THE DEMOGRAPHIC TRAP OF ITALIAN CITIES. A MULTIDIMENSIONAL ANALYSIS [1]

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Abstract. One of the main effects of the demographic crisis facing Italy is the depopulation of entire areas of our country. In 2023, the Italian population fell by 180,000 due to a decline in births and an increase in deaths. The aim of this paper is to analyze the phenomenon of depopulation provincial capitals in recent years, using data from the Istat Census of Population and Housing. The impact of the various components that contribute annually to the population balance in the different areas of the country is assessed. In particular, through an exploratory and multidimensional analysis of the phenomenon, the aim is to identify the main characteristics of demographic decline and the existence of territorial imbalances. The level of fragility of the municipalities is also highlighted which aims to identify the provincial capitals most exposed to environmental and socio-economic risk factors.

1. Introduction

In Italy there is a continuous decline in births which has led to a contraction of the population. Low fertility, which has persisted for 30 years now, and the consequent aging of the population continue to influence the country's demographic decline associated with economic-social uncertainty. Unfortunately, the numbers do not leave room for many doubts and Italy is close to a demographic trap scenario.

The aim of this contribution is to analyze the phenomenon of depopulation in Italy in recent years for the provincial capitals, using data from the Istat Census of Population and Housing and demographic balance. The dynamics and impact of the different components that annually contribute to the demographic balance in the different areas of the country are assessed. In particular, through a multidimensional analysis of the population with the Growth rate (r), the Fragility index and the Wroclaw Taxonomic Method (WTM) as exploratory models for measuring the causes of the phenomenon[2], the aim is to identify the characteristics of the demographic decline, the existence of territorial imbalances and areas most exposed

[1] The paper is the result of the common work of the authors. In particular: sections are attributed as follows: G. Lecardane paragraphs 1. 3 and 6, M. Carbonara paragraphs 2 and 7, F. Fullone paragraphs 4 and 5. A special thanks to Tommaso Damiani for the creation of the geographical maps.

[2] MTW method is very useful as a comparative analysis approach of the units, particularly territorial, observed (C. Tasciotti, 1973).

to environmental and socio-economic risk factors. The study offers stimulating food for thought on the logic and dynamics of our cities and the related urban, social and economic development processes.

2. Population and demographic dynamics in Italy

To describe the population end evolution of demographic dynamics from 2018 to 2023, Istat data on the demographic balance of the resident population and on the permanent population census were used. In 2023 the resident population in Italy is equal to 58.99 million, down by 7,000 units compared to the previous year. The decrease in the population resident is the result of the natural balance (-281 units with fewer births and more deaths) not compensated by the positive values of the migration balance with foreign countries (+274 units). The Southern Italy leads the reduction of the Italian population. (Tab. 1).

Table 1 - *Resident population budget by geographical distribution. 2023 (per 1,000 inhabitants) (a).*

GEOGRAPHICAL DISTRIBUTION	Population	Live births	Deaths	Natural growth	Internal migration balance	Foreign migration balance	Total balance
NORTHERN ITALY	27,490	174	305	-131	57	148	73
North west	*15,905*	*100*	*180*	*-80*	*30*	*96*	*46*
Nord east	*11,585*	*74*	*126*	*-52*	*26*	*52*	*27*
CENTRAL ITALY	11,724	69	133	-65	6	59	1
SOUTHERN ITALY	19,776	137	222	-85	-63	67	-81
South	*13,411*	*94*	*148*	*-54*	*-46*	*47*	*-53*
Islands	*6,364*	*43*	*74*	*-31*	*-17*	*20*	*-28*
ITALY	**58,990**	**379**	**661**	**-281**	**0**	**274**	**-7**

Source: Istat, Demographic balances of the Municipalities and natural movement of the present population (2023, provisional data).
a) Registrations and cancellations for other reasons (mainly due to reappearance or unavailability) are excluded from the calculation of the provisional budget of the citizen).

