

Economic transparency and poverty^{*}

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1. Introduction

The end of the 20th century was marked by a commitment on the part of several countries to the eradication of poverty. The same period was characterized by success in achieving price stability thanks to the new techniques adopted by central banks in conducting monetary policies. Nowadays, a number of central banks have adopted inflation targeting as a new nominal anchor. Under this strategy, the interest rate is the main instrument for the central banks in the implementation of monetary policy.

In most cases, the central banks define the interest rate taking into consideration the departure of the expected inflation from its target value, and a disinflation process in the economy is thus associated with an increase in the interest rate;¹ hence the need for an instrument able to enhance the central bank's accountability in achieving its targets, thereby contributing to reduction in the interest rate. As a consequence, transparency becomes particularly relevant in this analysis.

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¹ For an analysis of inflation targeting considering relations between inflation, unemployment, interest rate and economic growth for 14 countries with explicit inflation targeting, see de Mendonça (2007).

Central bank transparency plays an important role in the reduction of poverty because it increases the information set available to the public and reduces the asymmetries of information, thus helping to limit uncertainty and preventing discretionary behaviour on the part of the monetary authority. Furthermore, according to Svensson (1999), increasing central bank transparency contributes to the convergence of inflation expectation and inflation target (according to Phillips's output target curve), creating credibility and enhancing inflation control.

According to Blinder (2000), in practice the central banks take social costs into consideration when making decisions concerning monetary policy. The justification is that inflation corrodes the economic agents' purchasing power, which cannot be protected from inflation tax effects. Moreover, the use of high interest rates to reduce inflation implies credit constraint, which in turn prevents the economic agents from smoothing their consumption, thus reducing the level of social welfare.

The three above-mentioned variables (inflation, unemployment and interest rate) are determinants of poverty, and the possible effects arising from the central bank's management of monetary policy cannot therefore be neglected. This paper presents a theoretical model together with empirical evidence which indicates that an increase in central bank transparency contributes to a reduction in poverty. The following sections of this paper are organized thus: the next section presents a theoretical model that demonstrates the influence of central bank transparency on poverty, the third section presents empirical evidence confirming the theoretical perspective and the last section presents the conclusions.

2. Theoretical underpinning

Due to the lag in the transmission mechanism of monetary policy, decisions concerning definition of the interest rate produce their effects on real activity only some time afterwards. Hence, explanations based on anticipated future events contribute to an increase in the public perception of central bank behaviour, which in turn strengthens the inflation target credibility. Therefore, one advantage of eco-

economic transparency is an increase in the capacity of the central bank to affect inflation expectations, thus contributing to a fall in inflation tax. As inflation tax hits the purchasing power of poor households to a large extent, a fall in this tax reduces both poverty levels and inequality.

Under an inflation targeting system, when the inflation forecast proves higher than the inflation target, the central bank increases the interest rate with the purpose of promoting convergence between these variables. As a consequence, expectations regarding the future short-term interest rate are affected, which in turn implies changes in the future interest rate. This interest rate is important to the economy because it affects the level of economic activity through the effect on the public's consumption decisions (see Bernanke 2004 and Woodford 2005).

A factor which indirectly affects the living conditions of citizens is the central bank's accountability. An accountable central bank is expected to accomplish its predetermined targets, and not to succumb to the pressure of powerful economic groups set on promoting expansion in output. The latter circumstance arises from political shocks that force the central bank to deviate from its commitment to the public in favour of a small group that controls the greatest part of the national wealth. As a consequence, there is an increase in inequality indices and, taking Ravallion's (1992) decomposition to be valid, the consequence is an increase in poverty.

2.1. *The model*

Based on Cooley and Hansen (1991), it is possible to represent a dynamic analysis for the real interest rate that takes account of the effects caused by a change in the prices and also by the consumption decision between cash goods and credit goods (indicated by $\alpha/(1-\alpha)$ ratio). Hence, the optimization problem of the representative consumer's indirect utility function operating in a perfectly competitive environment yields:

$$r_t = \left(\frac{\alpha}{1-\alpha} \right) \left(\frac{p_{t-1}}{p_t} \right) \left(\frac{c_{2t}}{c_{1t}} \right) - (1-d), \quad 0 < \alpha < 1, \quad (1)$$

where r is the real interest rate, p is the price level, c_1 is the consumption of cash goods, c_2 is the consumption of credit goods, fraction d of capital depreciates each period.

