The Causal Relationship Between Government Expenditure and Revenue: The Case of Switzerland*

ANTONIO MANZINI** and MILAD ZARIN-NEJADAN***

1. INTRODUCTION

The causes of the growth of public sector in western industrialized countries have been a major concern among public finance scholars. These determinants may be broken down into non-institutional and institutional components. The non-institutional factors are derived from the traditional neoclassical framework. The demand by rational consumers for government-supplied goods and redistributive policies depends on relative prices, the level of income as well as some social, demographic and technological factors. One might therefore establish a causal relationship between these exogenous variables and the level of public spending. As to the institutional explanations, they heavily draw on the «public choice» literature which explains public sector growth by the existence of a political bias towards more spending. The vision of the state emerging from these models is opposed to that of a benevolent dictator found in the more traditional models. In this context, the most widely studied causes of the public sector growth are redistributive policies and bureaucracy expansion1.

According to both these approaches, causality should run from the expenditure to the revenue side of the budget. However, one cannot exclude finding a causality running the other way round, which would mean that the growth of the public sector is to be attributed solely to the growth of fiscal revenue. Factors likely to explain this phenomenon are budget constraints faced by the government for political, legal or institutional reasons and the increase through time of the «tolerable» level of taxation2. In a growing economy, the tolerable level of taxation is likely to increase because of the progressive nature of the fiscal system. If citizens, through elected representatives, do not intervene in order

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1. For a review of the literature dealing with the non-institutional determinants of public sector growth see BORCHERDING (1985) for United States and POMMEREHNE and KIRCHGAESSNER (1990) for Switzerland.

2. This explanation is very close to the «displacement effect» hypothesis advanced by PEACOCK and WISEMAN (1967) who thus explained the long term growth of the British public sector.
to modify either the tax rates or the tax base (or both), then the increase in resources available to government will probably be spent, resulting in the growth of the public sector.

Parallel to the literature explaining the growth of the public sector and thanks to the pioneering work of GRANGER (1969), considerable research effort has been devoted to the verification of causality links between economic variables. In this context, the investigation of possible causality linkages between government expenditure and revenue has come to take an important place. Basically, this type of research was motivated by the debate on the appropriate instrument to use in order to reduce the U.S. federal budget deficit.

This paper is an attempt to investigate the causal nexus between government expenditure and receipts at the federal, state and local levels in Switzerland. It represents a preliminary step towards the identification of the main determinants of the growth of the Swiss public sector. By comparing a wide range of evidence over the entire post-war period, this paper enables us to draw far more reliable conclusions as to the existence and direction of causality between the two variables under scrutiny than has been usually done in the literature.

The paper is organized in 4 sections. After this introduction, we go on to present briefly in section 2 the causality testing procedures used in this study. Next, in section 3, we report the results of these tests performed on the basis of post-war Swiss data on government outlays and revenue at the federal, state, local as well as aggregate levels. Finally, we conclude in section 4 by discussing the implications of our findings for the study of the determinants of public sector growth in Switzerland and by pointing out the limits of our results.

2. GRANGER CAUSALITY

To determine the existence and the direction of causality between our two variables, we employ the Granger criterion. Testing causality according to this criterion consists of considering the process generating the variables \( \{x,y\} \) as a vector-autoregressive system of infinite order:


4. RAM (1988a) using central government figures and JOULFAIAN and MOOKERJEE (1990) using central as well as state and local government data apply the Granger procedure to test the causality between expenditure and receipts in a certain number of countries including Switzerland. Note, however, that both studies fail to detect any causality running in one direction or the other in the Swiss case.

5. For thorough discussions concerning various causality criteria see for instance FEIGE and PEARCE (1979), KIRCHGAESSNER (1981) and GRANGER and NEWBOLD (1986).
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\[ y_t = \sum_{i=1}^{\infty} \alpha_i y_{t-i} + \sum_{i=1}^{\infty} \beta_i x_{t-i} + \varepsilon_t \]  
(1a)

\[ x_t = \sum_{i=1}^{\infty} \gamma_i y_{t-i} + \sum_{i=1}^{\infty} \lambda_i x_{t-i} + \nu_t \]  
(1b)

where \( \varepsilon_t \) and \( \nu_t \) are uncorrelated residuals.