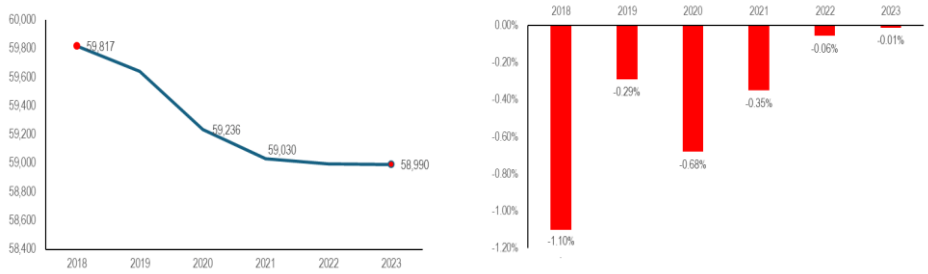
Between 2018 and 2023 the registered resident population in Italy decreases (-1.4 percent). Compared to 2022, the decline is smaller than in 2021 (-0.4 percent) and especially in 2020 (-0.7 percent), years during which the effects of the pandemic accelerated the process (Fig. 1).

In the North, the population decreased by 0.5 percent compared to 2018. In particular, the population change is negative until 2021 (-0.9 percent) but then reaches positive values in 2023 (+0.4 percent) (Fig. 2).

In the Central regions, the decline in the resident population is more sustained (-1.2 percent) than in the North. The population decreases until 2021 (-1.2 percent) and then remains stable in 2023 (Fig. 3).

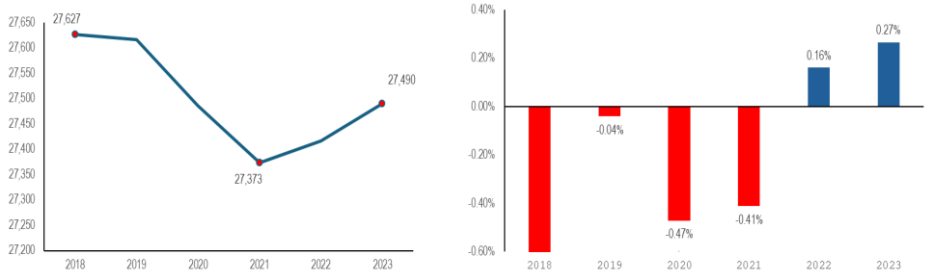
On the other hand, the regions of Southern Italy are more affected, with a negative population balance (-2.7 percent) compared to 2018. From 2020 the decline is more contained (-0.8%) (Fig. 4).

Figure 1 – *Resident population (per 1,000 inhabitants) and percentage change, Italy. 2018-2023.*



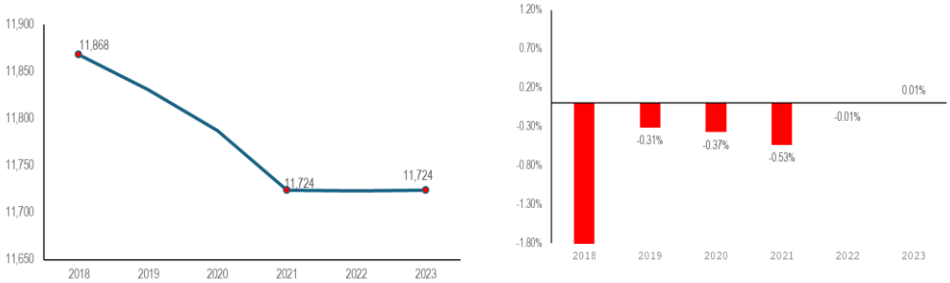
Source: Istat. Population census

Figure 2 – *Resident population (per 1,000 inhabitants) and percentage change Northern. 2018–2023.*



