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CREDIBILITY AND INFLATION TARGETING

FOUNDATIONS AND DEVELOPMENTS

TESIS

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A mi madre, quien aunque no pueda concientemente compartir conmigo este logro, siempre de una u otra forma estuvo a mi lado.

¡Te quiero, mamá!

A mi padre, quien aunque no me comprenda, siempre me ha poyado.

¡Te quiero, papá!

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Alejandro Negrete Reveles

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Preface

Inflation targeting is used by many central banks to create long-term stable conditions necessary for good economic performance. This will only be achieved if individuals and companies are willing to engage in long term commitments such as long-term financing contracts for productive investment, credits for consumption of durable goods, contracts for research and development, and so on. This willingness to engage and honor such commitments will thrive under a relatively strong certainty environment created at some important extent by the central bank monetary policy. This certainty is, according to State of the Art consensus, achieved by aligning the expectations the agents have that current and forthcoming economic conditions will remain stable over a long period of time due to the observed central bank policy actions. In this respect, one important issue is the impact of dynamic inconsistency triggered by political election cycles and unexpected optimizing opportunities. The latter exerts pressures on the central bank actions to take advantage of the temporary opportunities that arise time and again in order to promote additional output growth and a temporary decline in unemployment in a political attempt to win votes.

How the central bank deals with such temptations, pressures and unexpected shocks will strengthen or weaken its credibility and therefore the expectations of the agents with regards to future economic conditions. An in-depth theoretical understanding of inflation targeting will enable the reader to assess the policy actions followed by many central banks including ours. Even though Banco de México has adopted this path for monetary policy for over 10 years, there have been some inconsistencies in the way it has operated the approach that will not be covered in this document. This work will endeavor to explain inflation targeting via an objective theoretical base from within the views of the main proponents as a first step towards a subsequent doctorate research work on our central bank. It is my intention to add to the already existing but scarce theoretical literature about this topic in our university libraries in order to facilitate the forthcoming generations with a concise reference intended to understanding mainstream central banking. Additionally,

from the construction of the theoretical contents of this investigation I will try to validate the following general and particulars hypothesis:

General Hypothesis.- Credibility and inflation targeting have fostered favorable and measurable economic conditions in both, developed/advanced and emerging countries.

Particular Hypothesis 1.- The rational agents hypothesis represents a coherence axiom for econometric modeling under inflation targeting if credibility helps to anchor expectations.

Particular Hypothesis 2. - A certain amount of discretion is necessary in central banking as long as credibility is not compromised.

"Do not walk along paths whose destinations are uncertain; but if you know that one leads to a worthwhile destination, do not stop for anyone or anything"
Pablo Machado

Introduction

In the world of economic thought it is not infrequent to come across a great number of opposed opinions. Nevertheless, in the last few years there has been a consensus amongst monetary authorities from different institutions, national and international alike, with regards to the pursuit of price stability as the main objective of monetary policy. It is believed that through credibility, the conduction of monetary policy produces the certainty needed for agents to engage in long term commitments pursuant to increase investment projects, trade and output levels in general with the corresponding betterment in the living conditions of the population. This can only be attained if the monetary authority, namely central bank, or any other pertinent government body, achieves credibility. One alternative has become increasingly popular amongst a growing number of central banks: inflation targeting.

In order to understand it, this investigation has been divided into three chapters as follows: *1)* Monetary credibility modeling, *2)* Inflation: main theories and targeting *3)* development and interactions between credibility and inflation targeting. The first one is a theoretical walk through the standard assumptions, concepts and tools such as the natural rate of unemployment, Taylor's curve, mathematical statistics and game theory amongst others with the intention of showing how they insert themselves within the assumption of rationality.

The second develops inflation targeting concepts and issues after having reviewed relevant theories about inflation and its conception: The quantity theory of money, the monetary approach to the balance of payments and the modern theory of inflation. The relevant theoretical contents are covered using the most pertinent countries. Finally, the third one expounds and discusses the interactions between monetary credibility and inflation targeting within the most recent debate (undisputedly the most advanced and

discussed) in the United States which still stands as the leading economic power in the world despite the relevance acquired by The People's Republic of China and Western European countries like Germany and France in the current economic context. All the contents are supported in essential specialized literature about today's monetary policy.

This research does not intend to introduce inflation targeting as the only means towards creating credibility, it endeavors to instill in the reader a more in-depth understanding of this regime within itself and not from an outsider's limited perspective. Even though there is no perfect or comprehensive enough model to explain the economy, this regime uses a sturdy mathematical arsenal to try and prove beyond the shadow of a reasonable doubt the interactions of the main variables that interact in the economy. It is worth to notice that although monetary policy in itself has produced many Nobel laureates such as Milton Friedman, Robert Lucas Jr, Finn Kyland, Edward Prescott, Thomas Sargent and John Nash amongst others, it is still far from perfection, which turns it into fertile soil for new investigations and debates.

Chapter I

Monetary credibility modeling

"Being aware of our own ignorance is a big step towards wisdom"
Benjamín Disraeli

Overview

Economics is a social science that has evolved enormously since the early writings of Adam Smith in 1776. Today mainstream economics uses precise mathematical tools to try and describe first and then explain the phenomena seen in the economy under a methodological approach in order to arrive at robust conclusions that explain beyond mere empirism the behavior of the variables involved in the complex dynamic system we call economy. Macroeconomic policy today is conducted by the monetary authorities of many countries and international institutions such as the International Monetary Fund or the World Bank, using an analytical arsenal pursuant to turning the decision-making process into a scientific one. This first chapter is a journey through the aforementioned tools and assumptions central bankers and economists use in their continuing efforts towards understanding the role of credibility in central banking under the assumption of rationality.

A. Early methodological innovations

1. Rational expectations

The rational expectations hypothesis stands as a major landmark for contemporary economic modeling. It can be traced back to the early sixties, firstly found in the works of Muth in 1961 and later in the early seventies by Lucas. It is applied as a way of dealing with the fact that economic agents behave in such a way that they incorporate all available information into an efficient decision-making process in an attempt to optimize their benefits or reduce their losses. It is a proper technique to help economic modeling into incorporating asymmetries of information, stickiness of prices, supply and demand shocks, and other important variables in a forward-looking fashion. The rational expectations assumption implies that agents try systematically to make the most of their decisions based on the information and constraints imposed by the decisions of the other agents and the set of rules everyone must abide in the economy. It is a coherence axiom for any model trying to predict the future in a world of uncertainty. It is worth mentioning that both, new

Keynesians and new Classics alike consider this hypothesis as a modeling technique suitable for a far-from-deterministic world such as ours.

The economy is always exposed to shocks of any nature, what makes every forecast error-prone. Under the rational expectations assumption it is believed that outcomes being forecast do not differ systematically from the market equilibrium values. In other words, people in average do not make systematic mistakes (people learn) when predicting the future, and deviations from perfect foresight are only random but ever present. This hypothesis says that the actual equilibrium price will only deviate from the expected price if there is a sudden shock of unforeseeable information after the moment expectations were formed. This hypothesis is important to central bank policy making because any anticipation of the effects of a change in policies will offset the desired result rendering the new policies weak or ineffective. The policy ineffectiveness proposition by Sargent and Wallace provide a good example for this[1]. Another example can be found in financial markets, when the price of a security or commodity does not display all the information in the market, there will be arbitrage opportunities – because agents are rational – that, will eventually, move the price towards its equilibrium value.

It is of paramount importance to mention that purely rational and optimizing agents live entirely within the model being used and not in the actual population of a country given the fact that every agent figures out the model applied by the authority in a different way and any attempt to replicate individually how they do it would be absurd. However, if the forecasting ability of the models using the rational expectations hypothesis replicates the actual outcome in the economy, it is said that in average, agents do not make systematic mistakes and learn, thus are rational. Many have rejected the use of this assumption as fairly unrealistic and absurd, for example, Paul Davidson, a respected post Keynesian economist argues that any attempt to predict the future (if agents are truly rational) must heed the fact that the outcome may be entirely different, giving the agents a sound reason to

[1] The afore mentioned proposition states that if a central bank attempts to lower the unemployment rate through an expansionary monetary policy, economic agents will anticipate the effects of the change of policy and raise their expectations of future inflation accordingly. Consequently, the expansionary effect of the increased money supply would be entirely offset leaving the government with a higher inflation rate and the same rate of employment.

hold at hand cash balances for unforeseen scenarios, which would interfere with the acquisition of a rational expectations equilibrium. An interesting standpoint!

Now, in a more formal and precise context, understanding the rational expectations hypothesis needs reviewing of some probability concepts. For this initial approximation to the concept, the use of probability density and conditional probability density distributions along with the expectations operator are in order. All economic examples make use of either random discrete or continuous variables that can take any of a given number of values, having each value a set probability of occurring. This vector of probabilities describes in a complete manner the information about the stochastic behavior of the random variable. Consequently the expected value of a discrete or continuous random variable is the traditional central tendency measure of a probability distribution

$$\textit{Expected value} = E(X) = \Sigma_{i=1}^{n} P_i X_i \quad \ldots\ldots(1)^2$$

$$\textit{Expected value} = E(X) = \int_a^b X f(X)\, dX \quad \ldots\ldots(2)^3$$

When the probability distribution is affected by a condition such as an unexpected item of information I_{t-1} in $t\text{-}1$ that redistributes the probabilities amongst the values of the variables, then the notation $f(X_t \mid I_{t-1})$ will represent the density of the conditional probability of the random variable X_t, given the information available in $t\text{-}1$. The conditional expectation is thus defined as

$$\textit{Conditional expectation} = E(X_t \mid I_{t-1}) = \int_a^b X_t f(X_t \mid I_{t-1})\, dX_t \quad \ldots\ldots(3)^4$$

This forecast or expectation always carries a prediction error ε_t which is defined as

[2] Sheffrin (1985).
[3] Ibídem.
[4] Ibídem.

Forecast error = $\varepsilon_t = X_t - E (X_t \mid I_{t-1})$……………….………..……….(4)[5]

which carries two important properties namely *1)* the conditional expectation of the forecast error is zero because in *t-1* the conditional expectation is known so the conditional expectation is the forecast or expectation.

$E (\varepsilon_t \mid I_{t-1}) = E (X_t \mid I_{t-1}) - E (X_t \mid I_{t-1}) = 0$……………………………..(5)[6] and

2) the errors must not be correlated with any available piece of information the agents might have in order to ensure that each subsequent forecast error be unpredictable

$E (\varepsilon_t I_{t-1} \mid I_{t-1}) = 0$…………………………………………………(6)[7]

This second property is known as orthogonality. What Muth's rational expectations hypothesis does, is to make equal two different concepts namely the subjective psychological expectations about the economic variables possessed by the agents and the mathematical conditional expectation of the same variables. In short, the subjective expectations are in average, the same as the true values of the variables. In mathematical language, if we call ${}_{t-1}X_t^{\varepsilon}$ the subjective psychological expectation of the variable X_t, Muth's hypothesis asserts that

subjective expectation = ${}_{t-1}X_t^{\varepsilon} = E (X_t \mid I_{t-1})$ = *conditional expectation*……(7)[8]

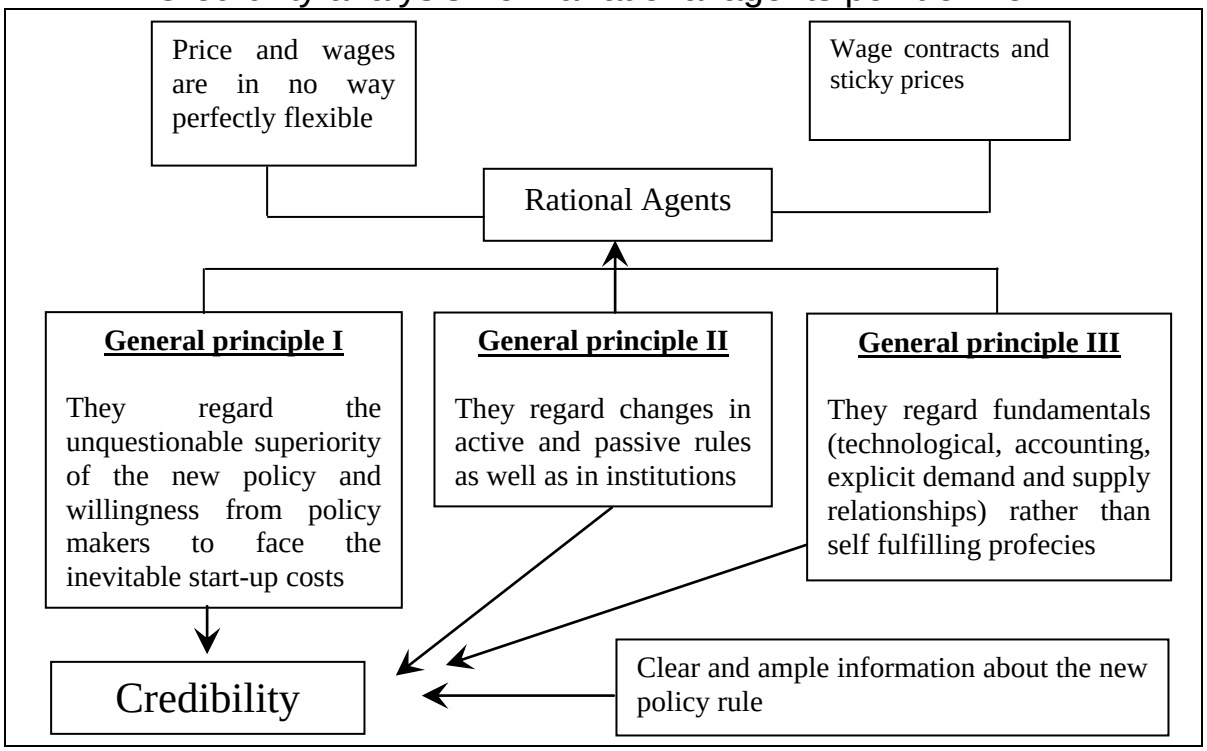
Therefore there is a relationship between the beliefs of the agents and the actual stochastic behavior of the system. This is the essence of the rational expectations

[5] Ibídem.
[6] Ibídem.
[7] Ibídem.
[8] Ibídem.

hypothesis. Furthermore, establishing credibility towards a change in monetary policy can be regarded from a rational expectations point of view (Taylor, 1982) which will reinforce the coherence of the analysis. The following illustration shows how.

Illustration1

Credibility analysis from a rational agents point of view



Source: Own elaboration with information from Taylor (1982).

2. Lucas critique

There is a consensus that current macroeconomic modeling cannot be regarded without bearing in mind this economist's contribution. It promotes the use of rational expectations and micro foundations in a world that is, to date, stochastic by definition. It represents to my understanding a major breakthrough in the evolution of economic modeling and to the way macroeconomics should be viewed. Before Lucas critique ("Econometric policy evaluation: A critique") in 1976, econometric models considered that the agents followed backward-looking expectations – adaptative expectations based in the past – instead of rational expectations – forward-looking and based on every available piece of information at the time expectations are formed.

He argued that decisions based on such backward-looking models could be misleading due to the fact that the coefficients in the model remained unchanged even in the face of known or evident upcoming changes in policies. Lucas believed that aggregating the rational behavior of representative agents in the economy was the best path to come to better macroeconomic decisions, therefore he always promoted the use of microeconomic foundations for macroeconomic analyses.

Lucas took on the task of demonstrating the inadequacy of such backward-looking framework through the widely used description of the economy in a time period t by a vector y_t of state variables, a vector X_t of exogeneous forcing variables, and a vector ε_t of independent (through time), identically distributed random shocks. Having said that, the motion of the economy is determined by a difference equation as follows

$$y_{t+1} = f\,(\,y_t,\, x_t,\, \varepsilon_t\,) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (i)$$ [9]

The function f is taken to be fixed but not directly known; the task of empiricists is then as Lucas asserts, to estimate f. For practical purposes, the estimation of the values of a fixed parameter vector θ is calculated with

$$f\,(\,y,\, x,\, \varepsilon\,) \equiv F\,(\,y,\, x,\, \theta,\, \varepsilon\,) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (ii)$$ [10]

and F being specified in advance. Formally speaking, the sequence $\{\, x_t \,\}$ of forcing vectors is regarded, Lucas said, as being "arbitrary" (not characterized stochastically). Since the past x_t values are observed, this causes no challenge in estimating θ and in fact simplifies somewhat the theoretical estimation problem. For forecasting, it is necessary to

[9] Lucas (1976).
[10] Ibídem.

insert forecast x_t values into F. Knowing the function F and θ, policy evaluation is, in Lucas' opinion, a straightforward matter. A policy is viewed as a specification of present and future values of some components of $\{ x_t \}$. These models have shown in the long-run, to have infinite variance, which leaves in Lucas' view, open the question of quantitative policy evaluation. In order to dismiss questions of the long-term behavior of the economy under alternative policies, policy-makers option was to focus instead on obtaining what is viewed as desirable behavior in the next few months.

Econometric Phillips curves roughly forecast the initial phase of the current inflation, but not the adverse shift in the curve to which that inflation led. One cannot meaningfully discuss optimal decisions under arbitrary sequences of $\{ x_t \}$ of future shocks. As an alternative characterization, then, let policies and other disturbances be regarded as stochastically distributed functions of the state of the system, or

$$X_t = G (y_t, \lambda, \eta_t) \quad \text{(iii)}$$[11]

where:

G is a known function,

λ is a fixed parameter vector, and

η_t a vector of disturbances.

Then the remainder of the economy follows this form:

$$y_{t+1} = F [y_t, x_t, \theta(\lambda), \varepsilon_t] \quad \text{(iv)}$$[12]

where the behavioral parameters θ vary systematically with the parameters λ governing policy and other shocks. The problem here is that of estimating the function

[11] Ibídem.
[12] Ibídem.

$\theta(\lambda)$. In a model of this sort, a policy is viewed as a change in the parameters λ, or in the function generating the values of policy variables at particular times.

A change in policy affects the behavior of the system in two ways:

- by altering the time series behavior of x_t; and,
- by leading to modification of the behavioral parameters $\theta(\lambda)$ governing the rest of the system.

It is clear that the way this latter modification can be expected to occur depends on the way the policy change is performed. If the policy change occurs by a sequence of decisions following no discussed or pre-announced pattern, it will become known to agents only gradually and maybe largely as higher variance or "noise". In this case, the movement to a new $\theta(\lambda)$ if it occurs in a stable way at all, will be unsystematic, and economically unpredictable according to Lucas. If, by contrast, policy changes occur as fully discussed and understood changes in **rules**, there is good reason to believe that the resulting structural changes can be forecast on the basis of estimation from past data of $\theta(\lambda)$.

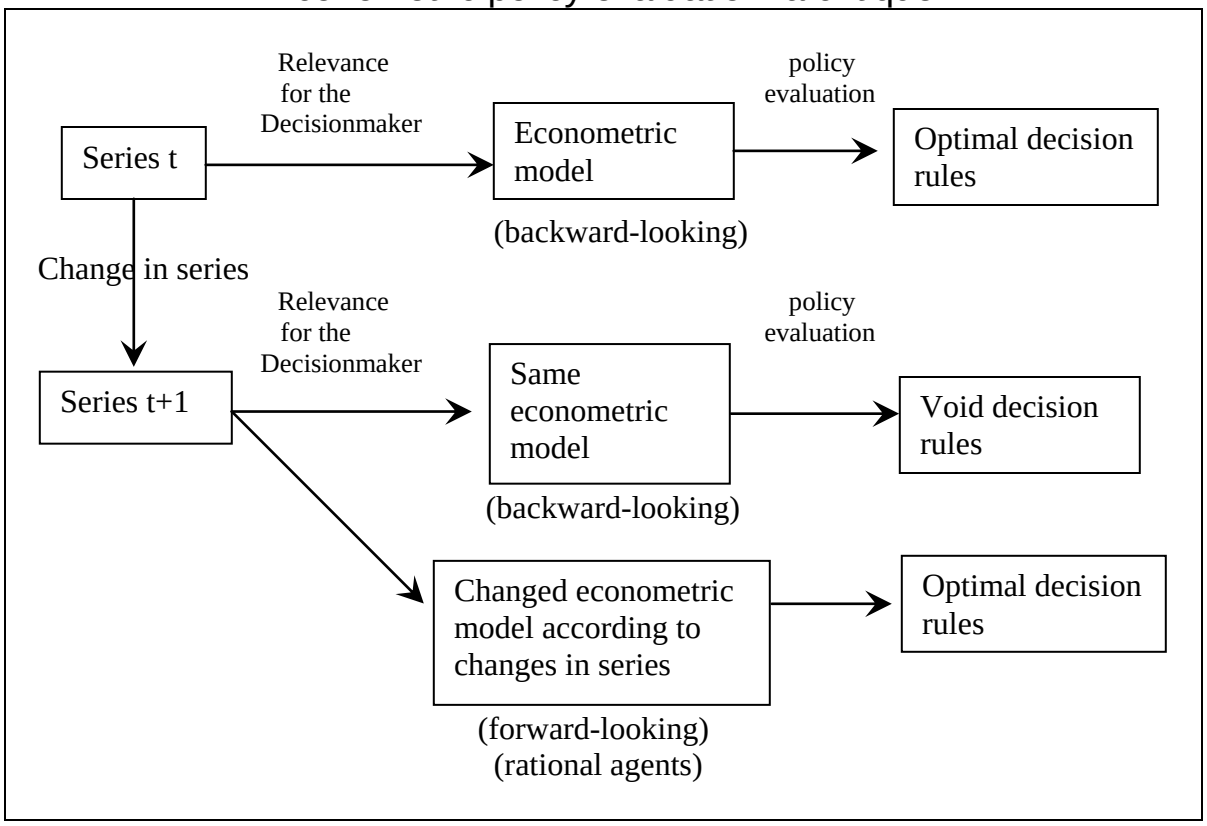
As can be seen, Lucas managed to put back again on stage the dynamic nature of economics after the Keynesian fad period, along with the rationality of expectations which were, as mentioned earlier, endogenous to the economy. Moreover, he states that expectations of future policy affect current decisions which arises the ongoing debate of rules *versus* discretion. These few lines taken from the concluding remarks in his document pretty much sum up his standing.

> "[G]iven that the structure of an econometric model consists of optimal decision rules of economic agents, and that optimal decision rules vary systematically with changes in the structure of series relevant to the decisionmaker, it follows that any change in policy will systematically alter the structure of econometric models."

Lucas emphasizes the fact that this may not be relevant in the short run but, that for policy evaluation turns out to be fundamental because it implies that comparing the effects of alternative policy rules under such backward-looking macroeconomic models is totally useless notwithstanding the good performance of such models over the sample period or *ex ante* short-term forecasting. The implications of this document for future mainstream economics was paramount for we have today far more sophisticated means to emulate the behavior of the economy and a solid base to erect even more realistic models for better policy evaluation. In Illustration 2 we can appreciate these conclusions.

Illustration 2

Econometric policy evaluation: a critique



Source: Own elaboration with information from Lucas (1976).

3. Dynamic inconsistency

Shortly after Lucas' critique contribution, a new point of interest came to light, namely the time inconsistency problem. As mentioned before, the economy is ever changing and adapting itself rationally to the ever changing conditions of a stochastic world. Consequently, time needed to be introduced as a new variable in economic modeling. Since the government plays its role as a rational agent in the economy, it will systematically try to optimize, in other words, the preferences of the decision makers will be different over time according to the ever changing conditions. When these preferences over time are inconsistent we are faced with a situation similar to a dynamic game.

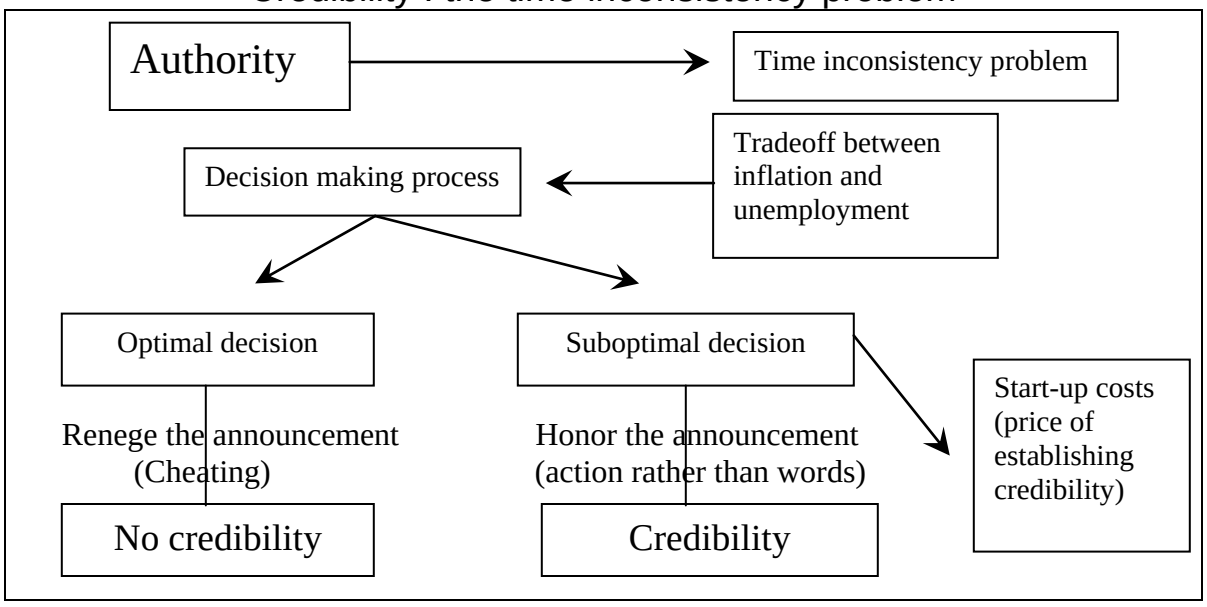
In game theory a dynamic inconsistency is a situation in a dynamic game where a player's best plan for some future period will not be optimal when that future period arrives, the inconsistency is primarily about commitment and credible threats. For example, a central bank that has been consistent in its policies might at some point feel tempted to renege its commitment and produce surprise inflation in order to boost output and reduce unemployment. Nevertheless, the assumption of rationality will not allow it to repeatedly cheat on the public since the agents will learn and anticipate such actions in the future, which makes credibility construction difficult. Monetary policy resembles a dynamic game where every agent makes a decision based on the rules and on the reactions and plans of the other agents.

Kydland and Prescott analyzed in their paper of 1977 "rules rather than discretion" the implications of following rules or discretion under the assumption of rational expectations in an attempt to expose the benefits and setbacks of each concept. This analysis is intimately related to the time inconsistency problem which after this paper was renamed as *dynamic inconsistency*. This dynamic inconsistency could be understood as the temptation the monetary authority feels not to follow the policy everyone knows it does and deceive the agents after the expectations have been formed in order to optimize other objectives it may have. The concept of consistency can be defined in terms of policy rules that must be available to the public and ideally easy to understand.

Consequently, discretionary policy, results in a breach of consistency pursuant to optimizing random short term opportunities. Paradoxically, if agents are rational any constant discretionary behavior will result in suboptimal planning or economic instability because the agents will be faced with uncertainty instead of clear rules which shed light ahead of the actions to be taken by the government. For the sake of their benefit, they will try to anticipate any move by the authority resulting in a chaotic series of decisions that will make central banking close to impossible. On the other hand, the use of rules provides the agents with a set of guidelines they incorporate into their expectations, which makes the future expectations easier to anticipate. This creates an atmosphere of certainty that fosters credibility in the actions of the authority and makes central banking objectives easier to achieve. If agents were not rational, discretionary actions would be optimal and future expectations would be absurd and pointless. John B. Taylor considers that once the time inconsistency problem is overcome by the authorities, it fosters credibility as shown in the following illustration.

Illustration 3

Credibility : the time inconsistency problem



Source: Own elaboration with information from Taylor (1982).

B. Some technical tools

4. Phase diagrams

These diagrams are frequently used and found in physics and engineering to show the various regions of stability existing in different kinds of systems. As examples I can mention the thermodynamic phases of a chemical system consisting of pressure, temperature, and composition or the phases of the radiation emissions of a device running on radioactive elements such as plutonium or cobalt.

In mathematics, a more proper name for phase diagrams is a **phase space** and was introduced in 1901 by Willard Gibbs[13]. This phase space is a geometrical representation that shows each possible state of a system corresponding to one unique point in time. The evolution over time of the system's state is given by the representations of every possible state of the system (combination of values of the system's parameters), in a multidimensional space.

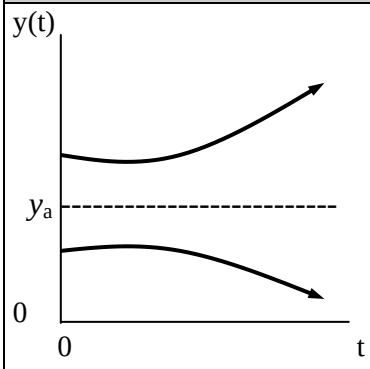
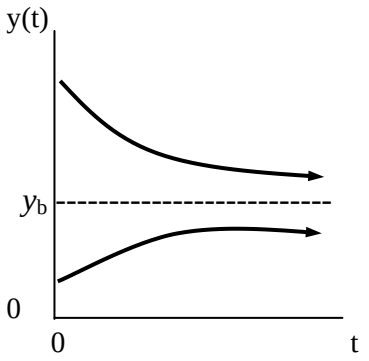
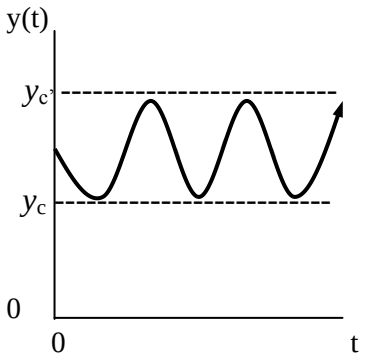
This representation is often referred to as a phase diagram. Formally speaking it is a qualitative analysis tool employed whenever the time trajectory is one of the main concerns. Given a first order differential equation in the general form $dy / dt = f (y)$ linear in the *y* variable or not, we can graph dy / dt against *y* in a phase diagram. This shows the qualities of the system through the shape or more properly "phase portraits" produced by the behavior of the system over time.

There are three main time trajectories namely unstable, stable and cyclical. See Illustration 4. These geometrical representations consider time as a continuous variable for which, as noted earlier, differential equations are in order.

[13] Physics professor at Yale University who lived at the end of the nineteenth century. He developed mathematical techniques for predicting the outcome of chemical reactions.

Illustration 4

Phase diagrams: continuous time trajectories

Unstable	Stable	Cyclical
		
The equilibrium is at point y_a. However, above and under this point the spearheads describe a wider gap away from equilibrium as time passes.	The equilibrium point y_b is a stable one since the spearheads converge towards this point as time passes.	This illustration shows a time trajectory that fluctuates indefinitely over time in a cyclical way.

Source: Adapted from Chiang (2006).

On the other hand, when time is considered as a discrete variable, difference equations come out as the alternative from which phase diagrams can also be traced. Formally speaking, the difference non-linear equations in which only the variables y_{t+1} and y_t appear can be represented through the equation

$$y_{t+1} = f(y_t) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (8)^{14}$$

where:

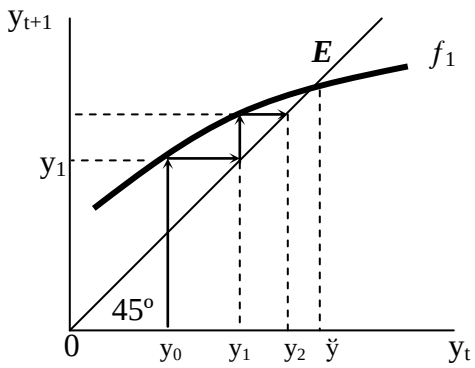
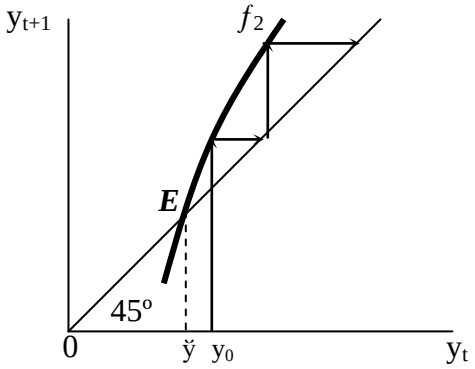
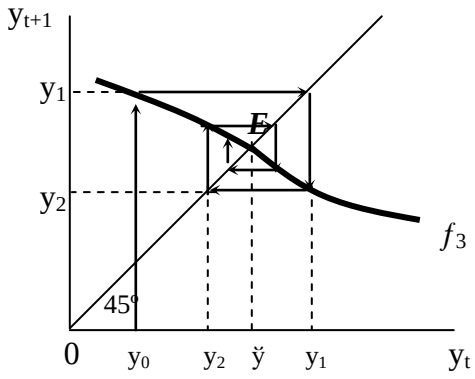
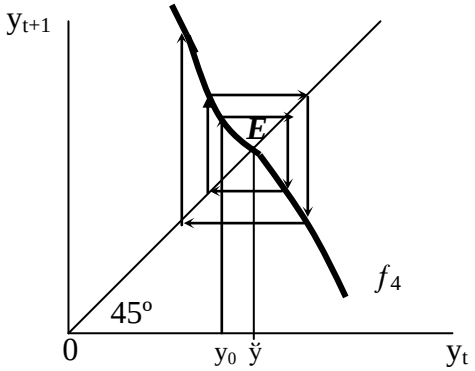
f can be a – any degree of complexity – function as long as is a function of y_t only without t as an argument.

[14] Chiang (2006).

