THE MARCHE REGION AND ITS INDUSTRY PATTERN: A QUANTITATIVE EVALUATION

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1. Introduction

The economy of the Marche region is characterized by what Giorgio Fuà called the "Marche model", a set of small - medium sized businesses distributed throughout the territory, in particular on the coasts and valleys, and clustered in industrial districts, (Fuà, 1993). The main districts include furniture in Macerata and Pesaro, pharmaceutical and naval industries in Ancona, paper and appliance industries in Fabriano, musical instrument industry in the district of Castelfidardo and footwear, of considerable national, as well as regional, importance in the Macerata district. Starting from 2009 this so called "Marche model" begun to show some critical features which persist in the present times. As to the manufacturing industry, stagnation manifested in heterogeneous trends among the dimensional classes of firms also in relation to the typology of economic activity. Medium-large sized firms showed an increasing trend in the revenues as opposed to the decrease of revenues experienced by the smaller ones. The expansion of mechanic industry is in contraposition to the quinquennial footwear industry decay, (Banca d'Italia, 2019). The post-earthquake reconstruction has served as an engine for a partial recovery of the construction sector deeply impacted by the 2008 crisis, recovery that in any case does not reach the pre-crisis level. A not-brilliant frame is shaped also by the trend of the services sector. After having adapted to the Marche region the latest national Input-Output Table (NIOT) by means of the Flegg Location Quotient method (FLQ), an analysis on the position occupied by the economic sectors and the identification of the regional key sectors will be carried out. To this regards the Rasmussen (Rasmussen, 1956) approach will be used.

The FLQ contains a crucial unknown parameter ($0 \leq \delta < 1$) that must be estimated. On the basis of similar studies concerning Peterborough's economy in 1968 (Morrison and Smith, 1974) and Scotland in 1989, (Flegg and Webber, 1997) an approximate value of $\delta = 0.3$ allows the derivation of closer multipliers to those obtained by

surveys than multipliers obtained by the conventional cross-industry location quotients.
The present work is aimed to provide, in Section 2, a global vision of the industrial framework at a national level. Section 3 is devoted to the regionalization of the national matrix by means of the FLQ method (Lamonica and Chelli, 2018). Section 4 presents the empirical results for both Italy and the Marche region, while Section 5 is devoted to the discussion of the outcomes. Section 6 is dedicated to conclusions.

2. The Italian framework

World globalization in latest decades leads to the international development of manufacture industry. Starting from 2018, though, this development phase began to slowdown mainly due to conjuncture factors: inward-looking American commercial policies, a confused framework on the possible outcomes of Brexit, tensions between USA and China and risks connected to the results of the elections in Europe. Within this climate of instability, Italy has to face its weaknesses, especially those related to the internal market and to its various industries that found themselves deprived of the stimulus given by the international demand, which is now more fragile.

Table 1 – *Value added (2018) and Exports (2019) in percentage values of world's total.*

1	China	28,5	China	15,1
2	USA	17,2	Germany	9,4
3	Japan	8,1	USA	8,1
4	Germany	6,1	Japan	4,4
5	South -Korea	3,1	South- Korea	3,9
6	India	3,0	Hong Kong	3,7
7	**Italy**	**2,3**	France	3,4
8	France	2,1	The Netherlands	3,2
9	Unted Kingdom	1,9	**Italy**	**3,2**
10	Indonesia	1,6	United Kingdom	2,8

Source: Confindustria Report 2019

This stagnation manifests itself not only under the point of view of the public component intrinsic in investments in infrastructures, but also in the private environment, even if supported by the incentives to the 4.0 digital conversion of manufacturing, (Confindustria Report, 2019). The concentration of industrial development towards new economic areas does not prevent Italy to be the seventh world manufacturing power, still in 2018 and the ninth country in relation to the export capacity (Table 1). The slowdown, which took place in 2017, has been common with the other European countries (France, Germany and Spain). A fundamental factor in favour of firms' development enriching the industry supply and improving the efficiency of productive systems is the 4.0 conversion of manufacturing. Technology 4.0 allows fastening the decision processes and new forms of interaction human-machine to connect the entire value chain within the firm.

