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The relationship between central bank transparency and the quality of inflation forecasts: is it U-shaped?[1]

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Abstract. A recent theoretical literature highlighted the potential dangers of further increasing information disclosure by central banks. This paper gives a continuous empirical investigation of the existence of an optimal degree of transparency in the lines of van der Cruijsen et al. [35]. We test a quadratic relationship between central bank transparency and the inflation persistence by introducing some technical and economic modifications. Particularly, we used three new measures of transparency. An appropriate U shape test that was made through a Stata routine, recently developed by Lind and Mehlum [25], indicates a robust optimal intermediate degree of transparency, but its level is not. These results were obtained using a panel of 11 OECD central banks under the period 1999-2009. The estimations were run using a bias corrected LSDVC, a newly recent technique developed by Bruno [5] for short dynamic panels with fixed effects, extended to accommodate unbalanced data.

JEL codes: C23, E58,

Keywords: intermediate optimal transparency degree, inflation forecasts, inflation persistence, u-shaped relationship, non linear modeling, LSDVC, Principal Component Analysis

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1 Introduction

Whether central banks shall increase their information disclosure any further is an issue that has important implications for both theoretical and empirical literature on central bank transparency. Having been characterized by secrecy for a long time ago, central banks seem to bring considerable efforts in enhancing their transparency practices. The importance lies in influencing the management of expectations, which is a key element of monetary policy decision-making.

Central bank transparency seems to be the norm, but how exactly that transparency should go? In fact, central banks face a potential conflict; a maximum of transparency needs not to be optimal for the efficiency of monetary policy. Accordingly, a conflict may occur when giving more information but with less clarity and common understanding among market participants as there are limits on how much information can be digested (Kahneman, [23]). Too much information may crowd out the formation of private beliefs which are crucial sources of information for a central bank, and thus for the effectiveness of the monetary policy decision-making.

Not everyone agrees that maximum transparency is optimal. Looking for example, at inflation targeting countries in Europe: The Norges bank (Norway) and the Sveriges bank (Sweden) have in recent years begun publishing their projections of the policy rate[2]. This issue has fed the debate regarding the possible harmful effects of such excessive transparency, especially with central banks that have an already high score of transparency. Andersson and Hoffman [1] argue that announcing the future interest rate path tracks may neither improve the predictability of monetary policy nor does anchor long term inflation expectations. Theoretically, there are two arguments that favour limiting transparency: uncertainty and confusion/information overload. In fact, by revealing too much information, agents focus on the complexity of the design of monetary policy and the uncertainty surrounding the forecasts. Moreover, the assumption that economic

[2] "A reason for doing this is to increase leverage over the longer term interest rates in the economy and hence be better in steering the important variables of the economy. As Norges Bank and Riksbank are inflation forecasting central banks, the publication of an endogenous interest rate forecast is important information to the private agents when the central bank publishes its inflation forecast". Danske research Report [9].

agents are able to absorb and attach a weight to all information provided by the central bank is probably high. This can lead to deterioration in the quality of inflation expectations (van der Cruijsen et al., [35]). The question of further information disclosure is especially appealing for central banks with high degree of credibility like OECD countries.
This paper extends the analysis of van der Cruijsen et al. [35] in number of ways;
First by making technical changes:

1. Introducing fixed effects[3] to the panel model
2. Using another set of control variables different from that used in van der Cruijsen et al. [35].
3. Changing the frequency of data, so we worked on an annual basis while the above authors used quarterly data[4].

Second, our economic contribution consists of checking the presence of an optimal intermediate transparency degree by trying three other measures of transparency:

4. We take the index of Minegishi and Cournède [27] as transparency's parameterization in our framework. The rationale behind the use of such index is its high correlation with the one updated by Dincer and Eichengreen [12], that is the index used in the empirical analysis of van der Cruisjen et al. [35]. To the best of our knowledge, we are the first to exploit such indicator to prove the existence of an optimal transparency degree.
5. A comparative result is made available by using the updated index of transparency by Siklos [31].
6. Due to multidimensional character of transparency concept, the hypothesis that the sub-indexes composing the overall index are correlated is very probable. In such case, a Principal Component Analysis (PCA) would be suitable to construct a new transparency index.

[3] A Fisher test was conducted prior to estimation in order to check the presence of individual effects.
[4] A detailed explanation will be given in the text.

Third, we argue that the usual test of non-linear relationship is flawed[5], and derive the appropriate test for a U-shaped relationship by using a Stata routine recently developed by Lind and Mehlum [25].

The remainder of this paper is as follows: Section 2 provides an overview of literature that favours limiting transparency. Section 3 presents the methodology, explains the new indicator of transparency used, and describes how well this indicator is related to inflation persistence, thereby providing new insights with respect to the robustness of previous research. Section 4 offers some concluding remarks.

2 Literature review and further arguments in favor of limiting transparency

A number of empirical and theoretical studies claim central bank transparency to have favourable effect on the economy (Dincer and Eichengreen [12], Minegishi and Cournède [27], Middeldorp [26], Trabelsi and Ayadi [34]). Some other papers, however, come to a different conclusion and find that either higher transparency is unfavourable or that it has an ambiguous effect at mitigating the uncertainty. In the literature related to the optimal degree of transparency, we find that transparency has not the same benefits or costs following the same theoretical framework. Indeed, the economy specification and the model assumptions can affect the optimal degree of transparency. This explains why theoretical conclusions may seem, at first glance, not robust.

However, even if we restrict the study of transparency by focusing on a specific well-defined model, the optimal degree of transparency can be different depending on the size of the information upon which the asymmetry information is based. This observation coincides with the words of Hahn [21]: "*One reason for the controversial debate about transparency, despite the seemingly wide-spread consensus that transparency is desirable, is that people have different views as to what transparency of monetary policy is.*"

[5] This includes also the paper of van der Cruisjen et al. [35] which misses such a test.

In practice, while the benefits associated with certain aspects of the information seem indisputable (for example, the publication of a numerical inflation target, the immediate announcement of the decision of the monetary policy ...), conclusions with regard to other dimensions of transparency are not always unanimous. The controversy between Buiter [4] and Issing [22] about the publication of minutes and voting records is an example of the lack of consensus on transparency with respect to certain types of information.

Geraats [19] gives an excellent overview of the pros and cons of transparency with several examples of welfare reducing information in a Barro-Gordon framework. By limiting transparency, Cukierman [8] argues that the expected welfare is improved. Faust and Svensson [15] show that complete transparency lead to inflationary bias. Van der Cruisjen et al. [35] concluded that there might be a limit to the benefit of transparency and that an intermediate degree of transparency might be desirable. Theoretical idea is that agents may become confused by information they receive that is in excess of the optimal level of transparency.

Such idea is consistent with the seminal paper of Morris and Shin [28] based on coordination games. According to theses authors, transparency could be costly if private sector agents put too much weight on the central bank's public signal because they are attempting to second-guess each other and the public signal acts as a focal point for higher order beliefs. Svensson [33] raises doubts over whether the parameter range necessary to deliver costly transparency in Morris and Shin's model is likely to hold in reality[6]. Demertzis and Hoeberichts [10] established a reasonable parameter range for which more transparency is not always desirable when it is costly for the private sector to process information. More public information reduces the incentives for the private sector to gather their own private information.

Recently, Bayeriswyl [2] thinks that accounting for information endogeneity highlights the detrimental effects of central bank transparency. Hence, endogenous information entails a further argument in favour of limiting transparency.

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[6] Morris, Shin, and Tong [29] provide some counter-arguments. They argue that if public signal is correlated with the private signal, then quantitative evaluation supports their original results

3 Econometric modeling

This section describes transparency data along with the other control variables used in the empirical analysis, and explains the econometric methodology employed before discussing the results.

3.1 Model description and preliminary analysis

3.1.1. Data

New measure of inflation persistence and its link to the quality of inflation forecasts

Since it is difficult to measure the quality of inflation forecasts, we follow van der cruijsen et al. [35] and take the degree of backward lookingness as a proxy. The lower the quality of inflation forecasts is, the larger the degree to which inflation will be set in a backward looking manner. It turns that inflation will be more persistent. Let us illustrate this by using a simple hybrid New Keynesian Philippe Curve (NKPC):

$$\pi_t = \chi_f E_t \pi_{t+1} + \chi_b \pi_{t-1} + kx_t \tag{1}$$

Where π_{it} is the inflation rate and x_t is the output gap. In the limiting case of $\chi_b = 0$, the equation become the pure forward looking NKPC and there's no endogenous inflation persistence. When $\chi_b > 0$, we get NKPC with endogenous inflation persistence, the higher χ_b is, the higher endogenous inflation persistence will be.

Now, we need a measure for inflation persistence. There's little agreement in the extant literature on how best to measure inflation persistence or persistence in general. Fuhrer [18] enumerated a battery of measures that attempt to capture the persistence in inflation:

- Conventional unit root tests;
- The autocorrelation function of the inflation series
- The first autocorrelation of the inflation series;

- The dominant root of the univariate autoregressive inflation process[7];
- The sum of the autoregressive coefficients for inflation;
- Unobserved components decompositions of inflation that estimate the relative contributions of "permanent" and "transitory" components of inflation (for example, the IMA(1,1) and related models proposed by Stock and Watson [32]).

The most employed measures are the second, the third and the fifth ones. This is because the autocorrelation function summarizes much of the information in time series; it may be then the best overall measure of persistence. In what follows, we will show that the measure suggested by van der Cruijsen et al. [35]) is even better (The one given in expression (3)).