The 2D graphic representation of the two variables y_{t+1} and y_t is also a phase diagram that allows a time trajectory analysis under the iteration process. See Illustration 5A.

Illustration 5A

Phase diagrams: discrete sample time trajectories

Variation 1	**Variation 2**
	
These phase lines f_1 and f_2 have positive slopes being $0 < f_1'(y_t) < 1$ and $f_2'(y_t) > 1$. The equilibrium is the intersection between the phase line and the 45º line since in that point $y_{t+1} = y_t$ which implies that y is at an intertemporal equilibrium. These illustrations show whether the change pattern of the phase line will drive us consistently from an initial value $y_0 \neq \breve{y}$ towards $\breve{y}$ (convergent) or away from it (divergent).	
Variation 3	**Variation 4**
	
These phase lines f_3 and f_4 have negative slopes being $-1 < f_3'(y_t) < 0$ and $f_4'(y_t) < -1$. The equilibrium is the intersection between the phase line and the 45º line since in that point $y_{t+1} = y_t$ which implies that y is at an intertemporal equilibrium. These illustrations show whether the change pattern of the phase line will drive us consistently from an initial value $y_0 \neq \breve{y}$ towards $\breve{y}$ (convergent) or away from it (divergent).	

Source: Adapted from Chiang (2006).

In economics this kind of geometric representation is very attractive because it allows the simulation of macroeconomic models in a dynamic fashion which enables the decision makers and economists to come to agree on better policies than the ones that would seem feasible under the far more limited static modeling approach[15].

The relevance of this particular tool in economics resides in its special dynamic feature to sketch the functioning of the system as time passes. In order to be able to determine the conditions under which the system shows a tendency towards an equilibrium, equilibria, chaotic behavior or divergence, the parameters of the system must be evaluated under achievable and reasonable assumptions such as rational agents, to ensure that the decision making process becomes more solid.

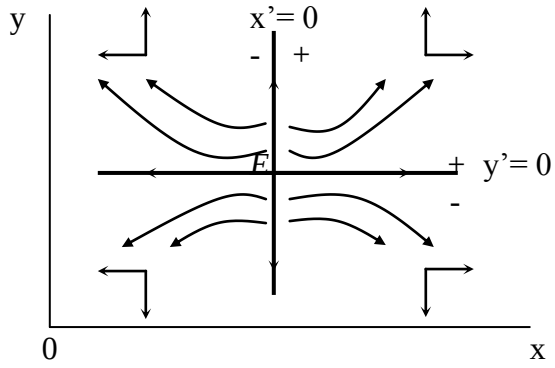
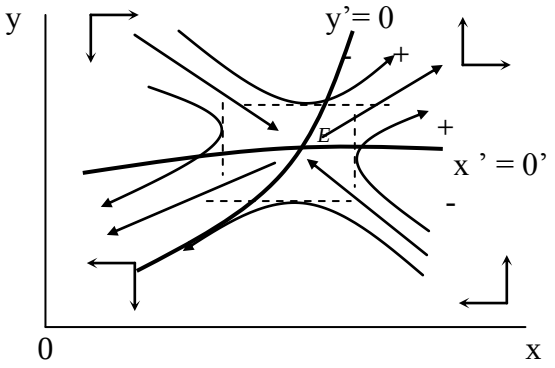
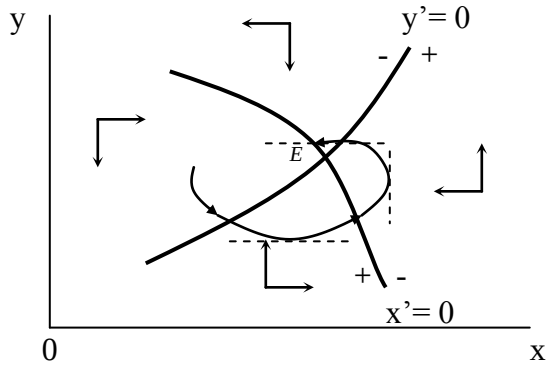
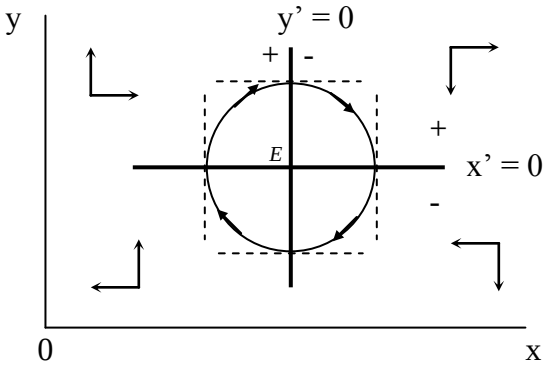
There can be four categories of equilibria namely nodes, saddle points, focuses and vortexes. A node is a kind of equilibrium in which all the lines flow in a non-cyclical fashion towards it (stable node) or flow likewise away from it (unstable node). A saddle point is stable in some directions but unstable in others; the focus features spinning trajectories towards it or away from it while the vortex is a kind of equilibrium where the lines draw circles or ellipses that depict an orbit around the equilibrium in a never-ending manner. See Illustration 5B.

It is widely accepted that there are very many variables to be considered in a system and consequently very many things that could go astray and affect our system, therefore the adoption of this tool into macroeconomics allows to change the parameters as needed to assess the ever changing conditions of the economy.

[15] A dynamical system has two parts: the notions of a state (the essential information about the system) and a dynamic (a rule that describes how the state evolves with time). A static model is deprived of the evolution of the parameters with time which could result in misconceptions of the behavior of the variables involved.

Illustration 5B

Phase diagrams: types of equilibria

Node	Saddle point
	
This is an unstable node as the phase lines flow away from the equilibrium.	This is a saddle point with two lines pointing towards the equilibrium namely stable branches and two pointing away from it namely unstable branches. All trajectories point initially towards the saddle point but eventually deviate.
Focus	**Vortex**
	
This equilibrium features lines that describe a spinning trajectory that flows cyclically towards the focus (stable focus) or away from it (unstable focus).	This equilibrium features concentric or oval trajectories around the equilibrium in an ever-ending motion. A vortex is automatically classified as an unstable equilibrium.

Source: Adapted from Chiang (2006).

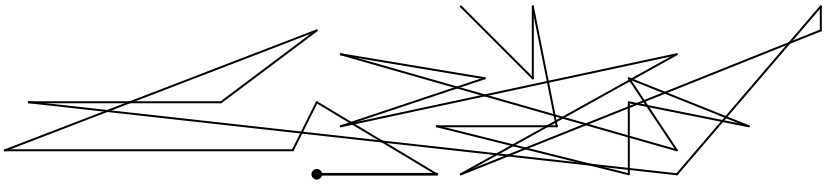
5. Probabilistic techniques

This topic alone provides enough material to write a whole investigation paper and I will only outline what I consider necessary for the theme of this document. Basic probabilistic techniques cannot do much when it comes to modeling economic dynamic systems due to the fact that they lack the inclusion of uncertainty and time as two of the main components reigning over any other variable involved. Economics has profited from the breakthroughs and tools used by physics such as stochastic calculus to model dynamic economic systems.

This particular branch of mathematics deals with systems that behave randomly, namely stochastic processes. For instance, in physics the random scattering of particles subject to random forces on a fluid medium is known as Brownian motion – see Illustration 6 – and is forecast or modeled through the Wiener process. The stock markets and its participants have embraced this tool to try to predict the behavior of stock prices in time under certain initial conditions.

Illustration 6

Stochastic processes: Brownian motion of a speck of polen



As this illustration shows the speck of polen follows a random walk that depends on the initial conditions of temperature and pressure of the tiny molecules of liquid that determine the changing kinetic energy forces each tiny particule exerts on the speck in different directions.

Source: own elaboration for illustration purposes.

For the purposes of this investigation I will depart from this last concept in order to provide an intuitive idea of how economic behavior is modeled. If we stop for a minute and ponder about how certain random experiments behave, it will be easier to understand why these tools are important. Think for example of a game that consists of throwing two dice and adding up the dots, the player whose guess matches the actual outcome wins. What number would you pick? If we make a list of the possible results it is plain to see that

number seven enjoys a larger probability of occurring than any of the other numbers involved. All the possible results that can originate from this game are known as the sample space and represent the collection of outcomes that a certain event may have. See Illustration 7 for the above mentioned game.

Illustration 7

Probability: Sample space. An illustration

Numbers involved	Combinations	Probability of occurrence
2	(1 , 1)	1/36
3	(1 , 2) (2 , 1)	2/36
4	(1 , 3) (3 , 1) (2 , 2)	3/36
5	(1 , 4) (4 , 1) (2 , 3) (3 , 2)	4/36
6	(1 , 5) (5 , 1) (2 , 4) (4 , 2) (3 , 3)	5/36
7	(1 , 6) (6 , 1) (2 , 5) (5 , 2) (3 , 4) (4 , 3)	6/36
8	(2 , 6) (6 , 2) (3 , 5) (5 , 3) (4 , 4)	5/36
9	(3 , 6) (6 , 3) (4 , 5) (5 , 4)	4/36
10	(4 , 6) (6 , 4) (5 , 5)	3/36
11	(5 , 6) (6 , 5)	2/36
12	(6 , 6)	1/36
Total:	36 possible results	36/36

Source: Own elaboration for illustration purposes

The best bet anyone can make is go for number seven since it is expected to occur 16.66% (6/36) anytime the dice are thrown or almost 17 times out of a 100. Any other number will carry less attractive probabilities and the possible results are limited to 36. If all players knew this, none would be likely to bet at a different number. When all the probabilities of occurrence are added up we come to 36 / 36 = 1 or 100% which can be interpreted as having complete certainty that any time the dice are thrown one of the 36 results will occur. This simple example takes us to other important concept, namely probability distribution. A probability distribution is the mathematical expression (formula if you will) that allows us to calculate the different probabilities without having to do the whole chart. More formally, If ***x*** is a random discrete variable, the function given by $f(x)$

$= P(\boldsymbol{x} = x)$ for each x contained in the interval of $\boldsymbol{x}$ is named probability function or probability distribution of $\boldsymbol{x}$.

A function can work as a probability distribution of a random discrete variable x if and only if its values, $f (x)$, comply with the conditions

$\boldsymbol{f (x) \geq 0}$ for each value in its dominion;

$\sum_{\boldsymbol{x}} \boldsymbol{f(x) = 1}$, where the sum extends along all the values contained in its dominion.

The example above complies with these two conditions and a probability distribution could be engineered as follows:

$$\boldsymbol{f (x) = [6 - | x - 7 |] / 36}$$

When we work with random variables that are continuous, the probability distribution is renamed as density function and the conditions change to reflect these conditions as follows

$\boldsymbol{f (x) \geq 0}$ for $-\infty < x < \infty$;

$\int_{-\infty}^{\infty} \boldsymbol{f (x) \, dx = 1}$, where the sum extends along all the values contained in its dominion.

There are many ways to sorting out the different types of distributions which take us one step further. See Illustration 8. There are multi-variable distributions which use the variable for different purposes. Consider a sample of enterprises from a certain industrial branch. They might have been chosen for different purposes being some of them the revenue level, technology used, number of employees, productivity levels, and so on. All

these random variables can be named x, y, z, etc. and studied in a joint probability distribution. More formally, the bi-variable case can be expressed as follows:

If x and y are discrete random variables, the function given by $\boldsymbol{f(x, y) = P(x = x, y = y)}$ for each pair of values (x, y) contained in the range of $\boldsymbol{x}$ and $\boldsymbol{y}$ is named joint probability function of $\boldsymbol{x}$ and $\boldsymbol{y}$. One of these functions can work as a joint probability distribution if the values, $\boldsymbol{f(x, y)}$ comply with

$\boldsymbol{f(x, y) \geq 0}$ for each pair of values (x, y) contained in its dominion;

$\sum_x \sum_y \boldsymbol{f(x, y) = 1}$ where the double sum extends along all the possible pairs of values (x, y) contained in its dominion.

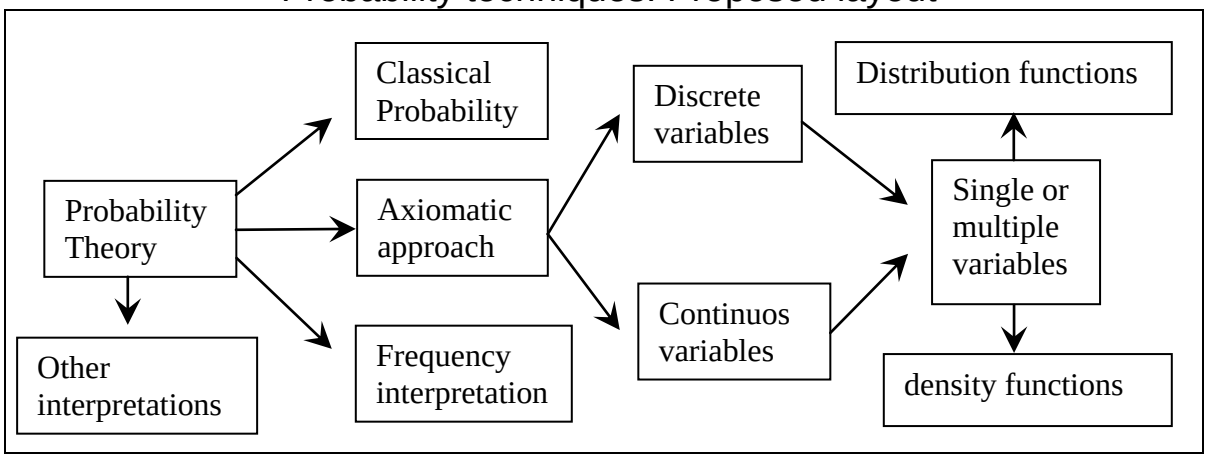
Likewise comes up the issue of working with continuous variables in which case the conditions are

$\boldsymbol{f(x) \geq 0}$ for $-\infty < x < \infty$, $-\infty < y < \infty$;

$\int_{-\infty}^{\infty} \int_{-\infty}^{\infty} \boldsymbol{f(x,y)\, dx\, dy = 1}$.

Illustration 8

Probability techniques: Proposed layout



Source: Own elaboration for illustration purposes

To complete this section the introduction of mathematical expectation is in order. This concept originated from random games and is the product of the amount expected to be won and the probability of winning. Think of a game in which the objective is to find a red marble in order to win 100 euros. There are a hundred cups sitting up-side-down on a table but only one is hiding the red marble. If we choose one of those hundred cups we have 1/100 probability of success and if multiplied by the prize results in a mathematical expectation of (1/100)100 = 1. This last value can be regarded as the average payoff of a single cup and if the game is carried out many times we could infer that we would lose 99% of the time. The following illustration shows how.

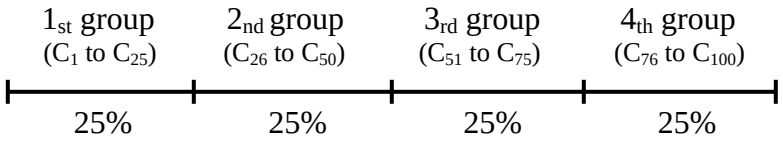
Illustration 9

Probability: Mathematical expectation

Cup	Probability	Prize	Mathematical expectation
C_1	1/100 = .01	100	1
C_2	1/100 = .01	100	1
C_3	1/100 = .01	100	1
C_4 to C_{99}	1/100 = .01	100	96
C_{100}	1/100 = .01	100	1
Total	100/100 = 1		100

Source: Own elaboration for illustration purposes.

If we could choose more than one cup, our expectations of finding the red marble increase. For instance, if we could pick 25 our expectations raise to losing 75% of the time and if we could pick 50, we would only lose 50% of the time. The amount expected to be won in this example (100 euros) is our random variable and the expected value of being under a certain cup is 0.001. Thus if we divide the hundred cups in 4 groups of 25 cups each as shown bellow, the expectation of finding our random variable in each group amounts to 25%.



The importance of these tools in economics resides in the fact that many variables that are random are assumed to behave in a certain density function whose expected value falls near the expected mean of the function. To complement this explanation it is necessary to introduce some concepts formally. If ***x*** is a discrete random variable and *f(x)* is the value of its probability distribution in *x*, the expected value of this random variable is

$$E(\mathbf{x}) = \sum_x x\, f(x) \qquad \text{.....(9)}^{16}$$

In the case of a continuous random variable the expected value is given by

$$E(\mathbf{x}) = \int_{-\infty}^{\infty} x\, f(x)\, dx \qquad \text{.....(10)}^{17}$$

However in economics as well as in other sciences, it is of interest not only the expected value of a single variable but the expected values of other variables related to the first. In this case when two discrete variables (*x* and *y*) are related through the equation *y* =

[16] Freund (1990).
[17] Ibídem.

g(x) being *f(x)* the probability function value in *x*, then the expected value of the random variable *g(x)* is determined by

$$E [g (\mathbf{x})] = \sum_x g (x) f (x) \text{.....(11)}^{18}$$

In the case of a continuous random variable the expected value is given by

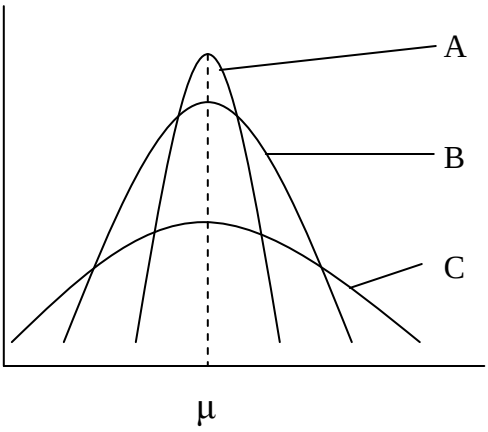
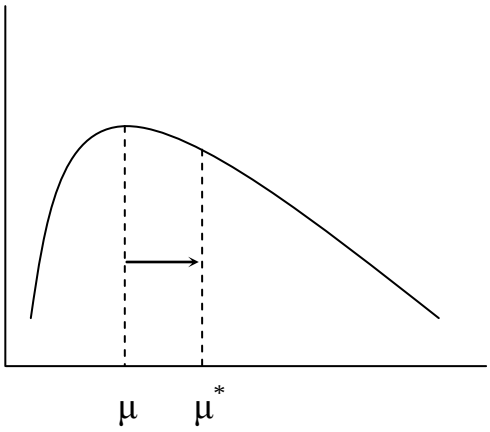
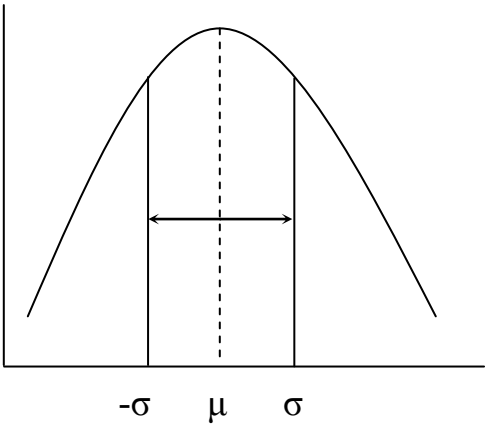
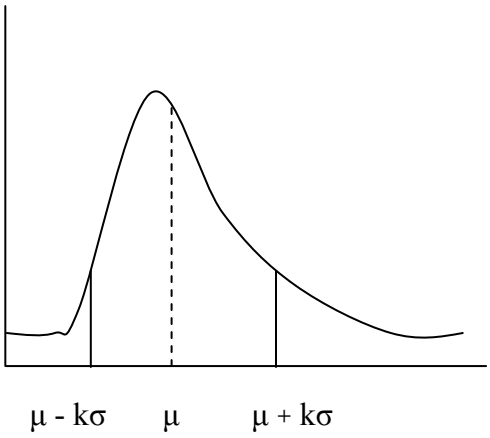
$$E [g (\mathbf{x})] = \int_{-\infty}^{\infty} g (x) f (x) dx \text{.....(12)}^{19}$$

There are in mathematical statistics three moments that provide us with information about the shape (thin, fat, flat symmetric or skewed) of the distribution or density functions namely first, second and third moments, which are commonly referred to as mean, variance and standard deviation. The first moment is a measure of central tendency or a figure that indicates how close the elements are gathered around the mean while the other two indicate how disperse the elements are and are known as dispersion parameters in consequence. See Illustration 10.

[18] Ibídem
[19] Ibídem.

Illustration 10

Mathematical Statistics: Moments and the Chebyshev theorem

Mean	**Variance**
	
This graph shows the position of the mean in three different symmetric probability distributions. *A* is known as leptokurtic, *B* as mesokurtic and *C* as platikurtic. Kurtosis is the degree of flatness shown by a probability distribution.	As opposed to the illustration on the left where the values gather around the mean, this distribution is skewed to the left which moves the mean from the top of the crest to the right showing the dispersion of values to the right due to variations in the values with respect to the mean.
Standard deviation	**Chebyshev theorem**
	
The standard deviation indicates the degree of disperssion (is denoted with the lower case sigma σ) of the values with respect to the mean. The larger the standard deviation, the more dispersion shown by the values.	This theorem, as explained in the main text, provides certainty about the possible location of the value of the random variable. In this sense, the standard deviation controls the dispersion of the distribution of a random variable.

Source: Own elaboration for illustration purposes.

The Chebyshev theorem as depicted above, demonstrates how important these parameters are in order to determine the probability of finding the random variable within the distribution or density functions. This theorem says that the probability of *x* having a value contained in two standard deviations from the mean is **at least** 3 / 4 and **at least** 8 / 9 in three standard deviations from the mean and **at least** 24 / 25 in five standard deviations from the same point.

This theorem provides a lower limit to the probabilities and help to provide useful information as previously noted. Another important concept is the conditional expectations of a variable given the event of other occurring. Formally speaking, if $\boldsymbol{x}$ is a discrete random variable and $f(x \mid y)$ is the value of the conditional probability distribution of $\boldsymbol{x}$ given $\boldsymbol{y} = y$ in *x*, the conditional expectation of $u(\boldsymbol{x})$ given $\boldsymbol{y} = y$ is

$$E [u (\mathbf{x}) \mid y] = \sum_x u (x) f (x \mid y) \quad \text{.....(13)}^{20}$$

In the case of a continuous random variable the conditional expected value is given by

$$E [u (\mathbf{x}) \mid y] = \int_{-\infty}^{\infty} u (x) f (x \mid y) \, dx \quad \text{.....(14)}^{21}$$

These solid and robust tools reinforce the criteria to choosing the more rational option when it comes to deciding over the possible values of different economic random variables way beyond the apparent evidence.

[20] Ibídem.
[21] Ibídem.

6. Non-cooperative games and Nash Equilibrium

Game theory was originally developed by John Von Neuman and Oskar Morgenstern in the early 1940s as a means to analyze competitive situations where there are conflicts of interests. There are two types of games namely cooperative and non-cooperative. As the name suggests the former describes a situation where two or more players interact with one another to maximize profits or minimize losses in an efficient way. In other words, they all communicate and abide by their commitments and work together towards the achievement of a common goal.

Here the conflict of interests amongst the players is irrelevant and the result comes out as being optimal. In non-cooperative games however, the players strive to get the most of their individual decisions for their own benefit in view of the decisions taken by the other participants. The players may not abide by what they say they will do, which puts uncertainty as an important element in this type of game. This last version is the one that suits dynamic economic modeling since all economic agents are considered rational and prone to changing their minds – strategies – according to the rules they must abide and the courses of action followed by the other agents.

Nowadays the economy is considered as a dynamic system working within a space of regulations imposed by governments and contracts and as a result, the agents are faced with the problem of optimizing their decisions in a multi dimensional space of rules. From here, it is plain to see that there are three basic elements in any game, namely the players, the list of strategies from which they can choose and finally, the results of the different combinations of strategies. In some games, the players have a dominant strategy – a strategy that pays off more, regardless of the strategies chosen by the other players – and in others not, nevertheless, when an equilibrium is reached under the strategies chosen by the players and each having the best pay off they can get, given the choices made, a Nash[22] Equilibrium has been produced.

[22] John Nash, born in 1928, was awarded The 1994 Nobel Prize in Economics for his contributions to Game Theory along with John Harsanyi and Reinhard Selten.

Consequently, a Nash Equilibrium can be defined as the combination of strategies or collection of decisions followed by the players – strategic game – that produce the best payoff for everyone so no player would like to change the result, holding all other decisions constant (because a player can only change his or her behavior). A very wide range of situations may be modeled as strategic games, for instance, the players may be firms, the action prices and the preferences a reflection of the firm´s profits. Or the players may be the candidates for political office, the actions campaign expenditures, and the preferences a reflection of the candidate´s probabilities of winning. Or the players may be animals fighting over some prey, the action concession times and the preferences a reflection of whether an animal wins or loses. Some other classical examples of Nash Equilibria are:

1. Coordination game: it is a Nash Equilibrium to all drive on the left side of roads, or all drive on right side of roads.
2. Prisoner's dilemma: it is a Nash Equilibrium to not cooperate in prisoner's dilemma.

For purposes of this investigation, the players may be everyone – firms, individuals and the government institutions – the action prices and rates of interest, and the preferences a reflection of profits, purchasing power and inflation level respectively. One way to find a Nash Equilibrium in a game is to examine each possible outcome of a game and compare payoffs. If a player could get a higher payoff *ceteris paribus*, then that strategy is not a Nash Equilibrium. The importance of this concept lies in the fact that it can be a logical useful solution concept for the analysis of incentives in any social institution, central banks and ministries of finance in what pertains to this work. As can be seen, with this relatively recent game-theoretic methodology, the scope of applied economic analysis performed worldwide by central banks, gradually broadened into redefining economics as being the study of rational competitive behavior in any institution of society.

A number of equilibria may exist given the endless sets of circumstances the economy may be faced with. This fact raises the problem of singling out within the collection of possible equilibria, the “best” selection under certain precise criteria. John Harsanyi and Reinhard Selten worked on this particular issue and were awarded along with

John Nash the 1994 Nobel Prize in Economics. In order to single out said equilibria, there are many approaches but I shall expose two which connect to the rational agents hypothesis: *a)* the risk associated to strategy selection under the knowledge they have about things that may occur and the personality and preferences of others and, *b)* the behavior of regular individuals featuring limited rationality and knowledge but whose experience may help for the correction of strategies pursuant to improving the pay off but making mistakes in such corrections. This second approach being more recent, studies whether these corrections lead to Nash equilibria or not and which ones would be selected[23].

In order to understand the first approach, consider the following example: A central bank (first player) has three options *a)* raise the inflation rate, *b)* keep the current inflation rate unchanged and, *c)* lower the inflation rate. The public (second player) can either believe the announcement or not. The payments for the six different options in the game are shown in the following box

Illustration 11

Game theory : an example

Central Bank	Believe	Don't believe
Raise	(0,0)	**(5,-2)**
Keep	**(2,2)**	(-2,0)
Lower	(2,2)	(-2,0)

Source: Own elaboration for illustration purposes.

If the public believes that the central bank will raise inflation, they will anticipate this move and offset the effect before it actually happens leaving the economy at the same employment level but with a higher rate of inflation. The opportunity to reduce unemployment vanishes and the payoffs are zero for both parties. On the other hand, if the public are fooled (don't believe) and the central bank engineers surprise inflation, the payoff for the government is positive and the public are left with a loss. The next scenario

[23] This approach was heavily studied and developed in the eighties by many other scholars such as Maynard Smith in an attempt to improve the concept of a Nash Equilibrium in non-cooperative games.

is fairly different. As you can see, if the central bank decides to keep inflation at the current level and the public believe it, there will be a positive payoff for the central bank but also for the public, which incidentally helps the construction of credibility.

When in this same scenario the public don't believe the central bank, the payoff for the authority will be negative as consequence of lack of credibility. The last row depicts a negative outcome for the central bank when the public don't believe it will lower the inflation rate. I hope that with this simple example it is clear how credibility affects the decision from the public. The central bank has two special strategies highlighted from which a positive payoff is obtained. What motivation could the central bank have to choose the less attractive payoff? The answer is simple, the central bank is motivated to choose the less attractive payoff because it seeks the construction of credibility for which renounces to the bigger short run payoff.

Even though there is dominance of the (5 , -2) strategy over the (2 , 2), the long run benefits obtained from credibility outruns the dominance and renders the first strategy incredible. As the box shows there can be many Nash Equilibria in a game, nevertheless the best course of action may end up being one, two, many or something else depending on the selection criteria under which we are working.

Formally speaking, a Nash Equilibrium exists in any finite game[24] with at least one optimal solution because as explained earlier, it is a vector of strategies (pure or mixed), one per player, such that no one can improve his or her own payoff by unilaterally changing strategies. For an N player game $G = (N, A = X^{N}_{i=1} A_{i,} u : A \rightarrow R^{N})$, a Nash Equilibrium is $\sigma \in \Delta = \Delta_1 X...X \Delta_N$, such that, $u_i (\sigma) \geq u_i (\sigma_i', \sigma_{-i})$ for all $\sigma \in \Delta, \sigma_i' \in \Delta_i$ Note that it is equivalent to the following definition: $u_i (\sigma) \geq u_i (a_i', \sigma_{-i})$ for all $\sigma \in \Delta, a_i' \in A_i$

[24] A game is finite if it has a finite number of players and each player has a finite number of actions.

In order to prove the existence of Nash Equilibrium, I shall first begin with the theorem he proposed in 1950.

Theorem. (Nash, 1950)Let G be a finite game. Then there exists a mixed strategy Nash Equilibrium for G.

The proof uses Brouwer's Fixed Point Theorem which states the following.

Theorem. (Brouwer, 1909) Let *B* be a closed and bounded, convex set. ***If f : B → B*** is a continuous map, then there must exist $X \in B$ such that ***f* (X) = X.**

I will proceed to the proof of the existence theorem. For every player *i*, let the set of actions A_i be $\{a_{i1},...,a_{im}\}$. For $1 \leq i \leq n,\ 1 \leq j \leq m,\ \sigma \in \Delta$, define $g_{ij}(\sigma)$ to be the gain for player *i* from switching to the deterministic action a_{ij}, when σ is the joint strategy (if this switch is profitable). So we have, $g_{ij}(\sigma) = max\{ u_i(a_{ij},\sigma_{-i}) - u_i(\sigma), 0 \}$. It is possible now to define a map between mixed strategies

$y: \Delta(A) \rightarrow \Delta(A)$ by

$$y_{ij}(\sigma) = \frac{\sigma_{ij} + g_{ij}(\sigma)}{1 + \sum_{j=1}^{m} g_{ij}(\sigma)}$$

There are two observations about this mapping:

1. For every player *i* and action a_{ij}, the mapping $g_{ij}(\sigma)$ is continuous with respect to σ. This is due to the fact that $u_i(\sigma)$ is obviously continuous, making $g_{ij}(\sigma)$ and consequently $y_{ij}(\sigma)$ continuous.
2. For every player i, the vector $(y_{ij}(\sigma))_{j=1}^{m}$ is a distribution, it is in $\Delta(A_i)$. This is due to the fact that the denominator of $y_{ij}(\sigma)$ is a normalization constant for any given *i*.