Italy has joined the European framework of Industry 4.0 only in 2016, with a certain delay with respect to other European countries, through the National Plan Industria 4.0. The main measure used for the restart of firms has been that of hyper – amortisation which is estimated to account for 10 billion euros in investment.

3. The Methodology

Input-output table (IOT) provide information on the flows of goods and services among economic sectors of a country over a given period. It represents one of the most important tools for analysing the economic structure of a country and the relationships among specific economic sectors. A serious limitation in the construction of an IOT is the great volume of information required that is not always completely available. The same problems arise, in an amplified way, if the goal is to adapt the IOT of a country (NIOT) to a subnational region of interest (RIOT).

In this section, we briefly review the most used location quotient (LQ) methods to estimate a RIOT. In Table 2, we show the national and regional IOT for an economic system of k sector in block matrix notation:

Table 2 – *Pattern of national and regional IOT.*

NIOT

x^n_{11}	$\cdots$	x^n_{1k}	f^n_1	x^n_1
$\vdots$	$\ddots$	$\vdots$	$\vdots$	$\vdots$
x^n_{k1}	$\cdots$	x^n_{kk}	f^n_k	x^n_k
v^n_1	$\cdots$	v^n_k		
x^n_1	$\cdots$	x^n_k		

RIOT

x^r_{11}	$\cdots$	x^r_{1k}	f^r_1	x^r_1
$\vdots$	$\ddots$	$\vdots$	$\vdots$	$\vdots$
x^r_{k1}	$\cdots$	x^r_{kk}	f^r_k	x^r_k
imp^r_{11}	$\cdots$	imp^r_{1k}	$f1^r_1$	
$\vdots$	$\ddots$	$\vdots$	$\vdots$	
imp^r_{k1}	$\cdots$	imp^r_{kk}	$f1^r_k$	
v^r_1	$\cdots$	v^r_k		
x^r_1	$\cdots$	x^r_k		

where:

- $\mathbf{X}^n=\left[x^n_{ij}\right]$ is the matrix whose entries are the total flows for intermediate use from the i-th sector to the j-th sector at national level;

- $\mathbf{X}^r=[x_{ij}^r]$ is the matrix whose entries are the flows for intermediate use from the i-th sector to the j-th sector at regional level (intraregional flows: both i and j sectors located in region r);
- $\mathbf{f}^n$ is the national final demand vector; $\mathbf{f}^r$ and $\mathbf{f1}^r$ are the regional final demand vectors of internal production and, respectively, imported from other regions;
- $\mathbf{IMP}^r=[imp_{ij}^r]$ is the matrix of imported intermediate inputs produced by the i-th sector of the other regions and acquired by the regional j-th sector;
- $(\mathbf{v}^n)'$ and $(\mathbf{v}^r)'$ are row vectors whose entries are the primary input (imports of goods and services and gross value-added components) by sector at national and regional level.

Moreover let $\mathbf{A}^n=\left[a_{ij}^n=\frac{x_{ij}^n}{x_j^n}\right]$, $\mathbf{R}=\left[r_{ij}=\frac{x_{ij}^r}{x_j^r}\right]$ and $\mathbf{M}^r=\left[m_{ij}^r=\frac{imp_{ij}^r}{x_j^r}\right]$ define the matrices whose entries are the national technical coefficients, the regional input coefficients and the regional import coefficients.

Assuming that only **NIOT** $(\mathbf{A}^n)$ and the vector of the regional total sectorial output ($\mathbf{x}^r$) are known, the LQ methods estimate the matrix of the regional input coefficients **R** adjusting the national technical coefficient in the following way:

$$\hat{r}_{ij}=a_{ij}^n q_{ij} \quad (1)$$

where q_{ij} represents the degree of modification of the national coefficient. Interregional import coefficients (the entries of $\mathbf{M}^r$) are estimated as difference between the national and the estimated regional input coefficient. The LQ methods are based on the assumption that the region has the same productive technologies of the nation:

$$a_{ij}^n=r_{ij}+m_{ij}^r \quad (2)$$

The most widely used LQ method is the *Simple Location Quotient* (SLQ) one. Here, the regional input coefficient is estimated as:

$$\hat{r}_{ij}=SLQ_i \cdot a_{ij}^n \quad (3)$$

where SLQ_i is defined as:

$$SLQ_i=\frac{x_i^r/x^r}{x_i^n/x^n} \quad (4)$$

where x_i^r and x_i^n are the total output (production) of the i-th regional and national sector respectively. When the regional total output is not available, the sectorial employment can be used.

