Asymmetric and Non-Linear Adjustments in Local Fiscal Policy

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Abstract

We analyse the revenue-expenditure patterns of local governments, allowing for asymmetric and non-linear adjustments of local spending and taxation to disequilibrium errors. Our results provide evidence of a downward inflexibility of both local government spending and local taxation, pointing to a budget-maximising local government.

JEL Code: H10, H71, C22.

Keywords: fiscal federalism, fly-paper effect, non-linear time-series, asymmetric adjustment.

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1 Introduction

The focus on fiscal federalism and the potential role of local governments in disciplining an excessive growth of public expenditure, has considerably increased in the recent years, following a remarkable growth of the public sector in industrialized countries. The debate on fiscal federalism is even more pressing for the European Monetary Union member countries, given the budgetary constraints they are subject to.

Traditional public finance analysis emphasizes the advantages of fiscal decentralization, as local governments have an informational advantage on central governments with respect to local costs and demand conditions, allowing them, under some conditions, to better satisfy local demands and deliver public services at a lower cost for public funds (see on this, Oates 1972, 1999). On the other hand, second generation models of fiscal federalism point to the existence of conflicting objectives between local and central governments, casting some doubts on the effectiveness of fiscal decentralisation (Oates, 2005). Besley and Coate (2003), in particular, introduce a political economy model where the conflict of interests between central and local administrations results in excessive spending by local governments. The soft-budget constraint of local governments is also analysed in Kornai *et al.* (2003).

In the light of the discussion above, it becomes very important to analyse more in detail the relationships among the spending and taxing decisions of local governments and the level of transfers received from higher levels of government. For this purpose, the empirical analysis on the revenues-expenditure patterns of local governments is traditionally based on the implicit assumption of symmetry: e.g. local expenditure is expected to increase and decrease symmetrically

following changes in unconditional transfers received and own resources. To the best of our knowledge, very few studies have considered possible asymmetries and non-linearities in local fiscal policy, as in Gamkar and Oates (1996), Stine (1994) and Heyndels (2001).

Using annual time-series data for Italian municipalities, our paper examines the relationship between local revenues and expenditures in a non-linear framework. The analysis of Italy is of particular interest, not only because Italy is an EMU country, but also because it introduced some important reforms, where the country initially strenghtened its centralisation process, only to subsequently enhance the delegation of spending powers to local authorities.

There are two main differences between our paper and the studies mentioned above. First, we use the Johansen (1988, 1995) multivariate cointegration technique, which allows for long-run properties and short-run dynamics of local expenditure, taxation and state transfers to be jointly analyzed, allowing for possible endogeneity of the variables[1]. Second, we allow for asymmetric and non-linear adjustment to disequilibrium deviations of the fiscal variables from their equilibrium levels, following the methodology introduced by Escribano and Granger (1998).

We find evidence of a "strong" fly-paper effect, in the form of a high transfer-elasticity of local spending, associated with an insignificant long-run effect of local taxation. This means that local spending is ultimately driven only by the size of transfers received, regardless of the ability of local governments to raise revenues from their own resources.

The adoption of non-linear modelling allows us to report asymmetric ad-

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[1] Knight (2002) argues that transfers are the result of a political bargaining process and therefore should be considered as endogenous.

justment, in the form of downward inflexibility of both local expenditure and taxation. When local expenditure is below its equilibrium level with transfers, it raises relatively fast, while when it is below, its reduction is not statistically significant. In the case of municipal taxation, taxes raise faster when they are below their equilibrium level, than they reduce when they are above.

Our empirical results therefore point to the existence of a budget-maximising local government, questioning the opportunity of further delegation of spending powers to local governments, when unaccompanied by a corresponding increase in their fiscal responsibility and control over local spending.

The paper is organized as follows; the next section presents a short survey of the economic literature on the local revenue-expenditure models. Section 3 estimates the long-run relationships among local expenditure, transfers and taxes whereas section 4 reports the short-run equations allowing for asymmetric and non-linear adjustment. Finally, section 5 provides some concluding remarks and suggestions for further research.

2   Local Revenue-Expenditure Models and the Fly-Paper Effect.

Traditional economic literature on the revenue-expenditure patterns of local governments has emphasised the existence of a "fly-paper" effect[2]. The fly-paper effect refers to the empirical regularity that the transfers-elasticity of local expenditure is higher than its own-resources elasticity. It is important to consider that the fly-paper effect is not an anomaly[3] within the rational choice, as argued by Hines-Thaler (1995), but, instead, it is a signal that local and central

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[2] The term "flypaper" is derived from the well-known remark by Arthur Okun that "money sticks where it hits".

[3] See on this Roemer and Silvestre, 2002.

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governments might have different (and potentially conflicting) objectives. This happens because fiscal discipline at a general government level has the characteristics of a non-excludable public good[4]. As a consequence, there is a common pool problem where local governments are incentived to overspend, to promote the interests of the local citizens/taxpayers, in the case of a responsive government, or of their elected politicians/bureaucrats in the case of a Leviathan-type of government[5].

The costs of the fly-paper effect (state transfers to cover local fiscal unbalances, given the soft-budget constraint of local governments) will be shared at a national level, while its advantages will be internalized by the single jurisdictions. If the fly-paper holds, delegation of spending powers to local jurisdictions, unaccompanied by a corresponding increase in their fiscal responsibilities, will have the effect of expanding rather than contracting public sector size (Legrenzi 2000, Milas-Legrenzi 2002), as local governments are incentived to free-ride on the national fiscal discipline.

The fly-paper effect has received considerable empirical support in the literature (Hines and Thaler 1995), but has generally being analysed under the assumption of symmetry.

Under the hypothesis of symmetry, the local government reduces its expenditures in response to reductions in transfers received, whereas in the presence of asymmetries, the local government might decide to enhance its capacity to raise revenues, in order to keep unchanged the level of local expenditure. This is the so-called positive fiscal replacement hypothesis, and it is empirically supported

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[4]At a general government level, the fiscal discipline can be identified in the compliance to Maastricht and Amsterdam criteria for the EMU, while at a local level there is no such definition, although a local balanced budget would be desirable to achieve the nation's budgetary objectives.

[5]For further information on the distinction between "responsive" and "excessive" government, see Buchanan (1977) and Legrenzi and Milas (2002).

by Gramlich (1987), for the US. On the other hand, Paine and Stine (1994) identify a "super flypaper" effect for a panel of Pennsylvania counties: when grants are cut, own revenues also fall, resulting in a negative fiscal replacement. The findings of Gamkar and Oates (1996) for the US suggest that the flypaper effect operates in both directions, providing no support in favor of asymmetric behavior.