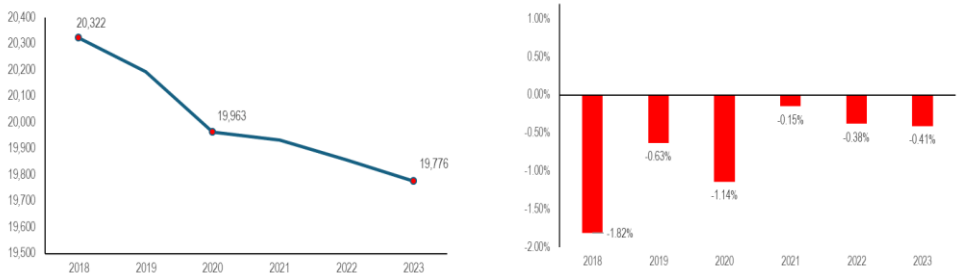
Source: Istat. Population census

Figure 3 – *Resident population (per 1,000 inhabitants) and percentage change, Central. 2018–2023.*



Source: Istat. Population census

Figure 4 – *Resident population (per 1,000 inhabitants) and percentage change, Southern. 2018–2023.*



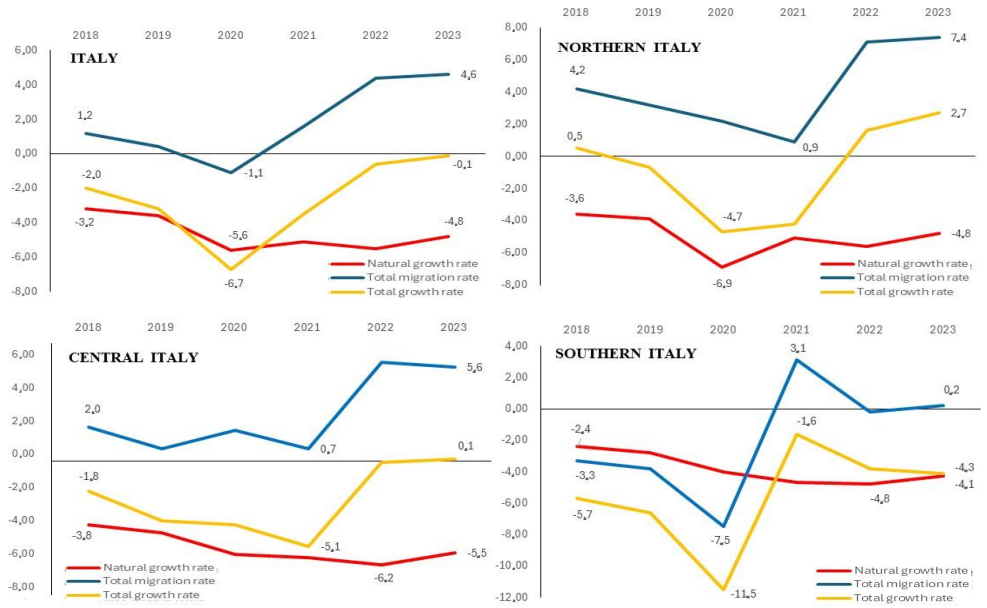
Source: Istat. Population census

3. Natural growth, migratory and total growth rates

The demographic dynamics in Italy in terms of births, deaths and transfers of residence are on the rise after 2020, due to the pandemic and migrations slowed down by the prescription of barriers to entry at national borders and by the limitations imposed on internal movement (Fig. 5).

In relation to the natural, migratory and total growth rates that distinguish the Italian territory, the markedly negative variations are concentrated in the South with a decrease in the natural growth rate (from -2.4 per thousand in 2018 to -4.1 per thousand in 2023) and the migration rate (from 3.1 per thousand in 2021 to 0.2 in 2023) unable to counteract and slow down the decline in the population. The Northern and Central Italy remain the most attractive areas the impact of foreign migration flows continues to be opposed and decisive to that of Italians. The North, in the face of a worsening natural growth rate in 2023 (-4.8 per thousand) compared to 2018 (-3.6 per thousand) confirms once again the area of the Country most attractive for migratory flows. In 2023, the overall migration rate (7.4 per thousand) managed to offset the negative natural balance and raise the total growth rate to the highest levels in the last 5 years (+2.7 per thousand). Also, in Central Italy appreciable results have been recorded although the demographic dynamics are contained with positive effects on the population. It is difficult, however, to hope that immigration will be the only possible solution to the demographic decline. Other factors influence the phenomenon, but demographers and statisticians consider these migratory flows a fundamental variable to reverse the trend of depopulation of our Country. New immigrants from abroad, in fact, contribute to population growth and rejuvenate the age structure.

