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A NONLINEAR OPTIMAL SCORING ESTIMATE OF THE RELATIONSHIP BETWEEN BUDGET RULES AND FISCAL PERFORMANCE IN THE EUROPEAN UNION

ABSTRACT

Tests of the budget rules/fiscal performance relationship are metric-sensitive and arbitrary in the evaluation of the stringency of the rules, aggregation of these evaluations in an index and imposition of a linearly specified model. In this paper we propose a nonlinear principal component analysis to solve these problems and evaluate the relative disciplinary power of each rule. A battery of regressions on 1980-1999 optimally transformed data relative to 12 EU countries confirms that more stringent rules reduce fiscal imbalances, but not budget size, while increases in the degree of stringency of the rules are negatively correlated with public expenditures growth.

JEL CLASSIFICATION CODES: H61, H62, C49

KEYWORDS: budget rules, fiscal performance, nonlinear principal components.

1. Introduction and literature review

Recent contributions to the literature on the determinants of public deficits focus on budget procedures to explain the considerable cross country differences in fiscal performances within highly interconnected and similarly developed economies, such as the OECD countries, the Latin American countries and the U.S. States (Alesina and Perotti, 1994, 1996). These contributions rest on the idea that democratic institutions allow policymakers to partially internalize the political costs of their spending decisions, with consequent deficit bias in financial choices (Buchanan and Wagner, 1977; Alesina and Perotti, 1994). Different budget procedures, however, put similarly deficit-biased policymakers under different sets of constraints. Budget outcomes should thus vary with the degree of stringency of these constraints (von Hagen, 1991; von Hagen and Harden, 1995, 1996).

This literature has initially emphasized the effects of imposing *numerical* targets on fiscal variables, such as budget deficit, public expenditures and debt. The provisions of the Maastricht Treaty and the balanced budget rules adopted by almost all the U.S. states are expression of this line of reasoning. Empirical tests of these theories have yielded mixed results. Some studies find no significant correlation between measures of fiscal discipline and single budget rules, such as veto power and balanced budget laws (Holtz-Eakin, 1988; Bunch, 1991). Others find that these rules "work", provided that they are coordinated with other constraints on fiscal discretion at other stages of the budgetary process (Poterba, 1994 and 1996; Alt and Lowry, 1994; Bayoumi and Eichengreen, 1995; Bohn and Inman, 1996; Padovano, 1998). Otherwise, these rules prove not only ineffective, but generate incentives for "creative accounting" and for a reduction of the transparency of the budget process (Milesi-Ferretti, 1997).

These results led scholars to shift their attention from numerical to *procedural* budget rules. These are the regulations that govern each stage of the budget process, from the

formulation of the budget proposal by the executive, to its discussion and approbation by the legislature and to its final implementation (von Hagen, 1992; von Hagen and Harden, 1996; Alesina and Perotti, 1996). These models generally predict that budget procedures lead to greater fiscal discipline inasmuch as they strengthen the prerogative to the prime minister or the finance minister over the spending ministers, limit universalism, reciprocity and amendments in parliamentary budget sessions and constrain bureaucratic discretion in the execution of the budget law (Baron, 1989, 1991; Baron and Ferejohn, 1989; von Hagen, 1992). Empirical analyses seem to lend support to these predictions: von Hagen (1992), de Haan and Sturm (1994) and de Haan, Moessen and Volkerkink (1999) find indexes of centralization of the budget process negatively correlated with budget deficits, government debt and government expenditures in the EU countries. Alesina, Hausmann, Hommes and Stein (1996) find similar results using a comprehensive sample of Latin American countries.

Though encouraging, these empirical studies suffer of several methodological shortcomings that cast doubts on whatever finding they get. A first shortcoming arises from the *approximation* of the degree of stringency of each rule. All studies capture this qualitative dimension by assigning numerical evaluations to each rule (von Hagen, 1992; de Haan and Sturm 1994; Alesina, Hausmann, Hommes and Stein, 1996; Padovano, 1998; de Haan, Moessen and Volkerkink, 1999; and, among the official publications, ACIR, 1987). Although these assignments are generally reasonable assessments of the rigorousness of each rule, this procedure relies upon an arbitrary numerical coding of ordinal variables. Subsequent analyses based on these variables are sensitive to the coding method chosen and thus produce spurious results.

A second shortcoming derives from the *aggregation* of the rules. As the number of rules that compose a budget process is usually very large, regressing fiscal variables on the entire set of rules leads to highly parametric and unsatisfactory statistical models. To save degrees of

freedom, empirical studies estimate the rigorousness of the budget process as a whole; more specifically, they construct some index that sums the numerical values assigned to each rule of the process (von Hagen, 1992; de Haan and Sturm 1994; Alesina, Hausmann, Hommes and Stein, 1996; Padovano, 1998). Implicitly, this means that the way a budget process constrains fiscal choices can be represented by a linear additive function where all rules have equal weight, i.e., they are perfect substitutes for each other in achieving the same degree of fiscal discipline. It may be the case, however, that certain provisions restrict the choice set of fiscal decision makers more than others. Yet, the arbitrariness and the high level of aggregation of these indexes make it very difficult to learn the relative constraining power of single rules within the budget process.

A third shortcoming is inherent to the *form of the correspondence* between budget rules to fiscal outcomes. Theory (such as von Hagen, 1991) provides little guidance for the specification of regression models in empirical tests. Most studies suppose that the degree of stringency of a rule categorized in *n* variants increases linearly with the number of variants. There are reasons to believe, however, that a nonlinear relationship is more appropriate. For instance, Crain and Miller (1990) show that the general veto and the line item reduction veto (the most and the least general form of veto power on a budget law) are less restrictive than the intermediate form, the line item veto. This is a *prima facie* evidence of a U-shaped relationship. These doubts lead Von Hagen (1992) and Padovano (1998) to use non-parametric significance tests. While this approach is correct in principle, few studies adopt it because it does not clearly expose the form of the relationship under test.

To improve on each of these shortcomings, our paper proposes a Nonlinear Principal Component Analysis (hereafter, NLPCA) of the data set. NLPCA encloses a number of data transformation procedures (see Kruskal and Shepard, 1974, Young, Takana and de Leeuw, 1978, Winsberg and Ramsay, 1983 and the extensive discussion in Gifi, 1990) which

generalize the standard principal component analysis to a method capable of both analyzing qualitative data and reducing the number of qualitative exogenous variables for subsequent use in the standard analysis of linear models. More precisely, NLPCA assigns to each country a (small) number of scores that summarizes the degree of stringency of the overall budget structure. This summary is the solution of an optimization process that: a) minimizes the loss of explanatory power in the reduction process; b) keeps the ordinal properties of the underlying data; c) yields evaluations of the degrees of stringency of the rules that are invariant to monotone transformations, which implies that it is not sensitive to the interval differences between the numerical evaluation of the data; d) highlights which rule has the greatest disciplinary power; e) provides a non linear transformation of the independent variables based on precise mathematical properties that yields the most appropriate specification of the relationship between budget procedures and fiscal outcomes; f) permits a quantitative summary of the budgetary changes occurred in each country during the study period.

With these improvements in the specification of the estimates we reach three main results: 1) more stringent budget procedures limit deficit spending; 2) there is evidence of a nonlinear relationship between budget rules and fiscal performance; 3) not all (sets of) budget rules have the same disciplinary power with respect to a given indicator of fiscal performance. For example, the negotiation of the budget proposal within the government seems to affect the level of the deficit the most, while the regulation of the amendments to the budget proposals and of the implementation of the budget bill appear the most important limit to the expansion of the public outlays.

Lagona and Padovano (2000) is a first application of NLPCA to verify the relationship between budget rules and fiscal performance in (some of) the EU countries during the 1980s. Two are the crucial improvements of this paper with respect to Lagona and Padovano (2000).

First, we now dispose of a larger data set, which consider a greater variety of budget rules, more countries and, most importantly, observations for two decades, the 1980s and the 1990s. Second, the availability of two time periods allows us to check whether changes in the stringency of the budget rules, which certain countries implemented between the 1980s and the 1990s, have produced the predicted changes in the fiscal performance.

The rest of the paper is organized as follows. Section 2 illustrates the data set of the budget rules underlying our analysis. Section 3 explains the motivations for implementing NLPCA in this matter of inquiry. Specifically, Section 3.1 explains the shortcomings of the approaches followed in the literature; Section 3.2 illustrates the main analytical properties of NLPCA. The results of NLPCA are discussed in Section 4 and applied to the investigation of the relationship between budget rules and fiscal performance in Section 5. Section 6 reassumes the main findings of our analysis.

2. Data description

2.1. Independent variables. Von Hagen (1992) still provides the most comprehensive and coherent description and codification of the budget rules of a group of independent countries characterized by homogenous and advanced economies, namely, 12 EU member countries in the 1980s. De Haan, Moessen and Volkerkink (1999) extend and improve the data set to the 1990s, other rules and EU countries. Combining these sources we are able to base our analysis on information about the budget procedures of Belgium, Denmark, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, Spain, Sweden and the United Kingdom for the period 1980-1999.

The characteristics of each country's budget procedures are reassumed according to: 1) the internal organization of government; 2) the formulation of the budget proposal within the government; 3) the discussion and approbation of the budget law in the parliament; 4) the

informativeness of the budget law; 5) the flexibility in the implementation of the budget law; 6) the stringency of long-term budget documents.

Each of these six "stages" is further disaggregated into several rules, up a total of 29. Specifically, about the internal organization of government (stage O), the data set considers how many government levels have fiscal power (variable O1), whether regional authorities must balance the budget (O2), if they need the central government's authorization to borrow (O3), whether they are autonomous in planning their budget (O4), and how many ministries participate in drafting the central government's budget (O5). Information about the formulation of the budget proposal (stage N) evidences whether it foresees a constraint on the budget totals (variable N1), who has the power of setting the agenda (N2), if this power is explicitly codified in the budget rules (N3) and what type of negotiations lead to the formulation of the budget proposal (N4). Five characteristics of the discussion and approbation of the budget by the legislative (stage P) are recorded: the parliament power to amend the government proposal (variable P1), whether these amendments are required to be offsetting (P2), if their approbation can cause the fall of the government (P3), whether the parliament votes on the entire budget law or on its chapters (P4) and if the total budget size must be voted on before or after the approbation of the single provisions (P5). The informativeness of the budget law (stage I) is evaluated according to the inclusion of special funds in the budget (variable I1), the existence of one or more budget documents (I2), the transparency of the overall document (I3), the links made to national accounts (I4) and the inclusion of government loans to non-government authorities (I5). The stage of the implementation of the budget (called F) is disaggregated into six dimensions: the possibility of the Minister of Finances to block expenditures (variable F1), the existence of cash limits for spending ministers (F2), the requirement of the approbation of a controlling authority for the disbursement of funds (F3), the possibility of transferring resources from one chapter to

another (F4), of changing the budget during its execution (F5) and of carrying unused funds over to next year's budget (F6). Finally, the information regarding long-term budget documents (stage L) regards the type of fiscal variables targeted (L1), the length of the planning horizon (L2), the forecasting method (L3) and the degree of commitment of the long-term budget (L4). For a more detailed discussion of these variables, see von Hagen (1992) and de Haan, Moessen and Volkerkink (1999).