On the other hand, non-linearities may arise if the fiscal authorities react differently to deviations of state transfers from their equilibrium level. For instance, the local authorities may be more willing to raise taxes rapidly when they are below their equilibrium level with respect to transfers, rather than lowering taxes rapidly when these are above their long-run level.

In the context of the European Stability and Growth Pact, testing for asymmetries and non-linearities in the revenue-expenditure models becomes increasingly important for economic policy purposes, in order to evaluate reforms in the transfer system and the effectiveness of decentralization in constraining the growth of government spending.

3   The Empirical Model.

We base our empirical analysis on the Italian municipalites. Italy is a member country of the European Monetary Union with a typically high level of public debt (around 122% of GDP in 2006), a high deficit (4.6% of GDP in 2006[6]), for which the control of public spending is particularly important. Increasing the authonomy of local governments is highly debated in the political arena, as a possible solution to constrain public expenditure growth. The financing of

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[6] The data on the Italian deficit and debt are taken from the 2005 *Annual Report* of the Italian Central Bank (Banca d'Italia).

local expenditure is heavily reliant on transfer-financing from the state, and the Italian Constitution links the levels of transfers granted to local governments to their "financing needs".

Italian municipalities are the lowest level of local government in Italy, being therefore closer both to the local preferences and the local costs conditions, with respect to the central government. They enjoy some degree of fiscal autonomy, setting their own property taxes, and are responsible for the local public services provision (transport and public utilities)[7]. Another advantage deriving from the choice of the Italian municipalities derives from the policy switches in their fiscal autonomy. The 1973 reform limited the taxing powers of the Italian municipalities, on the grounds of the higher efficiency of a centralised tax collection system. On the other hand, the reforms of the 1990s enhanced the taxing powers of municipalities, increasing their autonomy, on the belief that this would help constraining the public expenditure and help the country to respect the EMU requirements[8]. An Internal Stability Pact was introduced in 1999, requiring to extend to local governments the European Stability Pact requirements, in the annual Budget Law. [9]

Our sample consists of annual observations over the 1955-2003[10] period, and is taken from the Italian official statistics from ISTAT, in real terms. G measures the expenditures of the Italian municipalities, TR the transfers received from higher levels of government, and TAX the municipal taxation.

All the variables are expressed in logs. We chose annual data on the grounds of the annual frequency of the budgetary choices of local governments. Higher

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[7]For more detailed information on the competencies of the Italian municipalities, see Legrenzi (2000).

[8]For further information and analysis on the Italian reforms, see OECD (2005).

[9]For a critical review on the reforms of the Italian fiscal federalism, see Bordignon (2004).

[10]The year 2003 is the latest available in the national statistics. The data from 2001 onwards are nevertheless provisional.

frequency data will give us more degrees of freedom, but, nevertheless, will bias the analysis, given the annuality of the municipal budgets[11].

Levels and first differences of the variables are plotted in Figure 1.

Preliminary analysis of the time-series properties of the data suggested that all variables are non-stationary in levels[12] . Given the possible endogeneity among the variables in question, we employ the Johansen approach to cointegration. Following Johansen (1988, 1995), we write a p-dimensional vector error correction model as:

$$\Delta y_t = \sum_{i=1}^{k-1} \Gamma_i \Delta y_{t-1} + \Pi y_{t-1} + \mu + \varepsilon_t \tag{1}$$

where $y_t = [G, TR, TAX]\prime$ is the set of non-stationary I(1) variables discussed above, $\varepsilon_t \sim niid(0, \Sigma)$, μ is a drift parameter, and Π is a $(p * p)$ matrix of the form $\Pi = \alpha\beta'$, where α and β are $(p * r)$ matrices of full column rank, with β containing the r cointegrating vectors and α carrying the corresponding loadings in each of the r vectors.

Allowing for an unrestricted intercept term and a lag length of k = 1 in the VAR model[13], Table 1 reports the λ-max and the λ-trace test statistics for cointegration together with their corresponding 95% critical values (calculations are done in Microfit 4.1; see Pesaran and Pesaran, 1997, and in E-views 5.1). The empirical results provide evidence of two cointegrating vectors, which is stronger for the λ-max rather than the λ-trace statistic. We consequently proceed by assuming the existence of two cointegrating vectors. For exact iden-

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[11] A further difficulty arises since the municipal fiscal year does not coincide with the calendar year, which forms the basis of the municipal data collection.

[12] Results are available on request.

[13] The k=1 is chosen by both the Schwarz information criterion and by the Hannan-Quinn information criterion. The Akaike would have supported a lag lenght of 3. Given the small sample considered, we set k=1 to avoid the loss of too many degrees of freedom.

tification we impose a unit coefficient on municipal expenditure ($\beta_{11} = 1$) and a zero coefficient on taxes ($\beta_{13} = 0$) in the first vector, and a unit coefficient on municipal taxation ($\beta_{23} = 1$) and a zero coefficient on municipal expenditure ($\beta_{21} = 0$)in the second one. These restrictions are justified on the grounds that, given the possibility of one cointegrating vector based on the $\lambda - trace$ statistics, we also normalized on G and tested for zero long-run effects from taxes within one cointegrating vector. This hypothesis was not rejected at conventional levels of statistical significance[14]. This result motivates the exclusion of taxes from the first cointegrating vector as a valid identifying restriction. We have also tested for weak exogeneity of transfers for the rest of the system. This is a test on the adjustment (alpha, α) coefficient on TR in the two cointegrating vectors. The test is a Likelihood Ratio (LR) test distributed as a $\chi^2(2)$ under the null, giving a value of 4.204, which is insignificant at the 5 percent level (p-value = 0.122). In statistical terms, weak exogeneity of transfers implies that we can proceed by estimating short-run equations for G and TAX conditioning on TR without loss of any significant information. In economic terms, conditioning on transfers has the interpretation that within current local government fiscal policy decision-making, state transfers are exogenous, confirming our normalization choice.