The consumption of cash goods is made through the use of money and is divided into consumption of the poor (c_{1pt}) and of the non-poor (c_{1npt}),

$$c_{1t} = \gamma c_{1pt} + (1 - \gamma) c_{1npt}, \quad 0 < \gamma < 1. \quad (2)$$

The model assumes that the citizens under the poverty line cannot buy goods using the credit market and that the non-poor's consumption is equal to the consumption of goods using money (c_{1npt}) and credit (c_{2npt}),

$$c_{npt} = (1 - \gamma) c_{1npt} + c_{2npt}. \quad (3)$$

Therefore, it is possible to rewrite equation 2 based on the result in equation 3, i.e.,

$$c_{1t} = \gamma c_{1pt} + c_{npt} - c_{2npt}. \quad (4)$$

In this model the income (y_t) is obtained through the sum of consumption of cash goods and credit goods, and investments (gross fixed capital formation - $gfcf$) by economic actors. As a consequence,

$$y_t = \gamma c_{1pt} + c_{npt} - c_{2npt} + c_{2npt} + gfcf_t \quad (5)$$

$$y_t = \gamma c_{1pt} + c_{npt} + gfcf_t.$$

The fact that only the non-poor buy credit goods implies

$$c_{2npt} = c_{2t}. \quad (6)$$

Therefore, substituting equations 4 and 6 into equation 1, and making the substitution of equation 5 into this result, the ratio y_t/c_{1pt} is²

² The procedure to derive the expression is presented in the Appendix.

$$\frac{y_t}{c_{1pt}} = \frac{\gamma[r_t + (1-d)] \left(\frac{p_t}{p_{t-1}} \right)}{\left(\frac{\alpha}{1-\alpha} \right)} - \left(\frac{y_t}{gfcf_t} + \frac{y_t}{c_{1t+1}} \right) \frac{\gamma[r_t + (1-d)] \left(\frac{p_t}{p_{t-1}} \right)}{\left(\frac{\alpha}{1-\alpha} \right)} - \frac{\gamma}{(1-\gamma)} \frac{y_t}{c_{1npt}}. \quad (7)$$

A hypothesis of this model being that poor households use all their income (y_{pt}) buying cash goods (c_{1pt}), then $c_{1pt} = y_{pt}$. Thus, equation 7 can be rewritten as

$$\frac{y_t}{y_{pt}} = \frac{\gamma[r_t + (1-d)] \left(\frac{p_t}{p_{t-1}} \right)}{\left(\frac{\alpha}{1-\alpha} \right)} \left[1 - \left(\frac{y_t}{gfcf_t} + \frac{y_t}{c_{1t+1}} \right) \right] - \frac{\gamma}{(1-\gamma)} \frac{y_t}{c_{1npt}}. \quad (8)$$

The above equation denotes that increases in the real interest rate and inflation (p_t/p_{t-1}) provoke a decrease in the share of the poor's income in the total income (the difference between y_t and y_{pt} increases). It is important to note that, under the hypothesis that each individual has the same income, y_t represents a fully egalitarian income distribution. Under this perspective, a fall in the y_t/y_{pt} represents a fall in the income inequality. On the other hand, an increase in inflation and interest rate reduces the poor's consumption.

The influence of central bank transparency on income inequality can be understood through the use of a central bank loss function in the contingent state. In this case, the central bank (*cb*) publishes part of its forecasts on supply shocks and minimizes the loss function considering that the public builds its inflation expectations conditioned by these forecasts (e^0). Hence, the relative term to the contract of the central bank with the public reveals that, while the deviation of the inflation in relation to the shock that is observed by the public increases, the loss of reputation of the central bank also increases.

$$L = \frac{1}{2} E_t^{cb} \sum_{n=0}^{\infty} \beta^n \left[\lambda (x_{t+n} - u_{t+n})^2 + \pi_{t+n}^2 + \tau (\pi_{t+n} - e_{t+n}^0)^2 \right]. \quad (9)$$

Equation 9 has a component that takes into consideration the objective relative to output ($\lambda > 0$), an intertemporal discount rate ($0 < \beta < 1$), the number of periods (n), an element that captures the political shocks (u_t), an incentive contract that takes into account punishment (τ) for deviations in relation to the inflation target, the in-

flation rate (π_t) and output gap (x_t). (e^o) is composed of the central bank forecast on supply shocks (e^{cb}) and an error (w_t), i.e. $e_t^o = e_t^{cb} + w_t$. The difference between the shock observed by the public and that observed by the central bank is understood as a measure of economic transparency.