These variables are given numerical values that increase in the degree of stringency of the rule but vary for range and intervals. Table A.1 in Appendix A reassumes this information. Table A.2 illustrates the rules adopted by each country.

Because of the severeness of the degrees of freedom problem, scholars fill the gaps in information about the budget rule of each country by taking the average of the numerical evaluation of the other rules of that same country (see von Hagen, 1992; de Haan and Sturm, 1994; Alesina, Hausmann, Hommes and Stein, 1996). These linear combinations, however, reduce the true unobserved total variance of the data set. As in our data set the variance is of considerable magnitude, this procedure appears inappropriate and likely to yield incorrect parameter estimates. We instead choose to be as respectful as possible of the data. Accordingly, we have supplemented the missing information with those published by OECD (1987, 1995), at the cost of dropping Luxembourg from the data set, for which the OECD sources proved unhelpful.

2.2 Dependent variables. Again to maximize the comparability of the results of our approach with those of the literature, we choose as same dependent variables: 1) the ratio of total budget deficit to GDP (measured as the difference between lending minus repayments), called TDEF; 2) the ratio of primary deficit to GDP, PDEF; 3) the stock of the public debt outstanding to GDP, DEB; 4) the ratio of the total public expenditures of the consolidated government to GDP, EXP. We have also considered the ratio of total revenues to GDP, but it

proved multicollinear with total public expenditures, so we dropped this variable from the analysis. All data on the dependent variables are form OECD *Economic Outlook* (1999).

Given the high persistence in the regressors, we take the average for the 1980s and the 1990s of the dependent variables as our regressands.

3. Regression on nonlinear optimal scores

3.1. Problems in summarizing budget rules. The general purpose of this analysis is to test the alternative hypotheses of dependence between differences (cross countries and between periods) in budget procedures and differences in fiscal performances, against the null hypothesis of independence. To illustrate this matter in formal terms, let z_{ist} be the value of the s^{th} variable in country i at time t, t=1,2 (e.g., the debt-to-GDP ratio), and let $\hat{x}_{ikt}$ score the degree of stringency of the k^{th} budget rule in country i (e.g., the veto power of the finance minister). Furthermore, let $z_{is}= z_{is2} - z_{is1}$ and $\hat{x}_{ik}$ be (signed) measures of the change, from period 1 to period 2, occurred in the i^{th} country with respect to the s^{th} fiscal variable and the degree of stringency of the k^{th} budget procedure (the way we evaluate x_{ik} is the topic of Section 3.2.) We consider two models:

$$\text{M1:} \quad z_{ist} = f(\hat{x}_{i1t} \dots \hat{x}_{iKt}) + \varepsilon_{ist} \tag{1}$$

$$\text{M2:} \quad z_{is} = g(\hat{x}_{i1t} \dots \hat{x}_{iKt}) + \xi_{is} \tag{2}$$

where f and g are monotone decreasing function of the changes in the budgetary process and the errors ε and ξ are drawn from independent random variables with zero expectations. M1 tests the hypothesis that differences (cross country and between periods) in budget procedures result in differences in fiscal performances; M2 tests the hypothesis that changes in the budgetary processes determined changes of fiscal performance.

The efficiency of any statistical estimation of both M1 and M2 is an increasing function of the degrees of freedom. In our analysis, the large number of the budget rules

relative to the total observations requires to restrict the available independent variables to a smaller set of regressors. However, the standard methods for reducing the number of independent variables present several problems. First, the high heterogeneity of budgetary procedures in the EU countries in the two periods of our sample, shown in Table A2, does not legitimate the deletion of regressors with low variability or/and with a high association with other variables. NLPCA, instead, captures such heterogeneity. Secondly, clustering the independent variables into homogeneous groups and conducting separate ANOVAs is also unsatisfactory, in the absence of a theory that indicates how each rule influences fiscal outcomes and, consequently, how to group the rules. Most analysts have resorted to indices that summarize the information in the K variables, by assigning to each country i $J<K$ linear combinations a_i of the x scores of the form

$$_1a_i = \sum_{k=1}^{K(1)} w_k x_{ik} \text{ , ... , } {}_Ja_i = \sum_{k=1}^{K(J)} w_k x_{ik}$$

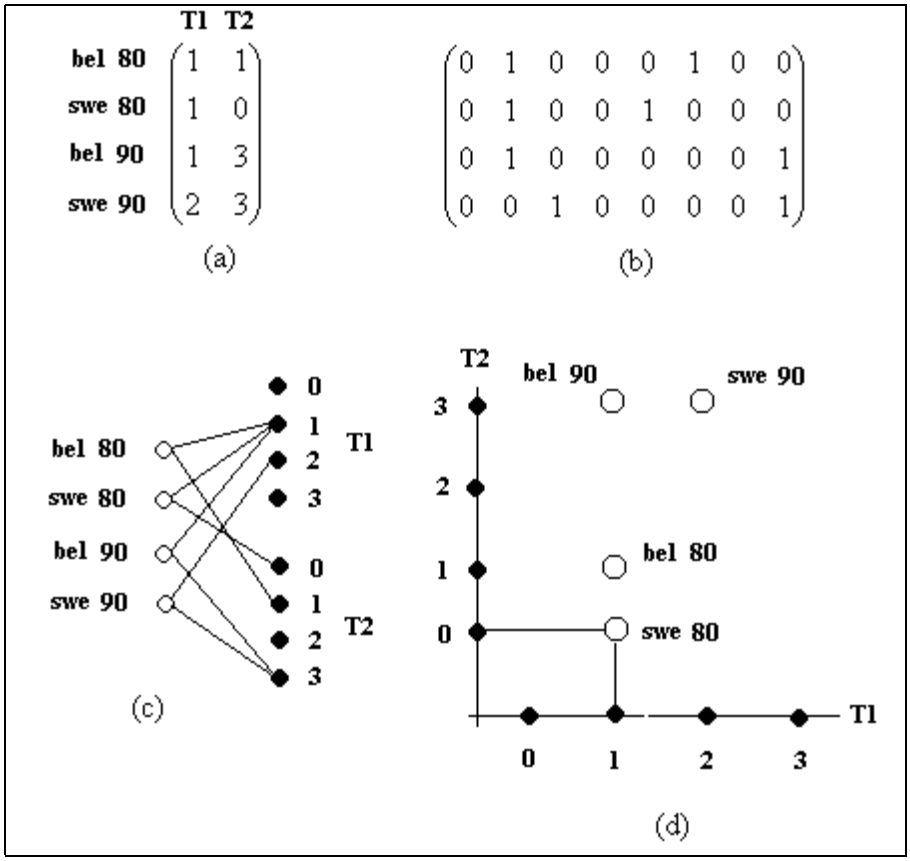
where x_{ik} scores the stringency of the k^{th} budget rule in the i^{th} country, while $K(j)$ is the number of the budget variables clustered in the j^{th} groups, $\Sigma_j K(j)=K$, and, finally, the w_k are weights that assess the relative importance of each rule in the budget process. In subsequent regression analyses, the estimated coefficients on the a_i regressors vary with the values of the xs and the ws. The problem is that both the scores x and the weights w are *a priori* elicited, i.e., they are not grounded on a theory or on an optimization problem that defines their properties. In other words, the xs and the ws are essentially arbitrary transformations of the data made by the analyst. As such, they are unsatisfactory. Furthermore, any coding of non-metric data, like those using rank numbers (von Hagen, 1992) or order statistics (Padovano, 1998), makes the estimates sensitive to the *cardinal* properties of the data, which in fact do not exist. The data feature characteristics, or, more precisely, categories of which theory at best suggests the *ordinal* ranking. Finally, in the empirical literature the prevailing weighting schemes of the budget scores are binary, i.e., the weight is chosen to keep or exclude a

variable from the analysis (von Hagen, 1992; de Haan and Sturm, 1994; Alesina, Hausmann, Hommes and Stein, 1996). Again the theoretical literature does not provide any explicit indication to call these variables out.

It is to be noted, however, that if the *x*s were "truly" metric scores, a standard Principal Components Analysis (hereafter, PCA) could be implemented in order to find optimal weights and, therefore, an optimal summarization of the independent variables. This would also yield insights on which variable carries the greatest explanatory potential, i.e., which rule holds the greatest disciplinary power on the fiscal indicator under scrutiny. In this case the problem would be to respect the ordinal nature of the data. We thus need a generalization of PCA suitable for observations expressed in an ordinal scale.

3.2. Nonlinear optimal scoring of budget stringency. In formal terms, Table A2 is a rectangular $2n \times K$ matrix **X**, which contains the categories of K ordinal variables collected for n countries during the 2 periods under consideration. The first n rows enter with the stringencies relating to period 1981-90, while rows $n+1$ through $2n$ enter with the values relating to the second period under consideration (1991-99). Hence, the $(i,k)^{th}$ and $(i+n,k)^{th}$ entries of matrix **X** are equal to the stringency of the k^{th} budget rule in country i during the two periods.