Variable of interest: Transparency score

According to Geraats ([**Error! Reference source not found.**], p. 8), "*One of the biggest impediments to transparency research has been the dearth of data. It is not surprising since it is challenging to measure to what extent the private sector has the same information as the monetary policy makers*." There were two approaches to measuring transparency. The first one focuses on financial market reactions to monetary policy decisions and communications (See for instance, Blinder [3], Ehrmann and Fratzcher [13]….). The second one, which interests us, focuses on the availability of information that is pertinent to the policy maker: e.g. the survey conducted by Fry et al. [17] for 94 central banks in 1998. Transparency is a qualitative concept for which few measures exist. Generally, we evaluate it punctually or for a restricted number of central banks, based on three criteria: the rapidity by which the central bank explains its decisions of monetary policy, the frequency of prospective analysis and the periodicity of bulletin and speeches published. Eijffinger and Geraats [14] have constructed complete indexes that distinguish five aspects of transparency as designed in the typology of Geraats [19]. Dincer and Eichengreen [12]

[7] As claimed by van der cruisjen et al. "Critique on the largest autoregressive root is the fact that it does not summarize the impulse response function well, as its shape depends on all the roots".

have expanded theses indexes by exploiting annual data on 100 central banks under the period 1998-2006.

In fact, the first indirect attempt to test the existence of an intermediate degree of transparency was brought by Dincer and Eichengreen [12][8] themselves. However, they used a classical definition of the inflation persistence that is the coefficient resulting from the regression of inflation on its first-lagged value. The estimations' results fail, however, to detect any significant impact of transparency in its quadratic form.

Based on central banks' information set, Minegishi and Cournède [27]have constructed the transparency index for 11 OECD central banks over the period 1999-2009. Table A.2 and Table A.3 show some descriptive statistics of that index as well as the correlation with the score of Siklos [31]. It follows that the correlation is quite high between both indicators (0.73) although there are some notable differences such as the ranking of central banks, the methodology of calculating both indexes, for example the index of Siklos which is based initially on Eijffinger and Geraats [14], contains 15 sub-index related to five aspects of transparency (political, economic, procedural, policy and operational) and the procedure is simply to sum up theses sub-indexes. Minegishi and Cournède [27] aggregated the scores relative to four aspects of transparency (policy objective, policy decision, economic analysis and decision-making process) using equal weights within each category. The overall measure includes 22 sub-indexes (See Appendix B for details). The index has significantly increased by 30.4% from 1999 to 2009 as shown in Figure 1 that plots the histogram of data.

[8] Note that earlier versions of that paper were written in 2007 and 2009.

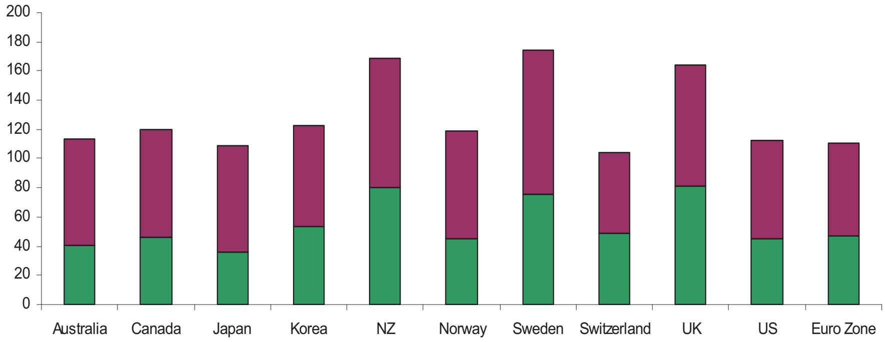

Fig. 1. Evolution of central bank transparency in OECD countries based on Minegishi and Cournède data. The cells coloured in green are the transparency index in 1999 and the pink ones are transparency index in 2009. There's a significant increase of transparency score by 30.4%

Control variables

- **Output gap as a % of GDP**: the difference between actual GDP and potential GDP, it is considered as the main indicator of inflationary pressures.
- **Exports as % of GDP**: it is used as a competition indicator. When competition is fierce, inflation persistence will be lower
- **Inflation targeting**: the conduct of better monetary policy explains low inflation. To prevent central bank transparency from grasping up an overall better conduct on monetary policy, we correct this for the fact that some countries are inflation targeters.
- **Governance factors**: the rule of Law measures the extent to which agents have confidence in and abide by the rule of society, and in particular, the quality of contract enforcement, the police and the likelihood of crime and violence.

3.1.2. Model's specification

In a panel context, for a given group of regressors, the estimated econometric model consists of the following equation:

$$\pi_{it} = \alpha_i + \lambda_1 X_{it} + \lambda_2 \pi_{it-1} + \lambda_3 \pi_{it-1} \times T_{it} + \lambda_4 \pi_{it-1} \times T_{it}^2 + \sum_{p=1}^{Q} \lambda_{5+p} \pi_{it-1} \times Y_{it} + \varepsilon_{it} \quad (2)$$

Where π_{it} is the inflation rate, expressed as the percentage increase of Consumer Price Index (CPI), X_{it} is the set of control variables that affect the inflation rate, T_{it} is the transparency score and Y_{it} is the set of variables that determines the inflation persistence.

Van der Cruijsen et al. [35] propose an original definition of inflation persistence (P), which is according to equation (2):

$$P = \lambda_2 + \lambda_3 T_{it} + \lambda_4 T_{it}^2 + \sum_{p=1}^{Q} \lambda_{5+p} Y_{it} \quad (3)$$

Where the coefficient of the squared term, is designed to capture non linearity.

The effect of transparency on inflation persistence is given by:

$$B = \lambda_3 T + \lambda_4 T^2 \quad (4)$$

In order to allow the regression to have a U shape, the standard approach has been to include a quadratic term in a linear model. Given (4) and the assumption of one extreme point, the requirement for a U shape is that the slope of the curve is negative at the start and positive at the end of a reasonably chosen interval of [*T*min, *T*max]. To assure at most one extreme point on [*T*min, *T*max] as assumed before, we require the following conditions:

$\lambda_3 + \lambda_4 T \min < 0 < \lambda_3 + \lambda_4 T \max$

If either of theses inequalities is violated, the curve is not U-shaped but inversely U shaped or monotone. Figure 2 illustrates the various transparency regimes for different settings of λ_3 and λ_4.

Accordingly, there exists an optimal intermediate transparency degree if $\boxed{\lambda_3 < 0 \text{ and } \lambda_4 > 0}$.

The estimated extreme point will be given by: $\hat{T} = -\dfrac{\lambda_3}{2\lambda_4}$.

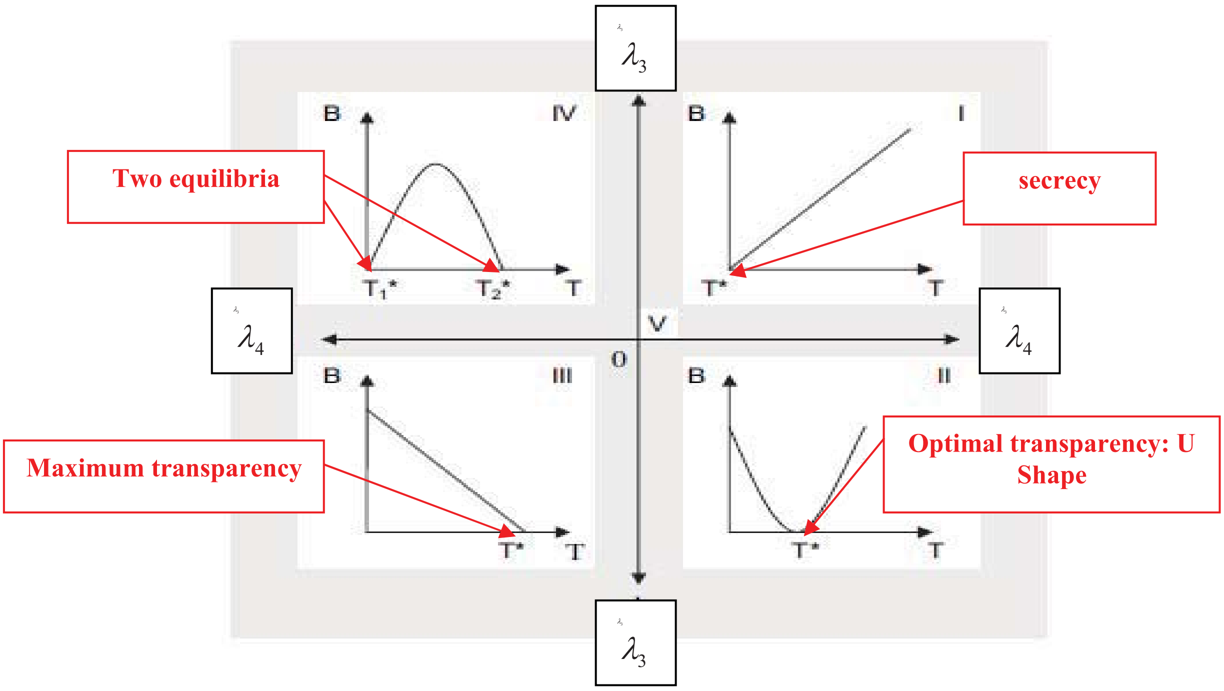

Fig. 2. Various transparency regimes (van der Cruisjen et al., [35])

3.1.3. Estimation method

We have estimated a fixed effect panel model. That estimation is more appropriate when focusing on a specific set of N individuals that are not randomly selected from some large population[9]. Since the sample data come specifically from OECD countries in this paper, the fixed effects model is more suitable for the analysis. The inclusion of individual effects is also justified by the fact that our control variables are time-variant, contrary to the set of controls used in van der Cruisjen et al. [35].