In addition to the previous information, it is assumed that the inflation is given by the new Keynesian Phillips curve

$$\pi_t = \delta x_t + \beta E_t \pi_{t+1} + e_t, \quad (10)$$

where $E_t \pi_{t+1}$ is the expected future inflation, β is the utility discount factor, $\delta > 0$ is the sensitiveness of inflation to the output gap, e_t is the inflation shock.

With the objective of finding the inflation and output gap which minimizes the central bank loss function, the optimization problem is solved. The results imply that³

$$\pi_t = \frac{\lambda \delta}{\lambda + \delta^2(1 + \tau)} u_t^{cb} + \left(1 - \frac{\delta^2}{\lambda + \delta^2(1 + \tau)}\right) e_t^{cb} + \frac{\delta^2 \tau}{\lambda + \delta^2(1 + \tau)} w_t \quad (11)$$

$$\pi_t = \frac{\lambda \delta}{\lambda + \delta^2(1 + \tau)} [u_t^p - \vartheta_t] + \left(1 - \frac{\delta^2}{\lambda + \delta^2(1 + \tau)}\right) e_t^{cb} + \frac{\delta^2 \tau}{\lambda + \delta^2(1 + \tau)} w_t,$$

$$x_t = \frac{\lambda}{\lambda + \delta^2(1 + \tau)} u_t - \frac{\delta}{\lambda + \delta^2(1 + \tau)} e_t^{cb} + \frac{\delta \tau}{\lambda + \delta^2(1 + \tau)} w_t, \quad (12)$$

u_t is the political shock, u_t^p is the political shock forecasted by the public, u_t^{cb} is the political shock observed by the central bank and ϑ_t is the public forecast error in relation to the political shock. As a consequence,

$$u_t^p = u_t^{cb} + \vartheta_t. \quad (13)$$

³ The procedure to derive this expression is presented in de Mendonça and Simão Filho (2007). It is important to note that, although the derivation for equations 11 and 12 is the same as that applied by the above-mentioned authors, the objectives are completely different, their analysis focusing on the influence of central bank transparency on the effectiveness of monetary policy.

When the central bank does not have political transparency and the public builds forecasts on political shocks for increasing output, equation 11 is reduced to

$$\pi_t = \frac{\lambda\delta}{\lambda + \delta^2(1 + \tau)} u_t^p. \quad (14)$$

Taking into consideration equations 11 and 12 in the loss function and minimizing this result in relation to the punishment for deviations in inflation from the target (τ), then

$$\tau = \frac{(\lambda + \delta^2)\lambda^2\sigma_u^2 + \lambda\delta(1 + \delta)\sigma_{e^{cb}}^2}{[(\lambda + \delta^2)^2\sigma_w^2 - \delta^4\sigma_{e^{cb}}^2]}. \quad (15)$$

The above equation reveals that an increase in the dispersion of the degree of central bank opacity (σ_w^2) implies a decrease in the power of incentive contract (τ) for the accomplishment of its targets. The substitution of this result in equation 14 implies that the inflation that minimizes the central bank loss function can be rewritten as

$$\pi_t = \frac{\lambda\delta}{\lambda + \delta^2 \left(1 + \frac{(\lambda + \delta^2)\lambda^2\sigma_{e^{cb}}^2 + \lambda\delta(1 + \delta)\sigma_{e^{cb}}^2}{[(\lambda + \delta^2)^2\sigma_w^2 - \delta^4\sigma_{e^{cb}}^2]} \right)} u_t^p. \quad (16)$$

With the intention of giving a microfoundation to the new Keynesian Phillips curve and to the social loss function, a relation between the interest rate and the inflation expectation is made through an intertemporal IS. Under this framework, on the basis of the result of the optimization process by economic actors, it is possible to evaluate the impact of economic transparency on the interest rate.⁴ Hence,

⁴ This equation is obtained by de Mendonça and Simão Filho (2007). However, as in footnote 3, the observation that the models are different also applies here.