Figure 1



To make an example, Figure 1a is a reduction of Table 2A to 2 countries (Belgium and Sweden), 2 rules (T1 and T2) and 2 periods (the 1980s and the 1990s). We can denote J_k as the number of the categories taken by the k^{th} rule (for instance, $J_k = 4$ if four degrees of stringency are admissible) and let $\mathbf{C}_k$ be a $2n \times J_k$ indicator matrix where the $(i, j)^{\text{th}}$ entry is equal to 1 if $x_{ik} = j$, and 0 otherwise. Merging these indicator matrices, a $2n \times \Sigma_k J_k$ matrix $\mathbf{C} = (\mathbf{C}_1 \ldots \mathbf{C}_K)$ is obtained (reported in Figure 1b), which is the connectivity matrix of a bipartite graph where vertices on one side are countries, vertices on the other side are categories and edges connect countries to budget categories (Figure 1c). Of course, it is always possible to map this bipartite graph in a K-dimensional Euclidean space; categories would be drawn on the K axes, countries become points with coordinates x_{ik} and edges are the perpendicular projection segments of countries on these axes (Figure 1d).

At this point, however, several problems appear. First and least, the number of scores for each country must be kept as small as possible, in order to save degrees of freedom for both the models M1 and M2. At the same time, the resulting scatter plot would be meaningless, since categories are ordinal, arbitrary scores and, accordingly, an Euclidean distance between two points relating to the same country in the two different periods cannot be used as a measure of the change of the stringency of the budgetary process occurred in that country from period 1 to period 2.

Notice that constructing a dissimilarity index that takes in account the ordinal property of the budget data could solve this distance problem. This would be helpful for M2 but not for M1, for which a score x_{ikt} is needed for each combination of country, rule and time period. Instead, the approach pursued here is based on finding a p-dimensional Euclidean space, where $p<<k$, where countries and budget stringencies are positioned so to retain the maximum amount of information from the original data, under the constraint of drawing this map in a way that countries are close to their budget categories, and categories are close to the countries that possess them. The selection of a dimension $p<<k$ derives from the need to save degrees of freedom for models M1 and M2. The choice of an Euclidean space stems from its properties (projections, triangle inequality) that allow to measure the change in the budgetary process of each country from one time period to another as the Euclidean distance between two points. Accordingly, our dissimilarity index to be used in model M2 is simply a distance between two optimal scores.

In formal terms, let $\tilde{\mathbf{X}}$ denote any $2n \times p$ matrix containing the p coordinates of the n countries and let $\tilde{\mathbf{Y}}_1 ... \tilde{\mathbf{Y}}_K$ be any $J_{kt} \times p$ matrices containing the p coordinates of the budget variables. We must find the $\hat{\mathbf{X}}$ and $\hat{\mathbf{Y}}_1 ... \hat{\mathbf{Y}}_K$ that minimize the average squared length of the edge in the p-dimensional graph - our loss function

$$L\left(\tilde{\mathbf{X}}, \tilde{\mathbf{Y}}_1 \ldots \tilde{\mathbf{Y}}_K\right) = 1/K \sum_{k=1}^{K} trace\left[\left(\tilde{\mathbf{X}} - \mathbf{C}_k \tilde{\mathbf{Y}}_k\right)'\left(\tilde{\mathbf{X}} - \mathbf{C}_k \tilde{\mathbf{Y}}_k\right)\right] \quad (3)$$

under the rank-one constraints

$$\mathbf{Y}_k = \mathbf{q}_k \boldsymbol{\lambda}_k' \quad , \quad k = 1 \ldots K \quad (4)$$

where $\mathbf{q}_k$ is a J_k-column vector containing the category quantifications for the k^{th} budget rule and $\boldsymbol{\lambda}_k$ is a p-column vector of weights – the "component loadings". In other terms, each quantification matrix $\mathbf{Y}_k$ is restricted to be one-dimensional, which implies that the category quantifications become proportional to each other, after having been mapped onto the p-dimensional space. Since minimization of (3) is required over two matrices of variables, the procedure we used is based on a reiterated application of an Alternating Least Squares algorithm until convergence is reached. Briefly, each n^{th} step includes the following substeps: S1) holding the $\mathbf{X}$ computed in the previous (n-1) step, computation of $\mathbf{Y}_1^* \ldots \mathbf{Y}_K^*$ through the minimization of (3); S2) holding the $\mathbf{q}_k$ computed in the (n-1) step, computation of the component loadings $\boldsymbol{\lambda}_k^{(n)}$, imposing the rank-one restrictions (4) on the $\mathbf{Y_k}$; S3) estimation of the category quantifications $\mathbf{q}_k^{(n)}$, using both the $\mathbf{Y}^*$ and the $\boldsymbol{\lambda}_k^{(n)}$ computed at substeps S1 and S2, respectively; S4) account of the restrictions imposed by the ordinal measurement level of the budget stringencies performing a weighted monotone regression in the metric $\mathbf{C}_j$; S5) computation of $\hat{\mathbf{Y}}_1^{(n)} \ldots \hat{\mathbf{Y}}_K^{(n)}$, updating the $\mathbf{Y}_1^* \ldots \mathbf{Y}_K^*$ by $\hat{\mathbf{Y}}_k^{(n)} = \mathbf{q}_k^{(n)} \boldsymbol{\lambda}_k^{(n)}$.

In particular, we emphasize that substep S4 takes into consideration the measurement level of the variables under study (Gifi, 1990; de Leeuw and van Rijckevorsel, 1980), by that making the score optimization invariant with respect to all the possible monotone transformations of the stringencies. As a result, when convergence is reached, matrix $\hat{\mathbf{X}}$ contains optimal score transformations that: a) meet the proportionality requirements stated in (2); b) minimize the loss of information due to the dimension reduction of data measured by (1); c) are invariant for any preliminary, arbitrary numerical coding of the rigidity of budget

rules in matrix **X**. They are, however, sensitive to the choice of the dimension p of the space over which the original country points are projected.

4. NLPCA estimates of budget rules rigidity

We have applied NLPCA to the data regarding all the stages of the budget process reported in Table A2. The original K=29 dimension of the space of the budget rules has been reduced to a p=2 space of their principal components (hereafter, PRIN1 and PRIN2). This saves 27 degrees of freedom while keeping approximately 60% of the overall variance present in the original data set, as shown by the first three Eigenvalues of the principal axes (Table 1). The consideration of additional principal components would capture only 9% more of variance in the dataset, at the cost of loosing the intuitive interpretation of a two-dimensional projection of countries and of reducing the number of degrees of freedom available for the subsequent analysis. Moreover, convergence of the ALS algorithm does not seem stable for $p \geq 3$, an expected result, as high values of p increase the chance of several local stationary points in the domain of (3). Conversely, p=2 drives (3) to a stable convergence after only 8 iterations. Hence, we choose to limit our analysis to p=2.

Table 1

Component	*Eigenvalue*	*Cumulative*
PRIN1	9.80	0.34
PRIN2	6.89	0.58
PRIN3	2.75	0.67

Graph B1 in Appendix B plots the original and the NLPCA monotone-transformed evaluations of the categories. The non linear shape of many transformations shows that the dependence structure between budget rules is nonlinear, i.e., an increase/decrease in the degree of stringency of budget rule X in country A does not entail a proportional variation of

the degree of stringency of rule Y in the same country. Hence, running a linear regression of (or applying any kind of linear estimator to) budget rules on indicators of fiscal performance fails to capture the nonlinear structure of the explanatory variables. The likely and spurious outcome of such estimates is low levels of statistical significance of the coefficients, like those found by de Haan, Moessen and Volkerkink (1999).

The first result of the application of NLPCA to the original data is the biplot (Gabriel, 1981), reported in Graph 1. To interpret the biplot, one must keep in mind that it displays the transformed data matrix $\hat{\mathbf{X}}$, which results after minimizing (3) and conducting an ordinary PCA that leads to the identification of the first two principal components. More precisely, any $\tilde{\mathbf{X}}$ is approximated by the product $\mathbf{P}\boldsymbol{\Lambda}^{-1/2}\mathbf{Q}'$, where the rows of the 24×2 matrix $\mathbf{P}$ are the standardized PCA component scores (with respect to the first two principal components) and $\boldsymbol{\Lambda}^{-1/2}\mathbf{Q}'$ is the 2×29 structure matrix. Hence the $(i,k)^{\text{th}}$ element of $\tilde{\mathbf{X}}$ (i.e., the degree of stringency of the k^{th} budget rule in the i^{th} country, after transformation) is approximated by the inner product between the i^{th} row of $\mathbf{P}$ and the k^{th} row of $\mathbf{Q}\boldsymbol{\Lambda}^{-1/2}$. As a result, in the biplot each budget rule can be represented by a vector in the two dimensional plane spanned by PRIN1 and PRIN2, while each country can be identified by a point in that space.

Three types of information can be extracted from the biplot: 1) Just like any principal component analysis, the coefficient of correlation between two variables, or between one variable and one axis, is the cosine of the angle between the two arrows. Angles strictly wider than 90° (evaluated counterclockwise) imply a negative correlation between the two variables, while strictly narrower angles indicate a positive correlation. Angles at 180° indicate a correlation coefficient of –1. Accordingly, the angle of the vector of each rule with respect to the axes indicates which of the two principal component captures that rule. Since the two principal components are orthogonal, a high correlation of a given rule with one principal component implies a low correlation with the other. Thus, while one cannot say that one

principal component exclusively captures certain rules and the other exclusively the remaining ones, it is legitimate to interpret one principal component as relatively more correlated with the rules that the other component explains the less. 2) Since transformations of categories are forced to be of rank one and ties are preserved, the distance from the origin along the direction of the vector denotes increasing degrees of stringency of the rule represented by that vector. 3) The orthogonal projection of a country point onto a rule vector indicates how stringent is that rule in that country; e.g., the country that projects farthest along the vector of a budget rule is the country with the highest degree of stringency with respect to that rule. Similarly, the projection of the country point onto the axis of the two principal components indicates how the country fares in terms of the groups of rules that each principal component captures.

