EMERGING CAPITAL MARKETS

Lecture 8. Evaluating Country Economic Performance: Stabilization II

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January 2012

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Outline

A. Size of a “Sustainable” Fiscal Deficit

B. Monetary Policy and Inflation Targeting (IT)

C. Rules of Thumb for Economic Sustainability

A. Size of a "Sustainable" Fiscal Deficit

A key question is what determined the amount of financing available to the Government on a "sustainable" basis.

Definitions:

FD = Primary Fiscal Budget Deficit (If sign is +, means deficit)
Y = Real GDP
Yn = Nominal GDP
fd = FD/Yn (fiscal budget deficit as a share of GDP)
B = Government Debt Stock
b = B/Yn (government debt as a share of GDP)
ΔB = Increase of government debt
$\%\Delta B$ = Rate of Growth of government debt
i = Nominal Interest Rate on government debt
r = Real Interest Rate on government debt
P = Price Level

A Sustainable Fiscal Deficit is one that can be financed over time without increasing the debt/GDP ratio, b. That is, the debt load b is in equilibrium and remains constant over time. If b were to increase over time, it would not be sustainable.

(1) Budget Constraint

$FD + iB = \Delta B$ The overall "primary" fiscal deficit (FD) plus debt interest payments (iB), must be financed (ΔB)

$FD = \Delta B - i B$ If $\Delta B = \%\Delta B \; B$ {$\%\Delta B$=growth rate of debt}, then:

$FD = \%\Delta B \; B - i B$ Dividing by GDP (Yn), we will get:

$fd = \%\Delta B \; b - i b$ In which "fd" is the ratio FD/Yn and "b" is B/Yn.

(2) Sustainability Condition

The condition of sustainability is that the ratio of debt to GDP "b" will not be increasing over time. For this ratio B/Yn to be constant, B and Yn will need to increase at the same rate; that is: **$\%\Delta B = \%\Delta Yn$**

If Nominal Y (Yn) = Real Y (Y) + ΔPrices, then, **$\%\Delta B = \%\Delta Y + \%\Delta P$**

If Nominal interest rates (i) = Real interest rates (r) + Δ Prices, then:

$fd^* = (\%\Delta Y + \%\Delta P)\, b - (r + \%\Delta P)\, b$

Or: **$fd^* = (\%\Delta Y - r)\, b$** where **fd*** is the sustainable fiscal deficit.

- If **$\%\Delta Y = r$** the sustainable fiscal deficit fd* is zero.
- If **$\%\Delta Y > r$** the sustainable fiscal deficit is positive (could have deficit)
- If **$\%\Delta Y < r$** the sustainable deficit is negative (need for fiscal surplus).

- The size of a sustainable fiscal deficit to GDP "**fd***" will depend on: (i) the growth rate of real GDP, %ΔY; (ii) the real interest rate on debt, r; and (iii) the ratio of debt to GDP, b that lenders would tolerate given the credit rating of the country (not a controlled #).
  - The higher the rate of growth of GDP, the higher the sustainable fiscal deficit to GDP can be.
  - The lower real interest rates, the higher the deficit can be.
  - When r > %ΔY (negative term), the higher the ratio of debt to GDP the lower the fiscal deficit can be, and vice-versa.
- Furthermore, if: **Δfd* = 0;** then **Δ(%ΔY - r) b = 0 ► Δ%ΔY = Δr**
- For the sustainable fiscal deficit "fd*" to be constant at the level "fd*" (not increasing/decreasing over time,) any change in real interest rate should equal a **change** in the rate of growth of GDP.

If **Δ%ΔY > Δr**, then the "sustainable" deficit will be increasing over time, creating "fiscal space" for additional expenditures.

If **Δ%ΔY < Δr**, then the "sustainable" deficit will be declining over time and actual deficits may need to be reduced.

Examples:

- A country is growing at 6% pa, borrows at a real rate of 5% pa and the maximum debt/GDP that lenders wish to hold is 60% of GDP.
- Then, the maximum sustainable primary fiscal deficit is 0.6% of GDP :

%ΔY	r	b	fd (fiscal deficit/GDP)
0.06	0.05	0.60	(0.06 - 0.05)(0.60) = 0.006 or +0.6% of GDP

- Other plausible scenarios show that if debt/GDP is 60%, the country needs to grow fast and pay low interest rates in order to afford any primary fiscal deficits (+):

Maximum Sustainable "Primary" Fiscal Balances with a Debt/GDP ratio of 60% (+ is deficit, - is surplus)

Real Interest on Public Debt	Real GDP Growth Rate					
	1.0%	2.0%	3.0%	4.0%	5.0%	6.0%
2.0%	-0.6	0.0	+0.6	+1.2	+1.8	+2.4
3.0%	-1.2	-0.6	0.0	+0.6	+1.2	+1.8
4.0%	-1.8	-1.2	-0.6	0.0	+0.6	+1.2
5.0%	-2.4	-1.8	-1.2	-0.6	0.0	+0.6
6.0%	-3.0	-2.4	-1.8	-1.2	-0.6	0.0
7.0%	-3.6	-3.0	-2.4	-1.8	-1.2	-0.6
8.0%	-4.2	-3.6	-3.0	-2.4	-1.8	-1.2
9.0%	-4.8	-4.2	-3.6	-3.0	-2.4	-1.8
10.0%	-5.4	-4.8	-4.2	-3.6	-3.0	-2.4

Under most conditions, on a sustainable basis, if the debt/GDP is 60%, a country must have a "**primary**" fiscal balance (excluding interest payments) between a "surplus" of 5.4% of GDP and "deficit" of 2.4% of GDP (average surplus 2.0% of GDP.)

If nominal interest payments are about 5% of GDP (with debt at 60% of GDP), the "**overall financial**" fiscal deficit should be no more that about 3% of GDP.