$$i_t = \Psi E_t \left\{ \begin{array}{l} \frac{\lambda \delta}{\lambda + \delta^2(1 + \tau)} u_{t+1}^p - \frac{\lambda \delta}{\lambda + \delta^2(1 + \tau)} \vartheta_{t+1} \\ + \left(1 - \frac{\delta^2}{\lambda + \delta^2(1 + \tau)} \right) e_{t+1}^{cb} \\ + \frac{\delta^2 \tau}{\lambda + \delta^2(1 + \tau)} \zeta_{t+1} \end{array} \right\} + \frac{\psi \rho \delta^2 \tau}{\lambda + \delta^2(1 + \tau)} w_t - 1. \quad (17)$$

The above equation denotes that an increase in central bank economic transparency implies a lower nominal interest rate in the short run. On the other hand, an increase in central bank opacity (w_t) in relation to the publication of its forecasts of supply shocks increases the interest rate level. With the objective of simplifying the result present in equation 17, the economic agents are assumed to be rational and an expectation operator is applied. As a consequence, the parts related to e_{t+1}^{cb} , ζ_{t+1} , w_t , and ϑ_{t+1} are eliminated, and thus the above equation is reduced to

$$i_t = \Psi E_t \left\{ \frac{\lambda \delta}{\lambda + \delta^2(1 + \tau)} u_{t+1}^p \right\} - 1. \quad (18)$$

The above equation is very important to this model because, by substituting equation 15 into equation 18 and dividing this result by (P_t/P_{t-1}) , it is possible to verify the effect produced by transparency on the real interest rate; then

$$\frac{i_t}{\left(\frac{P_t}{P_{t-1}} \right)} = \frac{\Psi E_t \left\{ \frac{\lambda \delta}{\lambda + \delta^2 \left(1 + \frac{(\lambda + \delta^2) \lambda^2 \sigma_u^2 + \lambda \delta (1 + \delta) \sigma_{e^{cb}}^2}{[(\lambda + \delta^2)^2 \sigma_w^2 - \delta^4 \sigma_{e^{cb}}^2]} \right)} u_{t+1}^p \right\} - 1}{\left(\frac{P_t}{P_{t-1}} \right)}. \quad (19)$$

Substituting equation 19 into equation A.1 (see Appendix) and using this result in the equation that reveals the inequality income (equation 8) yields

$$\frac{y_t}{y_{pt}} = \frac{\left[\gamma \Psi E_t \left\{ \frac{\lambda \delta}{\lambda + \delta^2 \left(1 + \frac{(\lambda + \delta^2) \lambda^2 \sigma_u^2 + \lambda \delta (1 + \delta) \sigma_{e^{cb}}^2}{[(\lambda + \delta^2)^2 \sigma_w^2 - \delta^4 \sigma_{e^{cb}}^2]} \right)} u_{t+1}^p \right\} - 1 + (1 - d) \right]}{\left(\frac{\alpha}{1 - \alpha} \right)} \quad (20)$$

$$\left[1 - \left(\frac{y_t}{gfcf_t} + \frac{y_t}{c_{t+1}} \right) \right] - \frac{\gamma}{(1 - \gamma)} \frac{y_t}{c_{inpt}}$$

The above equation reveals very important implications for income inequality due to change in economic transparency. It is observed that an increase in transparency ($1/\sigma_w^2$) implies an increase in τ which, in turn, provokes a decrease in the ratio y_t/y_{pt} . In other words, an increase in economic transparency contributes to a fall in income inequality. Furthermore, the presence of political shocks to expand the output (when a central bank is not independent) must be avoided with an increase in central bank transparency. The justification is that central bank transparency implies an increase in sensitivity of credibility in the achievement of the inflation target (increase in τ).

3. An empirical exercise

The theoretical model of the previous section shows that the level of poverty is influenced by central bank transparency. Hence, empirical analysis is important in order to validate the results found with concrete evidence. Therefore, the analysis developed in this section considers the main variables used in the theoretical section (inflation, real interest rate and economic transparency) for evaluating their impact on poverty. The idea is that countries whose central banks are more transparent have a lower poverty level.

In view of the limited information on the percentage of impoverished people in a given country, it is deemed opportune to use an inequality index as the dependent variable for the estimation. Fur-

thermore, according to Ravallion's (1992) decomposition, poverty is affected through income inequality and average income, which in turn justifies use of the Theil index to evaluate the effects of central bank publications (proxy of transparency) on the level of poverty.