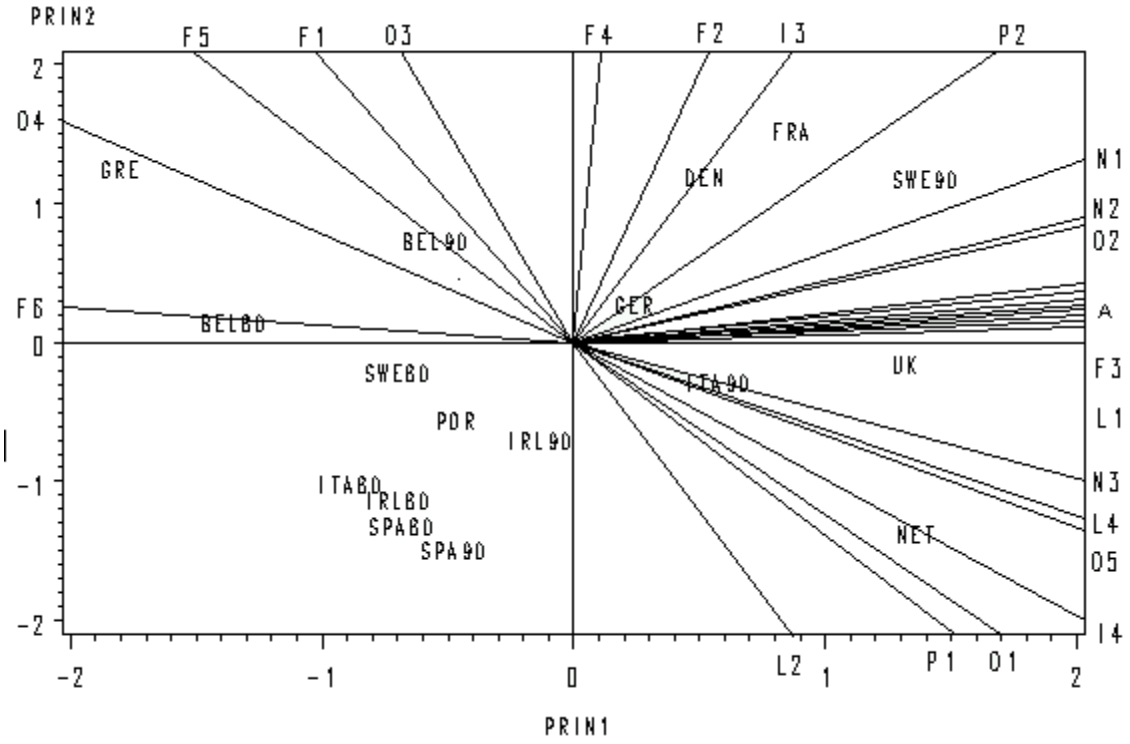
Graph 1 shows that PRIN1 captures the group of procedures N (structure of negotiations within government), P (structure of parliamentary process), I (informativeness of the budget draft) and most of the O (organization of general government). It thus can be taken as a measure of the rigidity of the rules for elaborating and approving the budget document, from its birth within the cabinet to its legification in the various government levels. PRIN2, instead, best explains most of the F (flexibility in budget execution), that characterizes the implementation of the budget law by the bureaucracy. Furthermore, most budget rules are positively correlated to each other, while F6 (no carry-over of unused funds) and to a lesser extent O4 (planning autonomy of local governments) present a negative correlation to the majority of rules. This is evidence that countries with rigid budget procedures for what it concerns, say, the negotiation of the budget proposal within the government and the approbation of the budget law by the parliament tend to allow the possibility of crediting to the next budget any resource not spent during the previous one and vice versa.

Coming to countries, France, Denmark and Sweden in the 1990s are those with the most

stringent budget rules, especially in terms of I3, P2, N1 and N2. The UK and the Netherlands derive the constraining power from rules in set A and N3, i.e., mostly from tight control of negotiations within the government, of the Parliament's power to make amendments, as well as from a good transparency of the budget document. Belgium and Greece seem to posses the most idiosyncratic budget processes, as they are characterized by a high degree of stringency of a few rules (especially O4 and F6) and a low degree of stringency in the other rules - though the situation has become relatively more equilibrated in Belgium during the 1990s. Budget reforms in the 1990s produced a remarkable increase of disciplinary power in Sweden, a moderate one in Italy, Ireland and Belgium, and little changes in the other countries.

Graph 1

Biplot of budget stringencies after NLPCA transformation



Note: Label of variables indicate the direction of the corresponding vector; A stands for variables I1,I2, I4, I5, P3-P5, N4, L3. Countries that reformed their budget approbation processes between the 1980s and the 1990s have their acronym followed by the decade, while those which have not undergone a process of reform have the same coordinates in the two decades and are thus indicated only by their acronym.

5. Budget rules and fiscal performance

We are now in a position to test the relationship between fiscal performance of the 12 EU countries of our sample and the estimated principal components of their budget procedures. The analysis is carried out in two steps: first we insert the four indicators of fiscal performance (public debt outstanding, total and primary public deficit and total public outlays) in the space of the principal components to illustrate the relationship between the dependent variables and each budget rule. By that we learn which rule carries the greatest disciplinary power with respect to each fiscal variable and how the rules interplay with each other in constraining the dynamics of the fiscal variable. To corroborate these findings, in the second step of the analysis we estimate a regression model for each dependent variable in their levels (model M1) and we check whether changes in budget rules have resulted in such changes of fiscal performance as theory predicts (model M2).

5.1. Diagrammatic analysis. To detect nonlinear relations between variables of fiscal performance and budget stringency, we have repeated NLPCA merging matrix **X** with the column of the scores of the dependent variables, taking one at a time. The biplots obtained are Graph 2 through 5. These plots cannot be overlapped, as the vectors of the independent variables rotate to match the best two-dimensional projection after entering each fiscal variable.

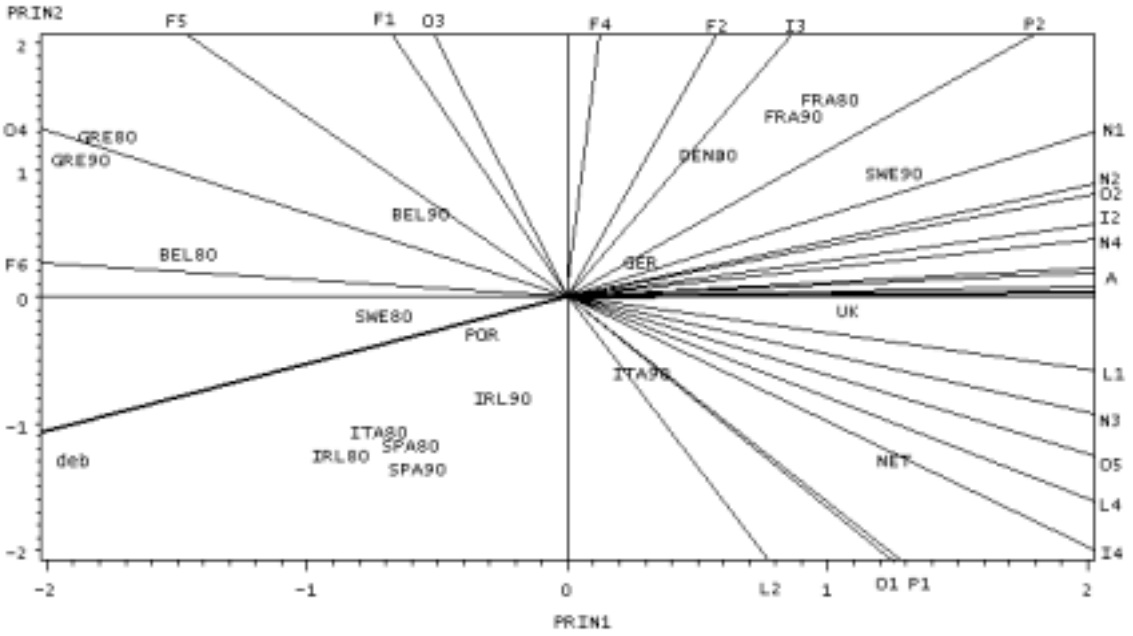
The results are strikingly different between financial variables (namely, total debt outstanding, total and primary deficit) on the one hand, and the public expenditure variable, on the other. As far as the financial variables are concerned, Graph 2 to 4 show that 15 out of 29 budget rules of our data set lie in the opposite half plane to that where the DEB, TDEF and PDEF are evidence of a negative correlation between these rules and each financial variable under scrutiny. This shows that a) budget rules do have a constraining power over financial decisions, i.e., decisions on how to finance a given level of expenditures; b) they exert such

power conjointly, i.e., it is the stringency of a set of rules that produces fiscal discipline, rather than a single rule in isolation. With respect to DEB, TDEF and PDEF this set of rules is remarkably stable, as it is invariantly composed by O2; N1, N2, N4; P2, P3, P4, P5; I1, I2, I3, I5; F2, F3, F4; L3. The rules with the greatest disciplinary power with respect to public debt set a constraint on fiscal totals already in the budget proposal (N1), provide that amendments be offsetting in order to be approved (P2) and regard the overall transparency of the budget document (I3). This is a very plausible result, since it indicates that fiscal disequilibria tend to increase when a) their variations are not made explicit from the beginning of the budget process, i.e., from the proposal of the new budget; b) there are no institutional structures on the parliamentary approbation of the budget that prevent the possibility of cycling majorities; c) obfuscated budget documents reduce the controlling power of the taxpayer-voter. As for total and primary deficits, the most stringent rules are, again, those that determine the difference between fiscal totals in the budget proposal (N1) and in the budgets of the local governments (O2), as well as those that increase the agenda setting power of the Finance Minister (N2). These results are consistent with the predictions of the theoretical literature (von Hagen, 1992; Baron, 1989, 1991; Baron and Ferejohn, 1989); however, our analysis provides a much more precise corroboration of theory than those available so far, as the biplots reveal the influence of single rules, rather than aggregated indexes.