[9] The random effects model is applicable if the panel data comprise N individuals drawn randomly from a large population

By looking to the dynamic panel in equation (2), two important econometric issues emerge in the empirical analysis, which need a solution:

1- Our cross sectional dimension of our panel is small; so that N consistent GMM estimators may be affected by potentially severe sample bias.
2- The unbalanced nature of our panel doesn't permit to correct the within estimator by applying the bias approximation formulae derived in Kiviet [24], Bun and Carree [6] and Bun and Kiviet [7], which is only valid for balanced panels. Our estimation strategy will employ a bias corrected LSDV estimator using formulae derived in Bruno [5] that accommodates also unbalanced panels. It is implemented in Stata, using Bruno's code XTLSDVC. We make our results comparable to the standard LSDV corrected for hetroscedasticity[10] and with Anderson-Hsiao consistent estimators. We think them as reasonable benchmarks as both time series and cross section dimensions are short. We got, indeed, slight differences in the estimated coefficients resulting from LSDV (White, Anderson-Hsiao) and LSDVC. While the first ones are reported for completeness, the more reliable outcomes are those from LSDVC.

3.2 Results and discussion

Results derived from using Minegishi and Cournède transparency index

This study uses annual[11] data for 11 OECD countries under the period 1999-2009. The choice of the period and frequency is restricted by the availability of data. These latter were mostly extracted from IMF (International Monetary Fund), WDI (World Development Indicators) databases. Countries and variables are listed in Table A.1. The choice

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[10] That method was employed by Minegishi and Counrède [27] when studying the impact of their transparency index on inflation in a dynamic panel model of OECD countries for the same period.

[11] Although quarterly data provide more observations, they may be subject to large measurement errors than are annual data.

of central banks' sample is also justified by the fact that their inhabitants are known for processing information.

All estimations were conducted using Stata10MP. In this subsection, we discuss the estimation results of the panel model.

From Table 1 and Table 1bis, we can draw the following observations: clearly the coefficients associated with the quadratic form are highly significant, particularly $\lambda_3 < 0$ and $\lambda_4 > 0$. In fact, transparency, in level, enters with a negative and significant coefficient and transparency squared enters positively and significantly. A large number of articles tried to test non monotone relationship, but hardly any of theses used adequate formal procedures when they test for the presence of the U shape. This includes van der Cruisjen et al. [35] analysis. They find that both λ_3 and λ_4 have the right sign and are individually significant. Based on this, they conclude that there's a U shape. Lind and Mehlum [25] developed a nice test to detect such a non monotone relationship. The results are given at the last lines of the Tables and show a significant intermediate degree of transparency in all specifications estimated. This strongly confirms a U-shaped relationship between transparency and the inflation persistence. LSDV estimates exhibit a satisfactory fit of our hypothesis, but an optimal intermediate transparency is more pronounced when we use LSDVC estimates. The result seems to be strong even when we consider lagged values of transparency (Table 2, Table 2bis), however, when the lag is equal or exceeds 3, the impact turns to be insignificant[12]. The procedure consists, as we mentioned in the above section, of two steps: first, we test for the existence of an intermediate degree of transparency. Second, it is interesting to determine the value of this intermediate score. For each regression, we determined the threshold at which the effect on inflation persistence is minimized. The values range between 0.65 and 0.68. The estimated thresholds (extreme points) generated by the test are very close to the optimum. To illustrate this, we take for example the regression (1) from Table 1bis, we see that the effect is powerful when opaque central banks begin to open up and diminishes once a bank reached the level of transparency equal to 0.68. This level will change when we introduce control variables.

Besides our main variable (transparency), we used a set of variables to serve as control determinants in the panel regressions. We

[12] The results are available upon request from the author.

consider economic and political factors among those likely to affect the level of inflation or its persistence. Inflation targeting as a dummy seems to affect the inflation level, but not its persistence. The output gap is highly significant in all specifications and determines the level of inflation as well as its persistence. This is very logical because output gap is a key indicator of inflation; a positive output gap shows inflation pressures and a signal that policy may need to tighten. The exports ratio to GDP impacts on inflation level, which is an indicator of competition[13], but doesn't affect the persistence of inflation. However, the rule of law has a significant and negative impact on the inflation persistence (See Table 2).[14] We find similar results by using LSDVC estimates. However, the significance of control variables is less pronounced by considering a bias correction *à la* Bruno (2005). The hypothesis of an intermediate transparency degree is confirmed by a graphical analysis. A visual inspection of the Figure 3 shows the form of parabola, each one corresponds to the regressions from (1) to (3) relative to Table 2bis.

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[13] Normally, we expect that more open economies have low inflation, but we found a positive impact. It is known in literature that the relationship openness-inflation has been considered as a puzzle.

[14] We also tried other political instruments such as political stability and regulatory quality but their respective coefficients were insignificant. We included them successively to avoid multicolinearity problem.

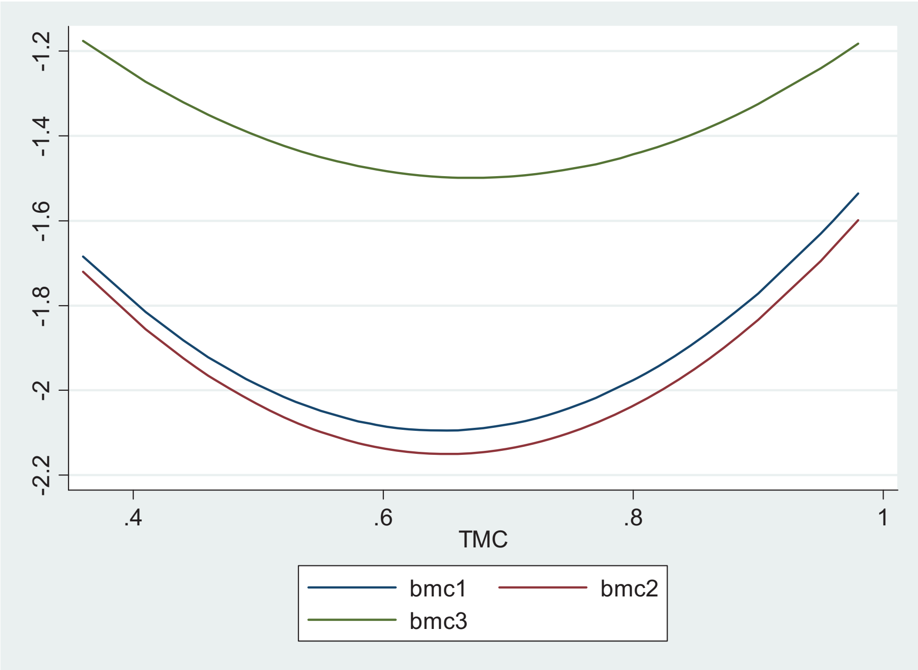

Fig. 3. Effect of Central Bank Transparency on inflation persistence: $B = \lambda_3 T + \lambda_4 T^2$ based on regressions (1) to (3) from Table 2bis. We divided the transparency score by 100 to aid the presentation of the results. TMC=Transparency index of Minegishi and Cournède [27].

Table 1. Central bank transparency and inflation persistence: actual and lagged values of transparency

	(1)		(2)		(3)		(4)		(5)		(6)		(7)	
	Coe f.	Sd.	Coe f.	Sd .	Coe f.	Sd .	Coe f.	Sd .	Coe f.	Sd .	Coe f.	Sd .	Coe f.	Sd .
α	2.2 37***	(0. 243)	2.8 38***	(0 .435)	2.2 38***	(0 .244)	3.0 08***	(0 .393)	2.2 66***	(0 .249)	2.3 28***	(0 .289)	2.3 15***	(0 .293)
IT_{it}			- 0.747*	(0 .449)			- 0.925* * *-* *0.925*	(0 .390) *(0* *.917)*						
π_{it-1}	1.6 21**	(0. 769)a *(0.* *790)b*	1.4 83*	(0 .809) *(0* *.930)*	1.6 07** *1.6* *07**	(0 .726) *(0* *.827)*	1.4 33 *1.4* *33**	(0 .965) *(0* *.846)*	1.6 00** *1.6* *00**	(0 .889) *(0* *.892)*	1.6 54** *1.6* *54**	(0 .778) *(0* *.894)*	1.4 22* *1.4* *22*	(0 .722) *(1* *.009)*
$\pi_{it-1}xT_{it}$	- 5.415* *	(2. 434) *(2.* *575)*	- 5.063* * *-* *5.063**	(2 .526) *(2* *.617)*	- 5.406* *	(2 .397) *(2* *.595)*								
$\pi_{it-1}xT_{it}^2$	3.9 96**	(1. 835) *(2.* *028)*	3.7 76** *3.7* *76**	(1 .886) *(2* *.050)*	3.9 86** *3.9* *86**	(1 .789) *(2* *.047)*								
$\pi_{it-1}xT_{it-1}$							- 5.184*	(3 .120) *(2* *.808)*	- 5.554* *-* *5.554** ***	(2 .971) *(2* *.827)*				
$\pi_{it-1}xT_{it-1}^2$							4.0 05*	(2 .349) *(2* *.215)*	4.2 53*	(2 .239) *(2* *.242)*				
$\pi_{it-1}xT_{it-2}$											- 5.785* * *-* *5.785**	(2 .602) *(2* *.961)*	- 5.469* * *-* *5.469**	(2 .356) *(3* *.040)*
$\pi_{it-1}xT_{it-2}^2$											4.3 31** *4.3* *31**	(2 .040) *(2* *.350)*	4.0 58** *4.0* *58**	(1 .852) *(2* *.422)*

