Multiplier impact of wine activity on inter-industry interactions[1]

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Abstract

Wine is usually studied as a separate activity. Our attempt is to introduce it within the industries composing output that react to disposable income changes. We first harmonize the available data in a Social Accounting framework. From this data base we get the parameters of a multi-industry multi-sectoral model. We apply on the model a type of dispersion analysis based on singular value decompositions. The results show the position held by wine with respect to the other activities in relation to changes in the composition of disposable incomes. They confirm that wine, in a mediterranean country as Italy, is linked to lower disposable incomes.

Keywords: *Wine, Input-Output, Macro Multiplier, Singular Values Decompositions, Economic Impact and Correlation*

Introduction

In last years the production of wine in Italy has undergone major changes (INEA,2004). Though a lot of producers have remained small, output is obtained and marketed in a way much similar to that of manufacturing products. According the Italian Statistical Office (ISTAT) only a 40-45 per cent of wine producers are farmers (Ciaccia, 1999) and a growing share of wine output is allocated to final demand (INEA, 2004).

Within the agricultural output, wine has become increasingly relevant for the role of leading activity it has assumed in recent decades. This role is confirmed by recent trends in wine exports, whose share on agriculture export has relevantly grown (EC, 2004).

Within the European Union, Italian wine is present with about 322 Doc (or controlled place name) wines, 21 Docg (or controlled and guaranteed place name) and 113 Itg (or typical place name). Since the EU continues to increase the degree of openness towards other European and extra-European countries, the CAP (Communitarian Agrarian Policies) will have to assume an increasing relevance on the growth of this activity. Subsidies can be assigned on the basis of either total output or value added and the results can be significantly different (INEA, 2004).

The analysis of the CAP for wine requires a clear picture of the inter-industry relations at a high level of the detail. Moreover, if the CAP affects income generation

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through direct transfer to producers incomes or subsides to investment, it is important to state formally the relationships between income by institutional sectors and output by industries.

In our analysis we attempt to model these links with the objective to give a picture of wine industries in national accounts. Hence we will need to build a multi-sectoral and multi-industry model starting from a Social Accounting Matrix to provide a consistent database (Bulmer-Thomas, 1982).

In section 2 we note how recent developments in national accounts make implicit reference to an extended income/output circular flow, which integrates output generation with income distribution. We show how this loop can be formalized and apply a method of analysis based on the singular value decomposition. This method evaluates the efficiency of various hypotheses of income changes among income classes in generating changes in outputs with specific reference to wine industries. In section 3 the data base construction for the application is described. It essentially consists in the reconciliation of data from the Central Statistical Office and other institutions specially devoted to the study of agricultural products to obtain a regional Social Accounting Matrix (SAM). Section 4 shows the results obtained through our analysis that combines spectral analysis with correlation analysis and produces a ranking of sectors and industries. Such ranking shows how the multipliers "ruling" the results perceive the change in each income sector and how industry outputs are affected by the set multipliers activated. A further cross correlation scrutiny of data gives the measure of relevance of how each industry output change has been affected by each change in sector income. The method has been applied with special reference to the special role of wine among industrial and sectoral interactions.

The multi-sectoral and Macro Multiplier approach

Recent developments in National Accounting have realized a substantial progress in the accounting system that integrates (United Nations, 1994) the keynesian income-expenditure model with the leontievian total output-intermediate consumption framework (Lager, 1988; Miyazawa, 1970). In this way the emerging accounting scheme makes reference to an enlarged income circular flow: final demands generate outputs and value added at industry level, which is distributed to factors and, through these, to institutional sectors in order to obtain, after taxation, disposable income by institutional sectors (Paytt, 2001). These sectors will determine personal consumption expenditure and investment, which will constitute final demand by n industries[2]. The complete model (Ciaschini and Socci, 2002) allows for the reconciliation of the income distribution loop by institutional sectors with the output generation loop by industries. In this paper we perform a partial analysis of the income circular flow concentrating only on the links between c sectoral disposable incomes and n total output industries.

The fundamental equilibrium equation is given by

$$\mathbf{x} + \mathbf{z} = \mathbf{M} \cdot \mathbf{i} + \mathbf{f} \tag{1}$$

where $\mathbf{M}$ $[n,n]$ is the matrix of intermediate consumption flows, $\mathbf{f}$ $[n,1]$ is final demand vector, $\mathbf{i}$ $[n,1]$ is the vector row sum (unitary vector) and where $\boldsymbol{x}$ $[n,1]$ is the vector of total output and $\mathbf{z}$ $[n,1]$ is the imports vector (Miller and Blair, 1985).