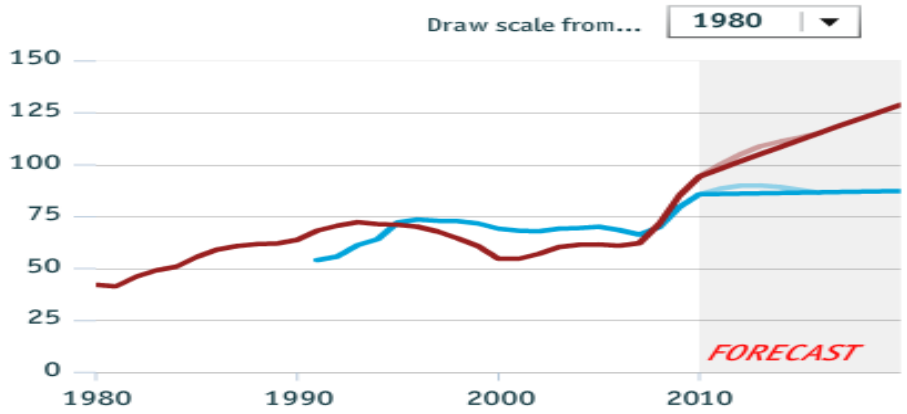
The Economist

Government debt dynamics

Gross general government debt, % of GDP

Euro area — United States

Pale lines show IMF forecasts, 2011-2016



Sources: IMF; *The Economist*

*Primary balance as % of GDP (ie, before interest payments)
†Payable on debt stock (approximately equivalent to ten-year bond yield)

Long-term assumptions, annual average %

Hide user forecast

	Euro area	US
GDP growth:	1.6	2.6
Budget balance*:	0.5	-4.7
Interest rate†:	3.9	2.7
Inflation:	1.5	1.2
	Reset	Reset

Enter values between -10 and +10; max 1 decimal place. Press Enter or move to another field to update chart.

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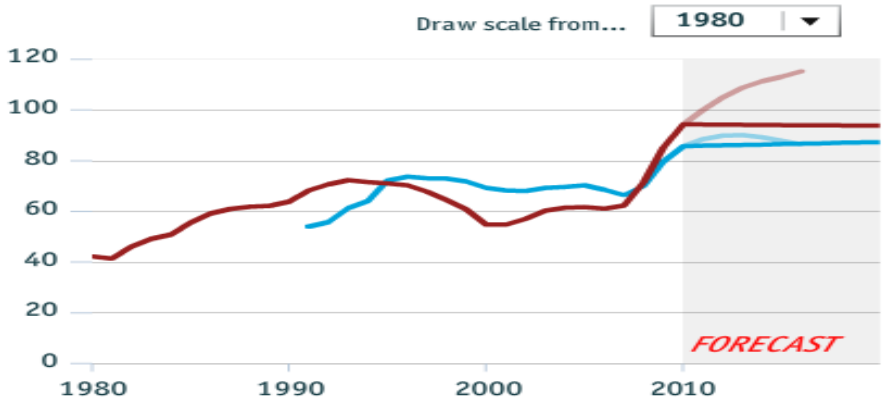

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- As long as the real interest rate exceeds economic growth, gvts have to run a primary surplus to control public debt growth relative to output.
- A primary deficit can be sustained only if the real interest rate is permanently lower than the rate of economic growth, which is unlikely:
- First, economic agents must be remunerated for deferring consumption; if “spenders” could consume more than “savers” both now and in the future, no one would want to save. In such a situation, the resulting shortage of savings would result in an increase in the interest rate sufficient to create incentives for deferring consumption over time.
- Second, excessive borrowing and investment at low interest rates would eventually lower the growth rate, given the decreasing marginal productivity of capital and possible efficiency bottlenecks in the use of inputs.
- Theoretically, a government with high credibility could run a primary deficit permanently, if such a government could borrow at a lower interest rate than output growth. However, taking excessive advantage of the opportunity to run a primary deficit and roll over public debt might push a government into a situation where a growth slowdown would force higher taxes on a generation already hit by slower growth (Ball, Elmendorf, and Mankiw 1995).

Seignorage and the inflation tax could allow temporarily for a higher deficit, but should not be counted on for the long term.

- **Seignorage** is the increase in real money demand that the Government can extract, which is due to increases in income and inflation.
- As income increases, the real and nominal demands for money would also increase. If in addition, there is inflation, people would wish to retain their real balances (real money demand), thus increasing their nominal money demand.
- These increases in nominal money demand can be matched by money supply increases and the monetary base could be expanded accordingly. The increases in the monetary base could finance the Government without inflationary pressures. It is a free lunch for the Government.
- The **Inflation Tax** represents the benefits that the Government (CB) extracts because it pays no interest (or little interest) on the monetary base. It amounts to a "subsidy" to the government that has to be paid by a "tax" to the rest of the economy. Some definitions add the Inflation Tax to the concept of Seignorage.
- Excessive Seignorage and inflation tax are not sustainable over many years, since inflation will eventually reduce the demand for money.

Present Value (PV) Approach to Fiscal Sustainability

- The previous analysis of fiscal sustainability says nothing about what determines the value of "b", the debt/GDP ratio. It sets aside the role of lenders in determining what debt strategy is sustainable.
- A broader PV approach says that a fiscal deficit is sustainable if the present value of future primary fiscal surpluses exceeds the present value of future primary fiscal deficits by a sufficient amount to cover the difference between the value of the initial government debt and the present value of the terminal debt stock.
- But to avoid a Ponzi game (under which debt is just accumulated), the present value of the terminal debt stock should be zero.
- This means that the fiscal sustainability condition is that the current value of debt should not exceed the present value of fiscal surpluses minus the present values of fiscal deficits. This ensures that the debt will be eventually paid, a normal lenders' requirement.
- This approach does not rule out either large fiscal deficits or high debt as long as larger future surpluses are "viable/feasible" policy options.

B. Rules of Thumb for Economic Sustainability in EMs:

Fiscal Deficit/GDP	< - 3%	(-3%) [2/]
Public Debt (Dom+Ext)/GDP	< 60%	(35%)
Public Debt Service/GDP	< 5%	(5%)
Current Account Deficit/GDP[1/]	< - 3%	(+3%)
External Debt (Pub+Private)/GDP	< 60%	(35%)
External Debt (Pub+Private)/Exports	< 120%	(70%)
Inflation Rate	< 5% (max 10%)	(5%)
International Reserves/Imports	> 25% (3 months of imports)	