		(1) Coef.	(1) Sd.	(2) Coef.	(2) Sd.	(3) Coef.	(3) Sd.	(4) Coef.	(4) Sd.	(5) Coef.	(5) Sd.	(6) Coef.	(6) Sd.	(7) Coef.	(7) Sd.
$\pi_{it-1} x IT_{it}$						0.015	(0.302) *(0.255)*			-0.037	(0.298) *(0.257)*			0.178	(0.407)
Sample		1999-2009		1999-2009		1999-2009		1999-2009		1999-2009		1999-2009		1999-2009	
N°observations		100		100		100		100		100		90		90	
Optimum		**0.68**		**0.67**		**0.68**		**0.65**		**0.65**		**0.67**		**0.67**	
Interval	**Lower bound**	-0.541		-0.541		-0.541		-0.505		-0.505		-0.505		-0.505	
	Upper bound	3.523		3.523		3.523		3.692		3.692		3.552		3.552	
Slope	**Lower bound**	-9.740** [0.015]		-9.151** [0.024]		-9.720** [0.013]		-9.234** [0.048]		-9.854** [0.031]		-10.164** [0.016]		-9.573** [0.013]	
	Upper bound	22.715** [0.017]		21.551** [0.025]		22.685** [0.015]		24.394** [0.045]		25.853** [0.030]		24.981** [0.019]		23.362** [0.019]	
U test [p-value]		2.16** [0.017]		1.99** [0.025]		2.20** [0.015]		1.68** [0.048]		1.89** [0.031]		2.10** [0.019]		2.16** [0.017]	
Extreme point		**0.677**		**0.670**		**0.678**		**0.647**		**0.653**		**0.674**		**0.674**	

Note: Results of the estimation of regression expressed in (2). T= Transparency index, IT= inflation targeting (set 1 at the date of adoption and 0 otherwise), *, **, *** imply statistical significance at 10, 5, and 1%, respectively. [a] Robust standard errors are between ( ). [b] Anderson-Hsiao standard errors are given in blue italic.

Table 1bis. Central bank transparency and inflation persistence: actual and lagged transparency_LSDVC

	(1) Coef.	(1) Sd.	(2) Coef.	(2) Sd.	(3) Coef.	(3) Sd.	(4) Coef.	(4) Sd.	(5) Coef.	(5) Sd.	(6) Coef.	(6) Sd.	(7) Coef.	(7) Sd.
IT_{it}			-0.742	(1.305)			-0.921	(1.321)						
π_{it-1}	1.621***	(0.00299)	1.484***	(0.00566)	1.607***	(0.00315)	1.433***	(0.00729)	1.600***	(0.00315)	1.654***	(0.00702)	1.422***	(0.0173)

$\pi_{it-1}xT_{it}$	-5.438***	(0.779)	-5.084***	(0.816)	-5.447***	(1.162)								
$\pi_{it-1}xT_{it}^2$	4.007***	(0.945)	3.789***	(0.994)	4.009***	(1.102)								
$\pi_{it-1}xT_{it-1}$							-5.181***	(0.848)	-5.559***	(1.294)				
$\pi_{it-1}xT_{it-1}^2$							3.988***	(1.020)	4.241***	(1.231)				
$\pi_{it-1}xT_{it-2}$											-5.787***	(0.915)	-5.473***	(1.412)
$\pi_{it-1}xT_{it-2}^2$											4.332***	(1.131)	4.061**	(1.371)
$\pi_{it-1}xIT_{it}$					0.0231	(0.358)			-0.0341	(0.360)			0.179	(0.421)
Sample	1999-2009		1999-2009		1999-2009		1999-2009		1999-2009		1999-2009		1999-2009	
N°observations	100		100		100		100		100		90		90	
Optimum	**0.68**		**0.67**		**0.68**		**0.65**		**0.66**		**0.67**		**0.67**	
Interval **Lower bound**	-0.541		-0.541		-0.541		-0.505		-0.505		-0.505		-0.505	
Upper bound	3.523		3.523		3.523		3.692		3.692		3.552		3.552	
Slope **Lower bound**	-9.773*** [0.000]		-9.183*** [0.000]		-9.785*** [0.000]		-9.213*** [0.000]		-9.847*** [0.000]		-10.167*** [0.000]		-9.579*** [0.000]	
Upper bound	22.798*** [0.000]		21.615*** [0.000]		22.805*** [0.000]		24.269*** [0.000]		25.760*** [0.000]		24.989*** [0.000]		23.378*** [0.003]	
U test **[p-value]**	3.86*** [0.000]		3.48*** [0.000]		3.41*** [0.000]		3.62*** [0.000]		3.27*** [0.000]		3.50*** [0.000]		2.78*** [0.003]	
Extreme point	**0.678**		**0.670**		**0.679**		**0.649**		**0.655**		**0.677**		**0.673**	

Note: Bias correction initialized by Anderson-Hsiao estimator. Bias approximation is carried out by the first leading term of the LSDV bias. Bootstrapped standard errors using 50 iterations are between () (cf. Bruno, 2005). *, **, *** imply statistical significance at 10, 5, and 1%, respectively.

Table2. Alternative estimates by including other control variables

		(1)		(2)		(3)		(4)	
		Coef.	Sd.	Coef.	Sd.	Coef.	Sd.	Coef.	Sd.
α		2.405***	(0.493)	1.943***	(0.274)	-1.260	(0.920)	2.367***	(0.224)
$exgdp_{it}$						0.109***	(0.030) *(0.033)*		
$outgap_{it}$		0.171** *0.171****	(0.079)a *(0.059)b*						
IT_{it}		-0.570	(0.483) *(0.910)*						
π_{it-1}		1.846**	(0.815) *(0.817)*	2.078*** *2.078***	(0.692) *(0.847)*	1.372 *1.372**	(0.889) *(0.801)*	2.937*** *2.938***	(1.092) *(1.231)*
$\pi_{it-1} xT_{it}$		-6.190**	(2.520) *(2.726)*	-6.551*** *-6.551***	(2.269) *(2.714)*	-4.821*	(2.793) *(2.666)*	-7.455*** *-7.455***	(2.797) *(3.007)*
$\pi_{it-1} xT_{it}^{2}$		4.836**	(1.939) *(2.173)*	5.138*** *5.138***	(1.798) *(2.190)*	3.965*	(2.105) *(2.100)*	6.222***	(2.189) *(2.388)*
$\pi_{it-1} xIT_{it}$				-0.135	(0.190) *(0.259)*				
$\pi_{it-1} xrl_{it}$								-0.689** *-0.689***	(0.291) *(0.358)*
$\pi_{it-1} xoutgap_{it}$				0.068** *0.068****	(0.029) *(0.022)*	0.057* 0.057***	(0.032) *(0.021)*		
Sample		1999-2009		1999-2009		1999-2009		1999-2009	
N°observations		80		80		79		90	
Optimum		**0.64**		**0.64**		**0.61**		**0.60**	
Interval	**Lower bound**	-0.541		-0.541		-0.541		-0.541	
	Upper bound	3.523		3.523		3.523		3.523	
Slope	**Lower**	-11.423***		-12.111***		-9.112**		-14.189***	

	bound	[0.007]	[0.002]	[0.038]	[0.004]
	Upper bound	27.890*** [0.007]	29.658*** [0.003]	23.121** [0.03]	36.394*** [0.002]
U test [p-value]		2.48*** [0.007]	2.83*** [0.003]	1.80** [0.038]	2.76*** [0.004
Extreme point		**0.639**	**0.637**	**0.61**	**0.60**

Note: Results of the estimation of regression expressed in (2). T= Transparency index, IT= inflation targeting (set 1 at the date of adoption and 0 otherwise), *, **, *** imply statistical significance at 10, 5, and 1%, respectively. [a] Robust standard errors are between ( ). [b] Anderson-Hsiao standard errors are given in blue italic.

Table2bis. Alternative estimates by including other control variables_LSDVC

		(1)		(2)		(3)	
		Coef.	Sd.	Coef.	Sd.	Coef.	Sd.
$exgdp_{it}$						0.0809*	(0.0337)
$outgap_{it}$		0.183*	(0.0791)				
IT_{it}							
π_{it-1}		1.955***	(0.00140)	1.964***	(0.00138)	1.300***	(0.0282)
$\pi_{it-1} x T_{it}$		-6.485***	(0.918)	-6.607***	(0.918)	-4.465***	(0.829)
$\pi_{it-1} x T_{it}^2$		5.019***	(1.048)	5.077***	(1.041)	3.325***	(0.968)
$\pi_{it-1} x IT_{it}$							
$\pi_{it-1} x rl_{it}$							
$\pi_{it-1} x outgap_{it}$				0.0728*	(0.0309)		
Sample		1999-2009		1999-2009		1999-2009	
N°observations		80		80		99	
Optimum		**0.65**		**0.65**		**0.67**	
Interval	**Lower bound**	-0.541		-0.541		-0.541	
	Upper bound	3.523		3.523		3.523	
Slope	**Lower bound**	-11.915*** [0.000]		-12.101*** [0.000]		-8.063*** [0.000]	

	Upper bound	28.881*** [0.000]	29.172*** [0.000]	18.967*** [0.001]
U test **[p-value]**		4.45*** [0.000]	4.53*** [0.000]	3.15*** [0.001]
Extreme point		**0.646**	**0.650**	**0.671**

Note: Bias correction initialized by Anderson-Hsiao estimator. Bias approximation is carried out by the first leading term of the LSDV bias. Bootstrapped standard errors using 50 iterations are between () (cf. Bruno, 2005). *, **, *** imply statistical significance at 10, 5, and 1%, respectively.