The direct and indirect output requirements for the final demand vector $\boldsymbol{f}$ is easily written in terms of the inverse

$$\mathbf{x} = [\mathbf{I} - \mathbf{A}]^{-1} \cdot \mathbf{f} \tag{2}$$

where $\mathbf{A}$ $[n,n]$ is the intermediate coefficients matrix which is usually determined as $\mathbf{M} \cdot \hat{\mathbf{x}}^{-1}$.

The final demand formation (by Input-Output industries)

$$\mathbf{f} = [\mathbf{F}^0 + \mathbf{K}] \cdot \mathbf{y} + \mathbf{f}^0 \tag{3}$$

where $\mathbf{F}^0$ provides the consumption demand structure by industry and is given by the product of two matrices, $\mathbf{F}^0 = \mathbf{F}^1 \cdot \mathbf{C}$, where $\mathbf{F}^1$ $[n,c]$ transforms the consumption expenditure by institutional sector into consumption by input-output (I-O) industry as a constant share of the consumption expenditure of the institutional sector, and $\mathbf{C}$ $[c,c]$ represents the consumption propensities by institutional sector[3]. $\mathbf{K}$ represents the investment demand and is given by $\mathbf{K} = \mathbf{K1} \cdot s \cdot [\mathbf{I\text{-}C}]$ where $\mathbf{K1}$ $[n,c]$ gives the investment demands to I-O industry as a share of investment expenditures by institutional sectors and s is a scalar that represents the share of private savings which is transformed into investment i.e. "active savings". Vector $\mathbf{y}$ represents disposable income of the institutional sectors and in our application will be considered as exogenous. $\mathbf{f}^0$ is a vector of n elements which represents exogenous demand[4]. Combining equation (2) and (3) we get

$$\mathbf{x} = [\mathbf{I} - \mathbf{A}]^{-1} \cdot (\mathbf{F}^0 + \mathbf{K}) \cdot \mathbf{y} \tag{4}$$

Our structural matrix can be defined as $\mathbf{R}$:

$$\mathbf{R} = [\mathbf{I} - \mathbf{A}]^{-1} \cdot (\mathbf{F}^0 + \mathbf{K}) \tag{5}$$

We now have the structural matrix in equation (5) that shows the interactions among industries and sectors. Each element shows the growth of the i^{th} output, $\mathbf{x}_i$, caused by a unit change income impulse, $\mathbf{y}_j$, in the j^{th} sectoral disposable income. Independently from its matrix formalization the model is very simple. Its simplicity mainly resides in the assumptions of fixity in coefficients and shares as well as in the absence of a price side (fix-price) and in its uni-periodicity. Matrix $\mathbf{R}$ provides a useful information based on a one-to-one multiplier relationship.

However we believe that policy effects would be better evaluated if we consider more complex compositions of policy variables. For this aim we consider the possibility of decomposing matrix $\mathbf{R}$ in a sum of c different matrices through the Singular Values Decomposition (SVD) (Lancaster and Tiesmenetsky, 1985). The most popular spectral decomposition is given by the eigenvalues and eigenvector decomposition. However this procedure, while extremely interesting for the study of the powers of $\mathbf{R}$, is not convenient for our aims, since it can be applied only to square matrices and produces roots which can be positive, negative or complex conjugated couples (Ciaschini, 1988).

A further type of decomposition may be derived which has not those inconveniences and produces roots that can be easily interpreted as aggregated macro economic multipliers. The decomposition proposed, Singular Value Decomposition (SVD), can be applied both to square and to non-square matrices. Here the general case of non-square matrix **R** will be shown. The square matrix case is easily developed along the same lines. The SVD is such that each sub matrix is "ruled" by a single scalar, called singular value, which shows the aggregated effect on the output vector of a demand vector of predetermined income sectoral structure. For this reason we will refer to these singular values as Macro Multipliers (Ciaschini and Socci, 2004). When this multiplier is greater than one the associated output change will be amplified.

Matrix ***R*** in fact can always be written as

$$\mathbf{R} = \mathbf{U} \cdot \mathbf{S} \cdot \mathbf{V}^{\mathbf{T}} \tag{6}$$

where **U** [*n*,*n*] and $\mathbf{V}^T$ [*c*,c] are two unitary matrices and **S** [*n*,*c*] is a matrix whose diagonal elements consist of the *s* scalars s_i for i=1,…*c* and zero for i >*c* . Scalars s_i are all positive and can be ordered in decreasing order. If we denote with $\boldsymbol{u}_i$ the columns of matrix ***U*** and with $\boldsymbol{v}_i$ the rows of matrix ***V*** we can express matrix **R** as:

$$\mathbf{R} = \sum_i s_i \mathbf{u_i} \mathbf{v_i} \tag{7}$$

each of the *i* elements of the summation represents a matrix composing of matrix **R** .