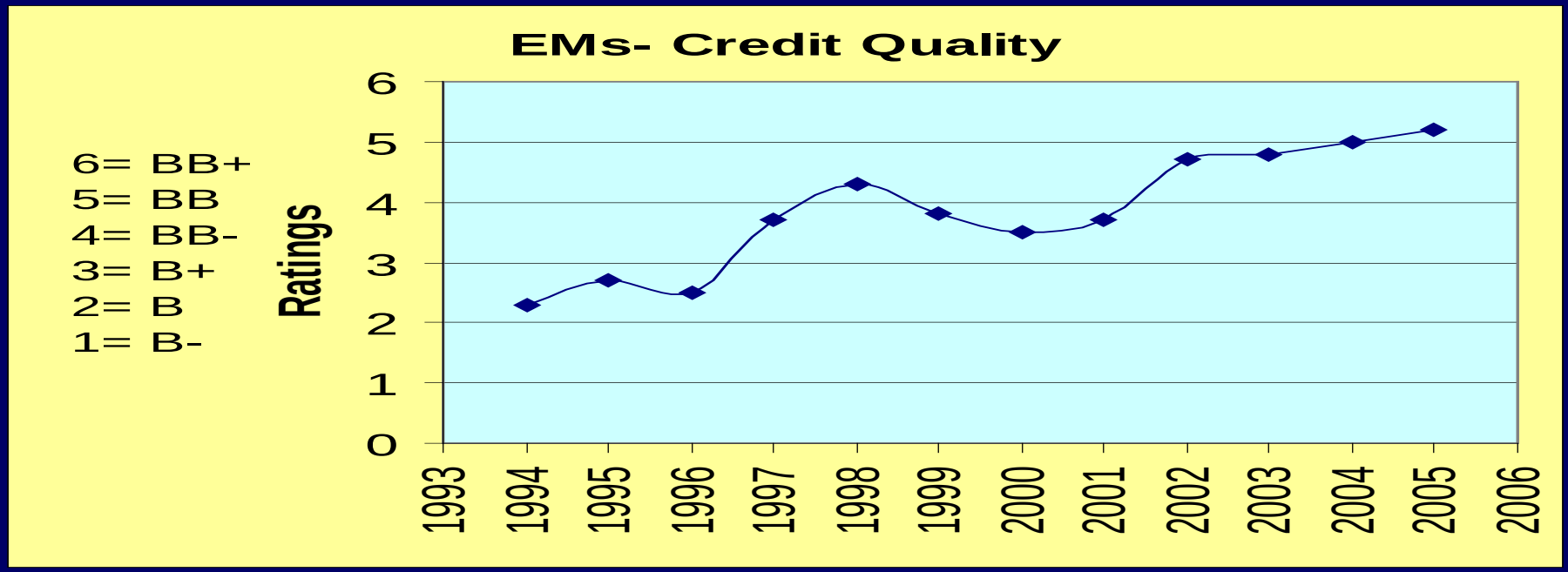
- These rules are not uniform. A lot depends on GDP and export growth prospects, level of Foreign Direct Investments and creditors' attitudes.
- If a country's numbers were to exceed these values, this does not mean that a financial crisis is imminent; but that you should get concerned and analyze the situation carefully.

[1/] Applying the same criteria as with Fiscal Deficits, but using CADs.

[2/] The numbers in parenthesis represent the average numbers for key EMs

Improvements in Macroeconomic Stability in EMs

	1997	1999	2001	2003	2005	2009
External Debt/GDP	38	45	40	39	31	35
External Debt/Exports	150	167	135	115	82	120
Ext Debt Service/Exports	23	26	23	18	12	na
Fiscal Deficit/GDP	-2.9	-4.0	-3.3	-2.9	-1.1	-3.0
Current Account/GDP	-1.3	-3.1	+0.6	+2.0	+3.4	+2.7
Inflation Rate	12	10	7	6	5	



Total External Debt (Public and Private) to GDP & Exports, 2009

Country	ED/GDP	ED/Exp	Country	ED/GDP	ED/Exp
Hungary	128	143	Malaysia	32	35
Bulgaria	110	159	Indonesia	28	123
Kazakhstan	99	257	Peru	28	126
Ukraine	92	204	Ecuador	25	95
Poland	58	125	South Africa	25	81
Panama	56	76	Thailand	24	35
Korea	45	83	Colombia	21	130
Turkey	44	176	Dom Rep	20	97
Argentina	42	182	India	18	86
Czech Rep	41	56	Mexico	18	62
Philippines	40	121	Venezuela	16	100
Russia	38	125	Brazil	14	122
Pakistan	36	322	China	8	33
Chile	35	82	**MEAN**	**35**	**120**