Imposing the restrictions discussed above yields the following restricted cointegrating vectors:

$$G = 0.71 \ TR \ (\text{s.e.} = .02) \tag{2}$$

and

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[14] Results are available on request.

$$TAX = 0.50\ TR \text{ (s.e.=.03)} \qquad\qquad (3)$$

The highly positive coefficient of transfers in the first vector confirms the existence of a fly-paper effect: a 10% increase in state transfers raises municipal expenditure by 7%. The irrelevance of municipal taxation in determining local expenditure represents a peculiarity of the Italian municipalities, which we consider to be a "strong" version of the fly-paper effect. This means that the long-run equilibrium values of local expenditure are entirely driven by the level of transfers received from higher levels of government.

The second cointegrating vector describes the relationship between local taxation and state transfers. Local taxation in the long-run is expected to increase by 5% in response to a 10% increase in state transfers. This means that increases in state transfers do not bring tax relief to the community. In addition to the long-run analysis, further useful insight to understand the spending and taxing decisions of the Italian municipalities is provided in the short-run analysis below.

4 Short-run adjustments of local taxes and spending.

Having verified the existence of a long-run equilibrium among the local fiscal policy variables, we model their short-run adjustments conditioning on transfers. The two cointegrating vectors given by equations (2) and (3) above are denoted by CV_1 and CV_2, respectively. We initially estimate a linear error-correction model for local expenditure and local taxation and subsequently test for possible non-linearities. In case where the null of linear adjustment is rejected, we proceed by estimating non-linear error-correction models.

Various authors have examined non-linearities in the behavior of error correction models (see e.g. Granger and Lee, 1989; Escribano and Pfann, 1998; Escribano and Granger 1998; and Escribano and Aparicio, 1999, among others). In particular, Granger and Lee (1989) partition the error correction term into its positive and negative components, and feed them back into the short-run dynamic equation. The idea here is to test for different speed of adjustments depending on whether the fiscal variables are above or below their unique (at the zero point) equilibrium. However, imposing a unique equilibrium around zero may be too restrictive. In order to relax this assumption, Escribano and Granger (1998) and Escribano and Aparicio (1999) among others, use a cubic error correction term. This type of nonlinear adjustment is more flexible than the Granger and Lee (1989) type of asymmetric adjustment as it allows for the possibility of more than one equilibrium point. This type of non-linear adjustment also allows for a faster adjustment when deviations from the equilibrium level get larger.

4.1 Short-run adjustments of municipal expenditure.

We initially estimate the error correction model on the assumption of linear response of municipal expenditure with respect to increases and decreases of State transfers from their equilibrium value. The model estimated is therefore:

$$\Delta G_t = C + \beta_1 \Delta TAX_t + \beta_2 \Delta TR_t + \beta_3 CV_{t-1}^1 + u_t \tag{4}$$

We also considered an EMU dummy, taking the value of 1 from 1993 onwards, to capture the impact of the European Monetary Union, and a centralisation dummy, taking the value of 1 between 1973 and 1990, to capture the centralisation of tax collection under the 1973 reform. The Internal Stability Pact

is captured by a dummy taking the value of 1 from 1999 onwards. All these variables were statistically insignificant in all models.

Regression results are reported in Table 2(i). The linear model is rather poor, failing most of the diagnostic tests. This might be due to omitted non-linearities. To detect this, we initially test for linearity in the residuals of the error correction model. We apply the well known Brock, Dechert and Sheinkman (1996, thereafter BDS) test statistic. Under the null hypothesis of linearity in the residuals, the BDS test follows the normal distribution whereas rejection of the null implies an unspecified non-linear structure[15]. Based on the p-values associated with the BDS test, the results in Table 3 suggest the presence of non-linear structure in the residuals of the error correction model.

Table 2 (columns (ii) and (iii)) reports the error correction equation based on different types of non-linear adjustment. First, as in Granger and Lee (1989), we take the deviations of lagged CV_1 around its mean value, and partition them into their positive and negative components (denoted by CV_1^+ and CV_1^-, respectively). Then, as in Escribano and Granger (1998) and Escribano and Aparicio (1999), we estimate a cubic error correction model. More specifically, we allow for lagged CV_1^2 and CV_1^3 to enter the short-run equation. The asymmetric model takes the form:

$$\Delta G_t = C + \theta_1 \Delta TAX_t + \theta_2 \Delta TR_t + \theta_3 CV_{1,t-1}^+ + \theta_4 CV_{1,t-1}^- + z_t \qquad (5)$$

The non-linear model takes the form:

$$\Delta G_t = C + \gamma_1 \Delta TAX_t + \gamma_2 \Delta TR_t + \gamma_3 CV_{1,t-1} + \gamma_4 CV_{1,t-1}^2 + \gamma_5 CV_{1,t-1}^3 + e_t \quad (6)$$

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[15] Several non-linearity tests exist in the literature. However, as Ashley and Patterson (2001, p.20) point out, the BDS test is the best among different tests for use as a non-linearity screening test.

The results in Table 2(ii) show the presence of an asymmetric adjustment for local expenditure that relies on a downward inflexibility of this fiscal policy variable. Indeed, the coefficient associated with the lagged value of CV_1^+ is statistically insignificant. This means that when local expenditure is below its equilibrium level with state transfers, it increases relatively fast, whereas when it is above its equilibrium, its reduction is not statistically significant.

The non-linear ECM results, in Table 2(iii), provides some evidence of possible non-linearities in the adjustment of local expenditure, given the statistical significance at a 90% confidence level of the CV_1^2 (but not the CV_1^3) regressor. Therefore, there is some evidence of a faster adjustment when deviations from the equilibrium level get larger.

Next, we plot the asymmetric and non-linear types of adjustment against CV_1 (see Figure 2 and Figure 3, respectively). From Figure 2 there is evidence of asymmetric adjustment as the cross-plot is far from being a straight line. The plot of the nonlinear cubic polynomial in Figure 3 suggests the existence of asymmetric adjustment around a unique equilibrium point.

The recursive estimates of the asymmetric ECM for local spending, in Figure 6, verify the insignificance of CV_1^+ as the estimates $\pm$ the 2 standard error bands always include zero. On the other hand, the recursive estimates for CV_1^- suggest that the asymmetry gets stronger over time, in the sense that the point estimate starts from around -0.18 to reach -0.25 at the end of the sample.

4.2 Short-run adjustments of the local taxation.

We now report the ECM model for local taxation, allowing for possible non-linear and asymmetric behaviour. Results are reported in Table 4. As for local spending, we perform a BDS test on the residuals of the linear ECM. Based on

the p-values associated with the BDS test, the results in Table 5 strongly suggest the presence of non-linear structure in the residuals of the error correction model for ΔTAX. Table 4(ii) and 4(iii) report the estimated error correction equation, based on the different types of non-linear adjustment discussed earlier. The CV_2^+, CV_2^-, CV_2^2 and CV_2^3 variables are constructed in the same way as the corresponding CV_1 regressors.