If the income change is chosen so that its structure is made equal to, say, vector $\mathbf{v}_i$ all the elements of the summation, other than $\mathbf{s}_i$, $\mathbf{u}_i$ and $\mathbf{v}_i$ become equal to zero, since vectors $\boldsymbol{v}_i$ (i=1,..,*c*) are orthogonal, and matrix ***R*** would reduce to:

$$\mathbf{R}_i = s_i \cdot \mathbf{u_i} \cdot \mathbf{v_i} \tag{8}$$

We can say that, given our matrix **R**, we are able to isolate impacts of different (aggregate) magnitude, considering that each latent Macro Multiplier present in matrix **R**, s_i can be activated through a policy along the income structure $\mathbf{v}_i$ and its impact can be observed along the output structure $\mathbf{u}_i$.

Since we want to apply the singular value decomposition in a framework of correlation analysis we standardize matrix **R.** This is done taking deviations from the mean value and dividing by mean square error. We then get matrix $\overline{\mathbf{R}}$ that is the standardized version of matrix **R**.

In this case SVD would produce the Macro Multipliers for new matrix. Since matrix product $\overline{\mathbf{R}} \cdot \overline{\mathbf{R}}^T$ represent the output correlation matrix and that square roots of its eigenvalues are the singular values of matrix $\overline{\mathbf{R}}$, we can conclude that each singular value can be interpreted as the share of the variance related to the associated singular value.

If we determine the cumulated percentage variance shares, we see that the first two singular values cover a significant percentage of total variance. We can confine our analysis of inter-sectoral and inter-industry interaction to the first two Macro Multipliers. Then, rather then considering matrix $\overline{\mathbf{R}}$, we can refer to matrix

$$\overline{\mathbf{R}}^0 = s_1 \cdot \mathbf{u}_1 \cdot \mathbf{v}_1 + s_2 \cdot \mathbf{u}_2 \cdot \mathbf{v}_2 \tag{9}$$

in which terms greater then two have been neglected. In matrix $\overline{\mathbf{R}}^0$ the economic interactions are all determined by the first two aggregate impact multipliers s_1 and s_2. We note that vectors

$$s_1 \cdot \mathbf{u}_1 = \begin{bmatrix} s_1 \cdot u_{11} \\ . \\ . \\ s_1 \cdot u_{n1} \end{bmatrix}, s_2 \cdot \mathbf{u}_2 = \begin{bmatrix} s_2 \cdot u_{12} \\ . \\ . \\ s_2 \cdot u_{n2} \end{bmatrix} \quad (10)$$

-which split the two Macro Multipliers into the n output sectors- represent how each of the two impact components affects the output sectors. On the other and vectors

$$\begin{aligned} s_1 \cdot \mathbf{v}_1 &= \begin{bmatrix} s_1 \cdot v_{11} & . & . & s_1 \cdot v_{1s} \end{bmatrix} \\ s_2 \cdot \mathbf{v}_2 &= \begin{bmatrix} s_2 \cdot v_{21} & . & . & s_2 \cdot v_{2s} \end{bmatrix} \end{aligned} \quad (11)$$

-which split the same two Macro Multipliers into the s institutional sectors- represent how the change in sectoral disposable income influence the two impact components.

The wine flows in regional Accounts

The determination of the various wine categories within national accounts is tied to the new denominations NACE REV.1 (EUROSTAT, 1996). The aggregation is based on the following criteria: the origin of grapes utilized for production, the type of wine produced and its uses. The wine output is distributed among the following branches:

01.13.1 Vine growing and wine-vine firms
-vine growing for wine grapes and eating grapes
-wine output from own production

01.13.5 Mixed wine-vine cultivations
-wine output from non-own production
15.93. wine output (from non-own production)
-15.93.1 Wine Making (special wines excluded)
wine output: table wine, v.q.p.r.d. wine (quality wines produced in predetermined regions);
wine production from concentrated grape must;
-15.93.2 Special Wine Making -this class does not include:
wine production associated with vine growing (01.13)
wine bottling and packaging, with no transformation, 51.17 and 74.82

The adoption of this classification allows for the isolation of these branches within the Input-Output that refer exclusively to wine [5]. We will need to construct a set of rows and columns for white and red wine. In order to obtain a regional input output table with an explicit wine activity it is necessary to break down the intermediate an final flows used in the various wine productions.