Figure 5 - *Natural growth, migratory and total growth rates. Italy and territorial distribution. 2018-23 (per 1,000 inhabitants).*



Source: Istat. Population census

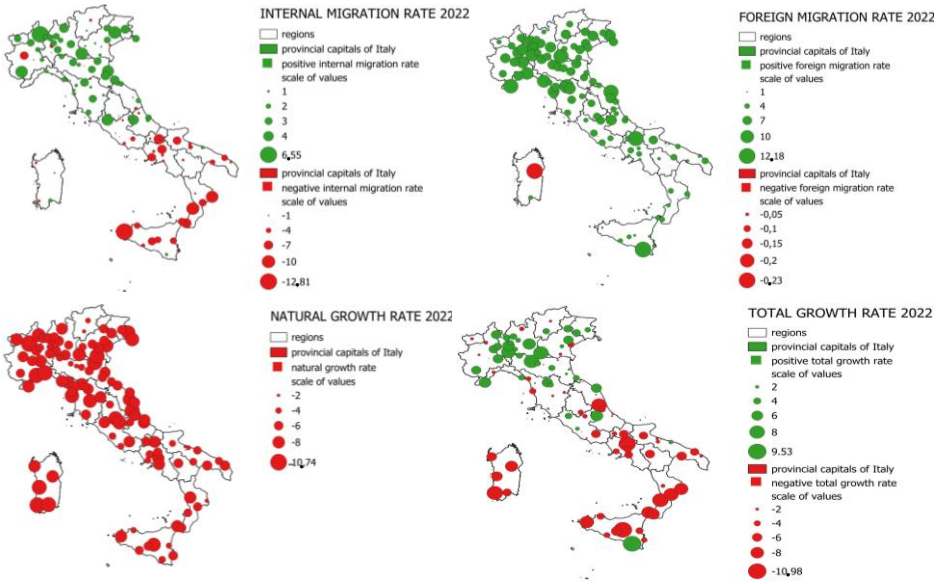
Since the latest data of 2022, depopulation in the territory is evident for most of the country's capital municipalities with negative natural growth rates. However, the migratory component, domestic and foreign, shows favorable levels of concentration in the cities of Central-North with better living conditions and opportunities (Fig. 6).

On the contrary, the cities of Southern Italy lose population mainly due to internal emigration. And it is precisely the «escape from the crisis» that pushes the southern emigration, especially of young people, that could have adverse structural effects both at demographic level and for the southern economy[3]. In fact, southern municipalities are more exposed to risk factors related to the main demo-social characteristics of the population and the economic-productive system, therefore, more subject to the abandonment of their places of residence.

These aspects are highlighted by the composite fragility index calculated by Istat for 2019 (increasing fragility score from 1 onwards) as a result of the combination of 12 elementary indicators describing the main dimensions (territorial, environmental and socio-economic) the fragility of municipal territories.

Figure 6 - *Natural growth, migratory and total growth rates in provincial capital municipalities. 2022 (per 1,000 inhabitants).*

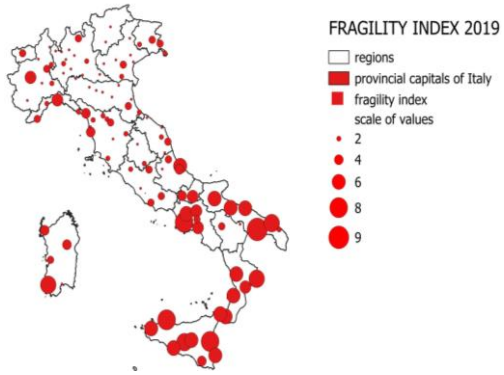
[3] L'emigrazione dei meridionali, la Rivista delle Politiche Sociali/Italian Journal of Social Policy, 4/2017 (S. Boffo and E. Pugliese, 2017).