The results in Table 4(ii) demonstrate the presence of an asymmetric adjustment for local taxation that relies on a downward inflexibility of this fiscal policy variable. Indeed, the coefficient associated with the lagged value of CV_2^+ (i.e. -0.01) is lower than the coefficient on CV_2^- (i.e. -0.30), and it is also statistically insignificant. This means that when local taxes are below their equilibrium level with respect to state transfers, they increase relatively fast, whereas when they are above their equilibrium, they fall relatively slowly.

The non-linear ECM results in table 4(iii) show the existence of possible non-linearities in the adjustment of local taxes, backed by the statistical significance of the CV_2^2 (but not the CV_2^3) regressors. Therefore there is evidence of faster adjustment when deviations from the equilibrium level get larger.

Next, we plot the asymmetric and non-linear types of adjustment against CV_2 (see Figure 4 and Figure 5, respectively). From Figure 4 there is evidence of asymmetric adjustment as the cross-plot is far from being a straight line. The plot of the nonlinear cubic polynomial in Figure 5 suggests the existence of one equilibrium.

The recursively estimated coefficients of the asymetric ECM for local taxation, plotted in Figure 7, show that the effect of the asymmetry is stable over time.

Overall, our results point to some form of budget-maximising behaviour

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by the Italian local governments, that the different reforms have so far been unable to tackle. A stronger link between municipal expenditure and municipal taxation, as well as spending and transfers reforms will be needed in order for decentralisation to effectively constrain the growth of government spending in Italy.

However, some caution must be taken when interpreting the results above. The use of aggregate data has the effect of lumping together the responses of all Italian municipalities, and therefore, the estimated response could reflect some mixture of symmetric and asymmetric coefficients (Gamkhar and Oates, 1996). Further, the degree of asymmetry might also depend on some characteristics of the local jurisdictions, that cannot be captured by the aggregate data (Gamkar and Oates, 1996). Territorial distinctions can also be relevant for Italy, given the importance of state transfers to southern areas (see also OECD, 2005). On the other hand, as our main focus is on the macro-economic impact of local fiscal policy, the use of aggregate data is necessary to assess the macro-asymmetries in the local revenue-expenditure models.

5   Conclusions

This paper models the local revenue-expenditure relationship in the case of Italian municipalities, using both linear and non-linear cointegrating techniques.

The long-run analysis shows the absence of a direct link between local expenditure and taxation, as local spending is entirely driven by the amount of transfers received by the central government. The short-run asymmetric model shows evidence of revenue-maximising behaviour by local governments, driven by the downward inflexibility of both local expenditure and taxation.

These results have important economic policy implications. First, the del-

egation to local governments of further power to spend should be attached to a higher level of fiscal responsibility, that is linking local expenditure to local taxation, in order for local governments to face an effective budget constraint. If this were not the case, the decentralization of public expenditure might provide the undesired outcome of an expansion rather than contraction in public sector size, given the downward inflexibility of both the local fiscal policy variables.

Further, the downward inflexibility of local expenditure appears to be a relevant problem in this context, that so far has not been explicitly tackled by the different reforms, evidenced by the insignificance of the policy dummies as well by the analysis of the recursively estimated asymmetric ECM coefficients.

There are at least two possible extensions of our analysis. First, territorial and dimensional differences might be captured within a panel data model of Italian municipalities. Second, it would be interesting to introduce and estimate a two-regime smooth transition autoregression model (STAR, see e.g. Granger and Terasvirta, 1993), where adjustment takes place in every period but the speed of adjustment varies on whether disequilibrium deviations are large or small. These issues can be addressed in future research.

References

[1] Ashley, R.A. and D.M. Patterson (2001). "Nonlinear Model Specification/Diagnostics: Insights from a Battery of Nonlinearity Tests", *Economics Department Working Paper* E99-05, VirginiaTech.

[2] Besley T. and Coate S. (2003). "Centralized versus Decentralized Provision of Local Public Goods: a Political Economy Approach", *Journal of Public Economics* 87: 2611-2637.

[3] Bordignon M. (2004), "Fiscal Decentralization: How to Harden the Budget Constraint", paper presneted st the Worksho "Fiscal Surveillance in EMU: New Issues and Challenges", Bruxelles, Novemner 2004.

[4] Brock, W.A., D.A. Hsieh and B.D. LeBaron (1991). *Nonlinear Dynamics, Chaos and Instability*, MIT Press, Cambridge.

[5] Brock, W.A., W. Dechert and J. Scheinkman (1996). A Test for Independence Based on the Correlation Dimension, *Econometric Reviews* 15: 197-235.

[6] Buchanan J.M. (1977) *Budgets and Bureaucrats: The Sources of Government Growth*, Duke University Press.

[7] Escribano, A. and F. Aparicio (1999). "Cointegration: Linearity, Nonlinearity, Outliers and Structural Breaks" in Dahiya, S.B. (ed), *The Current State of Economic Science*, Spellbound Publications, Vol 1, 383-407.

[8] Escribano, A. and C.W.J. Granger (1998). "Investigating the Relationship between Gold and Silver Prices". *Journal of Forecasting* 17: 81-107.

[9] Escribano, A. and G.A. Pfann (1998). "Nonlinear Error Correction, Asymmetric Adjustment and Cointegration". *Economic Modelling* 15: 197-216.

[10] Gamkhar S. and Oates W. (1996), "Asymmetries in the Response to Increases and Decreases in Intergovernmental Grants: Some Empirical Findings", *National Tax Journal* 49(4): 501-12.

[11] Gramlich E. M. (1987). "Federalism and Federal Deficit Reduction". *National Tax Journal* 40(3): 299-313.

[12] Granger, C.W.J. and T.H. Lee (1989). "Investigation of Production, Sales and Inventory Relationships Using Multicointegration and Non-symmetric Error Correction Models". *Journal of Applied Econometrics* 4: S145-S159.

[13] Granger, C.W.J. and T. Teräsvirta (1993). *Modelling Nonlinear Economic Relationships.* Oxford University Press, Oxford.

[14] Heyndels B. (2001). "Asymmetries in the Flypaper Effect: Empirical Evidence for the Flemish Municipalities", *Applied Economics*, 33, 1329-1334.