Wine outputs, according the NACE.REV.1 classification, are calculated considering: i) the value of wine output from own vines (agricultural firms), wine production by cooperatives and wine production by vine wine industry (Institute of Services Agriculture and Food market -ISMEA, 1997); ii) regional flows of wine forwarded to

Table 1. Social Accounting Matrix for Marche region (billion of Italian 1996 lira)

	1	2	3	4	5	6	7	8	9	10	11	12	13
1	584.47	74.29	50.54	0.00	0.00	11.26	2.60	1212.83	72.12	221.74	13.97	4.30	61.26
2	0.17	0.02	0.01	0.00	0.00	0.18	0.00	1.55	0.62	0.21	207.08	0.00	6.75
3	0.11	0.02	0.01	0.00	0.00	0.12	0.00	1.04	0.41	0.14	138.09	0.00	4.50
4	56.03	8.00	3.56	955.12	321.06	272.20	43.20	60.00	9.24	260.80	402.29	92.40	197.52
5	7.43	16.92	12.13	11.04	98.60	122.25	33.60	34.95	4.92	158.65	170.85	36.50	86.47
6	208.38	29.76	13.24	16.64	45.80	3131.20	2000.51	120.50	79.85	4066.35	226.80	174.06	289.02
7	37.11	4.30	2.36	1.30	39.40	115.40	1596.26	1438.25	0.58	946.00	253.00	7.50	703.72
8	421.14	60.15	26.75	0.10	0.00	737.65	0.00	810.85	4.45	893.95	3379.01	11.77	168.10
9	0.40	0.06	0.03	0.00	0.00	0.43	0.00	3.68	1.46	0.50	613.51	0.00	15.97
10	34.36	4.91	2.18	11.84	70.43	600.00	590.46	142.40	72.70	7504.02	1770.50	130.00	665.22
11	396.88	56.69	25.21	47.54	82.51	1656.40	1607.96	649.40	139.71	3501.40	7017.99	681.16	1041.48
12	0.09	0.01	0.01	0.71	12.56	28.80	628.91	0.70	1.69	7.80	13.60	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	239.87	70.07	43.40	128.82	680.41	1223.99	1211.01	708.76	10.29	3726.09	5444.09	578.67	5698.21
15	1158.49	227.90	152.31	205.20	169.79	995.66	714.85	344.99	17.39	5835.36	15397.56	1387.50	292.56
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	-212.68	171.26	118.01	1704.24	74.20	92.60	268.86	108.70	557.65	2159.10	1568.80	156.96	0.00
	44.26	0.71	1.28	74.55	1.16	26.44	149.12	32.00	18.74	110.83	0.00	0.00	0.00
	-257.88	170.55	116.73	1629.69	73.00	66.16	119.74	76.71	537.87	2048.27	1568.80	156.96	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	1177.40	23.60	42.56	1243.76	977.30	5209.84	4009.74	5658.23	736.25	4867.56	2678.68	41.10	0.00
25	558.14	5.72	10.31	1207.60	45.31	2461.86	2669.52	952.86	74.45	2254.26	1554.86	218.42	0.00
26	4668	754	503	5534	2617	16660	15377	12250	1784	36404	40851	3520	9231

14	15	16	17	18	19	20	21	22	23	24	25	26	
0.00	0.00	42.55	91.10	259.47	161.29	13.05	0.00	0.00	-2605.16	4288.98	106.19	4667	**1**
0.00	0.00	15.45	33.08	94.21	58.56	4.74	0.00	0.00	-6.54	336.97	0.61	754	**2**
0.00	0.00	10.30	22.06	62.82	39.05	3.16	0.00	0.00	-4.36	224.71	0.41	503	**3**
0.00	0.00	74.85	160.24	456.41	283.71	22.95	0.00	0.00	1171.40	594.70	88.20	5534	**4**
0.00	0.00	73.59	157.54	448.71	278.92	22.57	0.00	0.00	-2746.92	3587.76	0.92	2617	**5**
0.00	0.00	75.38	220.81	944.11	469.08	22.63	0.00	0.00	333.95	3308.29	883.50	16660	**6**
0.00	0.00	31.45	246.54	1652.31	672.04	8.20	0.00	0.00	6249.88	-1538.65	2910.54	15377	**7**
0.00	0.00	262.12	561.12	1598.23	993.46	80.38	0.00	0.00	11.65	2138.38	90.45	12250	**8**
0.00	0.00	36.55	78.24	222.84	138.52	11.21	0.00	0.00	-15.46	673.38	1.44	1783	**9**
0.00	0.00	299.93	878.64	3756.76	1866.55	90.06	0.00	0.00	8275.27	5143.82	4493.88	36404	**10**
0.00	0.00	1208.79	2587.67	7370.38	4581.43	370.67	0.00	0.00	-151.02	6908.23	1070.20	40851	**11**
0.00	0.00	254.97	545.81	1554.62	966.35	78.18	0.00	0.00	-575.99	0.00	1.50	3520	**12**
0.00	0.00	37.75	80.81	230.18	143.08	11.58	0.00	8530.20	193.60	0.00	3.60	9231	**13**
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	175.87	19940	**14**
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	26900	**15**
133.31	529.26	41.86	0.00	0.00	0.00	0.00	414.52	1271.93	0.00	13.38	2.41	2407	**16**
2005.84	875.43	0.00	4.14	0.00	0.00	0.00	1375.43	2533.58	0.00	1.33	1.04	6797	**17**
10378.92	5302.79	0.00	0.00	16.61	0.00	0.00	3988.45	6652.93	0.00	5.31	6.73	26352	**18**
6998.34	6244.45	0.00	0.00	0.00	3.07	0.00	3308.53	3400.46	0.00	0.98	3.78	19960	**19**
363.90	1450.94	0.00	0.00	0.00	0.00	0.00	250.65	606.38	0.00	0.00	0.45	2672	**20**
0.00	12128.37	40.51	159.89	553.34	380.47	12.39	3637.36	5720.12	0.00	0.00	1791.29	24424	**21**
0.00	368.32	203.18	1084.95	5344.27	4042.42	408.22	2585.33	0.00	0.00	3754.83	4158.31	28718	**22**
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	459	
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6307	
0.00	0.00	160.57	474.63	2205.01	1925.16	298.63	2241.77	0.00	0.00	0.00	0.00	7306	
0.00	0.00	40.15	604.06	3125.61	2107.55	109.59	0.00	0.00	0.00	0.00	0.00	5987	
0.00	0.00	-541.76	-358.53	1472.33	4525.84	1059.51	2725.57	0.00	0.00	3109.12	-1861.74	10130	**23**
0.00	0.00	239.20	242.69	314.14	355.77	452.83	4280.87	0.00	0.00	0.00	0.00	32552	**24**
59.24	0.00	0.00	0.00	0.00	0.00	0.00	1857.02	0.00	0.00	0.00	0.00	13930	**25**
19940	26900	2407	6797	26352	19960	2672	24424	28716	10130	32552	13930		**26**