Therefore y fulfills the conditions of Brouwer's Fixed Point Theorem. Using the theorem, we conclude that there is a fixed point σ for y. This point satisfies

$$\sigma_{ij} = \frac{\sigma_{ij} + g_{ij}(\sigma)}{1 + \sum_{j=1}^{m} g_{ij}(\sigma)}$$

Notice that this is possible only in one of two cases. Either $g_{ij}(\sigma) = 0$ for every i and j, in which case we have an equilibrium (since no one can profit from their strategy). If this is not the case, then there is a player i such that $g_{ij}(\sigma) > 0$. This would imply,

$$\sigma_{ij}\left(1 + \sum_{j=1}^{m} g_{ij}(\sigma)\right) = \sigma_{ij} + g_{ij}(\sigma)$$

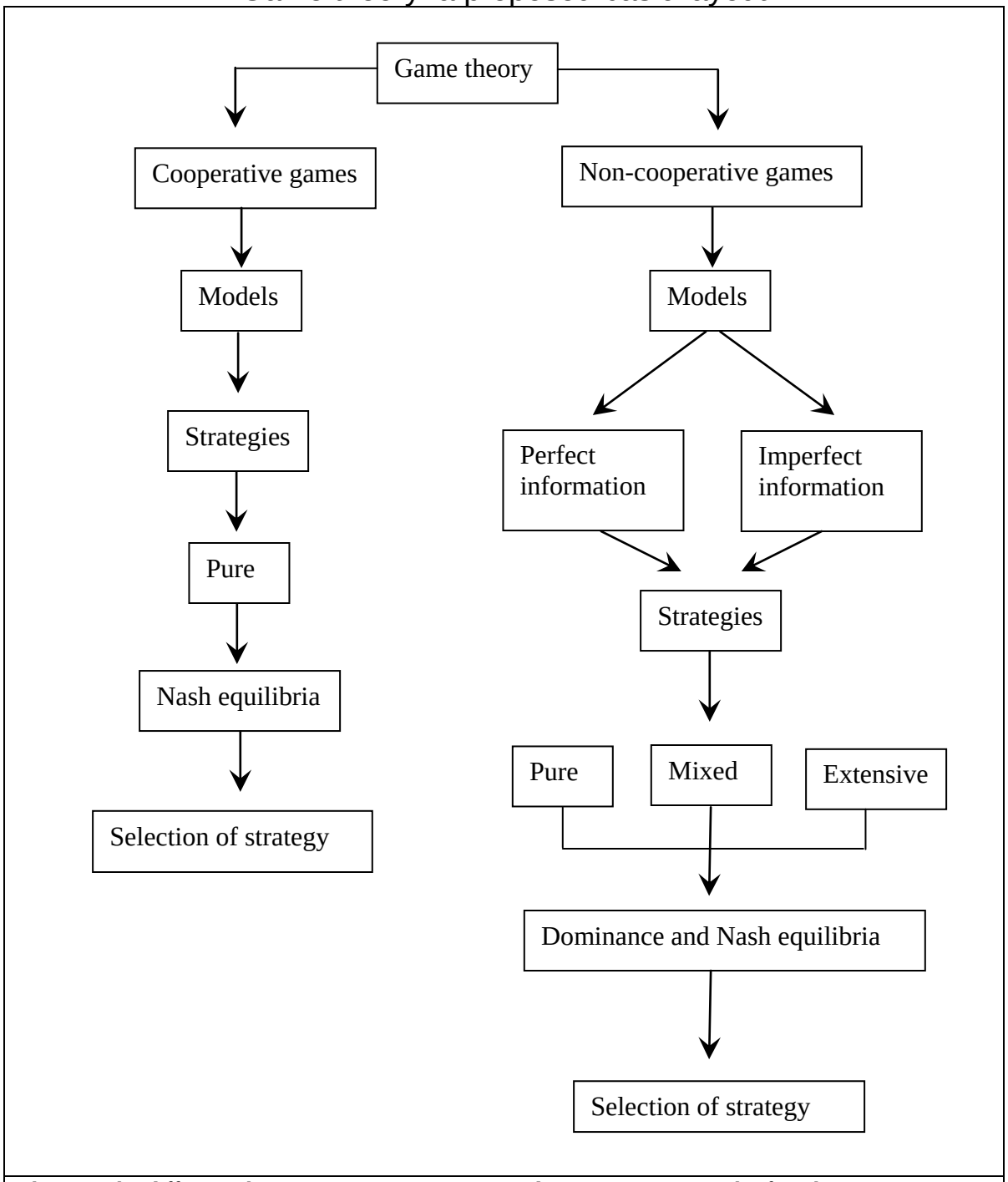
or

$$\sigma_{ij}\left(\sum_{j=1}^{m} g_{ij}(\sigma)\right) = g_{ij}(\sigma)$$

This means that $g_{ij}(\sigma) = 0$ if and only if $\sigma_{ij} = 0$, and therefore, $\sigma_{ij} > 0 \rightarrow g_{ij} > 0$. However, this is impossible by the definition of $g_{ij}(\sigma)$. Remember that $u_i(\sigma)$ is a mean with weights σ_{ij}. Therefore, it cannot be that player i can profit from every pure action in the support of σ_i (with respect to the mean). We are therefore left with the former possibility, $g_{ij}(\sigma) = 0$ for all i and j, implying a Nash Equilibrium. The construction of credibility is a very important must for central banks if we reckon the rationality of the players as an undisputed feature to be considered when applying monetary policy actions. Under these principles, Nash equilibria analysis is important to help inflation targeting central banks to assess different scenarios under which some Nash Equilibria could be discarded for a less optimal (at least in the short run) strategy. To wrap things up, I would like to put forward in Illustration 12 a simplified layout to game theory, which as stated before, stands as a large branch of the analytical tools available nowadays in economic analysis.

Illustration 12

Game theory: a proposed basic layout



What sets the difference between cooperative games and non-cooperative is the fact that non-cooperative implies that agents are not forced in any way to abide by their commitments whereas cooperative feature full commitment by the agents. The former suits best economic behavior for which its study is paramount for modern economic modeling.

Source: Own elaboration with information from Zapata (2007) and Kreps (1990).

C. Natural rate and equilibria

7. Natural rate of unemployment

The natural rate of unemployment (NRU), U^*, is a hypothetical assumption in modern economics introduced by Nobel laureates Milton Friedman and Edmund Phelps in the 1960s. It is the level of unemployment that is consistent or adequate with the potential output in the long run. An important indicator of the level of economic activity is the unemployment rate, when it is high means that the resources of the economy are not being used at an adequate rate (potential rate), which results in a reduction in the output level. This is known as a contractive breach. On the other hand when it is very low, it means that the resources are being used at a pace that cannot be sustained for long, which results in higher levels of output. This is known as an expansive breach. The natural rate of unemployment is the part of the total unemployment rate that can be attributed to frictional and structural unemployment alone.

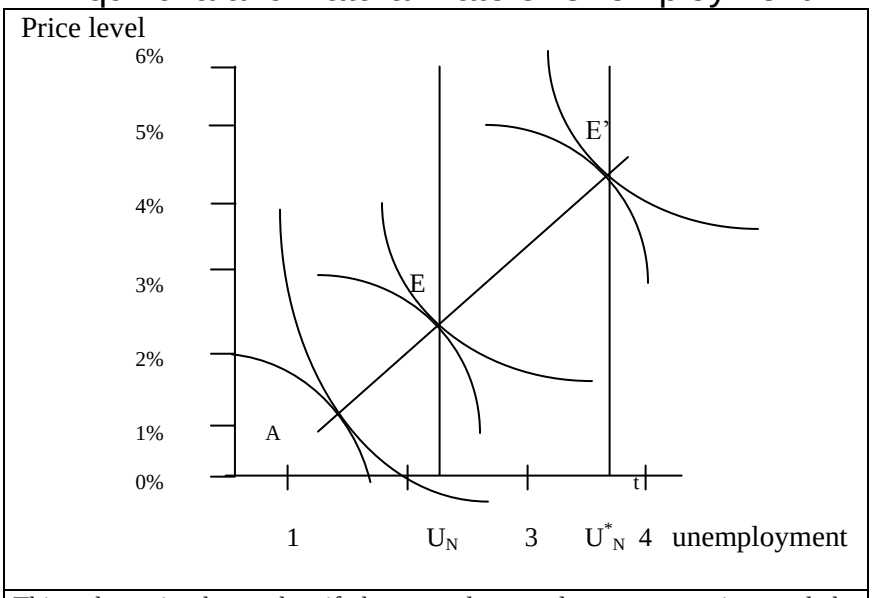
That is, when the cyclical unemployment level is zero and therefore there are no contractive or expansive breaches. That is why this NRU is consistent with the potential output in the long run. Cyclical unemployment can be expressed then as the difference between the total unemployment rate and the natural rate as follows, $U_t - U^*$. In a contraction the effective unemployment rate is larger that the natural rate of unemployment, $U_t > U^*$,which makes the cyclical unemployment positive $U_t - U^*$. But when the economy transits under an expansive breach, the effective rate of unemployment is inferior to the NRU rendering the cyclical unemployment rate negative. The latter case belongs to a situation where people are being employed at an unsustainable rate, which makes the effective rate of unemployment go under its frictional and structural regular rates.

This concept turns out important for the authorities and economists as a way to assess the current state of the economy and implement the best actions to attain the potential level of output and correct the deficiencies that convey to either breach. In "The role of monetary policy", Friedman says that the NRU is the level necessary for *real* wage rates to rise on average at a "normal" rate that can be maintained if capital formation,

technological improvements, etc., remain on their long run trends. Any excess or decline in unemployment with respect to the "natural rate" would result in an excess supply of labor or excess demand for labor respectively with the consequent pressure for the reduction or increase in real wage rates, see illustration 13. The natural rate is not fixed, it is constantly moving for all sorts of reasons other than monetary policy.

Illustration 13

Equilibria and Natural Rate of Unemployment



This schematic shows that if the natural unemployment rate rises and the government preferences remain unchanged, the new equilibrium inflation rate raises, moving the equilibrium point from E to E'.

Source: De Grauwe, (1994).

It is important because it deals with real wages and therefore incorporates the expectations for future inflation and the temporary trade-off between inflation and unemployment as well. This temporary trade-off comes not from inflation *per se*, but from an unanticipated rising rate of inflation which may reduce unemployment.[25] It is worth noticing that monetary authorities cannot use its control of nominal quantities to peg a real quantity such as the real rate of unemployment but said control can have important effects on real magnitudes. The fact that Friedman distinguished between nominal and real wages

[25] Friedman states in "The role of monetary policy" that a *rising* rate of inflation may reduce unemployment but a *high* rate will not.

gave way to the improvement of the relationship depicted in the Phillips curve. Friedman supports the idea that workers incorporate their inflation expectations when negotiating wages as shown in the follow lines taken from "The role of monetary policy".

> "A lower level of unemployment is an indication that there is an excess demand for labor that will produce upward pressure on real wage rates. A higher level of unemployment is an indication that there is an excess supply of labor that will produce downward pressure on real wage rates"

Consequently, labor will demand wage increases to offset increases in retail prices and will strongly resist any wage settlement that does not keep pace with the cost of living. Labor market participants are forward-looking, not backward-looking in their wage behavior. An increase in prices without any compensating increase in the nominal wage rate will produce a reduction in the supply of labor which explains the apparent bizarre existence of a rise in unemployment when there is a rise in inflation as well. The basic Phillips curve should be augmented to include the expected inflation rate P^e over the next contractual period to produce an upgraded version referred to as price expectations-augmented Phillips curve.

$$W = P^e + j\,(U^* - U)\ldots\ldots\ldots\ldots\ldots\ldots\ldots(15)$$

where:

$(U^* - U)$ is the difference between the equilibrium unemployment level U^* and the actual unemployment level U.

P^e is the expected inflation rate.

This equation says that the size of wage changes depends on two factors *1)* excess demand in the labor market and *2)* the expected inflation rate. Friedman argued that the coefficient on inflation expectations in the price expectations-augmented Phillips curve should be equal to one in order to preserve real wage rate and the existence of a trade-off between inflation and unemployment. As can be seen from this linear version of the price expectations-augmented Phillips curve each extra point of expected inflation increases the

intercept of the Phillips curve by exactly one point. For example an increase in the expected inflation rate from 0 to 5 percent will cause a 5 percent upward shift in the underlying Phillips curve and will result in a wage increases which are 5 percent higher, irrespective of the level of unemployment.

8. The Taylor curve

As a follow up of the previous section, it must be mentioned that William Phillips published a paper in 1958 titled *The relationship between unemployment and the rate of change of money wages in the United Kingdom 1861–1957*, where there seemed to be an inverse relationship between the rate of unemployment and the rate of inflation in an economy. This relationship was depicted in what came to be known as the Phillips curve already discussed. It showed that the lower the unemployment in an economy, the higher the rate of increase in nominal wages. This implied that central banks could lower the rate of unemployment by engineering some inflation to take advantage of the trade-offs along the mentioned curve.

However, in the seventies, many OECD[26] countries and the United States experienced high levels of both, inflation and unemployment – stagflation – which questioned this simple, predictable and persistent relationship between inflation and unemployment. As we have seen, Milton Friedman spearheaded a series of criticisms against the Phillips curve arguing that the failure of the relationship observed during the aforementioned decade required a return to non-interventionist, free market policies. In conclusion those events in the seventies demonstrated that this relationship only holds in the short run but cannot hold in the long run because it will only generate higher inflation without any improvement in the level of unemployment[27]. Good monetary policy should refrain from exploiting the short run relationship of this curve and be carried out with some desired long-run inflation target in mind. Additional to Friedman's contributions, in 1979

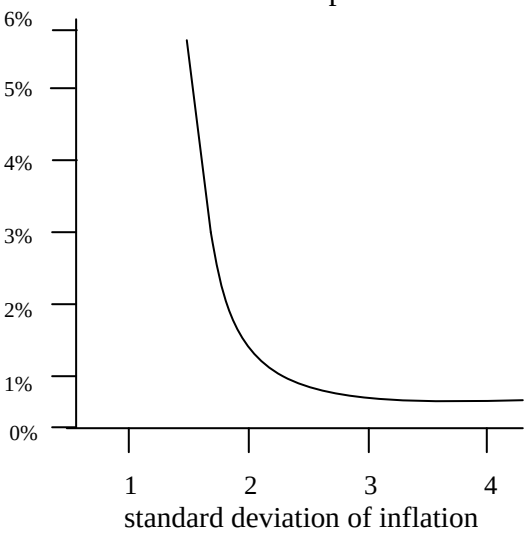
[26] Organization for Economic Cooperation and Development.
[27] The Phillips curve is vertical in the long run due to the fact that the economy is functioning at its full potential so there is no trade-off between inflation and unemployment. Edmund Phelps was awarded the Nobel Prize in Economics in 2006.

John Taylor discovered a permanent trade-off between the variability of inflation and the variability of output over time, hidden behind the temporary trade-off between inflation and unemployment. This breakthrough enables the policy makers to choose from a set of available options since monetary policy actions have only short run effects on the unemployment rate.

This new relationship – set of options – can be seen in what Taylor called the second order Phillips curve which eventually came to be known as the Taylor curve. See Illustration 14 for a comparison. This curve provided central banks with a set of possible courses of action to take according to their mandates and reaction functions. This enabled them to respond better and quicker (at least in theory) to many and sundry foreseeable and unforeseeable economic circumstances alike.

Illustration 14

Inflation and unemployment: Phillips curve and Taylor curve

Panel A. Phillips curve	**Panel B. Taylor curve**
	
Shows the menu of choices between different degrees of unemployment and price stability as roughly estimated from American data from 1933-58. Adapted from Paul A. Samuelson and Robert Solow, "Analytical aspects of anti-inflation policy" *American Economic Review (Papers and proceedings)*, 50, May 1960, pp. 177-94.	Shows the menu of choice between different deviations of output and inflation. Adapted from John B. Taylor, "Estimation and control of a macroeconomic model with rational expectations", *Econometrica*, 47 (5), 1979, pp. 1267-86.

Source: adapted from Chatterjee (2002).

9. The Barro-Gordon model

After all the above mentioned components were accepted and incorporated as tools and assumptions required for proper modeling, there were many attempts to best emulate rationality in an economy where the government failed once and again at honoring what it said would do (See Kydland and Prescott (1977)). In an attempt to reconcile rationality with the apparent irrational behavior of government policies such as counter cyclical monetary policies within a natural rate framework, Robert Barro and David Gordon issued a paper in the early eighties titled *A positive theory of monetary policy in a natural rate model.*

The framework proposed by the model, includes certain features for the achievement of an equilibrium: *a)* a decision rule for private agents, which determines their actions as a function of their current information, *b)* an expectations function, which determines the expectations of private agents as a function of their current information set, and *c)* a policy rule, which specifies the behavior of policy instruments as a function of the policymaker's current information set.

When the decision rule in *a* is optimal for agents given their expectations as calculated under *b* and if it is optimal for the policy maker whose actions are described by *c*, to perform according to agents' expectations *b*, given that the policymaker acknowledges the form of the private decision rules under *a*, the outcome is considered to be rational. Consequently, if agents find themselves before a maximizing policymaker, it would be unreasonable for them to keep expectations from which they know it will be in the policymaker's interest to deviate. If policy is precommitted, the only reasonable expectations that agents can have are those defined by the rule but if policy is sequentially chosen, the equality of policy expectations and realizations is a characteristic of equilibrium and not a prior constraint. The problem then is to determine which expectations the agents can reasonably expect to be realized.

The policymaker's goal is to maximize an objective reflecting "society's" preferences on inflation and unemployment for which adopts an activist policy that ends up having undesirable effects – excessive inflation at an unaltered rate of unemployment. This

apparent contradiction shows the inability of the institutional apparatus in charge of the monetary issues to commit its course of future actions (Kyland and Prescott, 1977). If commitment were feasible through the use of different technologies, the counter cyclical aspect of monetary policy would vanish. It is widely accepted that however optimal the behavior of agents and policymakers is under activists policies, they end up being sub optimal relative to outcomes where commitment is achieved. It is worth mentioning that at the time this model was made public, the United States as well as other countries were characterized by the absence of such a policy commitment. Thus the authors argue that the results of this model conforms a positive theory of monetary growth and inflation.

Before we go into the model, it must be clear that the policymaker always optimizes conditioned on the expectations function of the private agents whose expectations are formed by effectively solving the problem that the optimizing policymaker will face. The model of unemployment and inflation uses the unemployment rate U_t as a good indicator of the overall state of real economic activity and it equals a "natural rate" U_t^n plus a term that depends negatively on current unexpected inflation, $\pi_t - \pi_t^e$ and not on lagged values,

$$U_t = U_t^n - \alpha (\pi_t - \pi_t^e), \quad \alpha > 0 \text{.....(16)}^{28}$$

This equation is assumed to reflect the maximizing behavior of private agents on decentralized markets and can be expressed as a reduced-form function of monetary shocks since the natural unemployment rate changes over time due to autonomous real shocks, ε_t,

$$U_t^n = \lambda U^n_{t-1} + (1 - \lambda) U^n + \varepsilon_t, \ 0 \leq \lambda \leq 1 \text{.....(17)}^{29}$$

Where ε_t is independently, identically distributed with zero mean.

[28] Barro (1983).
[29] Ibídem.

The lambda values affect the realization of the shock ε_t and the natural unemployment rates accordingly. Nevertheless the effect fades away gradually over time. Equation (17) implies that the long run mean of the natural unemployment rate is U^n and is constant.

The contemporaneous or current unexpected inflation in equation (16) are introduced without distorting the main results making this analysis compatible with either monetary or real theories of business cycles. Equation eighteen summarizes the objective of the policymaker for each period in a cost Z_t, which depends on that period's values for the unemployment rate and inflation,

$$Z_t = a (U_t - kU^n_t)^2 + b (\pi_t - \pi_t)^2 ; a, b > 0, \ 0 \leq k \leq 1 \text{……..……} (18)^{30}$$

From this equation, we see the components that elevate the costs such as the departure of the unemployment rate from a target value, $k\ U^n_t$ which depends positively on the current natural rate or departures from π_t. If k equals 1 means the absence of external effects for which any departures of U_t from U^n_t in anyone direction would be penalized. The parameter k captures different distortions in the economy such as unemployment compensation or income taxation that make the natural unemployment rate exceed the efficient level rendering marketable output and employment too low $(k < 1)$.

This model requires that $0 < k < 1$ in order to generate activist policy since the choice of monetary policy is dependent of the value of k. The model pretends that the policymaker chooses π_t directly in each period in order to minimize the expected present value of costs. The objective is to minimize

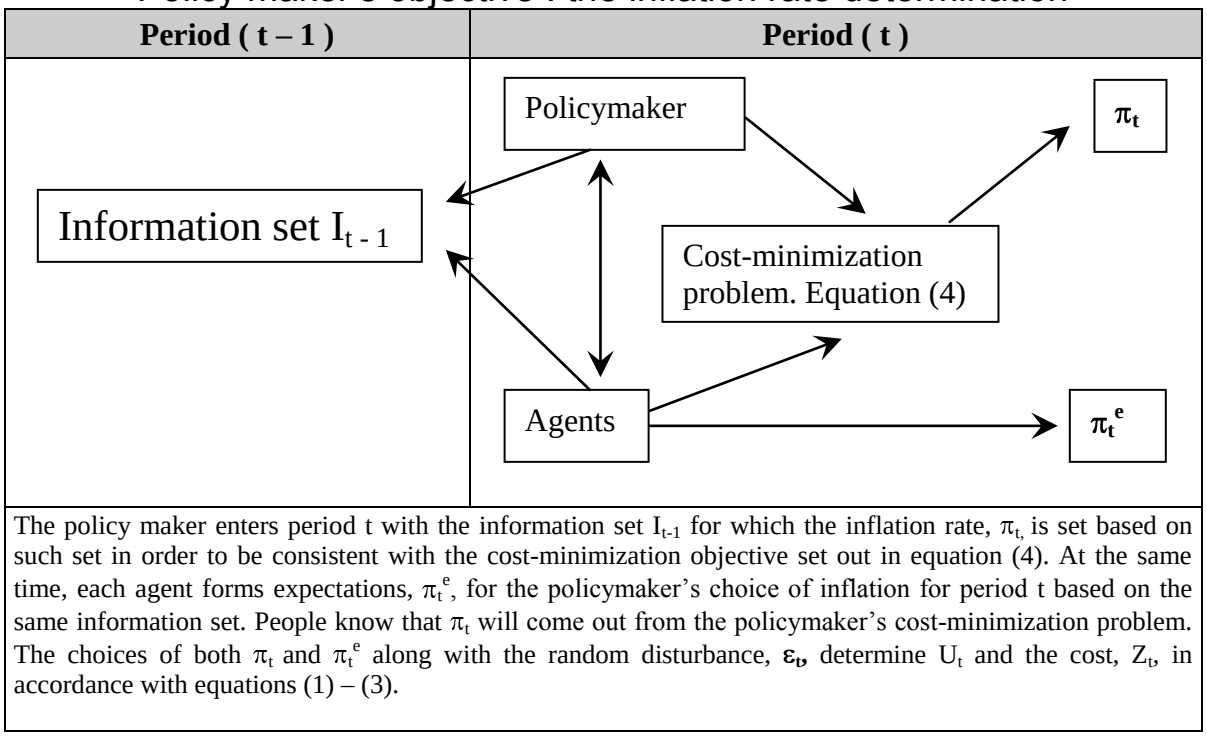
[30] Ibídem.

$$E\left[\sum_{t=1}^{\infty} Z_t / (1+r)^t\right] \mid I_0 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (19)^{31}$$

Where I_0 is the initial set of information and r is a constant, exogenous real discount rate and the policymaker's objective conforms with society's preferences. As mentioned earlier this resembles a game between the policymaker and a number of private sector agents. The structure of the game can be viewed in the following illustration.

Illustration 15

Policy maker's objective : the inflation rate determination



The policy maker enters period t with the information set I_{t-1} for which the inflation rate, π_t, is set based on such set in order to be consistent with the cost-minimization objective set out in equation (4). At the same time, each agent forms expectations, π_t^e, for the policymaker's choice of inflation for period t based on the same information set. People know that π_t will come out from the policymaker's cost-minimization problem. The choices of both π_t and π_t^e along with the random disturbance, ε_t, determine U_t and the cost, Z_t, in accordance with equations (1) – (3).

Source: Own elaboration with information from Barro, Robert and David Gordon (1983).

In the model the policymaker faces a choice problem where π_t^e is fixed and π_t is selected. Besides the agents knowing this, when π_t^e is determined the connection between π_t and future inflationary expectations becomes less clear. Another limitation is that π_t carries no information about the objective or technology of the policymaker which

[31] Ibídem.

eliminates the possibility of creating a reputation that would entail "credibility". People will perceive the process of selecting π_t as described by the reaction function, $h^e(I_{t-1})$ which consequently will produce inflationary expectations as follows,

$$\pi_t^e = h^e(I_{t-1}) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (20)^{32}$$

A solution to the authority cost-minimization problem would be finding a function $h^e(*)$ such that $\pi_t = h^e(I_{t-1}) = \pi_t^e$ and where the policymaker understands that π_t^e is generated from equation (20). Substituting U_t^n from equation (17) and π_t^e from equation (20) in equation (16) will determine the unemployment rate as

$$U_t = \lambda U^n_{t-1} + (1 - \lambda) U^n + \varepsilon_t - \alpha [\pi_t - h^e(I_{t-1})] \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (21)^{33}$$

Doing the same with U_t and π_t^e in equation (18) will determine the costs for period *t* as follows,

$$Z_t = a\{ (1-k) [\lambda U^n_{t-1} + (1 - \lambda) U^n + \varepsilon_t] - \alpha [\pi_t - h^e(I_{t-1})] \}^2 + b (\pi_t)^2 \ldots\ldots (22)^{34}$$

The policymaker minimizes $E_{t-1}Z_t$ and the first order condition, $(\partial/\partial \pi\ t)(E_{t-1}Z_t) = 0$ implies that the chosen inflation rate satisfies

$$\pi^*_t = a\alpha / b\{-\alpha [\pi_t - h^e (I_{t-1})] + (1 - k) [\lambda U^n_{t-1} + (1 - \lambda) U^n] \} \ldots\ldots\ldots (23)^{35}$$

The agents understand the nature of the policymaker's optimization problem in each period which enables them to understand that the actual choice, π^*_t satisfies equation (23).

[32] Ibídem.
[33] Ibídem.
[34] Ibídem.
[35] Ibídem.

Summing up, rationality entails the use of equation (23) to calculate $h^e(I_{t-1})$ in equation (20) and consistency requires $h^e(I_{t-1}) = \pi^*_t$. The unexpected inflation term, $\pi^*_t - h^e(I_{t-1})$ cancels out in equation (23), producing the formula for the expectations function,

$$\pi_t^e = h^e(I_{t-1}) = a\alpha / b (1 - k) [\lambda U^n_{t-1} + (1 - \lambda) U^n]$$

$$\pi_t^e = h^e(I_{t-1}) = a\alpha / b (1 - k) E_{t-1} U^n_t \ldots\ldots\ldots\ldots\ldots (24)^{36}$$

Therefore a policymaker facing the expectations given in equation (24) will strive to choose an inflation rate π^*_t that coincides with π_t^e to obtain an equilibrium (Nash equilibrium) because expectations are rational.

$$\pi^*_t = a\alpha / b (1 - k) E_{t-1} U^n_t = \pi_t^e \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (25)^{37}$$

Rationality also implies that the public know that policymakers can fool them and reduce unemployment temporarily by setting $\pi_t > \pi_t^e = h^e(I_{t-1})$ in period *t* or at any other *t + i* but formation of expectations takes this potential deception into account and a full equilibrium will ultimately involve $\pi_t = \pi_t^e$. The role of rules *versus* discretion is an important one to be considered since they affect the equilibria through expectations.

When commitments are feasible and enforced through the institutional apparatus, the time-inconsistency of the optimal solution is irrelevant and credibility enhanced whereas the inability to make binding commitments will entail a period by period optimization and lack of certainty with regards to the future actions to be followed by the policymaker. Rational agents will learn that the authority behaves in a countercyclically way, in the sense that inflation shocks reduce unemployment and the real value of government liabilities.

[36] Ibídem.
[37] Ibídem.

* * *

The understanding of inflation and the way it interacts in the economy with every economic agent under a certain set of rules, required a wide range of analytical tools and assumptions to try and produce the most close to reality outcomes beyond mere explanations or tautologies. The Barro-Gordon model represented the melting pot of many recently developed concepts such as rational expectations and credibility. It can be regarded as the father of a new family of models that conceive the economy as a complex phenomenon requiring complex analytical tools in order to arrive at conclusive statements.
In the next chapter, a deeper theoretical explanation of inflation and how it is viewed by the main theories is developed in order to introduce the concept of targeting. This is especially important because inflation targeting was engineered to allow central banks discretionary actions constrained by the use of a nominal anchor and a policy rule of non-mechanical application, as long as credibility is not compromised. The understanding of inflation by central banks along with the assumption of rationality, will determine the kind of actions it will follow and how it will deal with shocks without compromising its credibility.

Chapter II

Inflation: main theories and targeting

"If you regard a situation as a death or life matter, you will die many times"
Adam Smith

Overview

Throughout this chapter I will attempt to show the main conceptions of inflation as the center of gravity for many investigations along with the initial attempts to keep it under control within a defined flexible framework namely inflation targeting. It is important to understand the nature of inflation as conceived by the main theories in order to establish which conception is embraced by said approach and why. The chapter will also cover the main considerations to be regarded before actually implementing inflation targeting with a view to assess its convenience for the monetary authorities. I shall briefly make a recount of the origins and development of this relatively new approach to present you with concrete evidence that will lead us to determine whether the outcomes witnessed during its early and later stages have been good enough for central banking.

A. Understanding inflation

1. The quantity theory of money

Not only is it one of the oldest and most important economic theories but also one of the most challenged and controversial amongst economists. Its origins can be traced back at least to the mid-16th century when Jean Bodin, a French philosopher, attributed the huge rise in prices in Western Europe to the abundance of metals from the Spanish colonies in America. This theory was later on refined and integrated into the main stream of orthodox monetary tradition by John Locke, Richard Cantillon and David Hume during the 17th and 18th centuries. It became so important that represented the central core of classical monetary analysis during the 19th century. In the 20th century, it flourished in the *monetarist* school spearheaded by Milton Friedman, Karl Brunner, Allen Meltzer, Philip Cagan, and others. Today it remains as the pillar of orthodox monetary theory.

The quantity theory of money (QTM) explains that the main cause of variations in the value or purchasing power of money is the changes in the quantity in circulation, which implies that the stock of money is the main determinant of the price level. In order to support this apparently simple conclusion, it bears a set of interrelated postulates: *1)* the proportionality postulate, *2)* causal role of money, *3)* the neutrality of money postulate, *4)* the monetary theory of the price level, and *5)* the exogeneity of the nominal stock of money. The first one states that a given percentage change in the stock of money will produce an identical percentage change in the prices of commodities due to the assumption that people want to hold for transaction purposes a constant quantity of real cash balances (M/P), at the economy's full capacity level of real output. This postulate also implies that the demand for real cash balances and the velocity of money are stable.

The second postulate states that the causation runs from money to prices which implies that money works as the active variable and prices as the passive or dependent variable. At this point it should be noted that the first postulate is not achieved instantly, it is an equilibrium condition established via a dynamic adjustment process where the disequilibrium caused by a change in money invokes forces that cause prices to change until proportionality is restored and the disequilibrium eliminated. *Ergo* it is not an identity that holds at all points in time. The neutrality postulate states that except for the said transitional adjustment periods, monetary changes do not have any influence on real economic variables such as total output or employment. These last are determined by non-monetary factors such as tastes, technology, resource endowments and rates of technical substitution between factor resources. Nevertheless, this postulate along with the proportionality one refers to the long run equilibrium, and agree on the non-neutral effects of monetary changes during short-run transition periods.

The monetary theory of the price level states that the general price level – not relative prices – tends to be influenced predominantly by changes in the quantity of money, so price level instability stems mainly from monetary rather than non-monetary disturbances. The last postulate is a condition for money being the independent causal factor governing prices. It refers to the nominal rather than the real stock of money because the real stock is considered as an endogenous variable determined by the public's demand

for real balances. It is important to highlight that the existence of non-neutral effects demonstrated and stressed by Hume and Cantillon were frequently minimized by the classical version of the quantity theory of money. In brief, the Cantillon-Hume version stressed dynamic disequilibrium periods in which money matters much, classical analysts focused on long-run equilibrium in which money is just a veil. There were important contributions to the quantity theory of money by the bullionist and currency schools of thought during the nineteenth century from the experiences in England.

The bullionists contributed to the QTM during the first two decades of said century in locating the source of inflation in the central bank and that the stock of money could be effectively regulated via the control of a narrowly defined monetary base. The currency school, towards half of the century contributed in arguing that long lags between changes in the volume of notes outstanding and consequent changes in prices and the exchange rate existed. They asserted that these lags made the exchange rate response slow in registering the effect of a note overissue and consequently a late signaling for a corrective contraction by the central bank which accentuated economic disturbances. Another contribution from this school of thought was that money substitutes cannot impair the effectiveness of monetary regulation because their low circulation velocity made them quantitatively insignificant relative to notes as exchange media and because in crisis times they were poor substitutes for money in final payments.

The quantity theory of money was later reformulated by three neo-classical contributions. First the mathematical framework that took two alternative forms: *1)* Irving Fisher's equation commonly known as the equation of exchange $M\,V = P\,T$ where M is the stock of money, V is the velocity of circulation, P is the price level and T is the physical volume of market transactions and *2)* the Cambridge cash balance equation $M = k\,P\,y$, where M is the stock of money in circulation, k is the desired cash balance ratio, P is the price level of the national product and y is real national income or the national product valued at constant prices. These equations enabled neo-classical analysts to determine the conditions that must hold if the proportionality postulate is to be valid. Said conditions included the constancy of the velocity of money and of real output, Fisher's equation could

be expressed as $P = (V / T) M = (constant) M$ which shows a constant proportional relationship between average prices and the money stock.

The second contribution, owed to Fisher, Pigou and others, was the formalization, elaboration and extension of the Bullionist-Currency school ideas on control of the money supply by demonstrating that monetary control could be achieved in a fractional reserve banking system via control of an exogenously determined stock of high-powered money. The last contribution was the revival of the short-run non-neutrality of money which had been neglected in the classical analysis. Neo-classical economists integrated the quantity theory of money into their business cycles analysis to show how variations in the quantity of money represented a major cause of booms and slumps which made monetary regulation of the price level a prerequisite to the stabilization of economic activity. Notwithstanding the importance and dominance of the quantity theory of money, it was challenged and displaced temporarily during the 1930s by the ideas of John Maynard Keynes who took the old anti-quantity theory arguments of the Banking school of thought that he incorporated in his *General Theory*.

However, the monetarist school led by Milton Friedman responded with counterarguments based on theoretical developments and empirical research contributing to the resurgence of the quantity theory of money. Among the theoretical developments were *1)* the theory of real balance or wealth effect and *2)* Friedman's reformulation of the quantity theory of money as a theory of the demand for money. The first argued that the price decline in a depression due to a monetary expansion would increase the real wealth and consumption and investment spending directly until full capacity utilization had been attained, which proved the potential potency of monetary policy even in a depression and provided both, an escape from the keynesian liquidity trap and a counterargument contradicting the keynesian doctrine of underemployment equilibrium. Friedman's reformulation emphasized first that the QTM was a theory of the demand for money rather than a theory of the determination of the level of prices and nominal income and second that the essence of the quantity theory of money was the existence of a stable functional relationship between the velocity of money and a few independent variables that determine it.

Consequently, Friedman's reformulation rebutted many keynesian criticisms such as the assumption of full employment and that velocity was a mere arithmetic calculation deprived of economic content. The QTM assumes velocity as constant. As for the empirical research we have the reexamination of American financial history by Friedman and Schwartz's *A Monetary History of the United States, 1867-1960* and Cagan's *Determinants and Effects of changes in the stock of money, 1867-1960*. Both studies demonstrated the significant independent role played by money stock changes in US business cycles. All these boosted the QTM and fixed the monetarist school as the starting point for understanding modern monetary policy.