[15] Hines J.R. and Thaler R.H. (1995), " The Fly-Paper Effect", *Journal of Economic Perspectives*, 9(4), pp.217-226.

[16] Johansen, S. (1988). Statistical Analysis of Cointegration Vectors. *Journal of Economic Dynamics and Control*: 12, 231-254.

[17] Johansen, S. (1995). *Likelihood-based inference in cointegrated vector autoregressive models.* Oxford University Press, Oxford.

[18] Knight B. (2002), "Endogenous Federal Grants and Crowd-Out of State Government Spending: Theory and Evidence from the Federal Highway Aid Program", *American Economic Review*, 92(1), 71-92.

[19] Kornai J., Maskin E. and Roland G. (2003), "Understanding the Soft-Budget Constraint", *Journal of Economic Literature* 41(4), 1095-1136.

[20] Legrenzi G. and Milas C. (2002), "The Role of Omitted Variables in Identifying a Long-Run Equilibrium Relationship for the Italian Government Growth", *International Tax and Public Finance* 9(4), 435-450.

[21] Legrenzi G. (2000), "An Empirical Analysis of the Revenue-Expenditure Patterns of the Italian Local Governments", *Journal of Public Finance and Public Choice*, 18, 2/3, 171-185.

[22] Oates, W. E. (2005), "Toward a Second-Generation Theory of Fiscal Federalism", *International Tax and Public Finance,* 12(4), 349-73.

[23] Oates W.E. (1999), "An Essay on Fiscal Federalism", *Journal of Economic Literature*, 37, 1120-1149.

[24] Oates W.E.(1972), *Fiscal federalism*, Harcourt, New York.

[25] OECD (2005). *Economic surveys: Italy.* Paris.

[26] Pesaran, M.H. and B. Pesaran (1997). *Microfit 4.0: an interactive econometric software package*, Oxford University Press, Oxford.

[27] Roemer J. and Silvestre J. (2002), "The Flypaper Effect is not an Anomaly", *Journal of Public Economic Theory*, 4(1), 1-17.

[28] Stine W.F. (1994), "Is Local Government Revenue Response to Federal Aid Symmetrical? Evidence from Pennsylvania County Governments in an Era of Retrenchment", *National Tax Journal*, 47(4), 799-816.

Figure 1: Levels and first differences of the variables
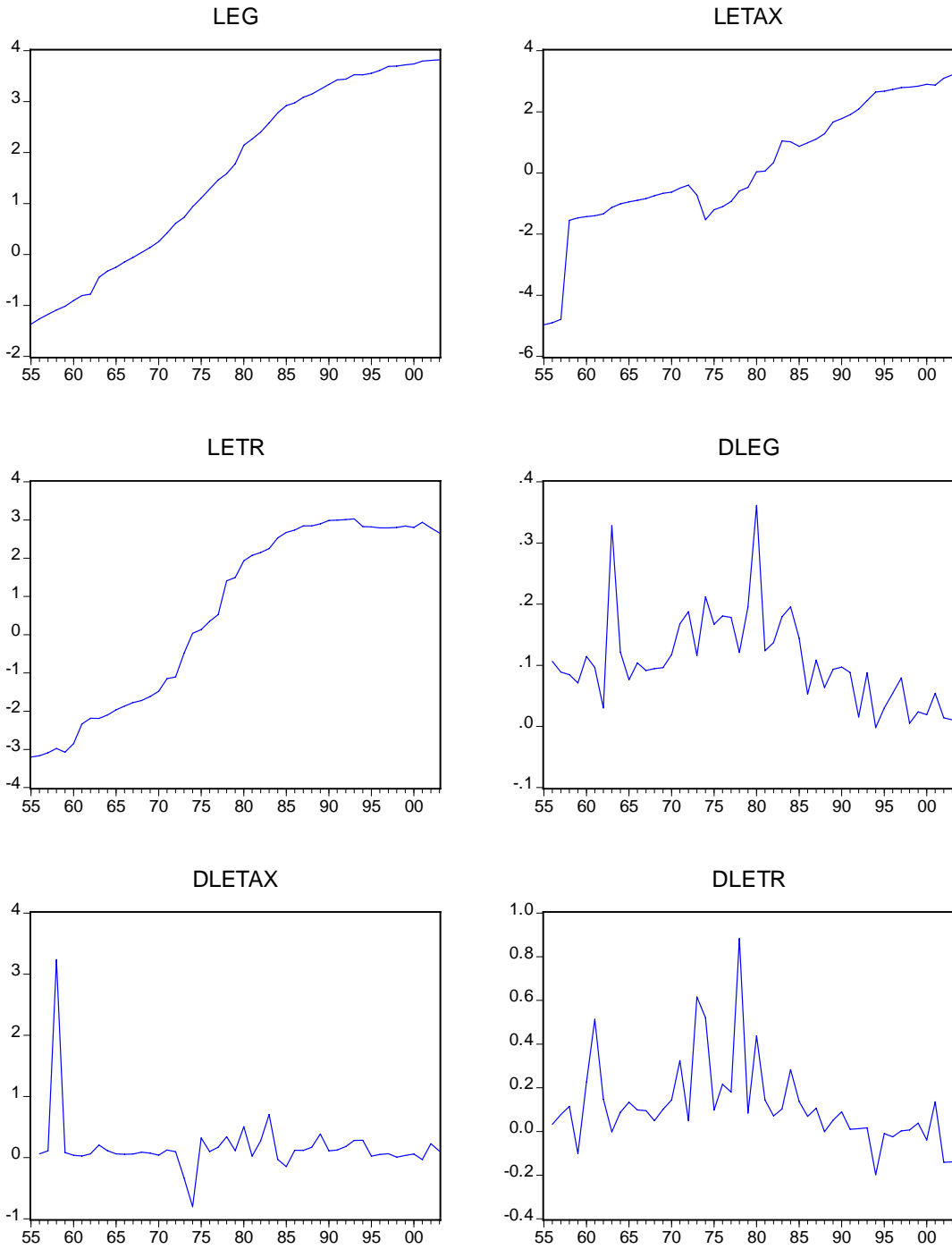
Figure 2. Asymmetric adjustment in local expenditure
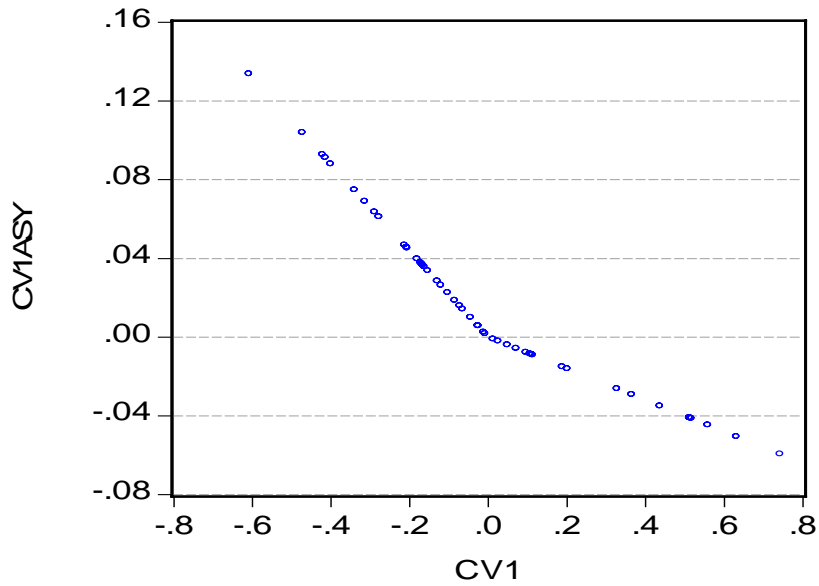
Note: CV1ASY = -0.08*CV1PLUS –0.22*CV1MINUS