distillation from MIPA (Minister of Agriculture and Forestry Policies); iii) data from the DOC wine Committee regarding DOC and DOCG outputs. These data allow for an accurate analysis of the attribution of wine output to agriculture rather than to other branches (wine by cooperatives, wine by manufacturing of wine).

In conclusion the analysis allows for the quantification of the value of wine output. This value is given by a share of 40-45 per cent wine from own vines, by another share of 40-45 per cent provided by cooperatives and a share from 10 to 20 per cent by wine by manufacturing of wine. Value added has been adjusted consistently. Total wine output has been then disaggregated into two branches: white wine and red wine (Ciaccia, 1999). Since total output is known and are also known the shares of the two types of wine we can easily determine the intermediate flows. The determination of the intermediate absorptions and final demands for the Marche takes place through the use of regional agricultural statistics compared with production technical data and households consumption data (ISTAT, 1996 and 2003). Moreover in order to determine the destination of wine output we utilized the market shares of the branch Alcoholic beverages in the inter-sectoral flow table for Italy 1996 (Lavanda *et. al.* 1997).

The two branches under examination show relevant absorptions from agriculture (grapes for wine production), from energy, water and transport sectors. For what regards the market shares output is oriented for a great part to final demand, consumption and export (EC, 2004), and to intermediate sector transport[6]. The greatest share of value added generated by the two branches is given by other incomes. It comprises mixed income and gross operating surplus. Taxes on output show a consolidated flow, which is positive but it is comprehensive of subsidies[7].

Now we need to reconcile these data on regional I-O flows with data on regional income distribution. The determination of regional income distribution for the Marche region we use is shown in (Socci, 2004). We than obtain the SAM shown in Table 1 where wine is explicitly taken into consideration. The denominations of rows and columns are presented in Table 2: 13 industries, 2 value added components, 7 institutional sectors, capital formation, Rest of Italy, Rest of the world.

The most effective disposable income change: application

From this regional SAM we construct the regional multi-sectoral and multi-industry model in equation (4). The inverse matrix in equation (5) is shown in Table 3.

Table 3 can be easily decomposed in a sum of seven different tables through the SVD, as shown in equation (6). The decomposition is such that each sub table is "ruled" by a single scalar, which shows the aggregated effect on the output vector of an income vector of predetermined sectoral structure. Given our matrix **R**, we are able to isolate impacts of different (aggregate) magnitude, considering that each latent Macro Multiplier present in matrix **R**, s_i can be activated through a shock along the demand structure $\mathbf{v}_i$ and its impact can be observed along the output structure $\mathbf{u}_i$.

Table 4 shows the Macro Multipliers which are present in matrix **R**. Macro multiplier s_1 (1.048) is the dominating one. This means that a change in the disposable income vector produces a change on the output vector 1.048 times greater[8]. Macro Multiplier 2 amplifies the effect of the change, while Macro Multiplier 3 reduces it. The last four Macro Multipliers have no effects.

