowing costs**: if $\Delta r < 0$, then the borrowing cost will fall, leading to an increase in investment, therefore bolstering aggregate demand. From aggregate demand, we find the **static IS equation** ($Y = AD \Rightarrow Y = Y(r)$). Now let's make it more complicated, by focusing on **consumption**.

The Dynamic IS Curve

The core concept of the dynamic IS curve is the **intertemporal choice of consumption** for agents in a given time and provides the baseline for more complex monetary policy models. Lifetime utility is given by:

$$\mathrm{U} = log\, C_1 + \beta\, log\, C_2$$

Agents live for two periods only (today and tomorrow), consume goods and can choose to hold a nominally denominated bond. By this, in the first period, an agent can choose to either **consume or save** and the budget constraint looks like this:

$$P_1 C_1 + B_1 = W_1 + P_1 Y_1$$

Which implies that wealth can be transferred to the second period:

$$W_2 = (1 + i_1) B_1 \Rightarrow P_2 C_2 = W_2 + P_2 Y_2$$

This allows us to build the **intertemporal budget constraint**:

$$P_2 C_2 = (1 + i_1)(W_1 + P_1 Y_1 - P_1 C_1) + P_2 Y_2 \Rightarrow P_1 C_1 + \frac{P_2 C_2}{1 + i_1} = W_1 + P_1 Y_1 + \frac{P_2 Y_2}{1 + i_1}$$

Which implies that the **present discounted value of lifetime consumption is the present discounted value of lifetime wealth**. This allows individuals to maximize their lifetime utility subject to their intertemporal budget constraint:

$$C_2 = -(1 + i_1)\frac{P_1}{P_2} C_1 + \left(d = \frac{(1 + i_1)}{P_2}\left(W_1 + P_1 Y_1 + \frac{P_2 Y_2}{1 + i_1}\right)\right)$$

Considering d an exogenous term, the maximization problem is:

$$\max_{C_1}\left(log\, C_1 + \beta\, log\left(-(1 + i_1)\frac{P_1}{P_2} C_1 + d\right)\right)$$

Which by FOCs:

$$\frac{1}{C_1} - \beta\frac{1}{C_2}\left((1+i_1)\frac{P_1}{P_2}\right) = 0 \Rightarrow \boxed{\frac{1}{C_1} = \frac{1}{C_2}\beta(1+r_1)}$$

Which is known as the **Euler Equation**, meaning that giving up one unit of consumption later will drop utility by $\frac{1}{C_1}$, but increase it $\frac{1}{C_2}\beta(1+r_1)$ in the next period. By this, monetary policy affects consumption via **real interest rates** ($(1+i_1)\frac{P_1}{P_2} = (1+r_1)$). Moreover, **expectations matter for current aggregate demand**. Indeed, the levels of consumption from the FOCs are:

$$C_1 = \frac{1}{1+\beta}\left(\frac{W_1}{P_1} + Y_1 + \frac{Y_2}{1+r_1}\right), C_2 = \frac{\beta}{1+\beta}(1+r_1)\left(\frac{W_1}{P_1} + Y_1 + \frac{Y_2}{1+r_1}\right)$$

Showing that consumption increases with lifetime resources: holding resources fixed, C_1 falls if $\Delta r_1 > 0$ while C_2 rises, **but the effects are blurred by expectations and could be flipped if rates/incomes are at certain levels**.

One can also choose to use the **log-linear Euler Equation**:

$$c_1 = c_2 - (r_1 - \rho)$$

Where $c_i = log\, C_i$, $r_1 = log(1+r_1)$ for small rates, and $\rho = -log\, \beta$. This, generalized to all possible periods and assuming a goods-output equilibrium, allows to obtain the **log-linear IS curve**:

$$y = y^e - (r - \rho)$$

Which **differs** from the traditional IS curve because:

- **Higher expected future output increases current output**, due to consumption smoothing (people consume more now expecting to repay later).
- **The effects of the real interest rate reflect intertemporal substitution**, meaning that the rate is more akin to the *relative price of current consumption with respect to future*.

Other Transmission Channels of Monetary Policy

The **Interest Rate Channel** is the traditional transmission system in the IS-LM and AS-AD analysis. It's focused on investment decisions by businesses and *extends later* to consumers' housing and durables consumption. However, the monetary authority can only influence the *short-term interest rates*, whilst **the long-term rates are the key rates for the economy**. Linking the two usually entails:

- **Sticky prices and expectations of inflation** matter, hence an adjustment of the short-run nominal rate leads to an adjustment of the real rate: $r_t = i_t - \pi^e_{t+1}$;
- **Expectations theory has the long-run rate being the average of all short-term rates**: $r_{n,t} = \left(r_{1,t} + \cdots + r^e_{1,t+n-1}\right) \cdot n^{-1}$

Either way, *expectations are key in monetary policy*.

The **Exchange Rate Channel** grew in importance during globalization due to its capacity to influence trade balance. An expansionary policy leads to lower rates, hence depreciation/devaluation of currency against foreign ones, **leading to a progressive improvement of net exports** and aggregate demand.

Rates affect **asset prices as well** for both intangibles like stocks and tangibles like housing or land. Two mechanisms link rates to asset prices:

- Decreasing rates leads to bonds becoming less attractive, hence pushing people towards equities (lower required return, hence higher prices – **Portfolio Channel**).
- Decreasing rates leads to inflates aggregate demand, leading to increased cash flows (**Dividends Channel**).

Both are captured through the **pricing identity**:

$$P_t = \sum_{i=1}^{i} \frac{D_{t+i}}{(1+r_e)^i} + \frac{P_{t+n}}{(1+r_e)^n}$$

Another explanation lies in the **Tobin's Q Theory of Investment**:

$$Q = \frac{MV_{Firm}}{\text{Replacement CoC}}$$

In short, market value *might embed unseen intangible capital and expectations about a firm's prospects* and Q provides **the market value of the firm with respect to the cost of repurchasing its equivalent in a capital market**. If Q is high, then the issuance of equity is more favorable because it's going to be cheaper than seeking new capital: if a monetary expansion ensues, the price of assets is going to inflate Q, leading to higher investment and aggregate demand.

Moreover, growing asset prices inflate individual wealth, incentivizing consumption and aggregate demand due to **households smoothing consumption on the basis of lifetime resources**.

The final point lies in understanding the **Credit View**: markets are not frictionless and monetary policy shifts aggregate demand by modifying borrowing conditions, making it a **financial accelerator of monetary policy**. In credit markets there are agency issues lying in the *adverse selection* (people that are less likely to repay debts might be eager to obtain loans) and *moral hazard* (people that borrow money might just gamble it away to chase high returns with a high default risk) information asymmetry dichotomy.

By this, credit intermediation through banks is crucial to assure lenders that the borrowers will at least post collateral to back up their demands for credit (*they will have only skin in the game*) or to ration credit to avoid adverse selection. In case of an expansionary policy, **bank deposits increase**, allowing banks to give more loans and boost investment and aggregate demand. At the same time, a monetary expansion **inflates net worth through higher asset prices** discouraging risky behavior from borrowers and people seeking to borrow, *reducing the asymmetric information problems*. This improves aggregate demand as well.

