possess the powers of supervision would mean to be able to develop easier a laxist monetary policy; and this serves the interest of the politician. Otherwise, if the central banker is conservative, he would pay attention to his not accommodating reputation. In this case, he would like to strengthen such reputation, with the same behaviour, also when he carries out the supervision policy.

The present paper intends to analyze theoretically this problem list[13].

The paper is structured as follows: after the introduction, in the second section we present the general model. In the third and fourth sections we examine the principal-and-two-agents model in the electoral and non-electoral periods. In the fifth and seventh sections the single-agent contract is analysed, in the electoral and non-electoral periods. The sixth and eighth sections give a comparison between the two contracts. In the ninth section remarks and possible developments are discussed. Finally, our conclusions.

2. The general model

This paper[14] analyses the advantage to be gained in entrusting the tasks of "banking supervision" and "monetary policy" to two agents, Banking Authority (BA) and Central Bank (CB), or to a single agent, CB. In this analysis two periods are examined: electoral and non-electoral. The model is that of a principal with two agents, where the principal is the political group in power, while the agents are, as we have said, BA and CB.

The politician has his own utility function U, which will take on four different values according to whether four different events take place. These events are:

Bs = stability in the banking system

Ps = price stability

–Bs = banking instability

–Ps = price instability.

The utility function U is defined thus:

[13] In the literature there are no theoretical models linking the problem of the choice of institutional setup of supervisory bodies, with the electoral cycle.

[14] The approach adopted is that proposed by Franck - Krausz (2004)

$$U = \begin{cases} u_1 & \text{if} \quad E_1 = Bs \cap Ps \\ u_2 & \text{if} \quad E_2 = Bs \cap -Ps \\ u_3 & \text{if} \quad E_3 = -Bs \cap Ps \\ u_4 & \text{if} \quad E_4 = -Bs \cap -Ps \end{cases}$$

A stable banking system means lack of banking crises. The banking system stability is promoted by a tight regulation policy, while the banking system instability is pursued by a loose regulation policy. We suppose that a low frequency of banking crises is the consequence of a strict regulation. Unless the politician has a blanket preference for stability in the banking system rather than instability regardless of whether or not it is an election period, he will attain greater utility if there is price instability in the election period and stability in the non-election period. This situation, in fact, gives the politician more probability of pursuing his objective, i.e. being re-elected. In the short term, price instability and therefore an increase in inflation - as long as it is not perceived by wage-earners - determines a reduction in real wages and a consequent drop in unemployment, and this may mean that the politician receives more support from electors, thus increasing his chance of being re-elected. In the long term, however, as Friedman asserts[15], there is no trade off between inflation and unemployment.

The "inflation surprise" effect is annulled in the long run, when wage-earners re-adjust their expectations in view of the inflation level actually chosen by the authorities. The preference for banking system stability is justified by the fact that a crisis in the system would lead to a loss of confidence among depositors, obviously not desirable for a politician whose immediate goal is to be re-elected. Most of all, in the non-election period it will be to the politician's advantage to have a stable banking system, because this makes it easier to achieve the objective of price stability. In fact, the presence of failed banks calls for the intervention of the central bank which, as lender of last resort, injects liquidity into the system to cope with the crisis, at the same time altering the equilibrium of the money market.

[15] Friedman (1968)

In the election period it will therefore be

$u_2 > u_1$; $u_4 > u_3$ (i.e. also $u_2 > u_4$ and $u_1 > u_3$).

As established by principal-agent models, the principal offers a contract to the agents giving them the incentive to act in the exclusive interests of the principal. This contract envisages a payment to be made to the agents, appropriate to the results they have attained. To be precise, BA will receive t_b if there is –Bs, and T_b if there is Bs (obviously with $t_b < T_b$), and CB will receive t_p if there is Ps, and T_p if there is –Ps (with $t_p < T_p$).

To give t to the agent, the politician will spend u(t), that is, a higher sum than will actually be paid to the agent; this is also due to the transaction costs he has to sustain.