Results by using Siklos (2011) data

We replicated the same estimations by using the same sample of central banks over the same period, but we replaced the index of Minegishi and Cournède [27] by a measure that is updated by Siklos [31]. Data can be extracted from the website: http://www.central-bank-communication.net/links/

The results are presented in Tables 3, Table 3bis and Table 4, Table 4bis and suggest broadly favourable effects of transparency on the inflation persistence, particularly $\lambda_3 < 0$ and $\lambda_4 > 0$. However, theses coefficients lose their significance when we consider lags of 2 and 3 in LSDV estimates, but when we consider LSDVC estimates, a lag of 3 of transparency turns to be significant. The U test confirms theses observations, as well as the graphical analysis which shows the U-shaped curve (See Figure 4). Turning to the control variables, they are significant and most of them have the expected signs. Contrary to the results using the index of Minegishi and Cournède [27], the inflation targeting dummy doesn't have a significant impact nor on inflation level, neither on its persistence[15]. This is because transparency is picking up the effect of that variable. In fact, IT turns to be significant and has its expected sign when we drop transparency from the regression. Compared to the findings of Dincer and Eichengreen [12], the impact of transparency on inflation persistence has well improved, and we could detect the presence of an intermediate optimal transparency degree. The existence of an optimal intermediate transparency seems to be robust to various settings, but the exact value of the optimum is not. However, we could observe that it is high because OECD are better skilled to process information as we mentioned above, and theses skills are country-specific. Nevertheless, we should note that the value of this level is not the same for all central banks: it doesn't only depend on the communication tactics perceived by the central bank (e.g. is the central bank inflation targeter? Does it use a simple rule of monetary policy?), but also, on the nature of the committee's decision-making process (whether it is collegial or individualistic). There's no unique approach for determining the

[15] We haven't reported these results to avoid the proliferation of tables, but are available upon request.

optimal degree of transparency, it differs through central banks' communication strategy despite the same beneficial effects.

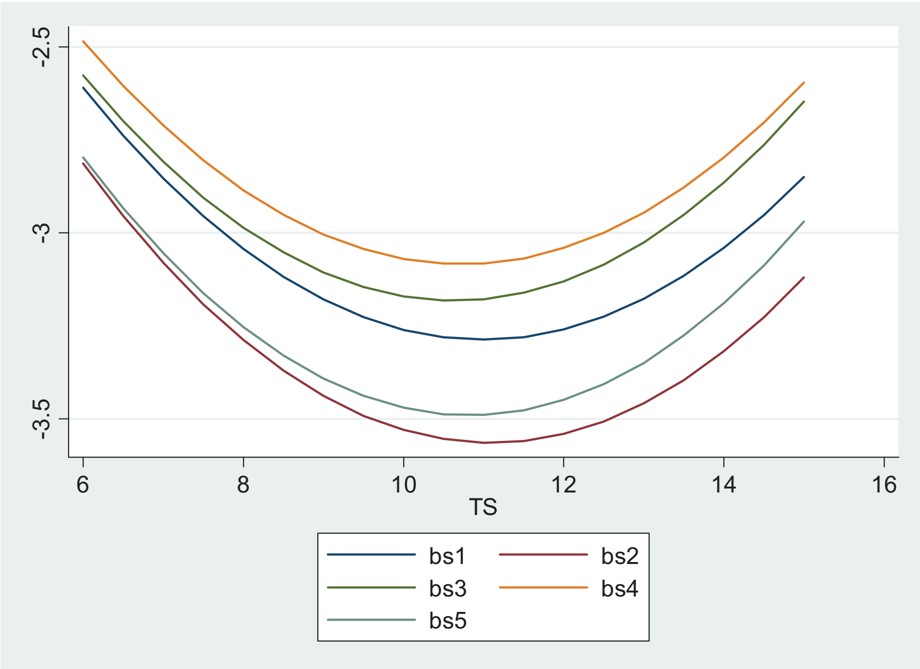

Fig. 4. Effect of Central Bank Transparency on inflation persistence: $B = \lambda_3 T + \lambda_4 T^2$ based on regressions (1) to (5) from Table 3bis. TS=Transparency index of Siklos [31]

Table 3. Comparative results using the updated index of Siklos (2011)

	(1)		(2)		(3)		(4)		(5)		(6)	
	Coef.	Sd.	Coef.	Sd.	Coef.	Sd.	Coef.	Sd.	Coef.	Sd.	Coef.	Sd.
α	2.329***	(0.234)	2.338***	(0.237)	2.052***	(0.257)	2.030***	(0.270)	2.439***	(0.227)	-0.576	(0.757)
$outgap_{it}$					0.169** *0.169****	(0.078) *(0.059)*						
$exgdp_{it}$											0.089***	(0.022) *(0.023)*
IT_{it}												
π_{it-1}	2.995*	(1.608)a *(1.740)b*	3.153*	(1.850) *(1.780)*	3.017*	(1.624) *(1.789)*	2.953*	(1.738) *(1.788)*	4.709***	(1.427) *(1.973)*	3.195**	(1.555) *(1.639)*
$\pi_{it-1}xT_{it}$	-0.595** *-0.595**	(0.296) *(0.320)*	-0.640*	(0.363) *(0.336)*	-0.595*	(0.303) *(0.330)*	-0.573*	(0.317) *(0.330)*	-0.808*** *-0.808***	(0.256) *(0.342)*	-0.643**	(0.298) *(0.303)*
$\pi_{it-1}xT_{it}^2$	0.027** *0.027**	(0.813) *(0.014)*	0.028*	(0.015) *(0.014)*	0.027** *0.027**	(0.013) *(0.014)*	0.026*	(0.013) *(0.014)*	0.040***	(0.011) *(0.015)*	0.029**	(0.013) *(0.013)*
$\pi_{it-1}xIT_{it}$			0.125	(0.318) *(0.269)*								
$\pi_{it-1}xrl_{it}$									-0.704**	(0.350) *(0.352)*		
$\pi_{it-1}xoutgap_{it}$							0.063** *0.063****	(0.029) *(0.022)*				
Sample	1999-2009		1999-2009		1999-2009		1999-2009		1999-2009		1999-2009	
N° observations	100		100		80		80		90		99	
Optimum	**11**		**11.5**		**11**		**11**		**10**		**11**	

Interval	Lower bound	-7.096	-7.096	-7.096	-7.096	-7.096	-7.096
	Upper bound	55.426	55.426	55.426	55.426	55.426	55.426
Slope	Lower bound	-0.979** [0.022]	-1.050** [0.03]	-0.992** [0.024]	-0.953** [0.034]	-1.383*** [0.0007]	-1.066** [0.016]
	Upper bound	2.403** [0.021]	2.556** [0.034]	2.505** [0.021]	2.387** [0.028]	3.682*** [0.0002]	2.653** [0.016]
U test [p-value]		2.403** [0.021]	1.79** [0.040]	2.00** [0.0246]	1.85** [0.034]	3.32*** [0.0007]	2.16** [0.017]
Extreme point		**11.009**	**11.108**	**10.645**	**10.740**	**9.974**	**10.821**

Note: Results of the estimation of regression expressed in (2). T= Transparency index, IT= inflation targeting (set 1 at the date of adoption and 0 otherwise), *, **, *** imply statistical significance at 10, 5, and 1%, respectively. [a] Robust standard errors are between ( ). [b] Anderson-Hsiao standard errors are given in blue italic.

Table 3bis. Comparative results using the updated index of Siklos (2011): LSDVC estimates

		(1)		(2)		(3)		(4)		(5)	
		Coef.	Sd.	Coef.	Sd.	Coef.	Sd.	Coef.	Sd.	Coef.	Sd.
$outgap_{it}$						0.171*	(0.0857)				
$exgdp_{it}$										0.0896**	(0.0344)
IT_{it}											
π_{it-1}		2.995***	(0.0000355)	3.153***	(0.0000250)	3.017***	(0.0000567)	2.954***	(0.0000649)	3.196***	(0.0000219)
$\pi_{it-1}xT_{it}$		-0.598***	(0.0523)	-0.643***	(0.0730)	-0.598***	(0.0620)	-0.575***	(0.0597)	-0.645***	(0.0487)
$\pi_{it-1}xT_{it}^2$		0.0272***	(0.00446)	0.0290***	(0.00472)	0.0281***	(0.00471)	0.0268***	(0.00450)	0.0298***	(0.00387)
$\pi_{it-1}xIT_{it}$											
$\pi_{it-1}xrl_{it}$											
$\pi_{it-1}xoutgap_{it}$								0.0650*	(0.0312)		
Sample		1999-2009		1999-2009		1999-2009		1999-2009		1999-2009	
N°observations		100		100		80		80		99	
Optimum		**11**		**11**		**10.5**		**10.5**		**11**	
Interval	**Lower bound**	-7.096		-7.096		-7.096		-7.096		-7.096	
	Upper	55.426		55.426		55.426		55.426		55.426	

	bound					
Slope	**Lower bound**	-0.984*** [0.000]	-1.053*** [0.000]	-0.996*** [0.000]	-0.955*** [0.000]	-1.067*** [0.000]
	Upper bound	2.417*** [0.000]	2.568*** [0.000]	2.516*** [0.000]	2.392*** [0.000]	2.659*** [0.000]
U test **[p-value]**		5.44*** [0.000]	5.57*** [0.000]	5.45*** [0.000]	5.43*** [0.000]	6.97*** [0.000]
Extreme point		**10.993**	**11.093**	**10.635**	**10.742**	**10.816**

Note: Bias correction initialized by Anderson-Hsiao estimator. Bias approximation is carried out by the first leading term of the LSDV bias. Bootstrapped standard errors using 50 iterations are between () (cf. Bruno, 2005). *, **, *** imply statistical significance at 10, 5, and 1%, respectively.