The previous ratio can be interpreted as the relative specialization of the region in the *i*-th sector compared to the nation. The SLQ_i can be greater than, equal to, or less than one. When the Location Quotient is less than one, the corresponding regional sector is relatively less important than the same sector at national level. In this case, the regional sector will not be able to satisfy all local requirements, so that some of its products must be imported from other regions and no exports can be made. The interregional import coefficients (m_{ij}) are usually estimated from the difference between the national coefficient and the estimated regional input coefficient.

By contrast, if the Location Quotient is greater than or equal to one, the sector is judged able to fulfil all requirements of regional purchasing sectors. In other words, the region is self-sufficient for that activity or has a relative advantage. Hence, in these circumstances, the regional input coefficients are considered to be national technical coefficients. In this case, no adjustment is needed, and consequently the regional sector has the same input coefficient as the nation. Therefore, the regional input coefficients are adjusted in the following way:

$$\hat{r}_{ij}=\begin{cases} a_{ij}^n \cdot SLQ_i & \text{if } SLQ_i<1 \\ a_{ij}^n & \text{if } SLQ_i \geq 1 \end{cases} \quad (5)$$

One of the first enhancements of the SLQ method is the Cross-Industry Location Quotient (CILQ).

Indeed, the SLQ method is a uniform adjustment that takes into consideration only the supply side (the row side), i.e. only the size of the selling industry. Unlike the SLQ, the CILQ considers both supplying and purchasing sectors.

The CILQ formula can be written as follows:

$$CILQ_{ij}=\frac{x_i^r/x_i^n}{x_j^r/x_j^n}=\frac{SLQ_i}{SLQ_j}, \quad (6)$$

and

$$\hat{r}_{ij}=\begin{cases} a_{ij}^n CILQ_{ij} & \text{if } CILQ_{ij}<1 \\ a_{ij}^n & \text{if } CILQ_{ij} \geq 1 \end{cases}. \quad (7)$$

Contrary to the SLQ method, the CILQ method is a cell-by-cell adjustment.

The *symmetric cross-industry location quotient* (SCILQ) is a variant of the CILQ method. It was designed to take into account the possibility of deriving regional coefficients that exceed national values, thus overcoming the problem of asymmetric adjustments. It takes the following form:

$$SCILQ_{ij}=2-\frac{2}{CILQ_{ij}+1}\ . \quad (8)$$

The *semilogarithmic location quotient* (RLQ) incorporates the properties of both the SLQ and CILQ methods and takes the following form:

$$RLQ_{ij}=\frac{SLQ_i}{\log_2\left(1+SLQ_j\right)}=\frac{x_i^r/x^r}{x_i^r/x^r}\Big/\left[\log_2\left(1+\frac{x_j^r}{x^r}\cdot\frac{x^n}{x_j^w}\right)\right]. \quad (9)$$

The RLQ has been criticized for underestimating imports from other regions when the size of the region is small. To overcome these drawbacks, the *Flegg location quotient method* (FLQ) was introduced. The key idea underlying the FLQ is that a region's propensity to import from other domestic regions is inversely and nonlinearly related to its relative size. By incorporating explicit adjustments for interregional trade, analysts should be able to gain more accurate estimates of regional input coefficients and hence multipliers. As with other non-survey techniques, the principal aim of the FLQ is to provide a means whereby regional analysts can construct regional tables that reflect a region's economic structure as much as possible:

$$FLQ_{ij}=\begin{cases}CILQ_{ij}\lambda & \text{for } i\neq j\\ SLQ_{ij}\lambda & \text{for } i=j\end{cases}, \quad (10)$$

where λ stands for the relative size of the region and takes the following form:

$$\lambda=\left[\log_2\left(1+\frac{x^r}{x^n}\right)\right]^{\delta}. \quad (11)$$