Short Run Output and Inflation

Knowing how monetary policy affects aggregate demand, we need to establish its effects on output and inflation, especially by understanding how **aggregate supply is affected**, alongside how **prices, wages, inflation and general equilibrium** are analyzed and defined. We do have evidence of the monetary policy effects on both outputs and prices: there is a short-run *non-neutrality* (there are meaningful effects on both) and then there is long-run *monetary neutrality*.

Aggregate Supply

The aggregate supply model assumes the existence of **sticky prices**, which imply that if aggregate supply shifts, there will be a change in prices but not a change in output in the long term, but cause fluctuations in the short term. By this define the **natural level of output** as the level of output that arises when prices are considered flexible. However, there are fluctuations around it when prices are considered fixed due to the business cycles. The AS curve can be defined through other frictions (like the more classical *Keynesian Sticky Wages*) but usually are similar to the one discussed here.

Now consider the log-level version of the short-run direct AS curve:

$$y_t = y_t^n + \alpha(p_t - p_t^e)$$

Where y_t and y_t^n are the actual and natural levels of output respectively, and **the former deviates from the latter the more** p_t deviates from p_t^e with α serving as the sensitivity of output to the changes in prices. In particular, α^{-1} is the slope of the inverse AS curve.

The reasons we adhere to a sticky prices model is because *firms are often slow at adjusting prices* for various reasons, going from **additional costs to changing prices** (menu costs, contracts or implicit social norms, sticky costs) to **asymmetric information** (firms may not know they should adjust). Either way, *to adjust prices, firms must have some degree of market power*.

Monopolistic Competition and Households

Consider a large number of indexed firms and each of them produces goods using only labor $N_t(i)$ as factor given a specific productivity A_t:

$$Y_t(i) = A_t N_t(i)$$

They sell **differentiated goods to cater to heterogeneous tastes of a broad clientele**; therefore, they can *set their own prices while not influencing the others' decisions* and therefore not influence the aggregate price level. The demand they face is:

$$Y_t(i) = \left(\frac{P_t(i)}{P_t}\right)^{-\varepsilon} Y_t$$

Where $Y_t(i)$ is the demand for the good provided by firm i at price $P_t(i)$. Y_t is the aggregate level of output and P_t is the aggregate price level. $\varepsilon > 1$ is the price elasticity of demand. Firm i shall then maximize profits subject to its production technology and demand function:

$$\max_{P_t(i)} \frac{P_t(i)}{P_t} Y_t(i) - \frac{W_t}{P_t} N_t(i) \text{ s.t. } \begin{cases} Y_t(i) = A_t N_t(i) \\ Y_t(i) = \left(\frac{P_t(i)}{P_t}\right)^{-\varepsilon} Y_t \end{cases}$$

Therefore, the problem becomes:

$$\max_{P_t(i)} \left(\frac{P_t(i)}{P_t}\right)^{1-\varepsilon} Y_t - \frac{W_t}{A_t P_t} \left(\frac{P_t(i)}{P_t}\right)^{-\varepsilon} Y_t$$

By taking the FOC:

$$(1-\varepsilon)\left(\frac{P_t(i)}{P_t}\right)^{-\varepsilon} Y_t + \varepsilon \frac{W_t}{A_t P_t} \left(\frac{P_t(i)}{P_t}\right)^{-1-\varepsilon} \frac{Y_t}{P_t} = 0$$

Which yields the optimal price:

$$P_t(i) = \frac{\varepsilon}{\varepsilon - 1} \frac{W_t}{A_t}$$

Where:

- $\frac{\varepsilon}{\varepsilon-1} = \mu$ is the **markup** depending on the price elasticity of demand: $\varepsilon \to \infty \Rightarrow \mu \to 1$;
- $\frac{W_t}{A_t} = MC_t$ represents the **marginal cost**, or nominal wage corrected by productivity.

Now assume an array of identical households getting utility from consumption C_t and disutility from working N_t:

$$U_t = log(C_t) - \frac{N_t^{1+\phi}}{1+\phi}$$

Where ϕ is the inverse **Frisch Elasticity of Labor Supply** or an indicator of how much the labor supply is affected by wage. At the same time, people are subject to a budget constraint for period t:

$$P_t C_t + B_t = (1+i_{t-1}) B_{t-1} + W_t N_t \Rightarrow C_t = (1+i_{t-1}) \frac{B_{t-1}}{P_t} + \frac{W_t N_t}{P_t} - \frac{B_t}{P_t}$$

Therefore, households maximize utility in the following way:

$$\max_{N_t} log\left((1+i_{t-1}) \frac{B_{t-1}}{P_t} + \frac{W_t N_t}{P_t} - \frac{B_t}{P_t}\right) - \frac{N_t^{1+\phi}}{1+\phi}$$

By taking the FOC:

$$\frac{1}{C_t} \frac{W_t}{P_t} - (1+\phi) \frac{N_t^{\phi}}{1+\phi} = 0 \Rightarrow \boxed{\frac{1}{C_t} \frac{W_t}{P_t} = N_t^{\phi}}$$

Which is the equivalence between the **marginal benefit of the labor supply** and the **marginal cost of the labor supply**. By this, the wage from labor supply will be:

$$\frac{W_t}{P_t} = N_t^{\phi} C_t$$

And knowing that the *goods market clears at* $Y_t = C_t$ and that *output reflects technology* $Y_t = A_t N_t$, we derive the **wage from labor supply as a function of output and technology**:

$$\frac{W_t}{P_t} = \left(\frac{Y_t}{A_t}\right)^{1+\phi} A_t$$

Optimal Prices and Output

Recalling the optimal price from the price-setting monopolistic competition framework:

$$P_t(i) = \mu \frac{W_t}{A_t} = \mu \left(\frac{Y_t}{A_t}\right)^{1+\phi} P_t$$

However, if prices are flexible as under the natural level of output, then **all firms will set the same price** and the following will occur:

$$1 = \mu \left(\frac{Y_t}{A_t}\right)^{1+\phi} \Rightarrow Y_t^n = \frac{A_t}{\mu^{1/1+\phi}}$$

Which implies that optimal prices are:

$$P_t(i) = \mu \left(\frac{Y_t}{A_t}\right)^{1+\phi} P_t = \left[\mu^{1/1+\phi} \frac{Y_t}{A_t}\right]^{1+\phi} P_t = \left(\frac{Y_t}{A_t/\mu^{1/1+\phi}}\right)^{1+\phi} P_t = \left(\frac{Y_t}{Y_t^n}\right)^{1+\phi} P_t$$

By taking the log:

$$p_t(i) = (1+\phi)(y_t - y_t^n) + p_t$$

Sticky Prices

Now assume there are two types of firms: **sticky and non-sticky firms**: the latter operates under the optimal condition we just discussed:

$$p_t(i) = (1+\phi)(y_t - y_t^n) + p_t$$

But the former will operate under **expected economic conditions**:

$$p_t(i) = (1+\phi)(y_t^e - y_t^{n,e}) + p_t^e$$

Which boils down to firms setting all the same price if $y_t^e = y_t^{n,e}$. Now let s represent the **degree of stickiness** of a given firm, making the optimal choice:

$$p_t = sp_t^e(1-s)[(1+\phi)(y_t - y_t^n) + p_t^e] \Rightarrow \boxed{p_t = p_t^e + \left[\frac{(1-s)(1+\phi)}{s}\right](y_t - y_t^n)}$$

This implies that prices are driven primarily by **expectations** and **deviations of output from the natural level**: the first effect is direct and proportional, higher expectations lead to higher prices 1:1, while the effects of deviating from natural level of output are tied to the degree of stickiness and the wage elasticity to output.