A useful device for clarifying the variables stressed in the quantity theory is the so-called quantity equation. The quantity equation has taken different forms according to the different variables stressed by quantity theorists. The most famous is the so-called transactions version:

$$MV = PT \quad \text{.....(1a)}$$

This version starts with the identity that any transaction has two sides: an amount of money paid and a corresponding quantity transferred at a certain price – for example, $20 paid for two books at $10 each. The left side of the equation sums up the amount of money paid out; the right side, the value of the transaction. Generalized to the whole economy, the left side of the equation becomes the amount of money in existence (M) multiplied by the average number of times per year (or other unit of time) that each dollar is used in effecting a transaction – the transaction velocity of circulation (V). The right side of the equation then becomes the product of an average price (P) times an aggregate quantity of goods (T).

In this version, all transactions of whatever kind are included – purchases of securities along with purchases of restaurant meals, purchases of the food ingredients by the restaurant as well as of the final meals. The inclusion of capital as well as current

transactions, and of intermediate as well as final goods, makes the concepts of total transactions (T) and the "general price level" (P) highly ambiguous and difficult to handle statistically. The emergence of national income accounting in recent decades has led to the substitution of the transaction version for an income version of the quantity equation:

$$MV = Py \qquad \text{(2a)}$$

In this equation y represents national income in constant prices (the total value at fixed prices of all final goods and services, including additions to the stock of capital), P is a price index, and V is the average number of times that the money stock is used for making income transactions (that is, payments for final goods and services, or alternately, for final productive services – services of labor, land, and so forth).

In both these equations the two sides are, by definition, precisely equal to one another – that is, each equation is an identity (like the equality of total assets and total liabilities on a double-entry balance sheet). In practice, the data on transactions or on income – the right sides of the equations – come from different statistical sources than do the data on the quantity of money, and only indirect data exist for velocity. As a consequence, when these equations are used to describe the real world, V is usually computed in such a way as to make the two sides equal, thus embodying all the statistical errors of the other terms.

These versions of the quantity equation emphasize the function of money as a medium of exchange – its use in making payments. But money also serves as a store of purchasing power in the interim between sale and purchase. This aspect is emphasized in the cash balance approach. It has generally been supposed that the amount of money people will want to hold for this purpose bears some relation to their income. This leads to the equation

$$M = k\,Py \quad \text{.....(3a)}$$

in which *M*, *P*, and y are defined as in equation *(2a)*, and *k* is the ratio of money stock to income. Although equation *(3a)* is simply a mathematical transformation of equation *(2a)* – *k* being numerically equal to the reciprocal of *V* – it brings out the difference between the aspects of money stressed by the transactions approach and those stressed by the cash-balances approach.

In particular, the cash-balances approach fits in better with general economic analysis than does the transactions approach. Equation *(3a)* can be regarded as describing the demand for money, with *P* and *y* being two of the variables on which the demand for money depends and with *k* symbolizing all the other variables. For completeness, the analysis requires another equation showing how the supply of money is determined. This approach provides a better bridge to the later Keynesian and more recent monetarist developments than does the transactions approach.

The purpose of the quantity equations is mainly to provide an analytical filing system to help sort out the forces at work. Their usefulness derives from the empirical hypothesis that each of the four main labels (*M, V, P,* and y for the income version) refers to a fairly distinct set of forces subject to influences that are different from those classified under another label.

In its simplest form, the quantity theory regards output (y) as being determined by the productive opportunities of the community and its tastes and preferences; it regards the quantity of money (*M*) as being determined by the conditions of production of the monetary metal plus the characteristics of the financial and banking structure (for a commodity standard) or the decisions of the monetary authorities and the financial structure (for a fiat standard); it regards velocity (*V*) as being determined by payments practices, the financial and economic arrangements for effecting transactions, and the costs of and returns

from holding money instead of other assets; and, finally, it regards the price level (*P*) as the variable that adjusts to reconcile the conditions of production determining *y* with the financial conditions determining *M* and *V*.

In the most rigid form of the quantity theory, velocity is seen as very stable. This view regards the level of prices as determined directly by changes in the quantity of money and as moving in strict proportion to the quantity of money. But the more sophisticated theorists never took this simplistic view. They all recognized that prices could not adjust instantaneously and fully and that, during so-called transition periods, changes in the quantity of money would affect output as well as prices. They also recognized that *V* was not a constant but itself a function of other variables, such as interest rates, and that it was subject to substantial random perturbations. As a result, they recognized that changes in output and prices could be produced in principle by independent changes in either *V* (the demand for money) or *M* (the supply of money).

On an analytical level the quantity theory of money is not the tautology of the equation; it is, rather, an analysis of the factors determining the quantity of money that the community wishes to hold. On an empirical level, it does not assume that *V* is constant; it holds that changes in the demand for money tend to proceed slowly and gradually or to be the result of events set in train by prior changes in supply, whereas, in contrast, substantial changes in the supply of nominal balances can and frequently do occur independently of any changes in demand. The conclusion is that substantial changes in prices or nominal income are almost invariably the result of changes in the nominal supply of money rather than of *V*. An implication of the foregoing is that monetary policy – policy as to changes in the quantity of money – is the appropriate means for preventing inflation or deflation and for avoiding wide cyclical fluctuations.

2. The monetary approach to the balance of payments

The parenthood of the monetary approach to the balance of payments belongs rightfully to the classical economist Adam Smith. He did not incorporate the quantity theory of money or the Humean price-specie-flow mechanism into his analysis of the balance of payments (BOP) while being totally familiar with both and a close friend to David Hume probably because he based his discussion of the international monetary mechanism on the experiences of the 18th century Scotland.

A small open economy whose money stock was too small to influence world prices, therefore taking its price level as determined in world markets. He assumed this economy followed a gold standard monetary system with a convertible paper currency, fixed exchange rates and full employment. Today this approach is defined as a framework for analyzing how integrated open national economies eliminate their excess money supplies and demands in a regime of fixed exchange rates. In order to illustrate how a small open economy achieves monetary equilibrium through the BOP, proponents use a simple model consisting of four equations:

$$M_d = k\ P\ Y \text{……....(1)}$$[38]

$$M_s = C + R \text{…….…..….(2)}$$

$$P = E\ P_w \text{……...….(3)}$$

$$M_s = M_d \text{…….…....(4)}$$

The first equation shows that the demand for money is a stable function of the product of prices *P* (given by world prices) and output *Y* (given at full capacity) and *k* being the fraction of nominal income *PY* that agents wish to hold in cash. The second defines the money stock as domestic credit *C* (exogenous variable) and foreign exchange reserves *R* (endogenous variable) acquired through the BOP. The third expresses the law of one price which through commodity arbitrage renders domestic traded goods prices *P* the same as world prices P_w converted into a common unit of account at the fixed exchange rate *E*. The

[38]Hetzel (2005).

last equation is the monetary equilibrium condition so that all money is willingly held and the market for cash balances clears. The equilibrium is achieved through cashflows (R) in the BOP as the next equations shows:

$$R = k\ E\ P_w\ Y - C \text{.....(5)}^{39}$$

This equation says that under fixed exchange rates the model uses the reserve flows through the BOP adjust to keep monetary equilibrium in the face of autonomous changes in the determinants of money supply and demand. The state of the BOP (B) and the change in reserves ($\acute{R}$) depends on the excess demand for money. It will be positive if there is excess money demand and negative if there is excess money supply and zero if there is no excesses at all. This can be expressed in the following equation $B = R = b\ (\ M_d - M_s\ )$ which holds that when actual cash balances fall short of desired levels, people will correct this discrepancy by exporting domestic goods and securities in exchange for imports of money. This is the key idea behind the monetary approach. From this model we can elicit at least six important propositions that feature the monetary approach to the BOP.

Illustration 16

Monetary approach to the BOP:Key propositions

1.- Price level exogeneity

2.- Money stock endogeneity

3.- Money stock composition

4.- Price to money causality

5.- Absence of relative price effects

6.- Direct expenditure effects

Source: Taken from Humphrey (1982).

[39] Ibídem.

As Humphrey (1982) details, Adam Smith adhered to these key propositions and rejected the QTM because causality runs from prices to money in a small open economy and also rejected the price-specie-flow idea because prices were given exogenously by world prices. For all that has been said, Adam Smith may be considered the father of the groundwork for the modern monetary approach to the BOP developed in the mid twentieth century by the International Monetary Fund's (IMF) research department under the direction of Jacques J. Polak, Harry G. Johnson and Robert A. Mundell.

3. Modern theory of inflation

Inflation is considered by many not only as a monetary phenomenon but also as being caused by a variety of different factors. Economists have come up with several different theoretical explanations for this economic phenomenon being the most popular the following: *1)* too much money and too few goods. This excessive growth in demand ends up pulling prices up, *2)* costs rising too fast. Companies will find themselves in need of increasing prices in order to maintain their margins causing inflation *3)* excessive money supply growth can also be a cause of inflation, *4)* the apparent simple trade-off between unemployment and inflation in the short run. *5)* cost-push and demand-pull inflation can interact to cause a wage-price spiral and *6)* price expectations - there is a precise link between people's price expectations and the level of inflation, nevertheless there is a great deal of debate among economists on the exact nature of the link.

Expectations as have been considered throughout the document, can be an important determinant of inflation. This has increasingly been recognized by economists and policymakers alike in recent years. However there is considerable disagreement between economists on what determines people's expectations; therefore a few years back, research was done to see how many times the word "recession" appeared in newspapers and the media to see if there was any relationship between the expectation of a slowdown and it actually happening. The outcome pointed out that there indeed appeared to be some relationship between the two. The rationale behind it was that as people began to expect a slowdown they would adjust their behavior to accommodate this, and in so doing help to

bring about the problem they had feared. One of the main reasons expectations are important is because people take them into account in their wage claims to make sure they get a real wage increase or at least keep their wealth unchanged.

This pulls up costs causing inflation. Moreover when people believe that increases in the money supply will simply cause inflation, then any increase will only lead to inflation and no real increase in output or employment because they will simply anticipate the effects. The latter is considered the monetarist position on expectations. Further, the rational expectations school assumes that people will look at the present situation and take no account of the past which means that they will instantly anticipate the impact of any changes. Under this assumption, the government bears no opportunity at all of getting away with subtle changes in order to try and boost demand, since people will simply anticipate the inflationary impact, and the changes will be useless.

As a consequence of there being so many interpretations about the origin of inflation, it is necessary to set a limit with regards to the monetary frame that is used by inflation targeting. In order to do so, first it is necessary to streamline the differences amongst the rationale behind the classical view of inflation and the New-Keynesian theory of inflation. The classical view of inflation says in plain English that inflation is a function of the supply of money and is known as the quantity theory of money already reviewed. In the previous section, a by-product of this view, namely monetary approach to the balance of payments was discussed. The New-Keynesian view which can be broken down into a classical component (quantity theory of money) and into a multi-cause component, considers this phenomenon not only as a monetary one but also as a demand and supply affected variable. This modern theory of inflation uses the relationship proposed by the famous Phillips curve but enhanced by agents' expectations.

The modern theory of inflation takes into account these three main components:

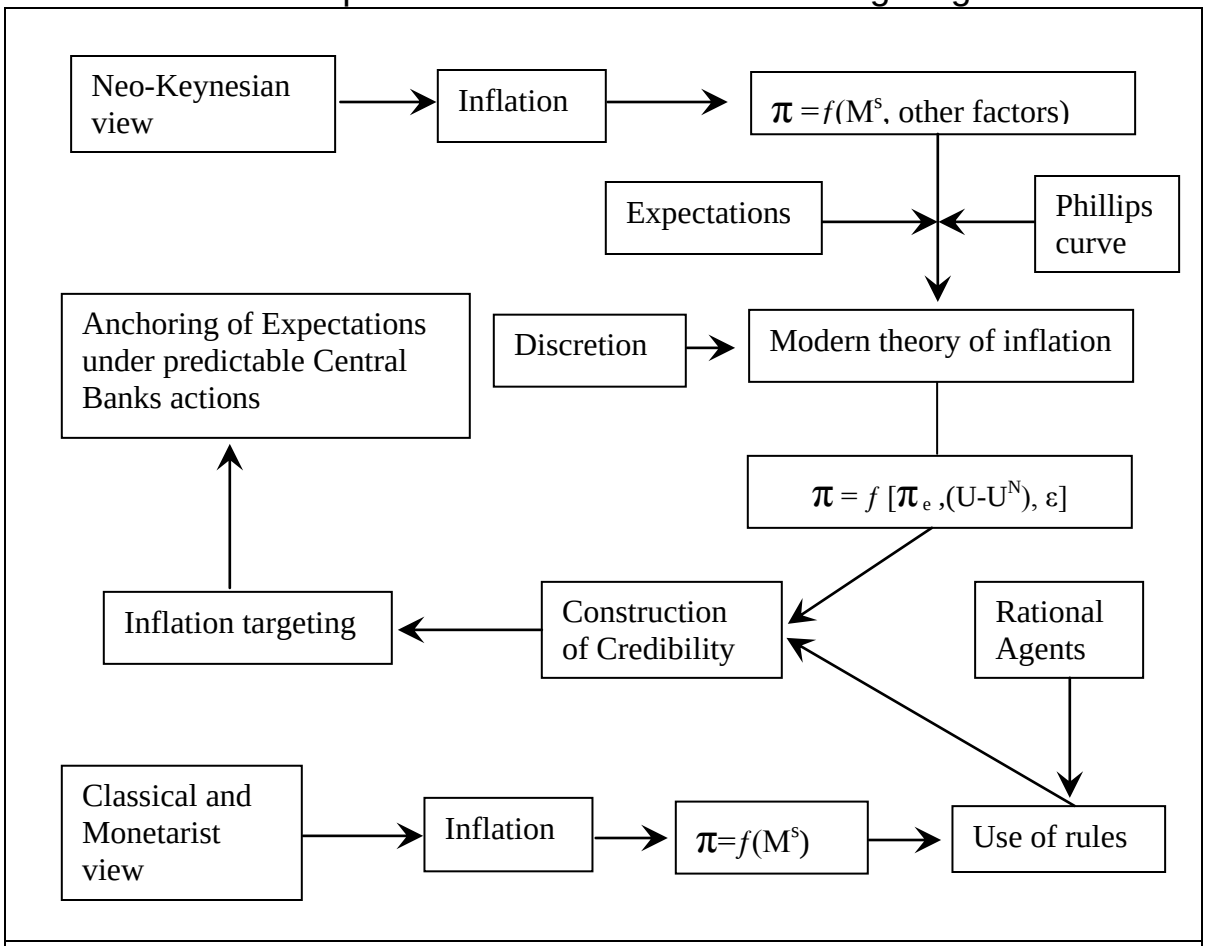
1) The inflation expectations,
2) the difference between the natural rate of unemployment and the observed unemployment rate and

3) a random variable and supply shocks.

Inflation targeting, which is a policy regime, assumes inflation in this Neo-Keynesian way and incorporates constrained discretion rather than the use of rigid rules in the conduct of monetary policy. The following schematic shows how inflation targeting is supported by the said view and the use of constrained discretion as a framework that deals with inflation in an inclusive fashion aiming at the best way to keep it under control.

Illustration 17

Conception of inflation and inflation targeting



The modern theory of inflation includes both views plus expectations, which makes it a compatible base for inflation targeting. As can be seen on the equation, the phenomenon of inflation is a function of the future inflation expectations, the weighted difference between the natural rate and the observed rate plus a random demand or supply shock variable.

Source: Own elaboration for illustration purposes.

B. Inflation targeting

4. Rationale

Inflation is a very particular phenomenon in economics. On the one hand it is good for the economy at levels that allow the ideally ever growing economic activity. On the other, high levels of inflation bring about a number of negative costs such as overexpansion of the financial system, as individuals and businesses use more and more of their resources to guard off the effects of inflation on their cash holdings, a larger susceptibility to financial crisis, as difficulties in adjusting to high inflation make the financial system more fragile; poor functioning of product and labor markets, as prices become noisy measures of the relative economic values of goods and services; the cost of frequent re-pricing, along with the costs of monitoring the prices of suppliers and competitors; and distributional effects, often dilapidating the middle class whose savings become worthless; the difficulty to assess the real growth and performance of business activities and the negative impact in interest rates that operate as the gas pedal in the economy. For these few and many other reasons, high inflation levels are in consequence undisputedly considered harmful for a country's economy.

One path to keeping inflation under control is the adoption of the approach known as inflation targeting. This approach is not only the setting of a targeted, ideally desired, level of inflation for the year or any other time period. It is a coherent and robust framework designed to think of the monetary policy actions available in order to keep the public's expectations anchored to the value made public by the authority. It is believed that this will maintain the long term interest rates on a level compatible with full employment with the intention to providing the economy with the most certain environment possible. This is no easy task at all and is carried out by the country's central bank. This anchoring of expectations is achieved through the use of a nominal anchor. The preferred nominal anchor used by most inflation targeting countries is the short-run interest rate although any monetary aggregate could do[40]. This nominal anchor gives the public information about the intentions and commitment of the authority regarding future economic conditions reflected

[40] Nominal anchors must ideally be easy to understand by the public so the interest rate is preferred over monetary aggregates.

in the level of inflation. The central bank in order to conduct the monetary policy is imposed either a single, dual or hierarchical mandate[41]. To comply with said mandate, the central bank can use either of two instruments, namely monetary instruments to steer the economy in the desired way.

These instruments can be, as mentioned above, the short run interest rate which is indirectly set by the central bank through open market operations or any monetary aggregate over which it has direct control[42]. Inflation targeting rests on the concept of credibility which must be constructed through actions rather than words. One way to achieve credibility is to make the central bank independent of the government so as to insulate it from political and electoral cycles and pressures. The central bank is independent in either choosing its mandate[43] or the policy instrument as well as financially for its expenses are mostly covered by yields from the investment portfolio it operates on its own behalf. This concept of independence turns out important in the formation of expectations of the agents in the economy and then anchor those expectations with the targeted inflation value announced by the central bank.

The commitment to achieve such value must be credible therefore the actions, constant central bank briefings to the public, announcements and the special feature of independence, all aim at constructing credibility. Here arises the ongoing rule *versus* discretion debate because under inflation targeting even though it is not mandatory to follow rigid rules for every possible scenario the central bank may face, some monetarist economists, like John Taylor, pronounce themselves for the use of rules.

[41] A single mandate consists in the achievement of a defined goal, the dual mandate puts the achievement of two defined goals on an equal footing and the hierarchical sets priorities with respect to the goals to be achieved.
[42] Open market operations are purchases and sales the central bank does in the money market in order to influence the cost of inter-bank funding according to the requirements of reserves each must keep by regulation.
[43] The mandate is in most cases given to the central bank by the congress giving it the freedom of choosing the policy instrument. The central bank governor in office must brief the congress on the results of monetary policy.

However, this approach is a framework designed to work under what Ben Bernanke, perhaps the most influential economist promoter of this approach, has called "constrained discretion", which is a combination of having rules but also the expertise and experience of the bank staff to deal with unforeseen and unexpected circumstances[44].

It is also of paramount importance to bear in mind that this approach does not focus exclusively on control of inflation – strict inflation targeting – ignoring output and employment objectives, on the contrary, as Bernanke (2003) says, virtually all recent research on inflation targeting takes for granted that stabilization of output and employment is an important policy objective of the central bank – namely flexible inflation targeting. Consequently, this approach is perfectly consistent with the central bank's obligation to maintain financial stability as has been the Fed's case during the October 1987 stock market crash or the September 11 terrorist attacks, let alone the current global crisis.

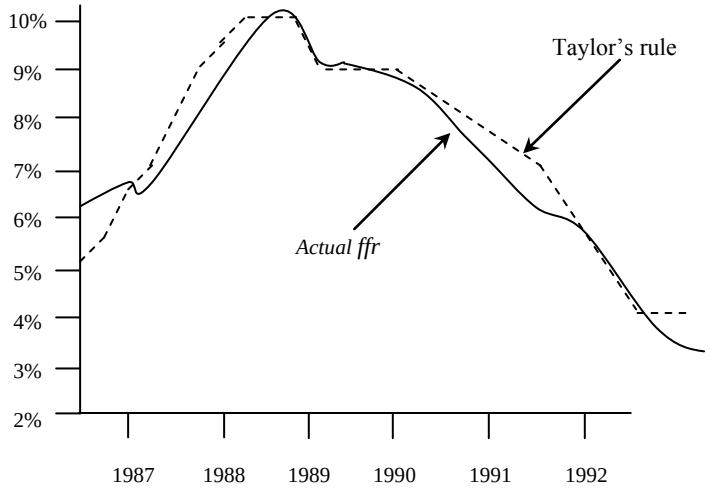
The Federal Reserve to date, under chairman Bernanke, does not officially follow this approach. Nevertheless, it operates as if it did, which reflects the wide variety of opinions and postures inside the States central bank. Taylor (1993) specifies a reaction function with positive weights on deviations from target inflation and from the natural rate of unemployment that closely tracks the actual policies followed by many central banks that target low inflation. He is against the use of optimal policy rules and pronounces himself for the use of simple policy rules on the grounds that optimal rules do not produce better results than simple ones. He developed his rule out of a multinational research he carried out using flexible exchange rates. It is worth mentioning at this point that he put forward a combination of three things to arrive at good monetary policy conduct *1)* the use of rules, *2)* flexible exchange rates and *3)* inflation targeting. These three came to be known as Taylor's tripod. The next illustration shows Taylor's rule versus the federal funds rate (ffr).

[44] Ben Bernanke, the current Federal Reserve chairman considers this issue the heart of the inflation targeting approach.

Illustration 18

US: federal funds rate (*ffr*), 1987-1992, and Taylor's rule

Panel A.



Panel B.

Taylor's rule

$$i = p + 0.5\,y + 0.5\,(p - 2) + 2$$

thus

if $p = 2$ and $y = 0 \longrightarrow i = 4$, $r = 2$
if $p > 2$ and $y = 0 \longrightarrow i > 4$, $r > 2$
if $p = 0$ and $y = 0 \longrightarrow i = 1$, $r = 1$

where

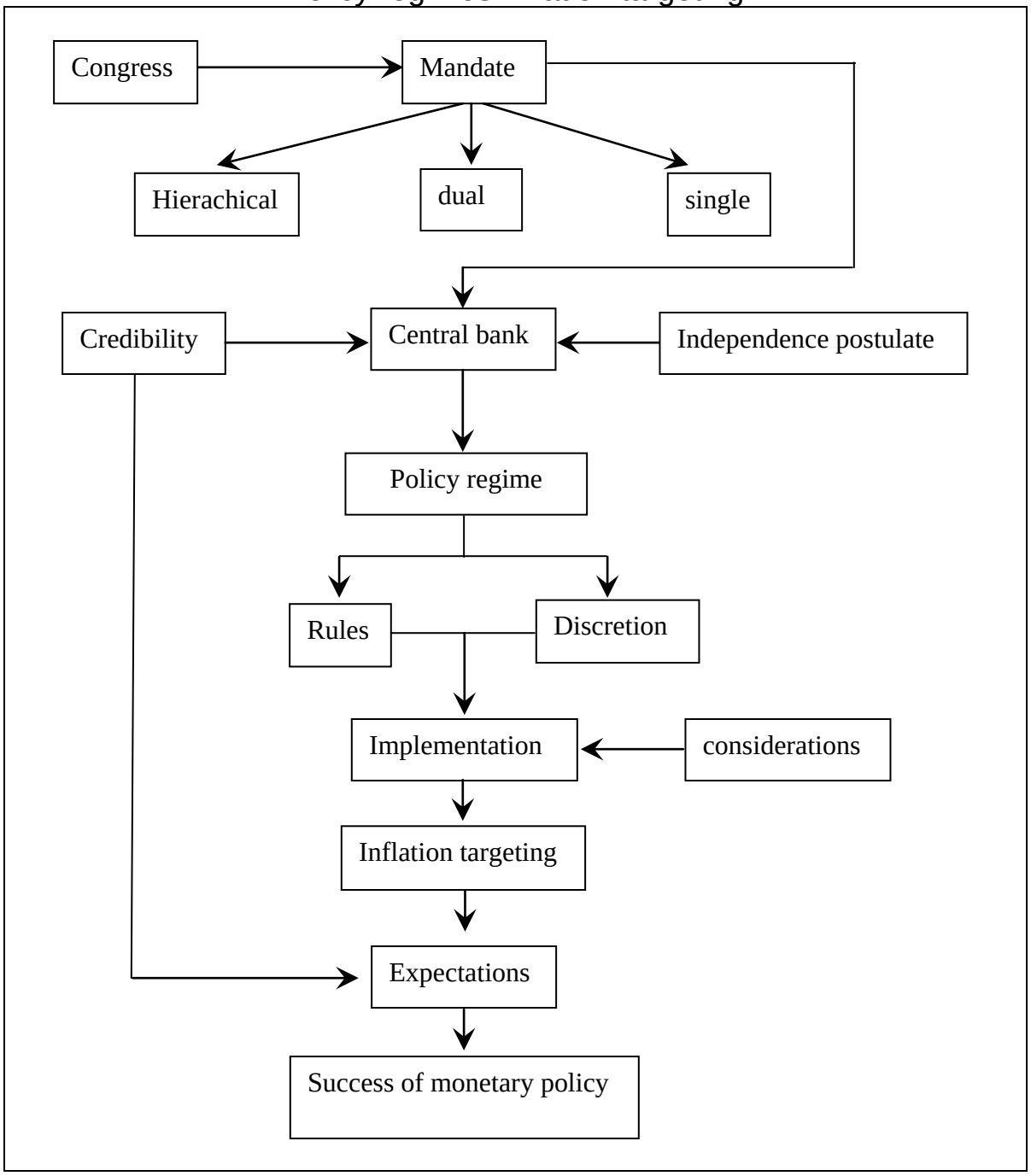
i = nominal interest rate (federal funds rate).
p = observed inflation.
y = output deviation from potential.
$r = i - p$ = real interest rate (long run).

Source: Own elaboration based on Taylor (1993).

As can be seen, inflation targeting stands as framework to create credibility through the consistent use of rules according to particular events with a view to anchoring the expectations of the agents. It can be somewhat flexible as long as said expectations are anchored, however sheer discretion is ruled out because despite being in some cases optimal, it is bad for the construction of credibility and would increase the social costs of adjustments in the variability of output and inflation. This point will be explained in depth throughout the next chapter. In the following Illustration, a proposed location for inflation targeting is shown.

Illustration 19

Policy regimes inflation targeting



Source: Own elaboration for illustration purposes.

Following Ben Bernanke`s conception of this approach, we can break it up in two components: *1)* a constrained discretion framework and *2)* a communication strategy conducent to anchoring expectations. As mentioned before, the first component attempts to reach a balance between strict policy rules and unfettered discretion by doing its best to stabilize output and employment in the event of short-run disturbances, moreover refers to the strong commitment to keeping inflation under control which will anchor the public's expectations on future inflation levels. Given that the monetary policy actions work with a lag in the economy, the central bank may have to anticipate future movements in inflation and act in advance. This particular feature makes inflation targeting a forward-looking approach.

The second component regards the central bank's regular procedures for communicating with the political authorities, financial markets, and the general public. This strategy is tightly related to transparency and thus credibility. The central bank promotes transparency through the issuing of public announcements of policy objectives, open discussion of the bank's policy framework, a timeframe for achieving the inflation target, central bank's forecasts and evaluations of the economy. All this aids the public in understanding and anticipating the forces being applied onto them which helps them to plan ahead in a way consistent with the expectations the central bank needs for the success of the policies being applied. Furthermore it gives certainty and fosters credibility in the actions carried out by the central bank. Inflation targeting requires the central bank to virtually "look at everything" which denotes the importance given to the experience and know-how of central bankers.

Nevertheless, setting an inflation targeting regime can be a very long and painful process especially when there are a number of opinions for and against within the institutional structure of the central bank. For instance, the Fed conducted monetary policy under the Greenspan administration following a discretionary regime that allowed the Fed to move the monetary policy as needed in order to promote not only low and stable inflation but also full employment. The reticence seen in the Fed towards adopting an inflation targeting regime rests mostly in the kind of mandate it must obey. Having a dual

mandate as the Fed does, makes monetary policy a complex task, in part due to the lack of precise indicators of the level of unemployment or inflation for that matter, which makes the conduction of monetary policy easier under a discretionary regime, moreover the adoption of an inflation targeting regime would impose a greater emphasis in rules than they have now, which implies an even greater challenge.

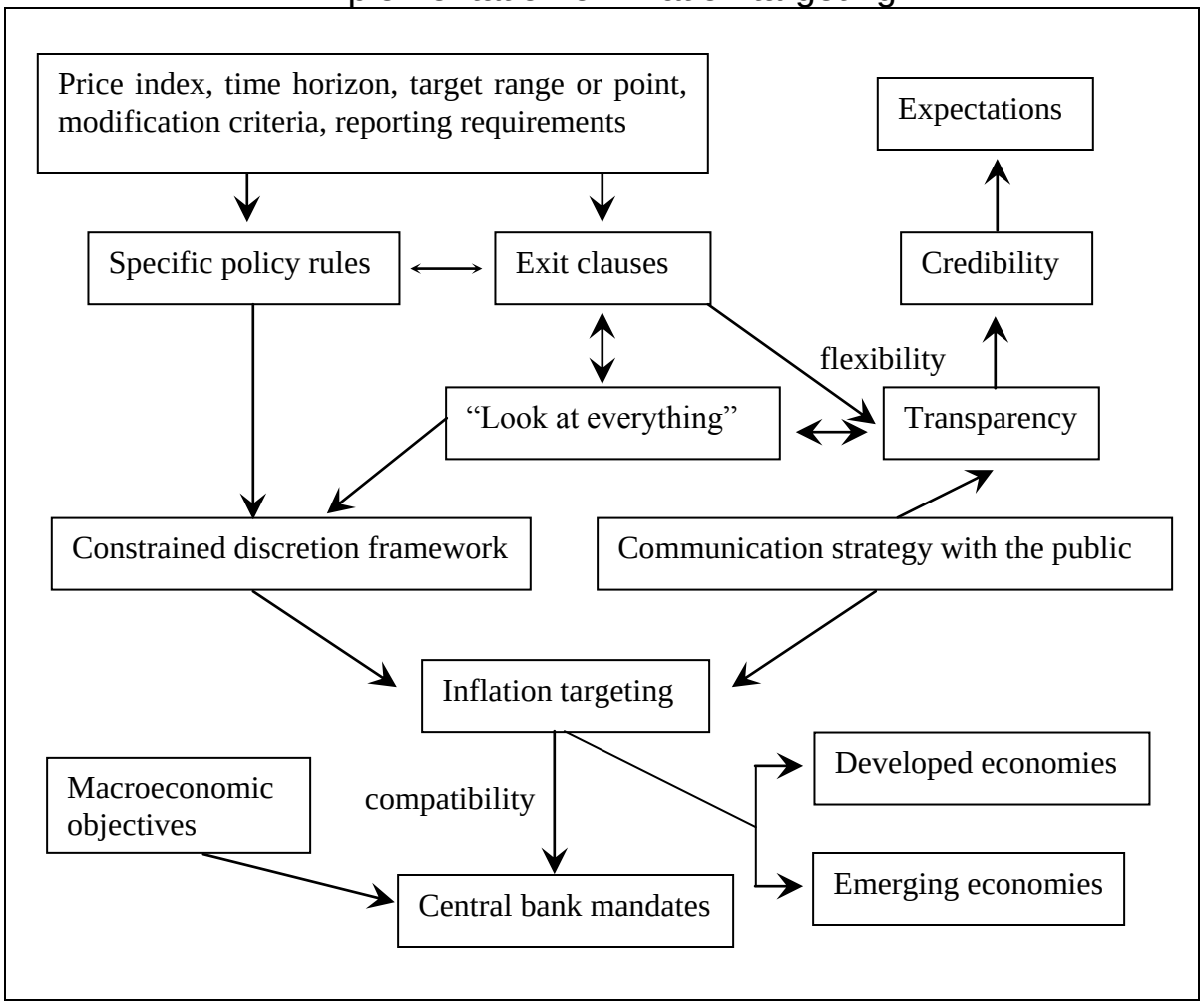
The current Federal Reserve chairman Ben Bernanke, despite being a great promoter of the inflation targeting approach, has not been able to make the Fed embrace formally such approach which evidences this internal debate. Concretely speaking, there are a few considerations Lawrence Meyer points out to be taken with care when considering the adoption of this regime[45]: *1)* the price index the inflation target should be based upon, *2)* should there be a specified time horizon for the target?, *3)* should the target be the overall measure of inflation or a core measure of inflation?, *4)* should the target be a point, a range or an average?, *5)* should the target be fixed or subject to modifications along the time horizon? , *6)* should the target be a price level or an inflation target?, *7)* should there be a cushion to price stability or not?, *8)* should there be additional reporting requirements once the explicit numerical inflation target is set or not? To come to an agreement about these issues would take many reunions, hearings and debates but are definitely important to shape any inflation targeting regime.

It is paramount to stress the importance of the interaction between transparency and flexibility because more transparency means less flexibility for all the agents can see the central bank's intentions which undermine discretion in the short run. In the long run, these two features tend to be mutually reinforcing thus the proper balancing of transparency and flexibility becomes a key issue.

[45] Lawrence Meyer is a distinguished scholar at the Center for Strategic and International Studies and president of Meyer's Monetary Policy Insights.

Illustration 20

Implementation of inflation targeting



Source: Own elaboration for illustration purposes.