Following this criterion, one can conclude in favour of a causality running from \( x \) to \( y \) if \( \beta_i \neq 0 \) and \( \gamma_i = 0 \ \forall \ i \). Conversely, if \( \beta_i = 0 \) and \( \gamma_i \neq 0 \), one would deduce a causality running from \( y \) to \( x \). If \( \beta_i \neq 0 \) and \( \gamma_i \neq 0 \), this would be interpreted as a sign of causality running in both directions («feedback»). Finally, if \( \beta_i = 0 \) and \( \gamma_i = 0 \), one would settle for the absence of any causal link between \( x \) and \( y \).

In order to establish a practical test based on this criterion, one has to limit the number of lags, then estimate both equations separately or together in a system, and finally test, at a certain level of confidence, the hypothesis \( \beta_i = 0 \) and \( \gamma_i = 0 \) individually or as a group by means of conventional \( t \) and \( F \)-tests.

The main problem with this procedure lies in the arbitrary choice of the number of lags retained for the two variables in each equation. Actually, the conclusions concerning the existence and direction of causality depends crucially on the order of the lag polynomial attached to each variable. This problem has been solved by Hsiao (1979) who proposed a test based on the Granger concept of causality which presents the advantage of optimizing the number of lags considered for each variable in equations (1a) and (1b) by minimizing Akaike's final prediction error (FPE) criterion defined as:

\[ FPE = \frac{T + m + n + 1}{T - m - n - 1} \left( \frac{SS}{T} \right) \]  
(2)

where

\( SS \)  = sum of squared residuals  
\( m \)  = number of lags for \( y \)  
\( n \)  = number of lags for \( x \)  
\( T \)  = number of observations

The procedure proposed by Hsiao for testing the uni-directional causality running from \( x \) to \( y \) consists of 3 steps:

(i) Determining the optimal order of the one-dimensional autoregressive process for \( y \) (i.e. one that minimizes \( FPE \)), say \( m^* \);

(ii) Fixing the number of lagged values of \( y \) at \( m^* \) and finding the optimal number of lagged values of \( x \) (again by minimizing \( FPE \)), say \( n^* \);
As a further check, fixing the number of lagged values of \( x \) at \( n^* \) and then finding the optimal number of lagged values of \( y \) by varying \( m \) between \( l \) and \( m^* \), say \( m^{**} \) \((m^{**} \leq m^*)\).

If the \( FPE \) of step 3 is lower than that of step 1, one can conclude that there exists a uni-directional causality running from \( x \) to \( y \), the equation (1a) being written as:

\[
y_t = \sum_{i=1}^{m^{**}} \alpha_i y_{t-i} + \sum_{i=1}^{n^*} \beta_i x_{t-i} + \varepsilon_t
\]

On the other hand, if the \( FPE \) of step 3 turns out to be higher than that of step 1, then the equation (1a) will be written as:

\[
y_t = \sum_{i=1}^{m^*} \alpha_i y_{t-i} + \varepsilon_t
\]

which means that no apparent causality running from \( x \) to \( y \) can be detected. Evidently, one should repeat the same procedure for testing causality running from \( y \) to \( x \), which leads to the optimal form of equation (1b). If the lagged values of \( x \) appear in (1a) while those of \( y \) are present in (1b), then one can conclude in favour of a feedback. Of course, if each equation is reduced to an autoregression, this will be interpreted as a sign of the absence of any causal link between the two variables.

3. EMPIRICAL INVESTIGATION OF THE SWISS CASE

In this section we investigate the government revenue – expenditure causality nexus using Swiss data at various levels.

3.1 Data Set

The data used are government receipts and outlays at the federal («Confederation»), state («cantons») and local («communes») levels. These are available only on an annual basis and cover the period 1950-1992. Given that these figures include intra-governmental transfers, the revenue-expenditure causality link was also tested using the aggregate data in which all transfers are cancelled out\(^6\). According to augmented Dickey-Fuller stationarity tests, the logarithm of the series turned out to be \( I(1) \) at the federal level and \( I(2) \) at

\(^6\) The aggregate figures are therefore lower than the sum of the disaggregate figures.
the state and local levels\textsuperscript{7}. The causality tests reported below were therefore applied to logarithmic second differences of the two series. As a check, however, tests at the federal level were also carried out using logarithmic first differences of the series. Finally, given that separate deflators for public revenue and expenditure are not available in Switzerland and that public budgetary exercises are usually undertaken in current prices, the tests presented below were conducted on series expressed in nominal terms.