By this, under the sticky prices model, **deviations from natural output increase prices over the expected levels**: intuitively, when $p_t > p_t^e$ some firms are still stuck at a lower price, and hence absorb more demand that, to be satisfied, **will require an increase in output**, finally raising prices over expectation.

Aggregate Supply, Demand and Monetary Policy

When prices and wages are sticky, and there is imperfect information, the AS curve is like mentioned before:

$$y_t = y_t^n + \alpha(p_t - p_t^e)$$

All three frictions are present in the real world, indicating that prices are directly influenced by natural output fluctuations as said before. However, in the long run the expectations should match actual prices and outputs, showing a perfectly inelastic AS curve. By this, we can estimate the effects of an **unannounced monetary policy expansion**, resulting in an unexpected shift of the AD curve.

In the **short run** the equilibrium will shift from natural output and prices to higher prices and higher output over natural. This is due to the fact that, since there was no anticipation, **expectations adjust to a higher price level** and sticky firms begin producing more as their lower prices increase demand and require higher supply.

In the **long run** the expansion is temporary and expected prices continue to rise to match expectations. In the end, the economy returns to its natural level of output but at a higher stable price. This summarizes the non-neutrality and neutrality of monetary policy given the slow adjustment of an economy to new price levels due to internal rigidities.

In practice, monetary expansions are endogenous stabilizers after an endogenous shock reduces the actual level of output below natural, and it's not a simple exogenous mechanism to shock the economy and transmit monetary outcomes.

The Philips Curve

Policymakers usually desire low inflation, high employment and high output growth, but monetary policy can usually achieve one or two at a time: expansionary policy raises employment and output but also inflation. To estimate such effects, we can use the **Philips Curve**, which represents the AS curve in terms of inflation and unemployment and *emphasizes the short-run effects of stabilizing inflation and output or unemployment*.

Consider the inverse AS curve and subtract the previous prices from both sides:

$$p = p^e + \frac{1}{\alpha}(y - y^n) \Rightarrow p - p_{-1} = p^e - p_{-1} + \frac{1}{\alpha}(y - y^n)$$

And impose that $x = y - y^n$, which yields the following form of the Philips Curve:

$$\boxed{\pi = \pi^e - \lambda x + \nu}$$

Now consider the Okun's Law, yielding the Unemployment form of the Philips Curve:

$$y - y^n = -\theta(u - u^n) \Rightarrow \boxed{\pi = \pi^e - \gamma(u - u^n) + \nu}$$

Where $\lambda = \alpha^{-1}$ and $\gamma = \alpha^{-1}\theta$, and ν is a term capturing any factors affecting π given π^e and the output gap (basically an econometric error term). Intuitively, the first two terms capture **inflation's response to cyclical changes** in output or unemployment, while ν captures shocks.

The core question is "**Is Money Neutral in the Long-Run?**" and the evidence points out that **it is indeed neutral**. Focusing on McCandless and Weber (1995), they ran cross-country and long-term statistical correlations between:

- Inflation and Money Growth Rate (**very highly correlated**, resembling unity).
- Real GDP and Money Growth Rate (**uncorrelated besides a subsample of OECD countries where there is positive correlation**).
- Inflation and real GDP growth rate (they are **essentially uncorrelated**).

Naturally, correlation doesn't imply causality and there could be problems of *reverse or spurious causality* with the first observation, besides the fact that **there could be other confounders driving both variables to comove**. Strong correlations *can be suggestive or supportive of causality*, but further analysis must be done.

Furthermore, there is no evidence of money supply growth affecting real output growth in the long run, same for inflation. The only exception is a **subsection of OECD countries where there is a correlation between money growth and output growth**. This is in no way suggestive of causality and could be a fluke.

In conclusion, the relationship between money growth and inflation is very strong and all theoretical models not consistent with these results should be questioned. Same for the absence of a relationship between money supply growth and output growth.

Short-Run Effects

Assessing the effects of monetary policy is inherently difficult:

- It is strongly influenced by other variables and by the **overall state of the economy**: all these *omitted variables* create inherent bias and affect MP decisions.
- Monetary policy is most often **countercyclical** and this usually biases effects towards being null. This creates a problem of *inverse causality*.

The following are methods to establish causal links between monetary policy and its effects.

Narrative Approach

This approach sees the use of **qualitative sources to provide information that could establish a causal relationship**. Romer and Romer (2023) used the Fed's records to identify monetary policy actions that were not necessarily motivated by output fluctuations or correlated factors.

They then argued that **output responses to such policy actions were unbiased estimates of MP effects**. Other examples of this methodology include:

- Using separate tax changes into those taken for countercyclical reasons and those taken for exogenous reasons (Romer and Romer, 2010).
- Oil price fluctuations (Hamilton, 1985).
- Timing of reporting on defense spending to better estimate the effects of the size and timing of government spending (Ramey, 2011).

Romer and Romer (AER, 2023) used Fed's transcripts to **evaluate when interest rates were changed for reasons unrelated to current or projected real activity**.

Jorda (2005) introduced the **Local Projection Model** which offers more flexibility than Vector Autoregressions by estimating **Impulse Response Functions** (IRFs). The approach works by assuming to have a *set of exogenous shocks* and then by directly estimating the IRF at each time horizon. The local projection for each horizon is:

$$Y_{t+h} = \alpha^h + \beta^h S_t + \gamma^h X_t + v_t^h$$

Where X_t are the exogenous and pre-determined variables and S_t is the MP shock at time t. OLS estimates of β^h (IRF for horizon h) are **unbiased so long the shocks are truly exogenous**. To tie it back to the Narrative Approach, have $S_t \in \{-1,0,+1\}$ to represent expansionary, null or contractionary policy and then regress the outcome variable on S_t and lagged controls:

$$Y_{t+h} = \alpha^h + \beta^h S_t + \sum_{k=1}^{K} \phi_h^k S_{t-k} + \sum_{k=1}^{K} \theta_h^k Y_{t-k} + \varepsilon_t^h$$

Different outcome variables can be used to test various effects. The sequence of β^h traces the impulse response of Y_t. The results Romer and Romer (2023) found are the following:

- A contractionary shock **increased unemployment by 1.6% and reduced GDP by 4.4%**, both statistically significant.
- Moreover, a contractionary shock reduces inflation by 1.5% more slowly and with more uncertainty than those effects on real output.

Vector Autoregressions

A VAR is used to capture the **evolution over time of interdependent variables** (multiple time series approach). Consider the following model where y_t is the output and x_t is the monetary policy instrument:

$$y_t = \theta x_t += \theta_{y,1} x_{t-1} + \cdots + e_{yt}$$

$$x_t = \phi y_t + \phi_{x,1} y_{t-1} + \cdots + e_{xt}$$

Where e_{yt} and e_{xt} are **structural shocks to y and x**. The shocks can be interpreted as:

- **Monetary Policy Shocks** due to shifting priorities for the MP Authority or the preferences of public officials.
- **Output Shocks** due to randomly shifting consumers' preferences.
- **Inflationary Shocks**, including shifts in prices of commodities like oil.