The transparency index used in this analysis takes into consideration the data available in Fry *et al.* (2000). This transparency index evaluates publications related to macroeconomic variables and also discussion of mistakes and risks in central bank forecasts. Table 1 shows the composition of the economic transparency index and its respective score. The different scores reveal the importance attached by the central banks to the publications concerning the economic future. From this perspective, the composition (score) of the economic transparency index is given by:

i) Forward-looking analyses in bulletins and discussion of past forecast errors – if the central bank carried out analysis of future prospects more than once a year the score is 100, if once a year the score is 50, if the periodicity is not defined the score is 25 and if there is no analysis the score is zero.

ii) Type of publication and risks of central bank forecasts – if the publications are composed of words, numbers and graphs in an adequate quantity, the score is 100; if the publications have a small quantity of words, numbers and graphs, the score is 50; in cases where there is no specification related to the type of information in the bulletins, the score is 25; in all other situations the score is null.

The inflation used by Fry *et al.* (2000) is the average between 1997 and 1998. Furthermore, the analysis in this section takes into consideration the nominal interest rate (interbank – average between 1997 and 1998) extracted from International Financial Statistics (IMF). As a measure of income inequality the Theil index, available from the University of Texas Inequality site (<http://utip.gov.utexas.edu>), was used. The data correspond to the vicinity of 1996 (average from 1996 to 1998). When there is no information available for the period, the most recent is used. Based on Deininger and Squire (1996), the justification for the use of data for heterogeneous periods is that indices of income inequality show small standard deviation over time.

TABLE 1
FORECAST EXPLANATIONS AND FORWARD-LOOKING ANALYSES

	Questions	Score
Forward-looking analyses in bulletins	Published more than once per year	100
	Published once per year	50
	Periodicity of publication is not defined	25
	There is no publication	0
Type of publication	Words, numbers and graphs	100
	Numbers and graphs	50
	Type is not defined	25
	There is no publication	0
Risks of central bank forecasts	Words, numbers and graphs	100
	Numbers and graphs	50
	Type is not defined	25
	There is no publication	0
Discussion of past forecast errors	Regular publication	100
	Irregular publication	50
	There is no publication	0

The methodology applied to evaluation of the effects of the central banks' decisions regarding poverty was made by cross-section analysis (Least Squares method) taking into consideration macroeconomic variables. As in this type of data the problem of a heteroskedasticity-induced biased estimation is common, the Newey-West (1987) estimator is used in such a way as to render analysis reliable. Moreover, the number of countries used in the research depends on the availability of data present in the above-mentioned sources.

It is important to note that an increase in inflation and real interest rate implies an increase in income inequality (see equation 10). Furthermore, economic transparency has a negative effect on both variables. Therefore, it is necessary to perform an empirical analysis divided into two steps. The justification is that real interest rate and inflation cannot be explicative variables together with economic transparency due to the effect of the latter variable on the former. Therefore, two models are considered in the analysis (see table 2). The first model estimates the impact caused by the inflation rate (*INF*), real

interest rate (*RIR*) and unemployment rate (*U*) on poverty (proxy is the Theil index). From this perspective, the model is given by:

$$\text{Inequality} = f(\text{RIR}, \text{INF}, \text{U}). \quad (21)$$

The expected signs are: $\partial f/\partial \text{RIR} > 0$; $\partial f/\partial \text{INF} > 0$; $\partial f/\partial \text{U} > 0$.

The second model considers the effect on poverty due to economic transparency (see equation 20). Hence, a regression is made taking into consideration economic transparency (*ET*) and discretionary central bank behaviour (*DCBB*) as explicative variables of income inequality. Thus,

$$\text{Inequality} = f(\text{ET}, \text{DCBB}). \quad (22)$$

The expected signs are: $\partial f/\partial \text{ET} < 0$; $\partial f/\partial \text{DCBB} > 0$.

TABLE 2

ESTIMATION LEAST SQUARES

Dependent variable - Theil index				
Model	Estimated coefficients (t-Statistics - Newey-West)	Obs	F-statistics	Adj. R ²
1	-4.9943 + 0.3925 INF + 0.3071 RIR + 0.4406 U (-9.0366)* (3.1573)* (1.8260)*** (2.0553)**	45	7.2093*	0.30
2	-4.3693 - 0.6748 ET + 0.2324 DCBB (-13.3880)* (-2.8660)* (2.2007)**	61	4.5219**	0.11
3	-4.1769 - 0.6992 ET + 0.3071 DCBB - 0.0448 CBA (-3.4511)* (-2.8907)* (1.9852)*** (-0.1738)	60	2.9956**	0.09

Note: Significant at the 1 (*), 5 (**) and 10 (***) percent level.