Here, δ ($0\leq\delta<1$) is a sensitivity parameter that controls the degree of convexity in the previous equation. The larger the value of δ, the lower the value of λ, so that greater adjustments of regional imports are made. Implementation of the FLQ formula is carried out in a manner similar to other LQ methods:

$$\hat{r}_{ij}=\begin{cases}a_{ij}^W FLQ_{ij} & \text{if } FLQ_{ij}<1\\ a_{ij}^W & \text{if } FLQ_{ij}\geq 1\end{cases}. \quad (12)$$

The value of parameter δ is the focus of the method. McCann and Dewhurst (1998) pointed out that regional coefficients may exceed national coefficients when there is regional specialization (i.e., the regional coefficient becomes larger than the national coefficient). Thus, Flegg and Webber (2000) proposed the *augmented FLQ* (AFLQ). The AFLQ is defined as follows:

$$AFLQ_{ij}=\begin{cases} FLQ_{ij}\left[\log_2\left(1+SLQ_j\right)\right] & \text{for } SLQ_j>1 \\ FLQ_{ij} & \text{for } SLQ_j\leq 1 \end{cases}, \tag{13}$$

where $\log_2\left(1+SLQ_j\right)$ represents the regional specialization of sector j and has been included to allow for the effects of regional specialization. If $SLQ_j>1$ and $FLQ_{ij}\geq 1$, the national coefficients are scaled upwards. However, to avoid an excessive upward adjustment, the constraint $FLQ_{ij}\leq 1$ is imposed. Consequently, the regionalization is performed as follows:

$$\hat{r}_{ij}=\begin{cases} a^n_{ij}AFLQ_{ij} & \text{if } SLQ_j>1 \\ a^n_{ij}FLQ_{ij} & \text{if } SLQ_j\leq 1 \end{cases} \tag{14}$$

In consideration of the results obtained by Lamonica and Chelli (2018) and Lamonica et al. (2019), for the purpose of estimating the Marche IOT, the FLQ method with δ=0.3 was used. Moreover, due to the lack of regional data about the sectoral total employed, a reduced version of the Marche IOT for the year 2015 to 19 production sectors was considered.

4. Empirical results

After having estimated the Marche IOT by means of the FLQ method, to assess the position occupied by various economic sectors within the Marche economy the Rasmussen approach was considered. The core of this approach is the inverse Leontief matrix i.e. $\mathbf{L}=(\mathbf{I}-\mathbf{R})^{-1}$ where $\mathbf{R}$ is the matrix of regional direct input coefficients. The generic L_{ij} entry of the $\mathbf{L}$ matrix measures the total requirement (multiplier), both direct and indirect, of goods and services produced by the i-th industry, which are necessary in order to satisfy one unit of final uses of the j-th sector. In other words, it measures the extent to which a unit increase in the final demand of the j-th sector causes a production increase in the i-th sector.

Consequently the j-th column-sum ($L_{.j}$) of $\mathbf{L}$ measures the total requirements needed by the j-th sector in order to produce one unit of final uses of its production;

or, the extent to which a one unit increase in the final demand of the j-th sector causes production increases in all sectors.

On the contrary, the row-sum of the **L** matrix ($L_{i.}$) measures the total production requirements of the i-th sector needed to off-set a unitary increase in final uses of each product. In other words, the magnitude of output increases in the i-th sector if final demand of all sectors increases by one unit.

Dividing $L_{.j}$ and $L_{i.}$ by the total number of sectors (k) yields the mean requirement (or the mean production increase) of the j-th sector ($L_{.j}/k$) and the mean requirement supplied by the i-th sector ($L_{i.}/k$). Alternatively, the mean impact on the economic system's production caused by a one unit increase in the final demand of the j-th sector and the mean impact on the i-th sector caused by a one unit increase in the final demand of all sectors. For the purposes of comparison, these two means are normalized with the general mean of all the elements in **L**:

$$\beta_j = \frac{L_{.j}/k}{i'\mathbf{L}i/k^2} \quad \text{for j=i,..,k} \tag{15}$$

$$\varphi_i = \frac{L_{i.}/k}{i'\mathbf{L}i/k^2} \quad \text{for i=1,..,k} \tag{16}$$

where *i* is a vector of one, a prime (') denotes a row vector. The index (15), known as 'Backward linkage' (or power of dispersion), measures the degree of activation of an economic sector: the more this is greater than 1, the more the sector is important for the economy of the country considered, because it requires a production level by the other sectors in excess of the general mean. By contrast, the more the index falls below 1, the less important is the sector considered.