Structural VARs try to establish the underlying correlation between the two variables, **but OLS cannot be used to estimate it due to the endogeneity issue** (y_t and x_t depend on each other). Two assumptions must also hold: structural shocks must be **exogenous and independent** and each variable must have **a contemporaneous impact on other variables**.

Substituting y_t and x_t we get a **reduced-form VAR** such that:

$$\begin{cases} y_t = \beta_{y,1}x_{t-1} + \beta_{y_2}x_{t-2} + \alpha_{y,1}y_{t-1} + \alpha_{y,2}y_{t-2} + u_{yt} \\ x_t = \alpha_{x,1}y_{t-1} + \alpha_{x,2}y_{t-2} + \beta_{x,1}x_{t-1} + \beta_{x,2}x_{t-2} + u_{xt} \end{cases}$$

Where error terms are composites of structural shocks as follows:

$$u_{yt} = \frac{e_{yt} + \theta e_{xt}}{1 - \theta_\phi} \quad \text{and} \quad u_{xt} = \frac{\phi e_{yt} + e_{xt}}{1 - \theta_\phi}$$

This implies that the **reduced form VAR turns structural shocks into residuals**, solving the endogeneity problem, allowing us to run OLS on the regression. To estimate the response of the output y_t with respect to e_{xt} we need to **recover the shock from the observable residuals we just built**.

Assuming the *Choleski Ordering* (contemporaneous effects of one variable of the VAR is muted), we identify the shocks in the following ways:

- Case 1: $\phi = 0$, therefore $u_{xt} = e_{xt}$ and $u_y\text{t} = e_y\text{t} + \theta e_x\text{t}$ meaning that **monetary policy doesn't respond to contemporaneous output shocks due to lack of data**.
- Case 2: $\theta = 0$, therefore $u_{yt} = e_{yt}$ and $u_{xt} = \phi e_{yt} + e_{xt}$ meaning that **output is unresponsive to monetary policy contemporaneously** due to decision lags.

After that, we estimate VAR and compute the "*impulse response*" of output to a policy shock. Christiano, Eichenbaum and Evans (1999) found that, through a VAR analysis, **monetary policy is non-neutral in the short run and neutral long-term**.

Quasi-Experiments

Coglianese, Olsson and Patterson utilized a DiD design in 2023 to estimate the effects of the Swedish Riksbank increasing rather exogenously the interest rates. They discovered that this unwarranted tightening **caused significant economic contraction, raising unemployment by up to 2%**, with wage rigidity being the primary driver of the increased unemployment. All-in-all, the contraction was found to be **more regressive than a typical business cycle**.

Monetary Policy Goals, Strategies and Tactics

Central Bank Mandates in the EU and US

In the United States, the Fed operates under a **dual mandate** under the Federal Reserve Act: the main goals are *maximum employment and price stability*. In Europe, the ECB maintains a **hierarchical mandate**, which puts *price stability first* and then, without prejudice to that, the ECB must support the Union's economic objectives including **balanced economic growth and full employment**. Both utilize tactics of **Flexible Inflation Targeting** (IT), stabilizing both inflation and the real economy with a **medium-term orientation** to make room to pursue the secondary goals of economic growth and full employment.

Price stability is defined as **low and stable inflation**, which can become highly problematic if uncontrolled:

- Changes in prices must mean something and if prices violently fluctuate it becomes **hard to assess the value of goods and services**.
- Price volatility fuels **uncertainty**.
- In case of unindexed taxation systems, the **after-tax returns might be arbitrarily reduced in real terms**.
- Wealth may get redistributed from lenders to borrowers with no reason.

CBs *never target zero inflation*, or the Zero Lower Bound (ZLB) on interest rates: it is more likely to be binding and **carries a significant risk of deflation**, which is bad as well (and disincentivizes consumption) and creates the risk of a very negative feedback loop.

On the topic of full employment and maximum sustainable output, there should be nuance:

- In the long-run, monetary policy is **neutral**:
  - Output and employment depend on factors beyond monetary policy.
  - The maximum of both is consistent with the factors' availability in the economy.
  - **Sustainability refers to the inflationary and deflationary pressures caused by positive or negative output/employment gaps**.
- In the short-run, business cycles still hold:
  - CBs cannot influence long-term employment or output but can **attempt to stabilize the economy around the long-term levels of both**.
  - This is especially true with expansionary policy during recessions and contractionary ones during bubbles.

By this, only the price stability mandate is truly achievable in the long-run and, in practice, CBs care about **inflation and measuring the short-run economic performance** to limit painful swings that could displace workers or factors or production. Price stability and employment are *usually complementary goals*, as a stable economy allows the long-term planning necessary to generate demand for goods, hence for labor.

There are times when **such goals stop being complementary**, such as during the 1970s Oil Crisis (a supply shock) where **high inflation and unemployment coexisted** (*stagflation*): in that case, the CB must make a choice between saving employment or saving the currency.

Inflation Targeting

It was introduced in New Zealand in 1990 and is now very widely adopted. It features:

- A publicly announced medium-term inflation target.
- A focus on inflation forecasting and other indicators.
- High levels of transparency and public accountability.

It usually targets the 2% annual CPI either as a point (the UK), a range (New Zealand) or a point and range (Canada): edges are "soft" and *don't trigger policy changes*. This is not to be confounded with **flexible IT**, which targets the output gap as well for stabilization.

In general, a CB will model its objective by minimizing a **loss function**:

$$L = \frac{1}{2}[(\pi - \pi^*)^2 + \omega_x(y - y_n) + \omega_i(\Delta i)^2]$$

Where ω_x and ω_i are the **weights given to the output gap and instrument changes**, and right now the modern IT regimes focus on public credibility, which translates into lowered inflation and lower ω_x.

However, due to time lags between rate changes and their impact on inflation or output, CBs rely mostly on **forecast inflation targeting** or setting rate paths so that inflation and output gaps approach target at the appropriate pace. This, in practice, means minimizing the *expected deviations from target* through the following loss function:

$$L = \frac{1}{2}E_t\left[\left(\pi_{t+f} - \pi^*\right)^2 + \omega_x\left(x_{t+f}\right)^2\right]$$

IT requires a high level of **transparency** (in direct contrast with traditional, more secretive central banking), and CBs publish regular policy reports that include:

- Inflation and other economic forecasts.
- Summary of analyses behind the forecasts.
- Rationale for policy decisions.

Transparency is a qualitative tool to **manage expectations** and this is important because *long-term rates* are unaffected by policy but dependent on expectations, and future inflation expectations from the private sector influence current pricing (and therefore inflation). Credibility is measured through the **spread between the private sector expectations and the inflation target**.

To strengthen the CBs commitment to its mandates, a high level of public accountability is exerted:

- The CB is **implicitly accountable** through its transparency and reporting.
- And it's **explicitly accountable** to the review of parliaments or independent experts

Overall, IT has been a success with some evidence of initial recessions (due to the initial inflation reduction), it has outperformed other strategies like exchange rate targeting and today sees global adoption. However, time lags remain a cause for concerns for timely policy action. By 2013, the Fed under Bernanke, the ECB (which introduced its first among major CBs) and the Bank of Japan (last to adopt) had all explicit IT mechanisms in place.

The Neutral Rate and Fed's Review of Monetary Policy

In 2019, the Fed completed its first comprehensive public review of its strategy MP tools, prompted by recent changes in the economic landscape. The key result was that the **neutral federal funds rate was rapidly decreasing**, potentially leading to the Fed eventually hitting the **Effective Lower Bound**, limiting its ability to conduct monetary policy. Similar trends have been observed in other major economies.