The results of both models (see table 2) denote that t-statistics for all variables in the analysis (transformed into natural logarithms) have statistical significance in estimation of income inequality. The importance of whole variables in the estimation (measured by F-statistics), such as for variation in the income inequality (measured by adjusted R²), has statistical significance. Furthermore, the signs obtained in the estimations show the expected behaviour. The coefficient related to the real interest rate (0.3071) reveals that an increase in this variable contributes to an increase in income inequality. The same idea is valid when the effects of inflation (coefficient equal to 0.3925) and unemployment (0.4406) are considered (see model 1). It

is important to highlight the significant contribution of an increase in economic transparency to a lower income inequality (-0.6748). On the other hand, it is observed that an increase in discretionary central bank behaviour (0.2324) contributes to an increase in income inequality.

Although the results for the estimation above denote the validity of the arguments of the theoretical model, a more robust test is necessary. With this objective, an explicative variable, which represents proxies of institutional variables, was introduced to the model. The idea is to evaluate whether the inclusion of these variables weakens the statistical significance of the economic transparency, thus revealing if an omitted variable affects the result of the model. Should it do so, it is to be interpreted as showing that the importance of central bank transparency related to the Theil index is being overestimated. As a consequence, nothing can be affirmed concerning the effect of economic transparency, since the value of this variable can be determined with institutional variables.

The proxy chosen to represent institutional variables is central bank accountability (CBA).⁵ With inclusion of this variable in the model a new LS estimation was made (see model 3 – table 2). The result shows that the statistical significance of economic transparency remains and the coefficient value is slightly different when compared to that of model 2. Furthermore, central bank accountability is not statistically significant.

4. Conclusions

The theoretical model shows a positive relation between poverty and political shocks caused by powerful economic groups. These shocks are neutralized by means of an incentive contract that contemplates penalisation for the central bank whenever it deviates from the inflation target. This contract, determined by law, reveals to the public the penalisation the central bank is subject to. As a consequence, central

⁵ It is important to note that this proxy was extracted from Fry *et al.* (2000) and their framework is close to the one used for elaboration of the economic transparency index.

bank transparency increases the accountability of the monetary authority in its achievement of the inflation target.

The empirical evidence shows that increases in inflation and in real interest rates cause an increase in the Theil index. On the other hand, economic transparency has a relevant role in the reduction of income inequality and, thus, through Ravallion's (1992) decomposition, contributes to an effective reduction in poverty. It is therefore shown that the more transparent the central bank is, the less inequality there will be and the less impoverished the nation will prove.

APPENDIX

This appendix presents the derivation of the equation relative to the ratio $\frac{y_t}{c_{1pt}}$.
Substituting equations

$$c_{1t} = \gamma c_{1pt} + c_{npt} - c_{2npt} \quad \text{and} \quad (4)$$

$$c_{2npt} = c_{2t} \quad \text{into} \quad (6)$$

$$r_t = \left(\frac{\alpha}{1-\alpha} \right) \left(\frac{p_{t-1}}{p_t} \right) \left(\frac{c_{2t}}{c_{1t}} \right) - (1-d), \quad \text{then} \quad (1)$$

$$r_t = \left(\frac{\alpha}{1-\alpha} \right) \left(\frac{p_{t-1}}{p_t} \right) \left(\frac{c_{npt} - (1-\gamma)c_{1npt}}{\gamma c_{1pt} + (1-\gamma)c_{1npt}} \right) - (1-d),$$

$$r_t + (1-d) = \left(\frac{\alpha}{1-\alpha} \right) \left(\frac{p_{t-1}}{p_t} \right) \left(\frac{c_{npt} - (1-\gamma)c_{1npt}}{\gamma c_{1pt} + (1-\gamma)c_{1npt}} \right)$$

$$\frac{[r_t + (1-d)]}{\left(\frac{\alpha}{1-\alpha} \right) \left(\frac{p_{t-1}}{p_t} \right)} [\gamma c_{1pt} + (1-\gamma)c_{1npt}] = c_{npt} - (1-\gamma)c_{1npt}$$

$$[\gamma c_{1pt}] = \frac{\left(\frac{\alpha}{1-\alpha} \right) \left(\frac{p_{t-1}}{p_t} \right)}{[r_t + (1-d)]} [c_{npt} - (1-\gamma)c_{1npt}] - (1-\gamma)c_{1npt}$$