The politician's expected net utility will therefore be:

$$\text{(1)}\quad E(U\text{-}u) = [u_1 - u(T_b) - u(t_p)]\,Pr(Bs \cap Ps) + [u_2 - u(T_b) - u(T_p)]\,Pr(Bs \cap -Ps) + \\ + [u_3 - u(t_b) - u(t_p)]\,Pr(-Bs \cap Ps) + [u_4 - u(t_b) - u(T_p)]\,Pr(-Bs \cap -Ps)$$

To obtain a certain outcome each agent must make an "effort". We will call e_b the effort of BA and e_p that of CB. Let us suppose, for the sake of simplicity, that both variables can assume only two values: $e_b = 0$ or $e_b = 1$ and similarly for e_p. For this reason, the possible couples (e_b, e_p) are four.

To simplify the writing, we put:

$$\text{(2)}\quad \begin{aligned} e_{00} &= (e_b = 0) \cap (e_p = 0) && \text{- no effort made in either function -} \\ e_{01} &= (e_b = 0) \cap (e_p = 1) && \text{- effort made only for price stability (restrictive monetary policy)-} \\ e_{10} &= (e_b = 1) \cap (e_p = 0) && \text{-effort made only for banking stability –} \\ e_{11} &= (e_b = 1) \cap (e_p = 1) && \text{-effort made in both functions –} \end{aligned}$$

and p_{00}, p_{01}, p_{10}, p_{11} the corresponding probabilities.

The probability of achieving a stable banking system is affected by the agents' behavior in line with political decisions. We therefore introduce the following probabilities:

$$P_{0b} = Pr(Bs \mid e_{01}) \qquad P_{1b} = Pr(Bs \mid e_{10})$$

$$P_{2b} = Pr(Bs \mid e_{11}) \qquad P_{3b} = Pr(Bs \mid e_{00})$$

Given the meaning of these probabilities, we expect that:

(2)' $P_{1b} \geq P_{2b}$; $P_{3b} \geq P_{0b}$

Under equal effort by the banking authorities, the probability of achieving a stable banking system is higher when monetary policy is expansionistic[16].

As for price stability, we insert the following probabilities:

(3) $P_{0p} = Pr(Ps \mid e_p = 0 \cap -Bs)$ $P_{1p} = Pr(Ps \mid e_p = 1 \cap Bs)$

$P_{2p} = Pr(Ps \mid e_p = 1 \cap -Bs)$ $P_{3p} = Pr(Ps \mid e_p = 0 \cap Bs)$

The probability of achieving a stable price level depends of whether the monetary authority makes an effort, and on the degree of stability of the banking system, since this is the channel conveying monetary policy. In particular, there is a higher probability of stable prices when the banking system is stable[17].

We therefore expect :

(3)' $P_{0p} \leq P_{2p}$; $P_{3p} \leq P_{1p}$.

The introduction of these conditional probabilities becomes necessary when we look at the agents' utility. This is a problem of constrained maximization. The politician has his own utility function and to maximize it he has to minimize costs. He will therefore have to identify what size incentives can maximize his expected utility, within certain constraints determined by the contract with the agents. These are incentive and participation constraints.

If we want to express the probabilities present in (1), through the probabilities introduced with (3), keeping in mind the definition of conditional probability[18] and the resulting properties, we obtain:

(4) $Pr(Bs \cap Ps) = P_{3p} [P_{3b}\, p_{00} + P_{1b}\, p_{10}] + P_{1p} [P_{0b}\, p_{01} + P_{2b}\, p_{11}]$

(5) $Pr(Bs \cap -Ps) = (1- P_{3p}) [P_{3b}\, p_{00} + P_{1b}\, p_{10}] + (1 - P_{1p}) [P_{0b}\, p_{01} + P_{2b}\, p_{11}]$

(6) $Pr(-Bs \cap Ps) = P_{0p} [(1 - P_{3b})\, p_{00} + (1 - P_{1b})\, p_{10}] + P_{2p} [(1 - P_{0b})\, p_{01} + (1 - P_{2b})\, p_{11}]$

(7) $Pr(-Bs \cap -Ps) = (1 - P_{0p}) [(1 - P_{3b})\, p_{00} + (1 - P_{1b})\, p_{10}] + (1 – P_{2p}) [(1 - P_{0b})\, p_{01} + (1 - P_{2b})\, p_{11}]$

[16] An inflationistic monetary policy is not desirable if one considers the goal of price stability. This conflict of interests is one of the factors in support of giving the roles to different authorities.