5. Early developments in industrialized and advanced countries

As in every major breakthrough, this approach was first developed and introduced in industrialized countries. After the setbacks encountered by such during the seventies and eighties of the Twentieth Century to control monetary targets in the fight against inflation, inflation targeting was adopted in the nineties as a new alternative. The first industrialized countries (pioneers) in the adoption of inflation targeting were New Zealand in 1990, Canada in 1991, the United Kingdom (UK) in 1992, Sweden and Finland in 1993 and Australia in 1994. The major experiences from which this new approach fed in order to

become a more stylized framework come from New Zealand, Australia, Canada, UK and Sweden. New Zealand passed some institutional changes by law in order to adopt this approach after having reduced its rate of inflation from 17% to 5% in 1989.

New Zealand's experience begins with the independence of its central bank and the mission to achieve a single and clear objective: price stability. In order to do so, the finance minister and the central bank governor were required to confer and come to an agreement so as to the conduct of policy objectives such as a numerical value for inflation and the time frame within which it had to be achieved. These accords had to be made public and according to the results obtained, the central bank governor could be removed or ratified. This last is an unusual feature of the law behind the adoption of this approach. This country's central bank was given incremental reduction rates of the rate of inflation (target) to be achieved within different timeframes, which gives their approach little flexibility. However the set timeframe of a year sometimes puts additional pressure to the achievement of the target which can provoke excessive fluctuations in the monetary policy instruments.

It must be remembered that the exchange rate has a faster impact on inflation that interest rates in open small economies such as New Zealand's. It is worth noting that the unfretted attempt to achieve the target carries undesirable effects such as the reduction of output when the interest rate is raised in order to contain inflation. This last happened at the end of 1996 when the fear of not achieving the 1997 target made this country's central bank adopt a restrictive policy raising the inter-bank interest rate at 10% which produced an undesired decline in output. This kind of experience made aware that there might be time and again transitory conditions such as demand or supply shocks that affect temporarily the level of inflation and the results presented by the monetary authorities. These conditions can be better maneuvered by the central bank and reasonably offset without big losses in output or employment as long as there is no obsessive desire to comply with a rigid deadline. It must be remembered that monetary policies work with a lag. This implies that a counter policy may be applied too late when the economy has already suffered the adverse effects of a previous wrong policy. Such is evidenced by the recession this country underwent in 1998.

As opposed to New Zealand, in Australia there was no law that enforced the adoption of inflation targeting. It was introduced very gradually by the central bank governor in his speeches and eventually the inflation targets became a formal commitment. Inflation targeting in Australia emphasizes flexibility in every aspect of its operation, from the target definition to the discretional nature of its actions in order to respond to disturbances. What both countries do share is the fact that both embraced inflation targeting after having reduced the inflation levels substantially. The stressed feature of flexibility in Australia helped the approach to deal smoothly with international disturbances such as the Asian crisis since the expectations remained anchored during the monetary easing engineered by the bank. This was only possible due to the fact that people believed the announcements of the central bank and trusted that it was the best thing to do.

The case of Canada is characterized also by flexibility and the targets are announced jointly by the government and the central bank. Canada also understood the lags in the effects of monetary policy and established larger timeframes for evaluation purposes. The central bank is not directly responsible before the government for the results obtained and there are no sanctions for the governor for not achieving the target as in New Zealand, rather the central bank answers the general public for its actions and outcomes like the Australian version. Canada has put special emphasis in reducing output volatility.

The UK adopted inflation targeting as the proper regime to set a nominal anchor in lieu of the exchange rate after the experience lived under the speculative attack on the sterling in 1992. Before 1997 the bank of England could only issue recommendations but did not have legal authority about the definition of the monetary policy. The outstanding feature of the UK inflation targeting is the attractive format used to improve transparency in monetary policy actions and to enhance the communication with the public. This format avoided dull formality and incorporated graphs, tables and figures to facilitate its understanding by the public. Later on, this format was emulated by many other inflation targeting central banks. It can be said that the success of inflation targeting in the bank of England was due to the focus on transparency and communication with the public which eventually helped it to gain its monetary policy instruments operational autonomy in 1997.

Sweden, as the UK followed for many years an exchange rate nominal anchor that required frequent interventions from the *Sveriges Riksbank* (this country's central bank) to maintain a long and almost unbroken record of exchange rate targeting (although with frequent *krona* devaluations) until the country could not sustain the exchange rate anymore during the 1992 currency-market turbulence. Not wishing to move on without a nominal anchor, they turned to inflation targeting in 1993. Sweden's adoption has some interesting features worth mentioning like choosing to use headline inflation in lieu of core inflation although the latter has gained importance in the bank's decisions and explanations; and the lack of independence of the bank. The government maintains legal control of the *Riksbank* but it sets the inflation target and the instrument interest rates in practice. The replacement of an exchange-rate-based policy that was in direct conflict with domestic economic goals with a more flexible inflation-targeting regime did not damage the bank's credibility in spite of the unrest that resulted in the loss of the exchange-rate peg.

The use of headline inflation deserves more explanation since it is one special feature of this country's approach. Originally it might have been a measure intended for those who felt that a strong, transparent commitment to price stability, was necessary to offset any credibility loss arising from the loss of the peg or due to the role of headline consumer price index in national wage bargaining. Either case Sweden's central bank ignores "special" or "transitory" influences on current inflation rates as long as they do not affect the forecast of future inflation. In other words, they compare core and headline inflation levels on a regular basis and respond to core inflation in the short run while asking to be assessed according to headline inflation levels in the long run, a feature shared with Canada's central bank. In the following illustration, some lessons from the early experiences under inflation targeting have been extracted.

Illustration 21

Lessons from pioneer industrialized and advanced countries

Lesson
1. Inflation targeting has been successful in controlling inflation.
2. Inflation targeting weakens the effects of inflationary disturbances.
3. Inflation targeting promotes growth and does not exacerbate production cycles.
4. Inflation targeting does not necessarily reduce the costs of reducing inflation.
5. The key to the success of inflation targeting is the emphasis on transparency and communication with the public.
6. Inflation targeting improves accountability and reduces the time inconsistency problem.
7. Larger transparency and accountability of inflation targeting help to promote central bank independence.
8. Answering to the general public seems to work just as well as answering to the government.
9. Inflation targeting is compatible with democratic principles.
10. Inflation targeting is far from being an strict rule approach.
11. The inflation targets have always been above zero without central banks losing credibility.
12. Inflation targeting does not ignore the traditional stabilization objectives.
13. Avoiding going under the lower value of the target interval is as important as avoiding going over the upper value.
14. Inflation targeting must be implemented after having reduced high levels of inflation.
15. A short timeframe or a tight target interval can cause control and instability problems in the instruments.
16. The upper and lower limits of the target interval can get life of their own.
17. To establish asset price targets or exchange rate targets worsens the performance of inflation targeting.

Source: Own elaboration with information from Mishkin (2000).

To wrap up all these early chapters in the development of inflation targeting, it can be concluded that these experiences lived by those pioneer countries have set the examples from which the key elements of an inflation targeting regime originated namely central bank independence and accountability, the establishment of an inflation target, a restrained discretion framework and a communication strategy with the general public. All these key elements rest on the base of credibility which once constructed by actions rather than words work in the benefit of monetary policy to achieve not only inflation objectives but also other important ones such as the level of employment, output or exchange rate as long as they reach a high level of coordination and find no conflict with one another, easily said than done.

6. Implementation in emerging countries

Turning now to the convenience of applying such targeting approach to emerging economies, there are antagonistic opinions. Some argue that the lack of educated staff and the presence of a weak financial system could enhance the desired effects rendering monetary policy destabilizing. Further, many institutional changes would have to be made in an already potentially weak political environment. Nevertheless John Taylor asserts that the use of rules (constrained in inflation targeting) in emerging economies has many of the same benefits that have been found in research and in practice in developed economies (Taylor, 2000).

He considers five particular issues in addressing the question of policy rules in said economies: *1)* the appropriate instrument in a monetary policy rule, *2)* the appropriate degree of specificity of the rule, *3)* the relationship of a monetary policy rule to inflation targeting, *4)* the implications of underdeveloped long-term bond markets for the choice of a policy rule, and *5)* the role of the exchange rate in a monetary policy rule. The first point is an important one since said economies may not have enough transmission mechanisms for which the preferred policy instrument namely short term interest rate may not be as appropriate as a monetary aggregate which conveniently remains under the central bank direct control.

The second is determinant given the fact that these countries are prone to discretion and have shown a tendency to disregard rules. The best path is to come to a country specific agreement. The third one establishes the importance of following rules in order to achieve the target and reinforces the first one. The fourth point stresses the implications of the lack of transmission mechanisms and trustworthy indicators for the proper application of the rule and the last one calls attention to the fact that exchange rates also work as nominal anchors being an important issue in the adoption of the inflation targeting approach that also functions as a nominal anchor. Consequently said approach must be used with flexible exchange rates. Remember Taylor's trinity.

Since this approach was first introduced in New Zealand back in 1990, inflation targeting has been adopted by 26 countries, out of which 16 are emerging market economies (See Illustration 18A). There appears to be a consensus among people from the IMF that more emerging market and developing countries are likely to switch to inflation targeting within the next 10 years or so. During the 1970s and 1980s higher inflation in both developing and developed countries did not promote neither stronger growth, external competitiveness, nor employment, on a sustainable basis. On the contrary, it showed to be bad for growth, for employment, and for balanced wealth distribution of real income in the long run.

These experiences have demonstrated that the main contribution central banks can make to good economic performance in the long run is to provide an environment in which inflation and inflation expectations are anchored at a low level. The experiences of the first world countries that have adopted inflation targeting are generally considered as having been successful in providing both, policy credibility and flexibility resulting in low inflation and growth performance, together with increased resilience to shocks. These experiences have also influenced emerging market economies into adopting inflation targeting. Nonetheless before going into detail about the convenience for emerging countries, let's go over some facts and features of inflation targeting in developed countries.

To begin with, economic agents are thought to prefer low and stable inflation rather than high and variable inflation. However, they also prefer high and rising real income per capita and output that is consistently close to the economy's maximum sustainable level of output. This logical assumption is often expressed in terms of a loss function where the loss to society is expressed as a weighted average of squared deviations of inflation from its target and of output from its potential level. The loss to society can be expressed as follows

$$L = a\,(\,\pi - \pi^{*}\,)^{2} + (\,1 - a\,)\,(\,y - y^{*}\,)^{2} \quad \text{.....(6)}^{46}$$

where:

π is the rate of inflation.

π^{*} is the target rate of inflation.

y is the level of output.

y^{*} is the target level of output or potential output.

The squaring ensures that deviations on either side of the targeted items are treated equivalently as losses. The weights, *a* and *1- a*, indicate the public distaste for deviating from their preferred rates of inflation and output. Even though it is possible in principle to achieve price stability and full employment simultaneously, an inevitable tradeoff between the variability of output and the variability of inflation exists. Said tradeoff is most obvious in the case of a supply shock, for example an abrupt increase in the prices of energy. An adverse supply shock typically raises inflation and lowers aggregate demand (by reducing the purchasing power of consumers), thereby moving inflation up and output down. This raises the question for monetary policy: Should monetary policy ease to reduce the decline in output or tighten to counter the rise in inflation? The structure of the economy is such that the quicker monetary policy tries to return inflation to its target (to reduce the variability of inflation), the greater the variability in output.

[46] Meyer (2001)

The purpose of a hierarchical mandate is to impose constraints on the operation of monetary policy, constraints that proponents believe enhance credibility, focus policy on what monetary policy can achieve, and reduce political pressures for policy to aim at impossible-to-achieve and potentially destabilizing output goals, such as a level of output above the economy's maximum sustainable rate. However, those same constraints might interfere with the pursuit of other legitimate objectives of monetary policy, specifically with policy adjustments to reduce the variability of output around potential output. Most inflation-targeting regimes explicitly recognize that returning inflation to its target too rapidly following some departure could result in excessive variability of output.

The solution has been to encourage a gradual return to the inflation target by explicitly or implicitly setting a policy horizon over which policymakers commit to return inflation to its target. Setting fixed horizons for the return to the inflation target, independent of the size or the nature of the shock, clearly reduces the flexibility of monetary policy. To be fair, many regimes explicitly note that the policy horizons need not be fixed or include escape clauses that would allow greater flexibility, for example, in response to a supply shock. But setting a policy horizon is intended to, and does, constrain policy responses. It may therefore interfere with an appropriate balancing of the full-employment and price-stability goals. This is especially the case if the mandate is hierarchical, where other objectives can be pursued only if the inflation objective is achieved.

The Taylor rule is a useful characterization of U.S. monetary policy. According to the Taylor rule, monetary policymakers should adjust the target for the short-term interest rate in response to deviations of output and inflation from their respective targets and in response to changes in inflation. It is therefore well aligned with a dual mandate. The kind of mandate the Federal Reserve bears. The Taylor rule can be written as

$$R = r^* + \pi + c\,[\,(y / y^*) - 1\,] + d\,(\pi - \pi^*) \quad \ldots\ldots\ldots\ldots\ldots\ldots (7)$$[47]

[47] Ibídem.

where:

R is the target nominal policy rate.

r^* is the equilibrium real level of the policy rate (consistent with price stability and full employment).

y is output.

y^* is the level of potential output.

π is inflation.

π^* is the target for inflation.

c and d are the parameters that describe the response of the policy rate to deviations of output and inflation from their respective targets.

The Taylor rule is consistent with the loss function described in equation 6 because the rule prescribes an adjustment of the interest rate in response to the deviations from target values that are presumed to give rise to costs to society. The Taylor rule also helps to make the point that policymakers can operate with an output stabilization goal and still ensure that inflation is, on average, consistent with the inflation target in the long run. All these arguments are important to clarify the importance of rules and certain flexibility to deal with unexpected shocks for inflation targeting under the assumptions of minimizing the loss function of society along with the compliance of its objectives. This last statement implies that inflation targeting regimes, either strict or flexible, sacrifice optimality for the sake of credibility.

Illustration 22

Countries following inflation targeting, 1990 - 2007

Country	Target	Date of adoption	Previous anchor
Australia	2 – 3 %	1993	
Brazil	4.5 % (+ / - 2 %)	1999	Exchange rate
Canada	1 – 3 %	1991	
Chile	2 – 4 %	1990	Exchange rate
Colombia	2 – 4 %	1999	Exchange rate
South Korea	3 % (+ / - 1)	1998	Money supply
Slovaquia	0 – 2 %	2005	Exchange rate
Phillipines	4 – 5 %	2002	Exchange rate and money supply
Ghana	0 – 10 %	2007	Money supply
Hungary	3 % (+ / - 1)	2001	Exchange rate
Indonesia	6 % (+ / - 1)	2005	Money supply
Iceland	2.5 % (+ / - 1.5)	2001	Exchange rate
Israel	1 – 3 %	1992	Exchange rate
Mexico	3 % (+ / - 1)	2001	Money supply
Norway	2.5 %	2001	Exchange rate
New Zealand	1 – 3 %	1990	
Peru	2 % (+ / - 1)	2002	Money supply
Poland	2.5 % (+ / - 1)	1998	Exchange rate
UK	2 %	1992	Exchange rate
Tczek Republic	3 % (+ / - 1)	1998	Exchange rate and money supply
Rumania	4 % (+ / - 1)	2005	Money supply
South Africa	3 – 6 %	2000	Money supply
Sweden	2 % (+ / - 1)	1993	Exchange rate
Switzerland	0 – 2 %	2000	Money supply
Thailand	0 - 3.5 %	2000	Money supply
Turkey	4 % (+ / - 2)	2000	Exchange rate

Source: Own elaboration with information from Iceland's central bank, 2007.

Even though all these positive features of inflation targeting, some controversy has arisen so as to the convenience of adopting this approach in emerging economies. This controversy spins around the benefits *versus* the costs that could arise from such adoption. These issues are *1)* whether achieving better inflation performance is likely to come at the cost of poorer growth performance, *2)* what pre-conditions need to be met for the adoption of inflation targeting, and whether these preconditions are likely to be too demanding for most emerging market and developing countries and, *3)* whether an inflation targeting framework is more robust than alternative approaches to financial market disturbances to which emerging market and developing countries may be particularly vulnerable. Even under such points of debate, inflation targeters typically succeeded in cutting their inflation rates from over 10 percent per annum to around 4 percent, roughly by twice as much as in non-inflation targeters.

The fact that inflation targeting has been successfully adopted by countries with very diverse structures such as New Zealand, Israel, Chile, Colombia, Brazil or Mexico is an indication that it can be a flexible policy framework adaptable over time to country-specific circumstances. The emerging countries that adopted inflation targeting managed to achieve substantial reductions in inflation in the 2000-2005 period without any significant sacrifice in terms of growth performance. However, inflation targeting countries are not immune to disruptive shifts in investor sentiment and the consequences for exchange markets and, ultimately, growth and inflation performance. In some cases the trigger has been a fairly general shift in investor feeling either toward or against emerging markets.

One of the main concerns for the plausibility of this approach in emerging economies is the role of the exchange rate. Let's take a few examples in Latin America. In this region the economies are partially dollarized making exchange rate fluctuations likely to have a larger affect on aggregate demand and supply. According to Mishkin and Savastano (2001), this is not inconsistent with inflation targeting. It only implies that this regime will care about exchange rate fluctuations, just as it should care about output fluctuations. It is true that the regime requires exchange rate flexibility and the economies of this region are highly open and dependent on external financing which makes exchange

rate shocks unavoidable. This calls for the need of incorporating an exchange rate term into the following equations.

$$\pi_t = \pi_{t-1} + \alpha_1 y_{t-1} + \alpha_2 e'_{t-1} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (8)^{48}$$

$$y_t = \beta_1 y_{t-1} - \beta_2 (i_{t-1} - \pi_{t-1}) + \beta_3 (e_{t-1} - e_{t-2}) + \eta_t \ldots\ldots\ldots (9)$$

where:

π_t is the inflation rate at time t.

α is the weight assigned to output and exchange rate respectively.

β is the weight assigned to output, inflation gap and exchange rate gap respectively.

y_t is the output level at time t.

i_{t-1} is the nominal interest rate.

ε_t is an aggregate demand shock.

e is the exchange rate.

η_t is an aggregate supply shock.

with the exchange rate determined by $e_t = \Phi\, i_t + u_t$

where e_t is the log of the real exchange rate expressed as a deviation from a "normal" (medium-term) level, u_t is an error term, and Φ captures the positive relation existing between interest rates and the value of the currency. The following policy becomes optimal for setting the interest rate and is consistent with inflation targeting.

$$i_t = \pi_t + b_1 (\pi - \pi^*) + b_2 y_t + b_3 e_t \ldots\ldots\ldots\ldots\ldots\ldots (10)^{49}$$

where:

i_t is the interest rate at time t.

b is the weight assigned to inflation gap, output level and exchange rate respectively.

[48] Mishkin (2001).
[49] Ibídem.

π_t is the inflation rate at time *t*.

$(\pi - \pi^*)$ is the difference between the inflation target and average inflation rate.

y_t is output at time t.

e_t is exchange rate at time *t*.

which will bear a relatively large coefficient b_3 but perfectly consistent with an inflation targeting regime. This addition makes the policy not only attentive to inflation behavior but also to exchange rate levels. Chile was the pioneer in the region with this type of monetary policy strategy after granting the monetary authority its independence and the mandate of price stability as one of its primary objectives in 1989. Chile's inflation history records two major stabilization programs, in 1959-62 and in 1979-82 based on a nominal exchange rate anchor as the main instrument for stabilization and both failed. A new strategy had to be followed to give credibility to the central bank so, the attack on inflation was gradualist; starting with targets of over 20% for 1991 and lowering them slowly to below 5%.

The success in reducing inflation and meeting the targets fixed the impression in the public that they were "hard" targets for which the bank could be made accountable. As a consequence, in 1994 the bank started announcing point targets rather than ranges but it was not until 1999 when the monetary authority explicitly announced a multi-year target for inflation. The output growth between 1991 and 1997 averaged almost over 8.5% per year which suggests that the adoption of this policy regime in Chile not only helped reduce inflation from double digit levels but also promoted output growth.

On the other hand, the anti-inflationary strategy of Colombia was unsuccessful due to the fact that there was no serious commitment to lowering inflation during the nineties despite the issuing of explicit numerical targets and timeframes by the central bank. It gave priority to output stability whenever it seemed to be affected by the inflation target resulting in an unsuccessful anti-inflationary strategy. In contrast, Brazil adopted inflation targeting quite rapidly and aggressively after the collapse of the *real*, it did it via a presidential decree containing all the key elements of an inflation targeting strategy.

It was the first comprehensive attempt to establish such a regime in Latin America after having performed some economic reforms such as the privatization of many state enterprises, reduction in import tariffs and elimination of non-tariff trade barriers, updated prudential regulation of the financial system and the liquidation of unsound financial institutions.

What Brazil failed to do quickly was a much needed fiscal adjustment which after the 1998 Asian crisis provoked a confidence crisis resulting in pressures on its foreign reserves and the *real* had to be allowed to float. Mexico followed a more gradual pace into the adoption of the regime first by explicitly announcing an inflation target and later by emphasizing on the inflation goal as the central objective of its monetary policy. As from April 2000 Banco de México has been issuing an *Inflation Report* which explains what has been going on in the inflation front and how it plans to achieve its objective, which contributes to its accountability and as from 2001 formally adopted the approach.

Let's see another example of totally different country, Israel. This small open emerging economy adopted this approach in 1992 with a very particular characteristic: a monetary policy based on two nominal anchors, a crawling exchange rate band and inflation targets. The bank of Israel managed to reduce inflation gradually from 18% to 10% between 1992 and 1996 and to 7% in 1997 until it reached 4.7% to September 1998. Israel decided to adopt this approach because it had been leading triple digit inflation rates during the 1970s and early 1980s which kept the country economically stagnant.

There are difficulties in conducting monetary policy with two nominal anchors for any number of reasons. First, it is difficult to maintain an exchange rate commitment in an open economy subject to capital flows, second a preset trajectory of the nominal exchange rate can slow down the process of real exchange rate adjustment to real and financial shocks, third there may be a distortion in the people's perception of exchange rate risk and finally the exchange rate targeting may conflict with other objectives of macroeconomic

policy, including monetary policy, such as the inflation target[50]. For this reason Israel gradually switched over the years towards increased flexibility of the nominal exchange rate, coupled with increased emphasis on inflation targeting via strong and aggressive responses of the central bank, when needed, with a view to constructing credibility.

Overall the outcomes suggest that inflation targeting stands as a good policy regime in emerging economies, however fiscal discipline and a sound and well-regulated banking system are paramount for its viability and success. Brazil and Colombia have been striving to deal with the former while Mexico's banking system raises doubts. Despite all this, the balance so far points at the adoption of this regime given the favorable outcomes from Chile, Brazil, Mexico and Israel, nevertheless it must be clear that credibility remains crucial and calls for changes in the institutional apparatus pursuant to preventing cheating by the authorities. This may not always be entirely possible in emerging market economies. In the following illustration the main entrance conditions and characteristics of the inflation targeting in emerging economies can be reviewed.

[50] It may well be that the level of the interest rate required to achieve the inflation target differs sharply from the level appropriate for sustaining the currency band.

Illustration 23

Inflation targeting: Emerging economies implementation

Emerging economy (year of adoption)	Entrance conditions	Implementation characteristics	Regime characteristics
Chile (1989)	- Exchange rate nominal anchor. - Three digit inflation rates. - No independent central bank.	- Gradualist approach. - No use of exchange rate as nominal anchor.	- Successful in both, disinflating and meeting inflation targets. - Use of interest rate as nominal anchor. - Single mandate of price stability. - Accountability of the central bank for the achievement of its objectives.
Colombia (1991)	- Inflation rates averaging 20-25%. - Priority to output stability.	- Explicit announcement of numerical targets. - Priority to output stability.	- Unsuccessful anti-inflation strategy. - Lack of credibility.
Brazil (1994)	- Double-digit inflation rates. - Lack of fiscal discipline. - Inefficient State enterprises. - Tariff and non-tariff barriers. - Weak financial legislation. - Unsound financial institutions.	- Fast via a presidential decree. - Wide range of economic reforms such as sale of state enterprises, elimination of barriers, legislation updating and liquidation of unsound financial institutions.	- Flexible exchange rate. - Independent central bank. - Multi-year inflation targets. - Responsibility of the central bank. - Accountability of the central bank. - Actions to improve Transparency.
Israel (1992)	- Triple digit inflation rates. - Exchange rate nominal anchor.	- Gradualist approach. - Two nominal anchors with a gradual emphasis on inflation targeting. - Aggressive responses towards inflation to build credibility.	- Flexible exchange rate. - Independent central bank. - Aggressive response. - Communication strategy with the public.
México (2001)	- High inflation levels during the 80s. - Exchange rate nominal anchor.	- Independence of the central bank. - Accountability of the central bank. - Flexible exchange rate.	- Flexible exchange rate. - Independent central bank. - Multi-year inflation targets. - Responsibility of the central bank. - Accountability of the central bank. - Communication strategy.

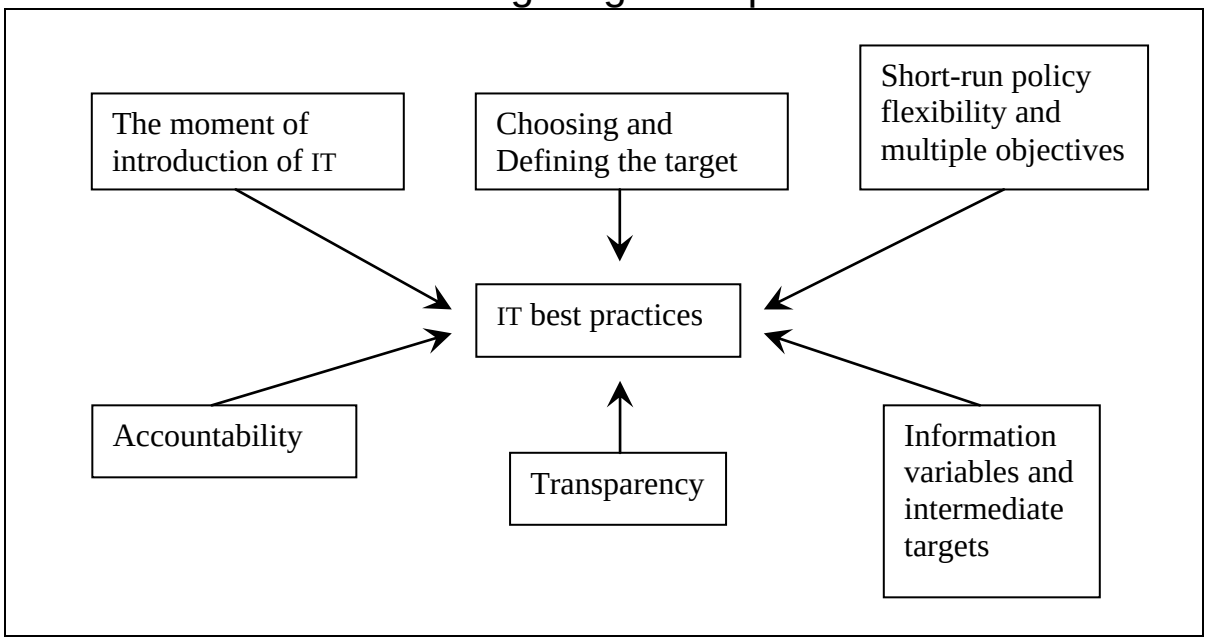
Source: Own elaboration with information from Blejer, Ize,Leone and Werlang (2000) and Mishkin and Savastano (2001).

7. Preliminary outcomes

After reviewing the previous sections we are now at a position where some questions can be addressed. Especially questions about the design and operation of inflation targeting, macroeconomic performance and alternative approaches to inflation targeting. This will provide us with a round perspective of the approach with a view to enabling us to address the next chapter with a clearer image of this policy regime. First, there appears to be a consensus about the "best practices" in inflation targeting that have originated from the experiences lived in countries that have adopted said approach. See next illustration.

Illustration 24

Inflation targeting: Best practices



Source: Own elaboration with information from Bernanke, Lauchbach, Mishkin and Posen (1999).

These best practices call for country-specific conditions to best suit the needs of the economy. With regards to macroeconomic performance, inflation targeting seems to, indeed, lead to lower inflation through the anchoring of expectations relative to their previous experience. Inflation targeting is also a proper regime due to its forward-looking approach to avoid deflationary risks and not only inflationary ones that promote boom and bust cycles or recessions. Moreover, according to Bernanke there appears to be little if any

reduction in the output loss (sacrifice ratio) associated with disinflation amongst countries adopting inflation targeting but as inflation targeting policies produce a continuing record of success in reducing inflation, both, pioneers and later adopters of this approach will begin to enjoy a "credibility bonus" in the form of a lower real cost of achieving any reduction in inflation.

The experiences lived to date under inflation targeting have brought to light a trade-off between flexibility and credibility (the center core of the next chapter) due to the fact that the more flexible the framework, the less credible it tends to be. In this same direction, the choice of a particular measure of the inflation rate, the adoption of measures to enhance credibility (specially frequent and transparent communication with the public), and the choice of the policy horizon, all affect the above mentioned trade-off. In contrast, too much flexibility may hurt people's confidence in the regime. In conclusion, the main message from the experience so far, is the need to establish credibility as early as possible in order to weaken the trade-off and consequently allow greater flexibility in the longer run.

Another important conclusion at which it was arrived through these experiences was that under inflation targeting, different objectives can be followed and attained but always bearing in mind that they must be consistent with inflation targeting. To date, we know that the coexistence of multiple anchors like a crawling currency band along with an inflation target or a monetary aggregate target together with an inflation target, sooner or later becomes a source of policy conflict which eventually damages credibility. A central bank can only aim at having full credibility for low inflation with the backing and understanding of the government and the public for which a legislative mandated inflation target helps enhance the public's understanding and support by providing a document that can be studied and explained in the nation's academic bodies and discussed to a larger extent in the press and media.

Notwithstanding all its benefits, inflation targeting is no *panacea.* It cannot wring inflation out of the economy without incurring costs in lost output and employment. Central bank credibility is not achieved immediately and must be earned by demonstrating that they

have the means and the will to reduce inflation and to keep it low for a period of time. As for alternatives to inflation targeting, I must first highlight that this approach provides a nominal anchor for future expectations and a framework within which policymakers exercise "constrained discretion". Any alternative must offer at least similar advantages and I shall only touch on them since they are not relevant for understanding the next chapter. Pegging the exchange rate to a low inflation country should make the domestic inflation rate approach that of the other country. Targeting a monetary aggregate is another alternative that gives the central bank more freedom of action to adjust monetary policy to domestic conditions. Finally, targeting Nominal Gross Domestic Product (GDP) could be a reasonable alternative to inflation targeting but there are a few setbacks in expectations due to the difficulty of giving such figures and the impact of those on the agents. That could make policy conduct difficult.

To wrap up the chapter, it can be said that although inflation targeting does not avoid the costs of achieving disinflation, we have seen that inflation targeting has been very successful in helping the pioneers and others to achieve and maintain low inflation rates, something good for the economy in the medium and long runs and also something they could not always do in their past experiences.

* * *

The phenomenon we call inflation has been studied from many standpoints and has always been the subject of controversies amongst economists. Some important consensus in today`s monetary policy is that the constant and consistent use of rules help create credibility in the population towards the monetary authority actions. Nevertheless, there are countless situations where the temptation to cheat on the public in order to comply with other objectives other than control of inflation exist. Good monetary policy is in Taylor's opinion the one that follows his trinity 1) rules, 2) flexible exchange rate and 3) inflation targeting. Even in developing countries, inflation targeting has had promising results, which in a sense contrast the use of rigid rules that create credibility, one of the pillars of inflation targeting. Consequently, there must be some kind of interaction amongst rules, inflation targets and the construction of credibility necessary for any inflation targeting regime.

Chapter III

Development and interactions between credibility and inflation targeting

"To hear or read without attention is a useless occupation"
Confucius

Overview

Credibility represents the backbone of contemporary monetary policy because agents behave rationally. As a consequence, all monetary targets to be attained depend upon the degree of credibility allocated by agents to the level of commitment of the authority towards the achievement of such targets. Some of the most important economists that have worked this interaction are John B. Taylor, Lars Svensson, Michael Woodford, Robert Hetzel, Bennett McCallum and Marvin Goodfriend to mention a few. One of the generally accepted features enhancing credibility is the independence of the central bank from the government; which impedes any pressure from the government onto this institution in order to profit from any dynamic inconsistency opportunities that may arise. Throughout this chapter, I will attempt to depict the interactions between credibility and inflation targeting using in the most part of the section the US financial crisis and the respective views of important economists. It is undisputed that the debate amongst economists as to the development and interaction between credibility and inflation targeting has reached its pinnacle within the US.

A. Contemporary perspectives

1. The role of credibility

There is a consensus in modern monetary policy about the role of the credibility hypothesis for policy evaluation purposes because agents are rational as explained in Chapter I. Everything boils down to the rationality of agents who will form their expectations once they have incorporated every available piece of information into their decision-making process. The degree of credibility assigned to the commitment of the authorities to stay with the rule in operation or not, is determinant for the success of monetary policy. During the time known as the "Great Moderation" characterized by low and stable inflation, long expansions and mild recessions, predictable policies and

guidelines were followed in lieu of discretion. One way to help build credibility is via more transparency which implies less flexibility and more predictability accordingly.

Discretionary policy involves frequent actions towards short-term developments, with little attempt to consider and communicate intentions for future actions. This gives little importance to the benefits of outlining a contingency plan and committing to that plan. Uncertainty can be enhanced via frequent and unanticipated government actions that interfere with long-term business and household planning. Policymakers have a natural incentive to alter previously adopted policies or to follow "inconsistent" policies which have detrimental effects in the long run behavior of the economy[51]. On the other hand, by being more constrained and committed to following a rule, the monetary authorities gain credibility and the expectations of the agents become more anchored as communication with the public about the conduct of monetary policy increases.