Table 4. Results using the updated index of Siklos (2011): Lagged values of transparency

	(1)		(2)		(3)		(4)		(5)		(6)	
	Coef.	Sd.	Coef.	Sd.	Coef.	Sd.	Coef.	Sd.	Coef.	Sd.	Coef.	Sd.
α	2.291***	(0.238)	2.020***	(0.264)	2.373***	(0.278)	1.738***	(0.374)	1.907***	(0.367)	1.768***	(0.393)
$outgap_{it}$			0.172**	(0.079) *(0.059)*					0.209** *0.209****	(0.091) *(0.067)*		
π_{it-1}	1.965*	(1.117)a *(1.272)b*	2.135*	(1.109) (1.314)	0.811	(1.080) *(1.101)*	0.796	(1.267) *(1.243)*	0.764	(1.145) *(1.546)*	0.709	(1.311) *(1.526)*
$\pi_{it-1} x T_{it-1}$	-0.404** *-0.404**	(0.208) *(0.235)*	-0.433** *-0.433**	(0.212) *(0.245)*								
$\pi_{it-1} x T^2_{it-1}$	0.018** *0.018**	(0.009) *(0.010)*	0.020** *0.020**	(0.009) *(0.011)*								
$\pi_{it-1} x T_{it-2}$					-0.190	(0.194) *(0.209)*	-0.163	(0.232) *(0.235)*				
$\pi_{it-1} x T^2_{it-2}$					0.008	(0.008) *(0.009)*	0.009	(0.010) *(0.010)*				
$\pi_{it-1} x T_{it-3}$									-0.229	(0.220) *(0.283)*	-0.221	(0.239) *(0.279)*
$\pi_{it-1} x T^2_{it-3}$									0.014	(0.010) *(0.012)*	0.014	(0.010) (0.012)
$\pi_{it-1} x outgap_{it}$							0.072**	(0.035) *(0.024)*			0.084** *0.084****	(0.034) *(0.025)*
Sample	1999-2009		1999-2009		1999-2009		1999-2009		1999-2009		1999-2009	
N° observations	100		80		90		72		64		64	
Optimum	**11**		**11**		**12**		**9**		**8**		**8**	

Interval	Lower bound	-7.096	-7.096	-7.096	-7.096	-7.539	-7.539
	Upper bound	55.426	55.426	55.426	55.426	55.426	55.426
Slope	Lower bound	-0.668** [0.026]	-0.731** [0.019]	-0.315 [0.159]	-0.290 [0.223]	-0.445 [0.117]	-.442 [0.136]
	Upper bound	1.661** [0.024]	1.891** [0.015]	0.782 [0.151]	0.836 [0.188]	1.360* [0.068]	1.402* [0.072]
U test [p-value]		1.97** [0.026]	2.10** [0.019]	1.00 [0.16]	0.77 [0.224]	1.20 [0.117]	1.11 [0.136]
Extreme point		**10.850**	**10.343**	10.844	9.042	7.997	7.566

Note: Results of the estimation of regression expressed in (2). T= Transparency index, IT= inflation targeting (set 1 at the date of adoption and 0 otherwise), *, **, *** imply statistical significance at 10, 5, and 1%, respectively. [a] Robust standard errors are between ( ). [b] Anderson-Hsiao standard errors are given in blue italic

Table 4bis. Results using the updated index of Siklos (2011): Lagged values of transparency_LSDVC estimates

	(1)		(2)		(3)		(4)		(5)		(6)	
	Coef.	Sd.	Coef.	Sd.	Coef.	Sd.	Coef.	Sd.	Coef.	Sd.	Coef.	Sd.
$outgap_{it}$			0.173	(0.115)					0.209*	(0.0996)		
π_{it-1}	1.966***	(0.000798)	2.136***	(0.000805)	0.811***	(0.112)	0.797***	(0.127)	0.765***	(0.135)	0.710***	(0.141)
$\pi_{it-1} x T_{it-1}$	-0.407***	(0.0548)	-0.436***	(0.0774)								
$\pi_{it-1} x T^2_{it-1}$	0.0188***	(0.00461)	0.0211***	(0.00598)								
$\pi_{it-1} x T_{it-2}$					-0.190*	(0.0923)	-0.163	(0.122)				
$\pi_{it-1} x T^2_{it-2}$					0.00878	(0.00782)	0.00902	(0.00988)				
$\pi_{it-1} x T_{it-3}$									-0.229***	(0.0695)	-0.223***	(0.0659)
$\pi_{it-1} x T^2_{it-3}$									0.0143*	(0.00597)	0.0147*	(0.00581)
$\pi_{it-1} xoutgap_{it}$							0.0729	(0.0632)			0.0850*	(0.0351)
Sample	1999-2009		1999-2009		1999-2009		1999-2009		1999-2009		1999-2009	
N° observations	100		80		90		72		64		64	

Optimum		**11**	**10.5**	**11**	**9**	**8**	**7.5**
Interval	**Lower bound**	-7.096	-7.096	-7.096	-7.096	-7.539	-7.539
	Upper bound	55.426	55.426	55.426	55.426	55.426	55.426
Slope	**Lower bound**	-0.673***	-0.735***	-0.314*	-0.290	-0.445***	-0.445***
		[0.000]	[0.000]	[0.061]	[0.131]	[0.003]	[.002]
	Upper bound	1.676***	1.904***	0.782	0.836	1.360**	1.410***
		[0.000]	[0.000]	[0.158]	[0.198]	[0.012]	[0.009]
U test		3.65***	3.24***	1.01	0.85	2.28**	2.42***
[p-value]		[0.000]	[0.000]	[0.158]	[0.199]	[0.013]	[0.009]
Extreme point		**10.826**	**10.325**	10.842	9.042	**7.797**	**7.565**

Note: Bias correction initialized by Anderson-Hsiao estimator. Bias approximation is carried out by the first leading term of the LSDV bias. Bootstrapped standard errors using 50 iterations are between () (cf. Bruno, 2005). *, **, *** imply statistical significance at 10, 5, and 1%, respectively.

Results using constructive transparency index by PCA

The index of transparency used by Siklos [31] is an updated version of the one constructed by Dincer and Eichengreen [12]. Theses authors have also updated the index of transparency based on the popular index of Eijffinger and Geraats [14]. The index of Eijffinger and Geraats has been criticized on a number of grounds. They remark themselves that it is obviously questionable to simply add the scores of the 15 components in order to obtain a meaningful measure. In this section, we fill in this gap by constructing a weighted index of central bank transparency. Much of the past research has focused on constructing an index, but ignores the possible correlations between the variables forming the index and may carry redundant variables. The principal component analysis (PCA) is a feasible solution to these issues by distilling components from a Pearson correlation matrix. This applies to the transparency index of Siklos [31] which is based on the aggregation procedure followed by Eijffinger and Geraats [14]. Di Bartolomeo and Marchetti [11] remarked that even the partition elaborated by theses authors is comprehensive, the possibility of correlations between the sub-indexes and the strong multidimensionality of the concept require the use of the standard methods of multivariate eigen-analysis (the most classical of which is the PCA) appear particularly suited.

Pearson correlation matrix of the set of initial sub-indexes of Siklos [31], given in Table C.1, shows a highly and significant pair wise correlations. Then, we proceeded to a PCA in order to extract a set of uncorrelated principal components, which are a weighted linear combination of the original data set:

$$PC_i = \sum_{i=1}^{15} \omega_i t_i \tag{5}$$

Where t_i is the sub-index of transparency score in Siklos [31]. Table C.3 displays the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy. KMO takes values between 0 and 1, with high values (0.845) indicating that overall the variables have too much in common to warrant a PCA analysis. We used, then the first principal component as a proxy for the new transparency score. It explains 37.74% of the total variance (See Table C.2). Results of our estimations are given in Table 5. An intermediate level of transparency is found to have the largest influence on inflation persistence especially when we introduce output gap as % of GDP as control determinant of inflation and inflation persistence, respectively. Again, while the U shape test indicates a significant intermediate optimal level of transparency, the level itself is not the same in all specifications. The impact of transparency on inflation persistence, however, is weaker when introducing lagged values of transparency (lags 1 and 2) though λ_3 and λ_4 have their expected signs.

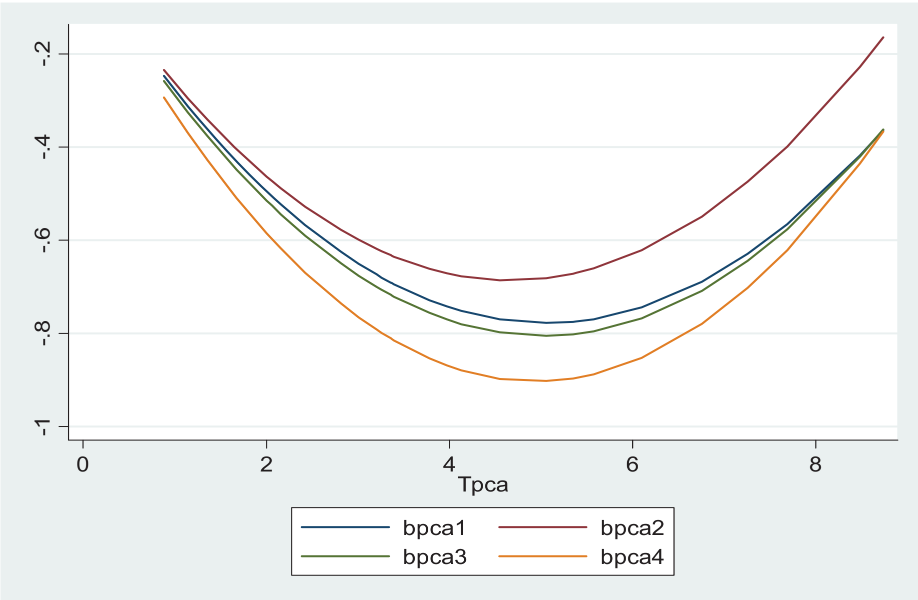

Fig. 5. Effect of Central Bank Transparency on inflation persistence: $B = \lambda_3 T + \lambda_4 T^2$ based on regressions (1) to (4) from Table 5bis. Tpca=Transparency index constructed by PCA.

Note that we didn't consider endogenous aspects of transparency (in all of the three cases) as in Dincer and Eichengreen [12][16]. However, as noted by van der Cruisjen et al., "*it is hard to find reliable instruments that strongly relate to central bank transparency*".