The Neutral Rate of Interest (r^*) is the rate at which **there is full employment and stable inflation**, and the monetary policy is neither contractionary nor expansionary: it is fully unobservable and must be estimated via economic modelling. It's very important as it is the **guidepost for monetary policy**. The FOMC's long-run projections show that the real neutral rate has fallen to 0.5%, reflecting **broader structural forces beyond the scope of monetary policy intervention**:

- Productivity growth is decreasing.
- There are high savings and retreating investment (*secular stagnation*, Summers).
- Capital inflows from abroad worsen CA balance (*savings glut*, Bernanke).
- Safe assets accumulation following 2008.
- Aging populations prefer saving to consuming or investing.

The result of this, is that the Fed will have to **rely more and more on unconventional tools for monetary policy** the more r^* approaches the ELB. The Fed's review upheld the 2% inflation target, and three main components were put in place:

- **Fed Listens Initiative**, where the CB would begin consulting with communities, unions and individuals across the US.
- **Flagship Research Conference** to convene a panel of top economists the discuss the relevant literature to the framework's review.
- **FOMC Discussions** beginning in July 2019 informed by research and documented.

In August 2020, the Fed released a **revised statement on longer-run goals and MP strategy**, reaffirming the 2% goal, but *recognizing that the neutral rate had declined* so much that the ELB could significantly constrain policy from then onwards: the 2% goal was turned into a **2% average inflation over time** to allow for periods of expansion after below-target inflation.

Again, in August, the Fed redefined maximum employment entirely, emphasizing **shortfalls of employment** and shifting the goal towards fostering a more **inclusive and sustained labor market expansion**.

The ECB's Strategy Review

The same trend on neutral rates was observed in Europe, limiting the ECB's toolbox and reliance on pure policy rates to meet objectives, both price stability and the others like social progress, employment, balanced growth and environmental quality. The ECB utilizes the **Harmonized Index of Consumer Prices** (HICP) as the main inflation measure and to that it adds the *owner-occupied housing costs*: the inflation buffer is necessary to avoid deflation and the trend of falling rates highlights the necessity to **avoid constraints to MP**.

In terms of IT, the ECB has a rather strict 2% goal, and anchors expectations by seeing any deviation as inherently undesirable. Moreover, the ECB pursues symmetry of MP effects in the Euro Area and maintaining it may require **forceful monetary policy that can create high-inflation transitory periods**.

The ECB operates largely at the *medium-term level* which makes it nimble enough to account for the nature, size and duration of the inflationary deviations and pursue the other secondary goals. Given the rapid approaching of the ELB, the ECB is more and more relying on **forward guidance and asset purchases** (unconventional monetary policy).

The ECB is also receptive to **climate change** as a threat to the stability of the economy, hence adopting the EU climate goals as incorporated factors in monetary policy matters such as disclosure, risk assessment and asset purchases/collateral.

The Taylor Rule

The Taylor Rule is a rather simple monetary policy rule:

$$i_t = \rho + \pi_t + \phi_\pi(\pi_t - \pi_t^*) + \phi_x x_t + v_t$$

Where ρ is the **steady-state real interest rate**, ϕ_π is the weight on the inflation gap and ϕ_x is the weight on the output gap, and v_t represents the **monetary policy shocks**. Why do we use it? Because it *fits the data very well* and serves as **description, prescription and benchmark**.

Monetary Policy with Inflation Targeting

The PC-MPR Model

To assess the CB's monetary policy under an IT tactic we need to establish the **Philips Curve – Monetary Policy Rule** model (PC-MPR):

- The Philips Curve represents the **supply side of the model** that relates the expected inflation gap with the output gap.
- The Monetary Policy Rule reflects the **preferences in trading off fluctuations in output ad inflation** (alongside a background IS curve), representing the **demand side of the model**.

Consider x, the output gap, and y^n the natural level of output with **perfectly flexible prices and wages**. *Note that Monetary Policy does not affect the natural level of output*:

$$\pi = \pi^e + \lambda x + \nu$$

Is the Philips Curve of slope λ and ν inflationary shocks. The slope is **inversely correlated to the degree of price/wage rigidity**: the flatter the slope (greater rigidity) the smaller the effects of an output gap on inflation. Prices are not instantaneously adjusted, rather they are **slowly adjusted on the basis of expectations**, primarily current inflation (based on the information available in price-setting) and future inflation (based on MP and multiperiod time-setting).

Going to the MPR side:

$$L = \frac{1}{2}[(\pi - \pi^*)^2 - \omega(x - x^*)^2]$$

Is the **CB's loss function** where π^* is the *inflation target* and x^* is the *desired level of the output gap*. This quadratic function is minimized and, by this:

- Small deviations from target are **penalized symmetrically**.
- Larger deviations are **much more penalized**.

The CB then decides to adjust the nominal interest rate, inflation and output gap on the basis of what is happening in the structure of the economy. Take the implicit DIS curve:

$$y = y^e - [(i - \pi^e) - \rho] \Rightarrow y = y^e - [r - \rho]$$

Which, with flexible prices yields the equilibrium:

$$y^n = y^{n,e} - [r^n - \rho]$$

Which implies that the **output gap is**:

$$x = y - y^n \Rightarrow \boxed{x = x^e - \left[[i - \pi^e] - r^n\right] + g}$$

And the CB can always find i that implements optimal x and π from that DIS. Assuming then that:

- Desired output gap is zero ($x^* = 0$).
- Inflation expectations are given, making the CB act under **discretion** (cannot commit to any further MP).

We substitute x from the PC in L, and then take the FOC with respect to π:

$$L = \frac{1}{2}\left[(\pi - \pi^*)^2 + \omega\left(\frac{\pi - (f = \pi_e + \nu)}{\lambda}\right)\right]$$

$$\Rightarrow \frac{\partial L}{\partial \pi} = 0 \Rightarrow (\pi - \pi^*) + \omega\left(\frac{\pi - f}{\lambda^2}\right) = 0$$

Which rearranged yields:

$$\boxed{(\pi - \pi^*) = -\frac{\omega}{\lambda}x}$$

Which is the **MPR Curve**, which is interpreted as **marginal cost equating marginal benefit** of higher inflation:

- $MC_\pi = (\partial L / \partial \pi) = \pi - \pi^*$;
- $MB_x = (\partial L / \partial x) = \omega x$;

From the PC, 1 additional unit of inflation generates λ^{-1} gap, meaning that it holds:

$$\frac{1}{\lambda}MC_x = \frac{1}{\lambda}\omega x = -MB_\pi$$

We can rewrite the MPR curve as:

$$\pi = \pi^* - \delta x$$

Where $\delta = \omega/\lambda$ is the slope. For monetary conduct, the CB must act in an **anticyclical manner**, decreasing the gap when there is inflation above target and vice-versa. Recalling the slope of the MPR curve, we have that:

- A greater ω means that **there is a higher weight in stabilizing the output gap** relative to inflation.
- A greater λ, slope of the Philips curve, implies that there is a smaller output gap cost to reduce inflation, the MPR curve becomes flatter and greater adjustments have to be made in x.