Table 2. Denominations of rows and columns of SAM

1	Agriculture
2	White wine
3	Red wine
4	Petroleum
5	Energy
6	Manufacturing Metallic and Chemicals
7	Manufacturing Machinery and equipment
8	Manufacturing food
9	Manufacturing Tobacco and alcoholic
10	Others Manufacturing
11	Transport and trade
12	Services mainly to businesses
13	Public services amministration
14	Wages and Salaries
15	Operating surplus
16	Household Income Class I
17	Household Income Class II
18	Household Income Class III
19	Household Income Class IV
20	Household Income Class V
21	Corporations
22	Government
	- Taxes on Imports
	- Taxes on products Net
	- Taxes on income
	- Social Contributions
23	Capital formation
24	Rest of Italy
25	Rest of World
26	Total

More interesting results are obtained applying the decomposition to standardized data. In Table 3 we show matrix $\overline{\mathbf{R}}$ obtained taking deviations from the mean value and dividing by mean square error (Hotelling, 1933). In this case decomposition would produce the macro multipliers shown in Table 4.

Table 3. Direct and indirect effects of sector disposable incomes on industry output

	I	II	III	IV	V	VI	VII
x_1	-0.018	-0.013	-0.010	-0.007	-0.002	0.005	-0.007
x_2	0.005	0.003	0.003	0.002	0.001	0.000	-0.001
x_3	0.003	0.002	0.002	0.001	0.001	0.000	0.000
x_4	0.005	0.002	0.000	-0.001	-0.002	-0.005	-0.021
x_5	0.030	0.022	0.015	0.012	0.007	-0.004	-0.009
x_6	0.040	-0.008	-0.041	-0.079	-0.129	-0.208	-0.031
x_7	-0.257	-0.053	0.092	0.242	0.442	0.771	-0.076
x_8	0.047	0.033	0.022	0.019	0.014	-0.002	-0.018
x_9	0.009	0.006	0.005	0.004	0.003	0.000	-0.002
x_{10}	0.088	0.088	0.100	0.046	-0.017	-0.065	-0.072
x_{11}	0.485	0.329	0.206	0.137	0.035	-0.178	-0.113
x_{12}	0.153	0.104	0.066	0.040	0.003	-0.068	0.000
x_{13}	0.020	0.015	0.012	0.009	0.006	0.000	1.000

Table 4. Latent Macro Multipliers in **R**

	Macro Multipliers
s_1	1.05
s_2	1.01
s_3	0.65
s_4	0.07
s_5	0.00
s_6	0.00
s_7	0.00
	2.77

Since matrix product $\bar{\mathbf{R}} \cdot \bar{\mathbf{R}}^T$ represent the output correlation matrix and that square roots of its eigenvalues are the singular values of matrix $\bar{\mathbf{R}}$, we can conclude that each singular value in Table 5 can be interpreted as the share of the variance related to the associated singular value. If we determine the cumulated percentage shares, we see that the first two singular values cover the 93 per cent of total variance. This means that we can confine our analysis of inter-sectoral and inter-industry interaction to the first two Macro Multipliers to get results valid for the 93 per cent of the cases. Following equation (9) we can refer only first two Macro Multipliers. A numerical representation of these impacts for our example is given Table 6 and 7. In Table 6 we observe the composition of the input vectors and in Table 7 the composition of output vector relative to s_1 and s_2 Macro Multipliers, as shown in Table 5.

Table 5. Latent multipliers in $\bar{\mathbf{R}}$

	Macro Multipliers	Cumulative percentage sum
s_1	3.20	0.62
s_2	1.61	0.93
s_3	0.37	1
s_4	0.0	1
s_5	0.0	1
s_6	0.0	1
s_7	0.0	1
	5.19	

Table 6: Impact of a disposable income on the Macro Multiplier

	First Impact Component $v_1 s_1$	Second Impact component $v_2 s_2$
Household Income Class I	1.861	0.240
Household Income Class II	1.116	0.059
Household Income Class III	0.556	-0.057
Household Income Class IV	0.118	-0.237
Household Income Class V	-0.493	-0.470
Corporations VI	-1.603	-0.803
Government VII	-1.555	1.268

Table 7. Impact of the Macro Multiplier on industry outputs

	First Impact Component $u_1 s_1$	Second Impact component $u_2 s_2$
x_1	-0.874	-0.485
x_2	0.990	-0.134
x_3	0.990	-0.134
x_4	0.796	-0.604
x_5	0.990	-0.133
x_6	0.742	0.671
x_7	-0.651	-0.759
x_8	0.966	-0.236
x_9	0.986	-0.162
x_{10}	0.937	-0.073
x_{11}	0.996	0.081
x_{12}	0.957	0.288
x_{13}	-0.510	0.859