C. Monetary Policy and Inflation Targeting (IT)

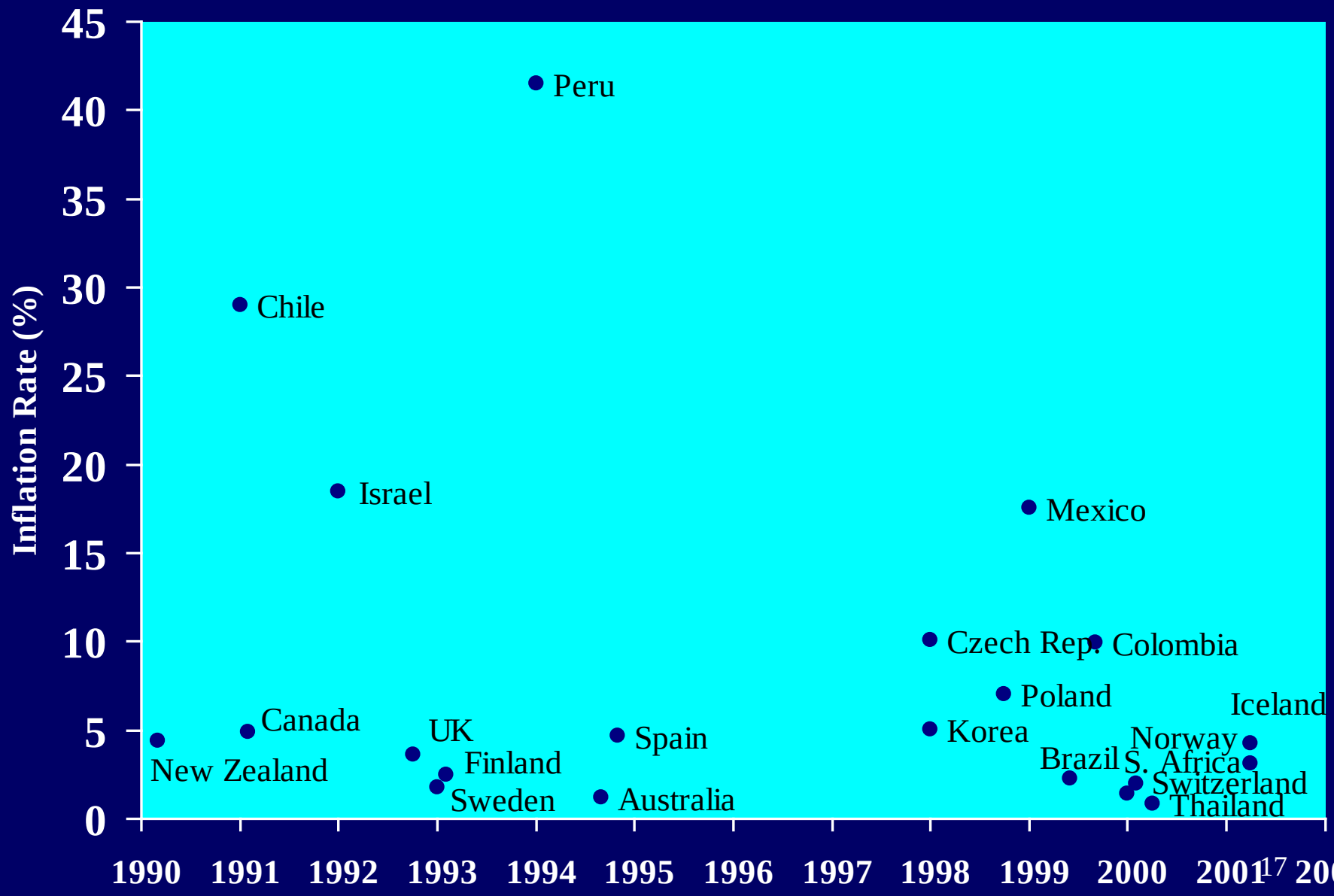
- The central task of the previous IMF-World Bank models is the design of a consistent set of policies intended to move an economy toward internal and external balance.
- They give central importance to **fiscal, monetary** and **credit** policies: the control of the fiscal deficit (public sector borrowings), money supply and credit growth to deliver the dual objectives of **GDP stability (particularly controlled inflation) and GDP growth**.
- But, the monetary sector enters only through the monetary aggregates and the identity of money supply and money demand.
- A main monetary policy tool **– the level of interest rates-** enters only through its effect on money velocity and money demand. Thus, one of the major ingredient of monetary policy is not used effectively.
- When there is a need to reduce excessive rates of inflation to "normal" levels, more direct action on inflation may be needed. The Central Bank has three possible routes:
    1. The CB can use a "nominal foreign exchange anchor": monetary policy aims at pegging the exchange rate to a country with low inflation to bring inflation to this level.

- This option however has made countries more vulnerable to balance of payments crises: As the peg is introduced when inflation is high, the currency becomes overvalued, depressing exports and encouraging imports.
- If the B/P deficits are covered by inflows of foreign capital, these inflows also lead to inflationary pressures as the Central Bank buys foreign exchange to maintain the peg.

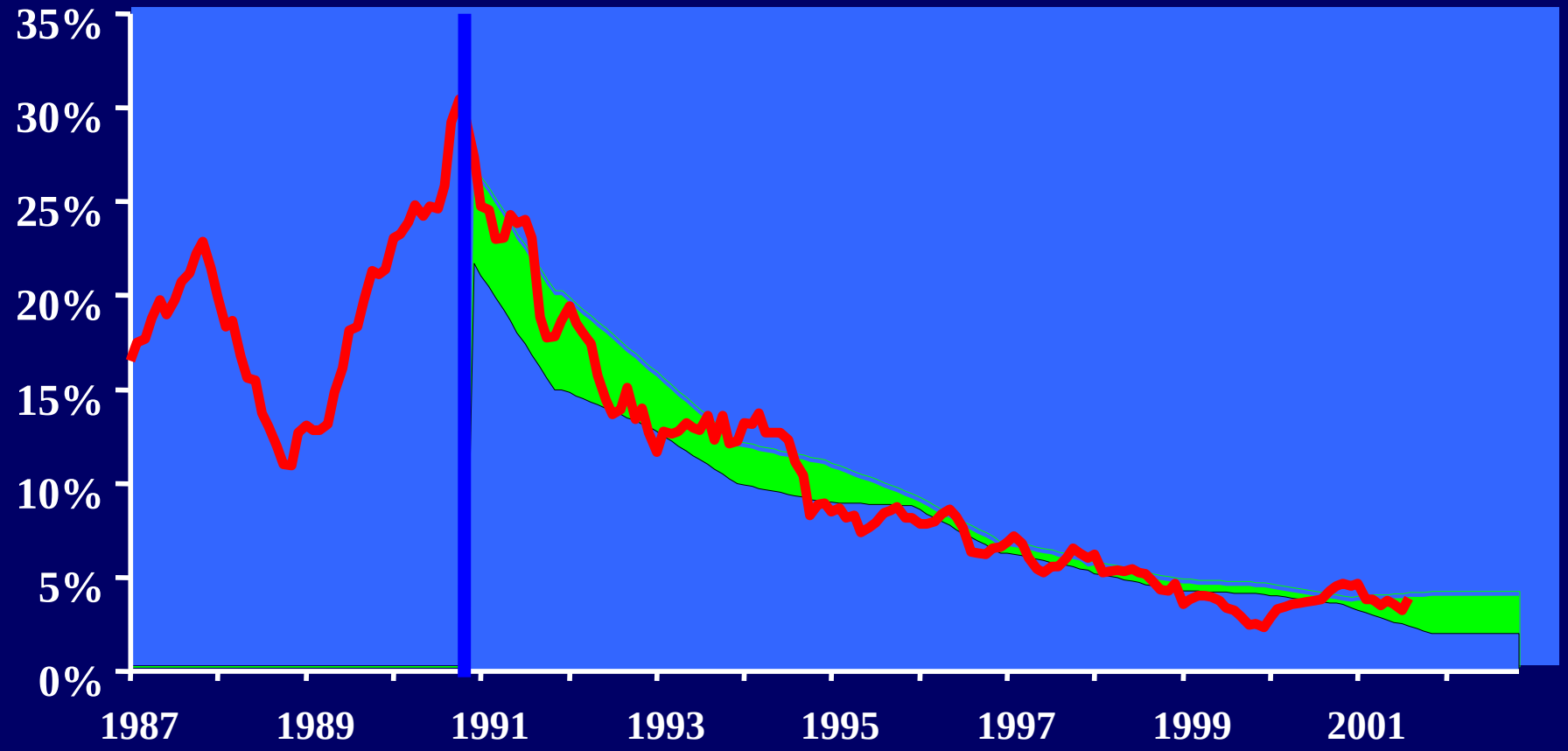
2. The CB can use a "**money growth anchor**": monetary policy aims at controlling the rate of growth of money supply.
   - This policy however has been almost abandoned now by CBs, due to the difficulties in measuring the correct money supply.
   - Also, inflation is caused by the difference between money supply and money demand and money demand is unstable.
   - Studies in many countries show that a better predictive power to forecast inflation contained in interest rates, past inflation, and economic activities. Monetary aggregates provides little additional predictive power when forecasting inflation.