Equilibrium Conditions

In the short-term, there is space for the two curves to move in the (x, π) space. Consider the equilibrium E_0 that satisfies both the PC and MPR curves with:

- Negative output gap: $x_0 < x$;
- Inflation between target and expected: $\pi^* < \pi < \pi^e$;

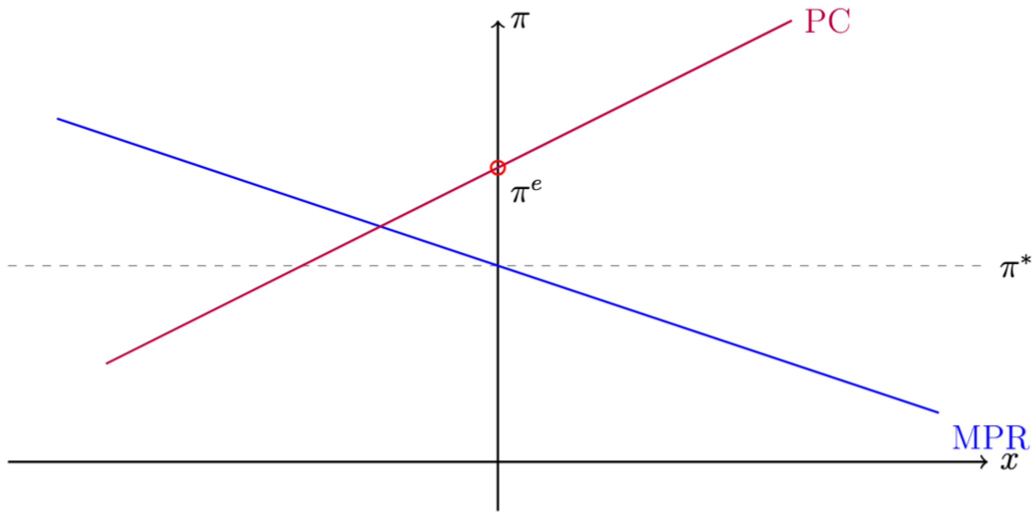
Consistency is clear because at negative x, firms set prices below π^e and the CB is willing to accept that because inflation is above target. We can equate PC and MPR and get that:

$$x_0 = \frac{\pi^* - \pi^e}{\delta + \lambda}$$

Over time, agents will begin revisiting expectations given that $\pi < \pi^e$ will persist over time and as π^e falls, the PC will shift downwards due to it being its intercept. Over time, the PC will converge to the **policy-mandated level of inflation** where:

- $x_1 = 0$, so, output converges to its natural level.
- $\pi_1 = \pi^*$ as said before.

Implying that in the long-run equilibrium, the CB will successfully anchor expectations of inflation.



Reactions to Shocks

Reduction in the Inflation Target

If the inflation target is revisited downwards by the CB, in the short-run the economy will suffer a **contractionary-like negative shock**, with actual inflation falling slightly and output gap becoming **negative** due to a downward shift of the MPR curve.

With the economy in recession and prices falling, the PC curve will shift much further down during the expectations' realignment, approaching the new target and bringing the gap to zero.

Credibility in this context is key: **the lower the credibility of the CB**, the **slower the recovery from the recession will be** and the **slower will be the convergence process**.

Shock to Expected Inflation

A change in expected inflation **shifts the PC curve upwards or downwards**, potentially creating a negative output gap with higher prices than before if π_e increases. This change is **not permanent** because unless the CB is unable to anchor expectations, expected inflation will gradually decrease towards target, with the CB's prestige influencing the speed of the convergence process.

Change in Preferences of CB

Let's assume that for some reason, a CB chooses to revisit its sensitivity to inflation and that it enacts:

$$\omega_0 < \omega_1 \Rightarrow \delta_0 < \delta_1$$

Thus, making the MPR curve **steeper than before**. This has similar effects to a **contractionary action**, but with a key difference. Supposing that the PC curve is above target and output gap is negative, **prices will increase due to higher inflation** and **output gap will decrease** in the short-term.

All arguments about credibility and convergence still stand.

Supply Shock

If the economy suffers a short-term positive supply shock such that $\nu > 0$, the PC curve will be shifted upwards, meaning that **for each output gap, inflation is higher** for exogenous reasons. The expectations won't be moved since the shock is short-term, but the CB will be **faced with a trade-off**.

Normally, the CB would reduce the output gap to reel in inflationary pressures from the shock, but due to the shock it **cannot reach the optimal level of inflation and gap** and has to choose between *having inflation above target* or *drastically reducing the gap in the short-term to maintain prices stable*. CB preferences are the primary indicators of what the CB will eventually do:

- If δ is very high and the CB is relatively lax, then it will allow for a larger increase in inflation to stave-off recession.
- The opposite will happen if δ is small and the CB is more conservative.

Stabilization Policy

The Two Sides' Arguments and Failures of Forecasting

There are two sides to monetary stabilization policy:

- Advocates of **active policy** view the economy as subject to constant shocks and monetary policy must respond to reel in shortfalls in output and employment and generally believe in the effectiveness of the policy's stabilization function.

- Advocates for **passive policy** instead argue that stabilization attempts are distortionary as the monetary and fiscal policy have **long and variable lags**. They also see that incompetence in policymaking is responsible for fluctuations and that our understanding is still too limited to be useful in formulating successful stabilization mechanisms.

Indeed, long lags **complicate the conduct of monetary policy** in the realm of stabilization. Two lags are most important:

- **Inside lags** are the time between a shock and the policy responding to that shock, and it's *especially large for fiscal policy*.
- **Outside lags** are the time between the policy action and its influence on the economy.

By this, stabilization requires the **economic forecasting of the situation post-lag** and this is a difficult job that requires *leading indicators* (like new orders of capital goods or stock indexes) applied to *large macroeconometric models*. For instance, there has been a persistent failure to **properly estimate the recovery period of the Great Recession**:

- The NYFed **fundamentally misunderstood the housing crisis** and lacked analysis in the rapid growth of mortgage engineering in financial markets.
- There was a strong **complacency habit in the perceived ease to sustain financial and economic stability** as under the Great Moderation (something that happens after periods of sustained growth).

The Lucas Critique

The Lucas critique states that: "*Given that the structure of an econometric model consists of optimal decision rules of economic agents, and that optimal decisions vary systematically with changes in the structure of series relevant to the decision-maker, it follows that any change in policy will systematically alter the structure of econometric models*" and is behind one of the most important paradigm shifts in macro theory.

It's indeed **naïve to predict the effects of policy on the basis of relations in historical data**, especially if data is very aggregate: such observations are unlikely to be structural as past policy interventions could depend on expectations and optimal behavior. By this, an **econometric model has to be built deep enough to hold parameters invariant to the policy decisions considered**.

This critique led to the production of **microfounded dynamic models**, which include the specifications of technology, preferences and other primitive constraints (*deep parameters*), alongside an equilibrium condition. At that point, individuals think intertemporally and make decisions that satisfy the resource and budget constraints.

Take the example of the *costs of disinflation*: historical estimates tend to be **very large in terms of output** but are unlikely to be reliable due to the Lucas critique. Indeed, traditional estimates assume **of adaptive expectations** and a policy change does update expectations for economic agents: the more credible a policy action is the *sharper the adjustment will be and a reduction in expected inflation might improve the output-inflation tradeoff.*

Monetary Policy by Rule or by Discretion?