3.2 Granger Tests

A certain number of Granger tests were carried out for various levels of government. The results of these tests are listed in Table 1. Each equation regresses one of the variables on a constant along with 1, 2, 3 or 4 of its own lags as well as an equal number of lags of the exogenous variable\textsuperscript{8}. Preliminary estimations showed that the presence of a time trend was never significant and had no serious impact on the quality of the equations. The figures given in the table are the $F$-statistics on the joint significance of the lags of the exogenous variable. In order to judge the reliability of the $F$-tests, we also include in the table the revised BOX-LJUNG (BOX and LJUNG, 1976) statistic attached to each equation estimated which helps us detect the presence of serial correlation of a certain order in the residuals. A first general observation emerging from the table is that the conclusions are rather sensitive to the number of lags considered. Therefore, in what follows, we only try to get a general impression as to the direction of causality between the two variables by checking through various lag lengths.

First, at the federal level, the general evidence is in favour of causality running from revenue to expenditure. As one can observe from panel 1a, the lagged values of expenditure appearing in the revenue equation are never jointly significant, while the lagged values of revenue appearing in the expenditure equation turn out to be significant with 2, 3 and 4 lags. Note that for every one of the 4 lag lengths considered, the $F$-statistic on lagged revenue in the expenditure equation is higher than that on lagged expenditure in the revenue equation. This might be interpreted as an indication, though hardly a proof, of causality running mainly from revenue to expenditure rather than the other way round. Panel 1a' shows that these conclusions are not altered when tests are conducted on logarithmic first differences of the series.

Second, at the state level, there is some evidence of causality running from revenue to expenditure. As one can see from panel 1b, in none of the 4 cases listed are the lagged values of expenditure jointly significant in the revenue equation. As for the expenditure equations, the lagged values of revenue are jointly significant when 1 and 2 lags are

\textsuperscript{7} At the aggregate level, revenue turns out to be I(2) whereas expenditure is I(1).

\textsuperscript{8} Considering a larger number of lags (up to 8) does not alter the results significantly and is therefore not reported.
included. Once again, we notice that the $F$-statistics are uniformly higher in the expenditure equations than in the revenue equations.

Third, at the local level, the conclusion as to the direction of causality seems to depend on the retained lag length. As one can observe from the results presented in panel 1c, expenditure seems to cause revenue unilaterally when 2 lags are considered. This conclusion is however reversed when the lag length is limited to 1. Note, however, that in this case the BOX-LJUNG statistic signals the presence of serial correlation in the residuals. The corresponding $F$-test should therefore be interpreted with care. Once again, the $F$-statistics are mostly higher in the expenditure equations than in the corresponding revenue equations.

Finally, at the aggregate level, one can detect a weak sign of causality running from revenue to expenditure. As one can see from panel 1d, the lagged values of expenditure are never jointly significant in the revenue equations, while the reverse happens to be true with 4 lags. Note that, as with the disaggregate data, the $F$-statistics are without any exception higher in the expenditure equations than in the revenue equations.

In summary, the results of the Granger tests speak in favour of causality running from revenue to expenditure, even though the evidence is strong only at the federal level. The generally higher value of the $F$-statistics in the expenditure equations compared to the revenue equations consolidates this general impression. On the basis of these tests, one can at least conclude to the absence of any uni-directional causality from expenditure to revenue.

3.3 Hsiao's Optimizing Procedure

As we saw earlier, the conclusions regarding the existence and the direction of causality could be quite sensitive to the number of lags considered. The next step in our empirical investigation consists therefore of establishing the optimal lag structure in the revenue and expenditure equations by means of Hsiao's optimizing procedure. The optimal polynomial forms resulting from the application of this procedure to various levels of government are listed in Table 2. The search was conducted for a number of lags varying between 1 and 4.

First, at the federal level (panel 2a), one can notice that the optimal form of the revenue equation boils down to a simple first-order autoregression. In contrast, expenditure is best explained by its own value lagged twice together with 1 lag of revenue. This result points to the existence of a uni-directional causality running from revenue to expenditure and confirms the conclusion reached above. These findings remain qualitatively the same when the test is conducted on first differences of the series (panel 2a').

Second, at the state level (panel 2b), the optimal form of each equation includes both variables lagged once. This outcome points to a bi-directional causality between the two variables and helps us revise to some extent the general impression left by the results of the Granger tests reported above.
Third, at the local level (panel 2c), the optimal structure of the revenue equation turns out to include 1 lag of revenue and 2 lags of expenditure. As for the optimized expenditure equation, it includes 1 lag of each variable. Once again, as with the state data, one observes here a bi-directional causality link between the two variables.