3. The CB can use "**inflation targeting** (**IT**)" as a nominal anchor to bring inflation down to desired levels.
   - Inflation targeting has worked well in many countries: It is consistent with modern view of the power and limits of monetary policy.
   - It addresses directly the need to determine a long-run inflation objective.
   - It provides more transparency and accountability to monetary policy.
   - It provides an stable policy guidance (forces the CB to take into account long-term consequences of short-term actions).
   - It shields CB from political pressures from government and private sector to relax monetary policy for short-term gains.
   - It provides a "framework of constrained discretion" (Bernanke et al.)
   - In the UK, a 1% incraese in interest rates will produce a 0.2%-0.3% decline in GDP in one year, and a 0.2%-0.4% decline in inflation after in two years.

Many countries have adopted IT under different inflation levels



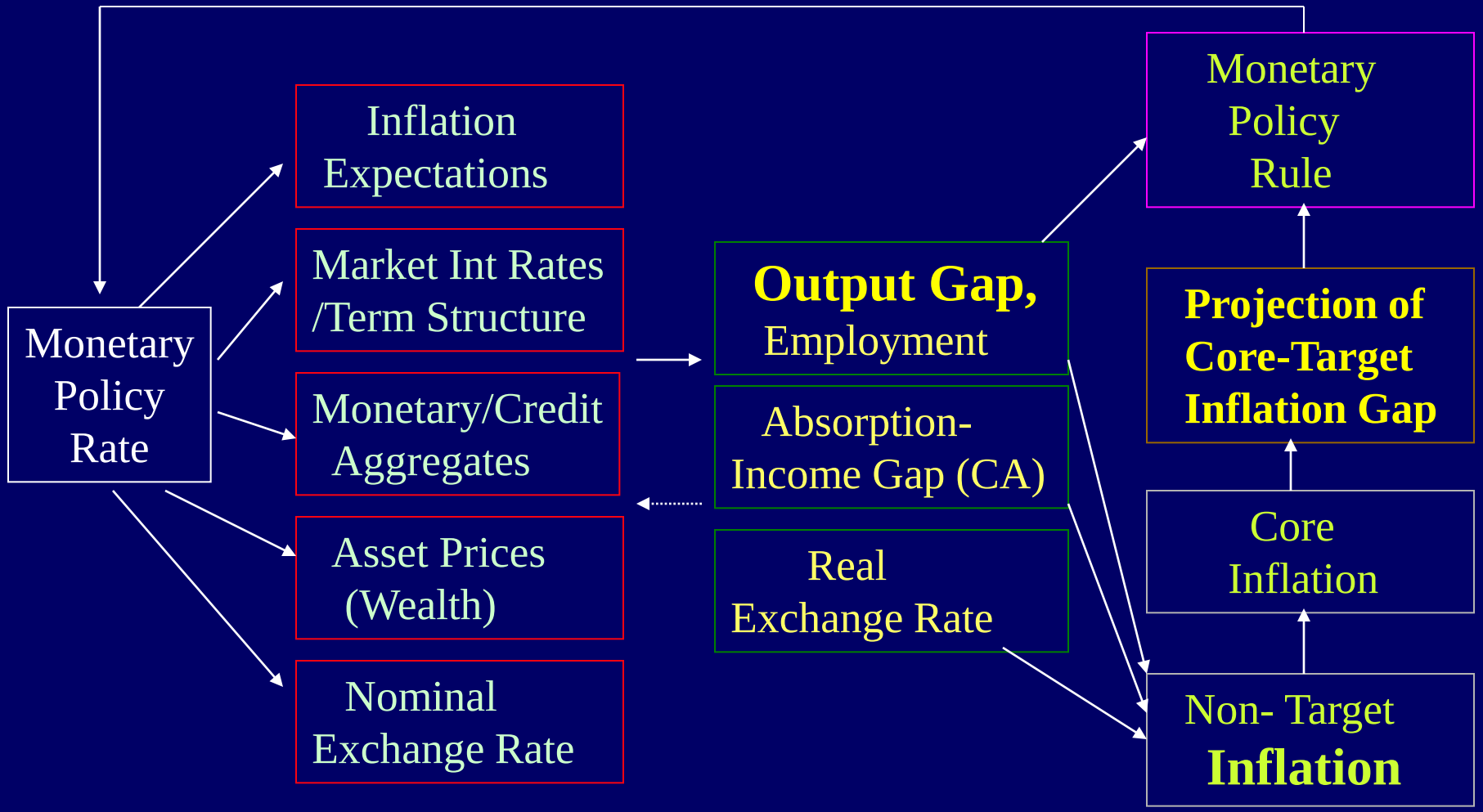
Chile: Inflation and Inflation Targets: 1987-2002



Sound Policy Framework: (1) Robust fiscal stance and healthy banking system; (2) Fiscal policy anchored by a 1% of GDP structural surplus; (3) Non-performing loans as low as 1.8% reflect the strength of the banking system; (4) Central Bank enjoys complete legal and instrument independence; (5) Exchange Rate float - clean between September 1999 and July 2001, dirty since August 2001.