Usually, CBs conduct monetary policy under a **fixed rule** communicated in advance, rather than acting under full discretion to **respond to the state of the economy each time**. This is advantageous under two main rationales:

- There is a **deep distrust of policymakers and the political process**.
    - Politicians and officials might act with incompetence or under self-serving hidden schemes.
    - Denying discretion prevents that
- Discretionary policy is subject to **time inconsistency**.
    - Even if policymakers are trustworthy, time inconsistency is a key issue because an inconsistent application of MP *can sway expectations in perverse ways*.

Imagine a CB that cares about inflation and output, and according to the PC, there is a trade-off between **stabilizing inflation and output** based on **expected inflation**. If that CB acts under full discretion, then it will be tempted to *announce low future inflation to improve the trade-off* ex-ante but then will **act expansionary** ex-post to *raise output*. This is **catastrophic for the credibility of the CB**, as agent will cease believing all announcements until the CB actually commits to one side of the trade-off.

Rule and Discretion in Practice

Assuming a CB acts under discretion and assuming it wants to keep $x^* > 0$, it will choose to minimize the usual loss function:

$$L = \frac{1}{2}[(\pi - \pi^*)^2 + \omega(x - x^*)^2] \text{ subject to } \pi = \pi^* + \lambda x$$

The FOC is $\pi = \pi^* - \delta(x - x^*)$ and, by assuming for simplicity that $\pi^* = 0$, we can solve the PC-MPR system:

$$\begin{cases} \pi = \pi^e + \lambda x \\ \pi = -\lambda(x - x^*) \end{cases} \Rightarrow \pi = \frac{\delta}{\lambda + \delta}(\pi^e + \lambda x^*)$$

In the long-run, inflation will equal expected inflation, therefore $\boxed{\pi = \delta x^* > 0}$ and by substituting this in the MPR curve we get $x = 0$.

Under a fixed rule however, the CB sets its inflation target to, say, zero and it holds that:

$$\pi = \pi^e = \pi^* \text{ and from the PC } x = 0$$

Which proves that **under discretion, the CB will reach the same output gap annulment with higher inflation than under a fixed rule**. Rules solve the inconsistency problem.

Unconventional Monetary Policy

Breakdown of Conventional Monetary Policy

The Taylor Rule prescribed sustainable monetary policy until the Great Recession in 2008, where it prescribed a FFR slump to -5%, which would have effectively **tanked the global economy via**

a liquidity trap. Such scenario was observed both in the Great Depression and the Japanese Great Slump of the mid 1990s and in both cases, it triggered a **massive deflationary spiral by letting real rates explode rapidly**.

Monetary policy is not powerless if overnight interbank rates reach ZLB, but it gets severely limited unless the CB can **work with longer-term factors** like expectations of future inflation and future short run policy rates, **facilitate credit flow** and **directly affect other interest rates**, usually tied to the real economy. Expansionary policies can indeed be enacted also by **lowering the short-term and long-term real rates** across various credit markets.

Extended Aggregate Demand and Real Rates

Considering the **dynamic IS Curve** we can develop an extended version of it, defining the **real interest rate faced by borrowers as** $\boldsymbol{r_t^b = i_t - E_t[\pi_{t+1}] + \delta_t - r_t^n}$, where $\boldsymbol{\delta_t}$ is the **risk premium**:

$$x_t = E_t[x_{t+1}] - (\boldsymbol{i_t - E_t[\pi_{t+1}] + \delta_t - r_t^n})$$

Long-term interest rates matter for households and firms and can be defined as:

$$r_{mt} = \frac{r_t + E[r_{t+1}] + \cdots + E[r_{t+m-1}]}{m} + \delta_t$$

Where δ_t is a **term premium** associated with maturity. This implies that expansionary policy can be carried out by **raising inflation expectations** or by **reducing interest rate differentials** today or try to influence their reduction in the future. Indeed, the DIS curve can be rewritten as:

$$x_t = -E_t \sum_{s=0}^{\infty} [i_{t+s} - \pi_{t+s+1} + \delta_{t+s} - r_{t+s}^n]$$

And monetary policy can be enacted to change parameters only in the future. That is the crux of **unconventional monetary policy**: acting on the cost and availability of credit, rather than acting on the short-term policy rate.

Inflation Expectations and Forward Guidance

Inflation targeting is an **expectations-management tool**: it ensures a relatively stable inflation expectation and prevents explosive real rates should rates fall too much. **Price target levels might work even better**, as they provide future compensation for shocks although inflation overshoots because of past shocks. Should the ideal interest rate be negative, the CB **can announce that rates will be brought to zero for a long period of time** with a cut in the early stages: the sum of expected short run rates remains the same resulting in the same effect as a negative cut. **Credibility is crucial in any case**: price level targeting can overinflate inflation expectations and there might be the issue of time-inconsistency in both cases, as there may be no incentives to remain expansionary post-crisis, thus deviating from the initially announced rule.

This is the basis upon which **Forward Guidance is executed**: the act of communicating in advance to **the** public the future stance of monetary policy (policy rates future path) to manage expectations. It can be organized in three broad categories:

- **Pure Qualitative FG**, where no explicit end or numerical threshold is given.

- **Calendar Based FG**, where the expectations are managed until a pre-determined date.
- **Threshold-Based FG**, where the policy will run until some objective threshold is met.

Clearly, the CB indicating that it will do something creates the **commitment/forecast conundrum**, where agents will have to speculate on the possibility that the CB is *indeed starting a rule to maintain rates low for a long period of time* (**Odyssean FG**) or *is merely forecasting future policy decisions* (**Delphic FG**). In the first case, the policy will be far more effective and adherent to the scholarly definition of FG, however the **time-inconsistency problem** will arise because the CB will be tempted to change policy upon the recession's end. In practice, such decisions are communicated publicly to make it too costly for policymakers to cancel the policy unilaterally.

Are these measures effective? The Bank of Canada announced a persistent cut to rates consistent with the FG framework in 2009: upon announcement, OIS rates fell accordingly and significantly. Indeed, OIS rates are defined as:

$$i_{nt}^{OIS} = \frac{i_t + i_{t+1}^e + \cdots + i_{t+n-1}^e}{n}$$

Indicating that a **persistent commitment to lower interest rates decreases expectations for rates further in the future more than those for rates close in the present**: the yield curve not only shifts downwards, but *is flattened as well*, contrary to the steepening of a simple policy rate cut announcement.

Balance Sheet Policies – Quantitative and Credit Easing

BS policies aim at **influencing AD by changing the size and composition of the CB's balance sheet** without touching overnight rates: how can this avoid a liquidity trap in a limited reserves regime like that of 2008? There are two main types of BS policies:

- **Pure QE**, expanding the liabilities (monetary base) of the Central Bank.
- **Targeted asset purchases or CE**, altering the composition of assets at the CB.

Pure QE has the goal to **expand the reserves so much that a zero-rates regime can be maintained** and acts through the *expected inflation channel*: if the economy is expected to leave the liquidity trap, then the expansion in the money mass will inevitably lead to higher inflation expectations. The key requirement for pure QE to work is a **clear announcement and credible commitment by the CB to the policy** similar to FG: in the early 2000s Japan tried pure QE, but it was perceived as temporary, leaving the policy with minimal impact.