Finally, at the aggregate level (panel 2d), the results point to a second-order autoregressive function as the optimal form of the revenue equation. They also suggest the inclusion of as many as 4 lags of expenditure and 3 lags of revenue in the final form of expenditure equation. In contrast to the weak evidence stemming from Granger tests, here we are able to establish a uni-directional causality running from revenue to expenditure.

In summary, the conclusions derived from the application of the Hsiao test to different levels of public revenue and expenditure confirm to a certain extent those reached on the basis of the previous tests. The results obtained here point to the existence of a uni-directional causality from revenue to expenditure at the federal and aggregate levels. However, some evidence of feedback can be detected at the state and local levels.

4. CONCLUDING REMARKS

This paper identified the causal relationship between public expenditure and revenue at various government levels in Switzerland. Unlike previous inconclusive attempts, the wide spectrum of evidence presented here points towards a uni-directional causality running from revenue to expenditure. This implies that fiscal revenue rather than planned expenditure should be considered as the main factor behind the growth of the public sector in Switzerland. In other words, the data support the view according to which public expenditure is subject to a binding budget constraint. The investigation of the causal link between government expenditure and receipts appears thereby to be a useful preliminary step towards the explanation of public sector growth in Switzerland.

In itself, this finding is hardly surprising in Switzerland given the institutional framework and the nature of the period under study. Fiscal revenue is mainly composed of direct taxes which are highly sensitive to variations in national income. During the economic growth of the sixties and the early seventies, tax proceeds increased faster than income, partly because in the absence of any indexation for inflation, the government took full advantage of the fiscal drag mechanism. This extra revenue was spent without there being necessarily any impetus from the demand side.

Finally, a few words of caution are necessary to remind us of the limits of this study. First, the data used at the disaggregate levels include intra-governmental transfers which could have biased the results to some extent. Second, the behaviour of individual cantons and communes may well differ from the «mass» behaviour documented by the results presented above. Third, the causality between government revenue and outlays can best be analyzed within a multi-variate (rather than bi-variate) framework involving other
potentially relevant variables such as the GDP or the rate of inflation. This formidable task is left to future research.

Table 1: Granger tests of causality

Figures shown are the $F$-Statistics on 1, 2, 3, or 4 lags of the exogenous variable in each equation estimated. Figures in brackets are the revised Box-Ljung $Q$-statistics of the $\chi^2$ test for white noise residuals.

1a: Federal

<table>
<thead>
<tr>
<th>Equation</th>
<th>1 lag</th>
<th>2 lags</th>
<th>3 lags</th>
<th>4 lags</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue</td>
<td>0.51</td>
<td>1.17</td>
<td>0.98</td>
<td>0.66</td>
</tr>
<tr>
<td></td>
<td>(18.78)**</td>
<td>(26.93)**</td>
<td>(15.50)*</td>
<td>(14.59)</td>
</tr>
<tr>
<td>Expenditure</td>
<td>2.19</td>
<td>4.52**</td>
<td>2.98**</td>
<td>3.43**</td>
</tr>
<tr>
<td></td>
<td>(15.33)*</td>
<td>(2.65)</td>
<td>(3.23)</td>
<td>(2.37)</td>
</tr>
</tbody>
</table>

1a': Federal (first differences)

<table>
<thead>
<tr>
<th>Equation</th>
<th>1 lag</th>
<th>2 lags</th>
<th>3 lags</th>
<th>4 lags</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue</td>
<td>1.92</td>
<td>0.26</td>
<td>1.20</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>(15.69)*</td>
<td>(16.36)*</td>
<td>(12.72)</td>
<td>(14.83)*</td>
</tr>
<tr>
<td>Expenditure</td>
<td>0.70</td>
<td>5.13**</td>
<td>4.08**</td>
<td>4.50***</td>
</tr>
<tr>
<td></td>
<td>(6.16)</td>
<td>(6.65)</td>
<td>(2.63)</td>
<td>(2.46)</td>
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1b: State

<table>
<thead>
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<th>Equation</th>
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<th>2 lags</th>
<th>3 lags</th>
<th>4 lags</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue</td>
<td>1.97</td>
<td>0.70</td>
<td>0.57</td>
<td>0.34</td>
</tr>
<tr>
<td></td>
<td>(3.68)</td>
<td>(3.70)</td>
<td>(3.35)</td>
<td>(1.82)</td>
</tr>
<tr>
<td>Expenditure</td>
<td>5.18**</td>
<td>2.60*</td>
<td>2.18</td>
<td>1.76</td>
</tr>
<tr>
<td></td>
<td>(7.57)</td>
<td>(8.35)</td>
<td>(7.80)</td>
<td>(3.54)</td>
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</table>