$$c_{1pt} = \frac{\left(\frac{\alpha}{1-\alpha}\right)\left(\frac{p_{t-1}}{p_t}\right)}{\gamma[r_t + (1-d)]} [c_{npt} - (1-\gamma)c_{1npt}] - \frac{(1-\gamma)c_{1npt}}{\gamma}$$

$$c_{1pt} = \frac{\left(\frac{\alpha}{1-\alpha}\right)}{\gamma[r_t + (1-d)]\left(\frac{p_t}{p_{t-1}}\right)} c_{2npt} - \frac{(1-\gamma)c_{1npt}}{\gamma}. \quad (\text{A.1})$$

Substituting equation

$$y_t = \gamma c_{1pt} + c_{npt} - c_{2npt} + c_{2npt} + \text{gfcf}_t \quad (5)$$

into equation A.1 yields

$$c_{1pt} = \frac{\left(\frac{\alpha}{1-\alpha}\right)}{\gamma[r_t + (1-d)]\left(\frac{p_t}{p_{t-1}}\right)} (y_t - \text{gfcf}_t - c_{1t+1}) - \frac{(1-\gamma)c_{1npt}}{\gamma}. \quad (\text{A.2})$$

Dividing both sides by y_t , then

$$\frac{c_{1pt}}{y_t} = \frac{\left(\frac{\alpha}{1-\alpha}\right)}{\gamma[r_t + (1-d)]\left(\frac{p_t}{p_{t-1}}\right)} - \left(\frac{\text{gfcf}_t}{y_t} + \frac{c_{1t+1}}{y_t}\right) \frac{\left(\frac{\alpha}{1-\alpha}\right)}{\gamma[r_t + (1-d)]\left(\frac{p_t}{p_{t-1}}\right)} - \frac{(1-\gamma)c_{1npt}}{\gamma y_t}$$

$$\frac{y_t}{c_{1pt}} = \frac{\gamma[r_t + (1-d)]\left(\frac{p_t}{p_{t-1}}\right)}{\left(\frac{\alpha}{1-\alpha}\right)} - \left(\frac{y_t}{\text{gfcf}_t} + \frac{y_t}{c_{1t+1}}\right) \frac{\gamma[r_t + (1-d)]\left(\frac{p_t}{p_{t-1}}\right)}{\left(\frac{\alpha}{1-\alpha}\right)} - \frac{\gamma y_t}{(1-\gamma)c_{1npt}}. \quad (7)$$

REFERENCES

- BERNANKE, B.S. (2004), "The logic of monetary policy", before the National Economists Club, Federal Reserve Board, December 2, Washington.
- BLINDER, A. (2000), *Central Banking in Theory and Practice*, MIT Press, Cambridge, Mass.
- COOLEY, T.F. and G.D. HANSEN (1991), "The welfare costs of moderate inflations", *Journal of Money, Credit and Banking*, vol. 23, no. 3, pp. 483-503.
- DE MENDONÇA, H.F. (2007), "Empirical evidence from fourteen countries with explicit inflation targeting", *Applied Economics Letters*, forthcoming.
- DE MENDONÇA, H.F. and J. SIMÃO FILHO (2007), "Economic transparency and effectiveness of monetary policy", *Journal of Economic Studies*, forthcoming.
- DEININGER, K. and L. SQUIRE (1996), "Measuring income and inequality: a new database", *Development Discussion Papers*, no. 537, Harvard University College.
- FRY, M., D. JULIUS, L. MAHADEVA, S. ROGER and G. STERNE (2000), "Key issues in the choice of monetary policy framework", in L. Mahadeva e G. Sterne eds, *Monetary Policy Frameworks in a Global Context*, Routledge, London, pp. 1-216.
- NEWBY, W.K. and K.D. WEST (1987), "A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix", *Econometrica*, vol. 55, no. 3, pp. 703-08.
- RAVALLION, M. (1992), "Poverty comparisons: a guide to concepts and methods", *LSMS Working Paper*, no. 88, World Bank.
- SVENSSON, L.E.O. (1999), "Monetary policy issues for the Eurosystem", *NBER Working Paper*, no. 7177, June.
- WOODFORD, M. (2005), "Central bank communication and policy effectiveness", *Working Paper*, no. 118989; <http://www.nber.org/papers/w11898>.