We can also give a graphical representation of each element in the four vectors. We will define the axis of the first Macro Multiplier on which we measure the elements of vectors $s_1\mathbf{u}_1$, $s_1\mathbf{v}_1$ and the axis of the second Macro Multiplier where we measure the elements of the vector $s_2\mathbf{u}_2$, $s_2\mathbf{v}_2$. We will then represent the couple $[s_1 \cdot v_{1i}, s_1 \cdot v_{2i}]$ (i=1,....,7), with seven arrows showing how the change in disposable income impacts on the two macro multipliers; and couples $[s_1 \cdot u_{i1}, s_2 \cdot u_{i2}]$ (i=1,....,13), with thirteen dots, showing how the two Macro Multipliers impact on sectoral output.

The modulus the arrows labelled I, II, III, IV, V, VI and VII (institutional sectors), represent the stimulus forwarded to the two Macro Multipliers by unit change in sectoral disposable income. Dots labelled x_1 to x_{13} represent the industry effects of the Macro Multipliers on the industry outputs. It has to be noted that the angle - or, better, its cosine - formed in the origin by two arrows, or by two segments connecting two dots with origin, or by arrow and a segment gives a the measure of the correlation coefficient between such two variables.

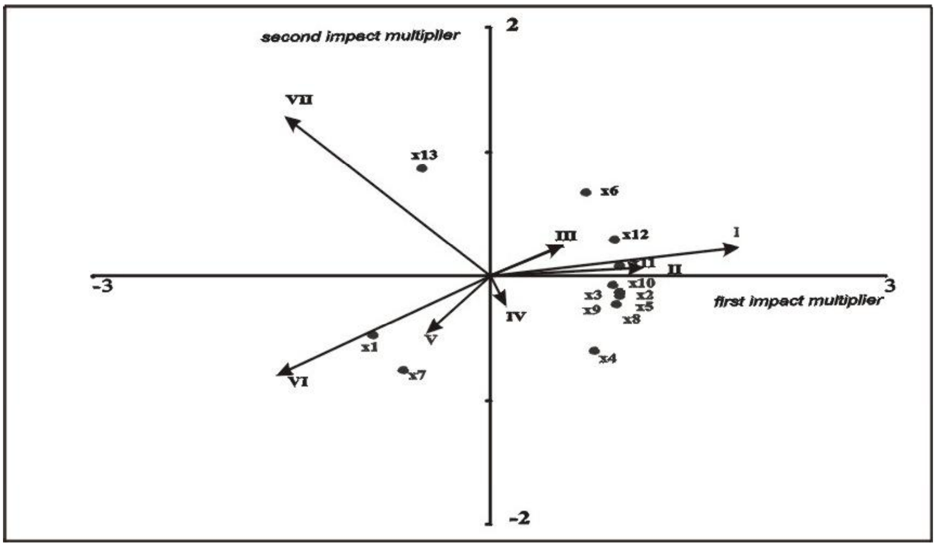

Figure 1. The interaction between disposable income by sector and output by industry.

Results and policy implication

The results of our analysis are twofold: the quantitative picture of wine production within the flows of a regional economy, as it emerges in table 1, and the policy implications that can be extracted from it, through the use of a simple extended IO model strictly consistent with the data base, as they become manifest in figure 1.

As to policy implications, the control of disposable income usually is activated for general purposes but can have severe outcomes on specific industries as wine. These outcomes depend on the linkages among institutional sectors (disposable incomes), among industries (outputs) and between industries and sectors. Figure 1 gives the representation of such linkages in terms of dispersions.

Let us take into consideration the linkages among institutional sectors. Whatever will be the change in disposable income suggested by the policy it will stimulate the economy according the proportions identified by the arrows. In fact the arrows indicate the level at which the two Macro Multipliers are activated. We note that there is high positive correlation among the first three income sectors. They tend to act on interaction in same direction. Income sector V (very high income class) tends to react in the opposed direction of the institutional sectors I (very low income class), II (low income class) and III (medium income class); as well as sector IV (high income class) with respect to sector VII (Public Administration). Sector VI (firms) have positive correlation with sector V (very high income class) and both sectors have negative correlation with sectors I (very low income class), II (low income class) and III (medium income class). Finally sector VII (Public Administration) has low correlation with all the sectors exclude sector IV (high income class).

For what regards the linkages among industries a set of industries, notably x_2 (White wine), x_3 (Red wine), x_5 (Energy), x_8 (Manufacturing food), x_9 (Manufacturing Tobacco and alcoholic), x_{10} (Others Manufacturing) and x_{11} (Transport and Trade) are rather concentrated with a correlation coefficient higher then 98 per cent. Industry 1 (Agriculture) and 7 (Manufacturing machinery and equipment) form a second set of positive correlated industries as well as Industry 6 (Manufacturing Metallic and Chemicals) and 12 (Services mainly to businesses) form a third set. This means that each industry within each set receives the same type of stimulus (same combination of Macro Multipliers).