This alternative to discretionary policies could be referred to as a systematic policies approach which specifies as clearly as possible a plan for the instruments of policy that is not only a simple or complex formula for policy but also a broader framework that allows for some judgment in interpreting or implementing the plan as necessary under the operation of the plan itself or its contingencies. The improvements in economic performance during the Great Moderation helped to upgrade peoples' lives. One piece of evidence for the good economic performance during those years, was the greater focus on inflation targets either informally (Federal Reserve) or more formally (New Zealand, UK, Riksbank, etc.).

For instance, the Federal Reserve decisions about an interest rate change before the 1980s were tied in vague ways to decisions about borrowed reserves and were left to the market to discover. After the 1980s a clearer communication strategy was implemented with the Federal Reserve announcing its interest rate decision right after having made it and providing explanation to the markets about what it is thinking of the future. These changes

[51] Because inflation takes more time to develop than the rise in economic activity, that is an important factor in the political election cycles, Taylor says that it may not be adequately taken into consideration in the public policy process.

enhanced the central bank's credibility to stick to its predictable operations and inflation targets. Other central banks followed similar actions because the overall aim had been to become as predictable and systematic as possible with the instruments and policy convincingly and consistently aimed at the inflation target or price stability objective. This represented a noticeable change from the days when central bankers tried to preserve their mystique and thought that they were supposed to surprise markets from time to time in order to make monetary policy effective.

The most important part of any regime change is the central bank's becoming markedly more responsive to developments in the economy when they adjust their policy interest rate. In other words, to the actual actions of the central bank rather than words. In this respect, the expectations of future inflation matter for pricing decisions today because with current price decisions expected to last into the future, some prices set in the future will be relevant for today's decision. This last is a remarkable outcome for monetary policy. For the first time expectations of future inflation come into play in determining the current inflation rate which gave a rationale for central bank credibility in its commitment to price stability and for setting an inflation target. An announced policy is credible, if the people believe that it will be implemented and react on those beliefs even in the face of occasional contradictory evidence. When the public is confident that appropriate policies are being followed (expectations are anchored), families and businesses can plan for the future, which promotes saving, investment, and economic growth.

I shall address this point by drawing your attention to the current crisis in the US for this country is the most studied case for credibility as a key component of standard modern economics. Taylor points out that in the case of monetary policy it was an interventionist deviation from the type of systematic policy responsible for the remarkably good economic performance in the two decades before the crisis what caused the mayhem. The financial crisis did not occur because of economic theory going wrong but because policy makers stopped paying attention to economics. In words of Hugo Contreras it would be like blaming calculus for airplane crashes in the world. The policy implications of the crisis are that those central banks that deviated from good policy need to get back to whatever they

were doing before the crisis. There's a need to earn back credibility and preserve central bank independence.

As a particular example, the Fed by consistently following a forward-looking policy has earned a high degree of credibility. This credibility is suggested by the lack of increase in measures of inflation expectations in the late 1980s as the economy drew closer to full utilization of its productive resources, a situation that in the past, typically was characterized by rising inflation expectations. In conclusion we can say that a high degree of monetary policy credibility will often lead to superior economic performance compared with the situation where a policy is not perceived to be very credible.

The ever changing nature of the economy leads to the constant change in economic relationships and credibility can help to solve such problems via the plausibility and consistency of the announced policy in the context of the overall economic environment and other policies. Monetary policy needs to maintain credibility in order to make sure that the goals of policy will be attained during periods of dynamic economic and financial developments. The experience and research have shown that a properly chosen systematic policy program is more likely to perform well than a short-sighted discretionary approach to policy.

Evidence of this can be found in the consistent part of the Volcker-Greenspan policy procedures carried out to restoring nominal expectational stability. Both Fed presidents behaved in a consistent way over their tenure which favored a policy rule rather than a discretionary policy undisciplined by explicit objectives and strategy (fine tuning). This consistent behavior can be expressed in the following model

$$i_t = i_{t-1} + \alpha (\pi_t^e - \pi) + \beta \Delta R_t^{RU} \qquad \alpha, \beta > 0 \ldots\ldots\ldots\ldots (i)$$ [52]

[52] Hetzel (2006).

where:

i_t is the funds rate

π_t^e is expected inflation

π^* is the inflation target

ΔR_t^{RU} is an estimate of persistence in the change in the rate of resource utilization, it measures the extent to which output is growing faster than potential output in a sustained way, that is $(\Delta y_t^s - \Delta y_t^p) > 0$, where(the log of) real output is y_t. The superscript "s" indicates "smoothed" real output, that is, output purged of transitory factors. The superscript "p" indicates potential output and Δ is the first difference operator.

Credibility will achieve the success of policy ultimate goals by bringing about a better economic outcome in the presence of unpredictable changes in the economy by reducing uncertainty about future developments and making it easier for economic decision-makers to plan ahead. The role of credibility hereto discussed can be considered as a consensus between New Keynesians and Rational Expectations Monetarists whose standpoint reflects the same spirit already expounded. I shall proceed to reinforce this statement by introducing some important monetarist's reflections about the interaction of credibility and rules.

Central banking as has been mentioned before needs to be explicit in its behavior in terms of state-contingent language if it is to achieve its objectives. A high degree of public communication and dialogue is required to maintain expectations anchored. Transparency refers to the clarity with which central banks state their objectives and their strategies to be followed in order to attain those objectives. The specialized literature distinguishes two kinds of transparency: *1)* policy-rule transparency and *2)* forward policy-action transparency. The first one refers to the articulation of the consistent part of its procedures and commitment to said consistency. The second refers to the forecasting of the funds rate.

This last has certain limitations due to the difficulties inherent to forecasting[53] while the other complements the market's forecast of the economy.

This is important because financial markets seek to understand how the central bank responds to incoming information and react accordingly. This affects the behavior of the yield curve in an either stabilizing or destabilizing way so the clearer the central bank is about the systemic part of its policy, the more stabilizing the behavior of the yield curve will be. Credibility implies that the yield curve responds in a stabilizing way in response to macroeconomic shocks so the implementation of a simple rule like the one depicted above could assume the following particular form

$$i_t = i_{t-1} + 0.125\,(\pi_t^{TR} - \pi^*) + 0.25\, I_t^{RU} \quad \text{.....(ii)}^{54}$$

where:

π_t^{TR} is trend inflation and replaces expected inflation π_t^e

π^* is the target for trend inflation.

I_t^{RU} is the rate of resource utilization.

0.25 is the standard size of funds rate changes.

0.125 is an arbitrary coefficient proposed by Hetzel.

This rule is proposed by Hetzel to single out the importance of credibility to assure stabilizing behavior of the yield curve via the belief of the financial markets that the central bank will raise the funds rate in a persistent way as long as a positive miss of the inflation gap exists and conversely in case of a negative gap. As for resource utilization, the terms $i_t = i_{t-1} + 0.25\, I_t^{RU}$ captures the "lean-against-the-wind" part of the policy where the interest rate will rise above its prevailing value in a measured persistent way as long as the rate of resource utilization is rising. The I_t^{RU} takes the value of 1 if the resource utilization

[53] External and internal supply and demand shocks, changes in the correlation of variables, new institutional changes and regulations, volatilities etc.

[54] Hetzel, op. cit.

rate is increasing, -1 if it is decreasing and zero if there is no variation. The important thing here is that the public believe that the central bank will raise the funds rate in a persistent way as long as the growth gap is positive.

This rule does not respond to expectations but monitoring them provides a means to ascertain its credibility and this last imply that the yield curve responds in a stabilizing way in response to macroeconomic shocks. If the economy is capable of returning to a balanced growth path is in good part to the ability of the markets to move the yield curve in a stabilizing way in response to shocks. This ability rests on a credible rule that passes on the belief that the central bank will maintain an unchanged low inflation rate. Robert Hetzel asserts that with credibility any changes in the forward rates that occur as a consequence of macroeconomic shocks are real because after a shock, markets work to forecast the cumulative change in the funds rate needed to align actual with potential output growth.

The existence of certain instruments such as the Treasury Inflation Protected Securities (TIPS) in the Unites States makes possible a continuous assessment of the Fed credibility because the difference between the yield on nominal Treasury securities and the real yield on TIPS of the same maturity give a good parameter of expected inflation. The stability observed in the inflation compensation figure (around 2.5%) from 2000 to 2006 reflects the high degree of credibility of the Fed despite the existence of a positive growth gap and an inflation shock that raised headline inflation[55]. In order to routinely monitor the credibility of policy actions, policymakers resort to observing market reactions towards "surprises" in the economic data releases; for instance, they can observe the reactions of the five-year TIPS yield and of the five-year inflation compensation number to the release of announcement surprises.

Further, when a real shock pushes output away from potential and there is credibility in the central bank, entrepreneurs do not associate it with a change in inflation and do not change their dollar prices to preserve their relative prices. Consequently we can assert that with a credible inflation-targeting rule, real shocks can provoke fluctuations in

[55] In early 2004 the price of oil rose from $34 per barrel West Texas Intermediate to around $65 in September 2005.

the price level but not in trend inflation due to stable expectations and with the benefit of no real costs to controlling trend inflation. To sum up Hetzel's view on the special feature of explicitness, we can say that he stands for the use of rules because a rule embodies a perceived commitment to a consistent behavior that shapes expectations in a predictable manner.

The use of rules shed light ahead in an uncertain world to build enough confidence in the public that the central bank will allow the real interest rate to vary sufficiently to keep aggregate demand for resources equal to available supply. If there is credibility the yield curve will react in a way that makes the change in forward rates entirely real in a stabilizing way so to speak. The belief that the monetary authority will move the funds rate by whatever amount is necessary for macroeconomic stability comes from a credible commitment to price stability.

In conclusion, for inflation targeting, credibility is an important feature in order to anchor expectations given the fact that this policy regime is designed to provide the monetary authority with enough discretion to do whatever it reckons fit, as long as the target is acquired. Such target cannot be acquired when there is no credibility in the actions of the central bank (expectations are unanchored), consequently, discretionary actions must be kept on track by the use of consistent easy to understand rules that give inflation targeting its particular feature of being a constrained discretion regime.

2. Discretion *versus* policy rules

There has been an ongoing debate in macroeconomics ever since a consensus was achieved in the conduct of monetary policy. There is a common belief by discretion advocates that the use of rules hampers the experience and expertise (know-how) of policy makers in dealing with unforeseen internal and external shocks by not allowing them complete power over policy instruments. This is commonly referred to as "fine tuning" and is considered by discretion adepts as the best means to optimize monetary policy decisions. On the other hand, rules advocates argue that the open and clear use of rules in the conduct

of monetary policy provide multiple benefits since it fosters transparency and the construction of credibility. Agents know given the particular circumstances what the course of action to be followed might be instead of being left with speculations.

Taylor as one of the most influential and important monetary economists has strived and openly pronounced himself for the use of rules rather than discretion. He has thoroughly expound in many papers after Luca's critique how the introduction of rational expectations as a modeling technique does not imply monetary policy ineffectiveness, that credibility has empirically significant benefits and that the time inconsistency demonstration of Kydland and Prescott make policy rules superior to discretion. He explains that the rules that have emerged from increased research on the subject do not generally imply fixed settings for the monetary policy instruments. The rules are responsive in this respect which makes clear why central banks following a rules approach call them reaction functions. Consequently, rules call for changes in the money supply, the monetary base or the short term interest rate in response to changes in inflation or real income.

The formulas behind the rules may differ in their forms and in the size of the coefficients, however according to Taylor there has been some indication of a consensus about the functional forms and the signs of the coefficients in the policy rules. Policymakers are in no way for the mechanical application of rules in an economy for technical reasons such as the time period for policy evaluation used in most econometric models. It may be too short to average blips in the price level due to temporary shocks or too long to hold the short term interest rate fixed between adjustments. There are proposals of possible options to modify these policy rules like the use of moving averages in the price level calculation over a number of quarters, averaging real or nominal output or going to a monthly model (with longer moving averages) to make the interest rate more responsive in the very short term. Nevertheless there's need for further research in such generalizations.

One setback about modifying rules is the fact that it would become more complex and difficult to understand specially if such algebraic policy rules intend to be sufficiently encompassing. This last issue raises a new problem since many factors such as the interpretation of a rise in prices, inflation expectations, the level and the growth rate of the

potential output, predictions about productivity, labor force participation and changes in the natural rate of unemployment are difficult to express into a precise algebraic formula. Furthermore, some episodes will emerge where monetary policy would need adjusting in order to deal with unforeseen special factors[56]. All this might suggest the superiority of discretion over rules, however there is a clear macroeconomic consensus about rules providing major advantages over discretion in improving economic performance even in a world where it is virtually impossible to follow to the script the algebraic formulas behind the rules.

In order to support the afore-mentioned consensus, it is appropriate to go deeper into the understanding of some key concepts. First, it must be understood that a policy rule need not be a mechanical formula or a fixed setting for the policy instruments. Policymakers can implement and operate the rule with a certain degree of informality as long as they understand the instrument responses that underlie the policy rule to add the judgment that cannot be done by computer. In contrast, pure discretion implies that the settings for the instruments are determined from scratch each period which hampers the path to a well-defined contingency plan for years to come[57]. A policy rule must be in continuous operation for a reasonably long period of time (several business cycles or years) See Illustration 25. If policymakers commit to the rule, they will certainly gain the advantages of credibility associated with it, besides no trustworthy assessment of the economy could be carried out if the policy is constantly changing.

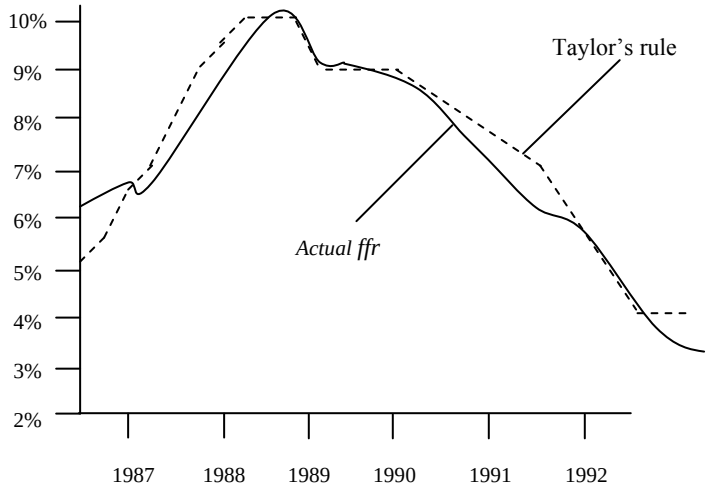
[56] The Federal Reserve had to provide additional reserves to the banking system after the stock market crack of October 1987, which helped to prevent a contraction of liquidity and to restore confidence.

[57] Three of the major time-consistency literature contributions – Kydland and Prescott (1977), Barro and Gordon (1983) or Blanchard and Fischer (1989) – a policy rule is referred to as the "optimal", the "rules" or the "pre-committed" solution to a dynamic optimization problem. On the other hand, discretionary policy is referred to as the "inconsistent", the "cheating" or the "shortsighted" solution respectively.

Illustration 25

US: federal funds rate (*ffr*), 1987-1992, and Taylor's rule

Panel A.



Panel B.

Taylor's rule

$$i = p + 0.5\,y + 0.5\,(p - 2) + 2$$

thus

if $p = 2$ and $y = 0 \longrightarrow i = 4$, $r = 2$
if $p > 2$ and $y = 0 \longrightarrow i > 4$, $r > 2$
if $p = 0$ and $y = 0 \longrightarrow i = 1$, $r = 1$

where

i = nominal interest rate (federal funds rate).
p = observed inflation.
y = output deviation from potential.
$r = i - p$ = real interest rate (long run).

Even though The Fed claims not to have followed Taylor's rule, the observed behavior of the *ffr* during this period shows to have a tight fitting around it, which allowed for credibility construction.

Source: Own elaboration based on Taylor (1993).

There are three important types of policy issues that are related to rules namely *1)* the design of a policy rule, *2)* the transition to a new policy rule and *3)* the day-to-day operation of a policy rule once it is operational. About the design of a policy rule, there can be substantial differences from one model to the next and that there is no agreement on a particular policy rule with particular parameters. However there have been some discoveries that have proved that the policy rules that focus on the exchange rate or money supply do not deliver as good a performance – measured in output and price variability – as policies that focus on the price level and real output directly. This has already been mentioned earlier in this work but suffice it to remember that the exchange rate functions as a nominal anchor and therefore hampers any intent to deviate the agents' attention towards another.

Consequently, it is preferable for central banks to set interest rates based on the economic conditions in their own country but paying little attention to exchange rates. The signs and magnitudes of the coefficients to be used should be also country-specific. A

transition to a new policy rule should be implemented once the results delivered by the current policy are no longer good enough. In such a case, it is of utmost importance to give special treatment to such transitions because expectations are rational and people have already adapted their behavior to the rule in operation and may be suspicious about the authority maintaining the new policy. They may at first not understand the policy and try to anticipate the credibility of such new policy by studying the past records of policymakers or by assessing whether the policy will work under the present situation. One way to offset undesired impacts of the new policy rule is to make it as credible as possible via constant announcements and gradual actual implementation.

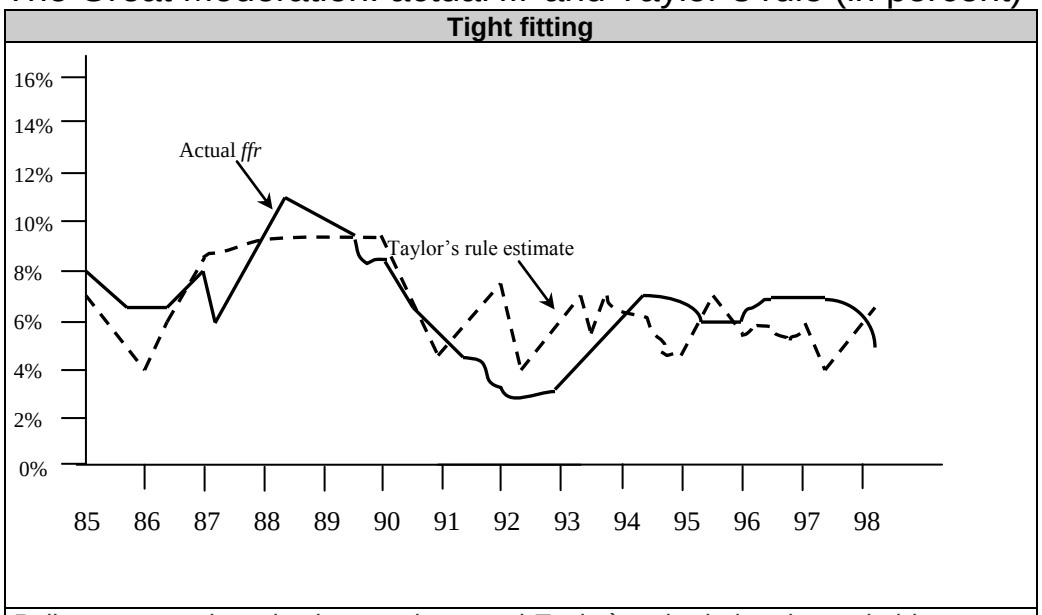
This is so because people may have committed to projects, plans or contracts under the assumption that the other rule would have been in place. These rigidities along with others suggest that the transition to the new policy should be gradual and announced publicly which will give people some time to change previous commitments without significant losses. Once the rule is fully in place it must remain operational as mentioned earlier for a long time in order to keep and restore any loss of credibility that might have arisen. How discretion could be inserted in the operation of policy rules can be depicted in the following points: *1)* to use the specific form of the policy rule as one of the inputs to the decision-making process, *2)* to list the general principles that lie under the policy rule and to leave it up to the policymakers to decide the policy setting without the guidance of the algebraic formula and *3)* a reasonable combination of the previous two.

To reinforce the interaction between discretion and policy rules, I would like to turn your attention to Taylor's view of the Great Moderation and its end in the current crisis beginning in 2007 as a good way to wrap up how he conceives the current functioning of macroeconomics and the insertion of the credibility hypothesis. First he says that the Great Moderation was the result of *1)* a regime shift in monetary policy provoked by a major change in monetary theory and *2)* a Great Awakening in monetary policy. The first achieved a decline in variability of output and inflation due to tight money growth policy to control inflation, the focus on inflation targets, the use of rules and transparency as well as "actions rather than words" which builds and enhances credibility by making central bank

actions more predictable. The second refers to the constant efforts carried out during the mid to late 1970s to find policies that would reduce the volatility of real Gross Domestic Product (GDP) and inflation.

Illustration 25 A

The Great Moderation: actual *ffr* and Taylor`s rule (in percent)



Policy was consistently close to the actual Taylor`s rule during the period known as the Great Moderation. This period was characterized by good economic performance.

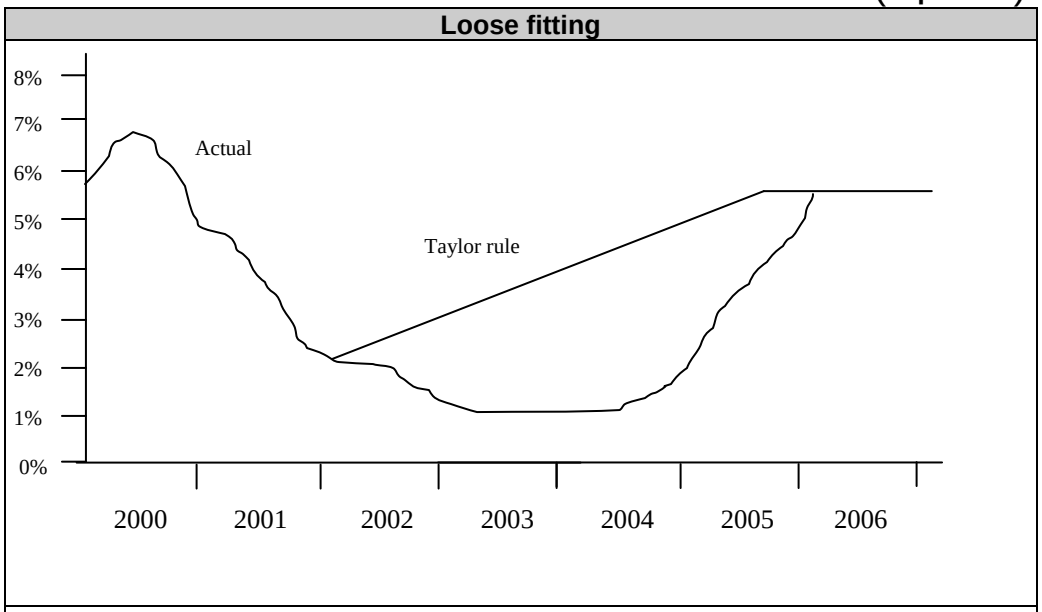
Source: own elaboration for illustration purposes.

This represented the birth of the New Keynesian school of thought that had at its center core a description of the inflation process including rational expectations and sticky prices along with a description of how the real economy was affected by the policy interest rate and a description of how the policy interest rate is set through a policy rule. There are close connections between the principles/recommendations and the actual policy including the importance for expectations of setting an inflation target, the importance of more predictable policy and the importance of responding aggressively to inflation and real output. The fact that policy changed in the directions of recommendations is certainly evidence of the said connection. This period finished with what Taylor called the Great Deviation from the policy rule the Federal Reserve had been using (See the section about the Taylor curve in chapter I).

During the period from 2003 to 2005, the short term interest rate in the US fell below levels that would have been predicted from the behavior of the Federal Reserve during (The Great Deviation) most of the period during the Great Moderation. Taylor considers that one effect of such low interest rates was the acceleration of housing starts and housing prices. This gave way to rising house prices that along with low interest rates originated flawed procedures that mortgage originators were using to assess the borrower's payment probabilities. When house prices declined the procedures collapsed. There was also a lack of information, transparency and accountability amongst private financial institutions and investors about the excessive risk taking in mortgages originated in the US[58].

Illustration 26

The Great Deviation: actual *ffr* and counterfactual *ffr* (**in percent**)



This deviation represents essentially discretionary government interventions in that they deviated from the regular way of conducting policy in order to address a specific problem, in particular a fear of deflation as had occurred in Japan in the 1990s.

Source: taken from *The Economist*, October 18, 2007.

[58] Taylor asserts that it is important to notice that the excessive risk taking and the low interest rate monetary policy decisions are connected and that the government sponsored agencies Fannie Mae and Freddie Mac were encouraged to expand and buy mortgage backed securities, including those formed with the risky sub-prime mortgages.

These mortgages were divided and packaged into complex financial instruments that were spread out amply within the US market and abroad by the incentive of large yields by financial institutions and investors. Monetary policy should have responded by helping to restrain spillovers by adjusting interest rates as economic growth slows instead of following a reduction of the federal funds rate policy way below the FOMC's[59] directives at the time in order to assist certain sectors and firms. Taylor coined the term "*mondustrial*" policy to refer to these policies. As banks, non-banking institutions, investors and others were not able to assess the counterparty risk behind financial instruments, uncertainty rose and financial stress augmented when foreclosures, insolvency and defaults began to occur.

Taylor criticizes also the Federal Reserve engaging in a selective credit policy and bailouts of different institutions without any articulated, clear and predictable strategy for lending and intervening into a financial sector. There was panic after the collapse of Lehman Brothers since it was reasonable to guess that the government would repeat its intervention into Bear Stearns, but it did not. He reckons that the regulators should have tried to clarify the policy by telling people "Here is what we think is going on, and here is what we are trying to do". The absence of such action deepened the stress under which the financial system was. We need better principles for "off the rule" behavior as in the case of liquidity shortages, frozen markets or risk management priorities. It can be concluded that it is not clear how effective these interventions were and they may have been counter productive on the grounds that the success of monetary policy during the Great Moderation period of long expansions and mild recessions was not due to discretion but to following predictable policies and guidelines that worked and were credible. The panic forced consumers and businesses to pull back, exports and imports fell sharply throughout the world with production declines accelerating as firms cut their inventories. Everything led the public to perceive the crisis as a repetition of the Great Depression, however when people realized this was not the case, stock markets started moving up around the world in early March 2009.

[59] Federal Open Market Committee is the Federal Reserve's internal body in charge of defining the conduct of monetary policy.

Taylor blames the government for having ignited, prolonged and deepened the crises due to three main reasons *1)* The excessive monetary ease by the Federal Reserve in which the *ffr* was held very low in the 2002-2005 period, *2)* the gigantic government sponsored enterprises Fannie and Freddie fueled the housing boom and encouraged risk taking as they supported the mortgage-backed securities market and *3)* the misdiagnosis of the crisis by policy makers who read the turbulence in the market as a liquidity problem rather that a counterparty risk. Taylor as expounded here, gives paramount importance to the benefits of rules (See Illustration 27) for which to wrap things up, he considers that in designing an exit strategy from the crisis it is important not only to list the instruments but also to describe and define the destination the Federal Reserve is aiming to. Equally important is to describe how the instruments will be changed or modified over time in order to reach that end. A simple exit rule[60]which would increase predictability and reduce the negative impact of the exit strategy would be undoubtedly his choice.

Illustration 27

Staying with the rule: benefits

Benefits that enhance credibility
1. Provides contingency plans to react to different events in the future.
2. Help prevent policymakers from getting caught in the classic time inconsistency dilemma.
3. Policy rules provide a transparent way to explain policy and can help reduce short-run pressures to deviate from what is optimal for the long run.
4. They reduce uncertainty by making policy more predictable.
5. They help others about the art and science of central banking.
6. They provide greater accountability.
7. They give a useful historical benchmark to determine if policy is different from past periods.

Source: Own elaboration with information from Taylor (2008a).

[60] Taylor says that one reasonable exit rule would be to reduce reserve balances by $100 billion for each 25 basis point increase in the *ffr* because by the time the funds rate hits 2%, the level of reserves would have been reduced by $800 billion and would likely be near the range required for supply and demand equilibrium in the money market. This will allow the trading desk at the NY Fed to carry out the interest rate decisions of the FOMC as it has in the past.

3. Flexibility within Inflation Targeting

It can be wrongly assumed that evaluating monetary policy boils down to checking whether inflation has been on target or not. This statement could not be more off. Inflation control is imperfect and therefore deviating-from-the-target actions taken by central banks following inflation targeting may have been deliberate as a means to dealing with unforeseen shocks that destabilize the economy. Since monetary evaluation policy has become a trend due to its importance with regards to the central bank's accountability it is reasonable to apply appropriate principles and methods for such activity. A simple comparison of the announced inflation target and the actual outcome is an inadequate evaluation method at least due to two reasons: *1)* monetary policy does not provide complete control over inflation and *2)* most central banks follow flexible inflation targeting rather that strict inflation targeting.

Monetary policy works in ever-changing economic conditions that cannot be entirely known, gathered or taken into consideration. This uncertainty feature along with the lack of knowledge of how monetary policy affects inflation and the real economy (transmission mechanism of monetary policy) and the duration of time lags between policy application and actual effects on inflation makes central banking an inaccurate activity. As pointed out earlier this time lag requires monetary policy to use sets of forecasts articulated to achieving a value equal to the announced inflation target in a couple of years ahead. During the time lags within the forecasts, the economy is subject to new internal and external shocks alike that could not be foreseen at the time the decisions were made. For this reason a direct comparison between outcomes and targets for inflation could be misleading.

The outcome may have ended up in line with the target even if the monetary policy decisions were wrong due to positive shocks or end up way off due to negative shocks even if the decisions were the right ones. The fact that inflation targeting is flexible (aims at stabilizing both inflation around the inflation target and the real economy) may result in conflict between its two main objectives. Think of a situation where an external oil price increase the general price level in an already sluggish economy, if the central bank wants to bring inflation back on target, an increase in the interest rate is in order, however, such an

action would worsen the output level even further which would destabilize the economy. Time plays an important role in responding to shocks because the magnitude, type and duration of the shock must be assessed and consequently decide on the gradual response by the central bank. For all this, to compare outcomes and targets for inflation in an evaluation of monetary policy is simply unfair and shallow.

Stabilizing the real economy should be described as stabilizing resource utilization at a normal level and that there is an asymmetry between the impact monetary policy has on this and the impact it has on inflation. Monetary policy is capable of affecting both the average level and the variability of inflation while only affecting in the case of real economy fluctuations in real variables around their average levels. Consequently, it results unwise to select a certain target for average output or employment other than the normal level determined by the gears of the economy and factors other than monetary policy. Under this clarification, a forecast that "looks good" means a forecast in which either, inflation is already on target or already approaching it and resource utilization is already normal or already nearing it at a proper pace. This is referred to by many central banks in different terms. For Sweden's central bank the term used is "a well balanced monetary policy". Svensson formalizes this reasoning by saying that it is a matter of selecting a policy-rate path that minimizes the following inter temporal forecast loss function

$$\Sigma^{\infty}_{\tau=0}\,\delta^{\tau}\,(\,\pi_{t+\tau,\,t}-\pi^{*}\,)^{2}+\;\lambda\,\Sigma^{\infty}_{\tau=0}\,\delta^{\tau}\,(\,Y_{t+\tau,\,t}-\tilde{Y}_{t+\tau,\,t}\,)^{2}\ldots\ldots\ldots\ldots\ldots\ldots(iii)^{61}$$

where:

δ is a discount factor satisfying $0 < \delta \leq 1$.

$\pi_{t+\tau,t}$ is the mean forecast in quarter t for inflation in quarter $t + \tau$.

π^{*} is the inflation target.

λ is a constant weight placed on the stabilization of resource utilization relative to the stabilization of inflation.

$Y_{t+\tau,\,t}$ is the mean forecast for (the logarithm of) output.

[61] Svensson (2009a).

$\tilde{Y}_{t+\tau,t}$ is the mean forecast for (the logarithm of) potential output.

$Y_{t+\tau,t} - \tilde{Y}_{t+\tau,t}$ is the output gap (measure of resource utilization).

$\pi_{t+\tau,t} - \pi^*$ is the inflation gap.

The sums of squares of the mean forecast gaps normally converge also for a discount factor equal to one. It is then a case of minimizing the sum of squares of the inflation-gap forecast, $\Sigma^{\infty}_{\tau=0} (\pi_{t+\tau,t} - \pi^*)^2$ plus the weight λ times the sum of squares of the output-gap forecast $\Sigma^{\infty}_{\tau=0} (Y_{t+\tau,t} - \tilde{Y}_{t+\tau,t})^2$.