Figure 3. Non-linear adjustment in local expenditure
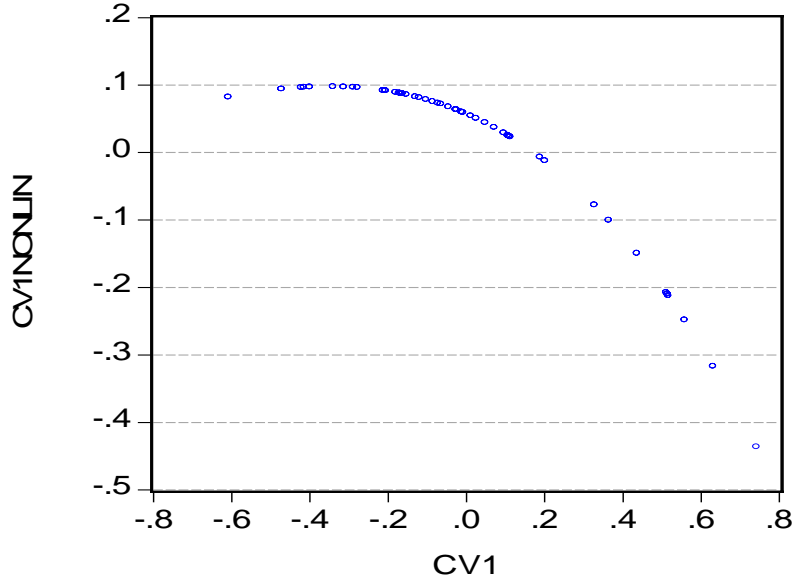
Note: CV1NONLIN = -0.12*CV1 +0.13*CV1^2 -.16*CV1^3

Figure 4. Recursive estimates for the asymmetric ECM for local expenditure.
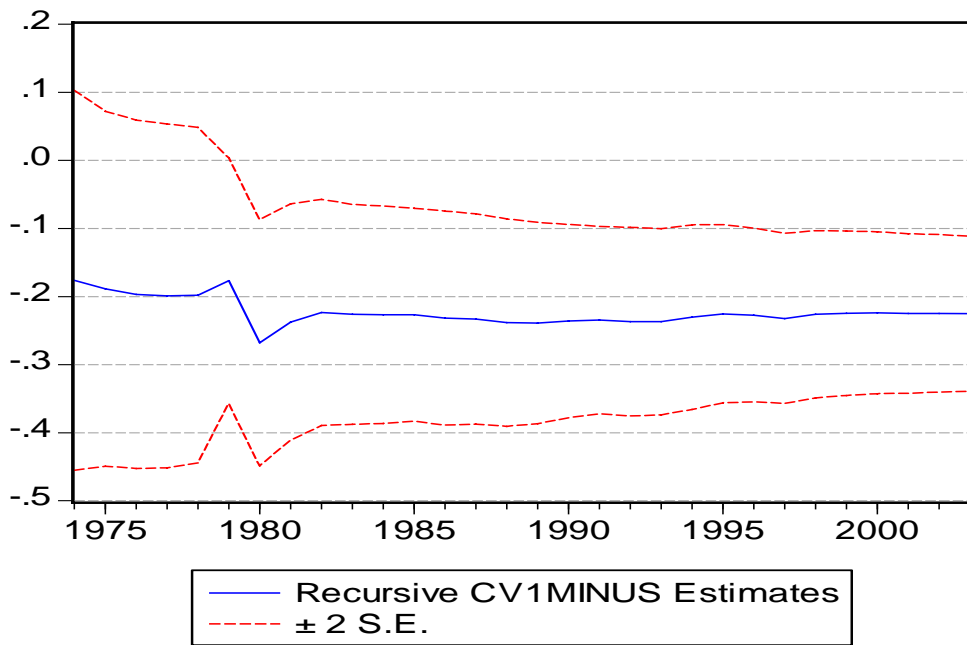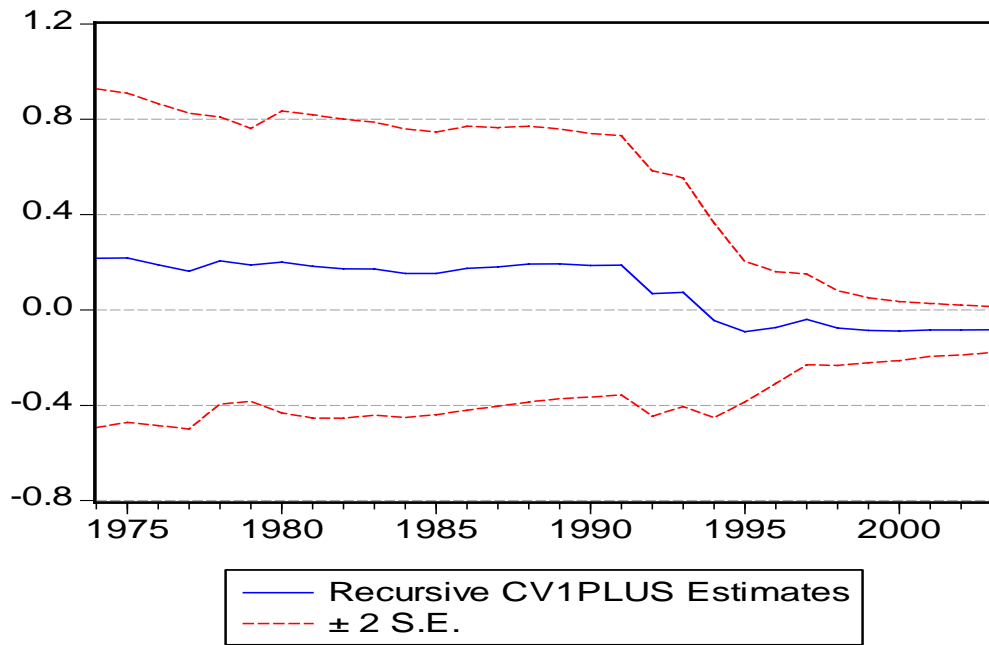
Figure 5. Asymmetric adjustment in local taxation
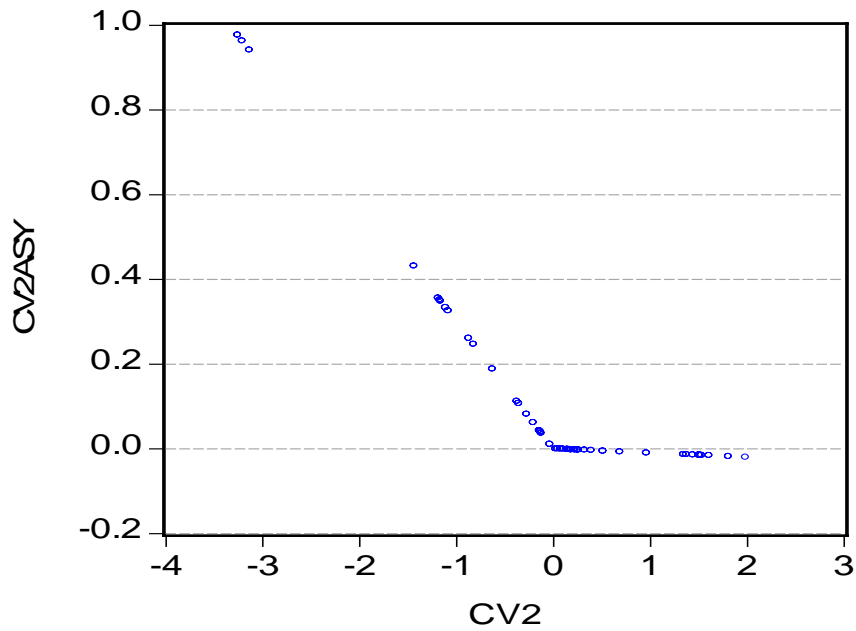
Note: CV2ASY = -0.01*CV2PLUS –0.30*CV2MINUS