- Under the IT system, the central bank manages monetary policy to contain **inflation** over the medium run, without causing a major **output gap**.
- Containing Inflation and Output gaps become the overriding policy goals.
- All the other indicators (the exchange rate, money stock growth, etc) become auxiliary variables; the central bank will take them into account only if this information helps it to improve its inflation/output results.
- IT involves the following three steps:
  1. The CB sets a "target" rate of inflation for the country for the "medium" term: international experience shows that the impact of changes in monetary policy on inflation works its effects through aggregate demand and output with a significant lag (nine months to two years).
  2. The CB makes forecasts of the likely rate of inflation based on current conditions. This step requires the developing of sound inflation forecasting methods. This inflation forecast may indicate that inflation may be likely to be above the "target".
  3. The Central Bank uses monetary policies (particularly the level of interest rates) to close the gap between the likely inflation rate and the "target" rate, while avoiding excessive output declines. This requires a good model of the "transmission mechanisms" from changes in monetary policy (interest rates – the Federal Funds rate in the US) into aggregated demand, **output gaps**, and then into inflation rates.

IT: Monetary Transmission and Policy Rule in Open Economies



In the UK, a 1% incraese in interest rates will produce a 0.2%-0.3% decline in GDP in one year, and a 0.2%-0.4% decline in inflation after in two years.

IT design features:

- **Inflation Target index**:
  - Most countries use the annual rate of headline CPI
  - A few countries adjust CPI to exclude volatile items, interest payments, taxes (Core Inflation).
- **Inflation Target range**:
  - Choice between a point forecast, a central point forecast with a range, a range, or just upper bounds.
  - Trade off between target accuracy and policy credibility.
  - Range targets are adopted when uncertainty is high (usual range 1 to 3 points variation).
  - Point target adopted when seeking credibility.
- **Inflation target horizon:**
  - Time period long enough to for monetary policy to have an effect on aggregate demand and inflation.
  - One calendar year horizon when far from stationary inflation.
  - Multi-year horizon when closer to stationary inflation.

IT: Forecast Procedure

Most Central Banks have two types of models:

a. Models to Forecast Inflation based on current conditions without any monetary policy action – Non-Target Inflation.

b. Models to Target Inflation based on the adjustment over time of interest rates and their **transmission mechanisms** to affect demand, output and inflation.

For these models, CBs follow a well-defined sequence of steps for preparation and for presentation to policy-makers and public:

1. Gathering information
2. Input data into the database
3. Maintaining a system to monitor and record news that could affect inflation outlook
4. Presenting interest rate scenarios to Monetary Policy Committee
5. Discussing technical proposals of the staff at policy level
6. Interact with staff on impact of alternative scenarios for future policy interest rates (i.e., the Federal Funds rate in the US)
7. Communicating inflation forecast to the market
8. Follow up

IT: Models to Forecast Non-Target Inflation based on Current Conditions without Monetary Policy Actions

Short-term forecasting:

A. Consumer Surveys and Expert Judgments

B. Statistical (time series) Econometric Techniques

Medium-term forecasting:

C. Structural Models based on Economic Parameters

Empirical studies show that no one single model predict inflation consistently better than others.

For this reason, many researchers and central banks use a combination of various models to forecast inflation.

A. Consumer Surveys and Expert Judgments

- Many countries include surveys of inflation expectation (for one or two years ahead) in their periodic consumers surveys. Surveys could be directed to consumers or to a pre-selected group of expert analysts.
- The monthly European Commission's Consumer Survey ask by phone 50,000 consumers in the Euro area on their inflation expectations one-year ahead.
- Results in the Euro area suggest that surveyed expectations are unbiased predictors of future prices and they incorporate – though not always completely – a broad set of macroeconomic information.
- In addition, although persistent deviations between consumers' expectations and rational outcome occur, consumers are shown to rationally adjust their expectations in order to eventually "weed out" any systematic expectational errors.
- Inflation expectations are also important from the perspective of aggregate price formation: the expectations augmented Phillips curve posits a relationship whereby the actual change in the price level is driven - in part - by expectations of its future change.

B. Statistical Inflation Forecasting Models

- Statistical time-series techniques: e.g., changes in inflation (π) 12-month ahead depends on recent (Lagged – L) changes in 1-month inflation:

$$\pi_{t+J} - \pi_t = \alpha + \beta(L)(\pi_t - \pi_{t-1}) + \varepsilon_{t+J}$$

$$\pi_t = \ln p_t - \ln p_{t-1}$$

Linear Stationary (constant variance) Models:

- Autoregressive Moving Average Models (ARMA –or Box-Jenkins), consists of two parts, an autoregressive part (lag of previous observations) and a moving average part (of the forecasting errors) .
- Autoregressive Integrated Moving Averages Models (ARIMA), an ARMA with differenced time series to make it stationary.
- Autoregressive Fractionally Integrated Moving Average (ARFIMA), which generalizes the previous ones.

Non-Stationary and Nonlinear Models:

- Autoregressive Conditional Heteroskedasticity (ARCH) models, which captures changes in variance over time.
- Artificial intelligence models, including artificial neural networks (inspired from the real neuron present in our nerve system) and multilayer feed-forward networks, which capture the non-linearity of data and "train" the model based on actual experience.

C. Structural Inflation Forecasting Models

1. **Standard Philips-Curve model** (NAIRU) represents an empirical relationship between inflation and the gap between actual output (y_t) and potential output (y^p_t) -- or unemployment. When the output gap is positive, inflation accelerates:

$$\pi_t = \gamma\,(y_t - y^p_t) + \varepsilon_t$$

2. **Expectations Augmented Philips-Curve model,** adds Lucas's rational expectations in which workers "forecast" wages and supply labor accordingly (which yields a demand/supply shifter Δx).

$$\pi_t = -\alpha_2 + (1-\alpha_1)\Delta x_t + \alpha_1 \Delta x_{t-1} - \alpha_1 (y_{t-1} - y^n_{t-1})$$

3. **New Keynesian Phillips curve**, introduces inflation expectations:

$$\pi_t = \beta\, E_t \pi_{t+1} + \lambda(y_t - y^p_t) + \eta_t \quad \{\text{derived from SR-AD: } y_t = y^p_t + a(p-p^e)\}$$

4. **Generalized Philips-Curve model**: changes in annual inflation depends on recent (Lag) changes in inflation and on current and past (Lag) values of real economic activity index (α_t)

$$\pi_{t+J} - \pi_t = \alpha + \beta(L)(\pi_t - \pi_{t-1}) + \gamma\,(L)\alpha_t + \varepsilon_{t+J}$$

5. The P Star model (P*) disregards output gaps (since potential output is hard to measure and the curve is unstable, with coefficients changing over time). It is derived from the quantity theory of money (m), assuming that velocity (v) and income (y) will converge relatively quickly to their long-term equilibrium, v*, y*:

$$p^*_t = m_t + v^* - y^*_t$$

- On this basis, inflation in the backward-looking P* model is:

$$\pi_t = A(L^k)\pi_{t-k} + B(L^k)(p^*_{t-k} - p_{t-k}) + \varepsilon_t$$

- Inflation for the forward-looking P* model will be:

$$\pi_t = \pi^e_t + \beta(p^*_t - p_t) + \eta_t$$

- Other variants of the P* model:

Real-Money gap: $\pi_t = E_t\pi_{t+1} + \beta(m^*_t - m_t) + \varepsilon_t$

Exchange rate: $p^* = Ep^*f/ER^*$

E -equilibrium nominal fixed exchange rate;

R* -equilibrium real exchange rate.