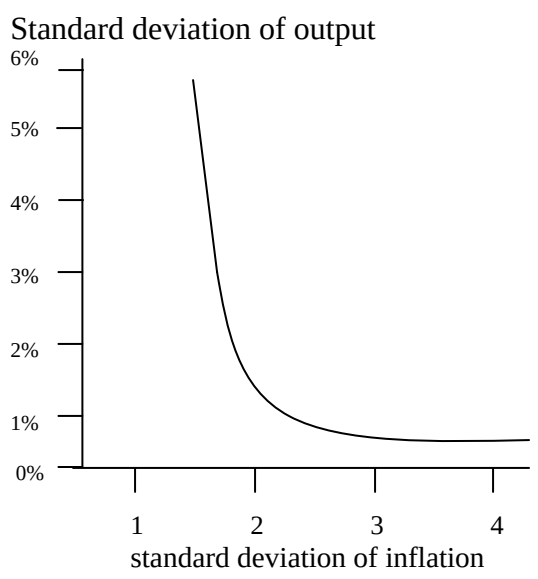
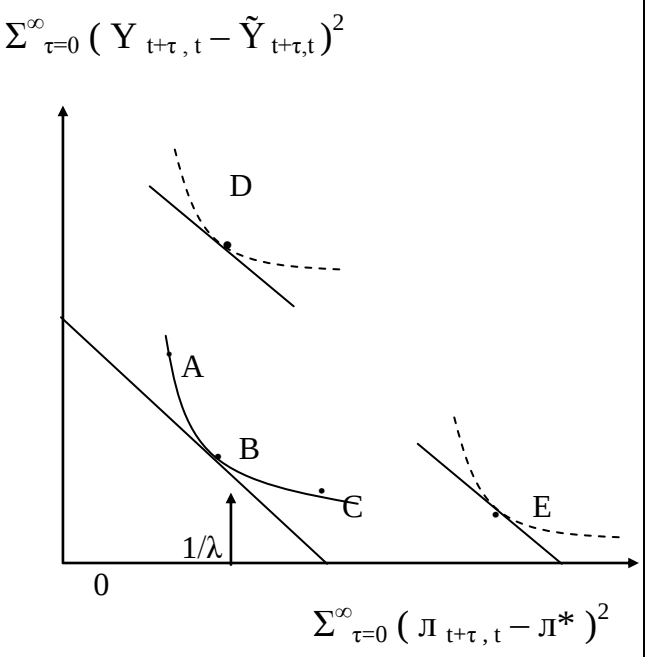
Having said all the previous, he argues that for evaluation purposes there are two options to choose from: *1)* an evaluation after the fact or *ex post* or *2)* an evaluation given the information that was available at the moment the decision was made or *ex ante.* It would be unfair to assess the conduct of monetary policy with the first option given the fact that policymakers have absolutely no means to know the nature, extent and impact on the economy of future shocks. For this reason the relevant question is whether monetary policy could have been better given the information available on the state of the economy and other factors when the decisions were made by the monetary authority. Now, if inflation targeting aims at stabilizing both, inflation and the real economy and in the event of conflicting objectives, strive for a reasonable balance between stabilizing both, a good *ex ante* evaluation would try to find out whether the central bank was successful at it or not.

Monetary evaluation can be carried out by the central bank itself or other professional forecasters, which raises new difficulties like forecasts based on different assumptions (some being more realistic than others) or the time at which such forecasts were made (having the older ones less information incorporated into the forecast than the new ones). Central banks forecasts are normally satisfactory so the next thing to do is to analyze *ex ante* the monetary policy deliberations on the basis of the forecasts. In order to do so, it is important to determine if the monetary policy conducted was efficient in the sense that there was no other policy-rate path that would have stabilized inflation and output better. Flexible inflation targeting aims at stabilizing inflation and resource utilization, in other words, minimizing the deviations from the inflation target and from the

normal level for resource utilization. In the next illustration, a modified curve referred to as forecast Taylor curve by Svensson, is shown as the efficient tradeoff between the conditional variability of the inflation-and output-gap forecasts.

Illustration 28

The forecast Taylor curve

Taylor curve	**Modified Taylor curve**
	
Shows the menu of choice between different deviations of output and inflation. Adapted from John B. Taylor, "Estimation and control of a macroeconomic model with rational expectations", *Econometrica*, 47 (5), 1979, pp. 1267-86.	The sum of squares of the inflation-gap forecast is measured along the horizontal axis and the sum of squares of the output-gap forecast along the vertical axis. The curve through points A,B and C is the forecast Taylor curve, that is, all the efficient combinations of forecasts for inflation and resource utilization, respectively, that it is possible to achieve in a certain decision-making situation with the help of different policy rate paths.

Source: taken from Svensson (2007) and from Chatterjee (2002).

In this illustration all points to the left and bellow the curve shown on the left cannot be reached due to the initial state of the economy and the transmission mechanism between inflation, resource utilization and the policy rate. All points to the right and above the curve are innefficient since it is possible for monetary policy to achieve a smaller sum of squares of the inflation-gap forecast for a given sum of squares of the output-gap forecasts, or vice versa. To wrap things up it can be said that monetary policy has been efficient if it is on the forecast Taylor curve. This is an *ex ante* analysis based on forecasts rather than actual outcomes. The analysis can become more complex if the central bank includes apart from the mentioned gaps other targets or limitations in its decision-making process.

Ex post evaluation provides valuable insights about the monetary policy conducted. Under this option we know what actually happened and the actual results, so the important point is to find explanations about forecast errors and deviations from targets. However, there is the major setback of having to wait at least a couple of years for the outcomes for inflation and the real economy for the full impact of the monetary policy measures to become apparent, a feature not shared by *ex ante* evaluation which can be carried out in real time as a part of the ongoing public debate on monetary policy. All this, helps to anchor the agents expectations of the central bank achieving the targets, so if economic agents share the central bank's view of how inflation will near the target, inflation expectations at sundry time horizons should converge to central bank's forecasts. How credible the central bank is can be measured by the intensity of correspondence between inflation expectations and the central bank's inflation forecasts and reports.

The financial crisis that began in 2007 raised serious questions about monetary policy and how it should be conducted. Svensson revised what he considers best monetary policy namely flexible inflation targeting and its relationship to financial stability and asset prices in order to determine whether monetary policy contributed to the crisis. Financial stability plays an important role in the performance of monetary policy. According to this author, under normal circumstances, at least in industrialized countries, financial stability is good and does not impose any constraints on monetary policy however in crisis times financial stability does pose constraints on monetary policy and force the monetary authority to modify its decisions. The central bank keeps track of the state of health of the

financial sector and issues reports that include an analysis of indicators, in particular early-warning indicators of potential future problems.

These reports assist the financial-regulation authorities in taking the proper actions once problems show up on the horizon as well as the agents into considering such perspectives into their information sets. Early action could prevent or smooth any financial instability, limiting the probability of future threats to financial stability and the corresponding monetary policy constraints. The role of financial stability for monetary policy resides mostly in the ability it has to function as a transmission mechanism for monetary policy as depicted in the following lines:

> "The idea of considering financial stability as a possible constraint on monetary policy rather than a target is consistent with the general idea of seeing financial stability, from a monetary-policy point of view, as an aspect of the transmission mechanism of monetary policy, where a reduction in financial stability typically changes the transmission mechanism and makes it less efficient."[62]

Central banks are concerned with anything that would affect inflation and resource utilization as has been said before. When asset prices increase largely and there is evidence of a possible bubble formation and future collapse, the central bank will act promptly to avoid any undesirable consequences for future inflation and resource utilization. The monetary authority responds because it is concerned with the repercussions for inflation and resource utilization, not with the asset prices as such. Simply, asset prices are not target variables *ergo* they do not enter the loss function.

Svensson considers the genesis of the crisis as conditions that have very little to do with monetary policy but were mostly due to regulatory failures and specific circumstances such as the US housing policy to support home ownership for low-income households. This author considers *1)* low world real interest rates due to global imbalances, *2)* the Great Moderation which led to a systematic underestimation of risk and very low risk premia in

[62] Taken from the speech "Flexible inflation targeting: Lessons from the financial crisis" delivered at the workshops "Towards a new framework for monetary policy? Lessons from the crisis", organized by *De Netherlandsche* Bank, Amsterdam, September 21, 2009.

financial markets, *3)* distorted incentives for commercial and investment banks to increase leverage that were made possible by lax regulation and supervision, *4)* distorted incentives to exercise less due diligence in loan origination because of securitization and to conduct regulatory arbitrage by setting up off-balance-sheet entities which for various specific reasons ended up still effectively remaining on the balance sheet, *5)* distorted incentives for traders and fund managers to take excessive risks because of myopic and asymmetric remuneration contracts and *6)* enormous information problems in assessing the risks of extremely complex asset-backed securities, and there was a huge underestimation of the potential for correlated systemic risks.

None of the above has anything to do with monetary policy except that monetary policy did contribute to the Great Moderation. The main argument blaming monetary policy for the crisis was that the US kept its policy rates too low during the period 2001-2005 which could have contributed to the excessive credit growth and a house-price bubble as Taylor lays out. Nevertheless, Svensson points out that during this time, and the information at hand, there was a genuine and well-motivated fear of the US falling into a Japanese-style deflationary liquidity trap. In such a scenario the optimal policy is a very expansionary monetary policy. From an *ex post* perspective it may be that the risk of deflation was exaggerated but there was no way to know this *ex ante*. The author considered the expansionary policy very appropriate and says that adding some *ex post* evaluation it can be noticed that it neither lead to high inflation nor to an overheated economy.

Somewhat higher interest rates would have made little or no difference at all and that higher rates of interest would have damaged the real economy and thrown the US economy into the feared Japanese-style deflation and liquidity trap. On the other hand, such an increase in the interest rates would have had no impact on the regulatory problems, distorted incentives and information problems mentioned earlier. He affirms that good flexible inflation targeting by itself does not achieve financial stability but specific policies and instruments are needed to ensure it. The best instruments to achieve financial stability are supervision and regulation along with an appropriate bank resolution regime. The creation and implementation of such instruments falls off the scope of central banking. For

all that has been said, Svensson concludes that flexible inflation targeting applied in the right way and using all the relevant information about financial factors needed for the forecast of inflation and resource utilization at any horizon, remains the best-practice monetary policy before, during and after the financial crisis.

There is an urgent need for a better theoretical, empirical and operational understanding of the role of financial factors in the transmission mechanism. Today, such a task is being addressed at academic circles and central banks. In this respect, it is of utmost importance to understand the difference between monetary policy and financial stability because even though they interact, both allude to different things. Monetary policy in the form of flexible inflation targeting (carried out by the central bank) has the objective of stabilizing both, inflation and resource utilization via policy rate and communication. Extra unconventional instruments can be used at crisis times such as fixed-rate lending at longer maturities, asset purchases and foreign-exchange interventions to prevent currency appreciation. Financial stability is achieved via other instruments like supervision, regulation and financial-stability reports with analyses and leading indicators that may provide early warnings of stability ruptures. The authorities in charge of the financial stability policy vary across countries. In some, it is the central bank, in others there are separate authorities and in others the responsibility is shared. The interaction between financial stability and monetary policy is that financial conditions affect the transmission mechanism of monetary policy.

It is widely accepted that central banking under an inflation targeting regime works with a forward-looking criteria. Forecasts under different scenarios are commonly discussed and reviewed in central banks' meetings and the procedures adopted are sometimes characterized as "forecast targeting" (Woodford, 2000). Nonetheless Michael Woodford dissents with a pure forward-looking criteria under an inflation targeting regime and contends that monetary policy should follow a history-dependent frame for optimal outcomes. In order to understand Woodford's view on this particular issue it is relevant to clearly state what he understands for pure forward-looking procedures.

> "By a purely forward-looking decision procedure for monetary policy I mean one in which the bank's action at any time is conditioned solely upon those aspects of the state of the world that are relevant for forecasting the subsequent evolution of the bank's target variables, which I shall here suppose to be the inflation rate and the level of aggregate economic activity"[63]

From here it can be understood that this kind of procedures disregards all past events and the decision-making process starts anew in each cycle generating conditional forecast paths for the target variables associated with alternative feasible policies aiming at minimizing a loss function or the achievement of a target. Past states cannot affect the action chosen by the monetary authority given the fact that forecasts dominate the decision procedure, a purely forward-looking perspective.

The bank chooses amongst candidate forecast paths, either evaluating them according to a loss function or selecting the path that satisfies some targeting criterion, such as the requirement that the forecast of inflation at some future horizon equals a target value, which may depend upon the output forecast. The bank's current action is then the one required by the chosen scenario. The procedure is as said, repeated afresh in each decision cycle. Some argue that it is incorrect to think of optimal policy at any point in time as dependant only upon state variables that determine constraints upon possible paths of the target variables from that time onward because such principles apply only to the control of a system in which the target variables evolve according to laws of motion that are purely backward-looking.

However in economics private-sector expectations of the economy's future path under an optimizing behavior are amongst the determinants of the current values of target variables *ergo* such conception of an optimal policy does not hold. In other words, a forward-looking behavior implies that more desirable responses of the target variables to a shock can be attained if it can be arranged for private-sector expectations about the future paths of the target variables to adjust in the proper way in response to the shock. Nonetheless, this can happen only if subsequent central-bank policy does in fact change as a result of the past shocks in such a way as to bring about the alternative evolution that it

[63] Woodford (2000).

was desired that people would expect. If the private sector expects the central bank to use pure forward-looking procedures at later dates precludes the said adjustment of expectations at the earlier date.

Introducing history dependence is consequently a targeting criterion that depends upon past values of the target variables, as well as their current and future values. A particular straightforward approach is to incorporate into the bank's loss function terms that represent the value, at earlier dates, of having people anticipate different subsequent paths of the target variables. The proposed loss function is then history-dependent, in that it effectively depends upon the cumulative sum of inflation rates over all past periods, rather than only upon the current period's inflation rate. In general, Michael Woodford agrees with the proposed Taylor rule and its "spirit" nonetheless supports the idea of including additional history-dependence. In the following formulation, interest rates respond to the growth rate of the output gap rather than to its level, and the coefficients ρ_1, $\rho_2 > 0$ imply inertial interest rate dynamics.

$$i_t = \rho_1 i_{t-1} + \rho_2 (i_{t-1} - i_{t-2}) + \psi_\pi \pi_t + \psi_x (x_t - x_{t-1}) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (iv)^{64}$$

where:

i_t is the target interest rate.

ρ_1 and ρ_2 are inertial interest rate dynamics.

i_{t-1} is the interest rate at t-1.

$(i_{t-1} - i_{t-2})$ interest rate gap between two past periods.

$\psi_\pi \pi_t$ weighed inflation level.

ψ_x coefficient of the output gap.

$(x_t - x_{t-1})$ is the output gap.

[64] Ibídem.

It is interesting to notice that these departures from Taylor's formulation characterize at least some econometric estimates of actual Fed reaction functions. One advantage of this criterion is that private sector anticipation of subsequent central bank action substitutes for preemptive actions by the central bank. To recap it can be said that an optimal procedure will not generally be purely forward looking, but will instead have to involve backward-looking elements such as one or more recent past levels of the interest-rate target or macroeconomic indicators such as an inflation rate or a measure of the output gap. This implies that the bank's interest rate target at any given time depends on past conditions as well as those measured at that time. The role of credibility here is paramount because the insertion of backward-looking elements in the rules followed by the central bank involve judgment of some sophistication about current conditions thus cannot be implemented mechanically and should be guided in such a way that expectations remain anchored.

This author argues that inflation-forecast targeting represents the intersection of two important approaches: *1)* the quest for a monetary standard and *2)* monetary stabilization policy. It is an improvement both over simpler rules, such as targeting a monetary aggregate and over weaker versions of inflation targeting. Under this approach, the central bank constructs quantitative projections of the economy's expected future evolution based on the way in which it intends to control short-term interest rates. A crucial part of the way in which the bank justifies the conduct of monetary policy is the public discussion of those projections for which a much more extensive communication policy is crucial if the central bank is to escape the limitations of he traditional alternatives of rigid rules or rudderless discretion.

To go deeper into this matter, the monetary standard I mentioned in the previous paragraph is an arrangement that serves to guarantee a stable value for a particular monetary unit over the foreseeable future. A monetary standard aims at creating confidence about the future value of money which is obviously paramount for economic agents' plans. The application of rigid rules is deemed necessary for the creation and maintenance of confidence due to the fact that monetary authorities must conform openly and transparently to the rules. On the other hand there is the ideal of monetary stabilization policy, under

which judicious adjustment of monetary policy answering to varying economic conditions can help to stabilize the real economy or more precisely, to ensure an optimal adjustment to economic disturbances despite lags in the adjustment of nominal wages and prices. Therefore to ensure the effectiveness of the monetary stabilization policy a significant amount of flexibility and discretion is thought to be necessary.

The ongoing debate of rules versus discretion is under this approach coming to an agreement as the following phrase (Woodford, 2007) shows: "*In fact, one of the principal benefits of a monetary standard – which is to say, of a regime that provides a clear anchor for expectations regarding the future value of money – is a greater scope for the use of monetary policy for short-run stabilization of the real economy.*" Once again the expectations of future inflation turn up as an important factor for the effectiveness of monetary policy. A mechanical monetary rule could have a certain advantage in the sense that it is possible to observe fairly directly whether it is being followed or not. Nonetheless, Woodford's alternative to said rule, would be to commit to explaining openly to the public the basis for the central bank's decisions.

By making clear and explicit these decisions and actions in such a way that the public knows the central bank improves not only the accuracy of its judgments about how to best achieve the bank's stabilization objectives but also in explaining the character of that policy to the public. These are important grounds for which forecast-based monetary policy has a crucial advantage. Inflation-forecast targeting is not tied to a mechanical formula that makes monetary policy a function of some very small set of present economic variables in part because the relationship of current economic variables to the variable that one actually wants to stabilize may change over time. However it is strongly tied to the issuing of regular publications of projections on the basis of which policy decisions have been made. Said publications function as a means to anchoring inflation expectations via the verification of the central bank's policy commitment by comparing it against the conduct of monetary policy in a way consistent with the commitment.

Not everything about inflation-forecast targeting is accepted without question. There are some dissenting voices that claim that such approach as a monetary standard would be too rigid or too flexible to pursue stabilization with the corresponding undermining in its credibility of its commitment to control inflation. Nonetheless, Woodford ascertains that neither is the case. This approach uses a wide variety of types of target criteria from which to choose according to a particular future horizon. Projections of real variables are included in monetary policy decisions along with a numerical inflation target. A particularly interesting example of inflation forecast targeting is Norway's *Norges* Bank because it has been amongst the most explicit current practitioners of the approach being discussed. Its target criterion involves real variables and inflation.

Each issue of its monetary policy report contains a section stating the criteria the bank looks for in an acceptable set of projections, described as the conditions that identify an appropriate policy intention. The first criterion is that the inflation projection should display "inflation close to the target in the medium term"; but there is also a second criterion which is that the projections "should provide a reasonable balance between the path for inflation and the path for capacity utilization." These two criteria are not set as competing goals that must be balanced with one another rather the first indicates the situation that should eventually be attained in a medium term that is not identified with a specific horizon, while the second describes the type of transition path by which it should be reached. It is worth mentioning that other monetary authorities have shown less willingness to discuss openly the way in which projections of output growth or other real variables are taken into account in their policy decisions.

The explicit discussion of the criterion employed to select amongst transition paths would not only increase the transparency of monetary policy, but also the credibility of the central bank's commitment to its medium-run target by making it easier for the public to judge whether departures of the current inflation rate from the target are consistent with a policy that remains committed to that target. Now let's turn to the production of projections by the central bank. It is in no way a trivial matter for these institutions because they must make assumptions about the conduct of policy not merely in the immediate future but over the entire forecast horizon. However each time such projections are produced, in each

decision cycle policy is only chosen for a short period of time after which there will be another decision.

Nevertheless one requirement for credibility of these projections is that the forecast-targeting procedure be intertemporally consistent. In other words, the future policy that is assumed in the projections should coincide with the policy that the procedure itself can be expected to recommend, as long as those aspects of future conditions that are outside the control of the central bank turn out in the way that is currently anticipated. Intertemporal consistency can be maintained if the path of policy is chosen so that the projections satisfy not a point in time target criterion but rather a sequence of target criteria, each making the same form, but for a sequence of horizons progressively farther in the future. However there is a downside to the approached being discussed namely inaccurate forecast due to the fact that systematic biases in the forecasting model might lead to systematic biases in policy.

Woodford concludes that this approach is a great way to anchor expectations about the future value of the currency while allowing substantial attention to short-run stabilization concerns. There are unavoidable limitations regarding the information and the economic models available to central banks, the target criteria should incorporate some degree of commitment to error-correction rather than being purely forward-looking. It would be a proper manner to attain a dual mandate such as the mandate born by the Fed and a way to make monetary authorities more accountable.

4. Rules within Inflation Targeting

There is a consensus that a monetary policy rule can be regarded as a prescribed guide for monetary policy conduct. There are those who allocate particular attention to targeting rules. Target variables are endogenous variables that enter a loss function that is increasing in the deviations of the target variables from prescribed target levels. The term targeting refers to minimizing such function and forecast targeting to using forecasts of the target variables effectively as intermediate target variables. A general targeting rule is a

high-level specification of a monetary policy rule that specifies the target variables, the target levels and the loss function to be optimized. A specific targeting rule is instead expressed directly as a condition for the target variables, a target criterion. Under certain circumstances commitment to a general targeting rule may be equivalent to a particular specific targeting rule describing conditions that the forecasts paths must satisfy in order to minimize a particular loss function.

Any policy rule implies a reaction function which specifies that central bank's instrument as a function of predetermined endogenous or exogenous variables observable to the central bank at the time that it sets the instrument. This implied reaction function should not be confused with the policy rule itself. For instance, the implied reaction function associated with a given policy rule will generally change in the case of changes in the model of the economy used in implementing the rule. Nonetheless an explicit instrument rule is a low-level specification of the monetary policy rule, in the form of a prescribed reaction function such as Taylor's rule. In Woodfords opinion, special attention should be given to decision procedures for monetary policy that can achieve the optimal equilibrium under commitment. However many rules may be consistent with the same equilibrium, even though they are not equivalent insofar as they imply a commitment to different sorts of out-of-equilibrium behavior.

The decision process has as transparent a connection as possible with the central bank's ultimate objective with a view to preserve to the greatest extent the attractive features of inflation-forecast targeting. The latter implies a decision process – organized around the pursuit of an explicit objective defined in terms of the ultimate goal variables – that bears several advantages such as the coherence of the policy upon the objective, the facilitation of communication with the public about the intended consequences of the bank's policy even when the full details of the implementation of the policy may be too complex to describe. It favors accountability by indicating the way in which the policy's success can appropriately be measured. In addition, there is the feature of robustness in the policy rule specification to possible changes in the details of the bank's model of the economy.

This last feature is important for comparing policy rules and choosing the best given the fact that not all rules continue to be optimal under some particular or restricted class of perturbations in the model. This author uses a great deal of econometric models and assumptions that go beyond the scope of this investigation to explore the possibility of implementing the optimal equilibrium in each of three possible ways. His highest-level policy specification is in terms of a general targeting rule, a loss function that the central bank is committed to minimize through a forecast-based dynamic optimization procedure. In the case of this way of specifying policy, the history dependence necessary for optimality must be introduced through a modification of the central bank's loss function, which must be made history dependent in a way that the true social loss function is not.

His second intermediate-level policy specification is in terms of a specific targeting rule, specifying a criterion that the bank's forecast paths for its target variables must satisfy. This kind of rule specifies a relation involving one or more endogenous variables that cannot be directly observed at the time that policy is chosen and that instead must be forecasted. A decision procedure of this kind is therefore still organized around the construction of forecast paths conditional upon alternative policies, even if explicit optimization is not undertaken. In the case of such a targeting rule, the history dependence necessary for determinacy and optimality must be introduced through commitment to a rule that involves lagged endogenous variables as well as forecasts of their future values. His lowest-level specification of policy is in terms of an explicit instrument rule, specifying the setting of the central bank's instrument as a function of variables that are exogenous or predetermined at the time.

The implementation of this kind of policy rule is no longer dependent upon either a model of the economy or an explicit objective function. He concludes that such rules are less transparently related to the ultimate objectives of policy than in the other two cases. Such rules also differ from the other two cases in that they are purely backward looking, as a result, the introduction of the dependence upon lagged endogenous variables required for determinacy and optimality is straightforward. He found that there is more than one example of a policy rule that both, renders equilibrium determinate and achieves the

optimal equilibrium, if the central bank's commitment to it can be made credible to the private sector.

In contrast, easy to understand simple monetary policy rules rather than optimal complex rules is what Taylor puts forward given the fact that the results of applying either one are not substantially different, providing the former, a greater chance for economic agents to understand the conception of the economy by the authority. This makes all agents aware of the rule the authority will apply given the specific circumstances rendering monetary policy effective. Remember Taylor's tripod consisting of *1)* use of rules, *2)* inflation targeting and *3)* flexible exchange rates.

5. Regulatory issues

I shall address this particular section through the views of Robert Hetzel towards the current crisis on the grounds that his stand point represents to my understanding an acute analysis that can be extended to other cases. As we know, throughout the development process of financial markets everywhere there have been painful and difficult episodes of crises and instability. The hideous consequences for the economy and well-being of families and nations alike have opened room for regulation discussions at both national and international levels. Banking international regulation to date must comply with the Basel accords which are conducive to strengthen the banking systems and reduce the episodes of crises. However recurrent episodes of financial disorder have been addressed by governments with a bailout policy which hereafter will be referred to as "safety net". In the current episode of financial crises, the rationale for this and subsequent extensions of the safety net was the prevention of the systemic risk of a cascading series of defaults brought about by wholesale withdrawal of investors from money markets and depositors from banks.

There is also the recognition of how financial safety net creates moral hazard via an increased incentive to risk taking which does not help to stability. A new financial regime should be implemented with the explicit purpose, among others, of limiting risk-taking

activities. For this author a good course of action would be to have a limited financial safety net and market monitoring of risk-taking that comes with the possibility of bank runs combined with procedures for placing large financial institutions into conservatorship. For this proposal to be effective, the author assumes that the financial system is not inherently fragile in the absence of an extensive financial safety net and expounds his arguments for a deeper understanding of the role played by market discipline and the price system in avoiding the worsening of crises episodes.

In the Great Depression, popular opinion held speculation on Wall Street responsible for the economic collapse just like in today's recession. There is the popular belief that it was the greed of bankers that created speculative excesses. The founders of the Fed wrote the real bills doctrine into The Federal Reserve Act based on the belief that cycles of speculative mania followed by busts accounted for economic fluctuations. There is no discussion regarding the modern models of economics reflecting the implicit assumption that the price system has failed and that government action should supersede its working. The current recession represents in no way a failure of the price system to regulate economic fluctuations but a failure of markets to regulate risk adequately. It reflects the way in which monetary policy and the financial safety net have undercut market mechanisms.

The author explains that the real interest rate plays the role of "fly wheel" in the stabilization of economic fluctuations around trend so when the public is optimistic about the future, the real interest rate needs to be relatively high as opposed to low real rates prevailing in an environment of pessimism. The real interest rate plays this function adequately in the absence of inertia introduced by central bank interest rate smoothing relative to cyclical variations in output. Said smoothing limits the decline in the interest rates in response to declines in economic activity via restraint in money creation and similarly limits the increase in interest rates in response to increases in economic activity via increases in money creation. He argues that there is a need for more regulation (that should come from the market discipline imposed through severe limitation of the financial safety net) of the risk-taking of banks.

He contends that there is no reason why tax payers' money should be used to guarantee the debt of banks any more than debts of other institutions including the industries, families and merchants. The existence of a financial safety net constituted by deposit insurance and the Too Big to Fail (TBTF) approach can preclude bank runs at the cost of creating high moral hazard incentives conducive to acquiring risky assets that offer a high yield without increasing capital commensurately. Hetzel proposes that demarcating the financial safety net is in order. On the insured side, regulators would limit risk-taking and impose high capital ratios whereas on the uninsured side, creditors with their own money at risk would take on this work by requiring limitations on risk-taking and high capital ratios. The big issue here is when the regulator fails to draw a credible line separating the insured from the uninsured, creating uncertainty.

The markets provide word that before the Lehman bankruptcy investors assumed that regulators would never let a large financial institution default on its debt. The official line between the insured and uninsured was not credibly drawn. Moreover the bailout of Bear Stearns debt-holders in March 2008 along with government sponsored giants Fannie Mae and Freddie Mac debt-holders in early September of the same year reinforced this perception. When Lehman brothers failed, many large institutional investors immediately withdrew their funds from other prime money market funds out of the fear that these funds could also be holding paper from investment banks faced with the possibility of default. In response to that, the financial safety net was extended to prime money market mutual funds and a major market disruption was avoided. Should these funds have been excluded, they would have been subject to market discipline of possible failure.

The TBTF approach followed by the Federal Deposit Insurance Corporation (FDIC) has superseded its authority to make an insolvent bank solvent by transferring funds to the bank only if it "is essential to provide adequate banking services in its community". It has used this language to justify expanding its mandate to balling out all creditors of insolvent banks which has changed the role of acting only after the bank has failed. This approach can be understood by the fear of the authorities towards systemic risk but by doing so foster risk-taking via an ever-expanding financial safety net. The author shares the views of

Goodfriend and Lacker that the contradiction of assuring stability through bailouts while increasing it via the moral hazard arising from bailouts can trigger ever-larger crises.

An example of this originated in the policy priority of the US to increase home ownership. Due to the financial safety net there was an incentive to risk-taking that encouraged leverage in the financial sector and affordable housing programs worked to make housing affordable by encouraging homeowners to leverage their home purchases with high loan-to-value ratios. These incentives for excessive leveraging created both by the financial safety net and by government programs to increase homeownership worked to create the fragility of the financial system revealed in 2007. This crisis is not something triggered by the greed of bankers and the absence of control due to deregulation, it is something provoked by the lack of market monitoring (debt-holders and depositors) bank risk-taking activities.

The major "deregulation" that has occurred, has taken the form of an expanding financial safety net that has undercut markets regulation of risk-taking by banks. This phenomenon was not limited to the US, it happened in various countries but based on the fact that US financial institutions securitized subprime loans and sold them worldwide, the perception of Wall Street igniting this episode of crisis prevails. Hetzel contends that even though current government policy with regards to bailouts can be described as "constructive ambiguity", the prevailing practice has been preventing uninsured depositors and debt-holders from suffering losses in the event of a bank or thrift failure. This last has profoundly diminished the monitoring of risk-taking by creditors.

For this author it is necessary to severely restrict the financial safety net as well as eliminating the TBTF. This can be achieved via the credible commitment by the government to take bailout decisions out of the hands of regulators. The government must commit not to bailing out the creditors of financial institutions, especially those of large banks. If a bank experiences a run, the chartering regulator must put it into conservatorship. This means that regulators would assume a majority of seats on the bank's board of directors and this body will decide whether to sell, liquidate, break up, or rehabilitate the bank. By law, this conservatorship must eliminate the value of equity and impose an immediate haircut on

all holders of debt and holders of uninsured deposits. Thereafter, as long as the bank is in conservatorship, the existing deposits and debt are fully insured.

A framework where banks can be grouped according to their size to form groups that would need to monitor each other's activities in the absence of a safety net would be a reasonable choice. A demonstrated willingness of banks to support each other would inspire depositor confidence. This would constitute a huge market for financial institutions marketing themselves as safe because of high capital ratios and a diversified asset portfolio of high grade loans and securities. These institutions would integrate a large enough core of run-proof institutions so that in the event of a financial panic creditors would withdraw funds from risky institutions and deposit them in the safe ones forcing the risky institutions to create contracts that did not allow withdrawal on demand. Depositors at the safe banks would make less money but it will be they and not the tax payers paying for the financial stability.

After having exposed these arguments, it should be clear that the lack of well defined rules and inconsistent discretionary actions by the Fed, helped to deepen the crisis, which highlights the need for rules creating a credibility environment that will anchor the agents expectations strong enough to apply some discretionary action when needed. This would have made the conduct of monetary policy somewhat easier and would have been perfectly compatible with Taylor's tripod. For this reason, I conclude that adopting inflation targeting by the Fed would have been a smart move but would have implied reducing somewhat the degree of freedom enjoyed by this institution.

6. Inflation targeting convenience

I will address this section by referring to the United States since its central bank has been the object of the best part of the investigation papers regarding this policy regime. To begin with, I will cite Bennett McCallum, who pronounces himself in favor of inflation targeting due to the evolution this approach has undergone since the early nineties. Today output objectives are included in the reaction functions of many central banks and a

growing number of analytical studies of inflation targeting by both academics and central banks economists use formal frameworks (models) in which said objectives appear along with a large number of projections. However, inflation targeting has been subject to critics on the side of economists who are not in favor of adopting such regime. A good example is the explanation provided by Donald Kohn, the second on board the Fed during Alan Greenspan's period. Given the low inflation rates observed during such period, the Fed's policy could have been considered as having practiced an implicit inflation targeting approach.

Nonetheless, Kohn and Greenspan agree that the good performance and low inflation levels were more related to unexpected developments than deliberate policy choices.[65] Both argue that the Fed exercised a more flexible approach than an inflation targeting regime would have permitted. In this respect, McCallum agrees with Bernanke and Goodfriend in which extra credibility is provided by inflation targeting. That enables central banks to move more aggressively at times at which policy easing is desired to prevent output reductions, without igniting fears of renewed inflation due to credibility. Most models used for monetary policy analysis by academics as well as central banks, include a relation or a sector that represents some specification of a Phillips curve (see chapter one) with gradual price adjustment. Typically, these specify that inflation depends in part on expected future inflation and in part on current and/or recent levels of employment or the output gap, or average real marginal cost.

The Phillips curve is not itself a complete model of inflation but only one of the relationships in a coherent model, other items must be considered since there are substantial dangers implied by the neglect of aggregates and other interest rates in a central bank's operating procedures. Broad liquidity considerations must be included in the pursuit of interest rate policy on the grounds that they influence the link between the interbank rate and market rates via their effect on the external finance premium and they also affect the behavior of market interest rates that the central bank must target in order to maintain macroeconomic stability. To wrap all up, this author's standpoint with regards to inflation

[65] Such unexpected developments were episodes such as the Russian debt default during 1998 and the sharp easing of policy throughout 2001.

targeting is that it is a favorable approach given its distinctive features of not only focusing on the control of inflation but also on the control of real variables via projections. The formal adoption of such an approach may mean less flexibility but it is greatly offset by transparency and greater credibility in consequence. This last feature strengthens the possibility of aggressive action by the central bank when necessary without creating fears of inflation.

Moreover, Robert Hetzel supports the use of rules in order to build credibility and anchor expectations which is important for the conduct of monetary policy and its effectiveness in the face of an unexpected shock. There is a consensus that Taylor's tripod which is the interaction amongst *1)* policy rules, *2)* flexible exchange rate and *3)* inflation targeting; constitutes the best prescription for central banking. However the last corner of the tripod has not been formally adopted by important central banks like the Fed. A feasible explanation for this lies in the understanding of the phenomenon of inflation by the head of the institution. This is so because a policymaker who believes that inflation is a "non-monetary phenomenon" is predisposed against an explicit inflation target.