Figure 6. Non-linear adjustment in local taxation
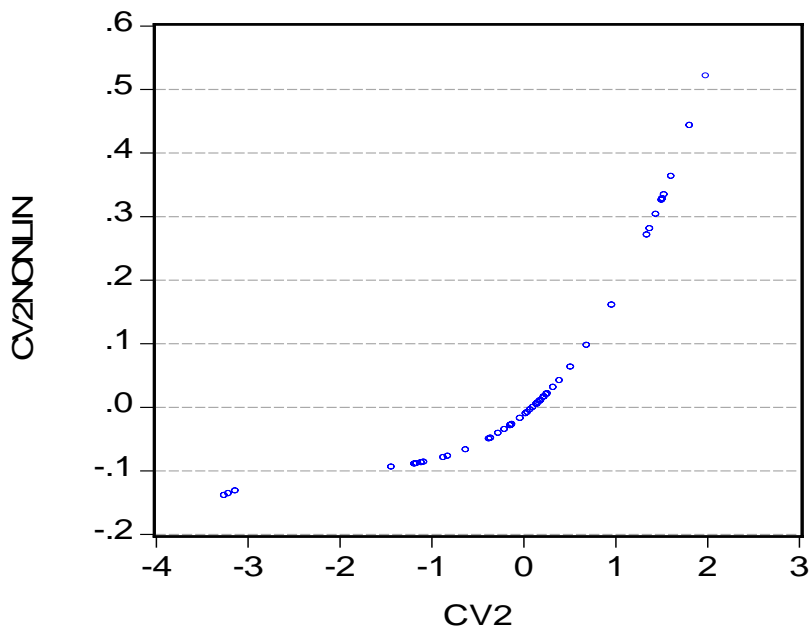
Note: CV2NONLIN=-0.13*CV2 +0.06*CV2^2

Figure 7. Recursive estimates for the asymmetric ECM for local taxation.

Recursive CV2PLUS Estimates
± 2 S.E.