Source: Istat. Population census

The total growth rate and the fragility index show a clear demarcation between Northern and Southern Italy (Fig. 7). The South is a fragile territory exposed to risks of natural and anthropic origin and to critical conditions in the main demo-social characteristics of the population and the economic-productive system.

Figure 7 – *Fragility index in provincial capital municipalities. 2019.*



Source: Istat – Fragility index

4. Average annual growth rates

Population growth is the result of two components that contribute to population change: natural change (births minus deaths), over a given period, and total net migration (immigration minus emigration), taking into account international and internal migration. Both contributions are evaluated over a given period, usually one year. In examining population growth rates, over several years, the logarithmic growth rate (r) is used as the population development model (Livi Bacci M., 1999).

$$r = \frac{1}{t}\ln\left(\frac{{}_tP}{{}_0P}\right) \tag{1}$$

To obtain average annual rates of birth, mortality and migration, when the reference period is several years, it is necessary to use (AP) person-years[4] as the denominator (Gallo et all, 2021):

$$\boldsymbol{AP = \frac{t({}_tP - {}_0P)}{ln\left(\frac{{}_tP}{{}_0P}\right)}} \tag{2}$$

$$\boldsymbol{r = \frac{1}{t}\ln\left(\frac{{}_tP}{{}_0P}\right) = \frac{\frac{({}_tP - {}_0P)}{t({}_tP - {}_0P)}}{\ln\left(\frac{{}_tP}{{}_0P}\right)} = \frac{\frac{\Delta_t N - \Delta_t M + \Delta_t I - \Delta_t E}{t({}_tP - {}_0P)}}{\ln\left(\frac{{}_tP}{{}_0P}\right)}} \tag{3}$$

$$\boldsymbol{r = \frac{\Delta_t N - \Delta_t M + \Delta_t I - \Delta_t E}{AP} = n - m + i - e = S_n + S_m} \tag{4}$$

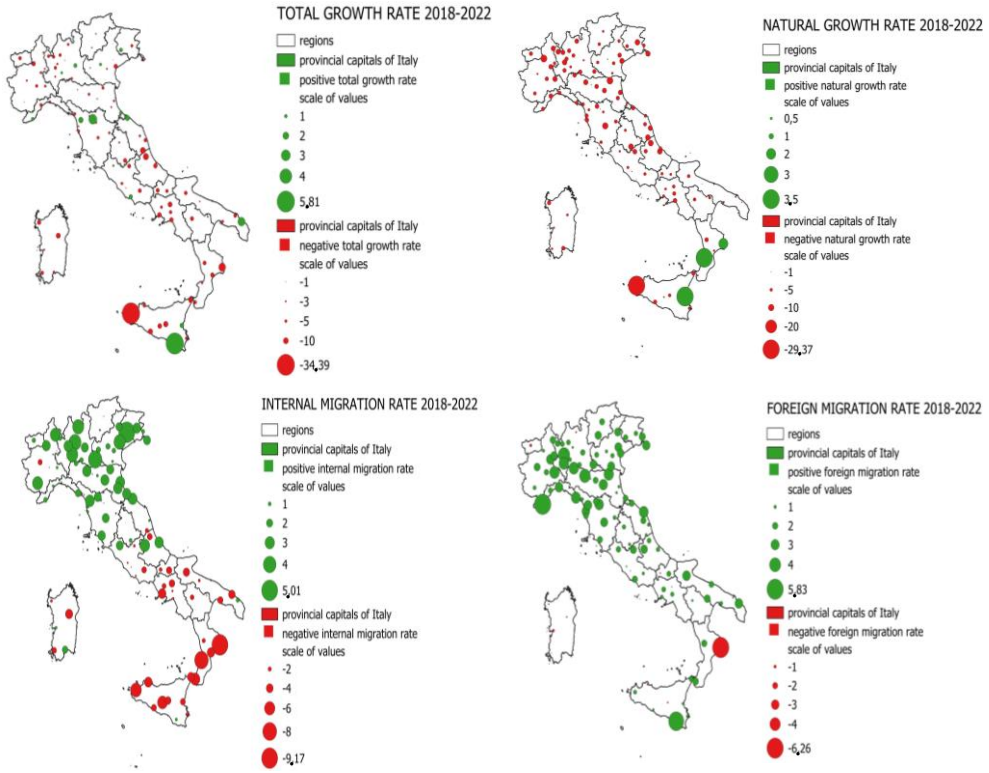
The average annual growth rate (r) over several years can be analysed as the algebraic sum of the following components: the rates of birth (n), mortality (m), immigration (i) and emigration (e), evaluated over the same period (Strozza, Unina), or a sum of natural growth rate (S_n) and net migration rate (S_m). Finally, the net migration rate can be further broken down into internal and external net migration rates.