CE focusing on CB assets works by typically acquiring **long-term government securities**, rather than short-term ones used in OMOs: this acts through both the signaling and the term premium channel. Indeed, this massive acquisition of long-term securities **depresses rates and lowers the term premium** δ_t, propagating such effects further through the *portfolio balance effects*: the key is that **assets of different maturities are not perfect substitutes**, allowing demand and supply to influence their price and yield and, thus, generate some form of **market segmentation**.

Moreover, the CB can acquire a wide variety of securities to **lower rates in specific credit markets, reduce spreads and facilitate credit flows**: this introduces a *market functioning channel* providing relief in stressed financial markets like the MBS market in 2008 by lowering yields and risk premia. CE allows even for **direct CB lending to households and both financial and nonfinancial businesses**.

Naturally, the risk of pure seignorage is clear, as such policies can be seen as **monetization of the government's budget**: historically this led to hyperinflationary spirals like in Weimar Germany and Zimbabwe. However, this type of policy is both **mediated by legal limits on how much the CB can purchase government securities** and aimed at **avoiding the worsening of ongoing deflationary spirals**, with no evidence of hyperinflation in any case post-2008.

Unconventional Monetary Policy during the Great Recession

After the 2008 Great Recession started, both the Fed and (later) the ECB reacted with both FG and Balance Sheet Policies: they began **purchasing longer-term securities** through LSAP (*large-scale asset purchase*) programs and with 4 rounds of QE. On top of that, there were programs to **directly lend money to financial institutions** (even nonbank or *shadow-banking* institutions) and **to borrowers directly on credit markets**.

The four rounds of Fed QE caused the balance sheet of the CB to balloon to never-before seen levels, creating the ample reserves regime we currently live under and then cemented it during the COVID-19 Pandemic. In general, however, it's not simple to understand **by which channel does unconventional monetary policy affect the economy**: an event-study approach is based on the effects of CB announcements on interest rates, although it has *endogeneity issues*: it's likely that the announcements' dates coincide with other major events occurring at the same time.

In the Euro Area, unconventional MP was seen as a complement to conventional MP to **support the transmission of MP in the face of FM seizures**, allowing that the select policy stance (still steered by short-term rates) passes through the real economy. The Fed used unconventional MP as an extension of conventional MP, **allowing it to ease and expand below-ELB**.

European Unconventional Monetary Policy

From the tensions in the ABS markets to the 2010 Sovereign Debt Crisis, the ECB had to contend with a total seizure of FM due to **weakened banks' balance sheets and undermined confidence** causing large disbursement of fiscal support **worsening public deficit and debt**. Two main vicious loops cooperated to worsen the sovereign debt risk:

- A **Bailout Loop** caused a dramatic increase in expectations of government support due to worsening sovereign creditworthiness itself, which reduced sovereign assets holdings in banks, digging in their solvency.
- A **Real Economy Loop** where fragile banks curtailed lending, slowing economic activity and depressing taxation revenues and leading into further sovereign vulnerability.

Interbank markets froze entirely and banks were forced into **credit crunching or fire-selling their assets**, causing a deflationary spiral: *enhanced credit support tools* were dispatched by the ECB to primarily aid distressed banks. Small tangent to describe key indicators:

- **Libor and Euribor** are interbank offered rates available at different maturities, indicating the **expectations of future policy rates** and **credit/liquidity risk in the banking sector**.
- The **Overnight Indexed Swap** rate is the interest rate swap over a fixed term in which a fixed rate is exchanged against an overnight floating index (like the FFR): it carries minimal counterparty risk as only net interest differences are exchanged, **reflecting policy rate expectations**.
- The **Libor/Euribor – OIS Spread** is the **default and liquidity risk in money markets**.

Once rate cuts became insufficient due to ELB, the following measures were implemented:

- **Fixed-rate full allotments** to provide unlimited liquidity to banks at the main refinancing rate.
- **Expanded collateral framework**, which allowed the ECB to accept a wide variety of securities, not only government bonds, as collateral.
- **Longer-maturity Refinancing (LTROs)** to gradually extend operations up to 3 years without engaging in outright asset purchases.
- **Foreign currency liquidity provisions** to supply US dollars to EU banks and Euros to non-EU banks through CB swap lines.
- **Covered bond purchases** to support long-term funding of banks and financial institutions.

In the second phase of the sovereign wealth crisis, the ECB had to fight **fiscal fragmentation** driven by increasingly high bond yields for several EA countries, partly driven by self-fulfilling expectations. To combat this, the ECB introduced the **Securities Market Program** to directly purchase government bonds and promised **Outright Monetary Transactions** to purchase government bonds under some conditions.

The former measure was introduced as a response to the Greek Debt Crisis of 2010, to acquire government securities in the secondary markets to restore market liquidity and ease te impact of sovereign stress on banks' balance sheets. The latter replaced SMPs in May 2012 to maintain the **singleness of MP** by reducing the sovereign market tensions that were upending the entire EA sustainability. OMTs work by fixing the "*bad expectational equilibrium*" problem: if lenders fear that a country is on the brink of bankruptcy, they will start calling-in loans or dumping bonds. If the CB announces that it will bail out the government no matter what, the panic will stop because the lenders will automatically have an insurer that will make them whole no matter what.

OMTs were however tied to **strict conditionality on the basis of the European Stability Mechanism program** and were targeted at the shorter end of the yield curve (or up to 3 years). Conditionality was adopted to manage the following factors:

- **Credit risk on the Eurosystem's balance sheet**, as all ECB operations involve some degree of risk and linking purchases to the ESM imposes solvency conditions to limit the CB's risk exposure.
- **Fiscal discipline shortfalls** were limited by the fact that OMTs were conditional on ESM clearance.
- **Market discipline shortfalls** were reeled in by letting lenders still have risk associated with their lending practices, but OMTs could still work to stop self-fulfilling spirals.

Upon announcement of OMTs, sovereign spreads for troubled countries began to decrease, but they shouldn't be seen as purely sound for discipline or purely indicative of self-fulfilling risk. Low spreads **do not indicate that the ECB will never be called to be the Lender of Last Resort**, while high spreads might undermine fiscal judgement: high interest costs can make debt unsustainable even with sound fiscal policy.

Other tools introduced by the ECB were:

- **Forward Guidance**, with the Governing Council announcing in 2013 that interest rates would have been low for a *long* period of time (beyond the horizon for net asset purchases). FG now clarifies the Council's intentions on both the **expected future path of interest rates** and the **horizon of the QE programs**.

- **Negative Interest Rates** were attempted at the deposit facility rate to bring the EONIA into negative territory to further the expansionary maneuver.
- **TLTROs** or (Targeted LTROs) were implemented to extend **long-term credit to commercial banks to reduce the borrowing costs** for households and firms. Three rounds of TLTROs were implemented from 2014 to 2019.

Finally, the ECB implemented **Pandemic Emergency Purchase Programs** or PEPPs, with broad availability in all jurisdictions (Greek securities requirements were waivered) and exceeding €1tn in value. They allowed for the extension of maturity ranges for public sector asset purchases and served as *benchmark for allocations across jurisdictions*, but with broad **flexibility over time and across jurisdictions and asset classes**.

It really well fitted the type of shock (exogenous and potentially staggered in nature, affecting all EA countries) and allowed for **interventions on the entire yield curve** preventing fragmentation of the Euro Area.

You can crush this! Go Forth and Conquer!

- *Piergiulio.*

FOR DOUBTS OR SUGGESTIONS ON THE HANDOUTS

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