Within the Fed there are different opinions and conceptions about this phenomenon which could explain why this important institution has been reluctant to adopting inflation targeting as an explicit policy regime, even in the face of recent events. Alan Greenspan for example understood inflation as a non-monetary phenomenon and explained the near-price stability at the end of his tenure through the fortuitously felicitous occurrence of benign non-monetary factors affecting inflation. The effects of the central bank reacting promptly to any deviations of the trend of inflation to keep it on track could be according to this view socially and politically undesirable. Consequently "fine tuning" would strive to keep unemployment levels at a desired level. This view is concerned that an inflation target would bias policy towards accepting additional variability in unemployment to stabilize inflation.

There is also concern that by removing the "flexibility" to distribute over long periods of time the unemployment necessary to control inflation, an explicit inflation target would engender criticism of the Fed's implementation of the dual mandate. Hetzel explains

that this particular view derives from a Phillips curve trade-off between unemployment and inflation that is invariant to the systematic part of monetary policy and that the base for this assumption is often the simple appearance in the data of persistence in inflation. There are two problems with this logic *1)* only inflation persistence that derives from price setting based on the extrapolation of past inflation (as opposed to the policy rule of the central bank or its anticipated future behavior) implies such a cruel unemployment-inflation tradeoff. Inflation shocks impart persistence to inflation but said persistence implies no such trade-off.

As long as the central bank has a credible inflation target, such shock does not propagate. It can allow them to affect the price level with the expectation that they will largely wash out over time. *2)* Monetary policy could be the source of the inflation persistence. To deal with an inflation overshoot adequately, the central bank could publicly announce an inflation target and commit to it. This commitment would imply a stated willingness to raise the funds rate in a measured way as long as expected inflation measured in financial markets exceeded the inflation target. In practice, however, the central bank what the Fed does is to keep the funds rate at its peak value when the economy weakens initially and then lowers it only slowly. By doing so, the Fed avoids any explicit association between an increase in the funds rate and rising unemployment. Output grows less than potential and the unemployment rate rises.

In this respect a policy rule would clarify what an explicit inflation target implies about other objectives. If a tradeoff between fluctuations of inflation around its target and fluctuations of real output around potential or trend output exists, real output and unemployment must be included as objectives along with inflation. Hetzel asserts that whether such a tradeoff exists depends upon the structure of the economy. As a consequence in order to evaluate the prospective working of an inflation target it is necessary to make explicit specification of a policy rule and a model of the economy. There are two different frameworks for explaining how central banks control inflation *1)* an "exploitable" Phillips curve and *2)* the quantity theory of money. It is the latter the one that best fits the understanding of current monetary standard. Two sets of ideas came together to

establish the intellectual basis for today's standard: The quantity theory and the rational expectations revolution. The quantity theory with its fundamental distinction between nominal and real variables explained the need for a nominal anchor that only a central bank could provide. Rational expectations, which emphasized the importance of policy rules in the formation of expectations, explained the importance of a credible rule. A model useful for explaining how central banks control inflation will incorporate the following generalizations shaped by these two sets of ideas: *1)* The price system works well to clear markets, *2)* individual welfare depends upon real variables not nominal magnitudes, *3)* individuals use information efficiently (form their expectations rationally) and *4)* there is a fundamental difference between a relative price and the price level which is an average of individual dollar prices.

The interactions amongst these generalizations comes from the fact that central banks control the price level through their control of nominal money relative to real money demand and that individuals base their expectation of the future price level on the systematic, predictable part of monetary policy given the fact that welfare depends on their ability to distinguish real from nominal changes. Therefore the achievement of an inflation target requires a monetary rule since individuals base their expectations and behavior (decision-making process) on the systematic part of the central bank's actions. These expectations function as a coordination device for price setters for changing their dollar prices that collectively allows the price level to change in a way that is compatible with the monetary policy rule and that avoids undesirable changes in relative prices.

When price setters do not have a common expectation compass providing for the coordination of the change in prices required by the policy rule then monetary non-neutrality arises. If the central bank announces an inflation target and follows a policy rule consistent with that target, actual inflation will equal the inflation rate consistent with the rule and both will equal the inflation target. In contrast if the central bank behaves in a way that makes the inflation rate unpredictable, it will create relative price distortions that affect real variables which mean that the behavior of relative prices will not wash out but will instead affect inflation. We could say that there is a worldwide consensus about central

banks determining trend inflation and a nominal anchor. Some central banks have turned to the use of the New Keynesian Phillips curve

$$\pi_t = \pi^e_{t+1} + b\,(y_t - y_t^*)\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(v)$$ [66]

This expression makes expected inflation central, actual inflation π_t depends upon expected future inflation π^e_{t+1} and a real variable measuring the intensity of resource utilization. This curve expresses the importance of credibility in controlling inflation. For instance the Fed has stabilized actual inflation by stabilizing expected inflation in the post 1989 period. In this same line of thought, a consensus has emerged that credibility is paramount for central bank control of inflation. A credible monetary policy can always and everywhere control inflation without resorting to high unemployment. Relative price shocks do occasionally pass through to the price level and that with credibility a positive relative price shock that passes through to the price level does not create an expectation of further inflation.

The Fed already uses an implicit inflation target and operates as if under inflation targeting however they have allegedly not been explicit about it due to some criticism conducent to the Fed abandoning its dual mandate by reducing inflation variability by increasing output variability. However Hetzel contends that the control of inflation requires monetary control rather than manipulation of output and unemployment in a way constrained by the tradeoffs apparently offered by a Phillips curve. An inflation target would require better and enhanced communication with the public in order to improve the understanding of policies aimed at explicit objectives. The difficulty of communication arises because the funds rate may need to change in a counterintuitive way given the behavior of inflation and the inflation target. The Fed would need a model to explain the relationship between funds rate changes and achievement of its inflation objective.

In conclusion we can say that Robert L. Hetzel is in favor of inflation targeting given the fact that the central bank achieves monetary control by keeping the public's

[66] Hetzel (2005).

expectations of inflation equal to its inflation target and by varying the funds rate in such a way that causes the real interest to follow the natural rate[67]. This tracking comes from procedures that move the funds rate away from its prevailing value in reaction to an estimated growth gap. By keeping expected inflation equal to its inflation target, money and inflation grow in line with the inflation target. By maintaining the real rate of interest equal to the natural rate, the central bank prevents monetary emissions that force undesired changes in prices.

In order to illustrate the overall convenience of inflation targeting, I shall turn to the successful monetary policy of the Federal Reserve in the last two decades or so owed to inflation targeting procedures that have been adopted gradually and implicitly over said period. This institution has never accepted being an inflation targeter. Nonetheless, its procedures resemble inflation targeting by "just doing it". It is believed that in a democracy a central bank should be fully accountable for the monetary policy that it pursues and that the adoption of inflation targeting procedures explicitly would improve the transparency of the policy process and the ability of Congress to hold the Fed accountable for monetary policy. As mentioned before there are a variety of intellectual forces within the Fed that are constantly debating, consequently the formal adoption of such approach is still to be concluded.

With a view to demonstrating the convenience of the above mentioned adoption, Goodfriend recalls the breakdown of mutual understanding between the Fed and the public after chairman Volker had taken office. The fed found it increasingly difficult to judge the public's inflation expectations and how its own policy actions might influence those expectations. Therefore, the Fed could not judge how a given nominal interest rate policy action would translate into an adjustment in real interest rates. The public could no longer discern the Fed's policy intentions and the Fed could not predict how the economy would respond to its policy actions. As a result macroeconomic stabilization became increasingly difficult. It was then clear for Volcker that monetary policy must be conducted so as to

[67] The natural rate of interest is the real interest rate that would exist in the absence of monetary disturbances. With perfect price flexibility captured by the real business cycle core of the economy, the real rate of return on money, bonds, and capital would follow variations in the natural rate.

preserve a mutual understanding between the public and the Fed and that price stability had to be the cornerstone of that mutual understanding.

It is a fact that credibility once lost is very difficult to retrieve and the stabilization of output relative to its potential under an interest rate policy becomes nearly impossible. Credibility can be very brittle as the inflation scare of 1987 demonstrates as people were concerned about the Fed's commitment to low inflation as Volcker's succession was nearing. When Greenspan took over and the Fed's credibility was compromised, actions to strengthen the institution's credibility had to be taken[68]. However the more than 2 percentage point increase in the bond rate from late 1993 to November 1994 indicated that the Fed's credibility for low inflation still was not secure. Nonetheless, the Fed took preemptive measures in late 1994 and managed to bring down inflation without creating unemployment by January 1996. The successful preemptive policy mentioned above brought the economy to virtual price stability. Goodfriend (Goodfriend, 2003) assures that inflation and inflation expectations were anchored more firmly than ever before.

When expectations are well anchored there is more room for action (flexibility) like the cut in the nominal federal funds rate by Greenspan's Fed from 6.5 to 1.75 percent in 2001 to cushion the fall in aggregate demand and employment. In 1994 the Fed began to announce its current *ffr* target publicly for the first time. This increased transparency has enhanced the understanding of monetary policy and facilitated a public debate about Fed's policy. It was according to Goodfriend that the Fed was practicing a form of flexible inflation targeting in its pursuit of price stability. Credibility for stable prices is self reinforcing to a great extent. Forward-looking sticky-price firms are less likely to pass cost shocks through to prices if firms expect the Fed to take policy actions promptly to conform aggregate demand to potential output in order to relieve the cost pressures.

[68] The Fed lowered the *ffr* tentatively and haltingly from a Peak around 8 percent at the start of the recession in mid-1990 to 3 percent in the fall of 1992. By September 1992, the bond rate had returned to the 7 percent range, inflation had come down to around 3 percent and the real *ffr* was therefore near zero and stayed there for eighteen months from September 1992 to February 1994. During that time the unemployment rate came down to 6.6 percent, the bond rate fell to the 6 percent range and the inflation rate fell slightly. It appeared that the Fed had acquired an additional degree of credibility for low inflation.

Credible price stability gives the Fed greater leeway to cut short term interest rates in response to a financial market crisis or to stabilize the output gap without creating an inflation scare in bond markets. Fed's credibility must be based on an understanding of how inflation targeting works rather than in the leadership of the Fed. Making the Fed's inflation targeting procedures explicit would help to achieve these ends by securing the Fed's commitment to low inflation and improving the transparency and accountability of the Fed for attaining its monetary policy objectives. Openly clarifying the priority for price stability would reinforce the Fed's commitment to low inflation and enhance the credibility of that commitment. It would balance the increased transparency of the Fed's interest rate instrument with greater transparency of its low inflation goal.

This new communication and transparency would give the FOMC the opportunity to address comments and questions from all perspectives. This would enable the Fed to build public understanding as well as confidence in its own policy positions. The forum would provide regular opportunities to comment on its assessments of the economy without appearing defensive or self-congratulatory. It would also provide a convenient and efficient means of acquiring regular professional advice and council on monetary policy, it would educate economists, the press and the financial markets so that eventually the public's confidence in monetary policy could be based on a deeper understanding of how inflation targeting works to optimize the outcomes from the economy.

* * *

The interaction between credibility and inflation targeting is of paramount importance for today's monetary policy. On the one hand, the construction of credibility by the consistent use of easy to understand well defined rules seems to go against the discretionary spirit of inflation targeting, on the other, the expertise of the authorities is needed to optimize monetary policy decisions or to deal with unforeseeable situations that may arise. Inflation targeting is a point of confluence for the ongoing debate of rules versus discretion and the use of rules to create credibility and anchor expectations. So far the facts speak for themselves and the team inflation targeting-credibility stand strong for years to come.

Final Chapter

Concluding reflections

Concluding reflections

In my opinion, monetary policy has undergone a huge ongoing evolution from the late sixties to date. Formerly, there was a different conception of inflation and of the role of central banks in the economy. In the last thirty years or so, the introduction of precise mathematical tools, game theory and stochastic analysis, has provided a solid base from which late monetary policy theory has been being constructed assuming the stochastic nature of the world we live in. Agents are undoubtedly to a **certain extent**, rational, despite the massive number of examples, arguments and criticisms that defy such statement; thus more research is being done in order to reach a consensus with regards to the pertinence of this modeling technique. It goes without saying that some important breakthroughs representing the starting point of modern mainstream economics are the Friedman-Phelps natural rate of unemployment, Lucas' critique, Muth's rational agents hypothesis, the endogeneity of expectations in the economy and Taylor's curve and principle as well as the belief in the existence of optimal equilibria.

Additionally, there were major breakthroughs during the late 1970s and early 1980s like dynamic forward-looking wage and price setting models by Stanley Fischer, John Taylor and Guillermo Calvo. In the seventies, Lucas persuaded monetary economists that it is extremely important in modeling monetary policy to let expectations rationally reflect the way that monetary policy is imagined to be conducted because even though each individual agent solves the model applied by the authority in a different way, the agents within the model know and solve the model by optimizing. I see fit to mention that, it is in the degree of accuracy reflected by those models that resides the assertion that the agents in the aggregate economy, behave in a rational fashion. Taylor in 1979 quantified econometrically the inefficiency of "go-stop" monetary policy in terms of the excess volatility of output and inflation relative to his estimated efficient policy frontier (see the Taylor curve in Chapter one). The foundations for the construction of a common ground for New Keynesians and New Classics were at place.

The different assumptions and theoretical stands in economics have produced a variety of valuable schools of thought that can be traced back to the debate between mercantilists and classics. These two main branches can be identified today as the New Keynesians and New Classics schools of thought already mentioned, who still debate, and share the driver's seat in the conduct of monetary policy. Both of these schools embrace the breakthroughs mentioned earlier but disagree mainly in the conception and treatment of inflation. For the New Classics, inflation is purely a monetary phenomenon and defend the flexible wages and prices preconception as well as the use of rules rather than discretion while the more practical approach from the New Keynesians, in view of the recent financial crisis, has originated two inner divisions, one in favor of rules, spear headed by Taylor and Bernanke and other favoring sheer policy discretion, a return to old fashion Keynesianism.

New classics are generally working from their intellectual trench and do their research under more controlled circumstances while New Keynesians are faced with the challenge of conducting monetary policy on a daily basis, which may explain, at least in part, their conception of inflation and their standings. I believe that the ongoing debate of rules *versus* discretion has found a comfortable resting place in inflation targeting as an intersection where the feature of flexibility allows for the use of rules and discretion, in different combinations, given the level of credibility enjoyed by the central bank. Consequently, inflation targeting represents an effort to best conduct monetary policy in a way consistent with both, rules and discretion in a country-specific fashion, no wonder why inflation targeting has become increasingly popular in both, industrialized and emerging economies alike given the various benefits it has over sheer discretion or the "stop-go" policy practiced during the seventies.

Inflation targeting has evolved ever since it was first adopted by the pioneer countries in the late eighties and early nineties whose experiences have produced a more sophisticated approach based on the role of credibility and expectations resulting in the more recent but less popular version called forecast inflation targeting. The use of different kinds of reports and communication strategies pursuant to anchoring expectations in an effort to better understand the relationships amongst macro variables and the transmission

mechanisms of monetary policy actions under different scenarios has made inflation targeting an expectations management tool. The latter has spurred a great production of working papers and investigations amongst central bankers and academics in order to continually improve monetary policy and there seems to be a consensus that good monetary policy should be conducted in a way as close as possible to Taylor's rule spirit and that **credibility** is a necessary condition for inflation targeting to function properly.

The experiences lived under the chairmanships of Paul Volcker and Alan Greenspan helped to reach a consensus on the way monetary policy should be conducted given the relevance expectations of future inflation play in the decision-making process of the private agents. Thanks to the continuing resolution of the Fed to bring down inflation without procrastination during Volkers office, the Fed gained credibility and anchored the expectations of the people, which can be regarded as an implicit inflation targeting approach. Greenspan gave importance to the anchoring of expectations and began in 1994 to communicate with the public by announcing its current federal funds rate target immediately after each FOMC meeting. With such measures, in time, the public came to see monetary policy through management of the federal funds rate as a stabilizing force for inflation, employment, and long-term interest rates.

In this respect, the particular hypothesis 2 finds a good example for its validity in the fact that credibility for low inflation strengthens the power of monetary policy to counteract recessions as demonstrated under Greenspan's office in 2001 when a recession arrived after the terrorists attacks and the inflation expectations were so well-anchored (the objective of inflation targeting) so as to enable the Fed to cut the federal funds rate aggressively from 6.5 to 1.75 percent to cushion the fall in aggregate demand and employment. Such recession turned out mild and might not have been classified as a recession at all but for the severe contraction in economic activity. Now, the fact that the Fed has not yet formally adopted inflation targeting reflects the inner fights arising from the massive variety of opinions and theoretical stands within this institution even though it is presided by Ben Bernanke, one of the most important supporters of inflation targeting in the world.

These debates continually provide valuable information that are continually integrated into the theoretical *corpus* of mainstream economics as long as they make use of today standard mathematical and probabilistic tools in order to prove their ideas beyond mere observations or insights. To blame today's mainstream economics for the financial debacle recently lived is as absurd as blaming engineering for plane accidents. I think that not following mainstream economics is precisely what paved the way for speculation to do its thing as Taylor argues in his book *Getting of Track*. Economics as a social science must remain theoretically solid through the use of sophisticated tools such as stochastic calculus and mathematical statistics to limit narrative approaches that explain things shallowly and within a particular context rather than reaching deeper into the phenomena to try to unveil the driving forces behind the events.

After the consensus was reached, most of the central banks in developed and emerging countries operate with an explicit inflation targeting approach or a framework similar to it, which have produced favorable results that can be witnessed in the low and stable levels of inflation enjoyed during the period known as the Great Moderation. Therefore it could be said that there is a consensus in the way in which monetary policy must be carried out, for instance, Goodfriend locates the beginning of such consensus with the success achieved under the chairmanship of Volcker in the early 1980s when the Fed managed to bring down inflation down to 4 per cent in the United States by 1984 after the high inflation levels of the seventies. This improvement in the level of inflation was achieved because the Fed tried systematically and consistently to bring down inflation through the use of a clear communication strategy with the public and, even though there were two recessions, in the end, it managed to anchor the agents' expectations and achieved what the "stop-go" policy of earlier years never did.

Let me clarify this last sentence, in the seventies the conduct of monetary policy was characterized as just said by a "go-stop" approach that responded to the variations in the balance of public concerns between inflation and unemployment. Employment was boosted in the go phase up to the point where the public became concerned about rising inflation, at this point the central bank would initiate an aggressive interest rate policy to

bring down inflation while unemployment rates moved higher with a lag. By pursuing low unemployment and fighting inflation only when it became the predominant public concern, central banks increased the volatility of both inflation and output by turning prices into false indicators for the decision-making process of the agents.

This "stop and go" policy supported in the simple relationship depicted by the Phillips curve is in part responsible for the seventies disarray of monetary policy, let alone oil price shocks. The collapse of the Bretton Woods system that de-linked all major world's currencies from gold created nervousness about inflation due to the absence of any formal constraint on money creation by central banks. Such scenario resulted in deep divisions within the academic world with regards to demonstrating whether the central bank could control inflation and to demonstrate if credibility in the central bank could influence inflation expectations, which eventually was demonstrated. During the seventies it was believed that inflation was driven mainly from other factors other than monetary policy such as fiscal deficits, commodity price shocks, inflation psychology, labor unions or large competitive firms.

Monetarists such as Milton Friedman, Karl Brunner and Allan Meltzer worked during the seventies to demonstrate that even though inflation could be affected by many factors in the short run, long-term sustained inflation is always associated with excessive money growth providing the central banks with the responsibility of controlling this phenomenon. Nonetheless, such ideas were highly controversial at the time. With regards to expectations, Robert Lucas and Thomas Sargent showed that in theory, inflation expectations could be made to conform to a central bank's desired low rate of inflation if a central bank was **credibly committed** to following a noninflationary money growth rule. In a credible disinflation, money growth, expected inflation and actual inflation could all slow together with little adverse effects on employment while in a non-credible disinflation, wage and price inflation would continue as before and the public would drive interest rates and unemployment up as it vies for increasingly scarce real money balances.

The problem of acquiring credibility, quickly or not, was a little bit controversial as well, given the fact that Kydland and Prescott demonstrated that rules were superior to

discretion because agents were rational and respond differently than nature. There was a political incentive for the central bank to promise to pursue low inflation and then to run an expansionary monetary policy aimed at lowering unemployment. There was a need for a commitment mechanism in order to get credibility since central bank independence was not enough. There are three important lessons that are among the founding practical principles of the new consensus in monetary policy. First, that monetary policy alone could reduce inflation permanently at a cost to output and employment that while substantial, was far less than in common Keynesian scenarios; second, that a determined independent central bank can acquire credibility for low inflation, even without an institutional mandate from the government and third, that a well-timed aggressive interest rate tightening can reduce inflation expectations and preempt a resurgence of inflation without creating a recession (Goodfriend, 2007).

Now, turning to inflation targeting again, its success made the International Monetary Fund (IMF) accept an inflation target as the new nominal anchor in its financial assistance program for Brazil in 1999 after that country's dollar peg collapsed. The IMF has utilized inflation targets in many of its assistance programs and was employed in at least halfway of the last decade in over 20 emerging market and industrial countries. Inflation targeting approaches are country-specific and bear diverse features such as: *1)* the systematic announcement of an explicit numerical inflation target by the central bank, *2)* the freedom of action necessary to reach the target, *3)* a transparency regime of central bank concerns and intentions about the economy and interest rate policy and *4)* formal governance mechanisms designed to hold a central bank accountable for inflation outcomes.

In this sense, The Maastricht Treaty of 1992 mandates that the "primary objective of the European System of Central Banks shall be to maintain price stability" a priority inherited by the favorable results obtained by the Bundesbank and reinforced by the theoretical breakthroughs of the last 30 years. Institutional support is designed also to anchor inflation expectations at the inflation target to secure the credibility of a central bank's commitment to low inflation because credibility is widely regarded around the

world as the **key** to effective monetary policy for it guards against inflation scares and improves the flexibility for monetary policy to stabilize employment over the business cycle. Explicit or implicit inflation targeting has demonstrated its virtues in a world where a fixed exchange rate is no longer a viable nominal anchor in an era of increasingly mobile international capital.

The interaction between credibility and inflation targets shows a more practical approach to the challenges being faced by central banks as some important economists like Svensson have pointed out. Inflation targeting can be broken down into three main components that I consider important: *1)* an announced numerical inflation target, *2)* an implementation of monetary policy that gives a major role to an inflation forecast (because if expectations are important, to operate on the forecast itself would ideally reinforce the forward-looking feature of the rule) and has been called "inflation-forecast targeting" and *3)* a high degree of transparency and accountability. It must be clear that inflation targeting central banks follow the approach in a flexible fashion since they also pursue objectives other than price stability as has been discussed earlier in this investigation.

I pronounce myself to the idea that monetary policy to a massive extent is "management of expectations" through which the economy is then affected. For instance, the expectations of future instrument settings such as the long-term interest rates will affect decisions about pricing today and therefore economic activity. As a consequence, the anchoring of expectations about the achievement of the inflation target is paramount to inflation targeting. Transparency and high quality reports are strong tools towards establishing and maintaining credibility. Once a high degree of credibility has been achieved the central bank will find itself in a position to be more "flexible" and also stabilize the real economy. Inflation targeting has been a considerable success as measured by the stability of inflation and the stability of real output along with the lack of evidence of it being detrimental to growth, productivity, employment, or other measures of economic performance, which supports the validity of the General Hypothesis of this document. However successful inflation targeting has been since its introduction in 1990, it has not gone without continuous learning.

Thinking about monetary policy as interest rate policy is one of the hallmarks of the new consensus that has made possible increasingly fruitful interaction between academics and central bankers. Much of the disarray reflected in the old disputes between monetarists and Keynesian economists has been resolved in the consensus benchmark model of monetary policy referred to as the New Neoclassical Synthesis or New Keynesian model, a convergence of the two currents from which it comes. Said model incorporates classical features such as intertemporal optimization, rational expectations and real business cycle core, together with Keynesian features such as monopolistically competitive firms, staggered sticky nominal price setting, and a central role for monetary stabilization policy. The idea is that optimal monetary policy should make such model perform as if prices were perfectly flexible which is to say that optimal monetary policy should make the economy perform like its imperfectly competitive real business cycle core.

The importance of credibility for central bankers is paramount because when an inflation-targeting regime is fully credible, firms are confident that inevitable departures of actual markups from flexible-price profit-maximizing markups will be temporary because monetary policy is expected to make them so. In effect, credibility for low core inflation makes beliefs of future costs in the sticky-price sector invariant to current shocks so that beliefs themselves anchor current pricing decisions to the targeted core rate of inflation. The absence of credibility exposes the economy to inflation scares. One reason why inflation targeting is technically demanding is that the natural rate of interest is not directly observable in markets and must be tracked with the help of a structural theoretical monetary model. Saying that interest rate policy should track the fluctuating natural rate of interest, is to support the idea arrived at in practice that interest rate policy should preempt rising inflation, which it can do without increasing unemployment.

Even though there is a consensus in the conduct of monetary policy among central banks, the extensive interactions between central bankers and academics have ignited numerous points of disagreement with the corresponding research conducent to improving central banking beyond its current boundaries. This constant debate of ideas, theories and practical evidence and experience will undoubtedly produce new breakthroughs aimed at

better understanding the relationships of nominal and real variables in economies that are monetary by definition.

In conclusion, it has been demonstrated throughout this document that credibility is a condition necessary to operate an inflation targeting approach given that agents behave rationally and cannot be deceived on a regular basis. Discretion, as long as credibility is not compromised, is necessary to deal with unexpected and strange external or internal shocks that cannot be considered in a reaction function of a central bank. Inflation targeting erects itself as the product coming from the melting pot of both, New Keynesians and New Classics. It stands as a flexible framework that has proved its feasibility and usefulness in industrialized and emerging economies alike. The constant experiences and intellectual exchange between academics and central bankers have made possible the evolution of inflation targeting into a more sophisticated approach that is far from being perfect but is the consensus there is to date.

Concretely, the General Hypothesis of this document turned out to be true as evidenced by the favorable economic conditions lived during the Great Moderations and the levels reached of low and stable inflation in both developed/advanced and emerging countries. The Particular Hypothesis 1, turned out to be true as well, given the fact that current economic models take off from the theoretical assumptions of credibility, dynamic inconsistency, forward-looking feature of the expectations among others, all of which conform and agree with the assumption of rationality. Finally, the Particular Hypothesis 2, was partially proven because as mentioned in the text of the document, a central bank will always be faced with circumstances where discretionary elements would have to be wielded regardless of its degree of credibility as the 1987 United States financial markets crack or the terrorist attacks on the Twin Towers in 2001 evidenced.

References

References

Barro, Robert and David Gordon (1983)/ "A positive theory of monetary policy in a natural rate model", *Journal of political economy* vol. 91 no. 4.

Bernanke, Lauchbach, Mishkin and Posen/ *Inflation Targeting. Lessons from the International Experience*, Princeton University Press. 1999.

Bernanke, Ben (2003)/ "A perspective on inflation targeting", FRB, Washington, March.

Bernanke, Ben and Michael Woodford, editors (2004)/ *The Inflation Targeting Debate*, University of Chicago press, Chicago.

Blejer, Ize, Leone and Werlang, editors. (2000)/ *Inflation Targeting in Practice*, IMF, Washington, March.

Chatterjee, Satyajit (2002)/ "The Taylor curve and the unemployment-inflation trade-off", *Business review*, FRB of Philadelphia, third quarter.

Chiang, Alpha and Kevin Wainwright (2006)/ *Métodos fundamentales de economía matemática*, Mc Graw Hill, 4th edition.

De Grauwe, Paul (1994)/ *Teoría de la integración monetaria: hacia la unión monetaria europea*, Celeste Ediciones, Madrid.

Freund, John and Walpole Ronald (1990)/ *Estadística matemática con aplicaciones*, Prentice Hall Hispanoamericana, 4th edition.

Friedman, Milton (1968)/ "The role of monetary policy", *American economic review* vol.58 no.1, March.

Goodfriend, Marvin (2003)/ "Inflation targeting in the United States?", Working paper no. 9981, NBER, Cambridge, September.

--- (2007)/ "How the world achieved consensus on monetary policy", *Journal of economic perspectives* vol. 21 no. 4, Fall.

Hetzel, Robert (2004)/ "How do central banks control inflation?", *Economic quarterly* vol. 90 no.3, Summer.

--- (2005)/ "What difference would an inflation target make?", *Economic quarterly* vol. 91 no.2, Spring.

--- (2006)/ "Making the systematic part of monetary policy transparent?", *Economic quarterly* vol. 92 no.3, Summer.

--- (2009)/ "Should increased regulation of bank risk-taking come from regulators of from the market?", *Economic quarterly* vol. 95 no.2, Spring.

Humphrey, Thomas (1982)/ "Adam Smith and the monetary approach to the balance of payments", FRB of Richmond.

Kydland, Finn and Edward Prescott (1977)/ "Rules rather than discretion: the inconsistency of optimal plans", *Journal of political economy* vol. 85 no. 3.

Kreps, David M. (1990)/ *Game Theory and Economic Modeling*, Oxford University Press, 1st edition.

Lucas, Robert Jr. (1976)/ "Econometric policy evaluation: a critique", *Carnegie Rochester conference series on public policy* vol. 1, January.

McCallum, Bennett (1995)/ "Two fallacies concerning central-bank independence", *American economic review* vol. 85 no.2, May.

--- (2007)/ "Inflation targeting for the United States?", *Cato journal* vol. 27 no.2, Spring-Summer.

Meyer, Lawrence (2001)/ "Inflation targets and inflation targeting", *Review*, FRB of St. Louis, November-December.
--- (2004)/ "Practical problems and obstacles to inflation targeting", *Review*, FRB of St. Louis, July-August.

Mishkin, Frederic (2000)/ "De metas monetarias a metas de inflación: Lecciones de los países industrializados", speech delivered at Banco de México seminar *Estabilización y Política Monetaria: La Experiencia Internacional*, México, November.

Mishkin, Frederic and Miguel Savastano (2001)/ "Monetary policy strategy for Latin America", *Journal of development economics* vol. 66.

Sheffrin, Steven M. (1985)/ *Expectativas racionales*, Alianza Editorial, Madrid, 1st edition.

Svensson, Lars (2007)/ "Inflation targeting", CEPS Working paper No. 144, Princeton University, May.

--- (2009a)/ "*Evaluating monetary policy*", forthcoming in Koenig, Evan, and Robert Leeson, editors, *From the Great Moderation to the Great Deviation: A Round-trip journey based on the work of John B. Taylor*, Hoover Institution press.

--- (2009b)/ "Inflation targeting: Lessons from the financial crisis", speech delivered on September 21, 2009. www.riksbank.se.

--- (2010)/ "Inflation targeting after the financial crisis", speech delivered on February 12, 2010, Mumbai, India www.riksbank.se.

Taylor, John (1982)/ "Establishing credibility: a rational expectations viewpoint", *American economic review* vol. 72 no. 2.

--- (1993)/ "Discretion versus policy rules in practice*", Carnegie-Rochester conference series on public policy* no. 39.

--- (2000a)/ "Summary remarks at Bank Indonesia, Conference *Inflation targeting and monetary policies in emerging economies*", central bank of the Republic of Indonesia, Yakarta, July.

--- (2000b)/ "Using monetary policy rules in emerging market economies", Stanford University, mimeo, December.

--- (2001)/ "The role of exchange rate in monetary policy rules", *American economic review* vol. 91 no. 2, May.

--- (2008)/ *Getting off track*, Hoover Institution Press, California.

--- (2008a)/ "The cost and benefits of deviating from the systematic component of monetary policy", Stanford University, February.

--- (2008b)/ "Monetary policy and the state of the economy", Stanford University, February.

--- (2008c)/ "Better living through monetary economics", Stanford University, November.

--- (2009a)/ "Monetary policy and the recent extraordinary measures taken by the Federal Reserve", *Testimony before the committee on financial services U.S. House of representatives*, February.

--- (2009b)/ "The need to return to a monetary framework", *Business economics* vol. 44 no. 2, April.

--- (2009c)/ "Systemic risk and the role of government", *Conference on financial innovation and crises*, FRB of Atlanta, May.

--- (2009d)/ "Responses to additional questions from the Financial Crisis Inquiry Commission", Stanford University, November.

--- (2010a)/ "An exit rule for monetary policy", Stanford University, February.

--- (2010b)/ "Lessons from the financial crisis for monetary policy in emerging markets", *Platinum jubilee celebration* Reserve Bank of India, Mumbai, February.

Woodford, Michael and Ben Bernanke (1997)/ "Inflation forecast and monetary policy", *Journal of money, credit and banking* vol. 29 no.4, November.

Woodford, Michael (2000)/ "Pitfalls of forward-looking monetary policy", *American economic review* vol.90 no.2, May.

--- (2001)/ "The Taylor rule and optimal monetary policy", *American economic review* vol.91 no.2, May.

--- (2003)/ "How forward-looking is optimal monetary policy?", *Journal of money, credit and banking* vol. 35 no.6, December.

--- (2007)/ "The case for forecast targeting as a monetary policy strategy", *Journal of economic perspectives* vol.21 no.4, Fall.

Yellen, Janet (2006)/ "Enhancing Fed credibility", *Economic letter* no. 2006-05, FRB of San Francisco, March.

Zapata, Paloma (2007)/ *Economía, política y otros juegos. Una introducción a los juegos no cooperativos*, Facultad de Ciencias, UNAM, December.