5. Average annual growth rates over the period 2018-22, in provincial capitals

The total growth rate for the period 2018-2022 has been evaluated in provincial capitals, as described in Eq. (4). As illustrated in Figure 8, depopulation is a widespread phenomenon in provincial capitals throughout the country. However, the intensity of depopulation varies and there are some exceptions. The 14 per cent of provincial capitals have a positive population growth rate (r). Looking at the components of growth over the period, the natural growth rate (Sn) is negative for all Italian provincial capitals, except for Latina in central Italy and Crotone, Vibo Valentia and Catania in the south.

[4] If ${}_tP = {}_0P$ then AP = t*${}_tP$

Figure 8 - *Population total growth rate and components, in provincial capital. 2018-2022 (values per 1,000 inhabitants).*

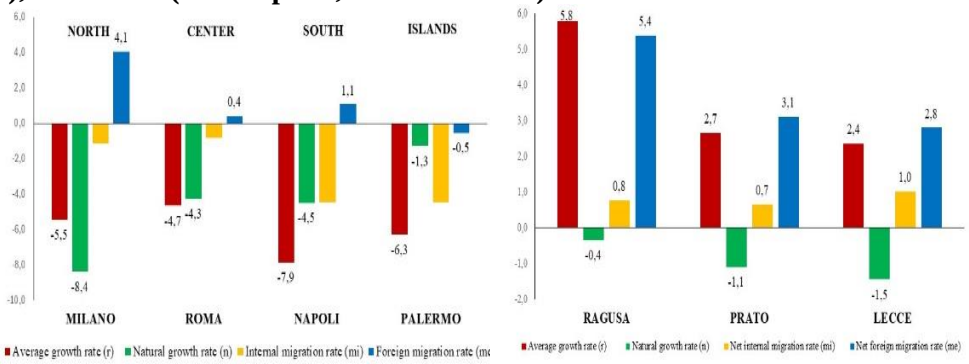


Source: Istat. Population census and Demographic Balance

The net internal migration rate (Smi) is quite polarised in Italy, contributing negatively to growth in the capitals of the southern provinces, while in most capitals of the central and northern provinces the Smi contribution to the growth rate (r) is positive. Finally, the net external migration rate component (S_{me}) is positive in 90 per cent of the provincial capitals, and more relevant in the northwest. A few capitals have a negative contribution of S_{me} to the growth, Aosta and Sondrio in the north (-0.9 and -0.5 per 1,000 inhabitants) and the most evident case of a negative external migration rate is Crotone (-6.3 per 1,000 inhabitants). An analysis of the main Italian capitals by territorial distribution (Fig. 9a) shows that the population growth rate is negative in all cases, but the influence of the rates contributing to the population growth rate of the cities is different. The negative growth rate of Milano population is due to the negative natural growth rate, which is not compensated by the positive net external

migration. The negative growth rate of Roma is mainly due to natural growth influence. In Napoli and Palermo, the influence of negative internal migration rate is also significant. On the other end the average growth rate (r) is positive in Ragusa, Prato and Lecce, (Fig. 9b) italian provincial capitals with the highest average growth rate (r), driven by the positive external migration rate. Finally, the depopulation is most severe in Trapani, driven by the very negative natural balance, Crotone, driven by internal and external migration rate and Teramo affected by negative natural growth.