Recursive CV2MINUS Estimates
± 2 S.E.
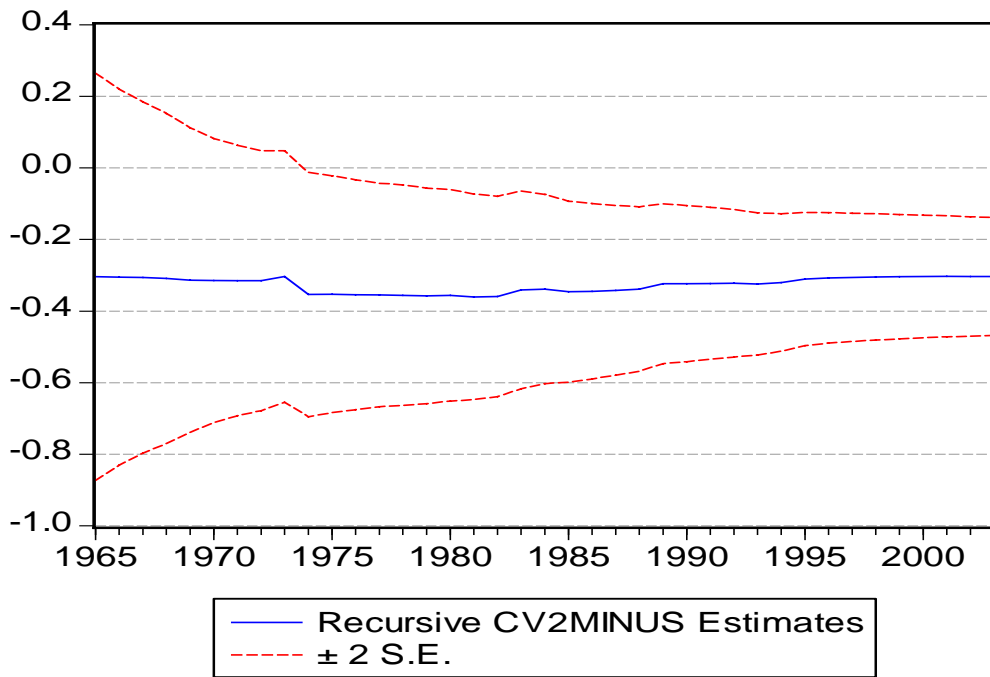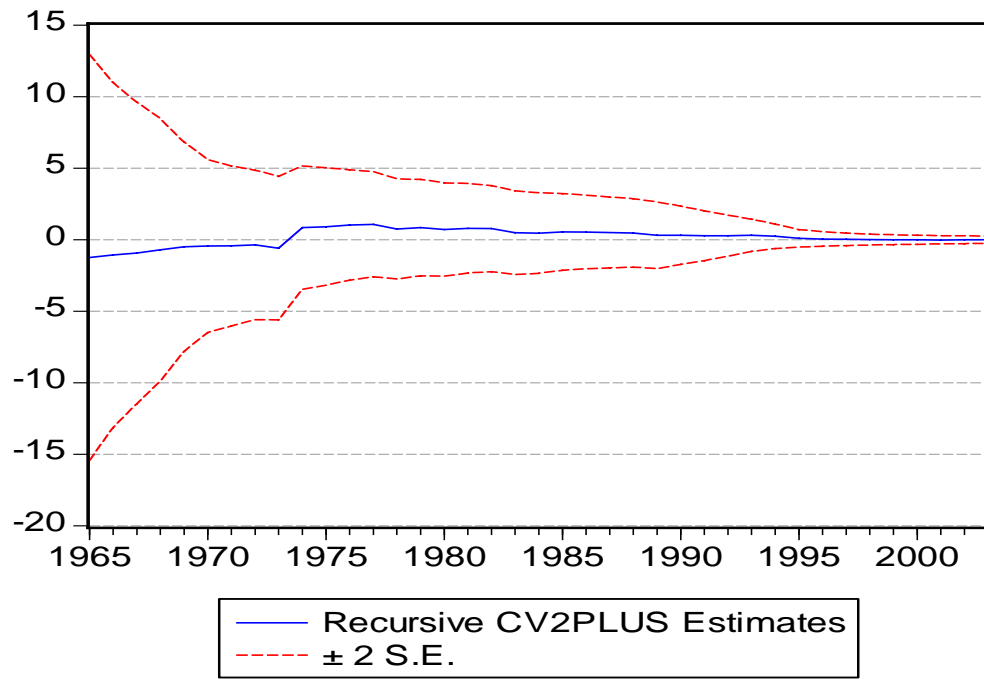
Table 1. Long-run analysis

		λ-max				λ-trace		
H_0	H_1	Stat.	95%	H_0	H_1	Stat.	95%
r=0	r=1	75.17	22.29	r=0	r$\geq$1	96.52	35.19
r$\leq$1	r=2	18.56	15.89	r$\leq$1	r$\geq$2	21.34	20.26
r$\leq$2	r=3	2.78	9.16	r$\leq$2	r=3	2.78	9.16

Table 2. Error correction models for local expenditure*

	(i)	(ii)	(iii)
C	0.26 (.00)	0.07 (.00)	.08 (.00)
ΔTR	0.10 (.01)	0.11 (.00)	.11 (.03)
CV1	-0.14 (.00)	-	-.12 (.03)
CV1PLUS(-1)	-	-.08 (.09)	-
CV1MINUS(-1)	-	-.22 (.00)	-
$CV1^2$ (-1)	-	-	.13 (.15)
$CV1^3$ (-1)	-	-	-.16 (.47)
Adjust. R^2	.47	.49	.49
s.e.	.05	.05	.05
Breusch-Godfrey	.83	.62	.89
Heteroscedasticity	.02	.14	.81
RESET	.19	.54	.73

(*) Figures in parentheses are the p-values. Adjust. R^2 is the adjusted coefficient of determination of the regression. RESET is the Ramsey's RESET test. (includes the square of the fitted value).

Table 3. BDS test on the residuals of the local expenditure linear ECM[1]

	$\varepsilon = 0.025$	$\varepsilon = 0.05$	$\varepsilon = 0.10$
M			
2	0.94	0.53	0.27
3	0.10	0.33	0.06
4	0.00	0.03	0.31
5	0.00	0.00	0.16

Table 4. Error correction models for local taxation.

	(i)	(ii)	(iii)
C	.21 (.00)	.09 (.41)	.11 (.00)
ΔTR	-.61 (.08)	-.41 (.25)	-.38 (.17)
CV2(-1)	-.20 (.00)	-	-.13 (.03)
CV2PLUS(-1)	-	-.01 (.95)	-
CV2MINUS(-1)	-	-.30 (.00)	-
$CV2^2 (-1)$	-	-	.06 (.02)
$CV2^3 (-1)$	-	-	.01 (.79)
Adjust. R^2	.18	.21	.20
s.e.	.45	.43	.43
Breusch-Godfrey	.12	.30	.28
Heteroscedasticity	.00	.00	.00
RESET	.34	.89	.26

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[1] The BDS test statistic tests the null hypothesis that a series is *i.i.d.* against the alternative of realization from an unspecified non-linear process. *m* is the embedding dimension and *ε* equals $0.5\sigma_L$, $1.0\sigma_L$ and $2.0\sigma_L$, respectively, where $\sigma_L = 0.05$ is the standard deviation of the residuals. Given that the choices of *m* and *ε* are crucial for the power of the test, we report the results for different plausible values of *m* and *ε* as suggested by Brock, Hsieh and LeBaron (1991). Only the bootstrapped *p*-values are reported.

Table 5. BDS test on the residuals of the local taxation linear ECM.

	$\varepsilon = 0.225$	$\varepsilon = 0.45$	$\varepsilon = 0.90$
M			
2	0.00	0.00	0.00
3	0.00	0.00	0.00
4	0.00	0.01	0.00
5	0.00	0.00	0.00

Notes: see table (2c), with $\sigma_L = 0.45$.

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