[17] "*Stability of the financial sector is important for monetary authorities, as monetary and financial sector stability are closely connected. History provides many examples where problems in the financial sector led to monetary instability. The Great Depression in the U.S. is probably the best known example where bank failures, combined with an inadequate response by the monetary authorities, resulted in a prolonged economic crises…*" (Eijffinger 2001)

[18] $Pr (A|B) = Pr (A \cap B)/ Pr (B)$

We prove the first one (4):

$Pr(Bs \cap Ps) = Pr(Bs \cap Ps \cap (e_p = 0 \cup e_p = 1)) =$

$= Pr(Bs \cap Ps \cap e_p = 0) + Pr(Bs \cap Ps \cap e_p = 1) =$

$= Pr(Ps \mid Bs \cap e_p = 0)\ Pr(Bs \cap e_p = 0) + Pr(Ps \mid Bs \cap e_p = 1)\ Pr(Bs \cap e_p = 1) =$

for (3)

$= P_{3p}\ Pr(Bs \cap e_p = 0) + P_{1p}\ Pr(Bs \cap e_p = 1) =$

$= P_{3p}\ [Pr(Bs \cap (e_{00} \cup e_{10}))] + P_{1p}\ [Pr(Bs \cap (e_{01} \cup e_{11}))] =$

$= P_{3p}\ [Pr(Bs \cap e_{00}) + Pr(Bs \cap e_{10})] + P_{1p}\ [Pr(Bs \cap e_{01}) + Pr(Bs \cap e_{11})]=$

$= P_{3p}\ [Pr(Bs \mid e_{00})\ Pr(e_{00}) + Pr(Bs \mid e_{10})\ Pr(e_{10})] + P_{1p}\ [Pr(Bs \mid e_{01})\ Pr(e_{01}) + Pr(Bs \mid e_{11})\ Pr(e_{11})]=$

$= P_{3p}\ [P_{3b}\ p_{00} + P_{1b}\ p_{10}] + P_{1p}\ [P_{0b}\ p_{01} + P_{2b}\ p_{11}]$.

These probabilities (4, 5, 6, 7) will assume different values according to the considered period: electoral or non electoral period.

The politician is sure that given adequate incentives, the authorities will act in his interests. Consequently, in the election period, the monetary authority will recieve incentives to make no effort to maintain stable prices. As we have already seen, in fact, price instability is preferable for the politician in the electoral period, while he always wants a stable banking system. The politician therefore supposes that there will almost certainly be $(e_b = 1 \cap e_p = 0) = e_{10}$, and the probability of this eventuating will be $p_{10} = 1$. All the other p_{ij} probabilities will be null. This result will be not the same if we consider the non electoral period. Therefore, in the **electoral period** we can re-write the probabilities (4, 5, 6, 7), in this way:

(4)’ $Pr(Bs \cap Ps \mid e_{10}) = P_{1b}\, P_{3p}$

(5)’ $Pr(Bs \cap -Ps \mid e_{10}) = P_{1b}\, (1 - P_{3p})$

(6)’ $Pr(-Bs \cap Ps \mid e_{10}) = (1 - P_{1b})\, P_{0p}$

(7)’ $Pr(-Bs \cap -Ps \mid e_{10}) = (1 - P_{1b})\, (1 - P_{0p})$.

On the other hand, in the **non-electoral period,** since the politician will prefer a stable banking system and price stability, he will give the agents adequate incentives to achieve this goal. To be precise, he will offer BA t_b if there is –Bs, and T_b if there is Bs (obviously with $t_b < T_b$), and he will give CB t_p if there is –Ps, and T_p if there is Ps (with $t_p < T_p$). Following the same line of thinking as before, the politician is convinced that both the authorities will make an effort to reach stability, one for prices, the other for the banking system. So for the politician there will be e_{11}, and the corrresponding probability will be $p_{11} = 1$. All the other probabilities will be null. From (4)-(7) it therefore follows that:

(4)'' $\Pr(Bs \cap Ps \mid e_{11}) = P_{2b} P_{1p}$

(5)'' $\Pr(Bs \cap -Ps \mid e_{11}) = P_{2b} (1 - P_{1p})$

(6)'' $\Pr(-Bs \cap Ps \mid e_{11}) = (1 - P_{2b}) P_{2p}$

(7)'' $\Pr(-Bs \cap -Ps \mid e_{11}) = (1 - P_{2b}) (1 - P_{2p})$.[19]