Figure 9 – Demografic indicators, (a) main Italian cities by territorial distribution. (b) Italian provincial capitals with the highest average growth rate (r); 2018-2022 (Values per 1,000 inhabitants).



Source: Istat. Population census and Demographic Balance

6. Wroclaw Taxonomic Method (WTM)

Wroclaw Taxonomic System (MTW), based on concept of theoretical ideal unity, built on the basis of the best values among those observed for each of the indicators considered. The results produced by this method are transformable into positions of territorial units within a general ranking[5].

To study the phenomenon of depopulation in Italian cities, the *Wroclaw Taxonomic Method* (WTM) was used, a synthetic tool starting from some main demographic indicators considered crucial for their impact on the territory[6]: *Birth rate* (a1), *Mortality rate* (a2), *Internal migration rate* (a3) and *Foreign migration rate* (a4). The WTM measurement model is of the "formative" type and the indicators are considered "cause" of the phenomenon to be measured.

[5] M. Mazziotta, A. Pareto, V. Talucci. *La costruzione di indicatori di disuguaglianza sociale: il caso delle regioni italiane*. XXXI Conferenza Italiana di Scienze Regionali, AISRE. 2010.

[6] C. Tasciotti, *Misura dello sviluppo socio-economico delle regioni italiane. Un'applicazione del metodo tassonomico di Wroclaw*, Bulzoni, Roma, 1973.

The Euclidean distance is then calculated as follows:

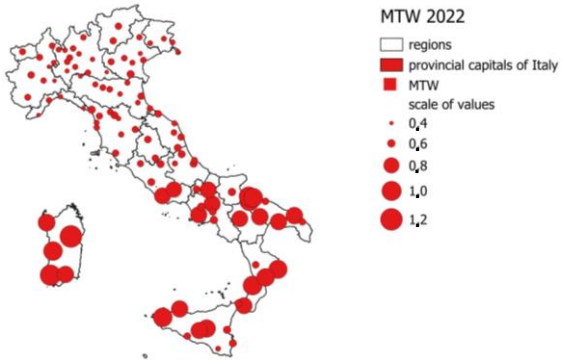
$$D_i = \sqrt{\sum_{j=1}^{m} (z_{ij} - z_{0j})^2}$$

where z_{ij} is the standardised value[7] of the index j for the city i and z_{0j} is equal to $\max_i (z_{ij})$. The composite index for the unit i :

$$WTM_i = \frac{D_i}{\overline{D}_0 + 2\sigma_0}$$

where $\overline{D}_0$ and σ_0 are the mean and the standard deviation of the distances D_i. WTM is a partially compensatory composite index, since we assume that a deficit in one area may be only partially compensated by a surplus in another and viceversa. The index is equal to zero when the distance between a given city and the 'ideal unit' is null (all the values coincide). The higher is the index, the greater is the difference between the two units. With WTM method, a weighting of the elementary indicators is implicitly implemented, which are more influential on the synthetic index, the greater the distances recorded with respect to the ideal situation. Figure 8 shows the map of the WTM index developed for the 109 provincial capitals of Italy. The values taken from the synthetic indicator show the positioning of the Italian cities in terms of population depopulation, which worsens as one proceed towards the highest positions. Also in this study, the result of the analysis returns the classic descending subdivision of the North and South territorial dualism.

Figure 8 – *Map of the WTM index. 2022.*



From the ranking (Tab. 2) we can observe the positioning of Italian municipalities according to the degree of depopulation that is aggravated by proceeding towards

[7] Each indicator is transformed into a standardised variable with mean 0 and variance 1.

the highest scores and positions. The ranking distinguishes among the top five cities of Northern Italy La Spezia (0.404), Mantova (0.416), Vercelli (0.424), Alessandria (0.427) and Imperia (0.431) with positive effects in demographic terms, unlike the southern cities of Sardegna and Puglia such as Nuoro (1.125), Carbonia (1.059), Andria (1.021), Oristano (1.017) and Barletta (0.982) those most affected by demographic depopulation.