Budget rules, instead, show a very limited constraining potential of the level of public expenditures. Graph 5 shows that most of the rules lie in the same half-plane of the EXP vector. The implication is that there is either no or a positive correlation between the stringency of the budget rules and the level of public expenditures. This comes as no surprise, since entitlements, such as health care, social security and unemployment insurance programs, represent a high and a growing share of total budget outlays in our sample (Alesina and Perotti, 1994). Entitlement programs are not subject to periodic revision in the budget

Graph 2

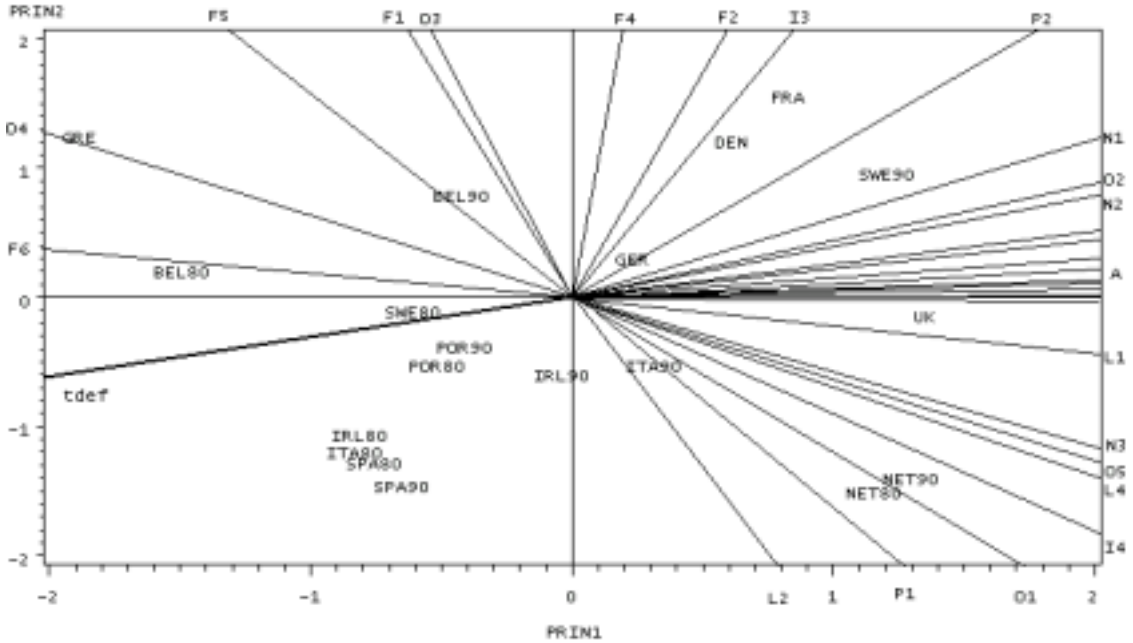
Biplot of budget rules, countries and DEB after NLPCA transformation



Note: Label of variables indicate the direction of the corresponding vector; A stands for variables I1, I5, P3-P5, F3, L3.

Graph 3

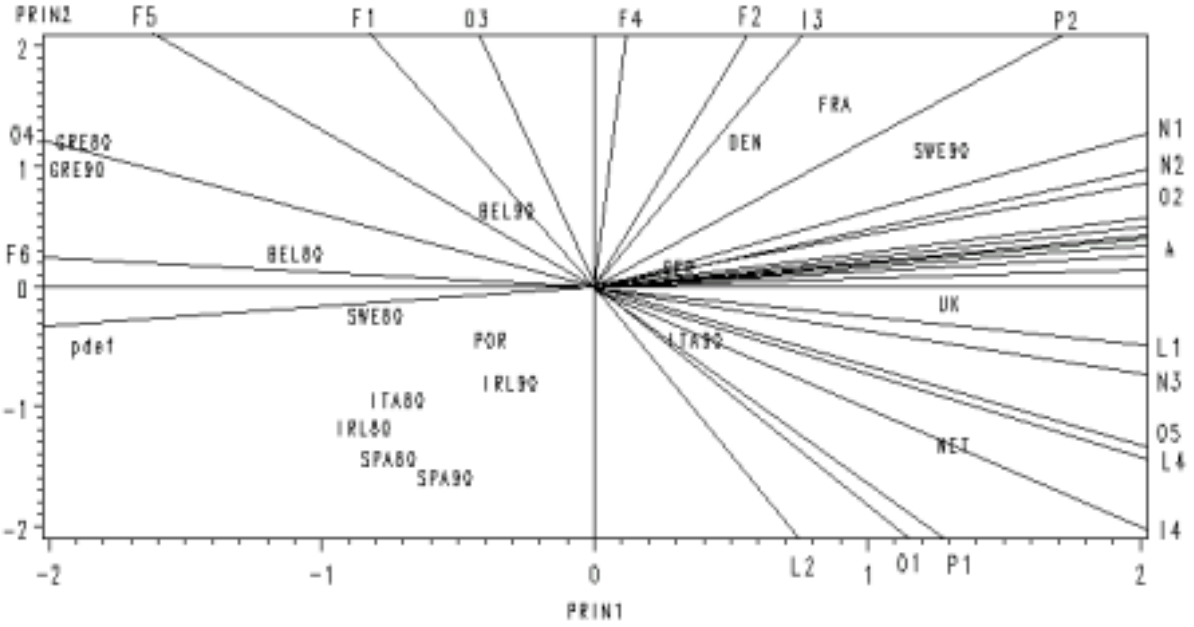
Biplot of budget rules, countries and TDEF after NLPCA transformation



Note: vector of the variable of fiscal performance is in bold; labels of variable indicate the direction of the corresponding vector; A stands for variables I1, I5, P3-P5, F3.

Graph 4

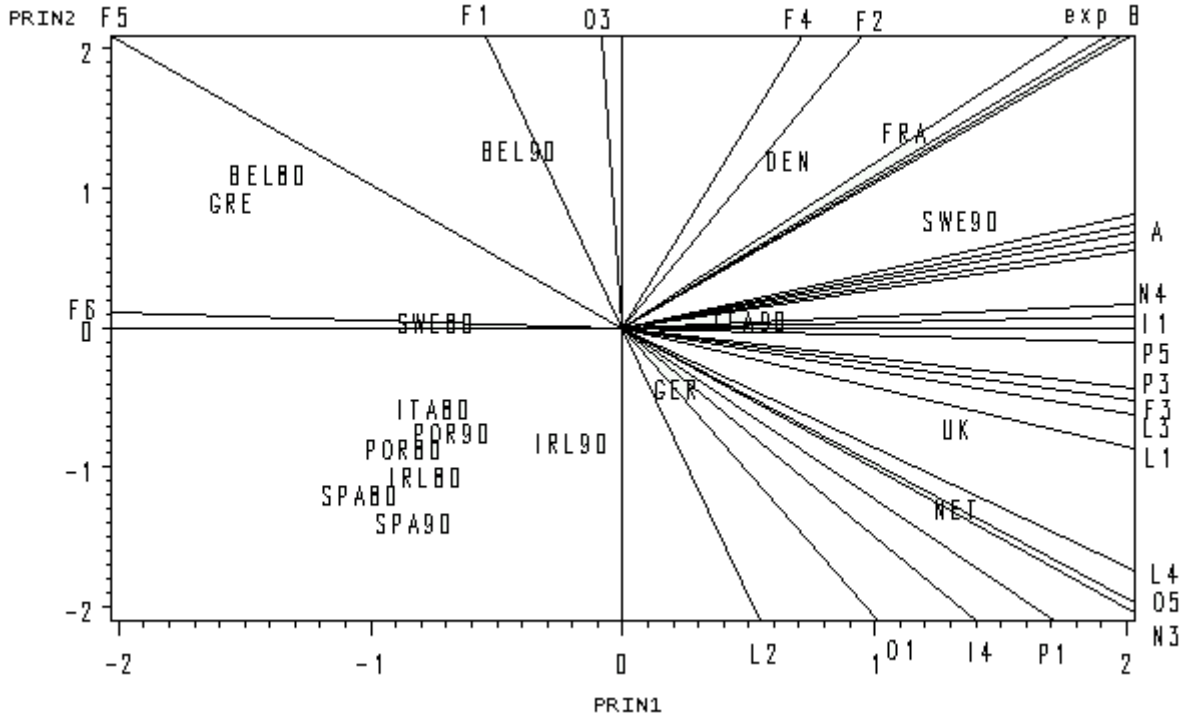
Biplot of budget rules, countries and PDEF after NLPCA transformation



Note: vector of the variable of fiscal performance is in bold; labels of variable indicate the direction of the corresponding vector; A stands for variables N4, I1, I2, I5, P3-P5, L3.

Graph 5

Biplot of budget rules, countries and EXP after NLPCA transformation



Note: vector of the variable of fiscal performance is in bold; labels of variable indicate the direction of the corresponding vector; A stands for variables O4, I3, P2; B for variables O2, N1, N2, P4, I2, I5.

sessions, where the issue to be decided upon is only how to finance the disbursements that they predetermine. The administration of these programs, however, is characterized by a certain degree of discretion (Emerson, 1988; Alesina, Danninger and Rostagno, 1999); interestingly, the two budget rules that approximate a –1 correlation coefficient with EXP are those that limit bureaucratic discretion in the administration of the budget, namely F5 (changes in budget law during execution) and F6 (carry-over of unused funds to next year).

5.2. Regression results. We are now in a position to estimate models M1 and M2. As we have argued in Section 4, in order to properly estimate the relation between indicators of fiscal performance and NLPCA transformed values of the stringency of budget rules, we need to use the NLPCA transformed values of the dependent variables as well. Graph b2 (Appendix B) illustrates how NLPCA transformed DEB, PDEF, TDEF and EXP.

These transformations take the form of a step function, since NLPCA clusters in a few groups the original continuous observations of the indicators of fiscal performance of the countries in our sample.

Given the small number of available observations (n=24), the set of independent variables is limited to at most two regressors and the intercept. It is important to bear in mind that, while our regression model is a standard OLS, the variables included in the estimating equation are the optimally transformed scores of the original data on budget rules and fiscal indicators. The fact that these transformations are non linear (as shown in Appendix B) confirms that the actual correspondence between budget outcomes and budget rules is nonlinear.

Table 2 reports the regression results for M1, testing the hypothesis that countries with lax budget approbation procedures tend to have high fiscal imbalances. The results of the estimates confirm what already found in the diagrammatic analysis. DEB, TDEF and PDEF are negatively and significantly correlated with PRIN1, the principal component that best

captures the great majority of budget rules, except most of the F, on the flexibility allowed in the implementation of the budget. In line with theory, the rules captured in PRIN1 are strongly and negatively correlated with financial disequilibria. Conversely, the absence of statistically significant coefficients on PRIN2 with respect to DEB, TDEF and PDEF imply that a low stringency in the F rules does not affect the choice of how to finance a given level of outlays. Rather, as the positive and significant sign of PRIN2 on EXP shows, it tends to increase the volume of these outlays. However, the positive and significant coefficients of PRIN1 and PRIN2 on EXP indicate that countries with more stringent rules are not characterized by a lower share of public expenditures on GDP.