Finally, the linkage between institutional sectors and industry outputs shows both the policy push and the industry pull. In particular wine industries, x_2 and x_3, perceive highly the change in disposable income of sectors I, II and III. Wine industries get more immediately the changes in disposable incomes of the lower income households. We can conclude that wine activity are driven by the same combination of Macro Multipliers that rules the manufacturing activities when stimulated by sectoral disposable income, while agriculture perceives a higher stimulus from the same sectors but opposed direction.

Notes

1 A preliminary version of this article was presented at the International Conference V.D.Q.S. *Enometrics IX* held in Budapest Hungarian, 22-24 May 2003

2 In the intersectoral table used for empirical analysis the producing activities are given by the branches of homogeneous production.

3 To see the appendix for the Input-Output and Institutional Sector

4 In application we assume $\mathbf{F}^0 = 0$ in this application and in $\mathbf{f^0}$ we consider also export minus import.

5 The branch can be constructed on the basis of the available information, and further disaggregated according various wine typologies.

6 In our table this branch includes trade hotels and restaurants.

7 The accounting table is presented in the appendix (13x13).

8 Given the problems connected with aggregation in multisectoral models, this feature of singular values s_i is not of minor relevance. They are aggregated multipliers consistently extracted from a multisectoral framework and their meaning holds both if we speak in aggregated or disaggregated terms.

References

Bulmer-Thomas, V., 1982. *Input-Output Analysis in Developing Countries*. John Wiley and Sons Ltd, New York.

Ciaccia, D., 1999. *Sistema delle statistiche agricole: rilevazione sui risultati economici delle aziende agricole (REA): primo bilancio e presentazione dei risultati*. ISTAT, Roma.

Ciaschini, M., 1988. Scale and structure in economic modelling. *Economic Modelling*, 6(4), 355-373.

Ciaschini, M., and Socci, C., 2002. Generalized multipliers approach to income distribution in a social accounting framework. *XIV conference on Input-Output technique*, 10-15 October 2002, Montréal, CANADA.

Ciaschini, M., and Socci, C., 2004. Macro Multiplier approach to output generation and income distribution in a Social Accounting framework, International Conference, *Economic Growth and Distribution: on the Nature and Causes of the Wealth of Nations*, Università di Pisa, Lucca.

EC, 2004. *Balances wine final COMEXT*. European Commission, Luxemburg.

EUROSTAT, 1996. *Système Européen des Comptes SEC95*. CEE, Luxembourg.

Hotelling, H., 1933. Analysis of a complex of statistical variables into principal components. *Journal of Educational Psychology*, (24), 417–441, 498–520.

INEA, 2004. *L'agricoltura italiana conta*. Ministero delle Politiche Agrarie, Roma.

INEA, 2004. *Rapporto sullo stato dell'agricoltura italiana*. Ministero delle Politiche Agrarie, Roma.

ISMEA, 1997. *La tavola delle interdipendenza settoriale 1995*. ISMEA.

ISTAT, 1996. *Conti Nazionali Economici e Finanziari dei Settori Istituzionali- Anno 1996*. Roma.

ISTAT, 2003. *La produzione di uva e vino*. Statistiche in Breve, Roma.

Lager, C., 1988. The use of a social accounting matrix for the comparative static equilibrium modelling in input-output analysis. *In*: M. CIASCHINI, ed. *Input Output Analysis Current developments*. London: Chapman and Hall London, 75-90.

Lancaster, P. and Tiesmenetsky, M., 1985. *The Theory of Matrices*. 2nd ed. New York: Academic Press.

Lavanda, I., Rampa, G. and Soro, B., 1997. La revisione delle tavole intersettoriali 1970-90: Metodi e procedure. *Rivista di Statistica Ufficiale*, Quaderni di ricerca, Milano: Franco Angeli.

Miller, R. E. and Blair, P. D., 1985. *Input-Output Analysis: Foundations and Extensions*. New Jersey: Prentice-Hall, Inc., Englewood Cliffs.

Miyazawa, K., 1970. *Input-Output Analysis and Structure of Income Distribution*. vol. 116. New York.

Pyatt, G., 2001. Some early multiplier models of the relationship between income distribution and production structure. *Economic Systems Research*, 13(2): 139–164.

Socci, C., 2004. Una SAM biregionale per le Marche. *In* A. FOSSATI AND R. TARGETTI ed. *Matrici regionali di contabilità sociale e analisi di politiche economiche: il caso della Liguria, Toscana e Marche*. Milano: Franco Angeli.

UNITED NATIONS, 1994. *System of National Accounts*. N.U., New York