Table 2 - *WTM ranking, Provincial capital cities. 2022.*

R	Provincial capitals	WTM	R	Provincial capitals	WTM	R	Provincial capitals	WTM	R	Provincial capitals	WTM
1	La Spezia	0.404	29	Lodi	0.585	57	Trento	0.698	85	Frosinone	0.804
2	Mantova	0.416	30	Siena	0.589	58	Bolzano	0.700	86	Potenza	0.828
3	Vercelli	0.424	31	Asti	0.602	59	Terni	0.703	87	R. Calabria	0.836
4	Alessandria	0.427	32	Livorno	0.604	60	Lecce	0.707	88	Campobasso	0.837
5	Imperia	0.431	33	Belluno	0.605	61	Fermo	0.710	89	Latina	0.838
6	Piacenza	0.470	34	Savona	0.606	62	Torino	0.711	90	Napoli	0.840
7	Treviso	0.471	35	Sondrio	0.613	63	Ravenna	0.715	91	Caltanissetta	0.846
8	Pavia	0.471	36	Cremona	0.614	64	Cosenza	0.717	92	Benevento	0.847
9	Trieste	0.494	37	Lecco	0.616	65	Bari	0.718	93	Taranto	0.850
10	Genova	0.504	38	Vicenza	0.626	66	Agrigento	0.721	94	Palermo	0.855
11	Brescia	0.506	39	Macerata	0.627	67	Pesaro	0.726	95	Cagliari	0.860
12	Firenze	0.514	40	Milano	0.635	68	Perugia	0.731	96	Matera	0.863
13	Como	0.517	41	Venezia	0.636	69	Avellino	0.733	97	Brindisi	0.867
14	Bologna	0.523	42	Rimini	0.637	70	A. Piceno	0.743	98	Sassari	0.877
15	Bergamo	0.533	43	Modena	0.637	71	Isernia	0.749	99	Enna	0.906
16	Forlì	0.541	44	Verbania	0.639	72	Roma	0.755	100	Catanzaro	0.916
17	Pordenone	0.545	45	R. Emilia	0.643	73	Messina	0.756	101	Crotone	0.943
18	Ragusa	0.547	46	Pistoia	0.653	74	Prato	0.758	102	Trani	0.969
19	Novara	0.550	47	Monza	0.655	75	Siracusa	0.760	103	Trapani	0.973
20	Udine	0.558	48	Cuneo	0.658	76	Teramo	0.760	104	V. Valentia	0.977
21	Varese	0.558	49	Pescara	0.659	77	Chieti	0.761	105	Barletta	0.982
22	Padova	0.561	50	Biella	0.661	78	Rovigo	0.769	106	Oristano	1.017
23	Gorizia	0.568	51	Aosta	0.667	79	Rieti	0.772	107	Andria	1.021
24	L'Aquila	0.572	52	Verona	0.673	80	Catania	0.786	108	Carbonia	1.059
25	Ancona	0.574	53	Viterbo	0.677	81	Massa	0.790	109	Nuoro	1.125
26	Pisa	0.574	54	Lucca	0.682	82	Caserta	0.792			
27	Ferrara	0.577	55	Arezzo	0.683	83	Salerno	0.794			
28	Parma	0.584	56	Grosseto	0.693	84	Foggia	0.794			

7. Conclusions

The multidimensional study of the population with the Growth rate (r), the Fragility index and the Wroclaw Taxonomic Method (WTM) as exploratory models for measuring the causes of the phenomenon, have made it possible to analyze and identify the main characteristics of the demographic decline, the existence of imbalances in territorial districts and the areas most exposed to environmental and socio-economic risk factors. The results show an Italy characterized by strong demographic heterogeneity. In the South, depopulation is more marked due to internal migration and natural growth. The Fragility Index also shows a clear demarcation between the provincial capitals of the North and the South, highlighting a direct relationship between depopulation and territorial fragility. In most provincial capitals, the natural growth rate is also negative, while the internal migration rate is negative for southern cities and positive for northern ones. Foreign immigration is highest in the provincial capitals of the North-West.

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