Table 2

ESTIMATES OF MODEL 1

	Dependent variable			
	DEB	TDEF	PDEF	EXP
C	0.7183***	0.0463***	0.0941**	0.4953***
	(0.0432)	(0.004)	(0.0419)	(0.0109)
PRIN1	-0.1328***	-0.0233***	-0.189***	0.4953***
	(0.0442)	(0.004)	(0.0428)	(0.0109)
PRIN2	-0.0678	0.0065	-0.0249	0.0358***
	(0.0442)	(0.004)	(0.0428)	(0.0112)
F stat.	5.7	17.89	9.92	11.66
	(0.0105)	(0.0000)	(0.0009)	(0.0004)

Note: Coefficient (Standard Error). F-statistics (p-value). ***, ** denote a 1% and a 5% significance level, respectively.

Model 2, instead, tests the hypothesis that an *increase* of the degree of stringency of budget rules from one decade to another in the same country produces a *reduction* of fiscal imbalances, and vice versa. It is the dynamic version of the hypothesis expressed in model 1. To test it, we introduce the variable DIST in the model, that measures the distance between the positions of the country points in the 1980s and in the 1990s in the space spanned by the two principal components (Graph 1). The dependent variables are measured in the same way, and are indicated as ΠDEB, ΠTDEF, ΠPDEF, ΠEXP. Given the small number of

observations, we exclude the outliers from the sample. Table 3 reports the outcomes of the regression.

Table 3

ESTIMATES OF MODEL 2

	Dependent variable			
	$\Delta DEB^{\dagger}$	$\Delta TDEF^{\dagger\dagger}$	$\Delta PDEF^{\dagger\dagger}$	$\Delta EXP^{\dagger}$
C	14.2399	-0.3388	-0.9035**	1.6008
	(8.0377)	(0.7594)	(1.0434)	(1.5288)
DIST	-14.6624	-4.4241***	-4.5887**	-9.7891**
	(20.2079)	(1.2385)	(1.8465)	(3.9)
F stat.	0.53	17.89	6.18	6.3
	(0.4888)	(0.006)	(0.0347)	(0.0364)

Note: Coefficient (Standard Error). F-statistics (p-value). ***, ** denote a 1% and a 5% significance level, respectively. (†) Sweden and Italy excluded from the sample. (††) Sweden excluded from the sample.

The most interesting result is the negative and statistically significant coefficient of DIST on EXP. The combination of this result with those of Model 1 suggests that, while countries with more stringent budget rules are not those with a lower expenditure to GDP ratio, there is evidence that an increase of the stringency of these rules during the two decades yields a slower growth of the public sector with respect to the whole economy. Therefore, while the data do not seem to support the static version of the theory, they do for its dynamic formulation. As for the other variables, the signs of the coefficients are negative, as expected, although the coefficient on DEB is not statistically significant. As DEB is a stock variable, it might take more than time elapsed after the budget reforms to obtain a change in the debt to GDP ratio large enough to make the estimated coefficient statistically significant. However, the negative and strongly significant coefficients on PDEF and TDEF are a reassuring evidence that changes in the stringency of the budget rules reduce policymakers' tendency to finance public expenditures via debt.

6. Concluding remarks

The NLPCA approach followed in this paper provides results that enhance those of the current literature along several dimensions. First, NLPCA bases the synthesis of the evaluations of the single rules into aggregate variable(s) on precise mathematical properties. Specifically, the number and the specification of these variables is optimized so as to minimize the loss of explanatory power in the reduction process. Conversely, the approach followed so far in the literature – the simple sum of the evaluations of the rules into one or more indexes – is not based on an optimization process. It thus carries a greater loss of information, *ceteris paribus*, and does not allow to know whether one single index, or more, is the most reasonable synthesis. Second, NLPCA keeps the ordinal properties of the indexes of the previous studies – the acceptable contribution of the numerical evaluations of budget rules - but yields results that are invariant to monotone transformations of the numerical coding of the rules. The other indexes, instead, are metric sensitive and are thus unsuitable for regression analysis. Finally, with NLPCA we know the table of correspondences between the single rules and the principal components. Knowing these correspondences and the coefficients linking each principal components to the dependent variable, we can infer which budget procedure carries the greatest disciplinary power on each indicator of budget performance. In line with theory, with respect to the financial variables (the ratios of debt, primary and total deficit to GDP) these are the ones that increase the agenda power of the finance minister in the negotiations within the government that lead to budget proposal, that increase the overall transparency of the budget bill and constrain the possibility for local governments to finance their expenditures in deficit. Theory receives only a partial support from the data with respect to the possibility that stringent budget rules place a binding constraint on public expenditures. Our analysis shows that countries with more stringent rules are not characterized by a smaller public sector compared to the size of the economy;

however, increases in the degree of stringency of the budget rules do produce a slower growth of the expenditures to GDP ratio.

Finally, our analysis suggests two lines of refinement of the theory on the relationship between budget rules and fiscal performance. First, the shape of the NLPCA transformations of the original data on the degree of stringency of the budget rules suggests that their disciplinary power often increases in a non linear way, and that the relationship between these rules and the indicators of budget outcomes is also non linear. Second, we have pointed out that different rules have different constraining powers with respect to different indicators of budget performance; we thus need more disaggregated theoretical formulations of the relationship between budget rules and fiscal performance.

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APPENDIX A

Table A.1

Numerical evaluations of budget rules

Stage	Symbol	Rule	Range	0	1	2	3
Organization of general government	O1	N. of government levels	0-3	4 + social security	3 + social security	2 + social security	2
	O2	Local government balances the budget	0-3	No requirement	Requirement exists but is not considered binding	Requirement is binding	Defici exceed expen
	O3	Local government needs authorization to borrow	0-1	No authorization is required	Authorization from higher government level is required		
	O4	Local government has planning autonomy	0-3	Lower level governments are autonomous	Lower level governments may be placed under the surveillance of higher level governments	Lower levels governments have limited autonomy	Lower govern no aut
	O5	N. of ministries involved in draft of overall balance	0-2	1	2	3	
Structure of negotiations within government	N1	Application of a constraint on fiscal totals	0-4	None	Debt to GDP	Debt to GDP and Deficit to GDP	Expen GDP c
	N2	Agenda setting for budget negotiations	0-4	Minister of Finances or cabinet collects bids from spending ministers	Minister of Finances or cabinet collects bids subject to guidelines	Cabinet decides on budget norms first	Minist propos norms on by
	N3	Scope of budget norms in the setting of the agenda	0-3	Expenditure or deficit	Specific	Broad and specific	Broad
	N4	Structure of negotiations	0-2	All cabinet members involved together	Multilateral	Bilateral	Betwe minist

Table A.1 (continued)

Stage	Symbol	Rule	Range	0	1	2	3
Structure of parliamentary process	P1	Amendments	0-1	Unlimited	Limited		
	P2	Amendments required to be offsetting	0-1	No	Yes		
	P3	Amendments can cause the fall of government	0-1	No	Yes		
	P4	All expenditures passed in one vote	0-2	Yes	Mixed	Votes chapter by chapter	
	P5	Global vote on total budget size	0-1	Final only	Initial		
Informativeness of the budget draft	I1	Special funds included	0-4	No	Some	Most	Yes, b budge
	I2	Budget submitted in one document	0-2	No	Recently yes	Yes	
	I3	Assessment of budget transparency by respondents	0-2	Hardly transparent	Not fully transparent	Fully transparent	
	I4	Link to national accounts	0-3	Not provided	Possible	Provided in separate	Direct
	I5	Government loans to non-government entities included in budget draft	0-2	No	Reported in separate document	Yes	

Table A.1 (continued)

Stage	Symbol	Rule	Range	0	1	2	3
Flexibility of budget execution	F1	Minister of Finances can block expenditures	0-1	No	Yes		
	F2	Spending ministers subject to cash limits	0-1	No	Yes		
	F3	Disbursement approval required from Minister of Finances or controller	0-1	No	Yes		
	F4	Transfers of expenditures between chapters	0-5	Unrestricted	Limited	Require consent of Minister of Finances	Requi parlia
	F5	Change in budget law during execution	0-4	At discretion of government	By new law which is regularly submitted during fiscal year	At discretion of Minister of Finances	Requi Minist and pa
	F6	Carry-over of unused funds to next year	0-3	Unrestricted	Limited	Limited and requires authorization of Minister of Finances and parliament	Not po
Long-term planning constraint	L1	Target variable	0-2	None	Expenditures or revenues	Total budget size	
	L2	Planning horizon (years)	0-4	One	Two	Three	Four
	L3	Forecasting method	0-3	Ad hoc forecast	Fixed forecast	Updated forecast, but not based on consistent macromodel	Updat consis macro
	L4	Degree of commitment	0-4	None	Internal orientation	Indicative	Weak

Source: von Hagen (1992); De Haan Moessen and Volkerkink (1999).

Table A.2

Summary of budget rules in the EU countries

Stage	Symbol	Rule	Range	Decade	0	1	2
Organization of general government	O1	N. of government levels	0-3	1980s	FRA, SPA	BEL, DEN, GER, ITA, NET, SWE	GRE, POR
				1990s	FRA, SPA	BEL, DEN, GER, ITA, NET	GRE, POR, SWE
	O2	Local government balances the budget	0-3	1980s	IRL, ITA, POR, SPA, SWE	BEL, GRE	DEN, FRA
				1990s	IRL, ITA, POR,SPA	GRE	DEN, FRA,
	O3	Local government needs authorization to borrow	0-1	1980s	GER, IRL, NET, POR, SPA, SWE, UK	BEL, DEN, FRA, GRA, ITA	
				1990s	GER, IRL, NET, POR, SPA, UK	BEL, DEN, FRA, GRE, ITA, SWE	
	O4	Local government has planning autonomy	0-3	1980s	IRL, POR, SPA, SWE	BEL, DEN, GER, NET	FRA, ITA, UK
				1990s	POR, SPA, SWE	BEL, DEN, GER, NET	FRA, IRL, ITA, UK
	O5	N. of ministries involved in draft of overall balance	0-2	1980s	BEL, GRE,	FRA, GER, IRL, NET, SPA, SWE, UK	DEN, ITA, POR
				1990s	BEL, GRE	FRA, GER, IRL, NET, SPA, SWE, UK	DEN, ITA, POR,

Table A.2 (continued)