[16] The fitted value of transparency was taken, based on a regression relating transparency to a constant and rule of law in their framework. Van der Cruisjen et al. [35] note that the quality of the model of Dincer and Eichengreen suffers from an omitted variable bias and it doesn't perform well according to R^2 criteria, whose value is close to zero.

Table 5. Central bank transparency and inflation persistence: PCA index

	(1)		(2)		(3)		(4)		(5)	
	Coef.	Sd.	Coef.	Sd.	Coef.	Sd.	Coef.	Sd.	Coef.	Sd.
α	2.316*** 2.271*** 2.356***	(0.333) (0.232) (0.279)	2.028*** 1.975*** 1.804***	(0.254) (0.260) (0.338)	2.002*** 1.949*** 1.723***	(0.269) (0.271) (0.364)	2.419*** 2.340***	(0.227) (0.332)	-0.637 -0.585 -0.704	(0.774) (0.773) (0.804)
$outgap_{it}$			0.171**0.171*** 0.175** 0.186**0.186***	(0.078)(0.060) (0.080)(0.060) (0.093)(0.066)						
$exgdp_{it}$									0.091**0.091*** 0.087*** 0.096***	(0.023)(0.024) (0.023)(0.024) (0.025)(0.026)
π_{it-1}	0.469 0.218 -0.021	(0.526)a(0.466)b (0.433)a(0.402)b (0.352)a(0.352)b	0.513 0.280 0.099	(0.536)(0.502) (0.436)(0.429) (0.436)(0.420)	0.479 0.281 0.104	(0.585)(0.503) (0.475)(0.428) (0.473)(0.419)	1.322** 0.738	(0.613)(0.757) (0.688)(0.750)	0.575 0.312 0.281	(0.474)(0.436) (0.237)(0.317) (0.337)(0.336)
$\pi_{it-1}xT_{it}$	-0.295	(0.226)(0.202)	-0.276	(0.228)(0.210)	-0.245	(0.239)(0.211)	-0.363	(0.236)(0.227)	-0.356 -0.356*	(0.221)(0.191)
$\pi_{it-1}xT_{it}^2$	0.029	(0.020)(0.018)	0.029	(0.021)(0.019)	0.026	(0.021)(0.019)	0.044**	(0.020)(0.021)	0.036* 0.036**	(0.021)(0.017)
$\pi_{it-1}xT_{it-1}$	-0.172	(0.177)(0.168)	-0.164	(0.181)(0.177)	-0.155	(0.188)(0.177)	-0.131	(0.237)(0.204)	-0.215	(0.173)(0.159)
$\pi_{it-1}xT_{it-1}^2$	0.017	(0.015)(0.015)	0.019	(0.016)(0.016)	0.018	(0.016)(0.016)	0.020	(0.021)(0.019)	0.022	(0.016)(0.014)
$\pi_{it-1}xT_{it-2}$	-0.086	(0.143)(0.146)	-0.032	(0.174)(0.174)	-0.026	(0.180)(0.174)			-0.199	(0.147)(0.141)
$\pi_{it-1}xT_{it-2}^2$	0.008	(0.012)(0.013)	0.005	(0.015)(0.016)	0.005	(0.016)(0.016)			0.017	(0.013)(0.016)
$\pi_{it-1}xrl_{it}$							-0.626* -0.516	(0.335)(0.352) (0.332)(0.351)		
$\pi_{it-1}xoutgap_{it}$					0.063** 0.067**0.067*	(0.030)(0.022)				

						** 0.071**0.071*** *	*(0.031)(0.02 2) (0.036)(0.02 5)*				
Interval	Lower bound	-3.009		-3.009		-3.009		-3.009		-3.009	
	Upper bound	30.432		30.432		30.432		30.432		30.432	
Slope	Lower bound	-0.471*[0.090] -0.279[0.153] -0.135[0.265]		-0.455*[0.100] -0.281[0.159] -0.066[0.400]		-0.402[0.139] -0.265[0.180] -0.060[0.412]		-0.628**[0.041] -0.251[0.246]		-0.572*[0.052] -0.347*[0.102] -0.303*[0.093]	
	Upper bound	1.485*[0.070] 0.903[0.128] 0.409[0.250]		1.528*[0.080] 1.017[0.114] 0.316 [0.342]		1.342[0.111] 0.962[0.129] 0.326[0.343]		2.321**[0.012] 1.080[0.158]		1.839**[0.047] 1.126*[0.089] 0.851*[0.100]	
U shape test [p-value]		1.35*[0.090] 1.03[0.153] 0.63[0.266]		1.28*[0.100] 1.00[0.159] 0.25[0.401]		1.09[0.140] 0.92[0.180] 0.22[0.412]		1.75**[0.041] 0.69[0.247]		1.64*[0.052] 1.28*[0.100] 1.25*[0.100]	

Table 5. *Continued*

	(1)	(2)	(3)	(4)	(5)
Extreme point	5.052 4.886 5.311	4.662 4.237 2.807	4.704 4.223 2.253	4.120 3.290	4.930 4.874 5.779

Note: Results of the estimation of regression in (2). T= Constructed transparency indexed using PCA. [a] Robust standard errors are between ( ). [b] Anderson-Hsiao standard errors are given in italic.

Table 5bis. Central bank transparency and inflation persistence: PCA index_LSDVC estimates

		(1)		(2)		(3)		(4)	
		Coef.	Sd.	Coef.	Sd.	Coef.	Sd.	Coef.	Sd.
$outgap_{it}$				0.177* 0.179 0.186	(0.0848) (0.0967) (0.103)				
$exgdp_{it}$								0.0952** 0.0891* 0.0981**	(0.0352) (0.0364) (0.0367)
π_{it-1}		0.469*** 0.218* 0.0214	(0.105) (0.0927) (0.125)	0.514*** 0.280* 0.0994	(0.130) (0.135) (0.150)	0.619*** 0.291* 0.105	(0.132) (0.132) (0.151)	0.576*** 0.312** 0.283*	(0.0911) (0.113) (0.135)
$\pi_{it-1} x T_{it}$		-0.308***	(0.0809)	-0.294**	(0.0976)	-0.321***	(0.0966)	-0.366***	(0.0781)
$\pi_{it-1} x T_{it}^2$		0.0305**	(0.0116)	0.0315*	(0.0130)	0.0320*	(0.0127)	0.0371***	(0.0106)
$\pi_{it-1} x T_{it-1}$		-0.183*	(0.0789)	-0.175	(0.103)	-0.191*	(0.0902)	-0.223**	(0.0766)
$\pi_{it-1} x T_{it-1}^2$		0.0187	(0.0112)	0.0205	(0.0137)	0.0221	(0.0120)	0.0228*	(0.0102)
$\pi_{it-1} x T_{it-2}$		-0.0967	(0.106)	-0.0340	(0.137)	-0.0307	(0.124)	-0.215*	(0.0873)
$\pi_{it-1} x T_{it-2}^2$		0.00931	(0.0151)	0.00594	(0.0180)	0.00632	(0.0155)	0.0192	(0.0109)
$\pi_{it-1} xoutgap_{it}$						0.0552 0.0703* 0.0711	(0.0308) (0.0318) (0.0368)		
Interval	**Lower bound**	-3.009		-3.009		-3.009		-3.009	
	Upper bound	30.432		30.432		30.432		30.432	
Slope	**Lower bound**	-0.491*** [0.000] -0.295** [0.020] -0.152 [0.216]		-0.483*** [0.003] -0.297* [0.054] -0.069 [0.386]		-0.513***[0.001] -0.324**[0.023] -0.068 [0.373]		-0.589***[0.000] -0.360***[0.004] -0.330**[0.015]	

	Upper bound	1.550*** [0.007] 0.955* [0.060] 0.470[0.283]	1.621** [0.011] 1.071* [0.075] 0.327 [0.368]	1.625*** [0.009] 1.152**[0.038] 0.353 [0.335]	1.892***[0.000] 1.168**[0.018] 0.953*[0 .053]
U shape test [p-value]		2.45*** [0.007] 1.56* [0.06] 0.57 [0.284]	2.33** [0.011] 1.45* [0.07] 0.29 [0.386]	2.40***[0.009] 1.79** [0.038] 0.32 [0.374]	3.32***[0.000] 2.11**[0.018] 1.63*[0.053]

Table 5bis. *Continued*

	(1)	**(2)**	**(3)**	**(4)**
Extreme point	5.040 4.890 5.191	4.671 4.267 2.862	5.016 4.332 2.429	4.930 4.872 5.604

Note: Bias correction initialized by Anderson-Hsiao estimator. Bias approximation is carried out by the first leading term of the LSDV bias. Bootstrapped standard errors using 50 iterations are between () (cf. Bruno, 2005).

4 Conclusion and avenue for future research

In this paper, we gave a further check of a recent result brought by van der Cruijsen et al. [35] who concluded the presence of an intermediate transparency at the optimum, based on the findings of a significantly negative coefficient on transparency term and a significantly positive estimate on the quadratic term and take them as evidence supporting the U shape curve. According to Lind and Mehlum [25], that conventional approach-although intuitive- is flawed. We revisit the hypothesis of an intermediate optimal central bank transparency by introducing both technical and economic differences in our specification. Particularly, we have used three other transparency indexes recently developed by Minegishi and Cournède [27], by Siklos [31] and an index constructed by PCA based on Siklos's data. We found that the hypothesis of U-shaped relationship was strongly depicted in the case of central banks considered in our sample. The test results overwhelmingly reject the combined null hypothesis of an inverted-U or monotone relationship in favour of a U-shaped linkage between inflation persistence and central bank transparency by using an appropriate test developed by Lind and Mehlum [25]. The results are robust for controlling other determinants of inflation and inflation persistence, but a little bit weaker when we used lagged values of transparency.