The other index (16), which is known as 'Forward linkage' (or sensitivity of dispersion), measures the level at which the output of one sector is used as input to the remaining productive sectors. It thus measures the degree of reaction of an economic sector. In this case, too, the more the index is greater than 1, the more important the corresponding sector is because it supplies its production to the others sectors at a level which exceeds the general mean. By contrast, the more the index falls below 1, the less important is the sector considered. The joint analysis of these two indices makes it possible to determine how an individual sector is woven into the economic structure of a country and how important it is.

The following Table 3 depict for the region Marche and the year 2015 the values of the two indices.

Table 3 – *Backward and forward indices for the Marche.*

A(1)	Agriculture, forestry and fishing	1.0341	0.8234
B(2)	Mining and quarrying and other industry	1.1057	0.728
C(3)	Manufacturing	1.4056	3.4121
D(4)	Electricity, gas, steam and air-conditioning supply	1.353	1.0357
E(5)	Water supply, sewerage, waste management and remediation	1.2637	0.9299
F(6)	Construction	1.2534	0.9372
G(7)	Wholesale and retail trade, repair of motor vehicles and motorcycles	0.978	1.2258
H(8)	Transportation and storage	1.0744	1.1732
I(9)	Accommodation and food service activities	1.0602	0.7105
J(10)	Information and communication	1.0592	0.9477
K(11)	Financial and insurance activities	0.8558	1.1708
L(12)	Real estate activities	0.6558	0.9012
M(13)	Professional, scientific and technical activities	0.9287	1.3225
N(14)	Administrative and support service activities	1.0849	0.9442
O(15)	Public administration and defence, compulsory social security	0.7206	0.5826
P(16)	Education	0.6839	0.5685
Q(17)	Human health services	0.9095	0.6281
R(18)	Arts, entertainment and recreation	1.1001	0.7894
S(19)	Other services	0.9173	0.6132
T(20)	Activities of households as employers; undifferentiated goods and services-producing	0.556	0.556

5. Discussion

In this paragraph we provide a short discussion of the results of the linkage analysis of the Marche region and compare them to the outcomes of a similar analysis performed for Italy. Results are shown in Figures 1 and 2.

In both cases the most relevant sector (or industry), so called *key industry* is sector C(3), Manufacturing, this sector is located in the first quadrant of both the graphs. Its relevance is higher regarding to Marche region, in fact in Figure 2 values of both backward and forward linkages are higher than those of Figure 1. This means that this sector sells to the other sectors materials for an amount higher than the average value of all the sectors and buys from the other sectors materials for a higher amount than all the other sectors. Another relevant issue to be mentioned is the fact that all the sectors linked to the Public Administration and public goods have both forward and backward linkages that lie under 1. Sectors K(11) - *Financial and insurance activities* and M(13) - *Professional, scientific and technical activities* in Figure 1 belong to the group of Forward Linkage Industries, that forward to the other sectors amounts higher than the average value of all sectors.