Interest rate : $\pi_t = E_t\pi_{t+1} + \gamma(i^*_t - i_t) + \varepsilon_t$

IT: Forecasting Accuracy

1. Ability to forecast magnitude of inflation. Comparing out-of-sample forecast performance of different statistical models based on Root Mean Squared Error (RMSE)

$$RMSE = \sqrt{1/N \sum(x_{t+h+i} - \hat{x}_{t+h+i})}$$

2. Ability to forecast direction of change of future inflation: percentage of directional prediction that are correct (PDPC) in a particular sample period

$$\hat{D}_{t+J} = \begin{cases} +1 \text{ } if \text{ } \pi_{t+J} > \pi_t \\ -1 \text{ } otherwise \end{cases} \qquad PDPC = 1/T \sum I\{\hat{D}_{t+J} - D_{t+J}\}$$

Forecast accuracy can vary significantly depending on variable being forecasted, the type of forecast model, theoretical assumptions, available information

IT: The Chilean Inflation Forecast Models

Chile has developed a toolkit comprised by various models:

- Leading indicators of prices and activity.
- Small semi-structural Vector AutoRegressive models (4 to 7 variables).
- Flow-stock (IMF) consistency model.
- Small backward-looking macro model for key relations and variables (π, Phillips curve unemployment, output, absorption (or CA), potential output, imperfect interest parity, yield curve).
- Micro-founded forward-looking rational expectations model for key relations and variables.

- Forecasts are made for a base scenario (most probable), with deviations derived from an assessment of the main risks.
- Base Scenario:
  - Key exogenous variables: international conditions (external borrowing costs, terms-of-trade, exchange rate), productivity, fiscal policy, trend growth
  - Policy assumption: current policy rate is maintained in the future (consistency, commitment)
  - Base scenario forecasts are the result of the interacion of predetermined and endogenous variables
- Alternative scenarios: based on forecasts reflecting alternative assumptions for the trajectory of predetermined variables.

IT: Transmission Mechanism Models to reduce the Gap between Non-Target and Target Inflation

- These models aim at establishing the effects of interest rate policy rules on the economy and identifying the sequence of interest rate changes that would generate a target inflation rate in the future.
- The models consist of a number of equations that include measures of aggregate demand, aggregate supply, and the transmission mechanism of the monetary policy tool (interest rates) into aggregate demand (output gap) and then on inflation.
- They are Based on the New Neoclassical Synthesis/New Keynesian Economics, the model usually has the following equations:
    1. New Keynesian Phillips curve relating output gaps to inflation
    2. IS curve relating real interest rates to output gaps
    3. Interest rate rule to set interest rates based on the forecast inflation gap and output gap
    4. Exchange rate equation based on uncovered interest rate parity extended with risk factor
    5. In the long-run, supply shocks represented by Cobb-Douglas/CES production function

IT: A Typical Transmission Mechanism Model for Monetary Policy under IT

- Consider a closed economy characterized by the following two equations: The first one is a Phillips curve for **inflation (π)** and the **output (y),** -- where **y** = current GDP growth and y* = potential GDP growth:

$$(1) \qquad \pi_t - \pi_{t-1} = \alpha_1 (y_{t-1} - y^*_{t-1}) + \varepsilon_t$$

- This equation is closely related to the short-term aggregate supply curve with sticky prices/wages.
- The second equation is related to the aggregate demand - IS curve that relates the output gap to the (policy) lagged **real** interest rate (i - π):

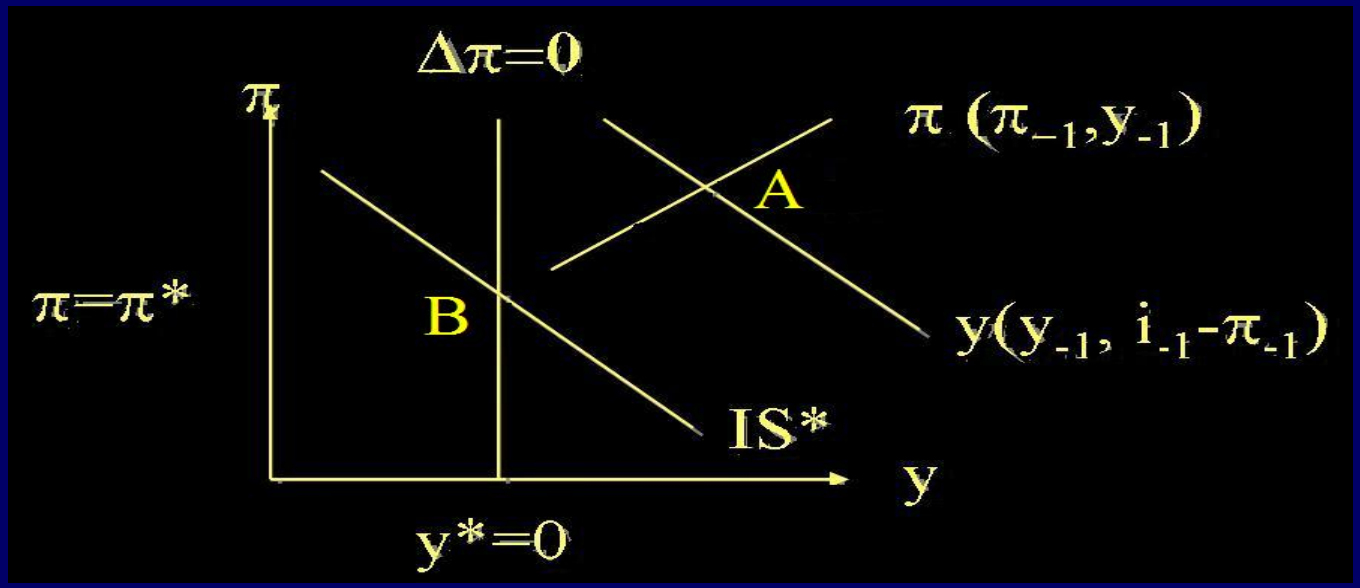
$$(2) \qquad y_t - y^*_t = \beta_1 (y_{t-1} - y^*_{t-1}) - \beta_2 (i_{t-1} - \pi_{t-1}) + \eta_t, \quad \beta_1 < 1,$$

- The negative coefficient on the real interest rate on future output in the ***IS*** relationship can reflect intertemporal substitution effects on consumption as in recent new Keynesian models as well as traditional effects on investment operating through both the cost and availability of credit.