We acknowledge that results obtained here as well as in van der Cruijsen et al. [35] depend crucially on the transparency indexes used. Although they are complete in the sense that they cover all aspects and dimensions of transparency, they are based mainly on a quantitative side. However, it would be misleading to evaluate transparency only on the basis of the amount of released information. The concept also encompasses features like accuracy, quality, truthfulness, and information relevance. These issues require further attention in forthcoming researches.

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A. Data, sources and some preliminary statistics

Table A.1. - Data and sample selected

Variable	Definition	Source
Dependent variable		
Inflation (π)	Consumer Price index (annual % increase)	IMF, World Economic Outlook Database http://www.imf.org/external/ns/cs.aspx?id=28
Independent variables		
Output gap ($outgap$)	Output gap as % of GDP	IMF, World Economic Outlook Database http://www.imf.org/external/ns/cs.aspx?id=28
Exports as a % of GDP ($exgdp$)	Exports as a % of GDP	World Development Indicators, World Bank http://data.worldbank.org/indicator
IT	Inflation targeting, dummy set to be 1 at the time the country has adopted IT and 0 otherwise	Pétursson (2004)
Rule of Law (rl)	Rule of Law	Worldwide Governance Indicators (WGI), World Bank http://info.worldbank.org/governance/wgi/sc_country.asp
Variables of interest		
T	Transparency index of M&C	Minegishi and Cournède (2009)
T	Transparency index of S	http://www.central-bank-communication.net/links/
Countries considered in our sample		
Australia, Canada, Euro area, Japan, Korea, New Zealand, Norway, Sweden, Switzerland, United Kingdom, United States		

Table A.2. Descriptive statistics

Variable		Mean	SD	Min	Max	N° Obs
Trans M&C	Overall	0.670	0.159	0.36	0.98	110
	Between		0.142	0.497	0.881	
	Within		0.082	0.427	0.893	
Trans S	Overall	10.481	2.229	6	15	110
	Between		2.180	7.5	13.772	
	Within		0.808	6.3	11.8	

Note: M&C refers to Minegishi and Cournède and S refers to Siklos.

Table A.3. Correlation matrix

	Trans M&C	Trans S
Trans M&C	1.00	
Trans S	0.73	1.00

Note: M&C refers to Minegishi and Cournède and S refers to Siklos.

B. Methodology of calculating transparency indexes

Table B.1. - The basics of constructing the transparency index of Siklos (2011)

Categories	Sub-indexes	Description	Values
Political	*Formal objectives*	Explicit communication and/or prioritization of final targets.	1; 0,5; 0
	Quantitative targets	Presence of targets quantification	1; 0
	Institutional arrangements	Presence of explicit contracts between CB and government (e.g. instrument independence).	1; 0,5; 0
Economic	*Economic data*	Provision of data on GDP, money supply, inflation, unemployment and capacity utilization.	1; 0,5; 0
	Policy models	Disclosure of the CB's formal macro-model(s) used for policy analysis.	1; 0
	Internal forecasts	Regular communication or publication of CB's forecasts.	1; 0,5; 0
Procedural	*Explicit strategy*	Provision of a description of a CB's policy rule (strategy).	1; 0
	Minutes	Release of the decision boards minutes (in 8 weeks)	1; 0
	Voting records	Publication of voting records (in 8 weeks)	1; 0
Policy	*Prompt announcement*	Decision on the main instruments or target announced at the latest day of implementation	1; 0
	Policy explanation	Provision of explanations of CB's announced decisions on targets/instruments.	1; 0,5; 0
	Policy inclination	Disclosure of CB's likely future actions	1; 0
Operational	*Control errors*	Provision of explanation for eventual deviation from the targets	1; 0,5; 0
	Transmission disturbances	Regular provision of information on disturbances affecting the transmission process.	1; 0,5; 0
	Evaluation of policy outcomes	Regular provision of CB's evaluation in light of its macroeconomic objectives.	1; 0,5; 0

Source: Di Bartolomeo and Marchetti (2004) according to Eijffinger and Geraats (2006). The index takes values between 0 and 15.

Table B.2. The score scheme of Minegishi and Cournède (2009)

Categories	Sub-categories	Sub-indexes	Values
Policy objective		*Policy objective(s)*	1; 0,75 ; 0,5; 0
		Quantification	1; 0,75 ; 0,5; 0
		Time horizon	1; 0,75 ; 0,5; 0
Policy decision	Policy changes	*Announcement*	1; 0,75 ; 0,5; 0
		Explanation	1; 0,75 ; 0,5; 0
	No policy changes	*Announcement*	1; 0,75 ; 0,5; 0
		Explanation	1; 0,75 ; 0,5; 0
		Future policy guidance	1; 0,75 ; 0,5; 0
Economic analysis		*Frequency of projection publication*	1; 0,75 ; 0,5; 0
		Endorsement of the decision-making body	1; 0,75 ; 0,5; 0
	Inflation projection	*Basic nature*	1; 0,75 ; 0,5; 0
		Projection time horizon	1; 0,75 ; 0,5; 0
		Projection frequency	1; 0,75 ; 0,5; 0
		Uncertainty	1; 0,75 ; 0,5; 0
	Output projection	*Basic nature*	1; 0,75 ; 0,5; 0
		Projection time horizon	1; 0,75 ; 0,5; 0
		Projection frequency	1; 0,75 ; 0,5; 0
		Uncertainty	1; 0,75 ; 0,5; 0
		Underlying assumptions	1; 0,75 ; 0,5; 0
Decision-making process		*Minutes*	1; 0,75 ; 0,5; 0
		Voting records	1; 0,75 ; 0,5; 0
		Public appearances	1; 0,75 ; 0,5; 0

Source: Minegishi and Cournède (2009). The index takes the values between 0 and 100.

C. Principal Component Analysis results

Table C.1. Pearson correlation matrix of sub-indexes: Data from Siklos (2011)

	t1	t2	t3	t4	t5	t6	t7
t1	1.0000						
t2	0.1039	1.0000					
	0.0003						
t3	0.3863	0.3026	1.0000				
	0.0000	0.0000					
t4	0.1905	0.2505	0.3559	1.0000			
	0.0000	0.0000	0.0000				
t5	0.1426	0.2640	0.2068	0.4602	1.0000		
	0.0000	0.0000	0.0000	0.0000			
t6	0.2012	0.2923	0.2983	0.4924	0.3871	1.0000	
	0.0000	0.0000	0.0000	0.0000	0.0000		
t7	0.2917	0.4574	0.3303	0.3197	0.2505	0.3763	1.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
t8	0.1049	0.1520	0.1346	0.3453	0.4307	0.3327	0.1252
	0.0003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
t9	0.0651	0.0381	0.1898	0.3979	0.4484	0.3768	0.0185
	0.0234	0.1851	0.0000	0.0000	0.0000	0.0000	0.5210
t10	0.2782	0.1431	0.2299	0.4938	0.4122	0.5059	0.3138
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
t11	0.2141	0.2217	0.2148	0.5275	0.5353	0.4494	0.2720
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
t12	0.0474	0.0285	0.0422	0.2872	0.3390	0.2289	0.0185
	0.0991	0.3213	0.1417	0.0000	0.0000	0.0000	0.5203
t13	0.2049	0.2794	0.2557	0.4479	0.4017	0.4295	0.2747
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
t14	0.2164	0.2646	0.2321	0.4231	0.3403	0.5200	0.2939
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
t15	0.2342	0.2883	0.2954	0.3719	0.3206	0.5660	0.4220
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

	t8	t9	t10	t11	t12	t13	t14
t8	1.0000						
t9	0.6850	1.0000					
	0.0000						
t10	0.4041	0.3142	1.0000				
	0.0000	0.0000					
t11	0.3760	0.4067	0.7646	1.0000			
	0.0000	0.0000	0.0000				
t12	0.3780	0.6311	0.2005	0.3842	1.0000		
	0.0000	0.0000	0.0000	0.0000			
t13	0.4110	0.3965	0.3963	0.4896	0.3069	1.0000	
	0.0000	0.0000	0.0000	0.0000	0.0000		
t14	0.3521	0.3331	0.4906	0.4132	0.1579	0.3690	1.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
t15	0.3012	0.2855	0.4023	0.3393	0.1949	0.4190	0.5379
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

	t15
t15	1.0000

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Note: t_i is the sub-index of Siklos overall transparency. P-values are given under each coefficient correlation.

Table C.2. Principal Component Analysis

Principal components/correlation	Number of obs = 1209
	Number of comp. = 15
	Trace = 15
Rotation: (unrotated = principal)	Rho = 1.0000

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	5.66163	3.81103	0.3774	0.3774
Comp2	1.8506	.842833	0.1234	0.5008
Comp3	1.00777	.0092738	0.0672	0.5680
Comp4	.998497	.126121	0.0666	0.6346
Comp5	.872376	.196428	0.0582	0.6927
Comp6	.675948	.0247708	0.0451	0.7378
Comp7	.651177	.0522965	0.0434	0.7812
Comp8	.598881	.0672295	0.0399	0.8211
Comp9	.531651	.0137568	0.0354	0.8566
Comp10	.517894	.0492991	0.0345	0.8911
Comp11	.468595	.0390217	0.0312	0.9223
Comp12	.429574	.0679442	0.0286	0.9510
Comp13	.36163	.151776	0.0241	0.9751
Comp14	.209853	.0459381	0.0140	0.9891
Comp15	.163915	.	0.0109	1.0000

Table C.3. Kaiser-Meyer-Olkin measure of sampling adequacy

Variable	kmo
t1	0.7902
t2	0.7552
t3	0.7935
t4	0.9443
t5	0.9398
t6	0.9223
t7	0.8541
t8	0.7934
t9	0.7416
t10	0.7837
t11	0.8003
t12	0.7617
t13	0.9422
t14	0.9170
t15	0.8923
Overall	0.8455