Figure 1 – *Dispersion Analysis Backward and Forward Linkages – Italy.*

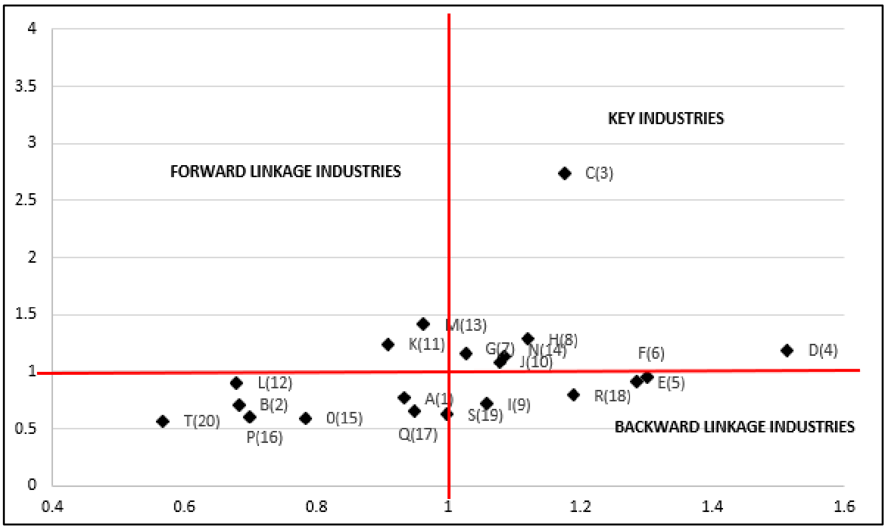
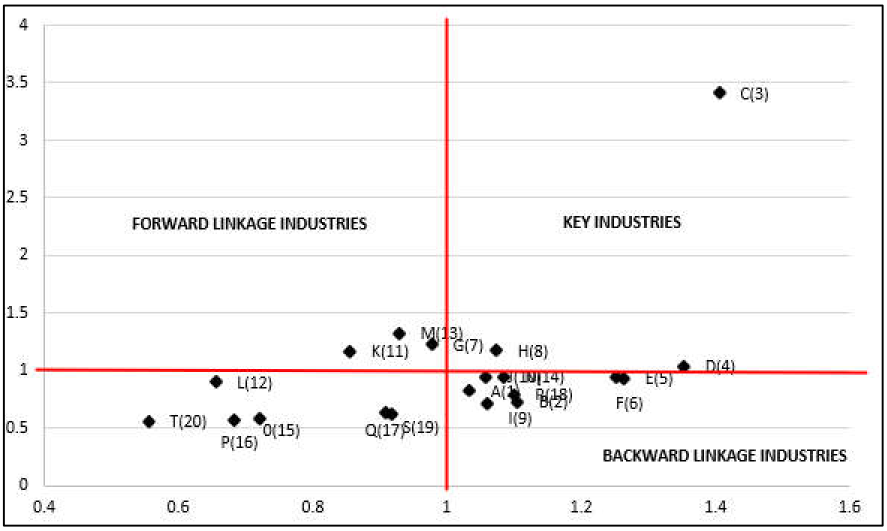


Figure 2 – *Dispersion Analysis Backward and Forward Linkages – Marche.*



When moving to Figure 2 these two sectors remain in the group of Forward Linkage Industries but this group also includes sector G(7) - *Wholesale and retail trade, repair of motor vehicles and motorcycles*. In both the Figures we can see that sectors: E(5) - *Water supply, sewerage, waste management and remediation*, I(9) - *Accommodation and food service activities*, R(18) - Arts, entertainment and recreation and S(19) - *Other services* belong to the class of sectors that purchase intermediate goods in higher amounts per unit of product over the average (their Backward Linkage coefficient is higher than 1) but their Forward Linkage coefficient is lower than 1, these industries are called Backward Linkage Industries.

6. Conclusions

Our paper provides a multisectoral picture of the economic framework both in Italy and in the Marche region. The National Input-Output Table is regionalized using the Flegg Location Quotients method, since we think that this method is the most effective among the so-called *non-survey* methodologies of regionalization. Linkage analysis highlights manufacturing as the key sector, C(3), especially at the regional level, stressing its relevance in the Marche region also in relation to the already mentioned districts of the "Marche model". The prominence of this industry both at national and regional level is expected to improve with the introduction within the production processes, of the Technology and Manufacturing 4.0. Industries linked to public goods are those that exhibit lower interactions; a possible introduction of Technology 4.0 is expected to improve all processes of Public Administration though higher digitalization and more efficient output supply.

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SUMMARY

The Marche region and its industry pattern: a quantitative evaluation

The "Marche model" is the term used to define the industry structure of the Marche region, i.e. small- medium sized firms settled in coasts and valleys and organized in small districts. By means of Flegg Location Quotients, we regionalize the national Input – Output Table (NIOT) and obtain the Regional Table (RIOT). Through the linkage analysis we compare the relevance of the industrial pattern at a regional and national level. Manufacturing reveals as the key sector both at national and regional level. It has to be noted that the same industry results even more performing at the regional level.

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