- Next, we assume that the CB seeks to stabilize both inflation and the output gap, which are related by the Phillips curve. Thus, the CB sets its policy instrument to further these objectives. Subject to (1) - (2), the CB minimizes the expected discounted infinite sum of inflation deviations from CB's inflation target (**Π***) and output deviations **(y-y*),** as follows:

$$(3) \qquad U_t = E_t \left\{ \sum_{h=t}^{\infty} \delta^{h-t} \left[\frac{(\pi_h - \pi^*)^2 + \lambda (y_h - y^*)^2}{2} \right] \right\}$$

- Hence the problem faced by the CB is how to bring the economy from the current (short-term) equilibrium at A to long-term equilibrium at B:



- The CB's problem can be broken down into a series of one-period problems because of the two-period lag from i to π:
- $\mathbf{i_t \rightarrow (y_{t+1} - y^*_{t+1}) \rightarrow \pi_{t+2}}$ $\rightarrow$ Hence $\mathbf{\pi_t}$ predicts $\mathbf{\pi_{t+2}}$, $\mathbf{\pi_{t+3}}$, ...
- The result of this problem is a policy function (an analytically-derived "Taylor rule") that sets the policy interest rate (i_t) as a function of inflation and output gaps:

$$(4) \qquad i_t = \gamma\left(\pi_t - \pi^*\right) + \rho\left(y_t - y_t^*\right)$$

where γ and ρ are non-linear reaction parameters that depend on CB preferences and the economy's behavioral coefficients.

- This equation says that the Central Bank ought to raise its policy interest rate when inflation is above the Central Bank's target.
- But the CB should lower its policy interest rate if current income is below its potential, in order to stimulate the economy.
- If inflation is below target and output is also below potential – which is the case in the US in 2009-2010 – then the US policy interest rate (the Fed funds rate) should be quite low to stimulate the economy.

- The CB's anti-inflation stance, compared with growth ("hawkishness") is reflected by the difference of the two parameters:

$$(5) \quad \gamma - \rho = f(\lambda, \alpha_1, \beta_1, \beta_2, \delta)$$

(-) (+) (-) (?) (?)

- Hence CB hawkishness: rises with inflation; rises with Phillips curve verticality; falls with output inertia, and is ambiguos regarding IS interest-sensitivity and CB's discount rate.

- **Taylor found that in the US: $\gamma = 1.5$ and $\rho = 0.5$**
- Therefore, if the "target" inflation Π^* is 2%, and the US "potential" GDP growth is 3%, then the Fed should trade T-bills through its NY open market operations to move the Federal Funds rate to "i":

$i = 1.5 (\Pi_t - 2\%) + 0.5 (\text{GDP growth} - 3\%)$

- If current inflation is high at 5%, and current GDP growth is low at 1%, then the Fed's target for the Fed funds rate should be:

$$i = 1.5 (5\% - 2\%) + 0.5 (1\% - 3\%)$$

$$i = 1.5 (3\%) + 0.5 (-2\%) = 4.5 - 1.0 = 3.5\%$$

In early 2010, with inflation below 2% pa and low GDP growth, the Fed funds rate should be zero (actually negative), as is the case at this time.

IT Model extensions to Exchange Rates and others

- Introducing other monetary transmission mechanisms
- Open economy: Introducing the exchange rate ***S*** in the transmission mechanism of the model. This could be done by introducing foreign exchange gaps in selected equations and a separate equation reflecting the uncovered interest parity condition:

$$E(S)/S = (1+i)/(1+i^*)$$

- Introducing imperfect policy credibility, model uncertainty, CB aversion to policy changes, conflicting fiscal-monetary objectives, etc.
- Introducing Cobb-Douglas/CES production functions to assess the impact on inflation of long term supply shocks

IT: Need for Better Understanding of Monetary Transmission Mechanisms

- Channels: expectations, interest rate and term structure, monetary and credit aggregates, asset prices (wealth), exchange rate.
  - Emerging economies: Channels are more blurred because of less developed financial markets and more pervasive price rigidities
  - Chile and Israel: widespread indexation (raises devaluation-inflation passthrough).
  - Brazil: financial sector does little lending to the private sector.
- Asymmetries and non-linearities: More prevalent in emerging economies
- Uncertainty of model structure, parameters, exogenous variables: Stable time series are rather short and/or unstable in emerging countries with long inflation histories or recent economic reforms
- Leads and lags: More uncertain / unstable in emerging economies

IT: Requirements for successful Inflation Targeting

1. Ability of CB to conduct independent monetary policy
   - Strong fiscal budget position to avoid fiscal dominance in setting monetary policy
   - Central bank independence to enhance credibility -- de jure (New Zealand, Chile) or de facto (UK, Israel, Brazil)
2. A clear CB mandate for price stability over other conflicting objectives (such as exchange rates or GDP growth). For many emerging economies a case could be made to add a maximum current account deficit as a policy objective. This leads to a more conservative monetary policy.
3. A reasonably well-developed ability to forecast inflation;
4. A well understood transmission mechanisms between monetary policy instruments and inflation;
5. a well-developed financial system;
6. Transparency and accountability for monetary policy.

IT: Main Technical Requirements for Conducting Monetary Policy under IT

(a) Technical capability:

- to understand and model monetary transmission mechanisms
- to model and forecast inflation

(b) (Timely) availability of relevant information to monitor the economy and technical capability to do it right

(c) A set of criteria for using policy instruments to keep the economy on track to meet the target (policy rule)

(d) Timely use of effective policy instruments, making full and unconstrained use of available instruments