Consequently, the politician's expected net utility will assume two different expressions, according to whether one considers the **electoral period**:

(8) $E(U\text{-}u \mid e_{10}) = [u_1 - u(T_b) - u(t_p)] P_{1b} P_{3p} + [u_2 - u(T_b) - u(T_p)] P_{1b} (1 - P_{3p}) +$
$+ [u_3 - u(t_b) - u(t_p)] (1 - P_{1b}) P_{0p} + [u_4 - u(t_b) - u(T_p)] (1 - P_{1b}) (1 - P_{0p})$

or the **non-electoral period**:

(9) $E(U\text{-}u \mid e_{11}) = [u_1 - u(T_b) - u(T_p)] P_{2b} P_{1p} + [u_2 - u(T_b) - u(t_p)] P_{2b} (1 - P_{1p}) +$
$+ [u_3 - u(t_b) - u(T_p)](1 - P_{2b}) P_{2p} + [u_4 - u(t_b) - u(t_p)] (1 - P_{2b}) (1 - P_{2p})$

[19] Since they will be useful later, let us complete the calculation of the other conditional probabilities, as follows:

(4)''' $\Pr(Bs \cap Ps \mid e_{01}) = P_{0b} P_{1p}$

(5)''' $\Pr(Bs \cap -Ps \mid e_{01}) = P_{0b} (1 - P_{1p})$

(6)''' $\Pr(-Bs \cap Ps \mid e_{01}) = (1 - P_{0b}) P_{2p}$

(7)''' $\Pr(-Bs \cap -Ps \mid e_{01}) = (1 - P_{0b}) (1 - P_{2p})$

(4)'''' $\Pr(Bs \cap Ps \mid e_{00}) = P_{3b} P_{3p}$

(5)'''' $\Pr(Bs \cap -Ps \mid e_{00}) = P_{3b} (1 - P_{3p})$

(6)'''' $\Pr(-Bs \cap Ps \mid e_{00}) = (1 - P_{3b}) P_{0p}$

(7)'''' $\Pr(-Bs \cap -Ps \mid e_{00}) = (1 - P_{3b}) (1 - P_{0p})$.

where however, this time, $u_1 > u_2$ and $u_3 > u_4$, i.e. the politician's utility is higher with a restrictive monetary policy. To make the relations between the different values of u_i clearer, let us say in the

electoral period:

$u_1 = G$; $u_2 = G(1 + R)$; $u_3 = g$; $u_4 = g(1 + r)$

G: measures the preferences for stability in the banking system;

R: represents the higher value that the politician obtains if there is price instability at the same time as stability in the banking system;

g: indicates the preferences for instability in the banking system;

r: is the higher gains obtained by the politician if there is price instability, given the instability in the banking system; with $G > g$ and $r < R$.

Substituting these values in (8), we obtain:

$$(8)' \quad E(U\text{-}u \mid e_{10}) = [G - u(T_b) - u(t_p)]\, P_{1b}\, P_{3p} + [G(1 + R) - u(T_b) - u(T_p)]\, P_{1b}\, (1 - P_{3p}) + \\ + [g - u(t_b) - u(t_p)]\, (1 - P_{1b})\, P_{0p} + [g(1 + r) - u(t_b) - u(T_p)]\, (1 - P_{1b})\, (1 - P_{0p}).$$

In the **non-electoral period** let us say:

$u_1 = G(1 + R)$; $u_2 = G$; $u_3 = g(1 + r)$; $u_4 = g$

and from (9) we obtain:

$$(9)' \quad E(U\text{-}u \mid e_{11}) = [G(1 + R) - u(T_b) - u(T_p)]\, P_{2b}\, P_{1p} + [G - u(T_b) - u(t_p)]\, P_{2b}\, (1 - P_{1p}) + \\ + [g(1 + r) - u(t_b) - u(T_p)]\, (1 - P_{2b})\, P_{2p} + [g - u(t_b) - u(t_p)]\, (1 - P_{2b})\, (1 - P_{2p})$$

As for the choice of cost function u(t), we use the function

$$(10) \quad u(t) = \begin{cases} t^2/2 & \text{if } t \geq 0 \\ -t^2/2 & \text{if } t < 0 \end{cases}$$

Thus $u'(t) = |t|$ and u is increasing.