Stage	Symbol	Rule	Range	Decade	0	1	2
Structure of negotiations within government	N1	Application of a constraint on fiscal totals	0-4	1980s	BEL, GRE, SPA, SWE	NET, POR	IRL, ITA
				1990s	GRE, SPA	NET, POR	BEL, IRL, ITA
	N2	Agenda setting for budget negotiations	0-4	1980s	BEL, GER, GRE, IRL, ITA, SWE	POR, SPA	DEN, NET, UK
				1990s	BEL, GER, GRE, IRL, ITA	POR, SPA	DEN, UK
	N3	Scope of budget norms in the setting of the agenda	0-3	1980s	GRE, IRL, SWE	BEL, DEN,	ITA, NET, POR
				1990s	GRE, IRL	BEL, DEN	ITA, NET, POR
	N4	Structure of negotiations	0-2	1980s	BEL, GRE, IRL, SPA	ITA	DEN, FRA, GER, NET, POR, SWE, UK
				1990s	GRE, SPA		BEL, DEN, FRA, GER, IRL, ITA, NET, POR, SWE, UK

Table A.2 (continued)

Stage	Symbol	Rule	Range	Decade	0	1	2
Structure of parliamentary process	P1	Amendments	0-1	1980s	BEL, DEN, GER, GRE, POR, SWE	FRA, IRL, ITA, NET, SPA, UK	
				1990s	DEN, GER, GRE, POR, SWE	BEL, FRA, IRL, ITA, NET, SPA, UK	
	P2	Amendments required to be offsetting	0-1	1980s	BEL, GER, GRE, IRL, ITA, NET, POR, SPA, SWE, UK	DEN, FRA	
				1990s	BEL, GER, GRE, NET, POR, SPA, UK	DEN, FRA, IRL, ITA, SWE	
	P3	Amendments can cause the fall of government	0-1	1980s	BEL, ITA, SPA	DEN, FRA, GER, IRL, NET, POR, SWE, UK	
				1990s	BEL, GRE, POR	DEN, FRA, GER, IRL, ITA, NET, POR, SWE, UK	
	P4	All expenditures passed in one vote	0-2	1980s	BEL, GER, GRE, IRL, POR, SPA	FRA, ITA	DEN, NET, SPA, UK
				1990s	GER, GRE, POR, SPA	FRA, ITA	BEL, DEN, IRL, NET, SWE, UK
	P5	Global vote on total budget size	0-1	1980s	BEL, DEN, GER, GRE, IRL, ITA, POR, SPA, SWE	NET	FRA, UK
				1990s	BEL, DEN, GER, GRE, IRL, POR, SPA	NET	FRA, ITA, SWE, UK

Table A.2 (continued)

Stage	Symbol	Rule	Range	Decade	0	1	2
Informativeness of the budget draft	I1	Special funds included	0-4	1980s	POR	IRL, ITA, SWE	BEL, DEN,
				1990s	POR	IRL	DEN
	I2	Budget submitted in one document	0-2	1980s	BEL, GRE, IRL, ITA, SWE, UK	DEN, FRA, GER, NET, POR, SPA	
				1990s	GRE, IRL, ITA, UK	BEL, DEN, IRL, NET, POR, SPA	
	I3	Assessment of budget transparency by respondents	0-2	1980s	ITA	BEL, DEN, IRL, NET, POR, SPA, SWE	FRA, GER, GRE, UK
				1990s	ITA	BEL, DEN, IRL, NET, POR, SPA	FRA, GER, GRE, SWE UK
	I4	Link to national accounts	0-3	1980s	BEL, IRL, ITA, SWE	DEN, GRE, POR, SPA	FRA
				1990s	ITA	DEN, GRE, POR	BEL, FRA, SWE
	I5	Government loans to non-government entities included in budget draft	0-2	1980s	ITA, POR	GER, GRE, IRL, SWE	BEL, DEN, FRA, NET, SPA, UK
				1990s	POR	GER, GRE, IRL	BEL, DEN, FRA, ITA, NET, SPA, SWE, UK

Table A.2 (continued)

Stage	Symbol	Rule	Range	Decade	0	1	2
Flexibility of budget execution	F1	Minister of Finances can block expenditures		1980s	BEL, DEN, IRL, ITA, NET, POR, SPA, SWE, UK	FRA, GER, GRE,	
				1990s	DEN, ITA, NET, POR, SPA, SWE, UK	BEL, FRA, GER, GRE, IRL	
	F2	Spending ministers subject to cash limits		1980S	BEL, IRL, ITA, SPA, SWE, UK	DEN, FRA, GER, GRE, POR, UK	
				1990S	IRL, ITA, SPA, SWE, UK	BEL, DEN, FRA, GER, GRE, POR, SWE, UK	
	F3	Disbursement approval required from Minister of Finances or controller		1980s	DEN, GER, GRE, IRL, ITA, SPA, SWE, UK	BEL, FRA, GER, NET, POR	
				1990S	DEN, GRE, ITA, SPA, SWE, UK	BEL, FRA, GER, IRL, NET, POR	
	F4	Transfers of expenditures between chapters		1980s	ITA, NET, POR	SPA	GER, GRE
				1990S	NET, POR	SPA	GER, GRE
	F5	Change in budget law during execution		1980s	NET	ITA	GRE
				1990S	NET	ITA	GRE
	F6	Carry-over of unused funds to next year		1980s	BEL, DEN, ITA	FRA, NET, SPA, SWE, UK	GER, POR
				1990S	DEN	FRA, NET, SPA, UK	BEL, GER, ITA, POR, SWE

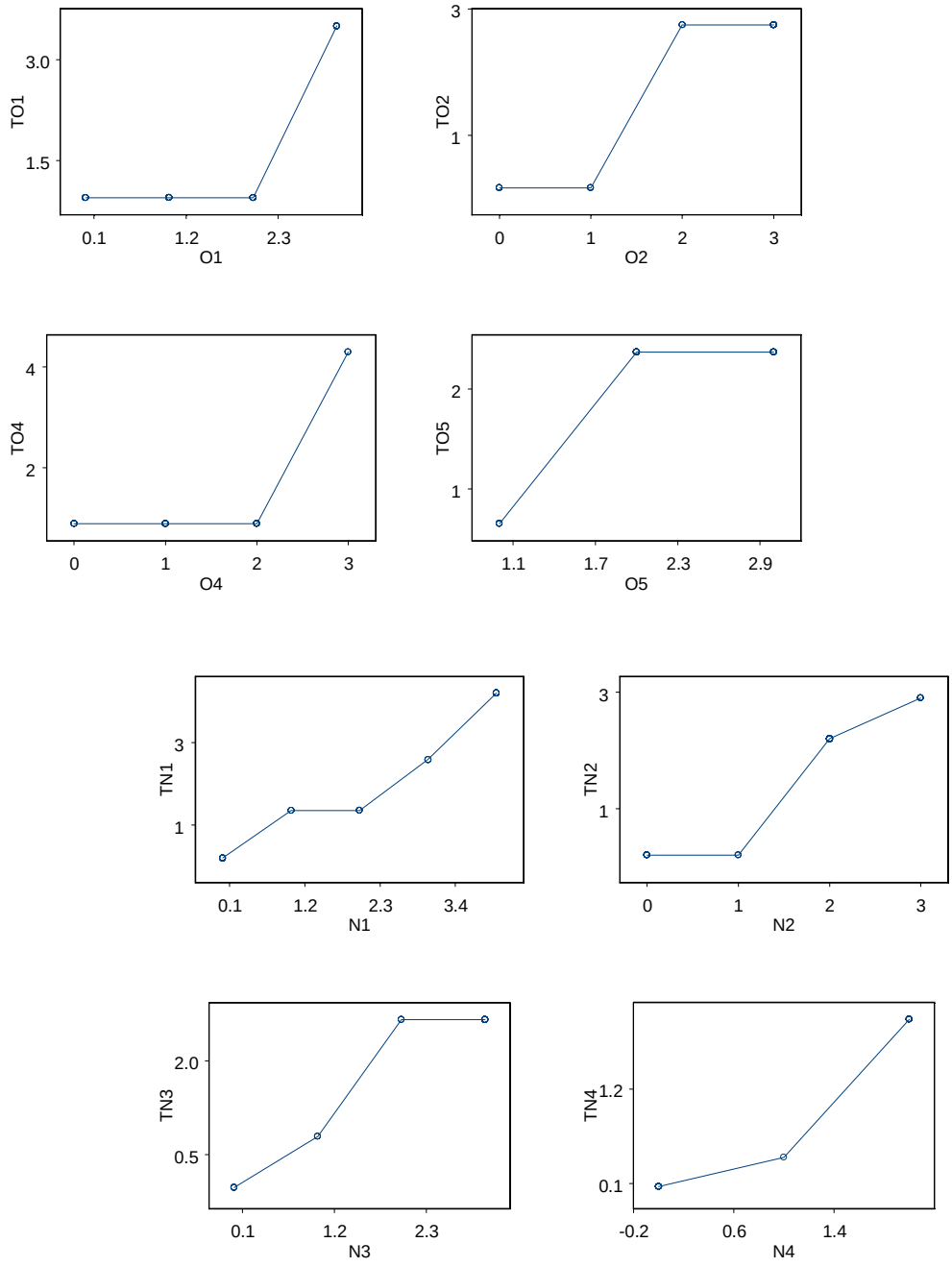
Table A.2 (continued)

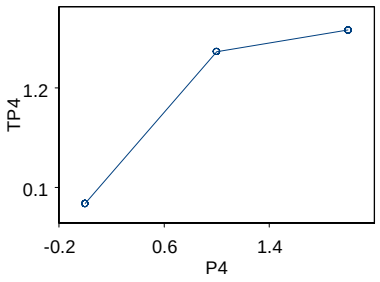
Stage	Symbol	Rule	Range	Decade	0	1	2
Long-term planning constraint	L1	Target variable		1980s	BEL, FRA, GRE, ITA, POR, SPA, SWE	DEN, UK	GER, IRL, NET
				1990S	BEL, FRA, GRE, POR, SPA,	DEN, UK	GER, IRL, ITA, SWE
	L2	Planning horizon (years)		1980s	BEL	FRA, SWE	DEN, GRE
				1990S	BEL	FRA	DEN, GRE
	L3	Forecasting method		1980s	BEL	FRA, GRE, IRL, ITA, POR, SPA, SWE	DEN, NET
				1990S	BEL	FRA, GRE, IRL, ITA, POR, SPA	DEN, NET
	L4	Degree of commitment		1980s	BEL	FRA, SPA, SWE	DEN, GRE, POR
				1990S		FRA, SPA	DEN, GRE, POR

Source: von Hagen (1992); De Haan Moessen and Volkerkink (1999).