1c: Local

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Revenue</td>
<td>0.05</td>
<td>3.08*</td>
<td>1.48</td>
<td>0.97</td>
</tr>
<tr>
<td></td>
<td>(9.53)</td>
<td>(8.75)</td>
<td>(7.12)</td>
<td>(6.22)</td>
</tr>
<tr>
<td>Expenditure</td>
<td>3.19*</td>
<td>2.30</td>
<td>1.70</td>
<td>1.51</td>
</tr>
<tr>
<td></td>
<td>(16.84)*</td>
<td>(12.68)</td>
<td>(13.44)</td>
<td>(10.26)</td>
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1d: Aggregate

<table>
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<th>4 lags</th>
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<tbody>
<tr>
<td>Revenue</td>
<td>0.00001(10.23)</td>
<td>0.05</td>
<td>0.52</td>
<td>0.44</td>
</tr>
<tr>
<td>Expenditure</td>
<td>0.0006(6.00)</td>
<td>1.22</td>
<td>1.57</td>
<td>2.19*</td>
</tr>
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</table>

/**/**: significant at the 10/5/1 per cent level.

Table 2: Hsiao's optimizing procedure

Figures between brackets are the optimal polynomial lag orders attached to expenditure (E) and revenue (R).

2a: Federal

<table>
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<tr>
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<th>Step 2</th>
<th>Step 3</th>
<th>Final form</th>
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</thead>
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<td>R(1), E(1)</td>
<td>-</td>
<td>R(1)</td>
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<tr>
<td>Expenditure</td>
<td>E(2)</td>
<td>E(2), R(1)</td>
<td>E(2), R(1)</td>
<td>E(2), R(1)</td>
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2a¹: Federal (first differences)

<table>
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<th>Step 2</th>
<th>Step 3</th>
<th>Final form</th>
</tr>
</thead>
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<td>R(2), E(1)</td>
<td>R(2), E(1)</td>
<td>R(2)</td>
</tr>
<tr>
<td>Expenditure</td>
<td>E(1)</td>
<td>E(1), R(2)</td>
<td>-</td>
<td>E(1), R(2)</td>
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2b: State

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<th>Step 3</th>
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<tr>
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<td>R(1)</td>
<td>R(1), E(1)</td>
<td>-</td>
<td>R(1), E(1)</td>
</tr>
<tr>
<td>Expenditure</td>
<td>E(1)</td>
<td>E(1), R(1)</td>
<td>-</td>
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</table>

2c: Local

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<th>Step 3</th>
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</tr>
</thead>
<tbody>
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<td>R(1)</td>
<td>R(1), E(2)</td>
<td>-</td>
<td>R(1), E(2)</td>
</tr>
<tr>
<td>Expenditure</td>
<td>E(1)</td>
<td>E(1), R(1)</td>
<td>-</td>
<td>E(1), R(1)</td>
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</table>
2d: Aggregate

<table>
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<th>Step 2</th>
<th>Step 3</th>
<th>Final form</th>
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<td>R(2), E(1)</td>
<td>R(2), E(1)</td>
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<tr>
<td>Expenditure</td>
<td>E(4)</td>
<td>E(4), R(3)</td>
<td>E(4), R(3)</td>
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REFERENCES


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SUMMARY

This article studies the causality link between government expenditure and revenue at federal, state and local levels in Switzerland. It attempts to gather empirical evidence regarding the question of whether the government pursues a «tax and spend» or «spend and tax» policy. The Granger and Hsiao causality tests are applied to data covering the period 1950-1992. The general evidence turns out to be in favor of a causality running from revenue to expenditure. However, the possibility of a feedback cannot be excluded at the state and local levels.

RESUME

Cet article explore le lien de causalité entre les dépenses et les recettes publiques aux niveaux fédéral, cantonal et communal en Suisse. Il cherche à éclaircir empiriquement la question de savoir si l'Etat décide d'abord le montant des dépenses à effectuer puis prélève les recettes nécessaires, ou si c'est plutôt l'inverse qui caractérise le comportement des collectivités publiques. Les tests de Granger et de Hsiao ont été appliqués aux données portant sur la période 1950-1992. Dans l'ensemble, les résultats témoignent d'une causalité allant des recettes vers les dépenses publiques. Néanmoins, une causalité bi-directionnelle ne peut pas être exclue aux niveaux cantonal et communal.

ZUSAMMENFASSUNG