APPENDIX B

Graph b1: NLPCA transformations of budget rules scores

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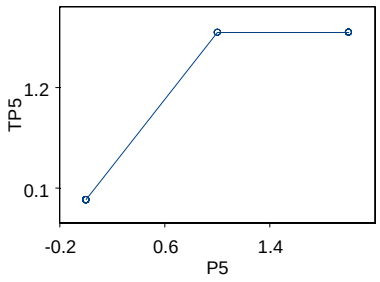
0.1
-0.2
0.6
1.4
P4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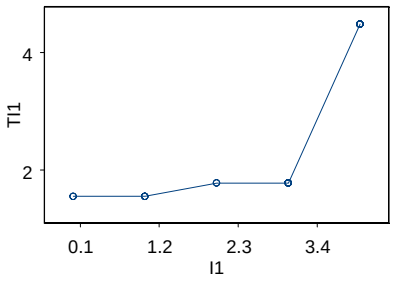
0.6
1.4
P5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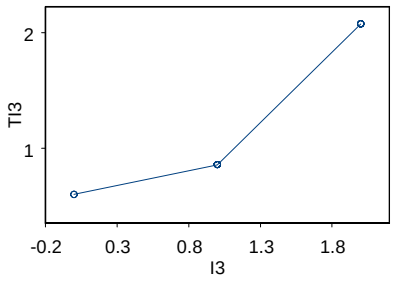
4
2
0.1
1.2
2.3
3.4
I1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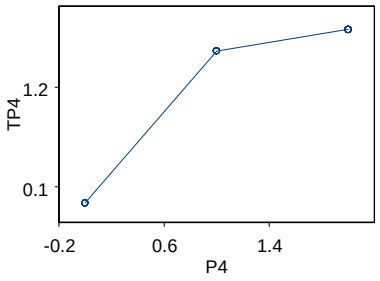
0.3
0.8
1.3
1.8
I3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0.1
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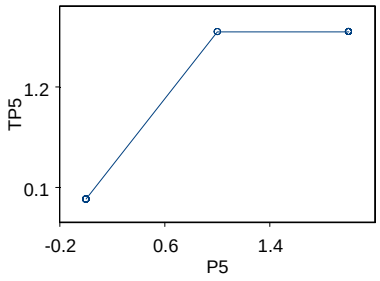
0.6
1.4
P4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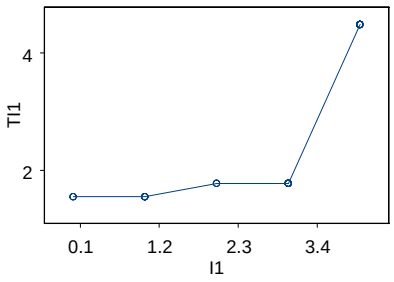
0.6
1.4
P5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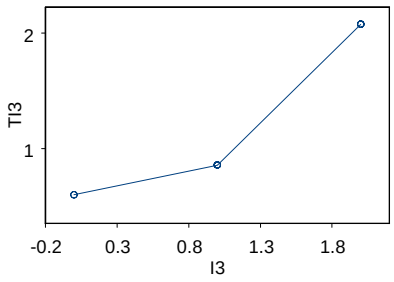
2
0.1
1.2
2.3
3.4
I1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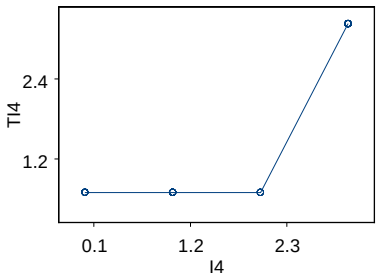
2
1
-0.2
0.3
0.8
1.3
1.8
I3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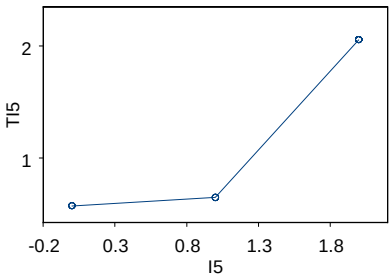
1.2
0.1
1.2
2.3
I4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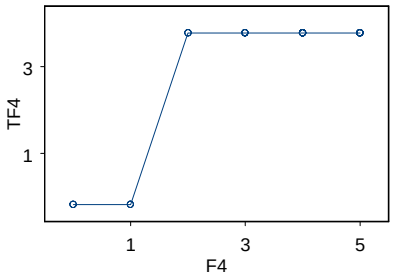
1
-0.2
0.3
0.8
1.3
1.8
I5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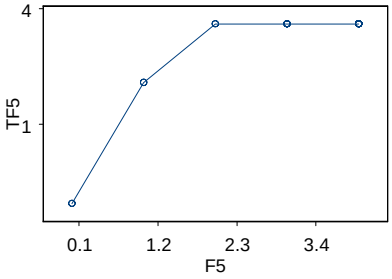
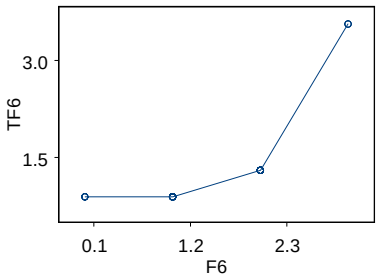
3
1
1
3
5
F4


TF5
4
1
0.1
1.2
2.3
3.4
F5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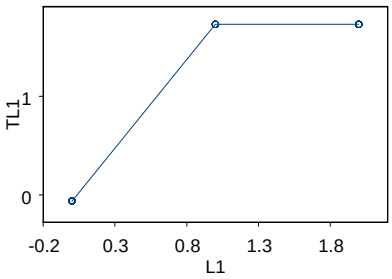
3.0
1.5
0.1
1.2
2.3
F6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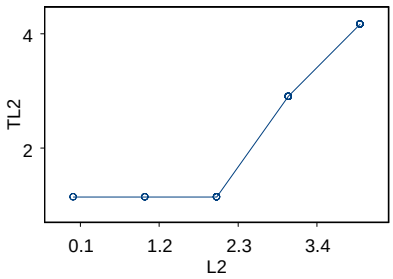
1
0
-0.2
0.3
0.8
1.3
1.8
L1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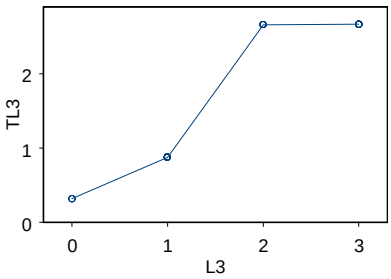
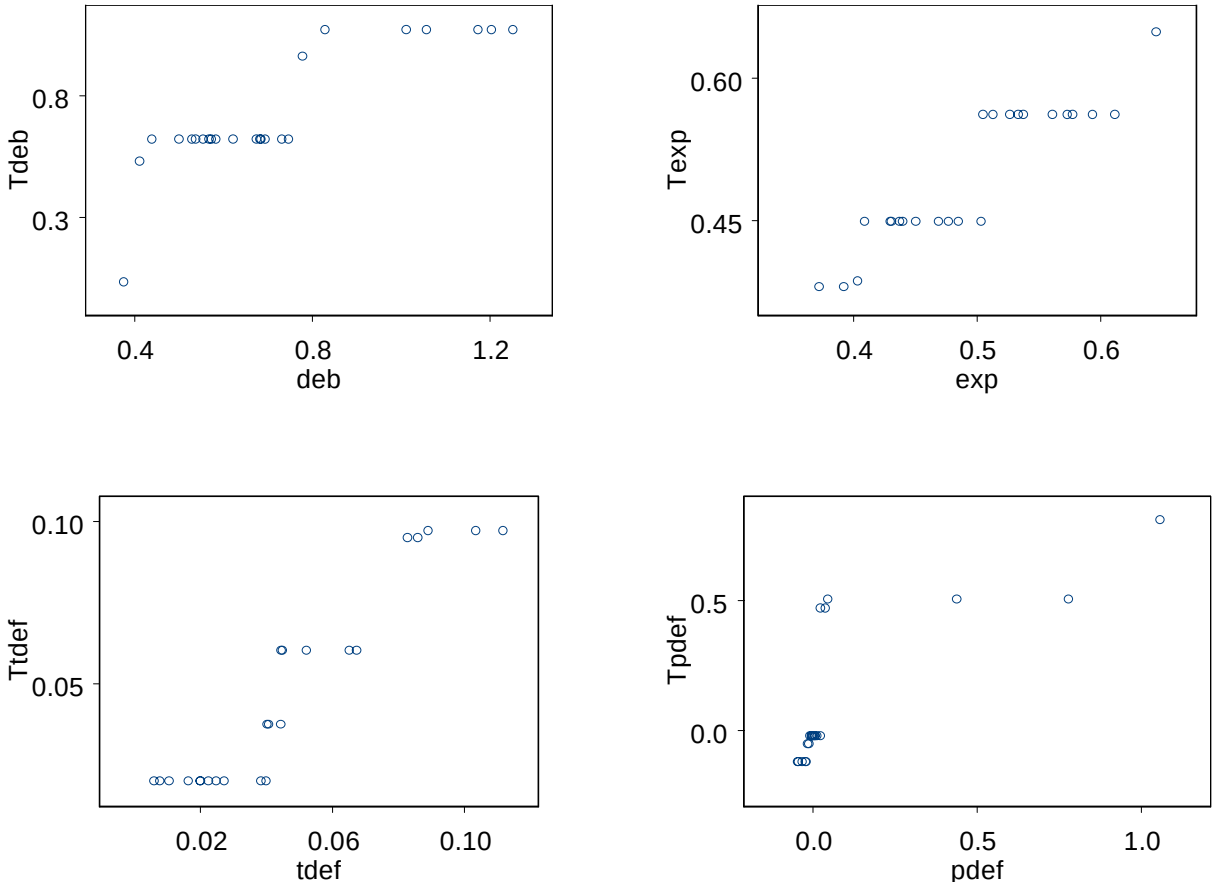
2
0.1
1.2
2.3
3.4
L2


TL3
2
1
0
0
1
2
3
L3

Graph b2: NLPCA transformations of fiscal variables



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